SASKATCHEWAN ELECTRICAL

energy options

FINAL REPORT

November 1991

LETTER OF TRANSMITTAL

December 6, 1991

John R. Messer
Acting President and CEO, SaskPower
2025 Victoria Avenue
Regina, Saskatchewan
S4P 0S1

Dear Sir:

It is our pleasure to submit to you the Final Report of the Electrical Energy Options Review Panel.

In accordance with our Terms of Reference, we deliver to you and the people of Saskatchewan a report of our findings from public meetings, tours and research on the possible viable options that could be used to meet SaskPower's future electrical energy requirements.

Respectfully submitted,

Dr. Roy Billinton, Chairman

Ms. Ann Coxworth

Ms. Vicki Dutton

Chief Roland Crowe

Mr. Russ Pratt

RLB/dkm

Enclosure

Saskatchewan Electrical Energy Options Review Panel
Final Report to SaskPower

November 1991

To request copies of the Electrical Energy Options Report, please contact:

SaskPower
Corporate Communications
2025 Victoria Avenue
Regina, Saskatchewan
S4P 0S1

Phone: (306) 566-3187 or 566-3179
Fax: (306) 566-2548

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Executive Summary

After completing an intensive hearing process, conducting selected site visits, examining written material and holding many discussions, the Panel has come to the conclusion that in addition to the analysis and selection of demand side initiatives and supply side options, there are several studies and actions which should be taken by SaskPower and the Government of Saskatchewan in order to meet Saskatchewan's future electrical energy requirements. These recommendations are summarized below, together with a brief statement on electrical generation options.

1. SaskPower should undertake a complete study of the current levels of efficiency in the use of electricity in all sectors of the Saskatchewan economy. This study should include a comparison of these levels with what is possible using currently available technology.

2. SaskPower should undertake a complete economic analysis of the potential for demand side management initiatives and should put in place immediately those which are cost-effective in terms of avoiding the need for additional generating capacity.

3. The Government of Saskatchewan should proceed immediately to establish an independent tribunal which will provide an arbitrator function between SaskPower and independent power producers. SaskPower and the independent tribunal should develop a highly visible framework, which includes an avoided cost policy, to facilitate the incorporation of a limited amount of non-utility generation and cogeneration in Saskatchewan's electrical energy system.

4. Saskatchewan has a wide range of possible electrical energy supply options. These include biomass, coal, hydro, natural gas, nuclear and wind facilities. Each of these options has limitations and conditions which constrain its use.

5. The Government of Saskatchewan should conduct a broad and thorough public review of nuclear power generation in Saskatchewan including short- and long-term nuclear waste disposal.

6. There is some potential for the generation of electrical energy in Saskatchewan using wind power. SaskPower should conduct a thorough study of wind regimes in Saskatchewan and make this information available to potential independent power producers.

7. SaskPower should closely monitor developments in the economic generation of electrical energy using solar radiation and create a plan for evaluating these developments in a Saskatchewan context.

8. SaskPower should closely monitor developments in advanced technologies such as fuel cells, magnetohydrodynamics, stored energy systems, batteries, fusion and hydrogen in order to properly assess their possible future implementation in Saskatchewan.

1.0 - Introduction

1.1 Background

Perspective is interesting. It changes with both time and circumstances and is colored by many factors. What was once considered to be overwhelmingly important, and hence a driving factor in decision making, will at some time be eclipsed by other, newly urgent, criteria. There is no point in debating past decisions, as they were made under circumstances quite different from those presently faced. Past decisions cannot be simply categorized as being right or wrong. There is no doubt, however, that those decisions have brought society to its present position and the point from which it must now proceed.

The generation and utilization of electrical energy has gone through some remarkable changes over the past century. Initially, little attention was paid to developing an optimum mix of generating options. The basic concern was to provide and distribute this new technology to as many individuals and organizations as possible. In North America, and particularly in Saskatchewan, this is no longer a major issue as virtually all individuals and organizations have access to electricity supply. Circumstances have changed considerably, the perceived problems are both local and global and society's perspective is different from that which existed even a few years ago.

For decades, electricity has been seen as an indispensable part of everyday life with tremendous benefits and few costs aside from the monthly utility bill. It has recently become evident that turning on the light switch is perhaps more costly than originally believed. What was once thought of as an environmentally benign source of energy has been linked to ozone depletion, acid rain, the greenhouse effect and other negative environmental concerns such as flooding, water diversion and radioactive contamination. Electrical energy is, and will continue to be, an indispensable element in modern society. Its utilization, however, carries with it a measure of responsibility for both the user and the organization generating and distributing electrical energy.

The generation of electrical energy cannot be considered in isolation. The amount of electrical energy required, the way it is produced and the price paid for it are all questions which must be considered when examining this issue. From a societal point of view, electrical energy is only one of the resources used to accomplish a hierarchy of objectives and goals. It is an important part of the resource mix utilized by society to meet those goals. In order to determine the role electrical energy will play in the resource mix, society must answer a number of fundamental questions — questions which will delineate its perspective and guide present and future decision making.

The first question could be, what role is the principle of sustainable development going to play? Sustainable development implies that economic activities which degrade or destroy the environment cannot continue to expand. Rather, the focus should shift to economic activity which can be conducted in ways which protect and enhance the environment. Sustainability means recognizing the limits imposed by nature when wastes are released and disrupt the environment. It respects the limitations of non-renewable resource use and of the necessity to use renewable resources at a rate which does not exceed their ability to replenish.

The extent to which people in Saskatchewan decide to adopt economic development policies based on such principles of sustainability will have a significant impact on decisions regarding the amount and type of electrical generation.

The second question which society needs to address is that of energy policy as it impacts on economic development. Electrical energy may be only one component of the overall energy sector but it is an important and growing component. Clearly, changes in electrical pricing policy will have an effect on industries which rely heavily on it. If, for example, electricity becomes too expensive, market forces will cause users to utilize other forms of energy which may cause other market distortions to occur. Similar distortions may occur if electrical energy is undervalued. In either case, the determination of price and availability of the resource is a fundamental concern in a provincial economy.

A third question, which is directly related to resource development and utilization, is that of who pays the costs of negative economic spin-offs associated with the activity. The question of negative externalities and who pays for them has plagued economists for years. Devising tax or penalty systems in which the appropriate person or industry pays the cost (or, in the case of positive externalities to whom the benefits occur) is extremely difficult. These difficulties are compounded when the systems are intended to limit other unintended market distortions.

Future sustainability, economic development and proper resource costing are only a few of the many questions which society must come to grips with when making decisions which will guide its future.

An increased awareness of the consequences of generating and utilizing electrical energy, coupled with an increasing desire by the public to voice its concerns, motivated SaskPower to invite the public to participate in a discussion of future options. The formation of the Electrical Energy Options Review Panel has, through its Terms of Reference, demonstrated the realization that difficult choices will have to be made — choices which will deeply affect the future environmental and economic development of the province. It is important that the residents of the province understand these choices and have input in the decision making process.

1.2 The Terms of Reference

The Electrical Energy Options Review Panel was appointed on November 27, 1990, by SaskPower. The Terms of Reference (as found in Appendix 1 of this report) provided to the Panel by the corporation outline the scope of the review process and can be summarized into the following objectives.

1) Obtain, through open public meetings, the views of people throughout Saskatchewan on how future demand for electricity could be altered or met.

2) Report to SaskPower on what the Panel heard from Saskatchewan people and to document, using findings from public meetings, tours and research, the possible viable options that could be used to meet Saskatchewan's future electrical energy requirements.

Also included in Appendix 1 are copies of the newspaper advertisements announcing the Panel's appointment and a copy of the SaskPower press release.

In order to comply with the Terms of Reference, the Panel planned a number of activities which were in accordance with its mandate and objectives. These activities are outlined in the following section.

1.3 Panel Activities

1.3.1 Public Input

At the press conference held on November 27, 1990, announcing the Panel's appointment, the first three venues where public meetings would be held were announced: Regina on January 23 and 24, Yorkton on January 30 and Kindersley on February 13, 1991. Notices of these meetings were also run in local newspapers for two weeks prior to the meeting date. In addition, radio announcements were broadcast the week of the meetings and posters were distributed to many communities. Examples of the newspaper advertisements, posters and the text for the radio advertisements make up Appendix 2. A similar advertising procedure was followed for all subsequent meetings.

In order to be accessible to as many residents of the province as possible, the Panel chose to hold meetings in as many provincial communities as were permitted by the time frame of the project and other commitments of the Panel members. In addition to the initial three meeting sites, the Panel announced meetings in 15 other communities in southern Saskatchewan and five communities in northern Saskatchewan (Appendix 3 provides a complete list of all meeting sites and the dates on which these meetings were held). In total the Panel visited 23 communities and held 26 days of public meetings between January and June of 1991.

In order to facilitate maximum public input to the process, the Panel decided on a very open and informal format for the meetings. The basic operating rules, as outlined by the chairman at each session, were ones of common sense and common courtesy. It was hoped that such a format would allow each presenter to express his or her views without being directly cross-examined or challenged by members of the audience. Since the objective of the hearings was to gather public views on electrical energy demand and generation options and not to engage in public debate, it was felt that this type of forum would be less intimidating and more conducive to public input than would a more formal process.

Pre-registered presenters were given time slots for their presentations in order to better manage the allotted meeting times. However, anyone wishing to speak who had not previously made arrangements to do so was also given an opportunity to be heard by the Panel.

At the time of the Panel's appointment and in subsequent advertising, the Panel's office phone number and address were given as a means for the public to request further information or to make arrangements to attend public meetings. In addition to this, the Panel sent out invitations to individuals or groups it felt may have a specific interest in submitting a brief. These included environmental groups, selected rural and urban municipalities, northern communities, students, consulting engineers, Indian bands and industrial associations. Approximately 300 invitations to make presentations to the Panel were sent out between January and March, 1991.

As part of its education mandate and also to increase awareness of the energy options process, the Panel developed and ran a series of information advertisements on several energy options. These advertisements on solar, wind, conservation, nuclear, coal, biomass and hydro ran one per week for seven weeks in all provincial daily and weekly newspapers (see Appendix 4 for selected copies of advertisements and where they ran) in January and February 1991. The mail-in coupon on the bottom of each advertisement proved an effective tool for generating interest in the process. In total the Panel received approximately 1,500 requests for more information.

The information kit sent in response to these requests included a copy of "Our Future Generation — Electricity for Tomorrow," a schedule of upcoming public meetings, a bibliography of references on alternative energy sources, copies of media releases announcing the Panel, Energy Options Newsletters (when they became available), Terms of Reference, and an invitation for the recipient to submit a brief to the Panel. It should also be noted that the Panel did not require briefs to be submitted in person at a public meeting. Those unable to attend meetings were encouraged to submit written briefs to the Panel. In total, the Panel received 27 written briefs (see Appendix 5).

When the Panel completed its public hearing process on June 21, 1991, it had heard presentations from 150 individuals, organizations or businesses (see Appendix 6), which in total resulted in 4,756 pages of transcripts.

1.3.2 Panel Orientation

In order to fully appreciate how "Saskatchewan's future demand for electricity might develop and the alternative means by which that demand could be altered or met," the Panel had to engage in a number of "self education activities." These activities took a number of forms. They included the "reading everything in sight" method, meeting with experts in the various fields involved, and visiting various types of generating facilities.

The following is a brief summary of the tours, meetings and consultations held by the Panel in order to acquire information relevant to its task.

Immediately after being appointed, the Panel undertook a tour of many of SaskPower's generating facilities. The tour began with the three major coal-fired plants in the southern part of the province, hydro plants at Nipawin and Island Falls, and concluded with a tour of three small hydro plants just north of Lake Athabasca. The Panel also had the opportunity to tour the system control center in Regina. This tour gave the Panel an appreciation for the SaskPower system, its components and how they interrelate and operate. More specifically, it enabled the Panel to see, first hand, the generation of electricity using coal and water. This left nuclear, biomass, conservation, wind and solar for the Panel to explore more closely. The Panel undertook an extensive series of tours and briefings in order to gain a working knowledge of the above options.

In order to obtain information on nuclear generating options, the Panel toured Atomic Energy of Canada Limited's (AECL) facilities at Pinawa (including the underground research laboratory - URL), Chalk River and Sheridan Park as well as nuclear generating plants at Point Lepreau (New Brunswick Power) and Pickering (Ontario Hydro). These tours provided the Panel the opportunity to examine AECL's present and future technologies and to see how AECL proposes to handle nuclear waste on a long-term basis.

The term biomass, is commonly used to encompass the use of a number of different fuels: waste wood, peat moss, even municipal waste or used tires to produce electrical energy. It was not considered necessary to visit a large number of sites each of which use a different fuel source. The Panel chose to tour a facility in Kirkland Lake, Ontario, owned by Northland Power. This plant uses steam produced from wood waste in conjunction with waste heat recovery from gas turbines in a combined cycle operation.

It was necessary to travel to the United States in order to visit wind and solar facilities. The Panel visited U.S. Windpower in Livermore, California and toured the Altamont Pass wind farm. It became immediately obvious that it is not possible to obtain an appreciation for the function and operation of such facilities without actually seeing a wind farm. The Panel did not tour a solar facility, but did meet with the Solar Energy Research Institute in Golden, Colorado and was given a very thorough and realistic appreciation for what could or could not be achieved using present day solar technology as well as some insight into possible future developments.

The final option which the Panel wished to explore more fully was that of electrical energy conservation and improved efficiency. In order to do this, the Panel met with organizations well known in the energy-efficiency and conservation field. These included Energy Probe in Toronto, and the Rocky Mountain Institute in Snowmass, Colorado. These meetings were valuable in helping the Panel understand what potential role demand side management (DSM) could realistically play in containing our ever increasing use of electrical energy. The Panel also reviewed DSM programs being undertaken by a number of Canadian and U.S. utilities.

In order to enhance the appreciation for how all of these options can be integrated into a functioning electric power utility system, the Panel met with two utilities who have incorporated a wide variety of generating supply and demand options into their system mix. The utilities, Ontario Hydro and Pacific Gas and Electric, are two of the largest electric utilities in North America.

In addition to touring the above facilities and meeting with other utilities, the Panel also sought expert input from regulatory bodies (The California State Energy Commission), independent power producers and industries actively engaged in cogeneration. The Panel's tours proved very useful in helping to understand the problems faced by utilities in rationalizing supply and demand issues as well as the uses and limitations of the various options. The Panel also had a joint meeting with the Saskatchewan Round Table on Environment and Economy to discuss the developing conservation strategy for the province and its relevance to the Panel's task.

1.3.3 Information Dissemination

Another important element of the Terms of Reference was the mandate given to the Panel to make information on electrical supply and demand available to the public. In some respects this was one of the more difficult objectives to achieve. Given the tight time frame between when the Panel was announced and when it began to hold meetings, it was impossible to undertake a comprehensive education process in preparation for the meetings. Therefore, most of the Panel's public education activities occurred concurrently with the meeting process.

The advertisement series, already discussed, gave a small amount of information on some, but not all, of the energy options. The information package sent to anyone requesting more information contained the "Our Future Generation" booklet, as well as a selected bibliography or source list that the reader could use to access more information if needed.

The basic text and graphics of the advertisements, with some alterations, were produced in poster size and sent to every school in the province. Included in this package was also an invitation to the school principal to encourage students to discuss the issue of energy options and to prepare a presentation to the Panel.

The Panel produced four newsletters (see Appendix 7) over the course of its study. These provided a synopsis of the Panel's meetings to date and discussed a variety of the topics raised at the Panel meetings. The newsletters also contained energy saving tips and other such information. They were sent to any member of the public, organization or business who had expressed an interest in being on an evolving mailing list. The Panel Chairman also accepted all invitations to appear on television or on the radio to promote public interest in the hearing process. When appropriate, the Panel issued press releases and articles which were made available to all provincial weekly and daily newspapers (see Appendix 8 for copies of these releases). In making these available the Panel sought to keep the residents of Saskatchewan apprised of its activities and the issues surrounding electrical energy options.

1.3.4 Acknowledgements

Conducting a review of this nature and incorporating the view of many individuals, organizations and businesses would not have been possible without the assistance of many people.

The most important input was provided by the people who appeared before the Panel during the public meetings. Their views, ideas and concerns, together with those of people who submitted written briefs, were indispensable in assisting the Panel in its task.

The Panel also wishes to thank SaskPower for the prompt and comprehensive answers provided to their many inquiries.

The Panel also thanks the many organizations which provided information and/or hosted us on our tours.

The Panel also acknowledges Meyer Verbatim Reporting Agency who transcribed the proceedings of the meetings. Their thoroughness and professionalism is very much appreciated.

The Panel also wishes to acknowledge the Panel office staff provided by SaskPower: Carmen Dybwad, Secretary to the Panel; Dean Krauss, Information Officer to the Panel; and Darcy McFarlen, Panel Office Secretary, were indispensable in assisting the Panel in performing its tasks.

2.0 - Electric Power Generation in Saskatchewan

2.1 The Past

In order to fully understand where society is going, it is necessary to have an appreciation of where it has been. Therefore, before endeavoring to comment on future electrical development, the Panel feels that a brief description of the history of electric power generation in Saskatchewan is in order. The provincial electric power utility was created in January 1929 with the passing of *The Power Commission Act* by the legislature. One month later, the office of the Saskatchewan Power Commission opened for business and the rest, as the expression goes, "is history."

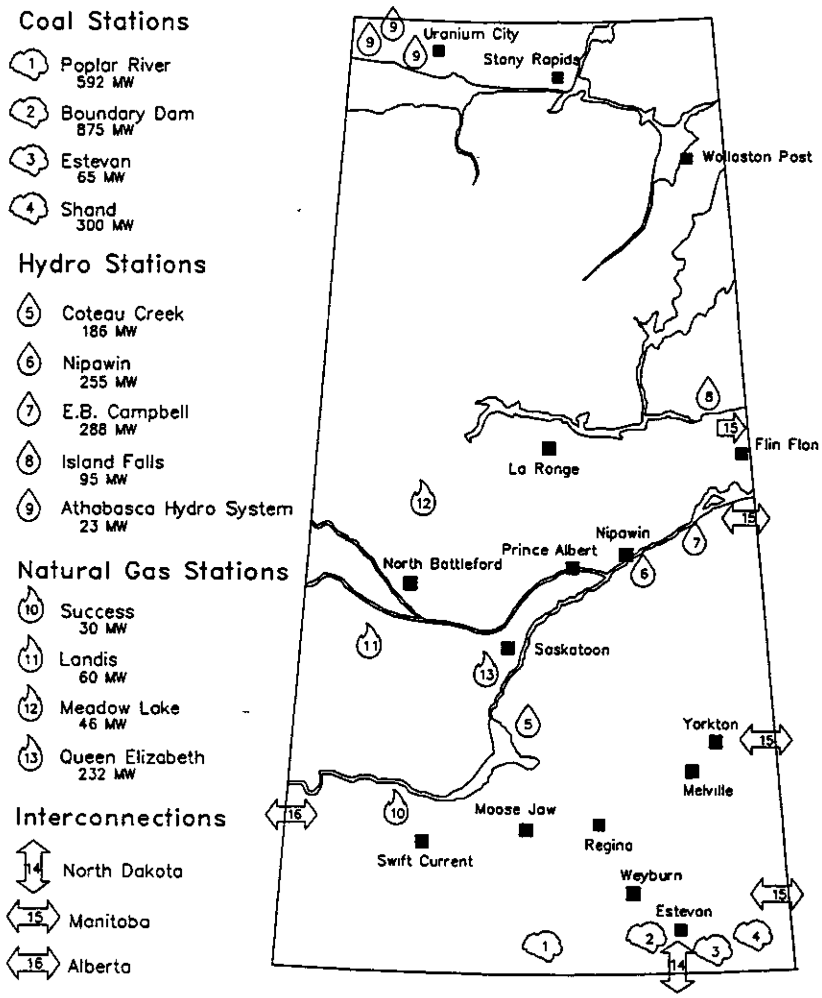
Before the incorporation of the Commission, the provision of electricity to residents of the province occurred in a patchwork fashion. At the turn of this century, the first customers ran a few lights using electricity provided by private enterprises from small steam generators usually located in the back room of their other primary business. This form of supply was soon overburdened by an ever increasing demand which, coupled with reliability problems, led to a call for public ownership of the generation and distribution facilities. Hence, by the time Saskatchewan entered confederation in 1905, all generating stations were municipally-owned. Twenty years later there were 111 individual generating stations within the province, but 80 percent of the population was still without electrical services. The Commission was incorporated to rectify this problem and to systematically plan the electrical development of the province. By the end of 1948, the Commission owned 35 generating stations and in excess of 5,500 km of transmission lines serving almost 400 communities and over 1,500 farms.

Clearly, the province had met its initial goal of establishing a reliable electric power service under public ownership. The next goal was to extend that service to every resident of the province. The growing demand for expanded service helped usher in a new era in the electrical history of the province. In 1949, in part because of the pressure to electrify the rural areas in Saskatchewan, the Power Commission became the Saskatchewan Power Corporation. Within a year, close to 1,300 new farm customers were added to the system. The addition of rural customers continued at a rapid pace until 1961 when 58,000 farms in total were served by the Saskatchewan Power Corporation.

The Saskatchewan Power Corporation not only faced the problem of serving an increased demand due to new customers, it also faced increased demand from its existing customers. Saskatchewan's dependence on electrical energy grew rapidly as the provincial economy evolved. This dependence was fostered both by economic development and by changing lifestyles. In every sector, in every area of the province, demand increased and the Saskatchewan Power Corporation grew to meet that demand.

In the 1950s, the corporation concentrated on increasing its generating capability by developing greater capacity at fewer but more central sites. The decision to proceed with the construction of the two new generating stations, Boundary Dam at Estevan, and Queen Elizabeth at Saskatoon had a significant impact on the overall design of the system. The decision to build Boundary Dam was particularly significant because this single plant now contributes approximately 50 percent of the base load energy production of the entire province. The current distribution of generating facilities throughout the province is shown in Figure 2.1.

Figure 2.1
Where Our Electricity Comes From



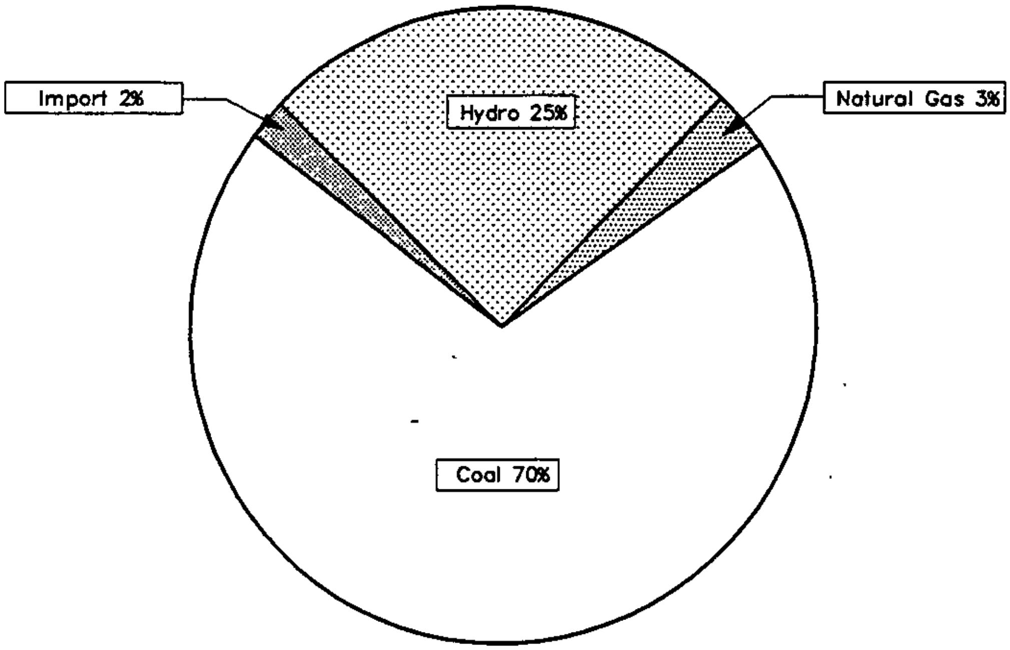
In addition to developing thermal stations, the corporation also began plans for developing hydroelectric generating facilities. These plans culminated in the building of the E. B. Campbell station (formerly Squaw Rapids) on the Saskatchewan River and the Coteau Creek station, on the South Saskatchewan River in 1966 and 1967 respectively.

In order to handle increasing peak load demands, gas turbine stations were built at Success (1967-8), Landis (1975), and Meadow Lake (1984), close to available gas supplies. Load growth continued, and correspondingly, development continued with the addition of generating stations at Poplar River (1981 and 1983) and Nipawin (1985-6).

2.2 The Present

SaskPower's present system is comprised of 13 generating stations totalling approximately 2,800 megawatts. These plants deliver power to 410,000 customers over 140,000 km of transmission and distribution lines. Roughly 70 percent of the province's electrical energy comes from coal-fired thermal plants, 25 percent from hydro stations, and 3 percent from natural gas facilities. The balance, about 2 percent, is made up from imports from neighboring utilities. This subdivision is shown in Figure 2.2.

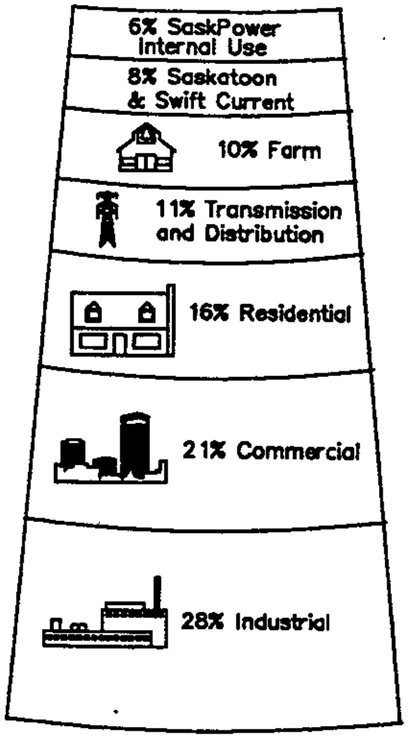
Figure 2.2
Power Sources



Power systems are characterized not only by their internal generating capacity but also by their connections to external generating capacity. Transmission connections with Manitoba, Alberta and North Dakota, serve a number of important functions for SaskPower. They serve as a means to sell electricity when SaskPower has a surplus, to buy when it is running short of capacity or to use as back up reserve and hence to defer the building of additional capacity within the province.

Supply is, however, only one side of the system equation. The other, equally important element is, of course, demand. Demand, like supply, is made up of a number of component parts. In Saskatchewan, the industrial sector accounts for roughly 28 percent of demand, the commercial sector 2l percent and the residential sector 16 percent. The balance of demand is made up by the farm sector, sales to the Cities of Saskatoon and Swift Current, transmission and distribution losses and SaskPower's internal use. The sector energy consumptions are shown in Figure 2.3. Since the '70s electrical demand in the province has grown by 5.4 percent per year in the residential and industrial sectors, 5.0 percent in the farm sector and 5.7 percent in the commercial sector.

Figure 2.3
Who Uses Electricity



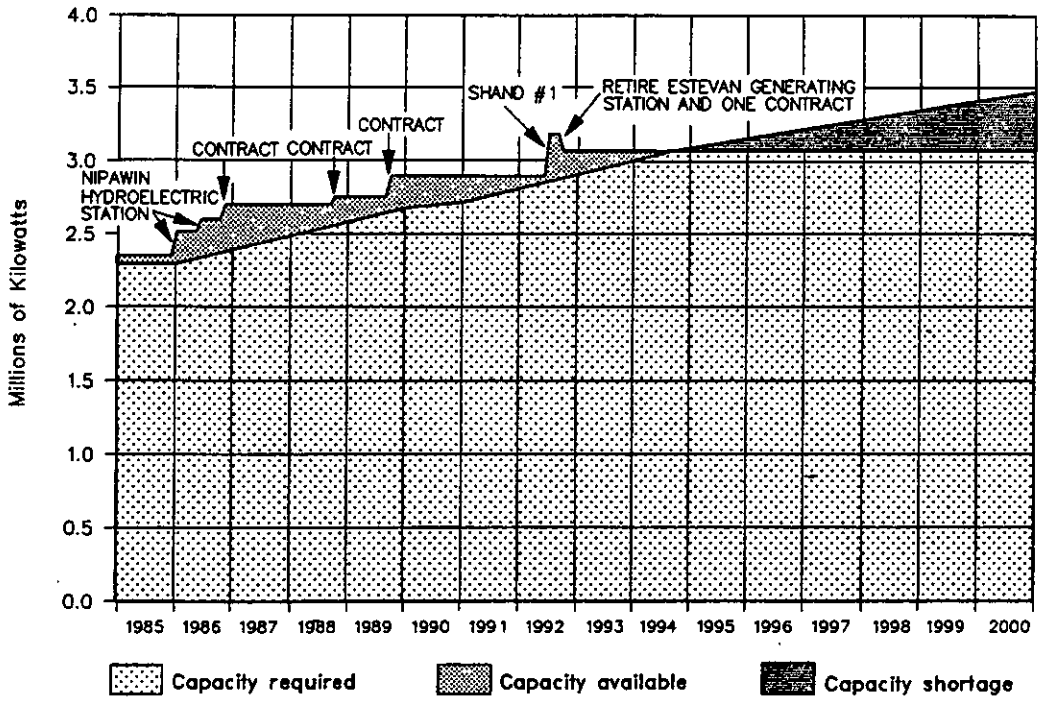
2.3 Future Considerations

It is anticipated by SaskPower that the rate of annual demand growth will slow over the next ten years, averaging closer to 2 percent per year as opposed to the over 5 percent experienced in the previous decade. This growth, coupled with the aging of existing generating stations and the retirement of some of SaskPower's contractual arrangements with neighboring utilities, suggests that SaskPower must add additional generating capacity to meet Saskatchewan's electrical energy needs. SaskPower expects to be in a generating capacity deficient situation by mid-1994. SaskPower's expected supply position is shown in Figure 2.4.

The Shand Generating Station is scheduled to commence operation in 1992. Planning for future generating capacity begins with those additions which follow the Shand generating unit.

In order to determine how to effectively respond to future demand, an electric power utility must know what electrical energy generation and conservation options are available and acceptable in terms of their environmental, social and economic impacts. SaskPower therefore must consider not only the technical parameters which influence its decision making, but must also clearly appreciate additional factors such as public acceptance of those decisions.

Figure 2.4
SaskPower's Supply Position

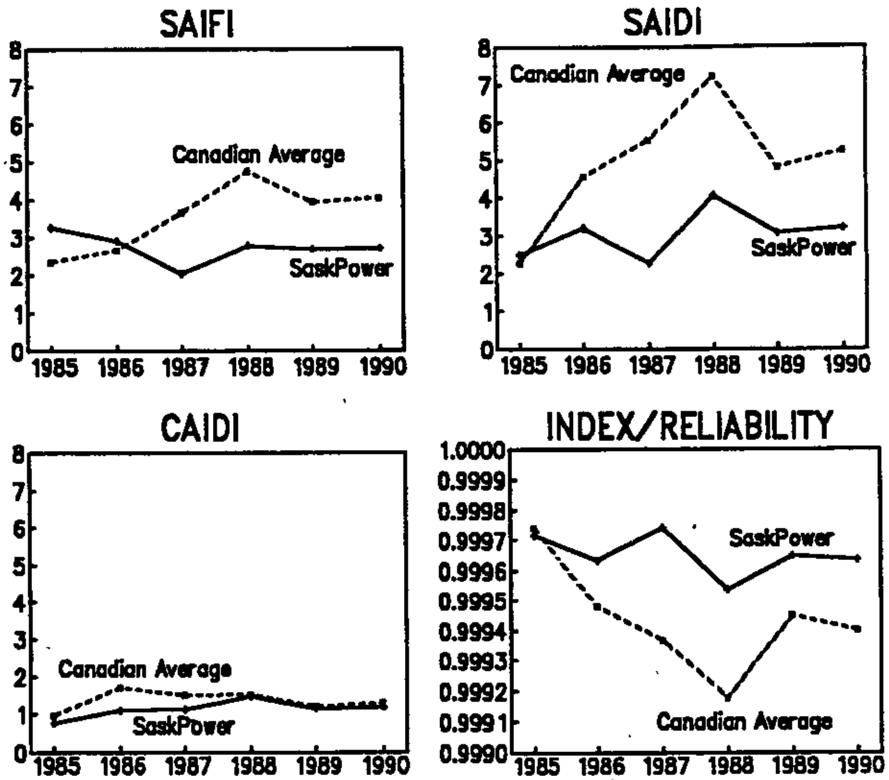


2.3.1 <u>System Considerations</u>

The Panel has been assigned the responsibility of assessing public awareness and acceptance of the various electrical energy demand and supply options. It should be clearly appreciated that this is only one segment of the overall information required by SaskPower in undertaking system planning. In attempting to fulfill its mandate of "meeting the electrical needs of Saskatchewan residents in a reliable, safe, efficient and environmentally responsible manner," the corporation must take into consideration: system reliability, the safety of its operations, the economics of its choices and their environmental impacts.

System reliability has been defined as "the ongoing ability of a power system to avoid outages and to supply electricity with the appropriate frequency and voltage to the customer." SaskPower has a good record of electrical service reliability. This can be seen from Figure 2.5, which shows average Canadian and SaskPower service continuity statistics for the 1985-1990 period. Figure 2.5 presents the four basic statistics used by the Canadian Electrical Association. The System Average Interruption Frequency Index (SAIFI) is the average number of interruptions per customer served per year. The System Average Interruption Duration Index (SAIDI) is the system average interruption duration per customer served per year. CAIDI is the Customer Average Interruption Duration Index and is the customer average interruption duration per customers interrupted during a year. The Index of Reliability shows the fraction of time that electric service was provided to the average customer. It can be seen from Figure 2.5 that SaskPower has an excellent record of service continuity. Generating system reliability is only one segment of overall system reliability but it should be clearly appreciated that the generating system options considered by SaskPower in its future plans should not impact adversely on the reliability expected by Saskatchewan consumers.

Figure 2.5
Service Continuity Statistics — Canadian Averages vs. SaskPower
Based on CEA and SaskPower Data 1985-1990



Operational safety is of paramount importance in an electric power system and in planning future facility additions. These considerations encompass not only the selection of generating facilities and their placement but also the location and design of transmission and distribution lines and other power related facilities.

Any business which manufactures or produces a product for sale must be conscious of how it uses its resources in order to maximize its output and minimize its costs. An electric utility is basically no different. In planning its system, SaskPower must take into consideration the resources available to it and their relative costs and efficiencies in order to provide the best mix of options while satisfying its mandate. This concept underlies the province's relative dependence on coal-fired generating stations. Coal in Saskatchewan is inexpensive and abundant and using it to generate electrical energy is a logical utilization of a provincial resource. Other jurisdictions, for example, Manitoba, use hydro power for exactly the same reasons. Continued use of these resources will, however, depend on public perceptions and the relative economics and availability of alternate sources of electrical energy.

An electric power utility must be continually aware of the impact of its operations on the environment. This concern therefore plays a vital role in the planning and selection of new facilities. These decisions affect not only the immediate environment surrounding the facilities but, in the case of generation options, extend throughout the province and, indeed, into the global environment.

2.3.2 Global Considerations

It has become abundantly clear that while local and provincial considerations are important to SaskPower in system planning, there are global considerations which have an important influence on the utility's planning regime. This is particularly true with respect to the environment. It is no longer sufficient to recognize only local or direct impacts. It is equally important for a utility to take into consideration the global impacts of its decisions. For a utility such as SaskPower, this means considering the contribution its activities make to CO_2 production, ozone depletion or acid rain. It may also involve recognition of downstream impacts due to changes to river systems, which may occur in jurisdictions beyond its own borders.

It can be argued that it is unrealistic to suggest that the actions of a province with a population of one million people can have a significant impact on the global environment. It is important , however, to recognize the adage, "think globally and act locally." The emissions from SaskPower's generating stations may be relatively insignificant in the context of global CO_2 production, acid rain and ozone depletion, but in consciously reducing such emissions, the corporation demonstrates its awareness of the seriousness of the global problem and its role as a global corporate citizen.

In addition to general concerns regarding the global environment, there are other factors, such as federal legislation, which may have a significant impact on electric utility decision making.

SaskPower must face the future with a rather complex blend of constraints and concerns. The Panel has attempted to recognize these constraints and concerns in developing its Position Statement.

3.0 - Position Statement

3.1 Introduction

Electrical energy supply in Saskatchewan has evolved over the past century from a few isolated generating facilities to a complex fully integrated system. Electrical energy consumers connected to the SaskPower system enjoy high quality supply at an affordable cost. This is an important factor in the economic and social well-being of the province and its residents. It is important therefore to clearly appreciate that the basic function of SaskPower is to meet the electrical energy needs of Saskatchewan in an environmentally responsible manner, at an acceptable standard of reliability and at the lowest possible long-term cost. Given the present trends in industrial development and lifestyles in Saskatchewan, it is expected that in addition to demand side management, energy conservation, purchases from independent power producers and plant-life extensions, new generating capacity will be required to meet increasing electric power and energy requirements and to replace retiring generating facilities and purchase agreements. These trends, however, should not be assumed to be fixed and it should be appreciated that this is a time of considerable change both locally and globally. The uncertainty associated with future economic directions and objectives coupled with personal attitudes towards energy utilization and conservation dictate that high priority be given to flexibility in the system and that SaskPower be in a position to respond to change.

3.2 Electrical Energy Demand Side Options

3.2.1 Energy Conservation and Efficiency

This is a dynamic area of application within the electrical energy industry. The technology for improving the efficiency of electrical energy utilization is developing rapidly. Attitudes towards demand side management (DSM) are evolving quickly as utilities throughout the industrialized world gain experience in this area. The Panel heard widespread support and enthusiasm during the hearings for demand side initiatives and their potential application in Saskatchewan. The Panel also concluded that SaskPower is not seen to be taking full advantage of possible options to reduce both power and energy demands. SaskPower is not seen by the public at large to be particularly receptive or responsive to public concerns in this area. The Panel believes that the potential for economically feasible conservation and efficiency improvement in Saskatchewan should be carefully and exhaustively evaluated. In the absence of such a study, it is difficult to predict the extent to which conservation and efficiency improvements will impact upon future electric power and energy requirements. Some indications can, however, be drawn from similar activities in other parts of North America and some of these are referred to in the technical section of this report.

The Panel suggests that SaskPower conduct a thorough review of demand side programs in other jurisdictions and their relevance to Saskatchewan. A comprehensive survey of present levels of efficiency in all areas of electrical energy utilization is required in order to estimate the potential for improvement with current available technologies. The Panel recommends that those DSM initiatives which are economically attractive should be implemented as soon as possible. SaskPower should perform a detailed economic analysis of each demand side management initiative in order to ensure that true costs and benefits are fully understood and that the initiative will not in itself increase the rates charged to its customers any more than that which would be realized by other alternatives.

The potential for demand side management including conservation and efficiency applications depends to a large extent on how the public at large perceive the need for and value of limiting electrical energy use. Conservation and efficiency gains are based in part on technological improvements, which require associated funding, and also on behavioral changes, which require recognition of the need for change. SaskPower has an important role to play in electrical energy education of the public at large and also of specific segments such as the commercial, industrial and educational sectors. SaskPower should establish a highly visible and functional department to perform these functions.

3.3 Electrical Energy Supply Options

3.3.1 Non-Utility Generation and Cogeneration of Electrical Energy in Saskatchewan

At the present time, all the electrical energy supplied to the grid connected Saskatchewan system comes from generating facilities owned and operated by SaskPower or from neighbouring utilities. In many jurisdictions, a significant component of the overall system electrical energy requirements is provided by non-utility generation and cogeneration facilities. These facilities provide a measure of flexibility and diversity in electrical energy supply and facilitate the orderly, economic and efficient use of natural resources. Non-utility generators can be defined as those facilities owned and operated by electricity producers other than SaskPower and include possible private and municipal utilities and independent power producers. A cogeneration facility is normally directly associated with an industry in which a significant requirement for electrical energy is coupled with a large demand for process heat, usually in the form of steam. The opportunities for cogeneration are therefore directly related to the facilities residing within the system. Saskatchewan has several industries which provide all or part of their electrical energy needs by cogeneration. These facilities do not, however, supply additional energy to the grid connected system. They do, however, decrease the total demand for electrical energy from the system.

The Panel believes that the Government of Saskatchewan should adopt policies that will facilitate the production of electrical energy by non-utility generation and cogeneration facilities in parallel with SaskPower. In order to perform this function, however, the role of SaskPower as the agency responsible for meeting the electrical energy needs of Saskatchewan, at an acceptable standard of reliability and at the lowest long-term cost must be clearly retained. At the present time, SaskPower does not appear to be particularly receptive to possible inclusion in the provincial electrical energy supply of energy generated by non-utility generation or cogeneration facilities. This may or may not be true but the perception very definitely exists. This may be due to the fact that all dialogue on this issue is done directly between SaskPower and the potential independent producer and there is no unbiased third party involvement. This is not the case in other provinces where regulatory bodies or energy commissions created by government legislation provide an arbitrator function in regard to perceived differences between generated energy costs and worth.

The Government of Saskatchewan should proceed immediately to establish procedures whereby independent power proposals and cogeneration alternatives can receive and be seen to receive proper scrutiny and consideration as viable provincial electrical energy sources. These procedures should ensure that all generation facilities added to the electrical energy system further the orderly, economic, environmentally responsible and efficient use of Saskatchewan's natural resources.

The most contentious issue in non-utility generation is the price paid by the utility for the electrical energy supplied to the system. In most jurisdictions, this is determined through a public hearing process by an independent tribunal. This opportunity does not exist in Saskatchewan at this time. The Panel recommends that such a tribunal be established. The pricing policy should be based on the philosophy that the rates to electric utility customers should not increase beyond those which would be incurred without the addition of the independent power facility, and that consumers should be indifferent, in terms of both power quality and cost, as to who actually generates electricity.

A small non-utility generation project may have a number of highly visible socio-economic benefits associated with it for the locale concerned. These benefits should not be a consideration in the determination of acceptable energy purchase rates. The Panel believes that any such benefits can be more appropriately recognized by applying direct government actions in the form of taxes and grants rather than by increasing electricity rates to the general consumer.

The Panel appreciates that benefits may accrue to society when electrical energy is generated by renewable energy sources rather than by non-renewable sources. These potential benefits should not restrict the possible development of non-renewable energy projects that meet the environmental standards set by the province. It should be clearly understood that selecting specific energy resources for preferential treatment could result in choosing options that would otherwise be uneconomical, thereby resulting in increases in electricity costs to all consumers.

Any policies regarding financial support for the development of renewable energy sources should be established by the Government of Saskatchewan rather than by SaskPower. The government may therefore choose to put in place an energy policy which provides subsidies or tax relief for renewable energy developments. A clear framework of provincial and national energy policies and environmental legislation would assist SaskPower to effectively incorporate renewable energy sources in its planning strategy. The proposed independent tribunal could provide the forum for discussion of the implications of such government policy decisions on electrical energy rates in Saskatchewan.

The Panel believes that an independent power producer should receive fair value for both the electrical energy and capacity provided to SaskPower. In broadest terms, this is commonly referred to as avoided cost, although there are many interpretations of the correct way to calculate this value. SaskPower should proceed immediately to prepare for public scrutiny an avoided cost policy and price schedule which can be used by potential non-utility generators and cogenerators in their financial planning and decision making.

The mandate of SaskPower imposes the obligation to deliver reliable electrical energy to the consumer in a cost-effective manner. In order to ensure that SaskPower has the opportunity to provide the required reliability of supply, it may be necessary to limit the energy provided by non-utility generators . The Panel recommends that a limit of 125 MW be placed initially on non-utility generation. This should be reviewed by SaskPower and the proposed tribunal as soon as relevant operating data are obtained. It may be found necessary to subdivide the allocated power generation into small and large independent power producer segments with different contracts and constraints.

SaskPower should also develop a standard contract applicable to all non-utility generation. Contracts for external power production should be long-term to provide energy stability and therefore the Panel suggests that all contracts be for at least 20 years.

3.3.2 Electrical Energy Supply Sources

Saskatchewan has a wide range of available electrical energy supply options and should take full advantage of the economic benefits associated with its natural resources while acting in an environmentally responsible manner. In principle, all the available options for the generation of electrical energy could be developed either by SaskPower or by independent power producers. Imposing a limit on the non-utility generation components will restrict the independent production to relatively small capacity components which utilize natural resources such as small hydro, wood waste, peat, natural gas and the wind. Economic evaluation of a particular option cannot be done using simplistic cost/kW of power or cost/kW.h of energy values. This is a complex system planning task in which the contribution of the particular option must be examined in a total system context. The Panel believes that certain options are technically viable and appear to be economically attractive. The Panel has not conducted a detailed economic analysis of each option, many of which are extremely site specific. The actual costs and the system benefits associated with a particular generation facility must therefore be determined by SaskPower when considering that option.

3.3.2.1 Coal

Saskatchewan has abundant reserves of low cost, low sulphur coal and should attempt to take advantage of this resource in an environmentally responsible manner. This cannot be done using conventional coal technologies for generating electricity and therefore "clean coal" technologies should be utilized. These technologies, such as pressurized fluidized bed combustion (PFBC) and integrated gasification combined cycle (IGCC) facilities are not totally clean in the sense of making zero contribution to carbon dioxide (CO_2) levels in the atmosphere. They are, however, a considerable improvement on conventional coal technologies and should be regarded as viable options for Saskatchewan. In view of the possible support by the federal government for a clean coal facility in Saskatchewan, this option looks attractive from many viewpoints. In addition to new sources of generation, clean coal technologies offer the possibility of plant life extensions and modifications resulting in decreases in CO_2 production at other coal-fired plants.

3.3.2.2 Hydro

Saskatchewan has the potential to generate additional energy from a number of hydro sites throughout the province. Some of these are possibly environmentally acceptable and economically attractive. These should be considered as viable options in meeting future electrical energy requirements. The negative reaction to building hydroelectric generating stations on the Churchill River, displayed in the 1978 report by the Churchill River Board of Inquiry, and the adverse aspects associated with the Rafferty-Alameda dams should not automatically rule out building further dams or hydroelectric plants in the province. Each potential hydroelectric site should be examined on its own merits both in terms of impact and environmental effects. Hydro power, given sufficient flow, has the potential of being the cheapest source of emission free electrical energy and should not be discarded without detailed and balanced scrutiny. Hydro power may also provide the opportunity for independent power production, particularly in northern communities provided that these communities have input into the justification and creation of the project.

3.3.2.3 Natural Gas

The present price of natural gas makes it an attractive option for SaskPower electrical energy generation and for independent power production. The basic philosophy in both Saskatchewan and Alberta has been to use natural gas for the generation of electrical energy at peaking plants rather than for base load production. Gas turbines are excellent options for peaking capacity due to short construction lead times, excellent load following capabilities and adequate unit sizes to meet peak demands. High gas costs in the past and relative instability in future gas prices coupled with the realization that this is a non-renewable resource have restricted the use of natural gas as a fuel for base load power generation. It is interesting to note that this philosophy does not seem to be adhered to in some other locations or situations. In California, it is expected that natural gas will be the basic fuel for large amounts of base load generation over at least the next decade. The utilization of natural gas will allow California utilities to limit the burning of coal and reduce their dependance on nuclear power plants.

Natural gas is also a preferred fuel at the present time for many non-utility generators due to minimal environmental impacts, low generating unit capital costs, short construction times and high availability at relatively low cost. It is rather anomalous that the two producing provinces should restrict their own use of a natural resource while selling this resource to other jurisdictions to use in applications not considered suitable by the producing jurisdictions. The use of natural gas in Saskatchewan for non-dispatchable power production by non-utility generation is contrary to the basic philosophy adopted by SaskPower. This contradiction in philosophy should be reconciled by SaskPower and the proposed tribunal before proceeding to purchase electrical energy from an independent power producer using natural gas.

The Panel further suggests that SaskPower review its basic philosophy on the use of natural gas for the generation of electrical energy and seriously examine the option of using this resource for both base load and peaking capacity.

3.3.2.4 Nuclear

This is undoubtedly the most contentious option for electrical energy generation in Saskatchewan. It is, however, a viable option which should be considered when planning Saskatchewan's electrical energy future. The proposed CANDU 3 technology offers a nuclear generating unit which is sized to permit reasonable integration in the SaskPower system. The CANDU 3 is, however, a prototype unit for which there is no technical or economic history. These factors must therefore be carefully assessed when considering its possible implementation in the SaskPower system.

It should be clearly appreciated that there are widely held and deeply felt concerns about nuclear safety, waste disposal and other issues which must be recognized and addressed. Past CANDU performance and the proposed development in the CANDU 3 technology suggest that all the relevant technical concerns can be basically satisfied. Extensive research is presently being conducted by Atomic Energy of Canada Ltd. on deep waste disposal and definitive criteria and procedures should be available for examination and discussion in the near future. Deep waste disposal will ultimately have to satisfy an intensive and public environmental review process before it can be considered to be acceptable.

There are, however, some fundamental philosophical objections to nuclear power generation which are held by a significant proportion of the general public. These concerns are much broader than the generation of electrical energy within Saskatchewan. They initiate with the mining of uranium in Saskatchewan and its utilization in various forms throughout the world. The construction of nuclear generating stations in countries considered to be relatively unstable and unpredictable is seen as a distinct threat to the global environment. The utilization of nuclear plant fuel in the creation of weapons which could reside in the hands of dictators, terrorists or irresponsible governments is seen as more than a distinct possibility and therefore something that cannot be allowed to happen. It can be argued that the presence of a CANDU 3 nuclear generating station in Saskatchewan will not affect the global nuclear power situation and the nuclear weapon scene. This, however, will not likely mitigate the deep rooted objections to nuclear power production held by a segment of the population. The utilization of nuclear power generation in Saskatchewan in the form of a CANDU 3 generating unit is a viable option. Objections to nuclear power must, however, be viewed in a broader context than the simple generation of electrical energy and treated in this way when making societal choices. The Panel recommends that the Government of Saskatchewan conduct a broad public review of nuclear power generation in Saskatchewan including short- and long-term waste disposal.

3.3.2.5 Biomass

Biomass sources in Saskatchewan include, but are not limited to, wood, peat and municipal solid wastes. Biomass may provide the opportunity for independent power production in northern locations where wood waste and related forest residues occur. The generating facilities at these locations will be small capacity installations directly associated with local forestry activities. It is not expected that SaskPower will utilize these resources due to the availability of lower cost alternatives, but could possibly purchase electrical energy from non-utility generators or cogenerators using these resources. Their utilization therefore becomes a question of economics and the provision of an equitable process for considering these options.

3.3.2.6 Wind

This is a popular option, at least in the eyes of the general public, for electrical energy generation. It has not been utilized extensively at this time by any electric power utility in Canada although some utilities have trial facilities. There is some potential in this area for future electrical energy generation in Saskatchewan and SaskPower should make a definite commitment to fully examining this potential. Wind power economics are directly related to available wind energy, wind system capacity factors, equipment availability and maintenance requirements. Electrical energy production from the wind is therefore very site specific. Some important information can be extracted from experience and research in other jurisdictions such as California but research and experience in the Saskatchewan environment is required.

Initial studies indicate that there may be only a limited number of economic wind power sites in Saskatchewan. This point can be illustrated using data provided by Environment Canada (see technical section of this report). The maximum average power output as a percentage of the installed wind turbine capacity is approximately

26 percent at Swift Current, 16 percent at Saskatoon and 7 percent at Hudson Bay. The data used to obtain these values are, however, incomplete and therefore before drawing any firm conclusions regarding wind power potential in Saskatchewan, the Panel recommends that SaskPower initiate a detailed study of wind regimes at a number of potentially suitable locations.

Energy generated by wind power could be supplied to the system either by an independent power producer or by SaskPower. It appears that the most cost-effective use of wind power is in the form of suitably located wind farms, which in essence are operated and controlled in a similar manner as a basic power plant with a number of small units. Modern wind turbines are complex pieces of equipment, requiring expert maintenance, located approximately 30 meters above ground level. They do not appear to be economically viable as single units located on farms scattered throughout the province. The bulk of the wind farms located in North America are in California. Most of these are privately owned and sell energy to the regional utility. It appears, however, that electric power utilities are now actively involved in owning and operating wind farms in addition to purchasing wind energy from non-utility generators. Wind is very definitely a non-dispatchable energy source and its random nature makes it difficult to assign a capacity or power credit in addition to an energy credit. It may therefore be necessary at some point in the future, due to system reliability considerations, to limit the wind power penetration in the system capacity composition. Initially, however, the Panel recommends that SaskPower proceed to collect appropriate wind data at specific locations in the province and proceed to make this information available to potential independent power producers. SaskPower should also actively monitor the research and development being conducted on wind turbines.

3.3.2.7 Solar

Solar radiation offers the potential of an unlimited source of energy with little danger of environmental damage. At the present time, solar radiation for grid connected electrical energy generation must be considered as a developing technology which cannot be economically utilized in Saskatchewan. As with wind power, solar energy can be economically and technically viable at remote locations where grid connected supply is not available or not economically feasible. Two basic technologies for producing electricity from solar radiation are presently in the development and demonstration stages. Photovoltaic devices convert sunlight directly into electricity while solar-thermal devices use solar energy to vaporize a working fluid which is then used to drive a turbine coupled to an electric alternator. Photovoltaics are not a viable alternative for grid connected electrical generation in Saskatchewan at the present time due to high costs and a lack of proven development in northern locations. Solar radiation has, however, considerable potential for the future. The Panel recommends that SaskPower actively monitor the research and development being done on the application of solar radiation in electrical energy generation.

3.3.2.8 Geothermal

Geothermal energy is not a viable option for generation of electricity in Saskatchewan as the maximum obtainable temperature is far less than that considered suitable for the commercial generation of electrical energy.

3.3.2.9 Oil

Electrical energy generated by oil-fired boilers is not a viable option for Saskatchewan. The costs and availability of oil compared to other alternatives makes it extremely unlikely that this resource will be used to generate electrical energy at other than remote locations.

3.3.2.10 Purchases from Interconnected Systems

The electrical energy supply system in Saskatchewan is interconnected with the systems in Manitoba, Alberta and North Dakota and therefore topologically is in a position to purchase both electric power and energy. These purchases can be made in a number of ways, such as economy interchange, seasonal diversity exchanges, firm capacity purchases and basic reserve sharing. SaskPower has already taken excellent advantage of these opportunities and should continue to do so when the purchase or exchange is economically advantageous and satisfies the system reliability constraints. The Panel does not believe, however, that power and energy purchases from other jurisdictions should be used to simply avoid building similar facilities within Saskatchewan. As an example, purchasing power from hydroelectric facilities in Manitoba while stating that the construction of dams in Saskatchewan is environmentally unacceptable is not considered to constitute valid acceptance of environmental responsibility.

3.5 Developing Technologies

There are a number of technologies which are in various stages of research and development. It can be suggested that clean coal technologies, wind power and solar energy are also in this category. These energy conversion systems are, however, in actual utilization and also in active research and development phases. There are some relatively new technologies, such as compressed air energy storage which offer potential for future utilization but which require extensive study before considering their application in Saskatchewan. There are a number of exciting technologies being studied and developed which have tremendous potential but are clearly not economically or technically viable for utilization in Saskatchewan within at least the next decade. These are as follows.

- Fuel cells, including phosphoric acid fuel cells, molten carbonate fuel cells and solid oxide fuel cells.
- Magnetohydrodynamics.
- Stored energy systems including stored energy in CO_2 and electric batteries.
- Nuclear batteries.
- Nuclear fusion.
- Hydrogen utilization.

The Panel recommends that SaskPower establish a specific body within their organization to observe, monitor and help educate the public on developing technologies for electrical energy production and utilization.

3.6 Conclusions

There is no single alternative on either the demand or supply side that will satisfy the electrical energy needs of the Province of Saskatchewan. The Panel firmly believes that SaskPower needs a well-balanced mix of many demand and supply alternatives in order to fulfill its mandate to satisfy the system load requirement as economically as possible, in an environmentally responsible manner, and with a reasonable assurance of continuity and quality. This includes realistic, practical and economically justified conservation and efficiency measures together with economic and reliable supply additions.

In order to facilitate the philosophy that all generation facilities added to the SaskPower system further the orderly, economic and efficient use of Saskatchewan's natural resources, the Government of Saskatchewan should establish an independent tribunal to provide the interface between external sources of electrical energy supply, SaskPower and the government.

As a Crown corporation, SaskPower has the potential to be used by government as a tool for public policy. The Panel clearly appreciates that decisions made on demand and supply side alternatives can have considerable impact on society in the form of employment and economic development. The Panel believes that it is inappropriate for SaskPower to be placed in the position of formulating provincial social policy. Socioeconomic benefits should be recognized by the Government of Saskatchewan and facilitated in the form of taxes and grants rather than by increasing electricity rates to the general consumer.

4.0 - The Options "What We Heard"

An important part of the Terms of Reference given to the Panel was a directive to solicit and receive public comment on the options available for meeting the province's future electrical energy requirements. In order to facilitate this, the Panel held a series of public meetings as described in Section 1 of this report. What was heard was as diverse as the province itself. The input received contained many options and reflected values and concerns from many perspectives.

These diverse viewpoints came from residents, ranging from grade school children to retired people; businesses which provide input to the generation of energy to those which rely extensively on electrical energy; concerned citizens who see nuclear energy as a way to save the planet to those who see it as a way to hasten its environmental demise. The common attribute of all these people was their willingness to take the time to express their views, and in doing so, to demonstrate their commitment to the province and its future.

While it is possible to reduce to print and summarize the range and diversity of the public input received by the Panel, it is not possible to convey the emotion and expression in the presentations. As with any translation, something is always lost. What follows is a representative sample of the many opinions the Panel heard while on its tour of Saskatchewan.

4.1 Conservation

If there was any issue on which there was consensus, it was that of the need for more conservation. There were no presentations which did not directly or indirectly refer to the need for greater conservation of electrical energy. The only disagreement on the need for conservation was with respect to how it should be promoted, enforced or incorporated in the Saskatchewan economy. The following excerpts from the transcripts and written submissions attempt to demonstrate the range of opinion on the topic of conservation.

> "Our society has to come to grips with what it perceives as needs and wants. We are a very wasteful lot, and our standard of living does not have to change drastically to eliminate wasteful use of electricity that serves no useful purpose (i.e. Christmas lights, street lights that come on before dusk, street lights that are on in small rural towns, when those towns are dead from 1:30 a.m. till morning.)"

(Mr. Normand Simard, Written submission to the Panel)

> "Nevertheless, we view conservation as a first priority in addressing future needs. We are committed to action on a local level which will promote greater attention by both civic employees and citizens of our city to avoidance, efficiency, waste reduction and consideration of lower net impact alternatives in the use of electrical energy."

(Mr. Bland Brown, City of Regina, Regina transcripts, January 24, 1991, p. 599)

The Panel also heard presentations which listed the various opportunities available for reducing energy demands. More specifically, the Panel was advised that there were gains to be made in terms of electrical efficiency which would not have a degrading impact on the quality of life.

> "Energy efficiency essentially means doing more with less. Whatever the energy source, energy efficiency, reducing energy production and consumption, reduces the environmental impact of whatever the source, ensures the long-term maintenance of the existing energy sources, and can generate net wealth by divesting money that would otherwise be spent on expansion of energy sources."

(Ms. Margret Asmuss, Saskatoon transcripts, March 22, 1991, p. 2747)

The same observation was also stated in a somewhat different way.

> "Now most conventionally-minded people will probably still insist on two things and will come and tell you these two things, that first of all exponential growth in energy consumption must and will continue and secondly that such growth will necessarily result in enhanced socioeconomic conditions. I submit there is actually plenty of evidence to the contrary."

(Mr. Bert Weichel, Saskatchewan Environmental Society, La Ronge transcripts, June 21, 1991, pp. 4625-4626)

It was noted that the savings from incorporating energy efficiency into our personal and corporate activities not only saves money, but also saves the environment.

> "In terms of energy consumption, considerable savings can also be achieved. For instance, if a consumer replaces a single 75 watt bulb with an 18 watt compact fluorescent bulb, that lasts 10,000 hours, the consumer can save the electricity that a typical U.S. coal plant would make from 770 pounds of coal. As a result, about 1,600 pounds of carbon dioxide, and about 18 pounds of sulfur dioxide, would not be released into the atmosphere."

(Ms. Margret Asmuss, Saskatoon transcripts, March 22, 1991, p. 2754)

How conservation targets should be determined and achieved were also concerns which evoked considerable comment.

There was a wide variation in opinion on the amount of electrical energy savings that conservation could reasonably generate, and there were those who felt SaskPower has severely underestimated the role that conservation or DSM could have on future demand projections.

> "SaskPower's projections for possible savings are rather conservative, about 12 percent by my calculations. The Canada wide studies have put the figure at 45 percent."

(Mr. Ian Monteith, Saskatchewan Environmental Society, Moose Jaw transcripts, April 9, 1991, pp. 3139-3140)

The question of how conservation should be incorporated also generated considerable discussion. Proposals ranged from rebate programs, to education and consumer awareness initiatives, and to financial disincentives such as rate increases.

4.2 Coal

The primary energy source for producing electricity in Saskatchewan has been coal. Approximately 70 percent of Saskatchewan's electricity is generated by coal-fired thermal plants located in the southern portion of the province. The wisdom of using coal resources was questioned during the Panel's meetings.

> "Although new sites such as Shand are relatively more environmentally sound, burning fossil fuels for electricity is not a sound method for generating energy and should be kept to a minimum, with other friendly alternatives replacing fossil fuel burning plants as they come off line in the future."

(Mr. Scott Ware, Regina Coalition for Peace and Disarmament, Regina transcripts, January 23, 1991, pp. 351-352)

> "At present, Saskatchewan is a world leader in production per capita of greenhouse gases such as carbon dioxide and carbon monoxide. Much of these gases released into the atmosphere come from our coal-fired electrical generation plants. This is a very serious problem and has been well emphasized over recent years."

(Mr. Guy Sanders, American Society of Heating, Refrigeration and Air Conditioning Engineers, Moose Jaw transcripts, April 9, 1991, p. 3231)

Carbon dioxide is not the only emission from coal-fired plants which is of concern, as the Panel also received submissions discussing other emissions.

> "Acid rain is distinctly a phenomenon of the industrial age. Sulphur and nitrogen oxides, the raw materials of acid rain, spin forth from a variety of sources and have a devastating effect on our environment. Lakes are unable to support life, trees are showing injury and dying from acid rain, and the surfaces of stone buildings and monuments are being corroded. When low sulphur lignite coal used by SaskPower is burned, it is converted to sulfur dioxide, a major contributor to acid rain."

(Ms. Crystal Beliveau, Written submission to the Panel)

In addition to negative comments on the continued use of coal to generate electricity, the Panel heard contrary opinions which recognized that measures must be taken to use coal in an environmentally responsible manner.

> "It might sound strange to you, but I'm very much for using the coal you have because that's a long-term resource and you wouldn't be thrown into any kind of panic to look for new resources, and what I see as a problem there, especially if you look at the United States, is you have to be able and willing to invest a good chunk of the cost, of the generating costs in bringing a station into work. A big chunk of the investment has to be for environmental purposes, and from other areas of the work, like, I know one example in Germany for example, about a third of the investment cost was put into environmental measures which make it an extremely clean burning generating station, with black coal in this case, but that would apply to brown coal as well."

(Mr. Jakob Pillibeit, Regina transcripts, January 24, 1991, p. 649)

SaskPower was encouraged to participate in the development of clean coal technologies.

> "I would like to encourage the construction of one of the advanced coal-burning technologies at one of our power, coal-burning power generating stations in Saskatchewan and the technology that, there are a few to choose from, but whatever would be the most appropriate for our type of coal and our needs, but I think SaskPower can play a role in demonstrating that clean coal technology can work, and can work in the Canadian economy."

(Mr. Al Shpyth, Saskatoon transcripts, March 21, 1991, pp. 1973-1974)

It was noted that the use of coal to produce electricity is a complex economic issue. Coal has been used extensively because of its relative cost and abundant supply, and this utilization has resulted in the creation and support of a number of industries and communities.

> "However, again coal I don't think, certainly because of the abundant supply of cheap inexpensive coal reserves and so on that we have, I don't think that SaskPower can afford to discount generating electricity by the additional coal generating plants. Again, I think that we're going to have to weigh benefits against risks and problems, and it may be in fact better to have electricity (than) through the generation of coal than not to have any electricity at all."

(Mr. Bud Burrell, SIAST - Kelsey Campus, Wynyard transcripts, April 27, 1991, p. 4071)

> "The economic benefits to Coronach are evident by the number of businesses in Coronach. School enrollment, hospital facilities, recreational facilities and participation of permanent residents with residential-related incomes. You would think maybe that it was all economic, but it goes back to the age of the population. If it wasn't for the mine and for the power plant, you wouldn't have young people to populate the schools. The recreation facilities, we wouldn't have them if we didn't have young people related to the employees, we would just have a senior citizens town and we wouldn't be able to have all these facilities, and the alternate means of electrical generation in respect to loss of coal-fired generators would be a major downfall of the community and the possible demise of the Town of Coronach."

(Mr. George Quarrie, Town of Coronach, Assiniboia transcripts, April 10, 1991, p. 3353)

And, similarly for Estevan:

> "First of all, it goes without saying that Estevan relies a great deal on the coal mining industry to help support our community's infrastructure. This support comes both directly in the form of employment. The numbers I have received from the coal company representatives have been in the neighborhood of 280 individuals employed with the coal companies, a

few hundred more with SaskPower. We're also talking about millions of dollars spent annually on goods and services acquired through local business, both by SaskPower and the coal companies. Indirectly, of course, all of this activity creates a spin-off; employment in other sectors, retail, wholesale, trade, professional services, personal services and those sorts of things.

(Mr. George Sereggela, Estevan Chamber of Commerce, Estevan transcripts, April 25, 1991, p. 3851)

4.3 Hydro

In discussions involving the development of hydro power in Saskatchewan the themes of scale and control were very important. Northern residents were generally in favour of hydro generation if it was done on a small scale and was locally controlled.

> "Cumberland House wants to build another dam; not a dam that disrupts the environment, not a dam that brings hardship to a small community, not a dam to meet the needs of a distant and invisible community. Cumberland House wants to build a dam for Cumberland House."

(Mr. Alan Storey-Bishoff, Cumberland House Development Corporation, Nipawin transcripts, March 8, 1991, p. 1356)

Decisions of this nature are driven partly by the desire to reduce negative environmental impacts, and partly by the need to have the resulting economic benefits accrue to the local community.

> "People are not opposing some of these projects like hydro, but they're concerned about the environment and concerned what benefits they get out of destroying the environment, especially the traditional users, the trappers, the fishermen, the tourist operators, and so on; people that use it for their livelihood. You know, they need to be compensated if anything's destroyed in their areas."

(Mr. Louis Bear, Sandy Bay transcripts, June 20, 1991, p. 4483)

The Panel also received input on overall hydroelectric power development in the province and on the potential for future utilization.

> "Hydroelectric power production is an entirely different matter. SaskWater strongly endorses further development of the hydroelectric potential of Saskatchewan. Generation of hydroelectric energy is clean and safe and above all, from our point of view, it uses a renewable resource without degradation of the quality and with insignificant consumptive losses."
>
> "In total, these new projects on the North and South Saskatchewan Rivers would have the capacity to generate over 1,200 megawatts of electricity from a renewable, non-polluting source of water."

(Mr. Dave MacLeod, SaskWater Corporation, Moose Jaw transcripts, April 9, 1991, p. 3113)

4.4 <u>Nuclear</u>

No option for electrical generation received more comments than that of nuclear power, and its relative merits were strongly debated during the course of the meetings.

A number of specific issues were raised regarding nuclear power generation. In broad terms, these issues can be characterized as: environmental, economic and safety related.

The environmental issues divide into the two broad categories of operating plant impacts and those of a long-term nature. Proponents of nuclear energy noted that nuclear plants do not discharge the same airborne pollutants as do fossil-fired plants.

> "Nuclear energy avoids the greenhouse effect, and also avoids causing acid rain."

(Mr. Jim Yule, Saskatchewan Chamber of Commerce, Saskatoon transcripts, March 22, 1991, pp. 2508-2509)

It was suggested that the waste by-products associated with nuclear generation are easier to deal with and ultimately more acceptable than the wastes from other generating processes.

> "Emissions from a nuclear power station, although they are hazardous, they are highly concentrated and they can be handled more effectively than the tons of waste that are released into the atmosphere from fossil-fuel plants."

(Mr. Richard Wilde, RLW Engineering, Saskatoon transcripts, March 21, 1991, pp. 2205-2206)

Others feel that the potential reductions in CO_2, SO_x and NO_x emissions are not sufficient to justify the statement that nuclear energy is more environmentally friendly than fossil fuel utilization.

> "If we don't have a method for safe storing for the thousands of years over time which it needs to be so stored, if future generations are going to exist in this world, let alone the safe storage of new radioactive material added to the atmosphere and to our ecology."

(Mr. Robbie Newton, Meadow Lake transcripts, March 2, 1991, p. 1301)

Opinions were also expressed on the long-term storage of nuclear waste.

> "The basic modelling challenge of nuclear waste disposal is to predict the action over many thousands of years of a complex system that does not yet exist and never has. Geologists still cannot even predict major events like earthquakes or volcanoes. No computer model can confidently predict how the earth will react over tens of thousands of years after holes are drilled into it and foreign chemicals giving off heat and radiation are inserted. Abnormal temperatures will exist in a rock formation for over 10,000 years and abnormal stress fields will exist for much longer. Until tens of thousands of years have passed, there will never be a scientific way to validate a model."

(Mr. Scott Ware, Regina Coalition for Peace & Disarmament, Regina transcripts, January 23, 1991, p. 350)

This opinion is not shared by Atomic Energy of Canada Ltd.

> "Now, to assess whether this concept provides a safe means of permanently disposing of used fuel, we've done extensive research on each of these barriers that I've just pointed out. We've investigated the integrity of various waste forms including used fuel. We've come to the conclusion that used nuclear fuel is a very durable waste form in the kind of geochemical environment found in the Canadian Shield."

(Dr. Dave Torgerson, AECL, Prince Albert transcripts, March 9, 1991, pp. 1442-1443)

It was noted that placing AECL in charge of waste disposal is a conflict of interest:

> "A more fundamental problem with Canada's waste disposal program is that it has been conceived and implemented by individuals and institutions committed to the preservation of the nuclear industry. AECL's mandate is to promote the use of nuclear power in Canada and abroad. Its interests will not be served by demonstrating the weakness of the concept of deep geological disposal, or by admitting that not enough is known to reach a scientific verdict."

(Mr. Scott Ware, Regina Coalition for Peace & Disarmament, Regina transcripts, January 23, 1991, pp. 350-351)

Costs of nuclear energy, including the environmental concerns stated above, were also raised.

> "If we care about the planet, an economic feasibility study of a nuclear plant should subtract from any potential sale of electricity, not only the costs of building a plant and transmission lines, but also costs associated with decommissioning, storage of wastes, as well as health and welfare costs if the waste storage sites become ineffective any time in the next 100,000 years, health costs associated with system failure, property losses as a result of system failure, anxiety produced, whether real or perceived, and environmental costs incurred through the entire nuclear fuel cycle."

(Mr. Dave Hiebert, Saskatoon transcripts, March 21, 1991, pp. 2177-2178)

Decommissioning costs were a stated concern for a number of presenters. However, representatives of the nuclear industry stated that these could be taken into consideration and prepared for well before the need for decommissioning arose.

> "For instance, in Ontario money is being set aside and is being charged at today's rates for decommissioning the nuclear power plants. That is usually included in any cost comparisons between nuclear and the alternatives."

(Mr. Ian Wilson, Canadian Nuclear Association, Regina transcripts, January 23, 1991, pp. 248-249)

A number of economic issues surrounding nuclear energy were raised. Proponents of nuclear technology see the potential for vertical and horizontal integration of industries as an exciting way of diversifying and stabilizing the economy. On the other hand, opponents feel similar types of spin-offs would be available from promoting other forms of energy production or conservation technologies. The following quotations typify these two positions:

> "This increase in the demand for nuclear energy will result in increasing demand for uranium and create economic opportunities for Saskatchewan which possesses vast reserves of uranium and presently supplies over 20 percent of the uranium produced in the western world. The increase in the use of nuclear energy will also create industrial opportunities for those sectors that have developed the infrastructure and skills to exploit them."

(Dr. Stanley Hatcher, AECL, Regina transcripts, January 23, 1991, p. 76)

> "The advantage I see with conservation, energy efficiency, and with decentralized renewables like wind power is that people are going to be working in their own hometown, their own city where they live, in their own neighborhood, and achieving the same end as the Shand project, but working close to home, also spending more money at home and providing support to the infrastructure and the community that they live in."

(Mr. David Weir, Regina transcripts, January 24, 1991, p. 572)

The final issue, but certainly not the least, is that of safety. Clearly in the minds of many in Saskatchewan, the possibility of a Three Mile Island or Chernobyl type accident is unacceptable.

> "Proponents of nuclear power point with pride to the safety record of most nuclear establishments. It is true that malfunctions, and the industry prefers to use the euphemistic term incidents or events, at most nuclear plants have resulted in few deaths and few direct injuries to date, and an undetermined amount of future cancers. However, whether the direct low level of deaths and injuries at present is the result of good luck or good management is moot. The major tragedy at Chernobyl has shown that when poor design is compounded with human error, disaster can and will strike. The known and future effects of this one incident are incalculable. Nuclear energy, as Knelman avers (states), is truly the unforgiving technology."

(Mr. John Pederson, North Battleford transcripts, March 16, 1991, p. 1815)

> "As far as mechanical safety goes, comparing the CANDU reactor to Chernobyl or Three Mile Island is like comparing an old crank-handled telephone to the modern cellular, which bounces signals off a satellite. They might do the same job, but they're not the same machine. The safety aspects used in the construction and operation of a CANDU are built around a defence-in-depth philosophy. It attempts to prevent accidents by providing high quality design, equipment and operators. It recognizes that one or more of these may be imperfect, so backup systems are put in place as part of normal operating procedures."

(Mr. Gene Chovin, La Ronge transcripts, June 21, 1991, pp. 4603-4604)

4.5 Wind/Solar

The Panel received considerable input on the utilization of renewable resources such as the wind and the sun. As is the case with all types of energy production, the pros and cons of renewable resources revolve around environmental concerns, reliability, availability and economics.

With respect to the environment, those who support the development of wind generating capacity view it in terms of its benign environmental impact and its non-depletable supply.

The panel received the following comment in Maple Creek, one of the windiest parts of the province:

> "Now, I know it can't meet all the demands of electrical energy in the future, but I don't see, if it's possible, why the wind is not harnessed, and in situations like where I live, I've lived here all my life and on the ranch that I live on in the Cypress Hills for 16 years and there's wind, wind, wind and more wind, cold days, hot days, wind and if that could be converted into electrical energy and fed into a line somehow, and apparently the technology is there to do that, it's 100 percent environment friendly, no pollution whatsoever, totally renewable, even though it's not constant every day of the year, but with other sources of electrical energy like hydro and coal-fired furnaces and what not, I can't see why it can't be a contributing factor to the needs in the future."

(Mr. Gerald Udal, Maple Creek transcripts, April 12, 1991, pp. 3409-3410)

A similar observation was made with respect to solar power.

> "Estevan people call themselves the energy capital of the world because of their coal supplies, but they also talk about themselves as being the sun capital of Canada, so it seems to me — and of course anyone living near the area knows how much wind they get. It seems to me that they could very well develop photovoltaic and wind farms and continue to call themselves the energy capital of Canada and for other reasons besides coal, and this of course could be done in other parts of Saskatchewan too."

(Ms. Isabelle George, Regina transcripts, January 23, 1991, pp. 108)

The concept that wind and solar facilities are environmentally benign is not universally shared.

> "Many have suggested that solar, wind, and biomass energy can overcome environmental problems caused by other forms of electricity generation. Undoubtedly each of these methods has a place, especially in some remote locations. However, given their current technological development, their use could create, rather than solve, environmental problems if they were used to produce electricity in the amounts needed today.

(Mr. Jim Yule, Saskatchewan Chamber of Commerce, Saskatoon transcripts, March 22, 1991, pp. 2504-2505)

"Well, I wouldn't want that in my area any more than I would want a bunch of gas wells or pump jacks, you know, it's one of the few remaining areas in populated Canada where it's still almost totally wilderness and that's worth saving, but one or two windmills per farm or ranch is totally a different story, but a farm like you see in California, I wouldn't want it.

(Mr. Gerald Udal, Maple Creek transcripts, April 12, 1991, p. 3426)

It was suggested that the idea of pursuing an energy alternative solely on the basis of its environmental considerations is ultimately unproductive.

"It seems inconceivable that we would just accept wind power on the basis that it's "green". If we cannot match loads, then there is not much left to sing about since that we, as wind enthusiasts, cannot guarantee supply, and if the utility still needs to have a standby capacity to cover for the wind turbines, we can only count the fuel that's not consumed while they are running."

(Mr. Izaak Cruson, Dutch Industries, Regina transcripts, January 24, 1991, pp. 426-427)

The potential for wind power in Saskatchewan was discussed by a number of presenters.

"I'll just point here to Saskatchewan and where our technology assessment has shown its potential, a potential installed capacity in the order of 800 megawatts. Again, if we could scale that down to what is economic in terms of the next 20 to 25 years, it would probably be about a quarter of that number, so something in the order of a 200 to 250 megawatt capacity that we potentially see for Saskatchewan. It would have to be connected to the grid."

(Mr. Jack Cole, Energy, Mines and Resources Canada, Regina transcripts, January 24, 1991, p. 466)

"A wind farm in southwest Saskatchewan would produce energy, some energy, 65 to 75 percent of the time."

(Mr. Orlando Martens, Dove Industries, Regina transcripts, January 24, 1991, p. 473)

In addition to the environmental benefits, the economic benefits or spin-offs associated with a large scale wind farm were noted.

"If wind technology was transferred to Saskatchewan, towers that cost $30,000 to $50,000 each could be manufactured in this province, as well as other manufacturing. It could create employment by providing construction and maintenance employment, manufacturing and assembly."

(Mr. Orlando Martens, Dove Industries, Regina transcripts, January 24, 1991, p. 474)

A major concern with wind and solar lies directly with its ability to be a reliable power source. This is of particular concern to large industrial power users.

"Wind and solar-generated electricity will not satisfy our needs when the sun doesn't shine and the wind fails to blow."

(Mr. Lawrence Hanna, Saskatoon Chemicals Ltd., Saskatoon transcripts, March 22, 1991, p. 2726)

Much of the discussion surrounding wind, solar and to some extent other electrical alternatives, involved the concept of independent power production policies. Comments on this are contained in a section devoted to this topic.

4.6 Biomass

Biomass is a term that encompasses a variety of fuel sources including peat, wood waste, medical and municipal garbage and used tires. The most common biomass fuels referred to were wood waste and peat. In each case, the Panel heard from individuals or organizations proposing the development of biomass facilities for the purpose of generating electricity for the provincial grid.

The use of peat as a fuel was described as follows:

> "Peat is our fuel of choice because it's safe, it's secure and it's very plentiful. It's in the ground. It won't burn up. It won't disappear. It's there. And it's as secure as coal, probably more secure than coal and certainly easier to get at. And we believe that we'll be able to prove that when we complete our environmental impact statement, but we believe that it's more environmentally friendly than any other option that you're presently considering.
>
> It will also provide, because the plants have to be located close to the peat bogs, and all of the peat bogs are in the north, then the jobs are going to be, and the plants are going to be located in the north and the jobs are going to be in the north as well. So it's very important to look at not only the power potential that this concept could generate, but also to look at the economic spin-offs that could be created through employment and small business development, and we'll be discussing that in a little bit more detail.
>
> When you create a job in the north the likelihood is, from the work I've done in the north before, is that you're going to take somebody who is being supported by transfer payments and then they become a contributing person to that tax base by paying income tax when they get employed. So we feel that by creating jobs in the north you get a double benefit into the economy."

(Mr. Dennis Young, NCB Holdings Inc., Meadow Lake transcripts, March 2, 1991, pp. 1225-1226)

The utilization of peat for the generation of electricity is, however, not universally accepted. It was noted that the role of peat in the ecosystem has not been studied enough to fully understand the impact its removal would have on the environment.

> "That point also came to mind when the regeneration and the use of peat was being talked of, or the question that came to my mind was what is the purpose of peat bogs in the ecosystem and has that been researched."

(Ms. Joyce Bahr, Meadow Lake transcripts, March 2, 1991, p. 1330)

The utilization of wood waste for the generation of electricity was advocated and the degree and extent of the amount and type of waste to be used debated.

> "As I've said, I believe there's a use for biomass, specifically wood waste to produce electricity, and I'm referring to the waste that is generated from the conversion of turning round wood logs into either lumber or pulp. During the processes of debarking and chipping and trimming of lumber there are wood wastes that are developed, and the same goes through in the production of chipping round wood for pulp. At the present time in Meadow Lake and elsewhere in the province most of this wood waste is either burnt to dispose of it or land filled. I am not advocating the collection of waste wood generated during the harvest process. I believe that has an important part to play in the renewal of the site itself and in the breakdown and for the nutrients. I do not believe we should be stripping the site of all nutrients, and a lot of the nutrients are found in the twigs, the leaves and the finer foliage."

(Mr. David Harman, Meadow Lake transcripts, March 2, 1991, pp. 1184-1185)

The Panel was advised that preliminary estimates of electrical power generation based on surplus mill wastes exceeds 100 megawatts.

> "This brief is made with the consent and the support of most — and since I wrote that, now all major mills in the forested region of Saskatchewan. Over 100 megawatts of power could be produced from the unusable wastes of the mills which are now being burned in fire cones or made into gigantic piles over acres of land."

(Mr. Frank Sudol, Prince Albert transcripts, March 9, 1991, p. 1625)

The economic benefits associated with biomass plants located in the North were noted.

> "Briefly, then, the experience of the state of Maine for the past ten years is as follows, not necessarily in the order of importance, but to me, it's important that we say something about jobs. Now, depending on the location of those 21 mills that they have in Maine that every megawatt requires no fewer than 3 permanent jobs. That's new jobs in addition to the jobs the mills already have and as many as 5. Therefore, a 25 megawatt plant would probably employ no fewer than 75 people on a permanent basis — these are new jobs — adding a great deal to the economy where the plants are located, a new tax base for government and a diversification for an old industry, which is really very much in dire straits at the moment. Well, hasn't it always been."

(Mr. Frank Sudol, Prince Albert transcripts, March 9, 1991, p. 1627)

This opinion was shared by a number of other presenters.

> "We would like to be heard from the north. Instead of having all the power plants and everything put in the south, we would like to have a few put in the north, which would then do a number of things. One is it would reduce some cost. It would provide some employment, which would then reduce the social burden on the province."

(Mr. Raymond Moskowec, Northern Village of Green Lake, Meadow Lake transcripts, March 2, 1991, p. 1158)

4.7 Other Supply Options

A number of other options were also discussed with the Panel in addition to the options previously noted. These include geothermal, natural gas and the purchase of electricity from other jurisdictions.

Geothermal electrical energy generation, as is the case with certain other supply options, is extremely site specific. The Panel received a comprehensive presentation on geothermal energy in Saskatchewan which included the following statement. This position was not contradicted during the course of the meetings.

> "I'll start out by saying right away that the potential for electrical generation in the Province of Saskatchewan is virtually nil, at least at the present stage of technical development."

(Dr. Lawrence Vigrass, University of Regina, Weyburn transcripts, April 24, 1991, p. 3664)

Natural gas turbines are commonly used in many jurisdictions to generate electrical energy. The role that natural gas could play in Saskatchewan's electrical energy future was discussed during the Panel's meetings and major issues concerning the use of natural gas for electrical generation were noted. These include the growing use of gas-fired electrical generation, the appropriateness of using gas for such generation and the use of natural gas in combined cycle or cogeneration facilities. The following quotations touch upon these points.

> "I can't speak to the potential in Saskatchewan, but in many jurisdictions gas-fired electricity generation is increasingly the preferred option for a significant part of the generation portfolio."

(Mr. Ian MacNabb, Canadian Gas Association, Moose Jaw transcripts, April 9, 1991, p. 3188)

> "I don't think anyone in the gas industry advocates putting natural gas under boilers at 30 percent efficiency and generate electricity in that way, nor should I say at the other end is natural gas going to supplement the major sources or generating sources of electricity."

(Mr. Ian MacNabb, Canadian Gas Association, Moose Jaw transcripts, April 9, 1991, p. 3202)

> "The major benefit of cogeneration is that it offers the potential for achieving substantial energy cost savings. It's a very efficient means of producing electrical and thermal energy with the overall energy conversion efficiency enhanced to roughly 80 percent or above through the utilization of thermal energy."

(Mr. Ian MacNabb, Canadian Gas Association, Moose Jaw transcripts, April 9, 1991, p. 3189-3190)

A number of presenters addressed the potential for cogeneration of electrical energy. The benefits were enumerated by Jack Balaban in his presentation to the Panel and can be briefly summarized as follows: reduced environmental impact; lower transmission losses; increased system reliability; greater system planning flexibility and finally, it reduces monopoly power of electrical utilities. (Mr. Jack Balaban, Delek Energy Ltd., Saskatoon transcripts, March 21, 1991, pp. 1996-1999)

Although there was widespread support for expanded cogeneration initiatives in the province, this sentiment was not unanimous.

> "Cogeneration is a bit of a red herring ... it's still assuming that we can just continue with this type of development that we have and that it's an environmentally sensible way to proceed, to go by cogeneration."

(Mr. Robbie Newton, Meadow Lake transcripts, March 2, 1991, p. 1306)

A common issue discussed repeatedly during the course of the meetings was that of ownership of power producing facilities. The Panel heard that not all generating capacity need be owned by the utility and that there is a place for non-utility generators in the province. Non-utility generation can take two basic forms; cogeneration and independent power production.

The Panel was advised that SaskPower should encourage the purchase of electricity from independent power producers.

> "Consideration should be given to the purchasing of electricity from other provinces and other small power producers. ... SaskPower should pursue, more fully, the option of purchasing power from non-utility generators. ... Although, SaskPower has a policy of buying from NUGs, we feel that it would actively encourage non-utility generation. Rather than building more plants to ensure that peak demand can be satisfied, consideration must be first given to these other alternatives."

(Ms. Margaret Crowle, Consumers' Association of Saskatchewan, Saskatoon transcripts, March 22, 1991, p. 2428)

It was suggested to the Panel that SaskPower should change its purchase policy with respect to independent or small power production in order to facilitate this type of development within the province.

> "In our case, rather than bid against a theoretical nuclear power plant going on stream at Poplar River, we would like to negotiate against the actual cost that's being incurred to build the one at Estevan, and never mind the dams here, that can be aside. But the last time we were, scrubbing laws were not in place. The 1.1 cents that they estimated it would cost to put scrubbing techniques in place to get rid of sulphur dioxides out of coal, that wasn't in place yet, so they said that was disallowed, you couldn't negotiate against that. Another outstanding article I remember, it came to digging up the coal, they wouldn't allow the cost of putting a dragline in place because they said they already had one there of sufficient capacity so that didn't count, but I see they have built one at Estevan since then, so that's what I'm talking about. I think we could take on Estevan fairly and beat them by a considerable amount."

(Mr. Albert Moyer, ENFOR, Meadow Lake transcripts, March 2, 1991, pp. 1282-1283)

It was noted that the benefits to the province of having some independent power production are those usually associated with decentralization initiatives.

> "SaskPower should realistically look at a much more diversified decentralized electrical supply package. It will be more responsive, less costly and have fewer impacts on the environment and more benefits for the rural and expansive nature of the province."

(Mr. Jim Elliott, Saskatchewan Natural History Society, Regina transcripts, January 23, 1991, p. 160)

Another supply option available to SaskPower is that of purchasing power from other jurisdictions, more specifically from Manitoba.

> "We must consider purchasing electrical power from other utilities who have additional generating capacity and can provide us with environmentally responsible methods. Manitoba Hydro is one possible utility. . . . Doing a little research with Manitoba Hydro, most of that is used up currently, but according to a recent study by this utility, the Manitoba river system has the potential of more than doubling present electrical generation by constructing more hydroelectric stations. SaskPower must seriously consider purchasing electricity from utilities such as this. As well, we must consider working with Manitoba Hydro and assist in the development of more hydro stations to supply our increasing demand. Hydroelectric power generation eliminates the production of greenhouse gases."

(Mr. Guy Sanders, American Society of Heating, Refrigeration & Air Conditioning Engineers, Moose Jaw transcripts, April 9, 1991, pp. 3234-3235)

4.8 Electrical Rates

Another topic which was raised during the Panel meetings was that of electrical energy and power rates. Although rate structures are obviously not a direct demand or supply option, the issue was raised repeatedly in connection with the effect that these options have on rates. The most common reference was in conjunction with conservation initiatives.

> "One of the things that I would suggest that SaskPower and other utilities try to do is have a differential pricing system where you don't give — in general, most people in business, they give discounts for volume use, the more you buy, the cheaper it is, and I would like to see just the opposite of that, the more you buy, the more expensive it gets. That would tend to , that would definitely increase the amount of conservation."

(Mr. Evan Morris, Ecotech Research Ltd., Regina transcripts, January 24, 1991, p. 509)

Although there was unanimous agreement with respect to the need for conservation and demand side management initiatives, the need for rate increases to make this occur was not a universally held idea.

> "It is important that SaskPower continue, along with other electric utilities throughout Canada, to pursue all relevant options for cost-effective demand side management, particularly those initiatives which help to

reduce rates for SaskPower's customers and to promote development of other local energy supply options."

(Mr. John Comrie, IPSCO, Saskatoon transcripts, March 22, 1991, p. 2572)

The need for reasonable electrical rates was a dominant theme expressed in many of the presentations made by Saskatchewan industries.

"As a major ingredient in our processes, electrical energy accounts for a large percentage of our production costs and is fully reflected in the price of our finished products. If our power rates are too high, we will not be able to maintain competitive prices. And we all know what that means to businesses.

For industry generally, I think the same thing applies. There is a real need to assure a reliable supply of economical electricity to support diversification, progress, sustained development for the benefit of the people of Saskatchewan. And that means rates that must compete with our neighbors."

(Mr. Lawrence Hanna, Saskatoon Chemicals Ltd., Saskatoon transcripts, March 22, 1991, p. 2727)

The need for competitive electrical rates, in order to create and maintain an industrial economy, was not seen as being important by everyone. There were presenters who viewed the preservation of the environment as being more important than expanding the economy.

"That's certainly a possibility, (that industries would leave the province if electrical rates increased) but I don't think that that supersedes the effect of all of these coal plants, et cetera, on the environment. I think we have to make some sort of a decision of what's more important, our environment or a few jobs."

(Mr. Scott Ware, Regina Coalition for Peace & Disarmament, Regina transcripts, January 23, 1991, p. 365)

As shown by the above quotations, the range of opinion not only across options but within options was considerable. There is no easy way to characterize the diversity of what the Panel heard with respect to electrical energy options. The following statement submitted in a written brief to the Panel best summarizes the section on "what we heard."

"No one way of producing energy is perfect. Perhaps a combination of different techniques and forms is required to produce a safer, less expensive energy for the people and the environment. The only way it is possible, is if the people of Saskatchewan are in agreement that this is what we need."

(Ms. Lona Takatch, Written submission to the Panel)

The quotations cited in this section provide only a brief indication of the concerns and opinions contained in the 4,756 pages of transcripts from the Panel meetings. A complete set of transcripts are on file in the SaskPower library.

5.0 - Technical Background

5.0 Introduction

In many of the preceding sections, references have been made either to specific generating processes or to technical developments associated with these processes. This section attempts to describe some of the basic concepts associated with the major available electrical generating supply options. The reader is encouraged to read the references cited in this section and in the bibliography, in order to gain a more complete understanding of the technical aspects of each of the energy supply options.

Saskatchewan has a wide range of available electrical energy supply options and should take full advantage of the economic benefits associated with its natural resources while acting in an environmentally responsible manner. Economic evaluation of a particular option cannot be done using simplistic cost/kW of power or cost/kW.h of energy values. This is a complex system planning task in which the contribution of the particular option must be examined in a total system context. Certain options are technically viable and appear to be economically attractive. This section does not provide a detailed economic analysis of each option, many of which are extremely site specific. The actual costs and the system benefits associated with a particular generation facility must therefore be determined by SaskPower when considering that option.

All footnotes in the technical background section are fully referenced in the bibliography.

5.1 - Demand Side Management

5.1.1 Introduction

Electric power utilities have historically been primarily concerned with providing their customers with a safe, reliable and affordable supply of electrical energy. These attributes were, and still are, key ingredients necessary to foster economic growth and development. Inherent in this "supply" mandate was the commitment by the utility to supply whatever electric power is required by its customers at whatever time it is required. Although this is still the primary mandate of most electric power utilities, there are a number of emerging economic, social, technological, regulatory and generating resource supply considerations that are causing utilities to review their criteria and constraints.

The construction of new generating capacity often requires major capital expenditures and long lead times. In addition, load forecasts, by their nature, are subject to a considerable degree of uncertainty, since it is often difficult to appreciate and quantify all the factors that influence future electrical energy and power requirements.

In more recent years, it has become apparent that load or demand side management strategies and initiatives may provide a means whereby some of the risks associated with forecasting and planning new capacity additions can be reduced. Electric utilities are finding cost-effective opportunities to utilize demand side management (DSM) initiatives in order to better utilize low cost base load generating capacity and to reduce the need for additional capacity. Rapidly developing technologies for improving end-use efficiency (as described, for example, in the Rocky Mountain Institute State of the Art publications) offer the possibility of cost-effective reduction of electrical energy consumption without diminishing end-use service.

Demand side management or DSM can be defined as "all initiatives undertaken by a utility to influence the magnitude or timing of the demand for electricity by its customers." Some examples of utility DSM programs include:

1) Rebates for the purchase of compact fluorescent lights and energy-efficient refrigerators;

2) Commercial and industrial lighting and efficient motor programs;

3) Time of use rates;

4) Interruptible rates;

5) Street light conversion programs;

6) Rebates for heat pumps and the utilization of wind or solar power for remote water pumping;

7) Home insulation and weatherproofing programs;

8) Shower head exchange programs;

9) Education of suppliers, builders, homeowners, etc.;

10) Energy audits.

Such programs must be implemented within a planned framework with adequate support, in order for them to be truly effective. A review of the literature describing utility experiences (for example, in the journal, Energy Policy) can prove to be informative. Particular attention should be paid to examining rate policies in the different jurisdictions and how these utilities recover the costs of DSM programs.

Utilities undertake DSM initiatives or programs with the expectation that these efforts will result in a reduction in the rate of growth in electrical energy consumption and will thereby reduce or defer the need to add expensive generating capacity. DSM programs also have the added benefit of widespread public acceptance since they are, for the most part, viewed as being "environmentally friendly."

5.1.2 Implementation of DSM Programs

An examination of U.S. utility experience with conservation and load management (C&LM) programs for commercial and industrial (C&I) customers has been prepared by the American Council for An Energy Efficient Economy in Washington, D.C. in order to summarize the lessons learned from program experiences. This report presents a list of factors which contributes to the success of DSM programs. The most important elements are:

Marketing — which employs multiple approaches (e.g., direct mail, media, etc.) but emphasizes personal contacts (via phone and face-to-face) with the target audience. The most successful programs are those that develop a regular, personal relationship with the target audience, including post-installation follow-up contacts to verify that measures are working properly and to promote additional measures. Personal marketing has been successfully used by utilities for all but the very smallest customers. Besides improving program participation levels, personal contacts can increase customer-satisfaction as well.

Targeting — of program approaches and marketing efforts to the different audiences. Program approaches and marketing efforts often need to be packaged differently for different decision-makers (e.g., customers, equipment dealers, architects, engineers, and developers) and for different types of investment decisions (e.g., new construction, remodeling, replacement of worn-out equipment, or retrofit of inefficient but functioning equipment). Target audiences should be involved in program planning so the final program design truly meets their needs.

Technical assistance — to help the target audience identify and implement C&LM opportunities. For retrofit programs, technical assistance includes energy audits and advice on equipment and contractors. For new construction, technical assistance often includes computer modeling and education for the target audience on new technologies. The depth of technical assistance should be matched to the type of customer and to the other services offered. Small customers generally require simple analysis and extensive assistance implementing measures. Large customers often need less assistance. If no financial incentives are available, it is often not cost-effective to do detailed technical audits. If sufficient incentives and other services are available so customers are likely to implement audit recommendations, then detailed audits may be worthwhile.

Simple program procedures and materials — Customers and trade allies are generally busy and have little time to decipher complex program procedures or marketing materials. One-step application procedures, assistance in filling out forms, and simple and catchy marketing materials and forms increase the likelihood of program participation.

Rebate programs for different measures should often be packaged together to minimize customer confusion. However, while programs should be kept simple from the customer perspective, it does not necessarily follow that program designs and procedures be simple from the utility perspective — to achieve high participation, savings, and quality control usually requires the utility to prepare and implement detailed marketing, technical assistance and quality control procedures.

Financial Incentives — to catch customer attention and reduce the first cost of implementing C&LM measures. Data on the effect of different incentive levels are limited but show that providing free measures results in the highest participation rates. High incentives (approximately 50 percent or more of measure cost) appear to promote greater participation than moderate incentives (in the order of one-third of measure cost). However, moderate incentives may not achieve higher participation than low incentives.

Multiple measures — for customers to choose from. When customers can choose from multiple measures, they are more likely to find appropriate measures and/or to implement more than one measure, thereby increasing savings. Many programs limit themselves to lamps and air-conditioners. Inclusion of additional lighting, HVAC, and motor measures, as well as allowing customers to propose their own measures, tends to increase participation and savings.

Promote new technologies — which are not widely adopted in the marketplace. In the typical program analyzed in this study, limited data indicates that approximately 30 percent of the participants were "free riders."[1] Free rider percentages are high when rebates are provided for technologies which are already being purchased by many customers (such as reduced wattage lamps and moderate efficiency air-conditioners). To the extent programs promote technologies which are not widely adopted, free riders are reduced. Furthermore, by promoting advanced energy-saving technologies (e.g., reflectors and variable-speed drives) greater savings can be achieved than with first generation technologies alone. On the other hand, because end-users are generally unfamiliar with advanced technologies, initial participation rates may be lower for programs emphasizing these technologies and substantial marketing efforts may be required to promote these technologies.[2]

Utility approaches to implementing DSM programs vary depending on the objectives and requirements of each program. Direct incentives, such as cash rebates or billing credits, provide the stimulus necessary for customers to purchase energy-efficient products that would normally be economically unattractive.

Demand side management programs vary considerably between the different energy sectors. Although they have similar objectives in mind, residential programs are decidedly different from commercial or industrial programs. Determination of the optimum mix of programs between and within the various sectors is a difficult task due to the large number of potentially suitable combinations of programs. The task is

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1 A free rider is a person who would have acquired the technology or product without the support (financial or other) of the program.

2 American Council for An Energy Efficient Economy, *Lessons Learned: A Review of Utility Experience with Conservation and Load Management Programs for Commercial and Industrial Customers.*

further complicated by the fact that selection of the optimum DSM program requires a significant amount of information from both customers and the marketplace. This information can be expensive to obtain.

A key factor in the success of any DSM program is the monitoring of the results in order to ensure their continued cost-effectiveness. As customer behavior changes over time, resulting in changes to the load shape and forecast, a DSM program may have to be reviewed or realigned with new corporate objectives or policies.

5.1.3 Status of DSM in Canada:

The stimulus for Canadian interest in DSM is basically similar to that in the U.S.A. Electric utilities are interested in methods of reducing demand in addition to addressing problems associated with constructing new generating facilities. It has become widely recognized that DSM programs enhance power system planning flexibility since they can adapt relatively quickly in response to uncertainties in the load forecast and customer energy use behavior.

DSM programs are primarily directed towards three main customer classifications. In the residential sector, efficient lighting, heating, and appliance programs are the most common and are typically encouraged through rebates or cash incentives. Commercial and industrial DSM programs are developed to provide financial incentives to cover the cost of converting to energy-efficient equipment. The more common applications are lighting, motors, space heating, ventilation, air-conditioning and water heating. A particular utility selection of DSM programs should be designed to respond to that utility's set of circumstances. What may work well in one utility, may not be cost-effective in another. A complete province by province review of DSM, entitled "Demand Side Management in Canada - 1990" has been published through a joint effort between Energy, Mines and Resources Canada and the Canadian Electrical Association. The Panel recommends this book as a source of detailed information on the status of DSM initiatives in Canada.

Encouraging and facilitating the efficient use of electrical energy is not confined to utility DSM programs. There is also a role for regulatory change, which may for example, result in building code amendments or minimum efficiency standards for new electrical appliances.

Efficiency improvement initiatives have been undertaken in several jurisdictions by Energy Service Companies (ESCO). These companies undertake energy audits for consumers (generally commercial and industrial), and put efficiency technologies and practices in place for these consumers. The costs of the program and a profit for the ESCO are recovered from a share of the resulting energy savings. Some electric power utilities have ESCO subsidiaries which may operate in an area served by another utility.

An interesting energy efficiency program is being operated in Alberta through the cooperation of several school boards and a non-profit organization. This program has resulted in significant reductions in energy use within the schools involved in the region.

Such programs are of benefit to the electric power utility concerned as they help to limit demand at no cost to the utility, and can be an important complement to the utility's own DSM initiatives.

5.1.4 History of SaskPower's Energy Conservation Program

SaskPower has been actively involved in energy conservation programs since 1978. The Warm-up Saskatchewan program which ran from 1978 to 1984 provided a $1,000 interest free loan repayable over three years for homeowners to improve the thermal efficiency of their home. SaskPower offered a $5.00 cash rebate for the purchase of an approved timer to reduce block heater energy consumption. During 1979 and 1980, 9,000 rebates were processed.

The Home Energy Loan program offered new home buyers a ($3,000) interest free loan repayable over 10 years. Under the three year program, which ran from 1981 to 1984, almost 1,400 loans were applied for, totalling over $2 million dollars.

The Insulwrap program for hot water heaters provided for the production and sale of water heater blankets. During the period 1980 to 1983, approximately 3,000 were sold.

SaskPower's Warm-up Saskatchewan program ended in February of 1984 and the Enerwise program began in March 1984. The new program included an extension of the loan period from three to five years, an increase in the loan amount from $1,000 to $3,000, and an increase in the number of efficiency improvements eligible for the loan. Under this Enerwise program, SaskPower received some 35,000 applications and administered loans totalling almost $40 million.

Information promoting the wise use of electricity was printed in brochures and various publications. SaskPower sponsored workshops and seminars and also provided educational programs for children and teachers. Energy audits were conducted for farm, commercial and industrial customers with recommendations on how to use electricity more efficiently.

With the above mentioned programs, SaskPower realized an energy saving of approximately 56 gigawatt hours per year and approximately 14 megawatts in demand. SaskPower's investment in these programs was over $14 million.

The Saskatchewan Natural Gas Distribution Program (SNGDP) was introduced in 1983 to expand natural gas service to rural areas. With the availability of a lower cost resource, more rural households have the option to convert to natural gas for space heating rather than using electric heat. SaskPower estimates that over the continuing life of this program these rural customers represent a potential savings of 330 MW compared to their collective use of electric heat.

In 1988, SaskPower initiated a three-year street light conversion program which involved replacing all existing mercury vapor street lights with more efficient high pressure sodium vapor lights.

The rink loan program was made available to Saskatchewan skating and curling rinks which added or installed new energy-efficient equipment. A $3,000 loan was available and repayable on a monthly bill over a maximum of 24 months at an interest rate of 12.5 percent annually.

SaskPower estimates that in the past 10 years, their demand side management programs have resulted in a savings of about 400 MW of demand growth and 600 gigawatt hours of energy.

5.1.5 Current DSM programs:

In addition to the continuing effects of past DSM programs, SaskPower currently has a number of programs designed to reduce growth in demand. These include:

1) **Special time of use rates** - for large industrial and commercial customers, designed to encourage them to use less electricity during peak demand periods and more in lower load periods.

2) **Capacity interruption contracts** - which allow SaskPower to reduce or curtail service to contracted customers during peak demand periods.

3) **The Powerwise program** - provides customers with information on how they can use electricity wisely and efficiently.

In addition to providing information services SaskPower has a number of specific programs to encourage energy efficiency.

a) **Farm yard lights** - this program promotes the conversion of farm yard lights to efficient high pressure sodium vapor units. The program provides for a loan of $137 per yard light converted. Repayments are made on the regular electrical bill at a rate of $8.32 per month for 18 months. Only conversion kits made in Saskatchewan are eligible for the loan program.

b) **Rink demand incentive program** - this program provides a refund for skating and curling rinks that operate an artificial ice plant during October and April. The purpose of this program is to extend the recreation season to maximize the use and benefit of these facilities to the people of Saskatchewan.

c) **Ground source heat pump grant** - SaskPower will provide a one-time $500 grant to the first 50 installations of ground-source heat pumps in Saskatchewan. In return, grant recipients will be required to grant permission to SaskPower to install monitoring meters on the heat pump equipment for a period of two years.

d) **Solar or wind powered livestock water pumping incentive program** - SaskPower offers a $500 grant toward the purchase and installation of a solar or wind powered water pumping system for farm livestock watering facilities. The solar and wind system, however, must be purchased from a Saskatchewan based supplier to qualify for this grant.

e) **Compact fluorescent light rebate program** - SaskPower's most recent Powerwise program announced in August 1991 provides a $10 rebate coupon for the purchase of an energy-efficient compact fluorescent light.

In addition to the above programs, commercial and industrial customers can request an energy audit. SaskPower staff would then review the energy use by the company and identify opportunities for cost-effective increases in energy- efficiency.

SaskPower predicts that over the next 10 year period, current and proposed DSM programs are expected to reduce growth in demand by 150 to 200 MW from growth that would have occurred in the absence of these programs. Over the next 20 years, the cumulative impact of all DSM programs is expected to represent a saving of more than 22,000 gigawatt hours. This is equivalent to two years of current energy sales to the entire province.

It is of interest to compare these anticipated savings with projections from elsewhere:

For example, the Northwest Power Planning Council in the U.S.A. describes in its 1991 Conservation and Electric Power Plan, its plan to acquire, at costs lower than new generation, at least 13,000 gigawatt hours of conservation and efficiency improvements by the year 2000. This represents well over half the projected energy growth required in a medium/high growth scenario for the region. SaskPower has proposed that it anticipates being able to meet about seven percent of projected energy growth during the next decade from DSM (i.e. reducing energy growth from 3 percent per year to 2.8 percent).

A Pacific Gas and Electric study of its own research headquarters building indicates potential energy savings of 67 percent at an average cost below 4 cents/kW.h. The small city of Osage, Iowa has become famous for its energy conservation program which resulted in zero electrical load growth during a period of industrial and economic expansion in the community.

In order to establish what is economically feasible in terms of DSM in Saskatchewan, it is necessary to undertake an extensive audit program to measure the present level of efficiency in different sectors. Efficiency technology is developing very rapidly, and the potential for efficiency improvement is expected to continue to grow. It is suggested by Amory Lovins of the Rocky Mountain Institute that, for example, "Twice as much electricity can be saved now as could have been saved five years ago, and at only a third of the real cost. Most of the best electricity saving technologies on the U.S. market were not available a year ago."[3]

5.1.6 <u>SaskPower and Power Smart</u>

Early in 1991, SaskPower joined Power Smart Inc., an energy conservation program first developed by B.C. Hydro. Power Smart Inc. is a cooperative effort that offers a number of product labelling and energy conservation programs. Through Power Smart, utilities will be able to influence manufacturers, retailers, and governments to support energy efficiency standards. In addition, members of Power Smart can take advantage of the cost-effectiveness of cooperative advertising on a national scale. Other member utilities of Power Smart Inc. include:

- B.C. Hydro
- West Kootenay Power
- CU Power
- TransAlta Utilities
- Winnipeg Hydro
- Manitoba Hydro
- Energy, Mines and Resources
- Yukon Energy
- New Brunswick Power
- Maritime Electric
- Newfoundland Power
- Nova Scotia Power
- City of Calgary Electric System

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3 Amory Lovins, *14th Conference of the World Energy Congress*, Montreal, 1989.

5.1.7 Potential Utilization In Saskatchewan

The potential for economically feasible conservation and efficiency improvement in Saskatchewan should be carefully and exhaustively evaluated. In the absence of such a study, it is difficult to predict the extent to which conservation and efficiency improvements will impact upon future electric power and energy requirements. SaskPower should conduct a thorough review of demand side programs in other jurisdictions and their relevance to Saskatchewan. A comprehensive survey of present levels of efficiency in all areas of electrical energy utilization is required in order to estimate the potential for improvement with current available technologies.

The potential for demand side management including conservation and efficiency applications depends to a large extent on how the public at large perceives the need for and value of limiting electrical energy use. Conservation and efficiency gains are based in part on technological improvements, which require associated funding, and also on behavioral changes, which require recognition of the need for change. SaskPower has an important role to play in electrical energy education of the public at large and also of specific segments such as the commercial, industrial and educational sectors.

5.2 - Non-Utility Generation, Independent Power Production and Cogeneration

5.2.1 Non-Utility Generation and Independent Power Production

5.2.1.1 Introduction

The evolution of electrical energy supply in Saskatchewan is outlined in Section 2. The present system has grown from a highly decentralized structure to a completely integrated and complex configuration containing large generating facilities interconnected by high voltage transmission lines.

At the present time, all the electrical energy supplied to the grid connected Saskatchewan system comes from generating facilities owned and operated by SaskPower or purchased from neighboring utilities. In many jurisdictions, a significant component of the overall system electrical energy requirements is provided by non-utility generation and cogeneration facilities. These facilities provide a measure of flexibility and diversity in electrical energy supply and facilitate the orderly, economic and efficient use of natural resources.

5.2.1.2 Non-Utility Generation

Non-utility generators (NUG) can be defined as those facilities owned and operated by electricity producers other than SaskPower and include private and municipal utilities and independent power producers.

The total installed NUG capacity in Canada as of December 31, 1990 has been estimated at about 8,053 MW or about 7.8 percent of Canada's total capacity. This includes minor utility and industrial generation. Of this total, 6,130 MW (76 percent) is owned and operated by industrial businesses, primarily pulp and paper, mining and aluminum smelting. The remaining 1,923 MW (24 percent) is provided by small private and municipal utilities.

The majority of the NUG capacity is hydro at 6,212 MW or 77 percent (Table 5.2.1), followed by natural gas at 914 MW or 11 percent, other (wood waste, flare gas, etc.) at 638 MW or 8 percent and oil at 289 MW or 4 percent.

Table 5.2.1
Installed Industrial and Minor Utility Generating Capacity (MW) by Fuel Type 1990

	Coal	Oil	Gas	SubTotal	Nuclear	Hydro	Other	Total
NF	0	28	0	28	0	214	0	242
PE	0	0	0	0	0	0	0	0
NS	0	34	0	34	0	5	19	58
NB	0	78	0	79	0	53	62	194
PQ	0	23	8	31	0	3,181	5	3,217
ON	0	0	437	437	0	1,249	72	1,758
MB	0	3	4	7	0	0	23	30
SK	0	21	37	58	0	0	22	80
AB	0	0	358	358	0	0	65	423
BC	0	99	50	149	0	1,507	370	2,026
YT	0	0	0	0	0	0	0	0
NT	0	2	20	22	0	3	0	25
CANADA	0	289	914	1,203	0	6,212	638	8,053

Source: Energy, Mines and Resources Canada, *Electric Power in Canada 1990*, pp. 104-105.

In Saskatchewan, natural gas, oil, and spent pulping liquor are the fuels used to produce electric power in industrial generators. Domtar Chemicals in Unity and Kalium Chemicals near Belle Plain have natural gas fired generating capacities of 1.2 and 35.5 MW respectively. Hudson Bay Mining and Smelting Co. Ltd. can use heavy fuel oil to produce 21 MW of power, and Weyerhaueser Canada uses spent pulping liquor in their pulp and paper facility in Prince Albert to produce 22.3 MW of their total requirement of approximately 59 MW.[4]

Proponents of non-utility generation argue that since private developers generally select relatively small scale generating plants, this puts them in a better situation to respond to changing economic conditions. Smaller size plants typically require shorter construction schedules, thereby reducing the impact of changes in inflation or interest costs. Proponents also suggest that the development of small NUG projects can result in significant local socioeconomic benefits. The proposed 15 MW Jans Bay peat-fired power plant, for example, is expected to provide full-time employment for 13 people, and seasonal employment for another 11.[5]

Small power producers often argue that existing power utility purchase policies limit independent power production by offering rates which are lower than the utility's cost to produce the same amount of energy. In effect, utilities are indicating their perspectives on NUGs through their buy back rates. Some utilities are quite receptive to NUGs, as they recognize them as a viable alternative to the construction of their own, usually large scale, generating stations. Other utilities, however, do not give serious consideration to NUGs in their generation development plan. In some jurisdictions, regulatory bodies provide the interface between NUGs and electric power utilities. The procedures used in different jurisdictions are, however, not uniform and in many cases are still evolving. This can be seen from the following comments regarding Ontario Hydro.

"Consideration might be given to the establishment of a new agency — a regulatory agency — to arbitrate disputes between independent power producers and Ontario Hydro ... The policy with respect to private power should be taken away from Hydro ... and made the responsibility of government."[6]

The most contentious issue in non-utility generation is the price paid by the utility for the electrical energy supplied to the system. The price utilities typically select is based on their "avoided cost." Avoided cost can be defined as the cost which would be incurred by an electric utility in providing new generating capacity if the utility were to provide the power itself rather than purchasing it from other sources. The determination of avoided cost is a very complex issue and there is no unanimity on a single basic procedure. Another concept which is gaining considerable support, particularly in the U.S.A., is that of competitive bidding. The 1978 Public Utilities Regulatory Policies Act in the U.S.A. forced

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4 Statistics Canada, *Electric Power Statistics,* Volume III, *Inventory of prime mover and electric generating equipment as of December 31, 1989,* p. 51 and 63.
5 Mr. Dennis Young, NCB Holdings, Meadow Lake transcripts, March 2, 1991, p. 1241.
6 Ontario Select Committee on Energy, *Report on Ontario Draft Demand/Supply Planning Strategy* cited by K. Morgan MacRae, *Critical Issues in Electric Power Planning in the 1990s,* p. 102.

utilities to purchase all the power offered by qualifying facilities. In some jurisdictions, this has resulted in an accumulation of excess capacity which utilities have had to purchase at rates higher than their actual avoided costs. Avoided costs are still required in competitive bidding processes since they usually establish the ceiling on energy prices.

5.2.2 Cogeneration

5.2.2.1 Introduction

Cogeneration is the simultaneous production of electrical energy and heat (usually steam) from a single fuel source. A cogeneration facility is usually associated with an industry in which a significant requirement for electricity is coupled with a demand for process heat, usually in the form of steam. The potential for cogeneration is therefore limited to industries which currently exist and to industries that may locate or develop in this province in the future.

Cogeneration is not necessarily associated with industrial facilities such as pulp mills, smelting plants, etc., and can arise in other ways. As an example, TransCanada Pipelines (TCPL) has proposed the development of electric power plants at compressor station sites in Manitoba. The power plants would utilize waste heat from existing gas turbine-driven compressor stations and would require no additional fuel to produce electrical energy.

In a typical electric power generation cycle, the thermal efficiency is normally 30-35 percent. This results in a considerable amount of the input thermal energy being discharged to the environment. The thermal efficiency of a typical process steam cycle is much higher at 80-85 percent. Cogeneration systems are designed to utilize this waste energy, resulting in a significant increase in the overall thermal cycle efficiency.

5.2.2.2 Description of Technology

Cogeneration systems can be divided into two basic categories; the topping cycle, and the bottoming cycle. The difference between the two is simply the order in which the heat is used.

In a cogeneration topping cycle, fuel is burned to produce mechanical power, which is converted to electrical energy in a generator. The exhaust heat from the cycle provides steam for heating or an industrial or manufacturing process. The topping cycle can utilize a steam turbine, a gas turbine, or a reciprocating engine. The overall thermal efficiency in a cogeneration topping cycle is about 80 percent. A number of different fuels can be used in topping cycles depending on the steam generating process. In a steam turbine, the fuel can be coal, fuel oil, wood waste, municipal waste, natural gas, or landfill gas. In a gas turbine, the fuel can be natural gas, fuel oil, or kerosene.

In a bottoming cycle, the process starts with a manufacturing or industrial process. Waste heat from the process is recovered and directed toward a heat recovery steam generator and passed through a conventional steam turbine to produce electrical energy.

5.2.3 Potential Utilization In Saskatchewan

Cogeneration is a mature technology and has been used to produce process heat or steam and electrical energy throughout Canada and the U.S.A. for decades. The potential for industrial cogeneration in Saskatchewan is dependent on the nature of the existing industrial or manufacturing base in the province. SaskPower estimates that large industrial operations which use varying degrees of process heat will have, by 1992, a total electrical demand of 350 to 400 MW.

The potential for these large industrial facilities to cogenerate electrical energy has been estimated to be 100 to 150 MW. There are also a number of smaller commercial and institutional facilities that have potential for cogeneration. These operations are small in nature, and it is possible that the economics are not sufficiently attractive for the owners to commit the required human and financial resources. The potential for cogeneration varies on a case by case basis since the optimum capacity at a site may be more or less than its electrical demand, depending on factors such as the heating load, the nature of the heating load (centralized or dispersed), plant engineering considerations, availability of financial resources, business philosophy, and long-term fuel prices and availability. If the cogeneration involves the purchase or sale of electrical energy to SaskPower, then the terms and conditions of the agreement can have a considerable impact on the justification of the facility. All of these factors must be carefully considered in determining both the economic viability and the optimum cogeneration capacity at a particular site.

The Panel believes that the Government of Saskatchewan should adopt policies that will facilitate the production of electrical energy by non-utility generation and cogeneration facilities in parallel with SaskPower. In order to perform this function, however, the role of SaskPower as the agency responsible for meeting the electrical energy needs of Saskatchewan, at an acceptable standard of reliability and at the lowest long-term cost must be clearly retained.

5.3 - Coal

5.3.1 Introduction

The utilization of coal to produce electrical energy has played a major role in the economic growth and expansion of industrialized countries over the past century. During this economic development, generating units have increased in size and complexity and considerable effort has been expended to improve the thermal efficiency of these facilities. Initially, relatively little attention was given to the effect of hydrocarbon combustion on the environment. This situation has changed dramatically as concerns about the so-called greenhouse effect, acid rain, ozone depletion, and waste management have led to severe questioning of the continued use of coal for industrial processes and particularly for electric power generation. It is worthy of note that in Saskatchewan, approximately 40 percent of the CO_2 added to the atmosphere as a result of human activity is due to the generation of electrical energy. In response to these concerns, the coal, oil and gas industries, electric utilities and research organizations worldwide are developing methods of utilizing this vast resource in more efficient and environmentally friendly ways.

Clean coal technology is a general term used to describe a wide range of processes for efficient coal combustion that provide for the reduction of sulphur dioxide ($S0_2$), nitrogen oxides (NO_x), and through gains in efficiency, reductions in carbon dioxide (CO_2) emissions. Research and development into clean coal technology from a Canadian context offers significant opportunities for the export of this technology to developing countries where it is expected that coal will play a significant role in meeting future electrical energy requirements.

5.3.2 Description of Technology

5.3.2.1 Conventional Steam Cycle

In the conventional steam cycle, fuel in the form of coal, oil, natural gas or biomass material is fed into a boiler. Combustion takes place in the boiler as air is mixed with the fuel. The heat energy in the boiler is turned into higher pressure superheated steam, which in turn spins a turbine, which drives a generator to produce electric power. Typical efficiencies of conventional steam cycle power plants are in the order of 30 to 35 percent.

SaskPower produces about 70 percent of its electrical energy requirements by burning coal in conventional steam power plants. These plants are all located in southern Saskatchewan close to the Canada-U.S. border and are essentially on top of a portion of the province's vast supply of lignite coal. These plants are called mine mouth plants due to the close proximity of the power plant to the coal fields. The table below shows SaskPower's coal-fired generating facilities.

Table 5.3.1
SaskPower's Existing Coal-Fired Generating Facilities

Plant Name	Location	No. of Units	Capacity (MW)
Poplar River	Coronach	2	592
Boundary Dam	Estevan	6	875
Estevan Generating Station	Estevan	3	65
Shand Generating Station[1]	Near Estevan	1	300
TOTAL		12	1,832

[1] Under construction.

SaskPower has also studied a number of potential sites for further coal-fired development. These candidates are shown in Table 5.3.2 below.

Table 5.3.2
SaskPower's Potential Coal-Fired Generating Facilities

Plant Name	Location	No. of Units	Capacity (MW)
Shand #2 & #3	Near Estevan	2	600
Poplar River (#3 & #4)	Coronach	2	600
Grainland	Near Lake Diefenbaker	4	1,200
TOTAL		8	2,400

SaskPower has also indicated that development at other potential sites is possible.

There are a number of clean coal technologies available at varying stages of development. These technologies are designed to reduce the levels of SO_2, NO_x, and CO_2 emissions associated with the utilization of coal to produce electrical energy. These include, but are not limited to, integrated coal gasification combined cycle (IGCC) fluidized bed combustion, furnace sorbent injection, and low NO_x burners. These technologies are briefly described in order to illustrate their complexity and their potential for use in Saskatchewan.

5.3.2.2 Integrated Coal Gasification Combined Cycle or IGCC.

One of the most promising clean coal technologies which is expected to achieve widespread utilization is integrated coal gasification combined cycle.

1) **Coal gasification** — is a long established technology which has undergone substantial developments over the past twenty years. The

aim of the advanced gasification processes is to produce a high yield of gas from coal in an environmentally benign manner. Several proprietary processes, each with different features, have been developed. Processes have been developed by Texaco, Dow Chemicals, Prenflo, Shell, KRW, Swartze-Pumpe U-Gas, and British Gas/Lurgi.

The following table lists **coal gasification** plants that have been built and operated:

Technology Company	Location	Date	Comments
Shell	Hamburg, Germany	1978-83	Demonstration
Shell	Houston, Texas	1987-91	Demonstration
Lurgi	Beulah, N. Dakota	1985	Production Plant
	Ube City, Japan	1984	Production Plant
Lurgi	Johannesburg, S. Africa	1955*	Production Plant

*First of several production plants.

Coal gasification technology involves the incomplete burning of coal in a gasifier at elevated temperatures and pressures to produce synthetic gas (syngas). This syngas is predominantly a mixture of carbon monoxide and hydrogen and has an energy content approximately one-third that of natural gas. Before the syngas is used to generate electricity, it is processed to remove particulate and sulphur components. The heat generated from the gasifier and particulate removal is one of the input streams into the steam turbine for the generation of electricity.

2) **Combined Cycle** — Combined cycle power generation using natural gas has been in operation for many years. The North American Electric Reliability Council (NERC) reports twenty-six units in operation. The majority of these units were constructed during the 1970s. Plant sizes range from 40 MW to 300 MW.

A combined cycle involves two phases of electrical energy generation. First, the syngas drives a conventional gas turbine generator. The waste heat from the gas turbine exhaust is then passed through a heat recovery boiler to produce steam which in turn drives a second generator, a conventional steam turbine generator. The level of nitrogen oxides is controlled by burning the syngas in specifically designed combustors in the gas turbine.

Using the knowledge and experience from the demonstration and operating plants, equipment and technology suppliers and utilities have undertaken to integrate the coal gasification and the combined cycle processes into IGCC plants.

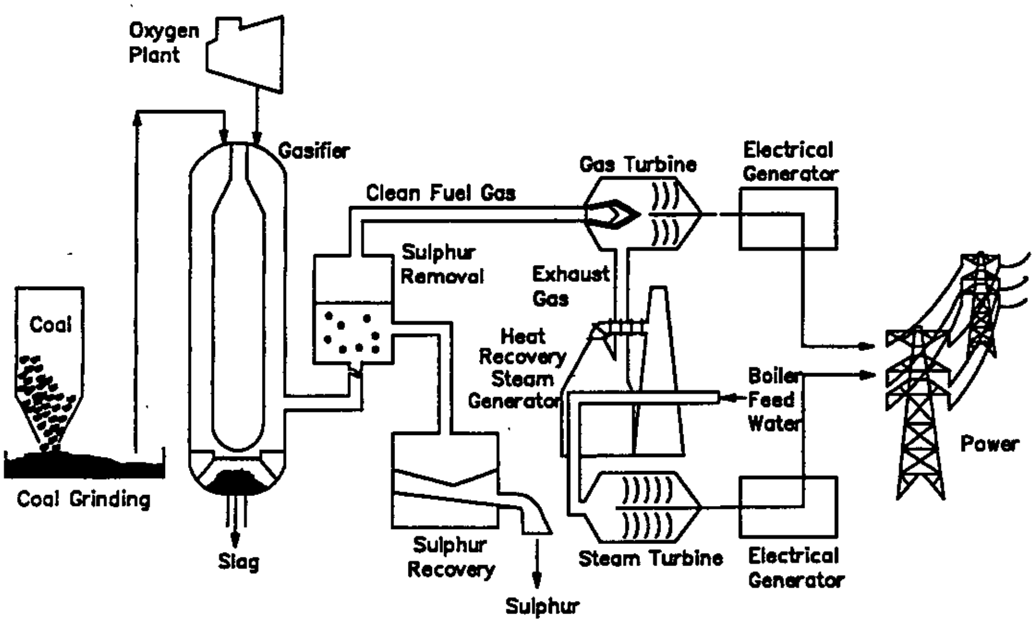
3) **Integrated Coal Gasification Combined Cycle** — the following lists the integrated coal gasification combined cycle electrical generating plants that are either currently being built or are committed to be built:

Technology Company	Location	In-Service Date	Capacity (MW)
Texaco	Cool Water, California	1984-89*	120
Destec	Plaquemine, Louisiana	1987**	160
Demkolec	Buggenum, Netherlands	1993	250
	Freetown, Massachusetts	1994	440
	Borssele, Netherlands	1999	600

Note: *Texaco, Cool Water, California, plant has operated for 27,000 hours as a demonstration plant. It will begin commercial operation soon. **The Plaquemine plant has operated as a self generation unit at a Dow Chemical facility.

Figure 5.3.1 shows the configuration of an integrated coal gasification combined cycle power plant.

Figure 5.3.1
The IGCC Process



One of the most significant advantages of the IGCC concept is that it offers utility planners a great deal of flexibility in responding to uncertainties associated with future load growth and fuel prices. This flexibility comes from the capability to install the total IGCC plant at once or in stages. Initially, a natural gas-fired turbine with no heat recovery system can be installed. This peaking capacity can be added quickly since gas turbines have relatively short lead times of about two to three years. In addition, this enables a utility to closely match load growth by adding capacity in corresponding increments.

The next step is to add a waste heat recovery boiler and a steam turbine system. This completes the combined cycle component of the plant and results in increased efficiency.

The final stage includes the addition of the coal gasification plant. This stage can be deferred until the price of natural gas rises sufficiently to make the coal gasification addition economical.

5.3.2.3 Fluidized Bed Combustion

There are two types of fluidized bed combustion technologies; atmospheric fluidized bed combustion and pressurized fluidized bed combustion.

1) **Atmospheric Fluidized Bed Combustion (AFBC)** — AFBC is based on jets of air passing through a mixture or bed of fuel coal, ash and sorbent (for sulphur removal) in a boiler during the combustion stage at relatively low temperatures. The purpose of operating the boiler at temperatures of about 815 - 875°C is to maintain the fluid nature of the combustion process and prevent slagging and corrosion of high temperature boilers.

- AFBC boiler designs have been classified as either bubbling or circulating. In a bubbling bed AFBC boiler, a dense bed of solids is maintained in the lower section of the furnace by firing coal and limestone in sizes of 30 millimeters and by operating at nominal furnace gas throughput velocities of up to 4 meters/second.

This AFBC boiler design process results in sulphur capture efficiencies of up to 90 percent and nitrogen oxide emissions which are 50 to 80 percent lower than those produced in conventional coal flames.[7]

In circulating bed AFBC boilers, fluidization velocities of up to 8 meters per second and 8 millimeter size coal is used in a bed of sorbent material. Air is injected at high velocity from below the bed and fluidizes the fuel and sorbent material, lifting the burning mass the full height of the boiler. Combustion gases flow into hot cyclones, then through the superheater. Particles removed by the cyclones are then recirculated to the original combustion chamber where they are mixed with fresh fuel and limestone. Since the fuel and limestone are retained longer in the boiler and are subject to continuous circulation, fuel combustion is more complete, allowing for higher sulphur dioxide capture levels.

The atmospheric circulating bed cycle is shown in Figure 5.3.2.

Future Development — AFBC technology has reached the commercial scale demonstration stage in efforts to assess its economic and environmental merits. However, most utility planners believe that atmospheric fluidized bed combustion will not play a significant role in electric utility planning until after the year 2000.[8]

Table 5.3.3 below indicates the installed coal-fueled fluidized combustion capacity by country.

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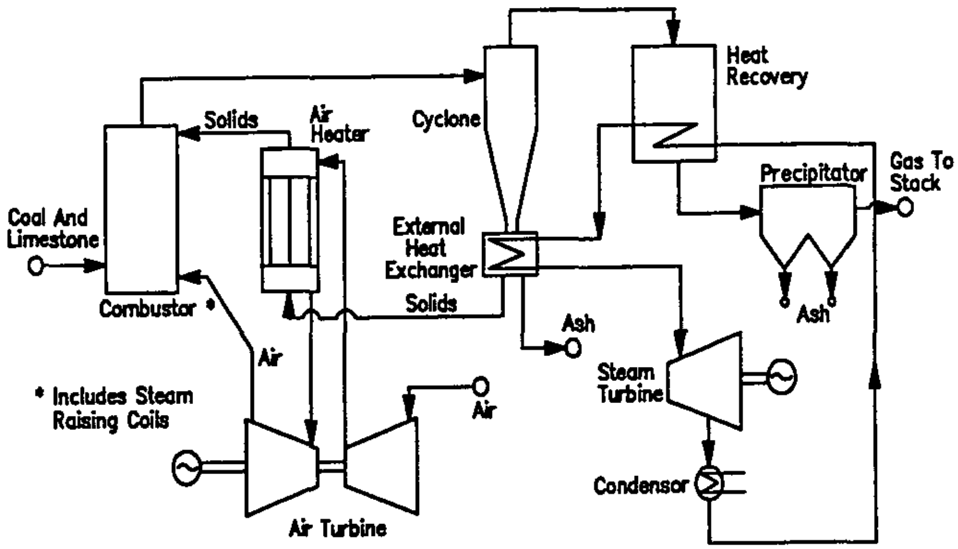
7 K. Morgan MacRae, *Coal - New Coal Technology and Electric Power Development*, p.186

8 Ibid. p. 189

Figure 5.3.2
Atmospheric Circulating Bed Cycle



SOURCE: A.D. Dainton, J.S. Harrison and J. Holmes, "Advanced Cycles for Coal-Fired Power Generation," 8th International Conference on Coal Research, Tokyo, Japan October 16--20, 1988.

Reproduced From: K. Morgan MacRae, "Coal -- New Technology and Electric Power Development," Canadian Energy Resource Institute, April 1991.

Table 5.3.3
Installed Coal-fueled FBC Capacity by Country

Country	Capacity (MW)
Germany	281
Japan	187
Scandinavia	221
United Kingdom	224
United States	584
Other	64
Total	1,881

Source: K. Morgan MacRae, *Coal-New Coal Technology and Electric Power Development*, p. 188.

There are five AFBC demonstration projects in various stages of development throughout North America. These are:[9]

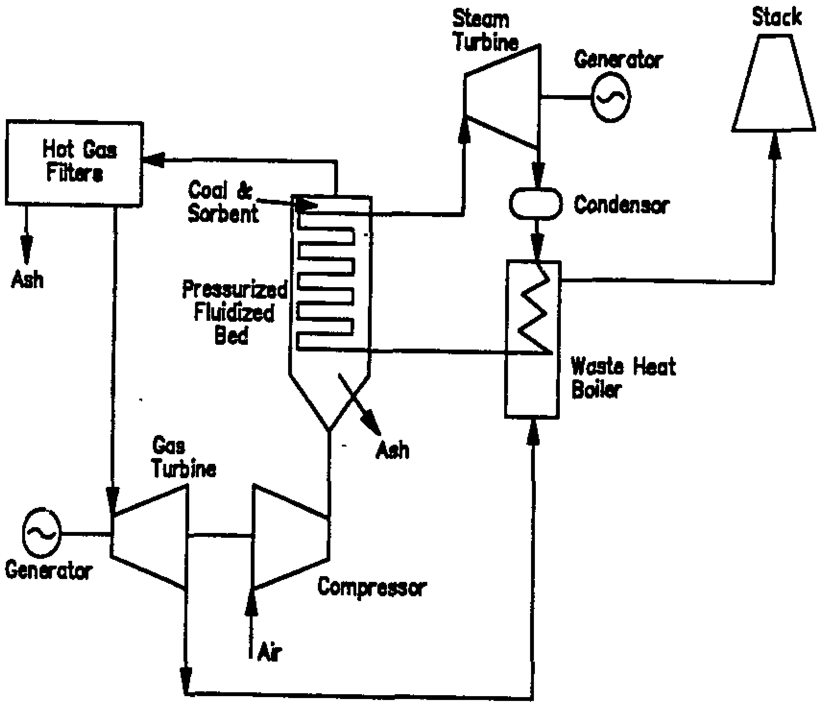
1) Northern States Power - 125 MW
2) Colorado UTe Electric Association - 110 MW
3) Tennessee Valley Authority - 169 MW
4) Wisconsin Electric Power - 500 MW
5) Montana - Dakota Utility Co. - 80 MW

9 Ibid. p. 189

Canadian research on FBC is occurring at the Canadian Forces Base at Summerside, PEI, and at Chatham, New Brunswick. Nova Scotia Power's Point Aconi plant, scheduled for an in-service date of 1993 will be the first commercial scale demonstration of circulating AFBC in Canada.

2) **Pressurized Fluidized Bed Combustion (PFBC)** — PFBC is based on the same principle as AFBC except that the boiler operates at pressure from eight to twenty atmospheres. Due to the operation of the boiler at these higher pressures, PFBC systems can increase efficiency relative to AFBC by adding a gas turbine to recover additional energy from the pressurized products of combustion. Through this combined cycle operation, plant efficiency can be increased to 40 percent or more. A typical PFBC combined cycle plant schematic is shown in Figure 5.3.3.

Figure 5.3.3
PFBC Combined Cycle Plant



SOURCE: K.V. Thombimuthu, Environmental Benefits of Coal Liquid Fuels (Ottawa, Ontario: CANMET, 1989), p.22.
Reproduced From: K. Morgan MacRae, "Coal – New Technology and Electric Power Development," Canadian Energy Resource Institute, April 1991.

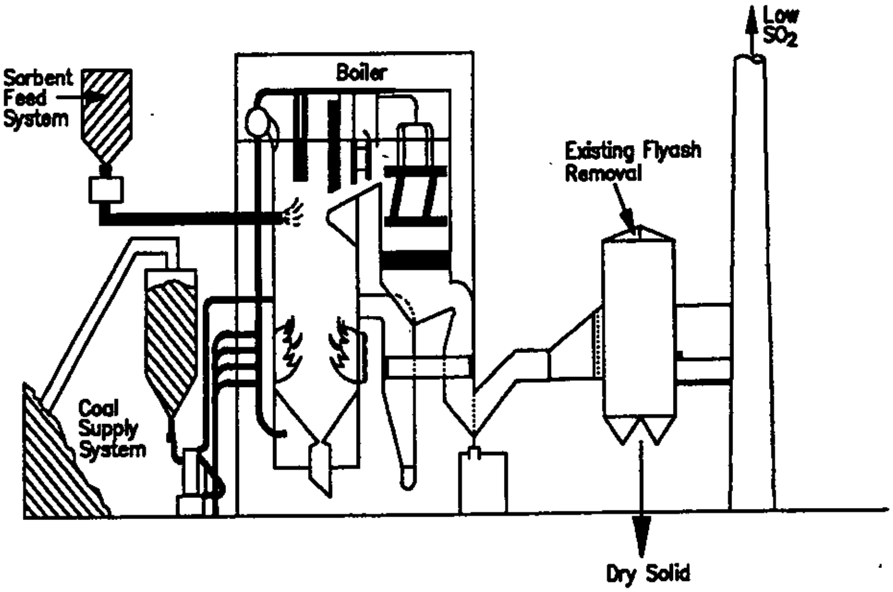
PFBC is currently being demonstrated in a 25 MW pilot plant in Grimethorpe, England. There are a number of other larger capacity projects currently underway in Sweden, Spain and the United States.[10]

Future Development — because PFBC utilizes a combined cycle for power generation, efficiencies are significantly increased over conventional coal technologies. PFBC development is less mature than AFBC, yet it is expected that PFBC will be commercially proven for units entering service after 2000.[11]

5.3.2.4 Furnace Sorbent Injection

This technology involves injecting lime or limestone into the furnace or boiler where it calcinates and reacts to form calcium sulphate which is later collected along with the flyash in a particulate-control device. The sorbent injection method of sulphur control is one of the simplest and can result in removal efficiencies of greater than 55 percent.[12] A schematic of sorbent injection is shown in Figure 5.3.4.

Figure 5.3.4
Sorbent Injection



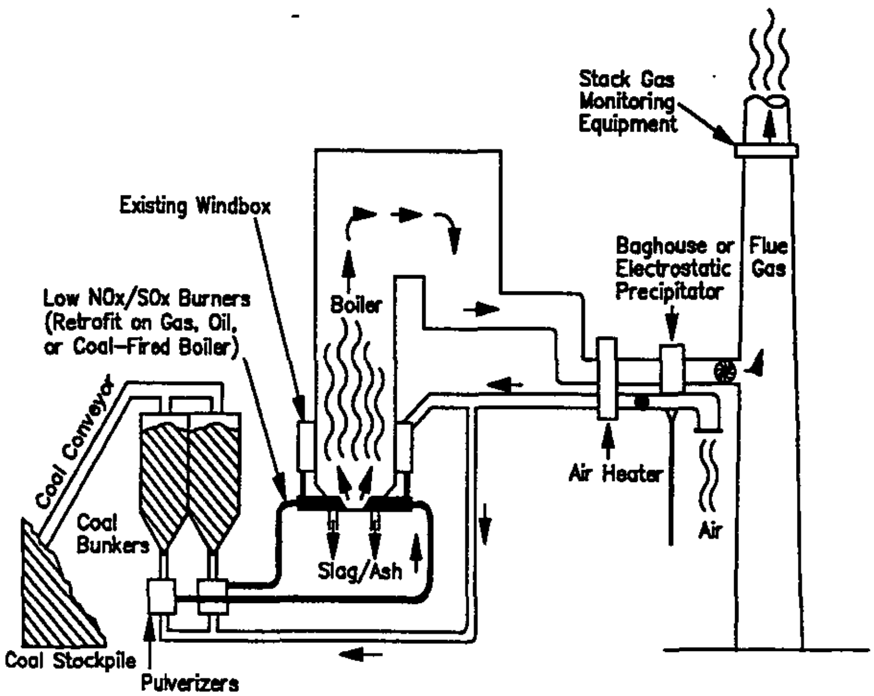
10 Ibid. P. 193
11 Ibid. p. 194
12 Ian M. Torrens, "Developing Clean Coal Technologies," *Environment*, Vol. 32, No. 6, July/August 1990.

SaskPower plans to use a furnace sorbent injection method called LIFAC (Lime Injection into the Furnace and Activation with unreacted Calcium) to reduce SO_2 emissions at the Shand Power Station, now under construction near Estevan. The LIFAC system combines powdered limestone (sorbent) and water to remove SO_2. In the first step of the LIFAC process, sorbent is injected into the boiler. This sorbent reacts with the SO_2 gases emitted from the combustion of coal. In the second stage of the LIFAC process, droplets of water are sprayed into the flue gas once it has left the furnace. When water is combined with SO_2 and the lime sorbent under these conditions, even more SO_2 is removed. SaskPower is the first utility in North America to introduce this new Finnish technology, which is expected to remove up to 90 percent of the SO_2.

5.3.2.5 Low NO_x Burners

Low NO_x burners are burners specifically designed to control air and fuel injection to the boiler, such that a fuel-rich combustion zone is created thereby reducing NO_x formation. These burners have been widely used and are considered fully proven and demonstrated. SaskPower has incorporated low NO_x burner technology in its Shand Power station scheduled for an in-service date of 1992. A pictorial example of low NO_x/SO_x burners is shown in Figure 5.3.5.

Figure 5.3.5
Low NO_x/SO_x Burner Example Installation



SOURCE: Alberta Department of Energy, Development of Clean Coal Technologies for Alberta, p.7

Reproduced From: K. Morgan MacRae, "Coal – New Technology and Electric Power Development," Canadian Energy Resource Institute, April 1991.

5.3.3 Potential Utilization In Saskatchewan

Saskatchewan has abundant reserves of low cost, low sulphur coal and should attempt to take advantage of this resource in an environmentally responsible manner. This cannot be done using conventional coal technologies for generating electricity and therefore "clean coal" technologies should be utilized. These technologies, such as pressurized fluidized bed combustion (PFBC) and integrated gasification combined cycle (IGCC) facilities are not totally clean in the sense of making zero contribution to carbon dioxide (CO_2) levels in the atmosphere. They are, however, a considerable improvement on conventional coal technologies and should be regarded as viable options for Saskatchewan. In view of the possible support by the federal government for a clean coal facility in Saskatchewan, this option looks attractive from many viewpoints. In addition to new sources of generation, clean coal technologies offer the possibility of plant life extensions and modifications resulting in decreases in CO_2 production at other coal-fired plants.

5.4 - Hydro

5.4.1 Introduction

Water has been used for decades to produce electric power throughout the world. In Canada in 1990, almost 63 percent of the total electrical energy produced came from hydroelectric facilities. In Saskatchewan in the same year, hydroelectric power contributed almost 31 percent of the total electrical energy produced in the province.[13]

The development of hydroelectric resources offers a number of advantages for utilities. These include low operating costs, the absence of emissions, superior reliability over thermal plants, the capability to respond quickly to increases in system loads, a relatively long plant life, and the utilization of a renewable energy source. Hydroelectric reservoir development also creates recreation and irrigation opportunities as well as providing downstream flood protection in years of high water flows.

There are, however, negative aspects to hydroelectric power development. Reservoir development can eliminate farmland, affect wildlife habitat and natural fish migration, and create above normal levels of mercury when the land is first flooded. More recently, concerns have been raised regarding methane emissions resulting from submerged vegetation. In addition, hydro reservoir development can eliminate or alter the traditional fishing and hunting grounds of northern residents. Hydroelectric power plants are also often located in northern areas requiring long transmission lines to transfer power to southern load centers.

The availability of the water resource in any given hydro project is dependent primarily on precipitation levels, which can vary significantly from season to season and year to year. Hydro plant capacity factors vary considerably but are typically in the range of 20-90 percent. Hydro plants are ideally suited to peaking applications but can be used as base load plants in situations where sufficient water is available.

Hydroelectric power development is a mature technology with proven high efficiency equipment.

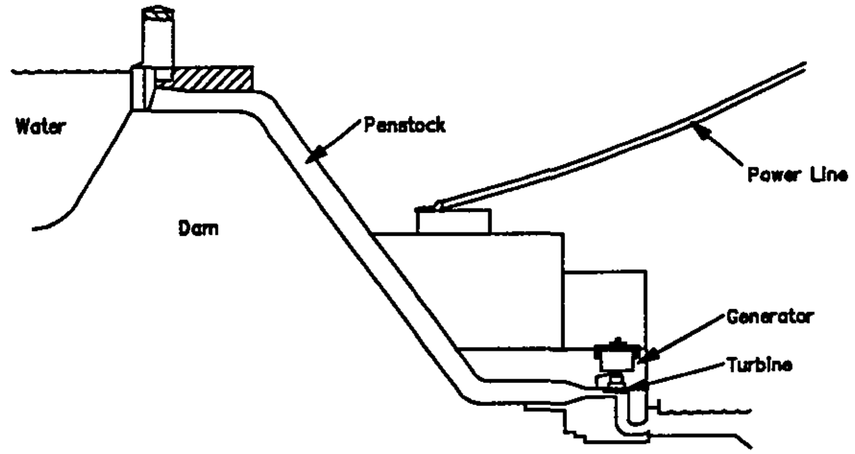
5.4.2 Description of Technology

Hydroelectric power facilities utilize the kinetic energy in flowing or falling water to generate electricity. Dams are used to capture and store water from streams and rivers for use when most advantageous to the utility system. Hydro plants can also be operated as run-of-river facilities in which the basic water flow is not affected.

A typical hydroelectric power plant is comprised of a water intake system, a supply pipe (penstock) to the powerhouse, a water wheel or turbine, an electrical generator, a water discharge system and a transmission system. Water enters the system through the intake gates and travels down through the penstocks and rotates a water wheel or turbine which is connected by a shaft to an electrical generator. The components of a conventional hydroelectric power system are shown in Figure 5.4.1.

13 Energy, Mines and Resources Canada, *Electric Power in Canada 1990*, p. 41.

Figure 5.4.1
Components of a Hydroelectric Power System

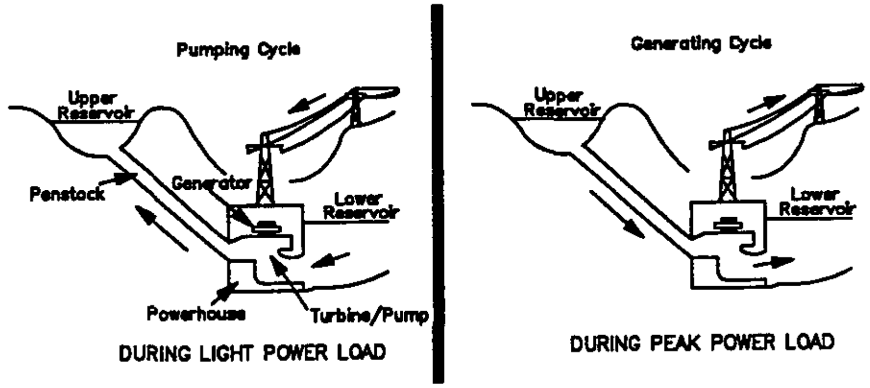


Source: University of Oklahoma, Energy Alternatives: A Comparative Analysis, May 1975.

Reproduced from: California Energy Commission, Energy Technology Status Report, Appendix A Volume 1: Detailed Electric Generation Technology Evaluation June 1991.

An important variation on conventional hydroelectric power can be created with a pumped storage system. Pumped storage hydro provides a means of storing potential energy by raising water to a higher elevation at low load periods to supply power at peak load periods. Pumped storage plants operate in a similar fashion to conventional plants except that the water is basically recycled. During low load periods, the water, after passing through the turbine is pumped through a reversible turbine from a lower reservoir back to an upper reservoir for reuse during peak periods (see Figure 5.4.2).

Figure 5.4.2
Pumped Storage



Source : National Hydroelectric Power Resources Study, Vol. 10, 1981, p. 2-2.

Reproduced from: California Energy Commission, Energy Technology Status Report, Appendix A Volume II: Detailed Electric Generation Technology Evaluation June 1991.

In the pumped storage process, energy is required to pump water to the upper reservoir thereby lowering the plant's net generation output and the plant efficiency to about 70 to 75 percent.[14]

SaskPower has indicated that there are no viable pumped storage hydro sites in Saskatchewan.

The potential size of a hydro plant is dependent on two variables: water discharge and hydraulic head. Water discharge is the volume rate of flow through the plant measured in cubic feet per second. Hydraulic head is the difference in elevation the water undergoes while passing through the plant.

5.4.3 Current State of Development

SaskPower currently has 7 hydroelectric power plants as shown in Table 5.4.1. The total installed hydro capacity is 847 MW, representing about 30 percent of SaskPower's total installed capacity (Table 5.4.1).

Table 5.4.1
SaskPower's Existing Hydroelectric Facilities

Site	Location	River System	Capacity (MW)	Energy Production[1] (GW.h) Low	Energy Production[1] (GW.h) High
Coteau Creek	Lake Diefenbaker	S. Sask.	186	301	1,129
Nipawin	Nipawin	Sask.	255	655	1,288
E.B. Campbell	Downstream of Nipawin	Sask.	288	603	1,358
Subtotal - Saskatchewan River Systems			729		
Island Falls	Sandy Bay	Churchill River	95	601	825
Athabasca System	Lake Athabasca Area	Charlot River	23		
Subtotal - Churchill and Charlot Rivers			118		
Total Saskatchewan			**847**		

[1] Energy production figures shown are the lows and highs experienced at each hydroelectric facility over the period 1970 to 1990. They do not necessarily occur in the same year at each plant. These figures are shown to indicate the variability of hydroelectric energy production in the province.

14 California Energy Commission, *Energy Technology Status Report*, Appendix A, Vol. II, June 1991.

5.4.4 Potential Utilization In Saskatchewan

SaskPower estimates that the undeveloped hydroelectric potential on the major river systems in Saskatchewan is 1,500 MW. Of this, 1,000 MW is located on the Saskatchewan River System, 400 MW on the Churchill River System and 100 MW in the Lake Athabasca drainage areas.

Table 5.4.2

Saskatchewan River System — Potential Hydro Sites

Site	Potential Capacity (MW)	Estimated Energy (GW.h)	Annual Capacity Factor (%)
1) Forks	456	1,486	37.2
2) Callaghan Dam	220	680	35.3
3) Choiceland	170	571	38.3
4) St. Louis	104	415	45.6
5) Fish Creek	74	294	45.4
6) Dundurn	74	294	45.4
7) Coteau Creek (expansion)	104	—	—
Total	1,202	3,740	

Churchill River System — Potential Hydro Sites

Site	Potential Capacity (MW)	Estimated Energy (GW.h)	Annual Capacity Factor (%)
1) Churchill River	300-400	1,750	50-67
2) Island Falls (expansion)	100	180	20.5
Total	400-500	1,930	

The potential hydroelectric sites in the Lake Athabasca drainage area are situated in the Black Lake area on the Fond du Lac River, with a total potential capacity of approximately 100 MW. There is some potential for small hydroelectric development in the extreme north of the province but these sites have not been fully assessed.

The economic competitiveness of hydroelectric power development depends on a number of site-specific costs and variables. These include environmental impact and mitigation, flow conditions and subsequent energy production, hydroelectric head, and length of transmission lines required. A thorough investigation of these factors is necessary in order to assess the value of hydroelectric power in comparison to other generating alternatives.

Saskatchewan has the potential to generate additional energy from a number of hydro sites throughout the province. Some of these are possibly environmentally acceptable and economically attractive. These should be considered as viable options in meeting future electrical energy requirements. The negative reaction to building hydroelectric generating stations on the Churchill River, displayed in the 1978 report by the Churchill River Board of Inquiry, and the adverse aspects associated with the Rafferty-Alameda dams should not automatically rule out building further dams or hydroelectric plants in the province. Each potential hydroelectric site should be examined on its own merits both in terms of impact and environmental effects. Hydro power, given sufficient flow, has the potential of being the cheapest source of emission free electrical energy and should not be discarded without detailed and balanced scrutiny. Hydro power may also provide the opportunity for independent power production, particularly in northern communities provided that these communities have input into the justification and creation of the project.

5.5 - Natural Gas

5.5.1 Introduction

The Western Canadian Sedimentary Basin extends from the Canada-U.S.A. border through the southern area of Saskatchewan, across most of Alberta, the northeast area of British Columbia and north through the Mackenzie Valley. This basin holds some of the largest natural gas reserves in Canada. The remaining proven reserves of natural gas in western Canada (70 Tcf) are currently greater than all natural gas production from 1947 to 1989 (60 Tcf). The largest reserves are found in Alberta, followed by British Columbia and Saskatchewan. The total cumulative production in the period 1947 to 1989 (60 Tcf) plus the remaining proven reserves as of 1990 (70 Tcf) are less than the estimated undiscovered potential (155 Tcf).[15] The total demand for Canadian natural gas has been forecast to increase from 3.9 Tcf in 1990 to 5.1 Tcf in 2000. Of this 1.2 Tcf increase, about one-half is destined for the U.S. market. Prior to 1987, a significant portion of Saskatchewan's gas supply came from Alberta under long-term contracts. Subsequent deregulation of the gas industry in Saskatchewan in 1987 resulted in greater production of Saskatchewan gas, allowing the province to become self-sufficient in meeting its own natural gas requirements in 1990.

Most of the natural gas used in Canada is for industrial purposes, followed by residential and commercial demand. In Saskatchewan, natural gas is used to satisfy the majority of the space and water heating market in the residential and commercial sectors and provides about 65 percent of the total hydrocarbons utilized in various industrial activities.

Canadian natural gas is forecast to fuel some 4,000 MW of new electrical generating capacity in the U.S. It is anticipated that a large component of this new capacity will be operated as base load plants. The California Energy Commission sees the utilization of advanced gas turbines in base load applications as a means of bridging the gap to the time when the costs of renewable energy generation technologies match those of lower cost non-renewable alternatives.

Gas turbines are ideal for peaking purposes due to their excellent load following characteristics. Gas turbines have short construction times, relatively low capital costs, and can be sized to closely match increasing load requirements. In addition, simple cycle gas turbines can be converted into combined cycle units with the addition of a steam cycle, thereby increasing system efficiency.

CO_2 emissions from the combustion of natural gas are about one-half that of coal. Nitrous oxides emissions are approximately 30-50 percent that of coal emissions. The combustion of natural gas emits no sulphur dioxide and no particulates.

Deregulation in the gas industry has resulted in increased exploration activities and the subsequent discovery and production of large volumes of natural gas.

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15 Mr. Gary Winslow, SaskEnergy Corporation, Saskatoon transcripts, March 22, 1991, p. 2473

The cost of natural gas is now at the point where it can be considered an attractive option for the production of electrical energy in Saskatchewan. The traditional application of natural gas in electrical generation in both Saskatchewan and Alberta has been to provide peaking power rather than operate as base load. This restricted use of natural gas for base load applications has been due to the high gas costs in the past, the relative instability of future gas prices, as well as the relative economics of gas-fired generation to that of coal.

Natural gas is viewed as the fuel of choice for non-utility generation or cogeneration applications due to its availability and present relatively low cost.

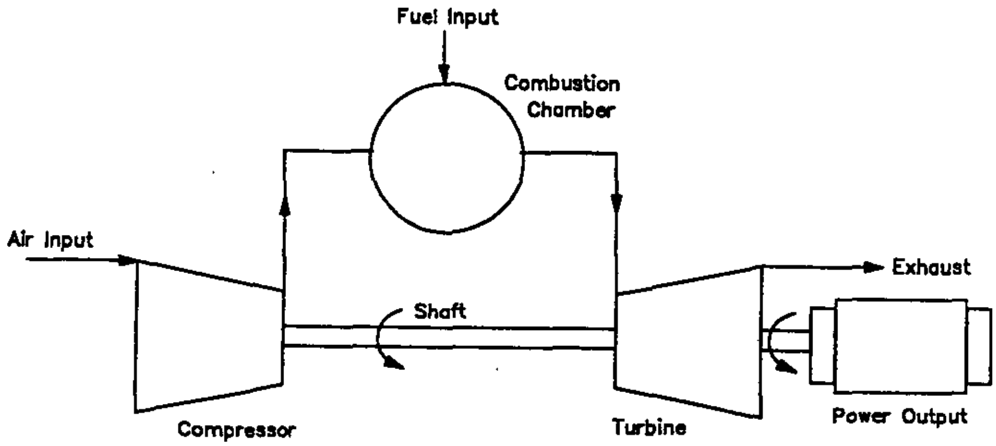
5.5.2 Description of Technology

The generation of electrical energy using natural gas can be accomplished in several ways. Simple cycle natural gas-fired turbines have been used to produce power for over 50 years. Natural gas can also be used as a fuel in a conventional steam turbine application or in a combined cycle plant.

5.5.2.1 Gas Turbines

Gas turbines are essentially derivatives of aircraft jet engines in which incoming air is compressed and passed into a combustion chamber where natural gas is burned. The expanding gases drive the turbine generator and are then vented to the atmosphere. Efficiencies of new modern gas turbines approach 40 percent. A schematic of a typical simple cycle gas turbine is shown in Figure 5.5.1.

Figure 5.5.1
Combustion Turbine Power Plant
Simple Open Cycle Gas Turbine Schematic



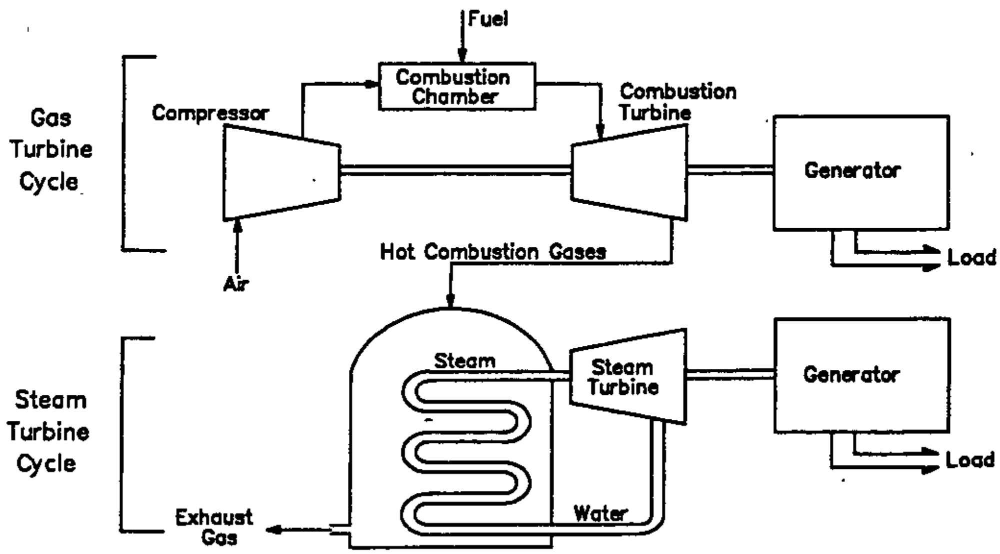
Source: The World Energy Book, Nichols Publishing Company, 1978.

Reproduced from: California Energy Commission, Energy Technology Status Report, Appendix A Volume 1: Detailed Electric Generation Technology Evaluation June 1991.

5.5.2.2 Combined Cycle Gas Turbines

Combined cycle power plants integrate gas turbine and steam turbine generating technology. In combined cycle plants, the hot exhaust gases from the gas turbine are passed through a heat recovery boiler to produce steam which in turn drives a conventional steam turbine. Combined cycle plants offer significant increases in plant efficiency over conventional gas turbine technology, reaching levels upwards of 50 percent. Combined cycle gas turbine technology is illustrated in Figure 5.5.2.

Figure 5.5.2
Combined — Cycle Power System



Source: Shepard, Michael and Dolsec, Albert, "Evaluation in Combustion Turbines," EPRI Journal, June 1986.

Reproduced from: California Energy Commission, Energy Technology Status Report, Appendix A Volume 1: Detailed Electric Generation Technology Evaluation June 1991.

5.5.3 Natural Gas Fuelled Electrical Generation in Saskatchewan

SaskPower currently has four natural gas-fired power plants as shown in Table 5.5.1.

Table 5.5.1

Plant Name	Plant Type	Capacity (MW)
Landis	Gas turbine	60
Success	Gas turbine	30
Meadow Lake	Gas turbine	46
Queen Elizabeth Power Station* (Saskatoon)	Steam turbine	232
Total		368

*multifuel plant

5.5.4 Potential Utilization In Saskatchewan

Saskatchewan has vast reserves of natural gas. Although natural gas is used primarily for fuelling industrial processes and space and water heating requirements, it has been used by SaskPower to produce electrical energy. This utilization has mostly been in peaking power applications in natural gas-fired turbines.

Gas turbine technology is both mature and well established throughout the industrialized world. It is finding increasing applications in combined cycle, cogeneration, and compressed air energy storage systems. The basic factor that has limited its use for base load generation in both Saskatchewan and Alberta has been the relative economics of natural gas-fired generation compared to that of coal.

The present cost and availability suggests that SaskPower should review its basic policy on the use of natural gas for the generation of electrical energy and seriously examine the option of using this resource for both base load and peaking capacity.

5.6 - Nuclear Energy

5.6.1 Introduction

Major nuclear accidents such as Chernobyl and Three Mile Island have served to dramatize the divison of public opinion on the utilization of nuclear energy to meet increasing world demand for electric power. On the one hand, its proponents describe nuclear power as a clean, safe source of energy which does not result in emission of greenhouse gases or create acid rain. On the other hand, there are those who feel that the risks posed by the use of nuclear energy could lead to events with totally unacceptable consequences and are therefore too great to justify its use.

The following section attempts to address a number of technical nuclear power related issues with the objective of providing a general framework. It should not be viewed as complete by any means. There is a wealth of information available from both the nuclear industry and nuclear opponents. Readers are encouraged to review the bibliography in this report in order obtain additional information on nuclear power.

5.6.2 Description of Technology

Nuclear energy is currently being produced by over 400 reactors in 25 countries with approximately another 100 reactors under construction. Countries such as Korea (50%), Belgium (60%) and France at (75%) have chosen nuclear power as a major source of their electrical energy. The global utilization of nuclear energy is shown in Table 5.6.1 below.

Table 5.6.1

	Reactors In Operation	Electricity Generated (MWe)	Percent Of Electricity Generation	Reactors Under Construction
North & Central America				
Canada	18	12,185	15.6	4
Cuba	0	0	0	2
Mexico	1	654	—	1
U.S.	110	98,331	19.1	4
South America				
Argentina	2	935	11.4	1
Brazil	1	626	.7	1
Europe				
Belgium	7	5,500	60.8	0
Bulgaria	5	2,585	32.9	2
Czechoslovakia	8	3,264	27.6	8
East Germany	6	2,102	10.9	5
Finland	4	2,310	35.4	0
France	55	52,588	74.6	9
Hungary	4	1,645	49.8	0

(Cont'd)

	Reactors In Operation	Electricity Generated (MWe)	Percent Of Electricity Generation	Reactors Under Construction
Italy	2	1,120	—	0
Netherlands	2	508	5.4	0
Romania	0	0	0	5
Spain	10	7,544	38.4	0
Sweden	12	9,817	45.1	0
Switzerland	5	2,952	41.6	0
U.K.	39	11,242	21.7	1
West Germany	24	22,716	34.3	1
Yugoslavia	1	632	5.9	0
Asia				
China	0	0	0	3
India	7	1,374	1.6	7
Iran	0	0	0	2
Japan	39	29,300	27.8	12
Pakistan	1	125	.2	0
South Korea	9	7,200	50.2	2
Taiwan	6	4,924	35.2	0
U.S.S.R.	46	34,230	12.3	26
Africa				
South Africa	2	1,842	7.4	0
TOTALS	426	318,271	—	96

(Source: International Atomic Energy Agency, Vienna) AMOUNT OF POWER produced by reactors worldwide is shown above in megawatts electric, along with the percentage of electricity each one provides. In the last column the reactors under construction as of December 31, 1989, are given.

In Canada, nuclear energy is produced using CANDU technology. CANDU stands for CANada Deuterium Uranium, indicating the use of deuterium oxide or heavy water as a moderator and natural uranium as a fuel. There are currently 33 CANDU reactors in operation and/or under construction in the world today. The majority of these are located in Ontario (20 units). The distribution of Canadian CANDU reactors is shown below:

Table 5.6.2

Country	# of Units	MW	% of Total Installed Capacity
Canada			
Ontario	20*	12,173	36
Quebec	1	685	24
New Brunswick	1	680	19
Canadian Total		13,538	13

(Source: Energy, Mines and Resources Canada, *Electric Power in Canada 1990*, p. 47)

The location of the remaining 11 CANDU reactors are shown below.

Argentina	1
Romania	5
Pakistan	1
India	2
Korea	2
World Total	33

*Includes four units at Darlington, one of which was brought on line in 1990.

5.6.2.1 The Fission Process

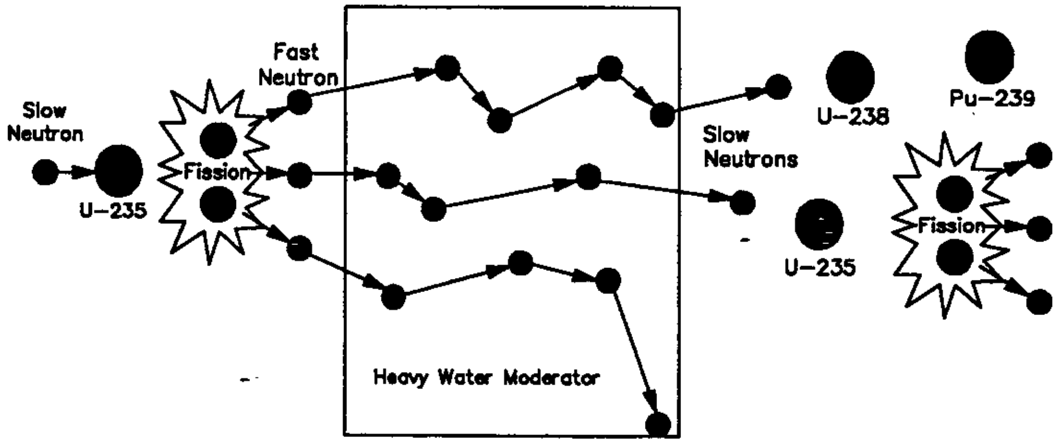
The fundamental process in nuclear energy production is the fission of atomic nuclei. All solids, liquids and gases are composed of chemical elements such as carbon, iron, oxygen and aluminum. An atom is the smallest unit of each element that still retains characteristic properties of that element. A single airborne dust particle, undetectable by the human eye, contains over a trillion atoms and still can only be seen under a powerful microscope. Most elements in nature exist in more than one form, the difference being in the number of neutrons (uncharged particles) contained in the nucleus, or, the positively charged core of the atom. These variations of an element are called its isotopes. Hydrogen, for example, can exist as three isotopes, ordinary hydrogen, deuterium and tritium with respective nuclear masses of one, two and three units.

Uranium, as found in nature, consists of 99.3 percent uranium — 238 (U238) (non-fissionable) and 0.7 percent uranium — 235 (U235) (fissionable). It is U235 that is the fundamental component of the fission process. When an atom of U235 is hit by a free neutron (moving at an appropriate speed) there is a high probability of a violent reaction, but if the atom is U238, then the probability is very low. The reaction is called fission or splitting of the atom, since the uranium atom splits into two or more lighter atoms, releasing energy. Two or three fast-moving neutrons are also emitted when an atom fissions. If one of these neutrons goes on to cause fission in another fissile or fissionable atom, emitting more neutrons which in turn could possibly cause further fission, the result is called a chain reaction. If a chain reaction occurs in a controlled fashion, energy is released at a slow enough rate that it can be used as a source of heat for the generation of electrical energy rather than in an explosive fashion. If a neutron hits a U238 atom, it is unlikely to cause fission. Rather they will likely combine to form uranium — 239, which then undergoes radioactive decay to create an isotope of another element, plutonium — 239. Although U238 is not fissile, plutonium 239 is, therefore U238 is termed a fertile material.

Natural uranium does not contain enough fissile atoms to sustain a chain reaction and generate useful amounts of energy. One solution to this problem is to increase the proportion of fissile atoms by enriching the uranium with U235 in enrichment plants. This is the approach used in the United States.

An alternative solution, used in Canada, is to use natural uranium but to increase the efficiency with which neutrons are used. The neutrons that are created as a result of the fission process are released at very high velocity. The probability of colliding with another U235 atom in order to sustain the fission process at these speeds is very low. Therefore, a moderator is used to slow down the neutrons in an effort to increase chances of fission. The fission process is shown in Figure 5.6.1.

Figure 5.6.1
Basics of Fission



Reproduced from: Atomic Energy Canada Limited, Nuclear Power in Canada: The CANDU System. J. A. L. Robertson, July 1990.

There are three common types of moderators used in nuclear power reactors: graphite, light water, and heavy water (deuterium oxide or D_2O). The most efficient moderator is heavy water and this is used in CANDU reactors. Deuterium is an isotope of hydrogen and when compounded with oxygen to form D_2O it is similar to ordinary or light water (H_2O) but heavier, hence its name — heavy water. Deuterium occurs naturally in ordinary water at a concentration of about one part in 7,000.

A chain fission reaction and the subsequent production of heat can occur in natural (i.e. non-enriched) uranium only if three conditions are simultaneously satisfied:

1. There must be sufficient uranium present, several megagrams or tonnes.
2. The uranium must be surrounded by a highly purified moderator.
3. The uranium must be appropriately spatially arranged.

These conditions will allow the neutrons generated from the initial fission to be effectively used to induce further fissioning in a chain reaction.

5.6.2.2 Uranium Fuel

Uranium is the fuel for all current nuclear power reactors. Canada is the world's leading uranium producer and more than half of Canada's uranium is located in Saskatchewan. Saskatchewan presently supplies over 20 percent of the uranium produced in the western world. Uranium refining facilities exist in Ontario. There are no enrichment facilities in Canada.

5.6.3 Types of Nuclear Power Reactors

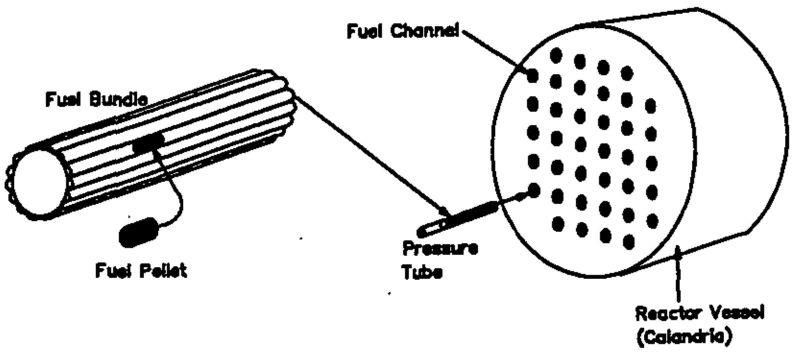
During the years of nuclear power reactor development, a number of different designs emerged using various combinations of fuels, coolants and moderators. Only a few of these combinations ultimately became widely accepted and utilized.

5.6.3.1 CANDU Reactor

The Canadian nuclear reactor program began during World War II when Canada was charged with developing the heavy water moderator reactor system as a method of plutonium production. This weapons related activity ceased with the end of the war but the experience gained during this period put Canada in the forefront of world scientific knowledge and technology in heavy water moderated reactors.

A CANDU reactor consists of a large tank of heavy water (calandria), with several hundred fuel channels penetrating the tank. Fuel bundles are loaded into pressure tubes which are in turn inserted into the fuel channels. The fuel bundle and fuel channel relationship is shown in Figure 5.6.2.

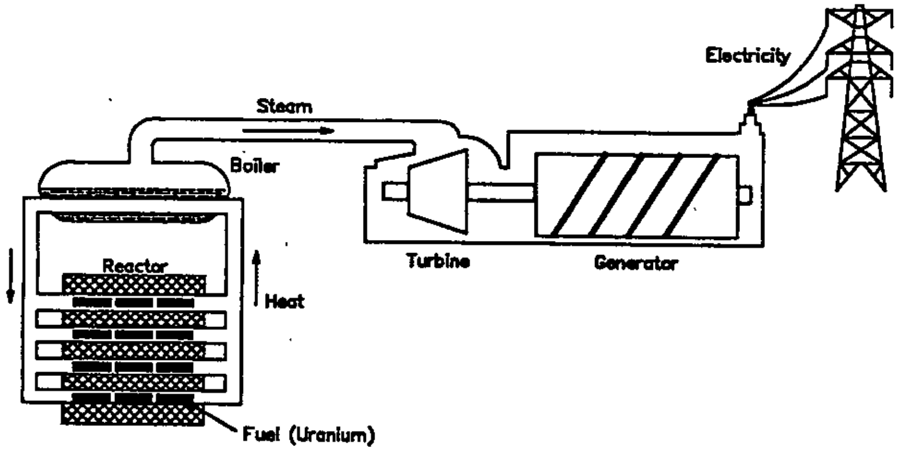
Figure 5.6.2
Fuel Bundle and Fuel Channel Relationship



Reproduced from: Atomic Energy Canada Limited, Nuclear Power in Canada: The CANDU System. J. A. L. Robertson, July 1990.

Heavy water coolant (in a separate circuit from the moderator) is pumped past the uranium fuel within the pressure tubes and the heat of fission is transferred to the coolant. The coolant flows to the steam generators where it gives up its heat to ordinary or light water to produce steam. The CANDU nuclear power plant is illustrated in Figure 5.6.3.

Figure 5.6.3
Candu Nuclear Power Plant



Reproduced from: Atomic Energy Canada Limited, Understanding Nuclear Power 1988.

After one or two years in the reactor, the fuel becomes sufficiently contaminated with fission products (the lighter elements into which the uranium splits) that it must be replaced. In the CANDU system, fuel bundles can be replaced while the reactor is in operation and producing power, thus avoiding the necessity to close down during refuelling.

The power level or output of the reactor is controlled by moving control rods into or out of the reactor. The rods are made of material which rapidly absorbs free neutrons, and they can be used to shut down the reactor if necessary. For extra protection, CANDU reactors have two independent shutdown systems, each of which is capable of shutting down the reactor quickly.

5.6.3.2 The CANDU 3

The CANDU 3 is the latest in the series of electric power reactors designed by the federal Crown corporation, Atomic Energy of Canada Ltd. (AECL). This smaller reactor (450 MWe) currently in the final design stages offers design simplification, standardization and modularity. AECL anticipates economical performance and a short construction time of just over three years. Another key feature of the CANDU 3 is that it offers generic design licensing by the regulatory authority before construction starts.

Since the early 1980s, electric utilities throughout the world have become increasingly interested in smaller sized generating units. AECL recognized this need and proposed the smaller 450 MW CANDU 3. By comparison, the next size CANDU reactor is the CANDU 6, a 665 MW unit. Small utilities have found it difficult to incorporate such a large single unit into their system. The new CANDU 3 therefore offers the potential for a significantly expanded market for AECL.

The Candu 3 is, however, a prototype unit for which there is no technical or economic history. These factors must therefore be carefully assessed when considering its possible implementation in the SaskPower system.

5.6.3.3 Magnox Reactor

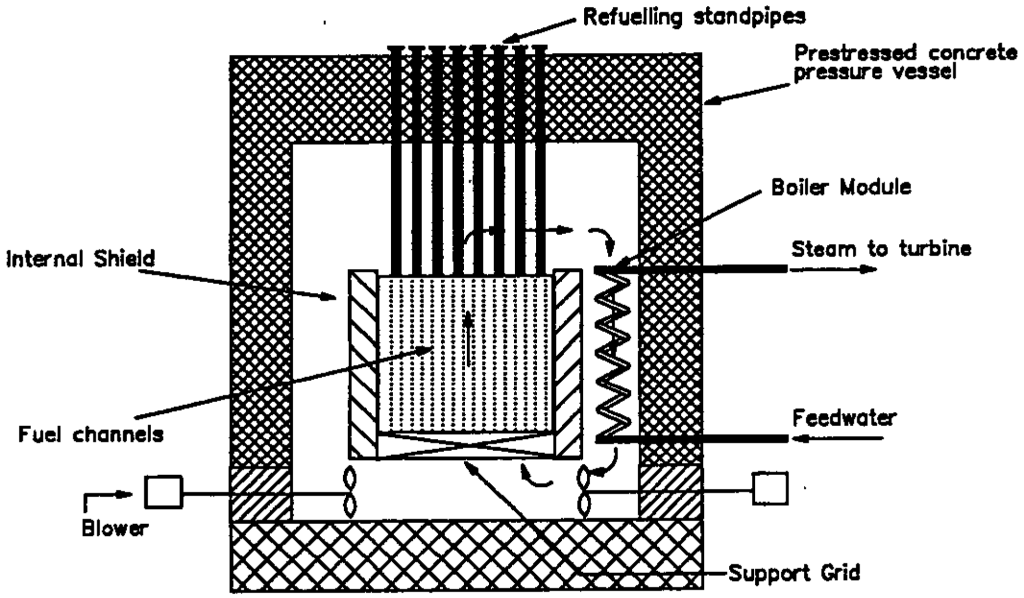
One of the first types of nuclear reactor used for large scale electrical energy production was the natural uranium, gas-graphite system developed in Britain and France. These early reactors were known as magnox reactors because the natural uranium fuel was clad in a magnesium alloy called magnox.

In the reactor core, the fuel elements are stacked in channels in a massive pile of graphite blocks. The coolant in these types of reactors is high pressure carbon dioxide. Neutron absorbing control rods are removed by chain mechanisms from separate channels in the graphite core and can be inserted by gravity for rapid shutdown.

5.6.3.4 Advanced Gas-Cooled Reactors (AGR)

The AGR is a development of the Magnox system designed to raise the temperature of the gas coolant to improve steam conditions. Stainless steel fuel cladding was used to accommodate these higher operating temperatures, and this results in a need to use enriched uranium. On-load fuelling is also used in the AGR reactor to ensure high availability of the plant. The entire reactor core and steam generators arranged around the core are contained in a pre-stressed concrete pressure vessel. The advanced gas cooled reactor is shown in Figure 5.6.4.

Figure 5.6.4
Advanced Gas Reactor

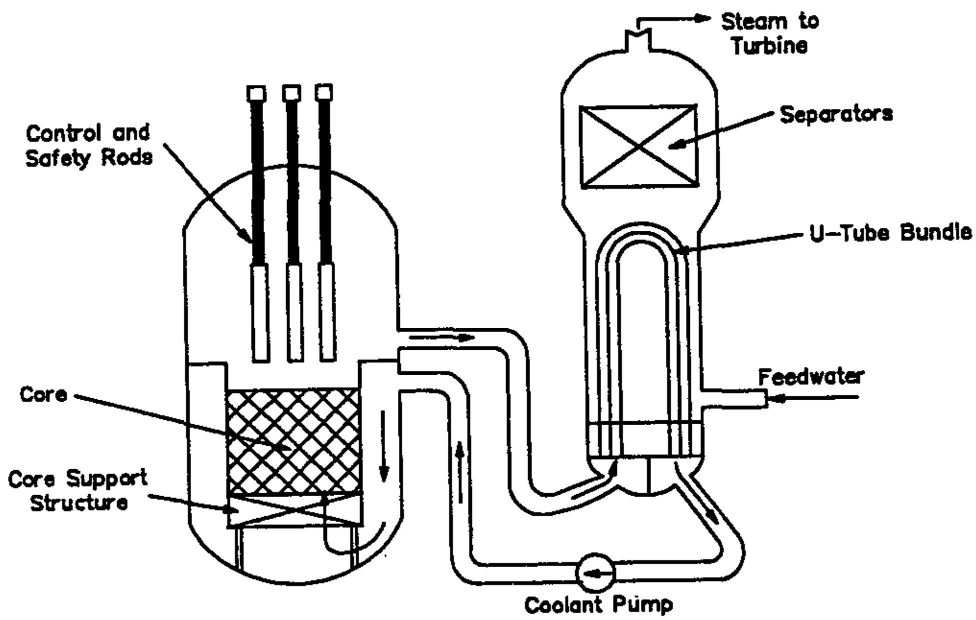


Reproduced from: Atomic Energy Canada Limited, Understanding Nuclear Power 1988

5.6.3.5 Pressurized Water Reactor (PWR)

The pressurized water reactor is widely used for nuclear energy generation throughout the world. This type of system was developed from the system used to power U.S. nuclear submarines. Light water, or ordinary water is used as both coolant and moderator. PWRs are designed to achieve a high coolant outlet temperature without boiling, thus requiring that the system must be highly pressurized. The reactor core is contained in a large steel pressure vessel with a removable lid. Reactor refuelling is done every 12 to 18 months while the reactor is shut down and the pressure vessel lid removed. The pressurized water reactor is shown in Figure 5.6.5.

Figure 5.6.5
Pressurized Water Reactor



Reproduced from: Atomic Energy Canada Limited, Understanding Nuclear Power 1988

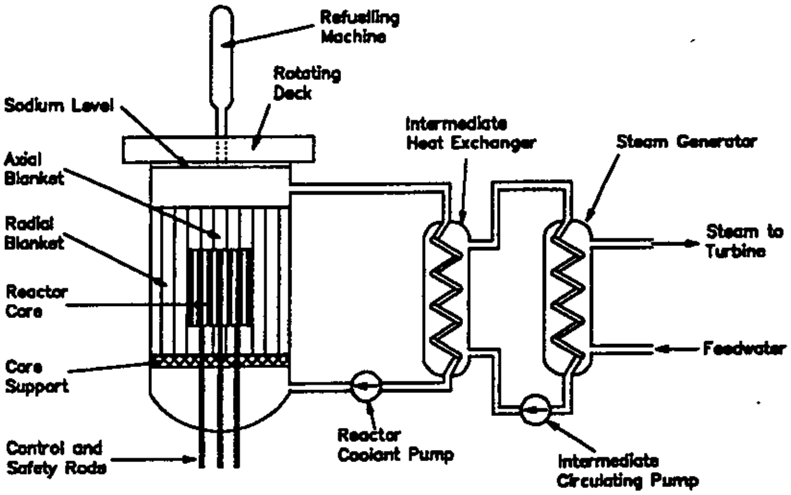
5.6.3.6 Boiling Water Reactor (BWR)

Boiling water reactors emerged when it was found that controlled boiling could be achieved in a self stabilizing condition at around half the system pressure of a PWR. In addition, obtaining steam directly from the reactor was also demonstrated. The BWR reactor uses enriched uranium fuel and is fuelled off-load at intervals of 12 to 18 months.

5.6.3.7 Fast Breeder Reactor (FBR)

The fast breeder reactor shown in Figure 5.6.6 is fuelled with a mixture of plutonium and uranium.

Figure 5.6.6
Fast Breeder Reactor



Reproduced from: Atomic Energy Canada Limited, Understanding Nuclear Power 1988

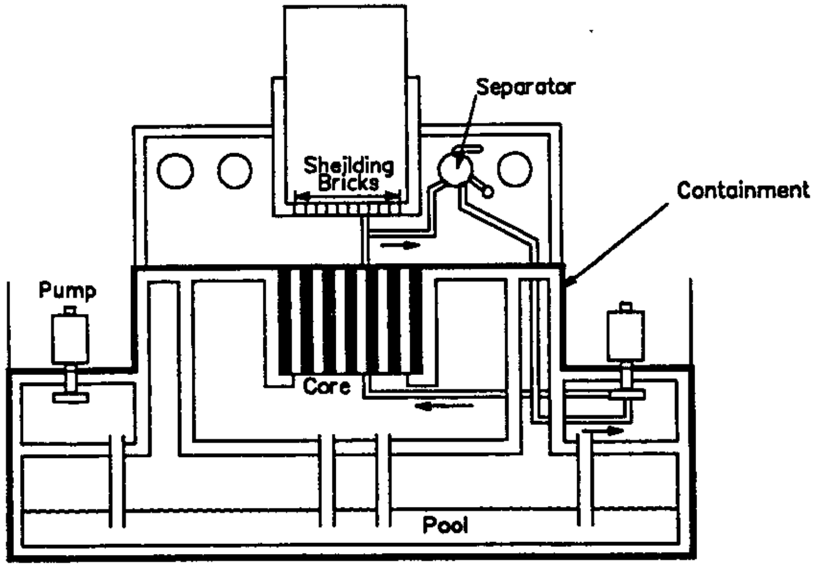
The process relies on the nuclear fission of plutonium and uranium to produce fast neutrons in the absence of any moderator. This extremely fast chain reaction in the compact core makes it possible to use the intense neutron radiation emanating from the edge of the core. By placing a blanket of depleted uranium (in most cases uranium — 238 waste product from enrichment plants) around the core, it is possible to convert a significant amount of the material to plutonium through neutron absorption. In fact, it is possible to produce more plutonium in the blanket region than that which is being consumed in the core, thus the process is known as breeding. The breeder reactor provides the possibility of substantially extending the world's nuclear fuel resources.

5.6.3.8 RBMK (Chernobyl) Reactor

A RBMK reactor consists of a huge container filled with graphite blocks, which is pierced by about 1,660 vertical holes which contain the pressure tubes and control rods. Water is pumped from the bottom of the pressure tubes over the fuel turning to steam and leaving the reactor at the top.

In this type of reactor, the graphite operates at about 700° C. At these temperatures, graphite, if exposed to air, will burn slowly. It is therefore very important to keep air away from the graphite. To accomplish this, the entire core is sealed in a metal container and a mixture of inert gases, helium and nitrogen (which do not react with graphite) are circulated inside the container. The Chernobyl type reactor is shown in Figure 5.6.7.

Figure 5.6.7
RBMK Chernobyl Reactor



Reproduced from: Atomic Energy Canada Limited, Understanding Nuclear Power 1988

5.6.4 Nuclear Power Plant Decommissioning

Decommissioning of aging nuclear power plants and nuclear waste disposal have become two of the most important issues surrounding the development of nuclear energy throughout the world. As the number of nuclear power plants approaching the end of their useful lives grows, so too does public interest in the decommissioning issue. The nuclear industry in turn has come to realize that the long-term future of nuclear energy is subject to the demonstration that reactors can be safely, efficiently, and economically dismantled and disposed of in an environmentally sound manner.

Decommissioning of a nuclear generating station can be defined as: "the removal of the installation from service at the end of its useful life and its transformation into an end-state that protects the health and safety of the general public, workers, and the environment."[16]

The determination of exactly when this occurs is dependent on a number of factors including maintenance costs, fuel costs, future power requirements, life extension costs, as well as environmental regulations.

The International Atomic Energy Agency (IAEA) has set procedural guidelines for decommissioning nuclear power reactors. Ontario Hydro will require Atomic Energy Control Board (AECB) licenses meeting those standards for all phases of decommissioning and of all transportation of resulting radioactive wastes.[17]

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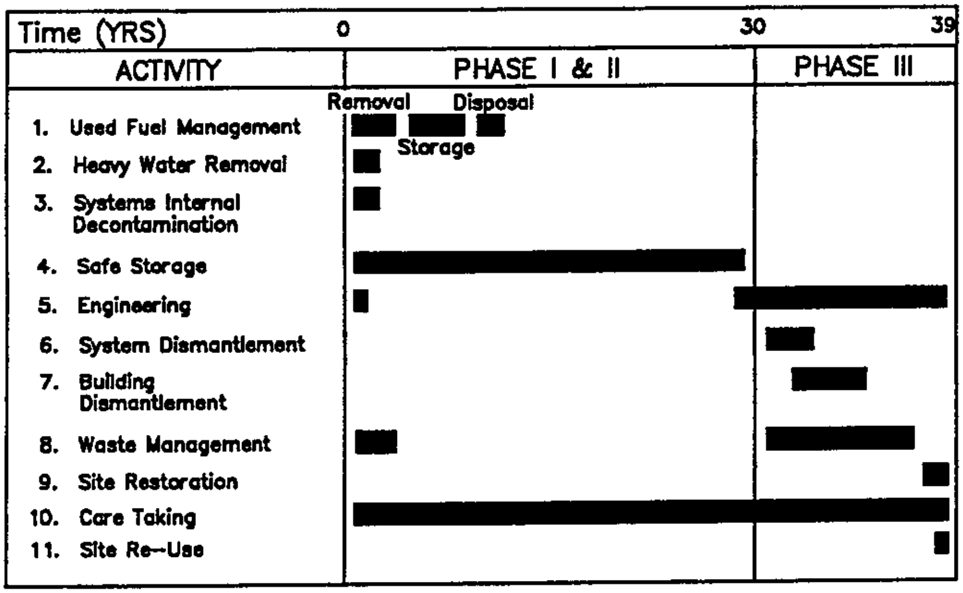
16 Energy, Mines & Resources Canada, *Response of the Government of Canada to the Report of the Standing Committee on Environment and Forestry, "High-Level Radioactive Waste in Canada: The Eleventh Hour,"* p. 13.

17 *Ontario Hydro, A Journalist's Guide to Nuclear Power*, p. 43.

As is common in other countries, CANDU reactors will be decommissioned in a three phase, forty-year program.[18] A typical decommissioning activity schedule is shown in Figure 5.6.8.

Figure 5.6.8
Typical Decommissioning Activity Schedule



Reproduced from: Nihal D. Jayawardene and Peter D. Stevens-Guille, "Strategy, Planning and Costing for Decommissioning in Canada", The Energy Journal, p184.

Phase I

Fuel would be removed from the reactor and kept in an on-site storage bay for 10 years until it could be transported safely to an approved storage or disposal facility. The heavy water systems would be drained and the water transported to storage, or to other stations for continued use. Piping systems would also be decontaminated. Regular monitoring would continue throughout this phase which would take two to three years.

Phase II

This involves storage with surveillance, lasting about 30 years, to allow radioactivity in the station to decay to lower levels. During this phase the used fuel would likely be moved from the station.

Phase III

All radioactive components would be dismantled and moved to a central storage site, and all buildings would be demolished. The site would be back-filled and all traces of the station would be eliminated. This would take about eight years.

18 Ibid. 43.

Nuclear power plant decommissioning was discussed in the House of Commons debates in June of 1990. In response to a number of questions about the decommissioning of nuclear power reactors in Canada, the Honorable Arthur Jacob Epp, Minister of Energy, Mines and Resources, reported on behalf of the Atomic Energy of Canada Ltd. (AECL) as follows:

> "Each nuclear facility owner is required to submit a decommissioning plan to the Atomic Energy Control Board. The selection of a decommissioning method and the costs thereof are the responsibility of the nuclear facility owner. Substantial reactor decommissioning experience exists today. Since 1960, some 65 research, test and demonstration reactors world-wide have been decommissioned.
>
> For the prototype nuclear facilities decommissioned by AECL, a method of long-term isolated, secured storage for the reactor system has been used. All active process materials are removed from the system and then the reactor containment building is sealed and secured for a period of about 50 years. During the period, radioactive decay will very substantially reduce the radiation fields present when final decommissioning is subsequently carried out, making the work easier and safer. Most of the nuclear facility area outside of the reactor containment building can be cleaned and reused immediately. This includes the administration buildings, most of the service area and the turbine hall. Based on experience, through the decommissioning of the Nuclear Power Demonstration (NPD) reactor in Ontario, and the Douglas Point (Ontario) and Gentilly (Quebec) prototype power reactors, typical costs for this method would be expected to be about $30M (1990) for a commercial power reactor. The cost of final decommissioning after the 50 year radioactive decay period is estimated at $60M (1990). Potentially, the site would then be used for a new nuclear facility."
>
> It is expected that the utilities would follow this practice. The utilities are already charging a small amount in the power bills, which is being accumulated with interest, to cover the cost of decommissioning. This amounts to 1 percent or less of the price of electrical energy produced.

There is as yet, no experience on complete decommissioning of a commercial electric power reactor, and therefore estimates of the total cost of decommissioning cannot be assumed to be firm.

5.6.5 Nuclear Waste Management and Disposal

Nuclear waste management and disposal is one of the most controversial issues surrounding the entire nuclear industry today. The public in general remains divided about both the utilization of uranium to produce electrical energy and the ability of the nuclear industry to develop a safe, long-term waste disposal facility.

5.6.5.1 Introduction

During the fission process which occurs in nuclear reactors, new elements are formed inside the fuel bundles. These new elements interfere with the fission process and are extremely radioactive. Most of them stabilize very quickly and after about 10 years are 1,000 times less radioactive than when first removed from the reactor. After a period of about 500 years, the penetrating radiation from a used fuel bundle will have decreased so much that people could be in the same room with it.[19] There are, however, some radioactive elements in the fuel bundles that continue to emit radiation which has much less penetrating power. These elements could still be harmful if they found their way into the air, drinking water or food. Used nuclear fuel should therefore be permanently contained in a manner which will prevent these elements from reaching the environment in sufficient quantities to harm living things.

5.6.5.2 Current Storage Practice

Used fuel bundles are currently stored in concrete pools at the generating station where they are produced. The water, which does not become radioactive by contact with a fuel bundle, serves as both a coolant and shield to protect operators from radiation. By the end of 1990, there were about 15,000 tons of used fuel in storage in Canada. This volume would, if stacked like cord wood, fill an Olympic size swimming pool.[20] Underwater storage has been used in Canada for more than 30 years.

Another method of storing used fuel bundles is in above ground concrete cannisters. A one meter thick wall of concrete serves to stop penetrating radiation. This method of storage is currently used at the Douglas Point reactor in Ontario.

Both of these storage methods require ongoing care and maintenance and eventually will have to be replaced. The objectives of radioactive waste disposal are to minimize any burden placed on future generations, protect the environment and protect human health, taking into account social and economic factors.[21]

An independent group of experts chaired by Professor Kenneth Hare of the University of Toronto studied the safe long-term storage of radioactive waste in Canada in 1977. The group recommended that the federal government should fund the development of the technology for permanent disposal. They went on to say that, of the various options for disposal, they considered underground disposal in geological formations to be the most promising within Canada.[22]

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19 Dr. David Torgerson, AECL, Prince Albert transcripts, March 9, 1991, p. 1435.

20 Ibid., p.1435.

21 *Regulatory Document R-104, Regulatory Policy Statement "Regulatory Objectives, Requirements and Guidelines For the Disposal of Radioactive Wastes — Long-Term Aspects,"* June 5, 1987, p. 2.

22 Dr. David Torgerson, p. 1438.

5.6.5.3 Government Involvement

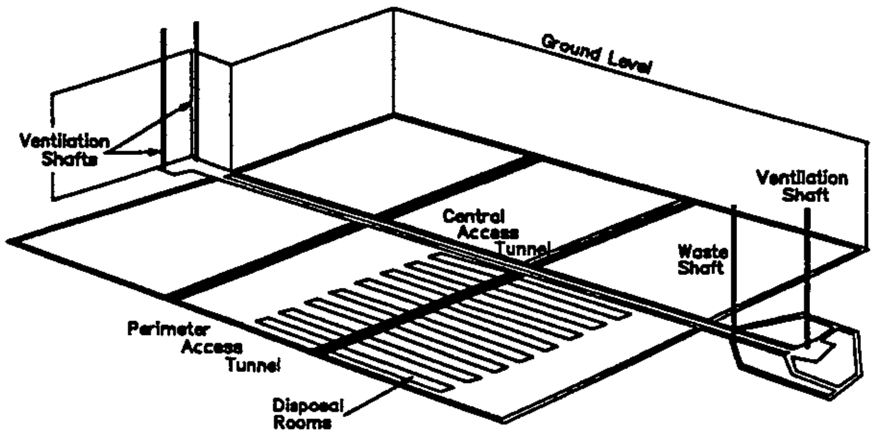
In June of 1978, the Governments of Canada and Ontario jointly announced the inception of the Canadian Nuclear Fuel Waste Management Program. This program was established "to dispose of radioactive waste from nuclear power reactors" safely in a deep, underground repository in intrusive igneous rock.[23]

Under the terms of the program, AECL was given the responsibility for conducting research on the immobilization and disposal of the wastes and for developing and demonstrating the associated technologies to do so. Ontario Hydro was given the responsibility for conducting research on interim storage and transport of used nuclear fuel. A joint statement was released in 1981 announcing that the program would undergo "thorough public and regulatory scrutiny" and that "no disposal site selections (would) be undertaken until after the concept (had) been accepted."[24] AECL is in the process of preparing a comprehensive environmental impact statement to be submitted for review by a Federal Environmental Assessment Panel.

5.6.5.4 The Permanent Nuclear Fuel Waste Disposal Concept

The Canadian concept for permanent nuclear fuel waste disposal is based on burying the used fuel in corrosion resistant containers in a disposal vault 500 to 1,000 meters deep in stable granite rock formations in the Canadian Shield. Figure 5.6.9 depicts the proposed underground vault which is composed of underground tunnels and disposal rooms is about 2 kilometers square, and is designed to hold approximately 190,000 tons of used fuel (this represents about 100 years output of Canada's present nuclear facilities).

Figure 5.6.9
Conceptual Design of a Disposal Vault for Nuclear Wastes



Reproduced from: OECD/NEA/AECL, Nuclear Waste Management, Canada.

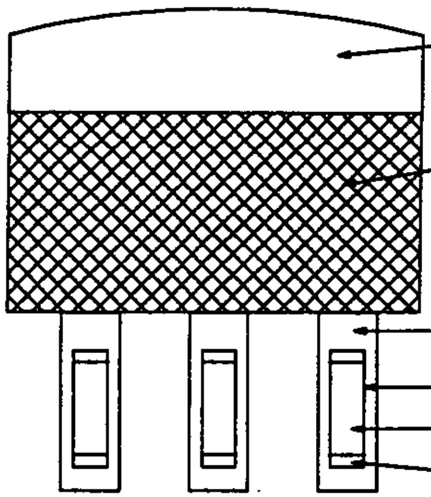
23 AECB, *Regulatory Document R-71, Regulatory Policy Statement "Deep Geological Disposal of Nuclear Fuel Waste: Background Information and Regulatory Requirements Regarding the Concept Assessment Phase,"* p. 1.

24 Ibid., p.2.

The fuel waste is sealed in corrosion resistant containers at the surface and then taken below in a shielded transport vehicle to a disposal room.

Holes are drilled in the floor of the disposal room to receive the containers. Once lowered into the hole, the space surrounding the container is filled with sand before the top layer of sealing material is added. When the rooms are filled, the rooms, access tunnels, and shafts are sealed with a mixture of clay and crushed granite. Figure 5.6.10 shows a cross-section of a typical disposal room. In order to fulfill its responsibility for assessing and developing the technology for the disposal of nuclear fuel waste, AECL developed the Underground Research Laboratory (URL) located in the Canadian Shield at Pinawa, Manitoba. Experiments conducted at the URL are assisting scientists in a greater understanding of how rock and groundwater behave at depth and how they are affected by heat produced by the used fuel.

Figure 5.6.10
Cross Section Through a Typical Disposal Room



Reproduced from: OECO/NEA/AECL, Nuclear Waste Management, Canada.

5.6.5.5 Cost Estimates for Waste Disposal

The cost of nuclear fuel waste disposal facilities can only be estimated at this time since no country has yet permanently disposed of its used fuel. The research obtained from various activities such as mining, immobilization, packaging and transportation provide a basis for making an estimate. The costs of a reference disposal vault including design, construction, commissioning, operation, transportation, decommissioning and other related activities have been estimated by Ontario Hydro based on the disposal of all used fuel from Pickering, Bruce, Darlington, and a future Darlington type station at $8.5 billion (1988 dollars) expended over a period of 80 years. This estimate is consistent with those of International Atomic Energy Agency member countries, whose estimates range from 2 to 10 percent of electricity production costs.[25]

25 *Nuclear Reactors in Canada,* Excerpts from Commons Debates, p.2.

Canadian nuclear utilities include a charge in customer billing to cover future costs of nuclear fuel waste disposal.[26] Some critics question the adequacy of these charges, given the lack of certainty about future disposal costs.

5.6.6 Nuclear Liability Act

The Canadian Nuclear Liability Act makes provision for compensation for any injury or property damage caused as a result of an accident at a nuclear power plant. The Act requires nuclear power plant operators such as Ontario Hydro to obtain liability insurance for damages up to a maximum of $75 million. Claimants do not have to prove negligence on the part of the operator, they need only prove they have suffered damage.

In the event an accident occurs where damages are likely to exceed $75 million, the federal government must appoint an independent tribunal whose task will be to receive claims, assess damages, and finally, recommend the level of compensation to be paid. Responsibility for claims exceeding the $75 million rests with the federal government. The Act does not limit the amount of government liability.[27]

It has been suggested that the ceiling of $75 million liability on the nuclear industry falls well short of appropriate restitution for a Chernobyl type nuclear accident and that a much larger financial burden should fall on the shoulders of the nuclear power plant operators rather than with the federal government. At the time the limit of $75 million was set, it exceeded the amount of liability which the insurance industry was able to cover. Today, more than 50 insurance companies pool together in the Nuclear Insurance Association of Canada to provide the coverage. Consideration is currently being given to raising the limit.[28]

5.6.7 Nuclear Industry Regulation

The Atomic Energy Control Act, 1946, required the creation of a federal government agency, the Atomic Energy Control Board (AECB) to ensure strict control over the development and use of radioactive and related material and equipment for reasons of national and international health and security.

The AECB regulates all radioactive materials including uranium, thorium, plutonium and all associated compounds. The AECB also regulates nuclear power stations, uranium mines, mills and processing plants, nuclear fuel fabrication plants, heavy water plants, and radioactive waste management facilities including AECL's proposed permanent disposal facility concept. The AECB regulates all aspects of the development, production and application of nuclear power including the formal licensing procedure governing nuclear power station site selection, construction approval, and the issuing of an operating

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26 Ibid.

27 Canadian Nuclear Association, *Nuclear Facts "Are Canadians insured against plant accidents?"* November, 1990.

28 Ibid.

license. The AECB inspects and monitors all facilities to which it issues an operating license and in the case of a nuclear power station, this activity continues throughout the life of the plant.

In some countries, operating licenses for nuclear power plants are granted for the entire life of the reactor (35-40 years). In Canada, operating licenses come up every 2 years for review.

The nuclear regulatory body, AECB is not to be confused with the federal Crown corporation AECL. AECL designed and developed the CANDU reactor and is responsible for conducting nuclear research and development. As a manufacturer and operator in Canada, AECL itself is subject to the regulatory authority of the AECB.

5.6.8 Potential Utilization In Saskatchewan

This is undoubtedly the most contentious option for electrical energy generation in Saskatchewan and it must be clearly appreciated that there are widely held and deeply felt concerns about nuclear safety, waste disposal and other issues which must be recognized and addressed. Some of the major concerns raised during the hearing process are as follows:

- The risk of reactor accidents, which could release radioactive materials into the environment, with possibly devastating effect on the agricultural industry;
- The necessity to keep fission products confined and isolated from living things for thousands of years and the lack of proven experience in doing this;
- The fear of possible adverse health effects from the low levels of emission of radioactive materials from reactors during normal operation;
- The perceived potential for power reactors to be used as a way of facilitating proliferation of nuclear weapons; and
- The perceived uncertainty of the economic cost of nuclear power, especially when future costs for waste management and decommissioning of reactors are taken into account.

The utilization of nuclear power generation in Saskatchewan in the form of a CANDU 3 generating unit is a viable option. Objections to nuclear power must, however, be viewed in a broader context than the simple generation of electrical energy and treated in this way when making societal choices.

5.7 - Biomass

5.7.1 Introduction

Biomass refers to materials that originate from biological sources such as wood, peat, agricultural waste, and even municipal garbage.

A sense of the potential which may exist for energy generation from biomass is provided by the claim that an area 125 miles by 125 miles (i.e. 10 percent of Canada's agricultural land) could produce enough hybrid willow to generate sufficient ethanol to replace all the gasoline used in Canada and also fuel 10,000 MW of electrical generation capacity.[29] These biomass yields are based on eastern Ontario growing conditions. Saskatchewan's climate would presumably result in somewhat lower yields.

One of the major advantages of utilizing biomass as an energy source is that the amount of CO_2 which is emitted is equivalent to that absorbed from the atmosphere by the original plant source of the fuel during its growing period. There is no net gain of CO_2 to the atmosphere, provided that the organic sources are used in a sustainable fashion.

The commercial use of biomass to produce electric power addresses the problem of waste disposal in the forestry industry and offers economic development opportunities in rural areas. The incineration of municipal solid waste (MSW) for process heat or electric power is also seen as a means of reducing problems associated with waste disposal. It is, however, not clear that burning garbage is environmentally benign. In some communities which generate energy from waste, recycling programs are seen as threats, as they compete for the better burning garbage. Possible toxic emissions and hazardous ash from incinerators continue to cause concern.

Biomass tends to occur in a very dispersed manner, not in a consolidated manner as do fossil fuels such as coal or natural gas. The cost of collecting large quantities of biomass for a commercial energy application can be significant, since the material by its very nature is often of low energy density and is usually damp or moist. As a result, the most economical applications of biomass energy generally involve a feedstock that has been collected or accumulated for some other reason. Alternative disposal methods of biomass materials such as MSW are often subject to "tipping fees" in congested urban areas if environmentally acceptable areas are not available nearby.

The use of biomass as a fuel source for power generation by electric utilities has been limited in part by the availability of lower cost resource supply options as well as the relatively small size of biomass facilities compared to larger more economical options. The availability of a continual supply of wood wastes at sawmills or pulp mills makes them excellent candidates for cogeneration or independent power production. The electrical energy produced from recoverable industrial or commercial process waste heat, results in increased thermal efficiency and thereby reduces operating costs.

29 *Sustainable Farming*, Winter 1991, p. 26.

The availability of mill wastes can vary with the demand for solid wood products, which is driven primarily by housing starts. This variability in supply can result in the need for large stockpiles of fuel wood. SaskPower currently does not have any biomass generating plants. They have however, signed a 25-year contract, subject to an environmental impact assessment, to purchase power from a peat-fired non-utility generator proposed for northern Saskatchewan. The plant development is subject to environmental approval.

Peat is one of the early stages in the formation of coal and Saskatchewan Energy and Mines estimates that 30 to 100 million tonnes of peat can be economically harvested in Saskatchewan.

In California, the *Public Utilities Regulatory Policies Act* (PURPA) legislation resulted in the emergence of a large number of independent power producers, or qualifying facilities, many of which utilize biomass as a fuel source. This resulted in the establishment of an expanded biomass market. Those producers using waste wood as a fuel source failed to secure long-term supply contracts and as a result, experienced significant increases in the cost of fuel wood.

Prior to PURPA legislation in 1978, California had about 100 qualifying facilities. This increased to between 600 and 700 after PURPA. Pacific Gas and Electric's (PG&E's) experience in integrating this number of generating units into their system has been favorable. However, their experience with fixed price contracts with qualifying facilities was not so positive. In the early 1980s, PG&E projected their avoided costs for a 10-year period at between 8 and 12 cents/kW.h (U.S.) and subsequently signed a number of fixed price contracts with qualifying facilities. During this period, both the price of oil and the load growth went down dramatically, resulting in PG&E overpaying a number of qualifying facilities.

Almost 8,000 MW of non-utility, biomass-based generation capacity was operating in the U.S.A. in 1988. Of this, more than 70 percent was in cogeneration systems. Wood-fired systems accounted for 77% of the total capacity, followed by MSW (11%), agricultural waste (7%), landfill gas (4%) and digesters (1%).[30]

5.7.2 Potential Utilization In Saskatchewan

It has been suggested that there is the potential for the development of 104 MW of electrical generating capacity in the province using currently unused surplus mill waste from lumber and pulp and paper industries located in northern Saskatchewan. This potential is shown in the Table 5.7.1.

30 Solar Energy Research Institute, *The Potential of Renewable Energy: An Interlaboratory White Paper*, p. B-8

Table 5.7.1
Preliminary Estimates of the Potential for Electric Power Development using Surplus Mill Waste in Saskatchewan [31]

Millar Western — Meadow Lake	33 MW
Big River (Weyerhaeuser) Mill	16 MW
L & M Wood Products — Glaslyn	2 MW
Weyerhaeuser Pulp Mill — P.A.	44 MW
Sask. Forest Products — Carrot R.	3 MW
MacMillan Bloedel — Hudson Bay	6 MW
Total	104 MW

Proponents of wood waste fueled generating stations argue that using wood to generate power provides an opportunity to use a renewable resource which is currently underutilized. They also argue that emissions from these facilities are significantly lower than those from the combustion of fossil fuels and that this type of economic development results in job opportunities and other related benefits. It has also been suggested that private ownership of these facilities minimizes the financial risk to SaskPower. SaskPower has not built any biomass facilities due to the availability of lower cost coal and hydro options. It may be possible, however, for non-utility generators to build and operate biomass facilities at competitive costs, particularly in cogeneration type applications.

There is little doubt that northern Saskatchewan has significant reserves of both peat and wood waste which can be utilized as feed stock for the generation of electrical energy. The future potential for their emergence in Saskatchewan is dependent on the long-term availability of low cost waste material that has no higher value use, such as the use of wood chips to make chip board, and the terms and conditions of a supply contract with SaskPower. The utilization of biomass therefore becomes a question of economics and the provision of an equitable process for recognizing the potential contribution to the SaskPower system.

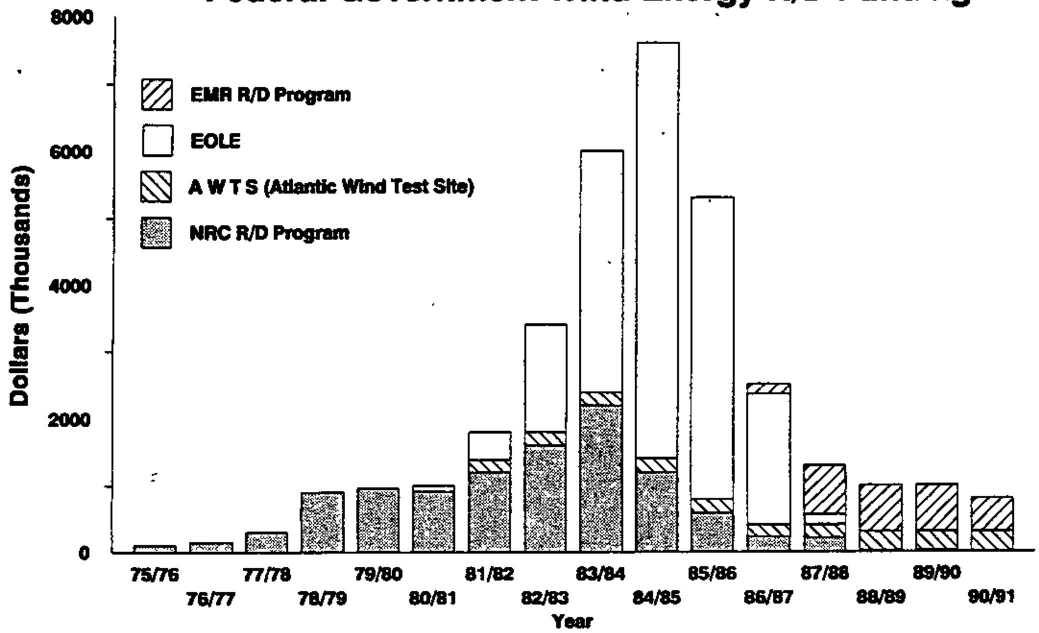
31 Mr. Frank Sudol, Prince Albert transcripts, March 9, 1991, p. 1625 (detail in written presentation).

5.8.1 Introduction

Wind energy has been used in Canada to pump water for domestic and agricultural purposes since the early 1600s and to produce electricity since the early 1900s. The utilization of wind as an energy source diminished in the early 1950s as rural electrification began extending into remote farm areas.

The Canadian federal government began funding wind energy research programs in 1975. The present R&D program started at the National Research Council (NRC) in 1972 with an annual budget of $60,000. In 1975, the Panel on Energy Research and Development began funding wind energy research and the budget was increased to $2 million per year, with extra commitments made to fund a test facility and the construction of Project Eole, a 4 MW vertical axis wind turbine (VAWT) at Cap Chat, Quebec. Canadian wind energy research, development and demonstration responsibility was later transferred to the Department of Energy, Mines and Resources (EMR). The annual program funding for wind energy research since 1975 is presented in Figure 5.8.1.[32]

Figure 5.8.1
Federal Government Wind Energy R/D Funding



Reproduced from: "Canadian Wind Energy Technical and Market Potential," Draft Document, Nov 20, 1990. Alternative Energy Division. Efficiency and Alternative Energy Technology Branch, CANMET.

32 Energy, Mines and Resources Canada, *Canadian Wind Energy Technical and Market Potential: Draft Document*, p. 2.

In European countries, government funding for wind energy is now about $140 million (U.S.) per year. Canada's level of activity in wind energy both in terms of installed capacity and government R&D funding is among the lowest of the industrialized countries.[33]

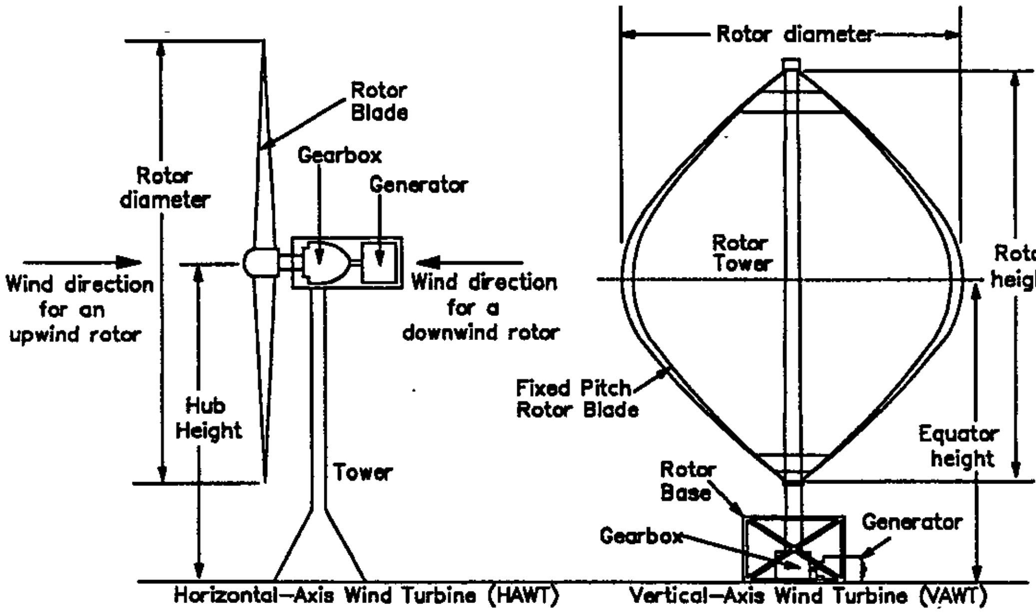
5.8.2 Technological Description

Wind energy is the kinetic energy in the movement of large masses of air resulting from the earth's rotation and uneven heating of the earth and atmosphere by the sun. Wind results from warm air being less dense than cooler air, and therefore tending to rise while cooler air sinks. The tilt of the earth's axis and its rotation, as well as the earth's orbit around the sun further accentuates this process. The result of these effects is that different areas of the world are heated at different rates during different times of the year, leading to variability in wind direction and velocity.

Coastal areas like California are particularly well-suited to wind energy generation due to the temperature differential between cool marine air and hot interior air and the natural funnelling effect of the various mountain passes.

There are two basic wind turbine designs: Horizontal Axis Wind Turbines (HAWTs) and Vertical Axis Wind Turbines (VAWTs). These designs are shown in Figure 5.8.2.

Figure 5.8.2
Basic Wind Turbine Configurations



Reproduced from: Wind Energy Technical Information Guide, Solar Energy Research Institute, December, 1989.

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33 Ibid., p. i.

Horizontal axis wind energy conversion systems are constructed on top of towers to provide clearance from the ground and to elevate the rotor into stronger and more stable regimes.

The amount of power available in the wind is proportional to the cube of the wind speed. For example, if the average wind speed is 20 percent higher than expected, the turbine should produce 73 percent more energy. On the other hand, an overestimate of the wind speed by 20 percent will lead to an output of about half the expected power.

Using current technology, HAWTs and VAWTs can convert approximately 40 percent of the energy in the wind to mechanical energy. A typical drive-train/generator efficiency is about 85 percent, resulting in an overall efficiency of about 35 percent.[34] This efficiency is comparable to the thermal efficiency of conventional power plants. Wind turbine availability has reached 95 percent in some cases, and over the past decade, wind power has matured into an economical and renewable energy supply system in those locations where adequate wind resources are available.

5.8.3 Current State of Development

There is approximately 2,000 MW of installed generating capacity using wind energy worldwide. Most of this (approximately 1,600 MW) is in California. In 1990, wind energy supplied utilities in California with 2.5 billion kilowatt hours of electricity generated from more than 17,000 wind turbines. U.S. Windpower, the world's largest wind energy company, has manufactured, installed and is operating more than 4,100 wind turbines in California. The majority of these have a rated generating capacity of 100 kilowatts.

The rapid development of wind energy technology in California in the early 1980s was largely due to favorable tax credits and energy rates for independent power producers. Numerous wind energy companies were created to take advantage of these attractive incentives. Many of them utilized technologies that were inadequately engineered and maintained, and as a result did not meet performance objectives and therefore many wind energy development companies went out of business. The federal tax credits that spurred the rapid development of wind farms in California expired in 1985. Wind turbine research and development has, however, continued with increased attention on efficiency and cost-effective design and development.

U.S. Windpower is currently working on an advanced 33 meter variable speed wind turbine that, is quoted as being "the key innovation that changes the wind industry from a push market that has largely depended on subsidies or environmental considerations to a pull market in which wind energy is fully economical at today's cost of energy from fossil fuels." [35] This new advanced wind turbine is being proposed by U.S. Windpower for use in the 9 MW wind farm development in the Pincher Creek area of southern Alberta.

Since wind energy is a non-dispatchable resource, its economic viability is closely related to wind availability, wind system capacity factors, equipment availability and

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34 Solar Energy Research Institute, *Wind Energy Technical Information Guide*, p. 3.

35 "Excellent Forecast for Wind," *EPRI Journal*, June 1990, p. 23.

maintenance requirements. The non-dispatchability of the wind has caused utilities to base their determination of the value of wind power on the cost of electricity generated using fuels that are most often displaced by wind energy. This value is in turn determined by the generation mix of the utility, the cost and availability of fuel supplies and how closely wind energy matches the utility's power requirements.

5.8.4 Wind Energy in Canada

There are numerous promising areas in Canada for wind energy development, both in remote and large scale wind farm applications. These include the Pacific Coast, Atlantic Canada, some remote Arctic communities, and the southern areas of Alberta and Saskatchewan.

A number of wind energy installations have been established across Canada. The majority of these are located on coastal areas in the Maritimes and British Columbia (Table 5.8.1). These facilities were installed for both research, development and demonstration purposes as well as to provide power for selected remote applications.

Table 5.8.1
Sample Canadian Wind Energy Installations

1. B.C. Telephone Company, 2 x 3 kW Northern Power Systems for battery-charging (telecommunications), Calbert and Swindle Islands, British Columbia.
2. Department of National Defence, 50 kW Indal, utility grid-connected, Christopher Point, British Columbia.
3. Sinnott Ranch, 40 kW Enertech, grid-connected farm, Pincher Creek, Alberta.
4. Pioneer Lodge, 60 kW Nordtank, grid-connected retirement home, Fort Macleod, Alberta.
5. Eastridge Secondary School, 2 x 60 kW Enertechs, grid-connected school, Cardston, Alberta
6. Lethbridge Wind Research Center, wind pump test site, Lethbridge, Alberta.
7. Leth ranch, 65 kW Nordtank, grid-connected farm, Taber, Alberta.
8. Agriculture Canada, 50 kW Indal, Swift Current, Saskatchewan.
9. Prairie Farm Rehabilitation Administration, 500 water pumpers throughout Saskatchewan for livestock watering.
10. Cambridge Bay wind farm, 4 x 25 kW Carters, utility grid-connected, Cambridge Bay, N.W.T.
11. Health and Welfare Canada, 2 x 7 kW Aerowatts, grid-connected nursing stations, Hall Beach, N.W.T.
12. Ontario Hydro, 60 kW Howden, utility grid-connected, Fort Severn, Ontario.
13. Kortright Center, 150 kW Adecon, research prototype, Kleinburg, Ontario.
14. Hydro-Quebec (IREQ), 65 kW Bonus, utility grid-connected Kuujjuaq (Fort Chimo), Quebec.
15. Hydro-Quebec (IREQ), 50 kW Indal, R&D test bed, Varennes, Quebec.
16. Project Eole, 4 MW Vicars, grid-connected research prototype, Cap Chat, Quebec.
17. Atlantic Wind Test Site, wind generator test site, North Cape, P.E.I.
18. Nova Scotia Power Corp., 200 kW WTG Energy Systems, utility grid-connected, Wreck Cove, Nova Scotia.
19. Newfoundland Light & Power Co., 300 kW Carter, utility grid-connected, Bell Island, Newfoundland.

There are approximately 900 water pumping wind turbines and about 500 small and medium wind turbines producing electricity in Canada. The total installed capacity of these turbines is approximately 1.5 MW. A further 6 MW of wind energy systems in the 25 to 500 kW range exist in Canada for a total of 7.5 MW.[36]

In early 1991, the Province of Alberta announced the Southwest Energy Initiative, the first of Alberta's experimental alternate energy developments. Under the initiative, wind, sun, and water will be utilized in trial projects in the Pincher Creek area of southern Alberta. The largest of these projects will be a privately developed 30 unit, 9 MW wind farm to be located on Cowley Ridge. The proposed wind farm will employ about 50 Canadians during construction, and three or four full-time employees during commercial operation in 1994. The farm, although in southern Alberta, will be operated via satellite from U.S. Windpower's headquarters in Livermore, California.

5.8.5 Future Potential

In a draft report called "Canadian Wind Energy Technical and Market Potential" by the Alternative Energy Division of CANMET, it is estimated that if current power purchase rates by Canadian utilities remained unchanged, the potential economically competitive grid connected wind capacity in Canada over the period 1990 to 2015 is only about 9 MW. The estimated capacity increases to 223 MW by the year 2015 if there is an approximately 25 percent reduction in turbine capital costs. If the power purchase rates paid to independent power producers by utilities included a capacity credit, coupled with a 10 percent decrease in turbine capital costs, the estimated grid connected wind capacity increases to 1,147 MW. It is interesting to note that only 4 MW of this 1,147 MW, is estimated to be in Saskatchewan.[37]

It is clear from the results of the CANMET study that potential wind turbine deployment is very sensitive to both turbine costs and utility pricing policies.

The future potential of grid connected wind farm generation in Saskatchewan is dependent on identifying the most suitable locations through studies on wind regimes at heights of approximately 30 meters. Environment Canada wind data is available from a number of monitoring stations across the province. This data, however, was collected at significantly lower heights than that which is advised by wind industry experts.

5.8.6 Potential Utilization in Saskatchewan

In order to assess the suitability of wind energy in the province, a preliminary study was done at the University of Saskatchewan to determine the expected wind energy available at 27 different locations across the province.

The study used wind speed recordings provided by Environment Canada's Atmospheric Services Department. These wind speeds were measured for the most part at a height of 10 meters at airport locations.

A single wind turbine generator (WTG) is assumed to be installed at each location with the following characteristics:

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36 CANMET, *Canadian Wind Energy Technical and Market Potential,* p.10.

37 Ibid., p. 38.

1) Unit rated capacity 225 kW
2) Cut-in wind speed 3.5 meters/sec.
3) Rated wind speed 15 meters/sec.
4) Cut-out wind speed 35 meters/sec.
5) Height 30 meters

Based on an assumed turbine efficiency curve for this hypothetical unit, and the mean wind speed, as calculated from the Environment Canada data, the annual expected exploitable wind energy (EEWE) and efficiency factors were determined for each location. These figures are presented in Table 5.8.2 below and are arranged in order of decreasing efficiency factors.

Table 5.8.2
The Expected Wind Energy and Wind Speed at Each Location

Location	Measuring Height Meters	Mean Wind Speed Meters/Sec	Mean Wind Speed Miles/Hr	Annual EEWE MW.h/Yr	EF (%)
Swift Current	10.1	6.27	14.04	511	25.9
Moose Jaw	10.1	5.69	12.72	447	22.7
Regina	10.2	5.75	12.87	442	22.4
Estevan	10.1	5.64	12.62	416	21.1
Rockglen	10.1	5.41	12.11	380	19.3
Bad Lake	10.1	4.86	10.87	337	17.1
Yorkton	10.1	4.85	10.85	321	16.3
Saskatoon	10.1	4.87	10.89	314	15.9
Wynyard	10.1	4.78	10.69	303	15.4
Kindersley	13.1	4.70	10.52	301	15.3
Broadview	18.0	4.54	10.16	280	14.2
Weyburn	13.1	4.55	10.18	268	13.6
North Battleford	11.0	4.32	9.67	267	13.5
Outlook	10.1	4.33	9.68	235	11.9
Prince Albert	10.1	4.00	8.95	232	11.8
Melfort	13.1	4.35	9.73	221	11.2
Scott	15.6	4.06	9.08	205	10.4
Buffalo Narrows	10.1	3.91	8.75	192	9.7
Collins Bay	16.2	3.93	8.79	171	8.7
Nipawin	10.1	3.84	8.59	169	8.6
Meadow Lake	10.1	3.49	7.80	162	8.2
Island Falls	27.4	3.50	7.85	144	7.3
Cree Lake	13.1	3.51	7.85	143	7.3
Hudson Bay	13.1	3.31	7.41	138	7.0
La Ronge	13.1	3.31	7.40	133	6.7
Uranium City	15.9	3.20	7.16	127	6.4
Waskesiu	18.3	2.58	5. 77	55	2.8

The results of this preliminary study as shown in Table 5.8.2 indicate that the most favorable regions for wind turbine development are in the southern part of the province. It also suggests that the expected wind energy production is extremely site specific. This can be demonstrated by comparing the EEWE of Estevan (416 MW.h/yr.) to Weyburn (268 MW.h/yr.). Although these locations are only 86 kilometers apart, the EEWE at Weyburn is only 64 percent that of Estevan. Clearly, a 36 percent reduction in EEWE will have a significant impact on the economic viability of a proposed wind turbine development. The data as presented in Table 5.8.2 are based on wind speeds measured at a height of approximately 10 meters. These figures will change if wind recordings are taken at actual specific sites and the measurements taken at a height of approximately 30 meters, the proposed hub height of new generation wind turbines.

Wind energy profiles can vary significantly from one location to another. Figures 5.8.3 and 5.8.4 show the expected wind energy at Yorkton and Swift Current respectively. The expected monthly wind energy profile at Swift Current more closely matches SaskPower's monthly load profile. This, coupled with the fact that Swift Current has the highest mean wind speed in the province, makes it a potential area for wind farm development.

Figure 5.8.3
Monthly Available Energy for each WTG at Yorkton

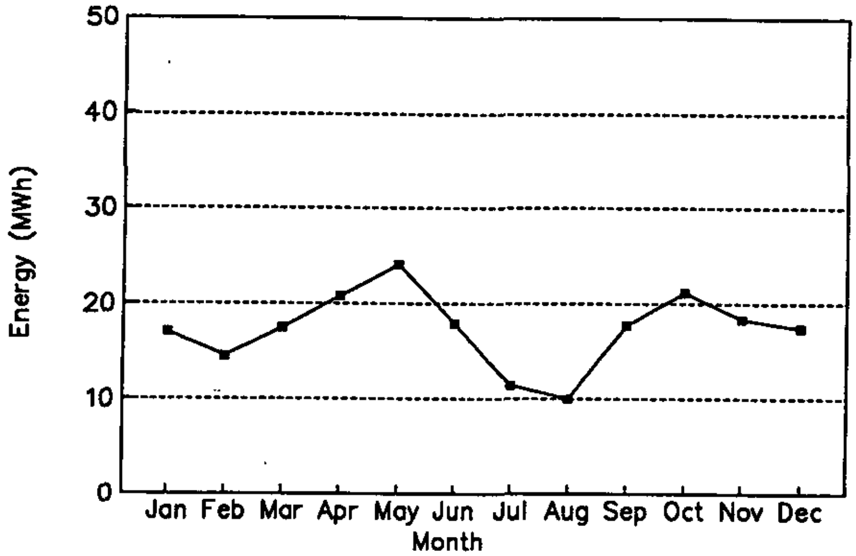
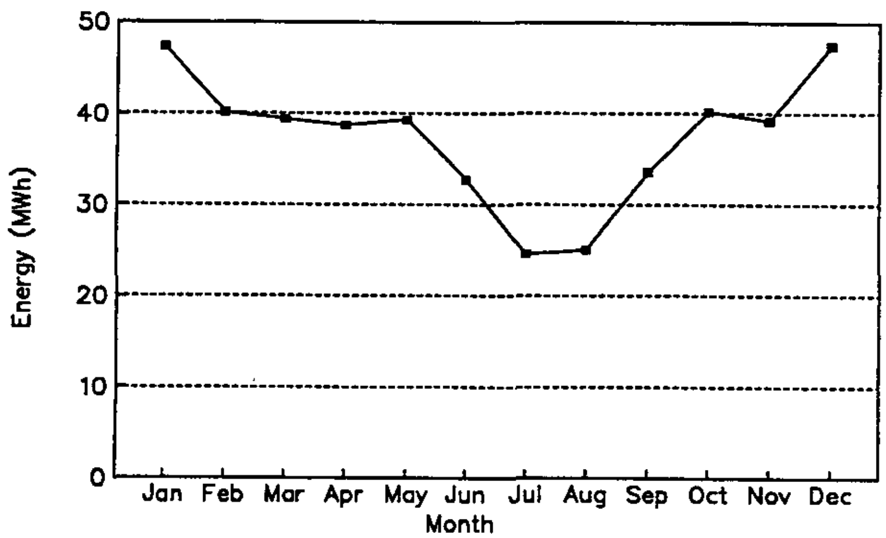


Figure 5.8.4
Monthly Available Energy for each WTG at Swift Current



Figures 5.8.5 and 5.8.6 show the mean hourly wind speed at Swift Current for typical November to February and March to June periods. These graphs demonstrate the consistent patterns of the average mean wind speeds over a 24 hour period for a number of months. Hourly wind patterns for other locations may be significantly different.

Figure 5.8.5
Hourly Mean Wind Speed at Swift Current

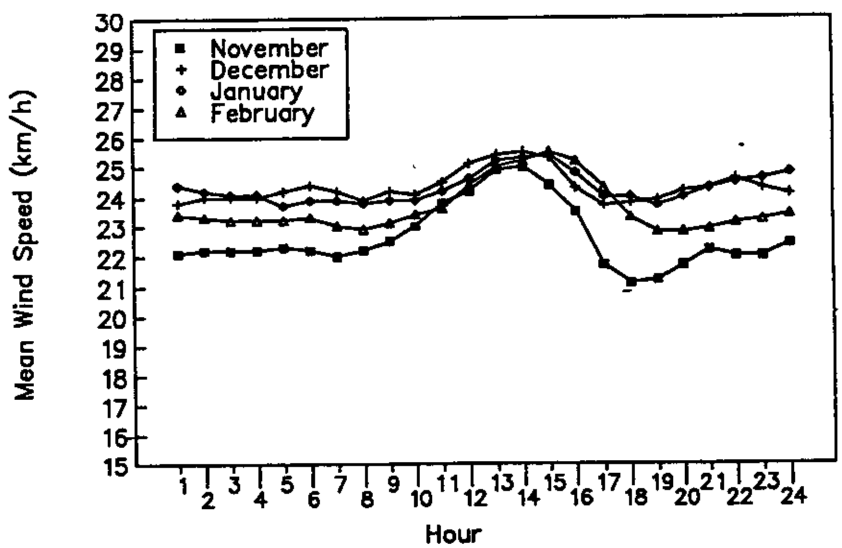
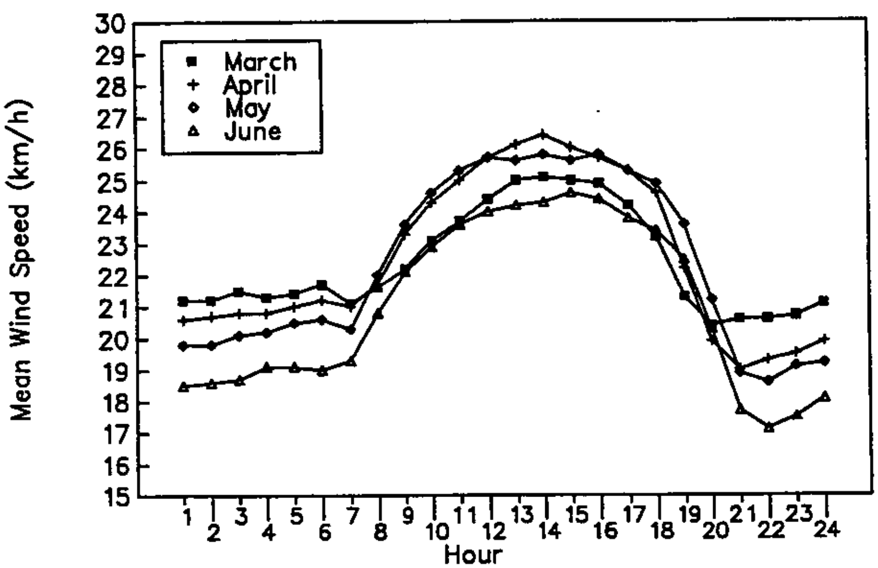


Figure 5.8.6
Hourly Mean Wind Speed at Swift Current



The data used to provide the results shown in Table 5.8.2 and Figures 5.8.3 to 5.8.6 are incomplete. It serves however to indicate that detailed information is required in order to assess the cost-effectiveness of wind energy in Saskatchewan. In addition to collecting appropriate data at specific locations in the province, SaskPower should actively monitor the research and development being conducted on wind research.

5.9 - Photovoltaics

5.9.1 Introduction

Photovoltaics (PV) is the direct conversion of sunlight into electricity. The use of photovoltaics dates back to the 1950s when the first modern cells were used to power orbiting satellites. Over the past 40 years, significant advances have been made through extensive research and development efforts in several countries including the United States, Japan, Australia, Germany and Italy. The goal of this research is to achieve higher energy conversion efficiencies and to lower the cost of the technology. While major advances have been made in both these areas, more work is needed if photovoltaic energy is to provide significant amounts of electrical energy.

The use of photovoltaic energy is particularly well suited to remote off grid applications where the cost to extend conventional utility service is prohibitive. Current uses of remote PV energy include lighting, electronic communications and monitoring equipment, agricultural water pumping, navigational beacons and battery charging.

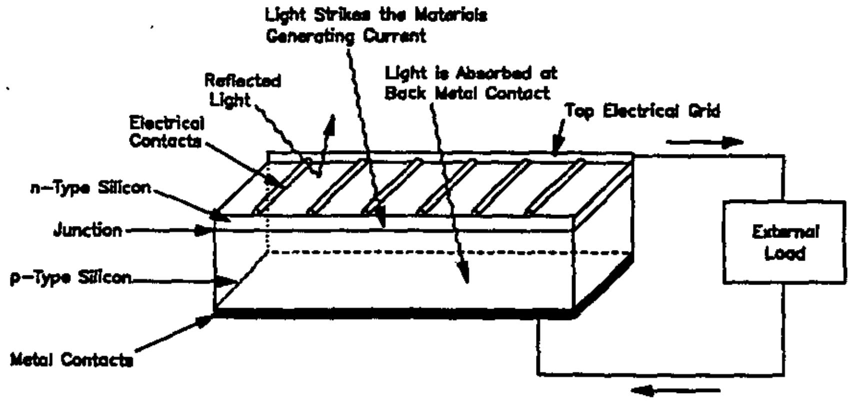
The sun releases approximately 95 percent of its energy output as light. About 1.5 quadrillion megawatt hours of energy reach the earth each year, and of this 47 percent reaches the surface, the rest is absorbed in the atmosphere or reflected into space.[38]

5.9.2 Description of The Photovoltaic Energy Process

Photovoltaic cells are semiconductor devices designed to produce electricity when exposed to light. Two semiconductor materials with different electronic properties produce an electric field at a common interface. When sunlight is absorbed in the cell, electrons are released from one of the semiconductor layers. The electric field then drives the electrons through an external circuit, producing current (see Figure 5.9.1).

38 Thornton, John P., Richard DeBlasio and Kenneth Zweibel, "Photovoltaics - Today's Reality, Tomorrow's Promise," *Energy Engineering*, Vol. 87, No. 3 (1990), p. 64.

Figure 5.9.1
Photovoltaics



Reproduced from: Solar Energy Research Institute, Photovoltaics Entering the 1990; Nov 1989, p.6.

Groups of cells are called modules and groups of modules are called arrays. A module is usually a square meter or less in size and has a generating capacity of 50 to 150 watts. Commercial crystalline solar modules typically turn 11 to 14 percent of the sunlight that strikes them into electricity.[39]

The power output of a module at noon on a clear day is called its peak-watt power because it represents a maximum typical output. A module characterized as 100 Wp produces 100 W of power during a clear midday.

5.9.3 Research and Development

Research and development efforts into photovoltaics were stimulated with the significant increases in energy prices experienced in the U.S. during the 1970s. The U.S. Congress, in 1978, passed *The Solar Photovoltaic Energy Research, Development and Demonstration Act* to develop this technology to the point where it was cost-competitive with conventional electrical generating methods. The U.S. government has put more than $800 million into PV research, while private industry has invested more than $2 billion. Annual investment on PV research, engineering, product development, and marketing by the private sector, currently exceeds $100 million.[40]

Worldwide, PV currently has a larger research budget than any other renewable energy source.[41]

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39 Solar Energy Research Institute, *Photovoltaics Entering the 1990s*, November 1989, p. 7.

40 "Photovoltaics - Today's Reality, Tomorrow's Promise," p. 67.

41 Ibid., p. 10.

As a result of this extensive investment, the cost of PV has fallen on average by more than 50 percent every five years. PV module costs are now in the range of \$200 to \$500/m^2.[42] Sales of PV modules have increased dramatically from only a few hundred kilowatts in the mid-1970s to just over 42 MW in 1989. The average growth rate of world PV module shipments in the period 1985 to 1989 is approximately 15.7 percent per year as shown by Table 5.9.1 below.

Table 5.9.1
World PV Module Shipments (MW) (Consumer & Commercial)

Country	1985	1986	1987	1988	1989
United States	7.6	7.0	8.65	11.3	14.7
Japan	10.8	13.4	12.45	13.0	14.2
Europe	3.7	4.3	4.7	6.9	7.9
Rest of World	1.4	2.3	2.8	4.0	5.3
Total	23.5	27.0	28.6	35.2	42.1

The Solar Energy Research Institute estimates that bulk generation of electric power using PV technology costs from 25 to 30 cents/kW.h (U.S.) at today's costs.[43] This is not competitive with conventional fossil-fired plants. Although the energy cost is high in relative terms, the 6.5 MW tracking array at Carrisa Plain, California is proof that large utility scale PV applications can be successfully integrated into the electric grid.

5.9.4 The Future of Photovoltaics

As research, development and demonstration efforts into PV systems evolve, further cost reductions can be expected as technological advances result in greater consumer and utility market penetration and eventual mass production of PV cells.

The use and timing of large scale PV will depend on a number of factors: first, the successful transfer of laboratory efficiencies to larger scale applications; second, continued involvement by electric utilities as they recognize that the value of obtaining practical experience can result in increased orders for PV and push costs down further; and third, the possibility that more stringent environmental constraints on fossil-fueled power plants may increase the costs of conventional electrical energy production, making PV more attractive.

42 Solar Energy Research Institute, *The Potential of Renewable Energy - An Interlaboratory White Paper*, p. G-1.

43 Ibid., p. 76.

5.9.5 Potential Utilization In Saskatchewan

PV technology will continue to play a role in meeting many of today's power generation applications where it is able to successfully compete with other alternatives. This has been primarily in remote applications where utility grid connection is uneconomic or impossible. However, the lack of large utility scale PV applications in northern climates such as Canada, as well as the high initial cost relative to other conventional generation alternatives, make photovoltaics an unattractive option for utility scale application in Saskatchewan at this time. However, development of this technology should be carefully monitored for future consideration.

5.10 - Geothermal Energy

5.10.1 Introduction

Geothermal energy is heat produced within the earth. This heat flows to the surface where it eventually dissipates into the atmosphere. The rate at which this heat flows to the surface is called the geothermal gradient and varies from one location to the next, depending to a large degree on the geological conditions below the surface of the earth.

Geothermal energy can be classified into high grade and low grade energy. High grade energy is typically associated with tectonically active volcano areas such as Iceland and California, which do not generally occur in the interior of continents. Geothermal systems in these areas are generally related to the utilization of magma (hot molten rock) in the energy production process. In these systems there is naturally occurring steam or hot water at temperatures above 150°C. A minimum temperature of 180°C is considered to be necessary for the commercial production of electrical energy.

Low grade energy occurs in areas of thick sedimentary rocks. Large aquifers buried at depths of 1,500 meters or more in these sedimentary basins have geothermal gradients of 30°-40°C per kilometer of depth. This low grade energy can be recovered and reused for space heating, low temperature drying processes, or for greenhouses. Low grade systems, by virtue of their size, contain much more energy than high grade or magmatic systems.

Southern Saskatchewan lies within the Western Canadian Sedimentary Basin which contains Phanerozoic (Cambrian and younger) sedimentary beds lying above the Precambrian crystalline basement (generally granite rocks). The highest temperature water available in Saskatchewan is likely to be in the deepest part of the basin south of Regina where temperatures exceeding 100°C were observed.[44] Regina was host to a geothermal test well project in 1982 to determine the availability and the economics of low grade geothermal heat recovery for space heating purposes at the University of Regina. The geothermal gradient at the Regina well increases downward at a rate of 37°C per 1,000 meters at shallow depths but the gradient reduces to 18°C per 1,000 meters in the lower parts.

The chemistry of the water in deep aquifers varies from place to place. Some deep aquifers in Saskatchewan contain water with a 35 percent dissolved solid content. Because of these high levels of dissolved solids, and the potential of environmental damage, the deep waters obtained from geothermal sources cannot be released at or near the surface, but must be reinjected back into subsurface aquifers that contain water of similar non-potable quality. In addition, the total dissolved solids in geothermal brine possess the potential for serious corrosion problems, particularly when hydrogen sulphide and oxygen are dissolved in the water.

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44 Dr. Lawrence W. Vigrass, "Geothermal Energy - A Saskatchewan Resource," Department of Geology and Energy Research Unit, University of Regina, June 1991, p. 6.

5.10.2 Potential Utilization In Saskatchewan

SaskPower currently does not have any geothermal power plants. The results from the Regina Geothermal Project in 1982 indicate that there may be some potential for the utilization of the abundant low grade geothermal energy. The maximum temperatures obtained in this project (100°C) are too low for what is considered to be the minimum temperature for use in commercial scale electrical power generation (180°C). Although the technology to produce electrical energy from geothermal sources is technically proven in areas where the resource exists, such as California, the relatively low temperatures of the geothermal brine held within the geological formation in southern Saskatchewan does not have potential for cost effective utilization as an electrical energy source for SaskPower.

5.11 - Oil

5.11.1 Introduction

Oil-fired generating capacity contributed 6.9 percent to the total installed capacity in Canada in 1990. During the same period oil-fired capacity in Saskatchewan was 24 MW (0.8 percent) of the province's installed generating capacity.[45] Of this 24 MW, 21 MW is in the form of non-utility generation at the Hudson Bay Mining and Smelting Co. Ltd. in Flin Flon (considered to be in Saskatchewan for data collection purposes). The remaining 3 MW is at SaskPower's internal combustion plants located in northern Saskatchewan. These diesel-fired plants provide power to the northern communities of Brabant Lake, Kinoosao, and Southend.

The Queen Elizabeth Power Station (QEPS) in Saskatoon has the capability to burn natural gas, coal or oil to produce electrical energy. This 232 MW power plant located on the shore of the South Saskatchewan River in Saskatoon is used primarily for peaking purposes and uses natural gas as the fuel source. Although QEPS is a multifuel plant, oil has seldom been used as the primary fuel for electrical energy generation.

5.11.2 Potential Utilization In Saskatchewan

With the large reserves of low cost lignite coal, natural gas and uranium in Saskatchewan, the utilization of oil for future large scale base load electrical energy generation is unlikely. Oil, particularly diesel oil, may be the only alternative to produce electrical energy for some remote northern communities where utility grid connection is impossible or not economical.

45 Energy, Mines and Resources Canada, *Electric Power in Canada 1990*, p. 48

5.12 - Purchases from Interconnected Utilities

5.12.1 Introduction

The Province of Saskatchewan is interconnected with the electrical grids in Manitoba, Alberta and North Dakota and is therefore in a position to exchange power and energy in both contractual agreements and spot market situations. This is usually done when it is economical to do so or when it is required for system reliability considerations. SaskPower has taken advantage of these opportunities in the past and should continue to do so in the future. Over the past 20 years, SaskPower has had a number of interconnection contracts with neighboring utilities as shown in the table below:

Table 5.12.1

Province / State	Utility	Type of Contract	Contract Duration	Capacity (MW)
Manitoba	Manitoba Hydro	Capacity export	Nov. 69 to Oct. 70	50
			Nov. 70 to Oct. 71	100
			Nov. 72 to Oct. 73	100
			Nov. 75 to Apr. 76	30
North Dakota	Basin Electric Power Company	Seasonal Diversity Exchange	1986 to 2001	100
		Winter Peaking Power Purchase	1988 to 1992	50
Alberta	Alberta Power	Reserve sharing	1989 to 2014	150*

* Reserve sharing agreement reduces to 125 MW in January 1995.

The 100 MW diversity agreement with Basin Electric of North Dakota has allowed SaskPower to defer the construction of an equivalent amount of generating capacity. An additional contract with Basin Electric allows SaskPower to purchase 50 megawatts of capacity until 1992 when Shand #1 is scheduled to be in-service. The reserve sharing agreement with Alberta Power Limited has deferred the need to add 125 MW of generation in the long term.

5.12.2 Potential Utilization In Saskatchewan

The interconnections between Saskatchewan, Alberta, and North Dakota have been, and continue to be, used for the purchase of electric power and energy. These purchases can be made in a number of ways such as economy interchange, seasonal diversity exchanges, firm capacity purchases and basic reserve sharing agreements. SaskPower has effectively utilized these interconnections by entering into contractual agreements with connected utilities since 1969.

SaskPower should continue to take advantage of its interconnections through purchases or exchanges of electrical power and energy when it is economically advantageous to do so.

5.13 - Plant Life Extension and Efficiency Improvement

5.13.1 Introduction

Plant life extension refers to those activities undertaken with the objective of extending the life of a generating station beyond that for which its component parts were originally designed. Typically, the physical structure of a power plant is not subject to the same rate of deterioration as the components involved in the production of the electrical energy. The components affected in general include the materials and equipment that are required to operate at high temperatures and stress. These components are subject to fatigue which can eventually lead to failure. In addition, power plant efficiency tends to deteriorate over time.

Plant life extension should be undertaken when it is economical to do so. Plants which are in relatively poor condition and which require costly extensive rehabilitation need to be evaluated against other more efficient alternatives. Life extension also provides opportunities to incorporate new technologies that were not available at the time the plant was constructed and thereby increase availability and efficiency and reduce environmental emissions and operating and maintenance costs. Plant life extension programs will vary widely depending on the age of the generating unit. These programs can extend the life of a power plant by 10 to 15 years.

SaskPower has a number of generating units which have exceeded their design life. These include: -

	Capacity (MW)
Island Falls Hydroelectric Station	95
Estevan Generating Station	65
Queen Elizabeth #1 and #2 Units	132
Boundary Dam #1 and #2 Units	132
Total	424

By the year 2000, SaskPower will have an additional 390 MW of capacity which will have reached the end of its design life:

	Capacity (MW)
Boundary Dam #3 and #4 Units	300
Success Gas Turbine	30
Landis Gas Turbine	60
Total	390

None of these generating units are scheduled for retirement in the next ten years, with the exception of the Estevan generating station and possibly the Success gas turbine.

Life extension activities have been conducted at the 60 year old Island Falls hydroelectric plant and more work is scheduled in the next few years. The Estevan generating station is not being considered for life extension due to economics. Life extension studies carried out at Boundary Dam #1 and #2 and Queen Elizabeth #1 and #2, have indicated that these units should remain in service.

SaskPower continually monitors and tests its generating plants in order to ensure that they are safe, reliable and efficient. As generating units reach the end of their design life, detailed tests and analyses are conducted to assess whether or not the plant can continue to operate in a safe and reliable manner, and to determine the extent and economics of refurbishment or life extension.

SaskPower, with other North American utilities, sponsored by the Canadian Electrical Association, recently participated in a project to develop a more structured approach to life extension evaluation. The Electric Power Research Institute (EPRI) of Palo Alto, California subsequently published a report called "Generic Guidelines for the Life Extension of Fossil Fuel Power Plants." These EPRI procedures or guidelines are extremely useful in conducting life extension evaluations.

5.13.2 Potential Utilization In Saskatchewan

Life extensions are typically viewed as a cost-effective alternative to the construction of new generating facilities, given current environmental regulations. The potential for more stringent emission regulations may require more costly control mechanisms, thereby making continued use of some existing facilities uneconomical.

5.14 - Fuel Cells

5.14.1 Introduction

A fuel cell is an electrochemical energy device that converts the chemical energy of a fuel into electrical energy. Similarly, a battery is a device that converts the chemical energy contained in its active materials directly into electrical energy by means of an electrochemical oxidation-reduction reaction. This type of reaction involves the transfer of electrons from one material to another through an electrical current. While the term "battery" is often used, the basic electrochemical unit being referred to is the "cell." A battery consists of one or more of these cells, connected in series or parallel or both, depending on the desired output voltage and capacity.[46]

5.14.2 Fuel Cell Development History

The first known fuel cell was developed in 1839. Subsequent R&D efforts using various fuels and electrodes resulted in the development and demonstration of a 5 kW system in 1959. NASA became interested in fuel cell research during the 1960s for use in their space program. Fuel cell technology was successfully used in the Gemini, Apollo, and space shuttle programs. Problems in transferring this technology to commercial power applications, and a concurrent reduction in government funding for fuel cell research in the late '60s and early '70s, brought development of fuel cells to a halt. A number of electric utilities and research organizations have since produced various designs and capacities of fuel cell power plants. The Tokyo Electric Power Company (TEPCO) has developed a 4.5 MW demonstration plant and expects to have an 11 MW fuel cell plant on-line this year. This plant will be the largest functioning fuel cell power plant in the world. Japan is particularly interested in fuel cells because of its dense urbanization, scarce load base, air pollution problems and its reliance on imported oil to meet its energy needs. The Japanese plan to have 1,000 MW of fuel cell capacity installed by the year 2000.

5.14.3 Potential Utilization in Saskatchewan

The electric utility industry in North America is primarily interested in power generation technologies that have a proven reliability and are cost-effective. Utility acceptance of fuel cell technology has been slow, probably due to the high capital cost and the absence of any utility size, full scale, reliable fuel cell power plants. The success of the various demonstration plants around the world and the possibilities of tighter environmental regulations will likely have a significant impact upon the acceptance and implementation of fuel cell technology.

46 David Linden, *Handbook of Batteries and Fuel Cells*, pp. 1-3.

5.15 - Magnetohydrodynamics or MHD

5.15.1 Description of Technology

In a MHD system, coal is burned at very high temperatures and the hot combustion gases are chemically treated with a potassium compound to increase electrical conductivity. These hot gases then pass through a magnetic field created using superconductors to create DC electric power. The emerging hot gases from the generator are then directed into a boiler system to create steam to drive a conventional steam turbine generator. Electrical energy is therefore created in the MHD part of the process and in the boiler/steam turbine generator. As a result it is anticipated that MHD power plants will have efficiencies of 40 to 50 percent.[47] This increased efficiency translates into significant reductions in CO_2 emissions over conventional coal-fired power plants.

Magnetohydrodynamic power generation is still in its development stage. As with other new generation technologies, it lacks market acceptance due to its high capital cost and lack of commercial size demonstration projects. Further, MHD generation requires the use of superconductors, an area of research that is still in the laboratory stage of development. MHD technology offers considerable promise due to its increased efficiency and environmental benefits. However, it is not expected to be commercially available for electric utilities until after the turn of the century.[48]

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47 K. Morgan MacRae, *Coal - New Coal Technology and Electric Power Development*, p. 78.

48 Ibid. p. 78.

5.16 - Compressed Air Energy Storage

5.16.1 Introduction

Compressed Air Energy Storage (CAES) power plants are designed to provide peaking power to electric utility systems. These plants use electrical energy from the grid during low load periods to compress and store air in an underground containment structure such as an excavated cavern or depleted oil field. During peak demand periods, this air is withdrawn from the cavern, heated, usually by natural gas combustion, and expanded through combustion turbines to produce electric power. Generally about one-half to two-thirds of the fuel consumed by gas turbines is used to compress the combustion air. In CAES systems, the combustion air is already compressed and no further energy is required for that purpose. Therefore, the heat rates for CAES systems are significantly better than conventional gas turbines. There are two types of air storage concepts in CAES power plants: constant pressure and constant volume concepts. In the constant pressure concept, water from a surface reservoir is used to displace the compressed air as it is withdrawn from the cavern to maintain a constant pressure. In the constant volume concept, the air pressure drops during power production. The selection of the appropriate CAES plant concept is, to a large degree, site dependent.

5.16.2 Commercial Applications

At Huntdorf, West Germany, a 290 MW CAES plant is in operation using a cavern leached in an underground salt dome. This plant has demonstrated a 90 percent availability and 99 percent starting reliability since 1978.[49]

Smaller, more modular compressed air energy storage systems called mini-CAES are attracting a lot of attention. These 25 to 50 MW systems allow utilities to develop storage systems as required, provide shorter construction time and less financial resources than for larger systems. The first mini-CAES is being operated by the Italian utility ENEL.

The Alabama Electric Corporation has begun construction of a 110 MW CAES plant scheduled to come on line in 1991. The Soviet Union has plans to build a 1,050 MW plant in the Donbass region, north of the Black Sea.[50]

5.16.3 Potential Utilization In Saskatchewan

Compressed Air Energy Storage systems can be called a developing technology. A lack of historical operating characteristics including reliability and production costs are some of the major drawbacks to achieving utility acceptance with this technology. Geological cavern conditions are extremely site specific and therefore it is difficult to directly transfer the technology from one location to another.

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49 California Energy Commission, *ETSR*, Appendix A, Volume II, pp. 16-17.

50 Ibid. pp. 16-18.

CAES economic viability will likely be proven one way or another through the operating experience gained from new installations and further research and development efforts to improve compressor efficiency and to clarify site-specific geological issues.

CAES should therefore be viewed as a developing electrical energy generation technology for Saskatchewan. SaskPower currently does not have any CAES systems.

5.17 - Nuclear Batteries

5.17.1 Introduction

The nuclear battery is a small nuclear reactor power supply designed to generate electrical energy and/or high grade steam heat in remote locations. The nuclear battery program originated in 1984 as a joint project between Atomic Energy of Canada Ltd. (AECL) and the Los Alamos National Laboratory to develop a small (20 kWe) nuclear power supply for radar stations in the North Warning System (NWS). This project was cancelled since full power demonstrations could not be achieved in time for the deployment schedule for the NWS application. However, Canadian development efforts in nuclear batteries continued for a time in a program focussed on their use as an auxiliary power source in diesel submarines as part of the Canadian Submarine Acquisition Project (CSAP). The CSAP program, however, decided on the use of full-powered nuclear submarines which would use a proven conventional design. During this development, the nuclear battery concept was expanded to consider more powerful versions which would more closely match the needs of the commercial marketplace. AECL redirected their development efforts to addressing the electrical energy needs of remote communities, which typically rely on diesel generators for their power supply. The capability of nuclear batteries to also produce high pressure steam heat for industrial applications may result in an expanded market.

5.17.2 Potential Utilization In Saskatchewan

The nuclear battery concept has developed into a unit directed to commercial applications for base load power requirements in remote locations. Other applications have been identified for the use of nuclear batteries such as in oil recovery processes which require high pressure quality steam.

Nuclear batteries are still in the developmental stages, with the short-term goal being to demonstrate the overall technical feasibility of the concept in a non-nuclear test. It is anticipated, therefore, that the utilization of this technology for the production of commercial scale electrical energy is at least a decade away. The role nuclear batteries or other developing technologies will play in the generating mix in Saskatchewan will depend on their relative economics when compared to other alternatives.

5.18 - Hydrogen

5.18.1. Introduction

Hydrogen is one of the world's most plentiful chemical elements. When used as a fuel, it combines with oxygen to produce water vapor. This feature makes the utilization of hydrogen for use in the transportation and electric power industry rather attractive. However, hydrogen does not naturally occur as an isolated element. It must be extracted from other materials that contain hydrogen such as water or natural gas. Hydrogen and oxygen in the form of water, can be separated through a process called electrolysis. This process requires as much energy as it releases as fuel, and this is one of the major obstacles preventing its wider use in commercial scale applications.

5.18.2 Hydrogen in Electrical Energy Production

Hydrogen can be used as an alternative fuel in combustion turbines but this utilization is still at the demonstration phase of development. The use of hydrogen as fuel in electric power generation avoids typical corrosion or sediment difficulties on turbine blades associated with the combustion of fossil fuels with their residues and ash content.[51]

Hydrogen can be produced by using off-peak power from base load power plants to electrolyze water. The hydrogen can then be stored for use in combustion turbines later during peak demand periods. This process also results in oxygen as a byproduct which can either be sold or stored for use in the combustion turbine.

One of the most promising ways to "split" water is to use solar power to produce electrical energy that can then be used in the electrolysis process. If achieved economically, this could result in the development of a valuable method of storing solar energy. Hydrogen gas, however, is highly explosive and research is continuing to find an effective method of storing it safely.

5.18.3 Hydrogen Economy

One concept that has been suggested for the extensive use of hydrogen in all sectors of the economy is the "hydrogen economy." This concept is based on the production of hydrogen using renewable or non-renewable energy sources in the electrolysis process. The hydrogen is then stored or transported for use in applications such as aircraft, ground transportation, fuel cells, urban and industrial electrical energy production, industrial uses, residential uses, and synthetic uses.

51 California Energy Commission, *ETSR,* Appendix A, Vol. I, June 1991, pp. 2-32.

5.18.4 Potential Utilization In Saskatchewan

Currently, SaskPower has no hydrogen-fueled electrical generating facilities. There are still obstacles to overcome in the economics of electrolysis as well as the safe storage and transportation of hydrogen before it can be expected to gain wider acceptance. Although the technology to produce electrical energy in hydrogen fueled combustion turbines has been demonstrated, its utilization in Saskatchewan as a fuel source for energy generation is remote. Saskatchewan's abundant supply of more economic natural gas is more likely to fill the role hydrogen can play in electrical energy generation, at least over the next decade.

5.19 - Energy Storage Systems

5.19.1 Introduction

Energy storage systems allow energy to be made available when it is required. A storage system allows any generated energy in excess of instantaneous demand to be saved for use later in times of peak demand.

5.19.2 Energy Storage Technologies

There are currently a number of energy storage technologies available that are being used in varying applications. Batteries are one of the more common energy storage technologies. Battery storage is based on using off-peak inexpensive power from the electric grid for charging the battery, and then discharging it during peak demands. Batteries are currently used in association with small scale solar photovoltaic and wind energy systems. However, utility scale battery storage technology is still in the development stage.[52]

Southern California Edison installed a 10 MW/40 MW.h battery storage system in 1988. This facility is the largest load levelling battery system in the world and will serve to demonstrate the technical and economic viability of battery storage systems. A number of other nations are experimenting with various types of battery storage technologies, including lead-acid, sodium-sulfur, zinc chloride, and zinc bromide.

Thermal energy storage systems use water, oil, molten sodium, or molten salt, as a storage medium. These types of storage systems are typically used in solar thermal applications.

Other energy storage technologies such as pumped hydro and compressed air energy storage have been described in earlier sections.

5.19.3 Potential Utilization In Saskatchewan

Energy storage systems such as batteries are well-suited for use in small scale photovoltaic or wind energy applications and are currently in widespread use. Electric utility scale battery storage technology is a developing technology worthy of observation. Its use in Saskatchewan on a utility scale therefore is dependent on the research, development, and demonstration efforts taking place in this field.

52 California Energy Commission, *ETSR*, Appendix A, Vol. II, June 1991, pp. 16-34.

Glossary of Terms

Acid Rain
Caused by emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x). These substances can be carried by prevailing winds and return to earth in acidic forms of rain, snow, fog or dust. If the environment can't neutralize the acid being deposited, plants, animals, soil and water can be damaged.

AECB
The Atomic Energy Control Board. It was created under the Atomic Energy Control Act, 1946, to ensure strict federal control over all development and use of radioactive and related material and equipment for reasons of national and international health and security.

AECL
Atomic Energy of Canada Limited. It was created as a Crown corporation on April 1, 1952, to develop nuclear technology for peaceful uses.

Alpha Radiation
Also known as alpha rays, it is a kind of particulate radiation, essentially, a helium nucleus. It can be stopped by a sheet of paper or the outer layer of human skin.

Atom
The smallest unit of an element that maintains the properties of the element.

Avoided Cost
Usually used to refer to the cost of new capacity which may be deferred as a result of some resource action.

Base Load
The minimum continuous load over a given period of time.

Base Load Generating Station
A generating station which is normally operated to supply all or part of the base load of a system and which consequently operates at full output whenever available. Base-load generating units tend to be large units with low operating costs.

Beta Radiation
Also known as beta rays. It is a kind of particulate radiation, essentially, an electron. It can be stopped by a three centimetre (one inch) thickness of wood.

Breeder Reactor — A reactor which makes more fuel than it consumes.

Calandria — In the CANDU reactor, a large stainless-steel tank which houses the fuel channels and the heavy water moderator.

CANDU — A Canadian-designed nuclear reactor. The name stands for "CANadian Deuterium Uranium" steam generating system. All nuclear generating stations produce steam from atomic fission to drive turbines and make electricity. CANDU uses deuterium oxide, "heavy water," rather than ordinary light water, as an essential component of the reactor. CANDU also uses natural rather than enriched uranium as fuel.

Capacity — The greatest amount of power that can be supplied by a generating unit, power station, or entire provincial grid system.

Capacity Purchase — Refers to the purchase of capacity from an interconnected utility or a non-utility generator.

Carbon Dioxide (CO_2) — A gas resulting from the burning of organic materials.

Coal — A fossil fuel composed mostly of carbon, with traces of hydrogen, nitrogen, sulphur and other elements. It was formed from remains of trees and plants alive millions of years ago.

Coal-Fired Plants — Coal-fired plants are power stations which burn coal to generate electricity.

Cobalt-60 — Radioisotope used for sterilization and cancer treatment, manufactured in CANDU reactors.

Cogeneration — The production of electricity along with useful steam or hot gases. The steam or gases are used for industrial purposes.

Combined Cycle — Combined cycle involves generating electricity using a gas turbine, and diverting the exhaust gases into a waste-heat boiler to produce steam. This steam can then drive another generator, producing additional electricity.

Conservation — Refers to all methods of reducing the demand for electrical energy.

Containment — The system which ensures that harmful amounts of radioactive material do not get out of a nuclear power station.

Core — The core of the reactor is the most radioactive part of the reactor, everything inside the calandria.

Cosmic Radiation — It is composed of various subatomic particles—protons, neutrons, alpha particles, parts of the nuclei of carbon, nitrogen and oxygen atoms, which constantly bombard the earth from outer space.

Criticality — A state at which the rate of production of neutrons in a mass of fissile material is precisely equal to the rate of loss of neutrons. Also, the point in starting of a reactor at which a nuclear reaction is sustained.

Decay — The process whereby a radioactive element changes into another element, releasing alpha, beta and/or gamma radiation.

Decommissioning — The activities involved in removing a plant from service, dismantling the plant, and restoring the site to be compatible with other industrial uses.

Demand — The amount of electricity required at a point in time.

Demand Side Management — DSM programs are undertaken to influence the amount and timing of customers' use of electricity, in order to reduce peak demand and overall consumption.

Deuterium Oxide — Heavy water D_2O. Deuterium is an isotope of hydrogen. See heavy water.

Dispatchability — The ability to vary or control the output of a generating unit.

Economy Interchange Refers to the purchase of energy from an interconnected utility in order to effect a saving in the cost of generation when the receiving party has adequate generating capability available to carry its own load.

Efficiency Refers to the amount of electrical energy used to provide a specific level of service. Improving energy efficiency in electric motor use, for example, implies producing a given level of mechanical power output with a lower electrical energy input.

Electron Negatively-charged particle orbiting around the nucleus of an atom.

Energy The amount of electric power consumed over a certain period of time, usually measured in kilowatt-hours.

Energy Source The primary source that provides the power that is converted to electricity. Energy sources include coal, petroleum and petroleum products, gas, water, uranium, wind, sunlight, geothermal and other sources.

Enriched Fuel Nuclear fuel containing more than the natural content of fissile atoms.

Externality A residual or side effect of an economic activity in which a benefit or cost is conferred upon a party who is not a party to the original transaction either as a producer, consumer, or agent.

Firm Energy or Power Electrical energy or power intended to be available at all times during the period of the agreement for its sale.

Fly Ash Fine ash from coal-fired plants that is normally expelled from the smoke stacks.

Fossil Fuels Carbon-based fuels, formed from remains of living matter. Examples include coal, oil, peat and natural gas.

Gamma Ray The most penetrating electromagnetic radiation.

Gigawatt (GW)

One billion watts.

Gigawatt Hour (GW.h)

A unit of bulk energy. A million kilowatt-hours. A billion watt hours.

Global Effect

Any environmental effect not limited to the locality in which the effect is created; may also be called a transboundary effect, e.g. acid rain and greenhouse effect.

Greenhouse Gases

Include methane (CH_4), carbon dioxide (CO_2), nitrogen oxides (NO_x), chlorofluorocarbons (CFCs) and other trace gases which trap heat in the atmosphere. This contributes to global warming.

Grid

Grid is a network of transmission lines and interconnections.

Half-life

The time it takes for half the atoms of a given sample of an isotope to undergo a specific radioactive decay process.

Heavy Water

Deuterium oxide, D_2O, the moderator and heat transport fluid used in the CANDU reactor.

Hydro Power

Electricity produced from the energy of flowing water. Water flows through a turbine, spinning the blades, which rotate a generator, producing electricity.

Independent Generation

Generation owned or operated by producers other than a utility. These producers usually have generating plants for the purpose of supplying electric power required in their own industrial and commercial operations. The term also covers private plants whose sole purpose is the sale of electricity to a utility.

Installed Capacity

The capacity measured at the output terminals of all generating units in a station, without deducting station service requirements.

Interconnections

Transmission lines connecting one utility to another, allowing power to be exchanged between utilities.

Interruptible Energy or Power

Energy or power made available under an agreement that permits curtailment or interruption of delivery at the option of the supplier.

Isotopes

Isotopes of an element are atoms of an element with the same number of protons but different numbers of neutrons. All isotopes of an element have the same chemical properties (i.e., they will combine with the same substances) but have slightly different physical properties (i.e., one will have greater mass than another).

Kilovolt (kV)

1,000 volts.

Kilowatt (kW)

Kilowatt - 1,000 watts.

Kilowatt-Hours (kW.h)

When a 100 watt bulb burns for 10 hours, it consumes one kilowatt-hour (kW.h) of energy. A typical household may consume an average 600 to 800 kW.h per month.

LIFAC

Limestone Injection in the Furnace and Activation of the unreacted Calcium. It is a process used to reduce SO_2 emissions from coal-fired plants.

Megawatt (MW)

Megawatt - 1,000,000 watts.

Mitigation Cost

The cost of reducing or eliminating the severity of an environmental impact, may also refer to the cost of replacing the loss of an environmental good.

Moderator

In a nuclear reactor, it is the substance which slows down the fast-moving neutrons to "thermal" velocities so they are more likely to cause subsequent fissions.

Neutron

A particle in the nucleus of an atom which has no charge.

Non-Utility Generation

Describes electricity produced by an enterprise which is not a power utility. It may be used to supply the producer's own needs, and/or sold to a utility.

NO_x	Nitrogen oxides emitted by fossil fuel plants as a result of combusting fuels; a pollutant.
Nuclear Liability	Federal legislation in Canada to regulate accident insurance for nuclear generating stations.
Nuclear power	Nuclear power plants use a controlled nuclear reaction to generate electricity.
Peak Demand	The maximum amount of power required at a particular point during a period of time, for example, daily peak.
Peaking Capacity	Peaking capacity is provided by generating stations which are usually operated to provide electricity during peak demand periods.
Photon	A measurable quantity of electromagnetic energy, almost like a particle.
Plutonium (Pu)	A heavy radioactive metallic element with an atomic number of 94 whose principal isotope Pu-239 is a major fissile material. It is produced artificially in reactors through absorption of neutrons by U-238.
Power	The rate at which electric energy is delivered. It is expressed in watts, kilowatts, megawatts, and other units of power.
Pressure Tube	In the CANDU reactor, a tube which holds the fuel bundle.
Proton	Positively-charged particle in the nucleus of an atom.
Radiation	Energy moving through space as waves or particles.
Radioactivity	The spontaneous disintegration of the nucleus of an atom.

Reserve Generating Capacity

The extra generating capacity required on any power system over and above the expected peak load. Such a reserve is required mainly for two reasons: (i) in case of an unexpected breakdown of generating equipment; (ii) in case the actual peak load is higher than forecast.

Reserve Sharing

Utilities maintain a generation capacity reserve or margin to allow for unusual peak demands, equipment failures and regular maintenance. Interconnected utilities can share this reserve capacity, thereby allowing the deferral or displacement of generation additions on either or both systems. Reserve sharing also provides the mutual benefits associated with service reliability, conservation of natural resources and capital, and economy of operation.

Seasonal Diversity Exchange

An arrangement that allows a summer peaking utility (for example, Basin Electric in North Dakota) to draw capacity and energy from a winter peaking utility (for example, SaskPower) in the summer period. The winter peaking utility then draws it back in the winter. This arrangement results in lower capacity requirements for both utilities.

SO_x

Sulphur oxides; a precursor to sulphates and acidic depositions formed when fuel (oil or coal) containing sulphur is combusted.

TCF

Trillion cubic feet.

Thermal Generating Station

An electric generating station where the turbine is driven by gases or steam produced by burning fuels (such as coal, oil, gas, wood or refuse) or by nuclear processes.

Thorium (Th)

A heavy slightly radioactive metallic element with an atomic number 90 whose naturally occurring isotope Th-232 is fertile and the source, when irradiated in a reactor, of U-233.

Transmission Line

A line used for the transmission of electric power at high voltage. Transmission lines may be constructed overhead, underwater or underground. Lines of voltage less than 115 kilovolts are usually considered to be sub-transmission or distribution.

Transmission System — Lines, transformers, switches, etc. used to transport electricity in bulk from sources of supply to other principal parts of the system. Transmission is generally at voltages of 115 kilovolts and above.

Tritium — A radioactive isotope of hydrogen which is a byproduct of the operation of a CANDU reactor: it builds up in heavy water.

Uranium — A radioactive element with atomic number 92, which is used as fuel in nuclear power production.

Wind Farm — A group of wind turbines used to harvest wind energy for electrical generation.

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Appendix 1

Terms of Reference

Press Release Announcing Panel

SaskPower Media Release Announcing Panel

Terms of Reference

The following are the Terms of Reference for the Energy Options Panel:

An independent panel of knowledgeable individuals, appointed by SaskPower but representing diverse perspectives with respect to electrical energy related issues, shall:

a) Review SaskPower's background document, "Our Future Generation," and any other documents the panel considers relevant to understanding how Saskatchewan's future demand for electricity might develop and the alternative means by which that demand could be altered or met as the province moves into the 21st century;

b) Use whatever means it considers appropriate to make the information contained in those documents readily available to the people of Saskatchewan to increase their awareness and understanding of how the future demand for electricity might develop and the alternative means by which that demand could be altered or met;

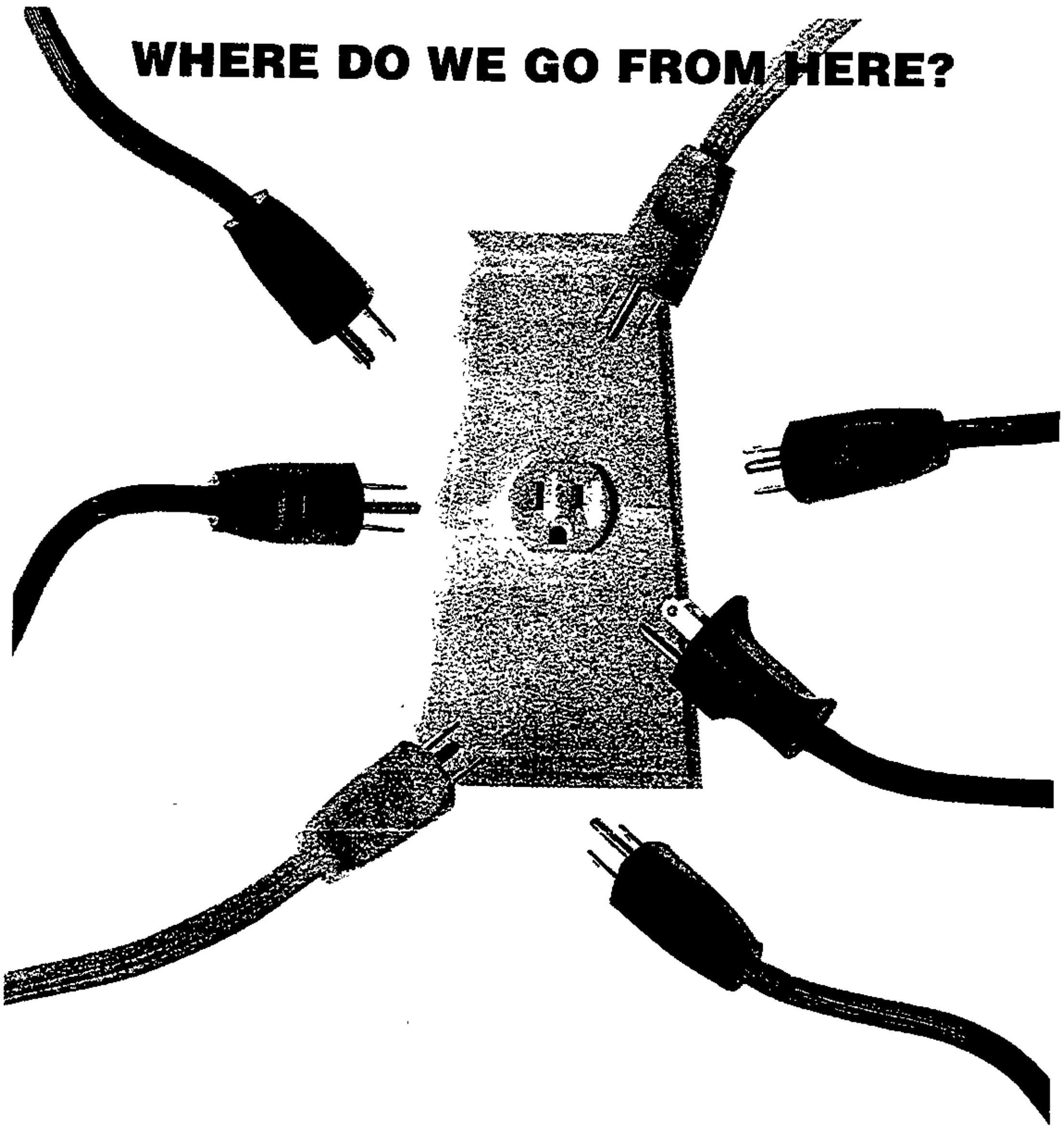
c) Obtain, through an open public process, beginning in late November, 1990, the views of people, throughout Saskatchewan on any matter related to the province's future demand for electricity or the alternative means by which that demand could be altered or met;

d) Arrange for the proceedings of that public process to be recorded and transcribed;

e) Use information obtained from its review of relevant documents and from public discussion to evaluate how Saskatchewan's future demand for electricity might develop and each of the alternative means whereby demand could be altered or met, in terms of their likely short- and longterm environmental, social, and economic implications; and

f) Prepare and forward to SaskPower and its customers, a report summarizing the panel's findings with respect to how the province's future demand for electricity might develop and the opportunities for, and limitations to, each of the alternative means whereby the demand could be altered or met, without making specific recommendations as to alternative (s) that should be pursued. The information presented in this report should provide SaskPower and Saskatchewan's electricity customers with the basis to manage and plan for the province's future electricity needs in a manner that is both responsible and consistent with the view of the people of Saskatchewan.

WHERE DO WE GO FROM HERE?



Planning for Power.

Ensuring that Saskatchewan people have adequate, reliable and economical sources of electricity is a never-ending process. That process is SaskPower's primary responsibility.

SaskPower currently operates 14 power stations to serve the province's needs for electricity. But those needs are increasing. And power stations, like everything else, have a limited lifespan.

We're always looking ahead, evaluating all possible alternatives to meet Saskatchewan's future needs for electricity. And you have an important role to play in this process.

Facing the Facts.

Few people realize just how difficult it is to make sure electricity is available whenever any of SaskPower's over 400,000 commercial, industrial or residential customers need it.

Did you know that .

- a typical resident of Saskatchewan uses three times as much electricity as one in Japan or the USSR? And 40 times the per capita consumption in China?
- electricity can not be generated in advance and stored for later use?
- coal-fired plants have a useful life of 30 years?
- it takes 10 years or more to plan and construct a major power station?

Considering the options.

There are many ways of generating electricity. In Saskatchewan we presently depend primarily on two sources – thermal (burning coal) and hydro (water generated). But that may change in the future. Other options such as wind, solar, biomass, nuclear and natural gas must also be considered. Energy conservation is another option – by using electricity more wisely and efficiently we may be able to delay the need for additional facilities.

The challenges of providing electricity are many. All options must be evaluated in terms of their environmental impact and costs to consumers. Yet, people still expect to have electricity when they need it.

You're part of the process.

SaskPower is opening its planning process to the public. An independent panel will hold meetings throughout the province during which everyone, including private individuals, businesses and interest groups will have the opportunity to present views on how Saskatchewan's future electricity needs can best be managed and met.

SaskPower has prepared a publication – "OUR FUTURE GENERATION – Electricity for Tomorrow" – to provide background on the issue and the options. It's available free, simply by returning the coupon below or calling toll-free 1-800-667-3574, ext. 20, or in Regina, 569-8424, ext. 20

SaskPower

Please send me a copy of "OUR FUTURE GENERATION – Electricity for Tomorrow"

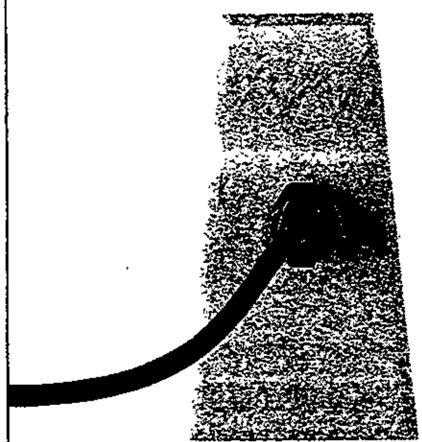
Name ____________________

Address ____________________

Phone Number ____________________

Mail to: Our Future Generation
SaskPower
12th Floor SE
2025 Victoria Avenue
Regina, Saskatchewan S4P 0S1

Seeking Public Input for Saskatchewan's Electricity Options



" . . . we will not abandon our traditional responsibility to supply reliable electricity at affordable prices. At the same time, we will maintain our strong commitment to protect the environment. We are looking at all options which will help us meet your electricity needs in the future. We invite you to consider these options and voice your opinions . . . "

— ***George D. Hill, QC***
President and Chief Executive Officer
SaskPower

Ever since electricity first became available, people have used it in increasing amounts. SaskPower has always managed to provide enough electricity to meet growing demands. But current predictions show that demand will surpass supply by the mid 1990s.

We will soon be seeking public input on our options for generating electricity in the future. Options include thermal, hydro, nuclear, solar and wind power and also conservation. The Electrical Energy Options Review Panel will hold public meetings in a number of Saskatchewan communities to discuss this vital issue.

The publication, OUR FUTURE GENERATION, Electricity For Tomorrow, a background on the issue & options, is available by calling toll free 1-800-667-3574 ext 20 or in Regina call 569-8424 ext 20.

The independent panel consists of these five members:

Dr. Roy Billinton
Chairman

Dr. Roy Billinton is Associate Dean of Graduate Studies, Research and Extension at the University of Saskatchewan's College of Engineering. He is former head of the Electrical Engineering Department at the university. Previously he was employed in the System Planning Department of Manitoba Hydro Dr Billinton is affiliated with a number of professional organizations relating to the field of electrical engineering. He has served as a consultant to many electrical and gas utilities including Hydro Quebec, Ontario Hydro, Manitoba Hydro, Alberta Power Commission, B C. Hydro, Canadian Electrical Association, Ontario Energy Board and the California Energy Commission.

Ann Coxworth

Ann Coxworth is Program Coordinator for the Saskatchewan Environmental Society. With a Master's degree from the University of California, her past work experience includes both research in nuclear chemistry and adult community education. She is a board member of the Saskatchewan Environmental Society and a member of the steering committee and management committee for the Canadian Environmental Network.

Chief Roland Crowe

Roland Crowe is presently Chief of the Federation of Saskatchewan Indian Nations. A farmer on the Piapot Reserve, his public involvement began in 1972 as a Councillor for the Piapot Band. He was elected Chief of the band in 1978 and was subsequently elected to the executive of the FSIN. He is presently serving his second term as Chief of the federation.

Russ Pratt

Russ Pratt is a Coordinator with the Energy and Chemical Workers Union and was one of the founding members of the ECW in 1980 He is currently president of the Canadian Council on Working Life He has also been Vice-President of the Saskatchewan New Democratic Party for the last five years. In 1983, he was selected as a member of the Governor General's Study Conference, and two years later was appointed to the SaskPower's Asbestos Review Committee.

Vicki Dutton

Vicki Dutton is involved in the operation of a farm, a commercial seed cleaning and processing plant and a nursery. She graduated from the University of Guelph with a Certificate in Horticulture, specializing in Landscape Design and Planning. She is involved in a number of organizations including the Saskatchewan Agricultural Implement Board and the Saskatchewan Wheat Pool.

For more information contact the panel by phoning 566-3501 (Regina).

SaskPower

SaskPower — Energy Options Campaign

Ad #1
- Introductory Ad (Where Do We Go From Here?)
- 4 Sask Dailies - October 6 & 20
- 9 City Weeklies - w/o October 15
- Remaining Sask Weeklies - w/o October 8 & 22
- Western Producer - October 11 & 25

Radio
- Where Do We Go From Here?
- 30 second radio spot
- selected northern stations - October 15 - 26
- selected stations - October 23 - 27
- October 29 - November 2
- Missinipe Broadcasting - October 15 - 26 (transmitted in Cree & Dene)

Ad #2
- Announcement of Energy Options Panel
- 4 Sask Dailies - November 30
- Wed - Fri Weeklies - w/o November 26
- Mon - Tues Weeklies - w/o December 3

Once the panel was announced, this was the last of SaskPower's involvement. From this point on, all ads carried the Energy Options panel logo.

For Immediate Release
27 November 1990

ELECTRICAL ENERGY OPTIONS REVIEW PANEL ANNOUNCED

SaskPower's senior vice-president of operations, Bob Lawrence, today introduced the five members of the Electrical Energy Options Review Panel.

"Finding out what Saskatchewan people feel about our future electricity sources will be an extremely important contribution to our planning process", sald Mr. Lawrence. "The five panel members are respected members of their organizations or communities. And we credit them for taking on this vital role, to help SaskPower meet the electrical needs of our province for many years to come."

The panel includes:

Dr. Roy Billinton (panel chairman), Associate Dean of Graduate Studies, College of Engineerlng, University of Saskatchewan, Saskatoon, Sask.

Ann Coxworth, program coordinator, Saskatchewan Environmental Society, Saskatoon, Sask.

Roland Crowe, Chief of Federation of Saskatchewan Indian Nations and farmer, Piapot Reserve.

Vicki Dutton, farmer and commercial seed cleaner, horticultural consultant, Paynton, Sask.

Russ Pratt, coordinator, Energy and Chemical Workers Union, and President, Canadian Council on Working life, Saskatoon, Sask.

Mr. Lawrence says public response has been enthusiastic since the release of 'Our Future Generation ... Electricity for Tomorrow'. The 30-page publication outlines how electricity is generated in Saskatchewan and lists the options available for meeting future demand.

"Publicatlon of the document and the upcoming review by the panel will accomplish two things: first to help all of us as consumers understand the options we have available to produce and save electricity; and secondly, to provide SaskPower with informed public opinion regarding future electrical needs in Saskatchewan and the alternative ways those needs might be met or altered."

Based on present forecasts, SaskPower predicts that demand for electricity will outstrip supply in the mid-1990s. To ensure that doesnt happen, planning decisions must be made soon. Members of the public and interest groups will be invited to submit briefs and make comments at open house meetings to be held in various communities throughout the province. Locations will be announced in local Media.

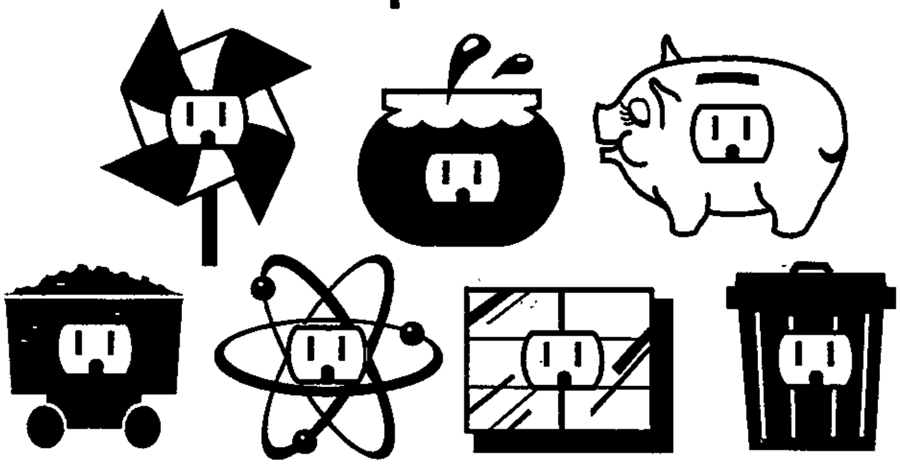
Appendix 2

Newspaper Ads

Notice of Meeting

Radio Announcements

Public meetings to discuss Saskatchewan's electrical energy options.



The Electrical Energy Options Review Panel is holding a series of meetings to discuss alternatives for meeting Saskatchewan's electrical energy needs. Public opinion is encouraged in the discussion of this vital issue.

Schedule of Upcoming Meetings

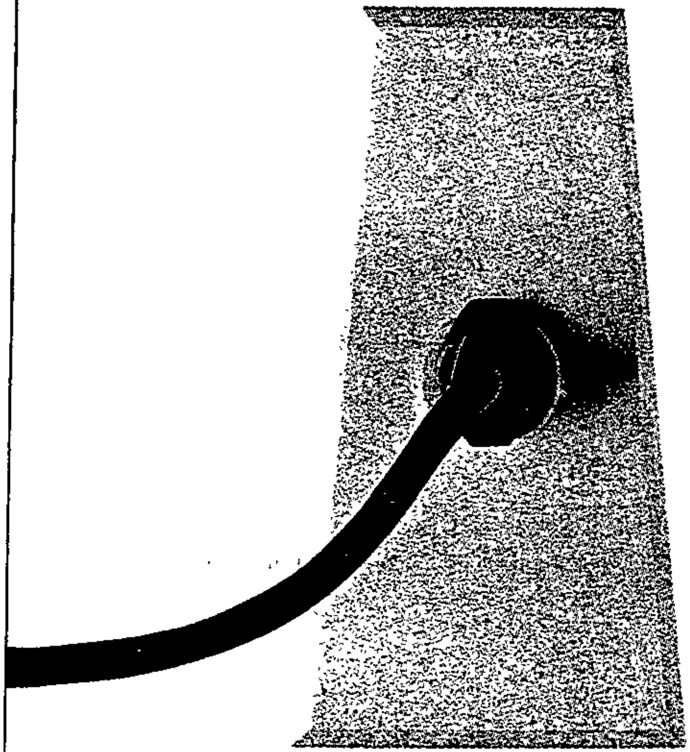
Wednesday, February 13	Kindersley	Tuesday, April 9	Moose Jaw
Friday, March 1	Lloydminster	Wednesday, April 10	Assiniboia
Saturday, March 2	Meadow Lake	Thursday, April 11	Shaunavon
Friday, March 8	Nipawin	Friday, April 12	Maple Creek
Saturday, March 9	Prince Albert	Saturday, April 13	Swift Current
Saturday March 16	North Battleford	Wednesday, April 24	Weyburn
Thursday, March 21	Saskatoon	Thursday, April 25	Estevan
Friday, March 22	Saskatoon	Friday, April 26	Esterhazy
Saturday, March 23	Saskatoon	Saturday, April 27	Wynyard

Time and locations for each meeting will be announced in local media.

A schedule of meetings for northern Saskatchewan will be announced at a later date.

For more information phone 566-3501 (collect).

Electrical Energy Options Review Panel



Notice of public meeting to discuss Saskatchewan's electrical energy options.

The Electrical Energy Options Review Panel is holding a series of meetings to discuss alternatives for meeting Saskatchewan's electrical energy needs. Public opinion is encouraged in the discussion of this vital issue.

A meeting will be held:

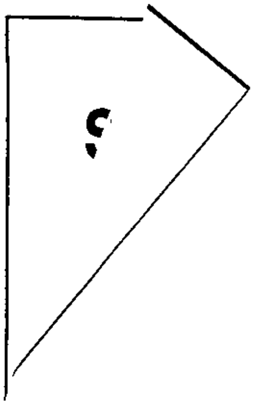
Location **Moose Jaw Heritage Inn, Moose Jaw**

Date **April 9**

Time **1:30 p.m. to 10 p.m.**

For more information phone 566-3501 (collect)

Electrical Energy Options
Review Panel



Notice of Meeting

ıe next independent

.ai Energy Options panel meeting

will be held in

Shaunavon
at the Shawnee Hall
Thursday, April 11, from 1:30 am to 10 pm.

-nergy Options Panel was convened by SaskPower to obtain, through open .gs, the input of Saskatchewan people on matters related to the future demand .ty. Alternative means whereby demand can be changed or met will also be d.

dividuals, organizations, or industries concerned about the future of electrical generation Saskatchewan are invited to attend and share their opinions with the panel.

For more information on the meeting and how you can make a presentation, contact the panel office at 566-3501 (collect).

Special Information

ANNOR: Do you know that electricity can't be generated in advance and stored for later use... it has to be there when you need it... and because it takes 10 years or more to plan and construct a major power station, SaskPower is always looking ahead... the question is, where do we go from here?... we're now asking for public input to find the best answer... an independent panel will hold meetings throughout the province... discussing all options for the future... for information see the ad in your newspaper or contact your nearest SaskPower office.

Appendix 3

Schedule of Public Meeting

Dates and Locations

Schedule of Public Meeting Dates and Locations
January - June, 1991

Dates	Location
Wednesday, January 23	Regina
Thursday, January 24	Regina
Wednesday, January 30	Yorkton
Wednesday, February 13	Kindersley
Friday, March 1	Lloydminster
Saturday, March 2	Meadow Lake
Friday, March 8	Nipawin
Saturday, March 9	Prince Albert
Saturday, March 16	North Battleford
Thursday, March 21	Saskatoon
Friday, March 22	Saskatoon
Saturday, March 23	Saskatoon
Tuesday, April 9	Moose Jaw
Wednesday, April 10	Assiniboia
Thursday, April 11	Shaunavon
Friday, April 12	Maple Creek
Saturday, April 13	Swift Current
Wednesday, April 24	Weyburn
Thursday, April 25	Estevan
Friday, April 26	Esterhazy
Saturday, April 27	Wynyard
Monday, June 17	Buffalo Narrows
Tuesday, June 18	Stony Rapids
Wednesday, June 19	Wollaston Lake
Thursday, June 20	Sandy Bay
Friday, June 21	La Ronge

Appendix 4

Series of Information Ads

Media Coverage of Ads

#1 in a series of reports on electrical energy options.

Is the answer blowin' in the wind?

How often have you heard that asked of Saskatchewan's energy alternatives? If only we could harness the power of the winds.

It's one of a number of alternatives that must be considered to meet Saskatchewan's future needs for electricity. There are also sources such as nuclear, solar, hydro, coal, biomass and energy conservation.

Wind power is presently being used to some extent in Saskatchewan, most notably to generate electricity to pump water for livestock in areas where it is uneconomical to access power lines.

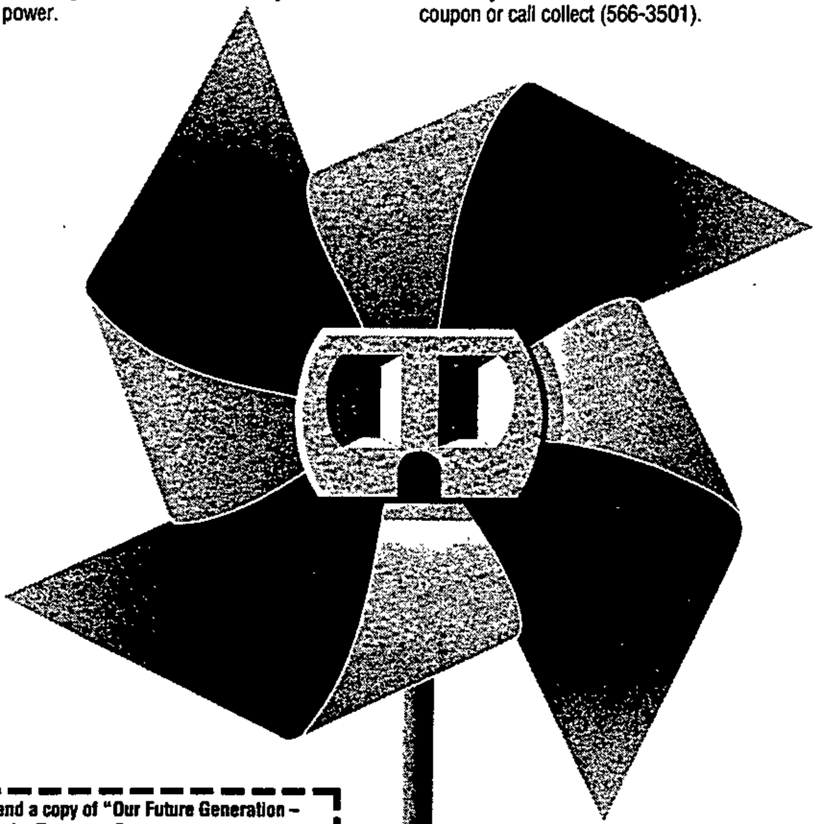
Though some areas of Saskatchewan have plenty of wind, you can't predict when it will occur. Nor has the technology yet been developed to make it economically feasible to meet large demands for electricity from wind power.

What happens when the winds aren't blowing? Electricity cannot be stored in quantities to meet major demands. It has to be generated as it is needed. So wind would be most suitable as part of a flexible system with other generating resources.

However, there are advantages to wind power. One of the most significant being that it is environmentally friendly, producing no waste products.

Many look to other areas of the world – such as California – where "wind farms" are used to generate electricity. But, you'll find that the technology may not be directly transferable to our colder climate.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow." Just return the coupon or call collect (566-3501).



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name --

Address --

City/Town --

Postal Code --

Phone # --

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

#2 in a series of reports on electrical energy options.

The power of the sun.

Saskatchewan's abundance of bright, sunny days is more than just a cheerful part of life. It also represents an opportunity to harness the sun's rays to produce electrical energy.

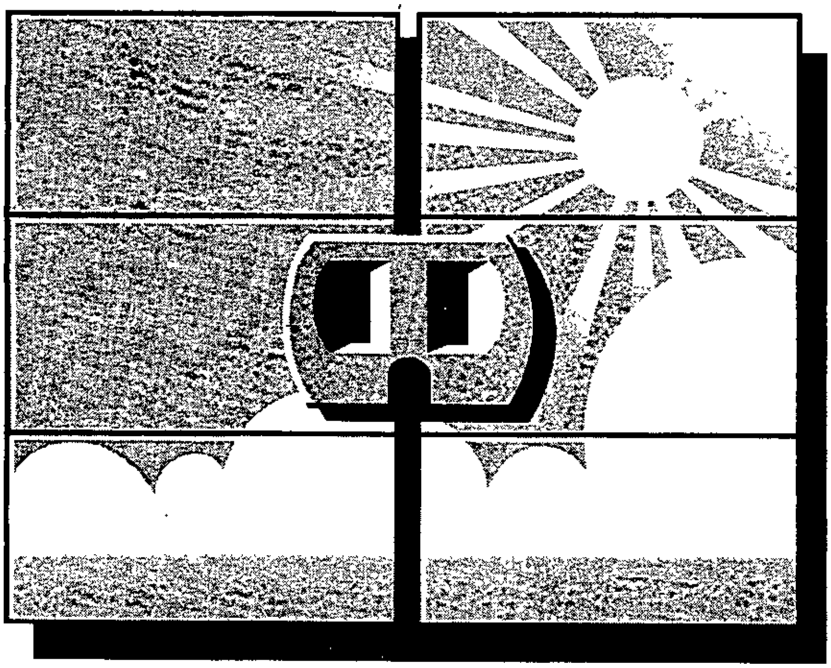
Solar energy is one of a number of alternatives that must be considered in meeting Saskatchewan's future needs for electricity. There are also sources such as nuclear, wind, hydro, coal, biomass and energy conservation.

The energy from the sun can be captured and converted to electricity in two different ways. The solar thermal method uses the heat to create steam which is used in a conventional system to generate electricity. Technology is available for plants which would each be capable of serving between 2,000 and 16,000 homes.

Solar panels (photovoltaic cells) convert solar radiation directly into electricity. A number of experimental plants are operating in the United States with peak outputs which would each meet the electrical needs of 100 average households.

Solar-powered generators are easy on the environment because they do not create any waste products. And it's an economical option in the sense that sunshine is free. However, it's availability is also limited by darkness and clouds. In winter, when energy use is highest, the sun provides about half the solar energy available during summer.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow". Just return the coupon or call collect – 566-3501.



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name ....

Address ....

City/Town ....

Postal Code ....

Phone # ....

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

#3 in a series of reports on electrical energy options.

Conservation is as good as energy in the bank.

The less electricity we use, the less electricity will have to be generated. By practicing demand side management, another term for energy conservation, we can reduce the need to develop new power stations.

Conservation is one of a number of alternatives that must be considered to meet Saskatchewan's future needs for electricity. Other options include nuclear, solar, hydro, coal, biomass and wind.

During the past ten years, various initiatives have resulted in a reduction of potential demand growth. Ongoing efforts could further that pattern, but it takes co-operation from everyone – homeowners, agricultural producers, business, industry and government.

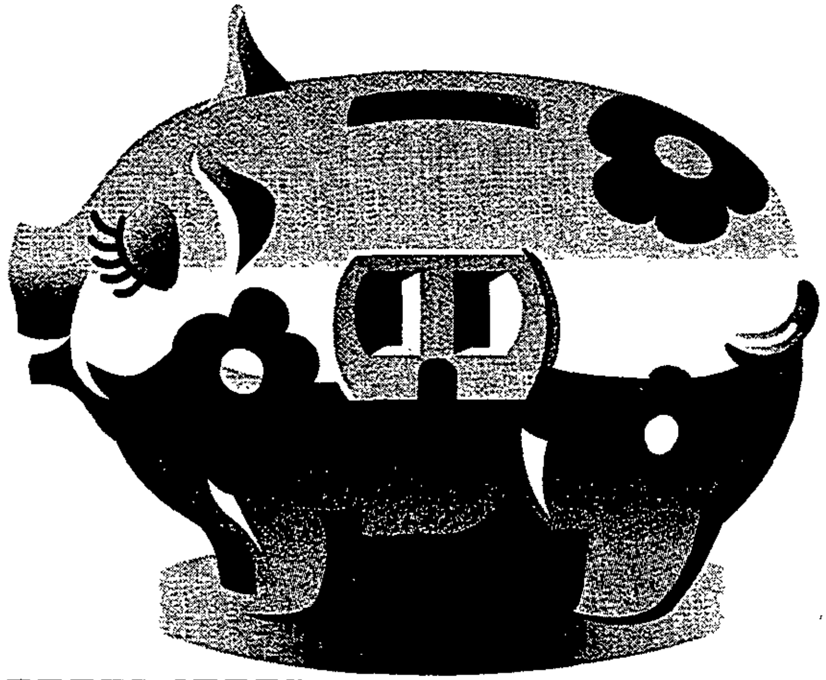
Special rate structures are available to some industrial customers to encourage them to use less electricity during peak periods. The installation of energy-efficient lighting for everything from city street lights to farm yards can also make a difference.

As natural gas becomes available to more and more customers across Saskatchewan, conversion to natural gas for space heating also helps reduce electrical demands.

Consumer information is available from SaskPower, and many other sources, on how each of us can make our homes more energy-efficient. SaskPower also has staff available to visit industrial and large commercial users and conduct energy audits with recommendations for cost-effective measures.

Energy conservation may never reduce demand to the extent where development of new generating facilities is not necessary. But it can make a difference in extending the life of existing resources.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow". Just return the coupon or call collect – 566-3501.



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name ....

Address ....

City/Town ....

Postal Code ....

Phone # ....

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

#4 in a series of reports on electrical energy options.

An idea that holds water?

Hydroelectricity has been a viable means of generating power for many years.

It's one of a number of alternatives that must be considered to meet Saskatchewan's future needs for electricity. Other options include nuclear, solar, coal, biomass, wind and energy conservation.

Potential still exists for development of hydroelectric power in Saskatchewan. Two-thirds of this potential is on the Saskatchewan River system, and the rest is on the Churchill River and the Lake Athabasca drainage area.

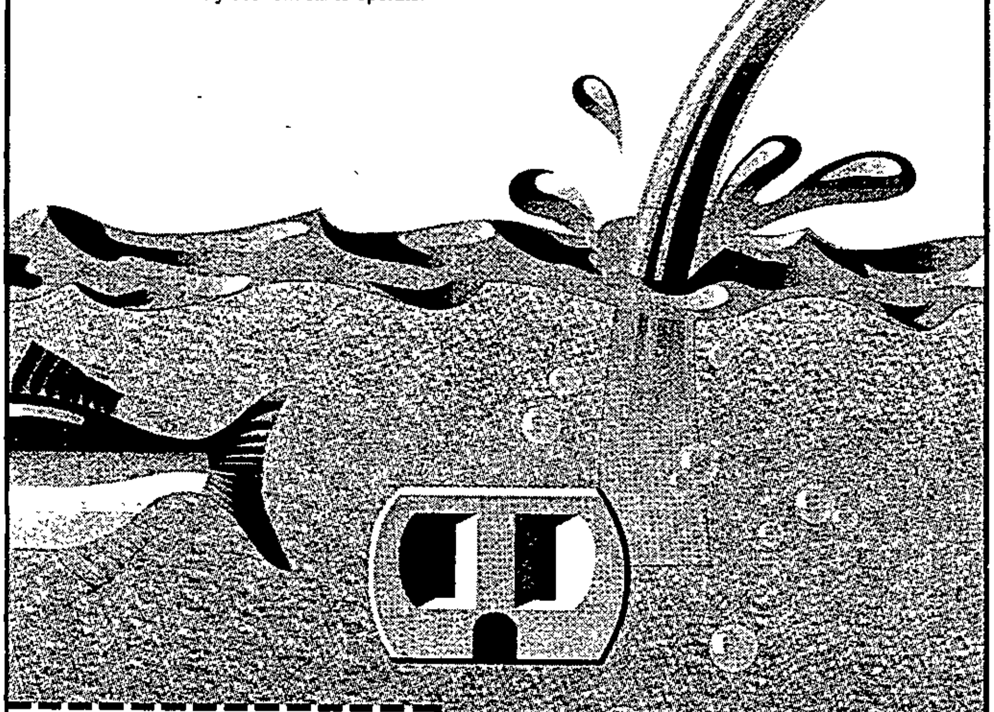
The potential for small hydro stations is primarily limited to northern Saskatchewan. Water flows on streams in the south vary too much from season to season and year to year to operate hydro plants reliably.

Hydro stations are more expensive to build than either coal-fired or natural gas plants, but are relatively economical to operate.

Hydroelectric energy uses a renewable resource but supply can be dependent on weather.

One consideration is the affect that the construction of a reservoir has on the environment. It may cover farmland or alter wildlife and fish habitat. But it may also provide water for irrigation, recreation and new habitat. In addition, downstream communities may be protected from flooding during high river flows.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow". Just return the coupon or call collect – 566-3501.



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name ....

Address ....

City/Town ....

Postal Code ....

Phone # ....

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

#5 in a series of reports on electrical energy options.

What's the nuclear reaction?

Half of Canada's supply of uranium is located in Saskatchewan. But the province has yet to develop it for the purpose of its own nuclear power.

It's one of a number of alternatives that must be considered to meet Saskatchewan's future needs for electricity. Other options include solar, hydro, coal, biomass, wind and energy conservation.

Canadian nuclear technology has been in use for 33 years in six countries around the world. Nearly half of Ontario's electricity is produced by nuclear power plants. And they're also in place in Quebec and New Brunswick.

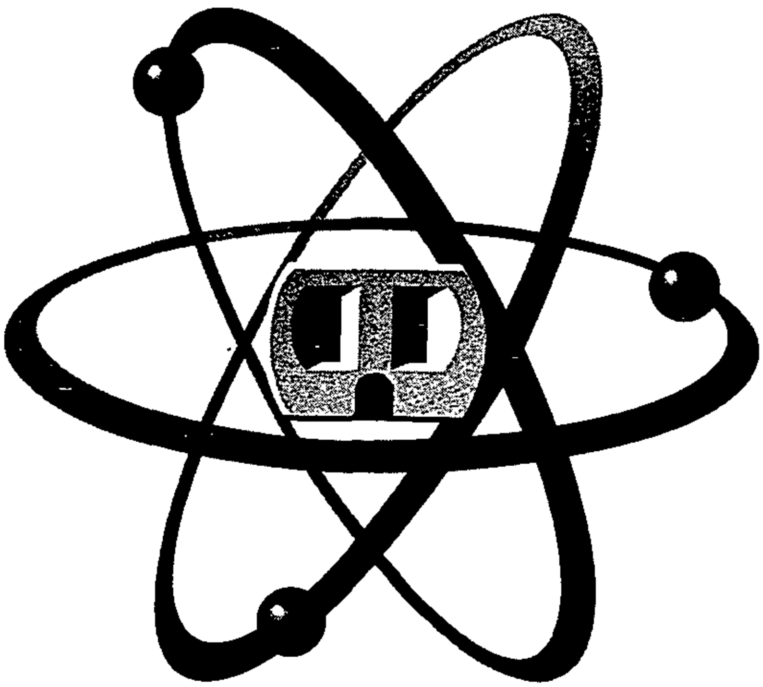
In Saskatchewan the main barrier to development has been low public acceptance, due to concerns over health effects, safety and long-term waste management.

Nuclear power development in Canada is strictly regulated to reduce risks to employees and the public. Several back-up systems are required to reduce the risks of mechanical failure or human error.

Recent research suggests that nuclear waste can be safely stored in specially designed containers buried deep in the Canadian Shield. However, environmental assessments are still in progress.

A major capital investment in a nuclear power station is required, but the operating costs are relatively low. There may also be substantial costs involved in retiring a nuclear plant.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow." Just return the coupon or call collect 566-3501.



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name ....

Address ....

City/Town ....

Postal Code ....

Phone # ....

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

#6 in a series of reports on electrical energy options.

Garbage in...energy out.

Actually, garbage can have a role to play in generating electricity. Biomass involves the burning of materials such as wood, peat, and even some municipal garbage, to produce power. The gas from decomposing garbage in landfill sites can also be used to produce electricity.

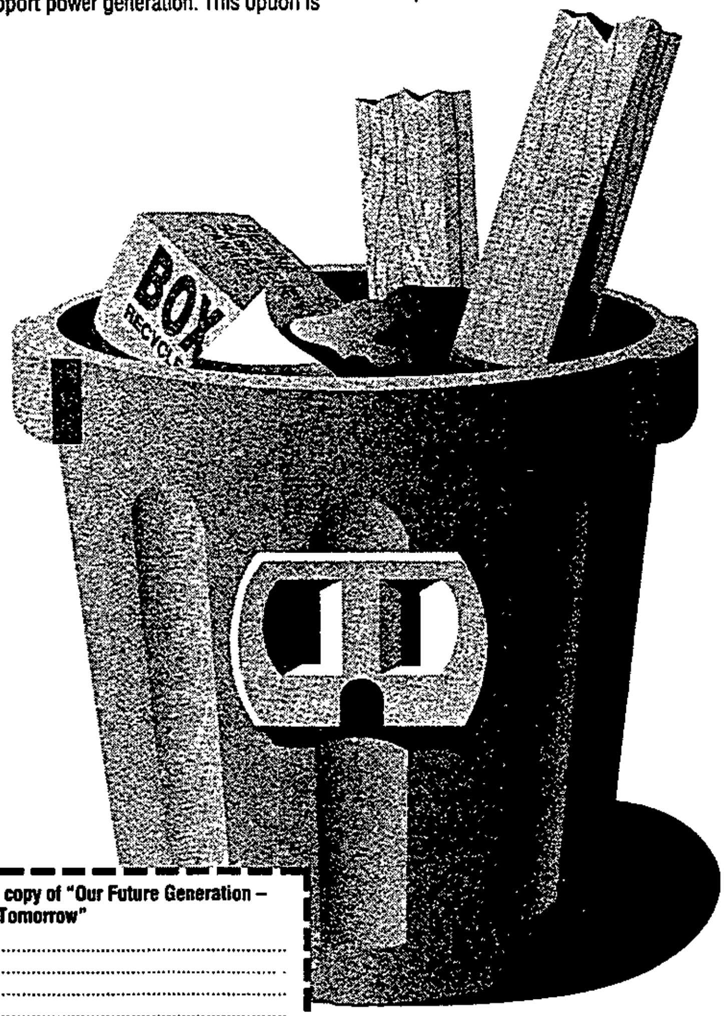
It's one of a number of alternatives that must be considered to meet Saskatchewan's future needs for electricity. Other options include nuclear, solar, hydro, coal, wind and energy conservation.

Peat is one of the early stages in the formation of coal. Several areas across central Saskatchewan have sufficient supplies to support power generation. This option is presently in use in Finland, Ireland and the Soviet Union, but the environmental impact in Saskatchewan is yet to be determined.

There are also several places in the world which burn garbage in large incinerators to produce power. Environmental concerns relating to toxic emissions and ash must be examined.

The cost of producing electricity through biomass varies greatly, depending primarily on the cost of the fuel.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow." Just return the coupon or call collect 566-3501.



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name ....

Address ....

City/Town ....

Postal Code ....

Phone # ....

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

#7 in a series of reports on electrical energy options.

In search of answers to some burning questions.

A number of varieties of fossil fuels can be burned to generate electricity. With Saskatchewan being the third largest producer of coal in Canada, it plays a major role in the province's energy resources.

Coal is one of a number of alternatives that must be considered to meet our future needs for electricity. Other options include nuclear, solar, hydro, biomass, wind and energy conservation.

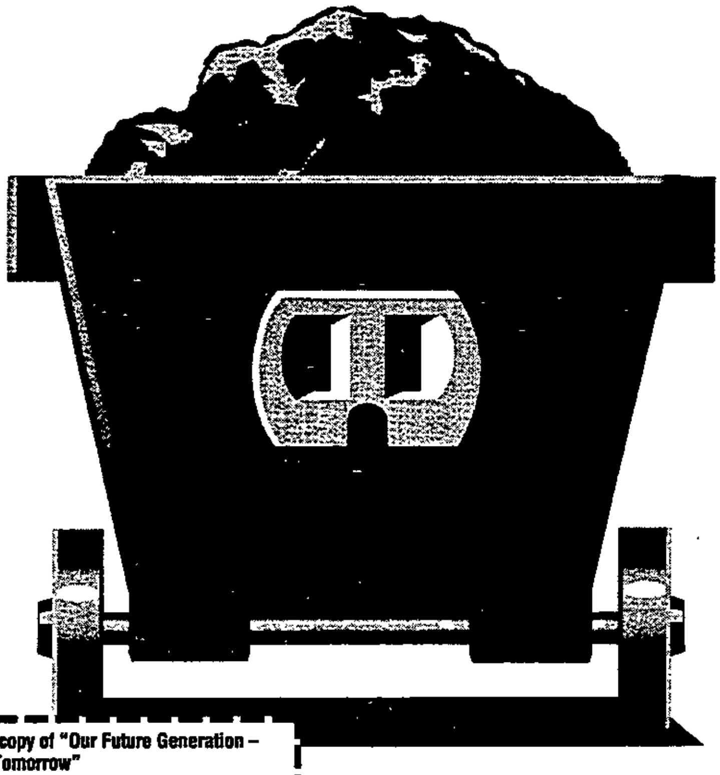
At the present rate of consumption, Saskatchewan has enough coal to generate electricity for at least 200 years. This lignite coal has a low sulphur content but there are still concerns related to CO_2 emissions. In addition to the by-products of burning coal, we must also consider the environmental impacts of mining and transportation.

The coal and electric power industries are now examining the feasibility of "clean-coal technology" which can be used to burn ordinary coal cleanly and more efficiently.

The process converts coal to gas, which burns relatively cleanly in a combustion turbine. The surplus heat is recovered in a boiler to make steam to produce more electricity. This could improve efficiency by up to 30% over conventional steam generation.

This method is expected to be more costly, using between 10 and 12% of the power generated for internal operations. The conventional coal-fired uses about 7%. However, the environmental benefits may justify the cost.

For information on all the options, read the publication "Our Future Generation – Electricity for Tomorrow." Just return the coupon or call collect 566-3501.



Please send a copy of "Our Future Generation – Electricity for Tomorrow"

Name ....

Address ....

City/Town ....

Postal Code ....

Phone # ....

Mail to: Electrical Energy Options Review Panel
2025 Victoria Ave.
Regina, Saskatchewan S4P 0S1

Electrical Energy Options
Review Panel

Energy Options Review Panel — Advertising

Ad #1
- Wind Power
- 4 Sask Dailies - January 16
- All Sask Weeklies - w/o January 14

Ad #2
- Solar Power
- 4 Sask Dailies - January 23
- All Sask Weeklies - w/o January 21

Ad #3
- Conservation (Demand Side Management)
- 4 Sask Dailies - January 30
- All Sask Weeklies - w/o January 28

Ad #4
- Hydro Power
- 4 Sask Dailies - February 6
- All Sask Weeklies - w/o February 4

Ad #5
- Nuclear Power
- 4 Sask Dailies - February 13
- All Sask Weeklies - w/o February 11

Ad #6
- Biomass Power
- 4 Sask Dailies - February 20
- All Sask Weeklies - w/o February 18

Ad #7
- Coal Power
- 4 Sask Dailies - February 27
- All Sask Weeklies - w/o February 25

Notice of Public Meeting Ads
- newspaper ads were placed in local papers two consecutive weeks prior to the meeting as well as radio announcements three to four days prior.

Public Meeting Schedule Ad
- 4 Sask Dailies - February 13
- All Sk Weeklies - w/o February 11
- 1 insertion in New Breed Magazine

Assiniboia Times
Assiniboia Today
Balcarres Local Exchange
Battleford Telegraph
Bengough Bulletin
Bengough Cross Country Connection
Biggar Independent
Birch Hills Gazette
Broadview Express
Canora Courier
Kamsack Times
Norquay North Star
Preecevile Progress
Carlyle Observer
Balgonie The City's Edge
Coteau Review
Craik Weekly News
Creighton Goldbelt Gazette
Cut Knife Courier
Davidson Leader
MT Publishing Co. Ltd. (Elrose Review)
Esterhazy Journal
Estevan Mercury
MT Publishing Co. Ltd. (Eston Press)
Foam Lake Review
Fort Qu'Appelle Times
Four-Town Journal
Gazette-Post News
Gravelbourg Tribune
Grenfell Sun
Gull Lake Advance
Herbert Herald
Hi-Way 15 Gazette
Hudson Bay Post Review
Humboldt Journal
Indian Head-Wolseley News
Ituna News
Kerrobert Citizen
Kindersley Clarion
Leader News
Kelvington Kronicle
Kinistino Post
Kipling Citizen
Lanigan Advisor
Leader Post
Lemberg Highway 22 Review
Lloydminster Meridian Booster
Lloydminster Weekly Times
Macklin Mirror
Maidstone Mirror
Maple Creek News
Meadow Lake Progress
Melfort Journal
Melvile Advance
Moose Jaw Times Herald
Moose Jaw This Week
Moosomin World-Spectator
North Battleford Advertiser Post
Northerner
Naicam News
North Battleford News Optimist
Nipawin Journal
Last Mountain Times Ltd. (Nokomis Times)
Outlook
Oxbox Herald
Prairie Progress
Prince Albert Herald
Radville Star
Redvers Optimist
The Riverbend Review
Rosetown Eagle
Rosthern Saskatchewan Valley News
Shaunavon Standard
Shellbrook Chronicle
South Sask. This Week
Spiritwod Herald
Star Phoenix
Stoughton Times
Strasbourg Beacon
Southwest Booster
Swift Current Sun
Tisdale Recorder
Triangle News
Unity Northwest Herald
The View From Here
Village Press
Wadena News
Wakaw Recorder
Waterfront Press
Watrous Manitou
Watson Witness
Weyburn Review
Whitewood Herald
Wilkie Press
Wolseley Bulletin
Wynyard Advance
Yorkton Enterprise

Appendix 5

List of Participants

Submitting Written Briefs

List of Participants Submitting Written Briefs

Ms. Crystal Beliveau
individual

Ms. Edith Bell
individual

Big River Economic Development Committee
Mr. Merv Weiss

Mr. Howard Boldt
individual

Mr. John Bury
individual

Ms. Kathy Dill
individual

Ms. Diane Dunlop
individual

Environic Energy Inc.
Mr. Stuart A. Busse

Ms. Velma Foster
individual

Mr. F. J. Fredeen
inidividual

Mr. Peter Hardie
individual

Ms. Nancy Howse
individual

I.B.E.W. Local 2067
Mr. Martin Nowakowski

J. D. Mollard & Associates
Mr. Jack Mollard

Ms. Karen Keuler
individual

Ms. Andrea Kozak
individual

Mr. Ross MacLeod
individual

Minatco Ltd.
Mr. Ken Haapanen

Mr. Murray Petrie
individual

Mr. Gary Rose
individual

Mr. Russ Rudd
individual

Mr. Normand Simard
individual

Mr. George Swerhone
individual

Ms. Lona Takatch
individual

The Canadian Manufacturers'Association

The United Steelworkers of America, Local 9279

University of Saskatchewan
H.R. Salisbury

Appendix 6

List of Individuals/Organizations

Submitting Briefs

List of Individuals/Organizations Submitting Briefs

Presenters	*Location*	*Date (1991)*
American Society of Heating, Refrigeration & Air Conditioning Engineers; Mr. Guy Sanders	Moose Jaw	April 9
Ms. Margret Asmuss individual	Saskatoon	March 22
Association of Consulting Engineers Mr. Ed Hinz	Saskatoon	March 22
Association of Professional Engineers Mr. Trevor Hurie	Moose Jaw	April 9
Atomic Energy Canada Ltd. Mr. David Bock	La Ronge	June 21
Atomic Energy Canada Ltd. Research Dr. Terry Rummery	Saskatoon	March 22
Atomic Energy Canada Ltd. Dr. Stanley Hatcher & Mr. David Bock	Regina	January 23
Atomic Energy Canada Ltd. Dr. Dave Torgerson	Prince Albert	March 9
Ms. Joyce Bahr individual	Meadow Lake	March 2
Mr. Brett Balon individual	Regina	January 24
Ms. Linda Batty/Linda Murphy individual	Saskatoon	March 23
Mayor Louis Bear individual	Sandy Bay	June 20
Beaver Management Ltd. Mr. Brian Grant	North Battleford	March 16
Mr. Ed Benoanie individual	Wollaston Lake	June 19
Big River Citizens for Energy Alternatives; Ms. Carla Braidek	Meadow Lake	March 2
Ms. Sybil Breti individual	Regina	January 24

Presenters	Location	Date (1991)
Mr. Stan Brooks **individual**	Moose Jaw	April 9
Mr. Wilf Buhler **individual**	Saskatoon	March 21
Canadian Petroluem Association **Mr. Gordon Hood, Mr. Brian Tyers,** **Bill Harlan, Mark Drazen**	Weyburn	April 24
Mr. Gene Chovin **individual**	La Ronge	June 21
Cameco Corporation **Dr. Bernard Michel**	Saskatoon	March 23
Canadian Gas Association **Mr. Ian MacNabb & Mr. Gerry Labas**	Moose Jaw	April 9
Canadian Nuclear Association **Mr. John Reid and Mr. Ian Wilson**	Regina	January 23
City of Estevan **Mayor John Empey**	Estevan	April 25
City of Regina **Mr. Bland Brown**	Regina	January 24
City of Regina **Mr. Randy Strelioff**	Regina	January 24
Ms. Barbara Clanchy **individual**	North Battleford	March 16
Coal Association of Canada **Dr. Giacomo Capobianco**	Saskatoon	March 21
Consumers' Assoc. of Sask. **Ms. Margaret Crowle**	Saskatoon	March 22
Dr. Bruce Cooke **individual**	Moose Jaw	April 9
Cumberland House Development Corp. **Mr. Alan Storey-Bishoff**	Nipawin	March 8
Ms. Terry Daniels **individual**	Wollaston Lake	June 19
Ms. Denecheze **individual**	Wollaston Lake	June 19

Presenters	*Location*	*Date (1991)*
Mr. Able Denecheze **individual**	Wollaston Lake	June 19
Delek Energy Ltd. **Mr. Jack Balaban & Mr. Randell Pardy**	Saskatoon	March 21
Mr. Bert Dezlion **invididual**	Wollaston Lake	June 19
D. G. Malcolm & Associates Inc. **Mr. Cliff Skrypnyk**	Saskatoon	March 21
Mr. Elmer Domes **individual**	Assiniboia	April 10
Dove Industries **Mr. Orlando Martens, Mr. Gary Martens & Mr. Jack Cole**	Regina	January 24
Dove Industries **Mr. Orlando Martens, Mr. Gary Martens & Mr. Garnet Schroeder**	Swift Current	April 13
Dr. Robert Dumont **individual**	Saskatoon	March 23
Dutch Industries **Mr. Izaak Cruson**	Regina	January 24
Mr. Andrew Dziadyk **individual**	Saskatoon	March 23
Ecotech Research Ltd. **Mr. Evan Morris**	Regina	January 24
ECI Energy Concepts **Mr. Vic Ellis**	Moose Jaw	April 9
Edmonton Public Schools **Mr. Eckhart Stoyke**	Lloydminster	March 1
Ms. Debbie Eisenhut **individual**	Meadow Lake	March 2
ENFOR **Mr. Albert Moyer & Mr. Jim Rowland**	Meadow Lake	March 2
Estevan Coal Corporation **Mr. Pearce Bowman**	Estevan	April 25
Energy Management Task Force **Mr. Lloyd Rogers**	Regina	January 24

Presenters	*Location*	*Date (1991)*
Estevan Chamber of Commerce Mr. George Sereggela & Mr. William Goodmanson	Estevan	April 25
Mr. Michael Fitzsimmons individual	Prince Albert	March 9
Dr. Peter Flood individual	North Battleford	March 16
Mr. Otto Fonau individual	Wynyard	April 27
Ms. Maria Fortugno individual	Saskatoon	March 21
Gaia Group Mr. Jim Elliott	Regina	January 23
Ms. Isabelle George individual	Regina	January 23
Mr. Abe Goertzen individual	Meadow Lake	March 2
Mr. Dave Greenfield individual	Saskatoon	March 21
Mr. Bob Guthrie individual	Regina	January 23
Dr. Leon E. Hannotte individual	Saskatoon	March 21
Mr. David Harman individual	Meadow Lake	March 2
Hatchet Lake Band Mr. Emil Hanson	Wollaston Lake	June 19
Hudson Bay Rural Development Committee; Ms. Vie Haugerud	Nipawin	March 8
Mr. David Hiebert individual	Saskatoon	March 21
Mr. Rob Howse individual	Wynyard	April 27
Northern Village of Ile a la Crosse Mayor Buckley Belanger	Buffalo Narrows	June 17

Presenters	Location	Date (1991)
IMC Canada Mr. Glenn Nicol	Esterhazy	April 26
Inland Cement Ltd. Mr. Jim Brown	Esterhazy	April 26
International Uranium Congress Mr. Jim Harding	Regina	January 24
IPSCO Mr. John Comrie	Saskatoon	March 22
Mr. Phil Joise individual	Wollaston Lake	June 19
Vic Juba and Bob Burrows individual	Lloydminster	March 1
Keewatin Communications Mr. Darren McKee	Shaunavon	April 11
Sat Katar Singh Khalsa individual	Saskatoon	March 23
Mr. Jamie Kneen individual	Wollaston Lake	June 19
Mr. Bob MacLeod individual	Saskatoon	March 22
Mennonite Central Committee Ms. Sheilagh Henry	Saskatoon	March 22
Mr. Owen Mickleborough individual	Assiniboia	April 10
Milestone School Mr. Adrian Nicholas, Ms. Angela Wilkie, Ms. Stacy Schiefner	Weyburn	April 24
Mr. Barry Mitschke individual	Regina	January 24
Mr. Al Moen individual	North Battleford	March 16
Ms. Shelagh Molloy individual	Regina	January 23
NCB Holdings Inc. Mr. Dennis Young	Meadow Lake	March 2

Presenters	Location	Date (1991)
New Breed Ms. Lorna LaPlante	Regina	January 23
Mr. Robbie Newton individual	Meadow Lake	March 2
Northern Village of Green Lake Mr. Raymond Moskowec	Meadow Lake	March 22
Mr. Liberty Pease individual	Saskatoon	March 23
P.A. Citizens for Energy Options Mr. Steve Lawrence	Prince Albert	March 9
Mr. Dennis Paddock individual	Prince Albert	March 9
Peat Marwick Stevenson Kellogg Mr. Roy Lloyd	La Ronge	June 21
Regina Environment Group Mr. Rick Morrell	Regina	January 24
Mr. John Pederson individual	North Battleford	March 16
Mr. J. V. Penna individual	Saskatoon	March 23
Ms. Marion Penna individual	Saskatoon	March 23
Mr. Jakob Pillibeit individual	Regina	January 24
Prairie Coal Ltd. Mr. John Morgan	Estevan	April 25
Regina Coalition for Peace & Disarmement; Mr. Scott Ware	Regina	January 23
RLW Engineering Mr. Richard Wilde	Saskatoon	March 21
Mr. John Robinson individual	North Battleford	March 16
Mr. Gerald Sarine individual	LLoydminster	March 1

Presenters	*Location*	*Date (1991)*
S.A.R.M. **Mr. Bernard Kirwan, President**	Swift Current	April 13
Saskatchewan Chamber of Commerce **Mr. Jim Yule**	Saskatoon	March 22
Sask. Environmental Society **Mr. Ian Monteith**	Moose Jaw	April 9
Sask. Environmental Society **Mr. Bert Weicher**	La Ronge	June 21
Sask. Homebuilders' Assoc. **Mr. Ken McKinlay**	Regina	January 24
Sask. Natural History Society **Mr. Jim Elliott**	Regina	January 23
Sask. Provincial Building & **Const.Trades Council; Mr. Ed Cowley**	Saskatoon	March 21
Saskatoon Chemicals Ltd. **Mr. Lawrence Hanna**	Saskatoon	March 22
Saskatoon Natural History Society **Mr. Ken Pivnick**	Saskatoon	March21
SaskEnergy Corporation **Mr. Gary Winslow**	Saskatoon	March 22
SaskPower Corporation **Mr. Bob Lawrence, Mr. Tony Harras** **Mr. Bob Walker**	Regina	January 23
SaskWater Corporation **Mr. Dave MacLeod**	Moose Jaw	April 9
Ms. Meg Shatilla **individual**	Prince Albert	March 9
Ms. Maisie Shiell **individual**	Regina	January 23
Mr. Al Shpyth **individual**	Saskatoon	March 21
SIAST - Kelsey Campus **Mr. Bud Burrell**	Wynyard	April 27
SIAST - Kelsey Campus **Mr. Shane Hodgson**	Wynyard	April 27

Presenters	*Location*	*Date (1991)*
SIAST - Kelsey Campus Mr. Tim Smith	Wynyard	April 27
Sierra Club Western Canada - Sask. Group - Mr. Ken Kelln	Regina	January 23
Small Power Producers Association of Alberta; Mr. Orrin Hart	Swift Current	April 13
SNC Inc. Mr. Mike Burns	Yorkton	January 30
Mr. George Spark individual	Wynyard	April 27
Mr. Jim Srayko individual	North Battleford	March 16
Mr. Frank Sudol individual	Prince Albert	March 9
Mr. George Symons individual	Estevan	April 25
Mr. Al Taylor individual	Regina	January 24
Mr. Bill Thompson individual	Regina	January 23
Mr. Paul Tidey individual	Regina	January 23
Mr. Torance Tornquist individual	Sandy Bay	June 20
Town of Coronach Mr. George Quarrie	Assiniboia	April 10
Town of Rosetown Mr. Brian Sim	Kindersley	February 13
Town of Willow Bunch Mayor Eugene Lesperance	Assiniboia	April 10
Mr. & Mrs. Jim Town individual	Prince Albert	March 9
Mr. Jim Trowell individual	Yorkton	January 30

Presenters	*Location*	*Date (1991)*
Mr. Gerald Udal individual	Maple Creek	April 12
Uncle Louie's Catholic Worker Community; Mr. Phillip Penna	Saskatoon	March 21
United Mine Workers #7606 Mr. Roy Ludwig	Estevan	April 25
University of Regina Dr. Lawrence Vigrass	Weyburn	April 24
University of Saskatchewan Dr. Graham Simpson	North Battleford	March 16
Federal Energy Management Task Force; Dr. Michael Stoneham	Saskatoon	March 22
Mr. Art Unsworth individual	Maple Creek	April 12
Mr. Mike Van Vliet individual	Regina	January 24
Mr. David Weir individual	Regina	January 24
Western Project Development Associates; Mr. Ken Dillen	Buffalo Narrows	June 17
Weyerhaeuser Canada Ltd. Mr. Marty O'Brien	Saskatoon	March 21
Mr. Clem Whakefield individual	Lloydminster	March 1
Mr. Marvin Wheale individual	Meadow Lake	March 2
Mr. Bob Woods individual	Buffalo Narrows	June 17
Mr. Dennis Woods individual	Saskatoon	March 23

Appendix 7

Energy Options Update Newsletters

energy options

U • P • D • A • T • E

April 1991

"We need to promote conservation to control our demand for electricity."

Energy Panel Has Mandate to Listen

"We need to promote conservation to control our demand for electricity." "We need to develop nuclear power, more natural gas or wind generated energy."

These are among the suggestions Saskatchewan's Electrical Energy Options Review Panel has heard since its public meetings began in January.

The independent panel is presently holding public meetings across Saskatchewan to gather information from individuals, industry representatives, businesses and special interest groups on how best to meet the province's future demand for electricity and to increase public awareness of today's energy issues.

"Difficult choices are going to have to be made in meeting our electricity needs of the future and it is essential that we hear the views and concerns of the public," says Roy Billinton, panel chairman.

The panel won't make specific recommendations on alternative energy or conservation, rather, it will report its findings to SaskPower and the people of Saskatchewan. "The information will be very important in enabling SaskPower to consider the views of Saskatchewan people when planning for the future," Billinton says.

SaskPower Targets Conservation

Saskatchewan's demand for electricity could exceed the available supply as early as 1994 due to increasing industrial and consumer needs.

That was SaskPower's energy and demand forecast presented on the opening day of the Electrical Energy Options Review Panel. The company says controlling demand for electricity while offering consumers incentives to use energy efficient appliances and equipment is one way to meet the province's electricity needs in the future.

"The continuation of programs like the Saskatchewan Natural Gas Distribution Program and SaskPower's PowerWise program will further reduce the potential power load in rural areas," says Bob Lawrence, SaskPower senior vice-president of Operations.

SaskPower has set a conservation target of 22 billion kilowatt hours of electrical

Energy Options Upcoming Public Meetings

Tuesday, April 9
1:30p.m.-10:00p.m.
Moose Jaw Public Meeting
Moose Jaw Heritage Inn
Jubilee C
1590 Main Street West

Wednesday, April 10
1:30p.m.-10:00p.m.
Assiniboia Public Meeting
Assiniboia Lodge Hotel
Banquet Room
122-3rd Avenue West

Thursday, April 11
1:30p.m.-10:00p.m.
Shaunavon Public Meeting
Shawnee Hall
3rd Avenue East

Friday, April 12
10:00a.m.-6:00p.m.
Maple Creek Public Meeting
Legion Hall, Normandy Room

Saturday, April 13
9:00a.m.-5:00p.m.
Swift Current Public Meeting
Horseshoe Lodge

Wednesday, April 24
1:30p.m.-10:00p.m.
Weyburn Public Meeting
Weyburn Inn, Inland Terminal
Room #5
Government Road North

Thursday, April 25
10:00a.m.-10:00p.m.
Estevan Public Meeting
Beefeater Inn
Taylorton Room
1305-9th Street

Friday, April 26
1:30p.m.-6:00p.m.
Esterhazy Public Meeting
Esterhazy Motor Hotel
Banquet Room

Saturday, April 27
9:00a.m.-5:00p.m.
Wynyard Public Meeting
Legion Hall

Week of June 17
Meetings in Northern Saskatchewan. Actual dates and places to be determined

A wind farm in southwest Saskatchewan could produce energy 65 to 75 per cent of the time.

energy over the next 20 years. That's equal to two years of current electricity sales for the entire province. "This also means that we would be saving two years of non-renewable resources," Lawrence says.

The company plans to reach its conservation target by promoting energy audits, conversion programs for street and farm lights, and rate incentives to large commercial and industrial customers.

Consumers are encouraged to purchase energy-efficient appliances and to use energy wisely in the home. Those in rural areas are encouraged to take advantage of grants and low interest loans for solar or wind-powered livestock watering facilities and ground source heat pumps.

How can demand for electricity exceed supply if Saskatchewan's population continues to decline? When questioned about this by the panel, Dr. Tony Harras, vice-president of Planning at SaskPower, pointed to a large industrial growth rate as the main factor contributing to increased demand for electricity.

"The province's efforts to diversify the economy has created new industrial customers. For example, a fertilizer plant, a heavy oil upgrader and a pulp mill are all currently under construction," says Harras.

SaskPower plans to address these new demands for electricity by looking at ways to upgrade or replace existing power plants and hydro stations that are approaching the end of their useful lives.

"Like most things, these facilities won't last forever," Harras says. "We have to plan for the retirement of these aging facilities, maintain adequate electrical generation reserves and meet the projected growth in demand."

Energy Alternatives to Meet Future Needs

There is clear support for possible new sources of electricity to meet Saskatchewan's future needs.

The province can continue to burn non-renewable fuels such as coal, diesel or natural gas. It can generate electricity by using renewable resources such as biomass, wind power, solar energy or water through hydro plants. It can build nuclear power stations or it can buy electricity from other provinces.

Through the Electrical Energy Options Panel, SaskPower is hearing what industry and the people of Saskatchewan have to say about possible sources of electricity for the future.

Wind: Clean And Environmentally Friendly

Southern Saskatchewan has the resource—strong, consistent and predictable wind—to make wind energy a viable alternative energy source in this province, the Electrical Energy Options Panel was told in Regina.

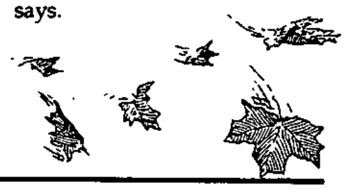
Representatives from two companies interested in developing wind power presented the panel with evidence that, in addition to providing an environmentally safe source of electricity, wind power could contribute to the diversification of Saskatchewan's economy by creating jobs and aid in rural development.

"If wind technology was transferred to Saskatchewan, it could create employment by providing construction and maintenance employment in addition to manufacturing and assembly jobs," Orlando Martins of Dove Industries told the panel.

Wind generated power is clean and inexpensive but supply depends on the weather, so it can be unpredictable. However, Martins says a wind farm in southwest Saskatchewan could produce energy 65 to 75 per cent of the time. That's enough, he says, to make wind power a viable source of supplemental electricity in the province.

When asked by panel chairman Dr. Roy Billinton about the environmental impact of a wind farm, Martins said there could be concerns about land use and aesthetics since each windmill requires about one acre of land.

"Our experience in other countries has shown that if the land was used for grazing, it won't be destroyed by a wind farm," Martins says.



The Potential of Nuclear Energy

"Nuclear energy is the only clean air option available today with a large scale potential to solve the world's energy and environmental problems," says Dr. Stan Hatcher, president of Atomic Energy of Canada Ltd. (AECL) in addressing the crown corporation's first presentation to the energy options panel.

One CANDU-3 nuclear reactor could provide 450 megawatts of capacity, or about 20 to 25 per cent of SaskPower's total capacity of 2,800 megawatts, says Hatcher. This makes it an alternative to increasingly expensive, non-renewable fossil fuels such as coal, natural gas or oil.

Burning fossil fuels create gases which, in turn, contribute to global warming and acid rain. By substituting some fossil fuelled electricity plants with nuclear power plants, carbon dioxide emissions could be reduced substantially, John Reid of the Canadian Nuclear Association told the panel.

Panel members raised concerns about possible health effects, safety and the long-term storage of nuclear waste. Representatives from both AECL and the Canadian Nuclear Association pointed out safety features such as reinforced concrete built into nuclear power plants, that would prevent or contain damage in the event of a nuclear accident.

"Most utilities around the world store their nuclear waste on site for possible recycling rather than transport it to remote areas in the Canadian Shield for burial," says Ian Wilson of the Canadian Nuclear Association.

"Today it simply isn't economical to recycle and recover the energy contained in nuclear waste, but nevertheless, utilities don't want to get rid of it because they may want to recycle the energy out of it someday," says Hatcher.

People voiced two common concerns about the nuclear energy option: nuclear waste disposal and the high cost of constructing nuclear power plants.

"We don't know the cost of disposal or storage of nuclear waste because it requires very long term storage," says Mike Van Vliet, who made an individual presentation in Regina. "And we don't know exactly how to dispose of it yet."

"Waste is the biggest reason I don't think it (nuclear energy) is the industry to get involved with," says David Weir, who also came forward in Regina. "We just don't have a way to dispose of nuclear reactor waste."

"I'm also concerned about spending a billion dollars to build a nuclear facility to meet a demand we may never see," says Van Vliet.

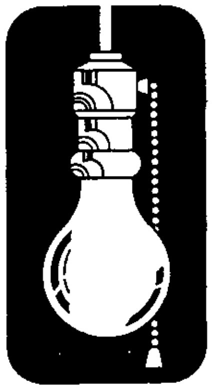
The Electrical Energy Review Panel

Dr. Roy Billinton, Chairman

Dr. Roy Billinton of Saskatoon brings a combination of academic and work experience to the panel. He is currently C. J. MacKenzie Professor of Engineering and Associate Dean of Graduate Studies, Research and Extension, College of Engineering at the University of Saskatchewan in Saskatoon.

He earned both an undergraduate and graduate degree in electrical engineering from the University of Manitoba and a PhD. and D. Sc. from the University of Saskatchewan. His academic achievements include some 350 publications on power system analysis, stability, and economic system operation. He is also a consultant to more than a dozen public and private boards and companies in North America.

Varied backgrounds give this panel a broad perspective.



Ann Coxworth

Ann Coxworth is the program coordinator for the Saskatchewan Environmental Society and serves as chairman of the Saskatchewan branch steering committee for the Canadian Environmental Network.

She earned an undergraduate degree from the University of Durham, England, an M.A. from Smith College, Massachusetts and an M. Sc. from the University of California. Her work experience includes research in nuclear chemistry and adult community education. She and her family are part of a small land management cooperative involved in conservation and small scale agriculture and woodlot management.

Chief Roland Crowe

Roland Crowe is Chief of the Federation of Saskatchewan Indian Nations (FSIN) and a farmer from the Piapot Reserve north of Regina. He was educated in Piapot and Marieval.

A member of the executive of the FSIN since 1982, Crowe is now in his second term as chief. He also served as councillor and Chief of the Piapot Band Council from 1972 to 1982.

Vicki Dutton

Vicki Dutton is a member of the Saskatchewan Agricultural Implements Board and is secretary to the Paynton Wheat Pool Committee. She and her husband operate a farm and a commercial seed cleaning/processing plant near Paynton, Saskatchewan. She also operates Paper Birch Nursery and is a freelance writer.

Dutton holds a certificate in Horticulture with a specialization in Landscape Design and Planning from the University of Guelph.

Russ Pratt

Russ Pratt is Coordinator of the Health, Safety and Industrial Relations Training Fund for the Energy and Chemical Workers Union in Regina. He is also the president of the Canadian Council on Working Life. In 1985, Pratt was appointed to SaskPower's Asbestos Review Committee and is a past member of the Governor General's Study Conference.

The Electrical Energy Review Panel: "It is essential that we hear the views of the public"

For information, or to express your views, contact:

"Saskatchewan Electrical Energy Options"

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Regina, Saskatchewan
S4P 0S1
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energy options
U • P • D • A • T • E
Volume 1, Issue 2 May 1991

"I think every citizen, every industry in Saskatchewan owes it to future generations to conserve energy."

Individuals Offer Simple Ways to Save Energy

Efficient use of existing power supplies, along with conservation, tops the list of recommendations from private citizens and special interest groups on energy options for the future.

"I don't think we've begun to tap the area of conservation that needs to be tapped and focused on," says Jim Trowell of Saltcoats. "Lights are left on unnecessarily, thermostats are set too high. We have to think about how much electricity we really need to use."

"We have to use a mix of energy sources to generate electricity," says Barry Mitschke of Lumsden.

"We should continue to use coal, but we have to control pollution."

At present SaskPower generates about 70 per cent of the province's electricity by burning coal, a process that discharges carbon dioxide and other gases into the atmosphere and contributes to global warming and acid rain.

The coal and electric power industries are studying ways to burn coal cleanly and more efficiently. A clean-coal technology that can control carbon dioxide emissions has been developed to control pollution at coal-fired generating plants. Most presenters stressed the importance of every person doing whatever they could to conserve energy.

"I think every citizen, every industry in Saskatchewan owes it to future generations to conserve energy," says Mitschke.

Mitschke points to the home he built in 1982 as an example of how average people can conserve energy while saving money on their utility bills.

"It's earth-sheltered, passive solar and energy efficient. It has compost toilets and I handle my own waste recycling sewage system," he says. "It probably uses 40 to 50 per cent less energy than the average house would."

Switching from incandescent to fluorescent light bulbs and lobbying for more energy efficient appliances to be sold in Canada are suggestions put forward by Ken Kelln of the Sierra Club of Western Canada, Saskatchewan branch.

"There's a refrigerator made in California that uses 10 per cent of the energy that my refrigerator at home uses," says Kelln. "If you consider the

Energy Tips

Here are a few helpful hints to help conserve energy around the home and at work.

- When purchasing new appliances check for an Energuide label; this will indicate power consumption per month. The lower the rating the more efficient the appliance.
- Washing loads of laundry in cold water whenever possible will not only save you money but will help your clothes last longer. So you don't forget, turn the thermostat down on the hot water heater.

(see more energy tips on back page)

Purchasing electricity from other utilities should not be considered a reliable source of power for future generations.

number of refrigerators in Saskatchewan, a phenomenal amount of electricity could be saved that way alone."

If conservation measures were mandatory in Saskatchewan as they are in some areas of the United States, Kelln says that energy efficiency would increase so much that fewer new power plants would have to be built.

"If we're more efficient making our widgets or manufacturing products, we'd use less energy per product," says Kelln.

The panel expects to gather more grass roots input as it continues holding public meetings throughout the province.

More Options Worth Considering

Through public meetings across the province, the Electrical Energy Options Review Panel is hearing what community groups, industry representatives, and individuals think about possible new sources of electricity to meet Saskatchewan's future needs.

Alternative energy solutions such as cogeneration, biomass, and importing electricity from neighboring utilities are all options worth considering when planning for the future.

Buying Electricity One Solution

To help meet future demand for electricity, SaskPower could consider increasing the amount of electricity it buys from other utilities and privately owned generators.

In an average year, two per cent of the electricity used in Saskatchewan is purchased on contract from outside the province. SaskPower presently imports electricity from neighboring utilities in Alberta, Manitoba, and North Dakota.

Buying electricity from other utilities, such as Manitoba Hydro, could save Saskatchewan the cost of building more power generating facilities and ease public concern about the impact of mega-projects on the environment, David Harman told the Electrical Energy Options Review Panel in Meadow Lake.

"I don't believe the public in Saskatchewan wants any more dams at this time," Harman said during his individual presentation.

When questioned by the panel, Harman admitted that a potential conflict exists if an increasing amount of hydroelectric power is purchased from outside the province while damming within Saskatchewan is discouraged.

Purchasing electricity from other utilities should not be considered a reliable source of power for future generations, Gary Rose of Regina says in a written submission to the panel.

He says that since power consumption in other provinces and the northern United States is subject to the same factors of supply and demand as Saskatchewan, other utilities sell electricity to the province at the rate of their most expensive means of production.

"For future security we do not want to rely on that rate," says Rose. Purchasing power from private power generators within the province is another option open to SaskPower.

"We believe that private power producers can play a major role in meeting the province's future electric energy requirements," Dennis Young, vice-president of public relations for NCB Holdings Inc. told the panel in Meadow Lake.

NCB Holdings plans to build a $30 million peat-fuelled power plant just east of Jans Bay, Saskatchewan that could be generating power by 1993. In 1990, the company negotiated a 25 year agreement with SaskPower to generate 15 megawatts of power and is now awaiting environmental approval.

Biomass Could Solve Two Problems

Burning renewable biomass resources such as wood waste, peat, and municipal garbage could generate electricity and provide an environmentally safe means of disposal.

Rather than hauling waste wood to landfills, pulp mills could burn bark, sawdust and wood shavings to produce electricity, says David Harman.

"Energy has been consumed in the harvest, transportation and production of wood waste," Harman says. "Burning the waste in a cogeneration facility would recoup some of this energy."

Peat-fired power plants in Finland, which is at the same latitude and has the same vegetation as central Saskatchewan, prove the viability of burning that biomass resources for electricity, says Dennis Young of NCB Holdings Inc.

"This technology has been available for 30 years, and power plants using the same process we plan to use have been running for years in Finland," Young says.

Other countries using peat to generate electricity include Brazil, the Soviet Union, Ireland and the state of Maine. The Jans Bay power plant would be the first plant of its kind in Canada to use this process.

SaskPower anticipates that northern Saskatchewan will see the greatest increase in electrical use in the province and representatives from northern communities have spoken to the panel in support of the construction of electrical power plants like the Jans Bay project. "Cogeneration/biomass plants in northern communities will meet current and future electricity demands," Raymond Moskowec of the Northern Village of Green Lake told the panel in Meadow Lake.

Both Moskowec and Young say that NCB Holding's plan to use local labor exclusively to construct and operate the peat-fired plant resulting in an added benefit.

Northern communities usually have chronically high unemployment and social assistance dependence, Moskowec says. An independently built and operated power-generating facility like the proposed Jans Bay plant would help break that cycle.

The panel anticipates further discussions on this topic when they travel to northern Saskatchewan in June.

Cogeneration: Industry Puts Back

SaskPower must encourage cogeneration if non-renewable resources will continue to provide the majority of electricity in Saskatchewan, the panel heard in Regina.

Cogeneration is the generation of electricity as a byproduct of another process, usually industrial manufacturing or waste disposal.

"Pulp mills in the planning stages do not have cogeneration capabilities built into them, the heavy oil upgrader doesn't have cogeneration. It seems to be a logical spot to have it," said Al Taylor during his individual presentation.

Promoting cogeneration could also make industrial consumption of electricity more efficient, says Mike Burns of the engineering consulting firm SNC Inc, who addressed the panel in Yorkton.

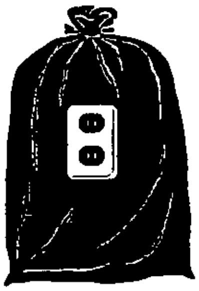
The agricultural processing industry is one candidate for cogeneration, Burns said when asked by panel chairman Dr. Roy Billinton to identify industries within Saskatchewan where cogeneration could be viable.

"Since a lot of the province's processing plants will be fairly energy intensive, a cogeneration facility might complement it well," says Burns.

Although his firm has not been involved in cogeneration in this province, Burns says SNC Inc. is building a plant at a municipal dump in Ontario that will generate electricity from burning trash.

"At that point, you are taking care of two problems with one plant," Burns says.

"The choices we make today are going to make a big impact"



Energy Tips

(continued from p.1)

- Household drafts can be reduced by installing child plug guards in electrical outlets throughout your home.
- Using energy efficient products such as compact fluorescent lights may be expensive initially, but will save energy dollars and can last up to ten times longer.

For more information on energy conservation write to:

Energy, Mines and Resources Canada, Communications Branch
580 Booth Street
Ottawa, Ontario
K1A 0E4

For information, or to express your views, contact:

"Saskatchewan Electrical Energy Options"
2025 Victoria Avenue
Regina, Saskatchewan
S4P 0S1
Phone: (306) 566-3501

Rate Increase Could Help Reduce Demand

While recognizing that increasing demand for electricity must be met, some people addressing the panel don't want the province to increase its debt load to finance more mega-projects like nuclear power plants or small hydroelectric dams.

Instead, some are suggesting that SaskPower risk public outcry and raise its rates now to encourage conservation and reduce future demand for electricity.

"I probably would be screaming along with the rest of the people if there was a tax put on my fuel to encourage me to conserve," says Jim Trowell, a retired farmer from Saltcoats. "But I think people would see they are getting a benefit by being forced to conserve."

"I think if the more you use the more you pay for, maybe you would cut back a bit," says Clem Whakefield, a retired farmer from the Maidstone area who says he and his wife Margaret "save power with all our might".

"When we first got the power they encouraged us to use more and more, and the more you used the cheaper it got," says Whakefield. "But I think maybe we've gone too far with that now."

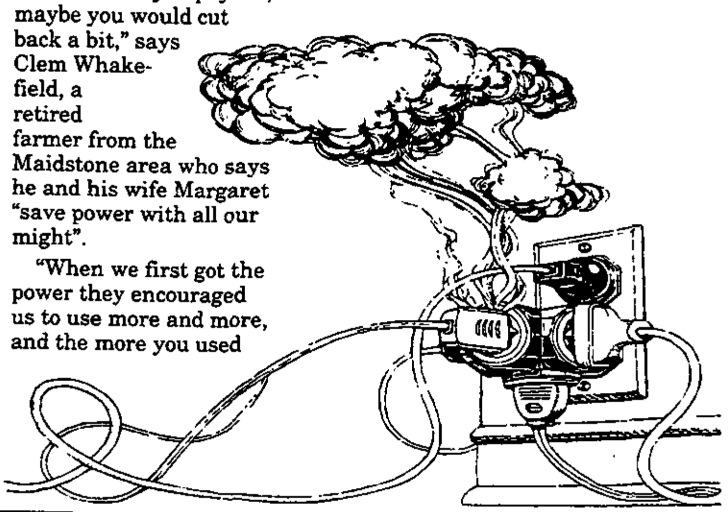
While every individual who makes a presentation to the panel knows that something must be done to meet the province's future demand for electricity, not all want to leave future generations with the legacy of a large debt or environmental conflict resulting from the construction of more mega-projects today.

"I really feel that any energy option that incurs further debt to the province at this time to a major extent is unacceptable," says Steve Lawrence of Prince Albert.

"Individuals and businesses are willing to pay more for their energy if they know the source is going to be relatively clean," says Paul Tidey of Regina.

"It's not going to happen overnight, but the choices we make today are going to make a big impact," says Tidey.

Some are suggesting that SaskPower risk public outcry and raise its rates to encourage conservation



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U • P • D • A • T • E

Volume 1, Issue 3 June 1991

"Because energy conservation saves money and reduces environmental impact, everyone wins"

Conservation is Good for Business

Since public meetings began in January, individuals and special interest groups have been recommending conservation as a means of meeting Saskatchewan's future energy needs. So have the largest consumers of electricity in the province; industrial and commercial customers.

"Conservation makes more than good sense," Marty O'Brien, vice-president of operations at Weyerhaeuser Canada's Prince Albert pulp and paper mill told the panel in Saskatoon.

"It makes, or at least saves, dollars, not to mention our non-renewable resources and the many environmental considerations."

Industrial and commercial consumers combined use half the electricity produced in the province—a number that's forecast to increase as the province's economy diversifies in the future.

Conservation techniques like cogeneration, interruptible service during peak demand periods, and time-of-use rates can all reduce the demand for electricity.

If demand for electricity is reduced substantially, the need for new power generating facilities would be reduced.

By moving to cogeneration, more industries could become energy self-sufficient, which would increase operational efficiency and make Saskatchewan industries more competitive in world markets, O'Brien says.

Industries with cogeneration capabilities could also sell any excess electricity back into the provincial power grid.

"Energy conservation is a good idea under any circumstances, both for the utility and for the consumer," Larry Hanna, vice-president and general manager of Saskatoon Chemicals told the review panel in Saskatoon.

"Because it saves money and reduces environmental impact, everyone wins."

Energy Tips

More hints to help conserve energy at home and at work.

- Replace worn weatherstripping around the inside of windows and door frames.
- Upgrade your home's insulation to the highest levels. Don't forget to insulate the hot water heater and pipes, too.
- Hang clothes outside to dry. It not only saves energy and money, it also makes your wash smell fresh.
- Install a programmable thermostat which automatically turns the heat down when it's not needed.

(see more energy tips on back page)

"The environmental issue to be faced now is how to eliminate sulphur and carbon dioxide emissions altogether".

Existing Power Sources Can Meet Future Needs

Whether suggesting alternatives to existing methods of electrical generation advocating energy conservation, or simply expressing their opinions on energy options for the future, Saskatchewan people are giving the Electrical Energy Options Review Panel plenty to think about at public meetings across the province.

Community groups, industry representatives and private individuals continue to offer their views on how to best meet the province's future electrical needs.

Continued Reliance on Coal One Possibility

Saskatchewan's abundant reserves of lignite coal makes continued reliance on coal-based electrical generation a top option to meet the province's future energy needs.

Supporters of the coal option are telling the panel coal makes sense for the future because it's safe to mine, transport, handle and burn in generating facilities.

"Let's not look at more expensive and possibly more dangerous alternatives when the answer is right here in front of us. Coal is the answer," Roy Ludwig of the United Mine Workers of America, local 7606, told the panel in Estevan.

Presently, 70 per cent of the province's electricity needs are met by coal-fired power plants.

As the third-largest coal producing province in Canada, it has been estimated that Saskatchewan has sufficient reserves of low-sulphur lignite coal to produce electricity for an estimated 150 to 200 years at present rates of consumption.

Technology is available to control sulphur and reduce carbon dioxide emissions at coal-fired plants—making continued reliance on coal a top option for future energy needs, Pearce Bowman of the Estevan Coal Corporation told the panel in Estevan.

Environmental issues like land reclamation and reducing stack emissions previously associated with coal mining and burning coal in power plants have been addressed, engineer Owen Mickleborough told the panel during his individual presentation at Assiniboia.

The environmental issue to be faced now is how to eliminate sulphur and carbon dioxide emissions altogether, he said.

Coal Gasification a Potential Solution

The coal industry has been pursuing the development of new coal-based technology for electrical generation which reduces coal's emissions.

Integrated gasification combined cycle or IGCC, could provide an answer to the problem of burning coal cleanly and efficiently.

"An IGCC plant produces no particulates, requires less land, uses less coal, and uses less water than conventional plants," Dr. Giacomo Capobianco, president and chief executive officer of the Coal Association of Canada, told the panel in Saskatoon.

This technology uses gas converted from

pulverized coal and steam produced from waste heat to generate electricity.

During the process, up to 99 per cent of the sulphur is removed from the gas and then burned in special combustors that reduce nitrous oxide emissions. Carbon dioxide can be recovered and liquefied for use in enhanced oil-recovery projects.

Coal ash left behind as an inert slag can be used in paving roads, while sulphur has industrial and agricultural applications.

While an IGCC plant is more expensive to build and operate than a conventional coal plant, it is still cost competitive.

"Coal combustion is clean and, through processes like IGCC, has the potential of being cleaner still," John Morgan of Prairie Coal Limited told the panel in Estevan.

Three utilities in Alberta and one in Saskatchewan are vying for the chance to build the first coal gasification fired power plant in Canada.

The plant would be used to evaluate other Canadian and U.S. coals and could stimulate a great deal of research and development activity in Saskatchewan, Morgan said.

SaskPower's Shand Station near Estevan is one of four potential sites for the 250 megawatt demonstration project.

A decision on the site will be made early this fall after a feasibility study and further testing of the coal gasification technology is complete.

Natural Gas Cogeneration Looks Promising

Saskatchewan needs a mix of energy options to meet future demand for electricity. Clean, efficient natural gas-fuelled cogeneration must be part of that mix, gas industry representatives are telling the review panel.

The major benefit of gas fired cogeneration is higher efficiency.

Increased efficiency results in less fuel consumption, which results in lower emissions of sulphur dioxide, carbon dioxide, and reduced particulate emissions, Randell Pardy, vice-president of marketing and corporate development for Calgary-based Northstar Energy Corporation, told the panel in Saskatoon.

Cogeneration facilities have a short lead time–from 12 to 36 months–and can be installed in increments of one megawatt to 100 megawatts.

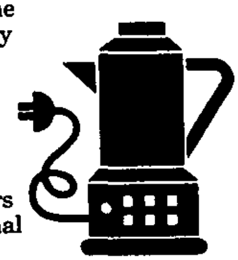
"This short a lead time reduces the risk that the [forecast] electric supply and demand are not in balance at any given point," Pardy says.

Cogeneration is a method of electricity production that recovers normally wasted thermal energy to make steam. That steam is then used to heat buildings or for industrial processes such as cooking pulp in paper making, recovering heavy crude from oil sands or liquefying potash.

Individuals speaking to the review panel are voicing concerns about the long-term supply of natural gas.

However, Ian MacNabb of the Canadian Gas Association, told the panel in Moose Jaw that known gas reserves in North America will last for decades.

Known gas reserves in North America will last for decades.



Energy Tips

(continued from p.1)

- Use awnings, blinds or drapes to reduce heat gain through windows and reduce air conditioner use.
- Use a microwave oven instead of a conventional oven. It will help to keep your house cooler in the hot summer months, and save you money.

For more information on energy conservation write to:

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For information, or to express your views, contact:

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2025 Victoria Avenue
Regina, Saskatchewan
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Phone: (306) 566-3501

Major Electricity Consumer Offers Options

As a consumer that uses as much electricity as the city of Regina, IPSCO's recommendations to the review panel deserve serious consideration, says John Comrie, corporate counsel for the Regina-based steel company.

Comrie made specific recommendations to the panel on behalf of IPSCO, the single largest consumer of electricity in the province.

According to SaskPower estimates, demand for electricity will outstrip supply as early as 1994. Given the long lead time needed by major power developments such as hydro and coal, IPSCO recommended a number of interim energy options.

"We hope the panel addresses carefully the short-term options which SaskPower must consider in order to ensure that reliable power service continues until major power developments can be completed," Comrie told the panel in Saskatoon.

Options such as demand side management, pursuing agreements with non-utility generators and developing improved transmission connections with utilities in neighbouring provinces should be considered to meet Saskatchewan's short-term needs, Comrie says.

Continued reliance on coal-based electrical generation, support for clean-coal technologies and support for the development of safe uranium-based energy options have also been recommended by IPSCO as long-term ways to meet the province's energy needs.

Regardless of which energy mix SaskPower chooses for the future, IPSCO and the province's other major industrial customers stress the importance of reliable, economically-priced electricity to the future of their operations.

"The importance of electricity in the steel industry in Saskatchewan is just typical of the importance of electricity to all Saskatchewan industry," Comrie says.

The province's major industrial customers stress the importance of reliable, economically-priced electricity.

Coming in the next issue

The Energy Options Review Panel is stopping in northern communities this month to hear what residents there have to say about energy options for the future. The next issue will look at concerns and suggestions from residents of northern Saskatchewan.

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Volume 1, Issue 4

September 1991

What northern residents want is to actively participate and benefit from any new developments in the north.

Residents Concerned About Northern Development

The Electrical Energy Options Review Panel is hearing the concerns Northern Saskatchewan people have about new energy developments in the north.

During the month of June the panel stopped in several northern communities, including Stony Rapids, Buffalo Narrows, Wollaston Lake, Sandy Bay, and La Ronge.

In addition to discussing specific energy options to meet the province's increasing demand for electricity, the panel heard people's opinions about how to best use the natural resources of Northern Saskatchewan to provide electricity and, at the same time, help to improve social conditions in the remote communities.

Native people in Northern Saskatchewan must be included in all facets of new energy-related developments in the north, the panel was told at almost every public meeting held in June.

"On any project in Northern Saskatchewan, or anywhere else in Saskatchewan, it is no longer enough to promise jobs and training on major projects," Ken Dillen, former Member of the Legislative Assembly of Manitoba and now president of Western Project Development Associates (WPDA) told the panel in Buffalo Narrows.

What the mostly native residents of Northern Saskatchewan want, says Dillen, is to actively participate in and benefit from any new developments in the north.

"We want to create development funds to generate economic and employment activity on our own terms, under local control," Dillen told the panel. "My people want to lead creative, productive, meaningful lives free from the bondage of welfare and dependency."

In order to do that, the people of Northern Saskatchewan must be made aware of potential development plans, they must be educated about the development, and they must be consulted before any development

Energy Walk

This fall conduct and 'Energy Walk' through your home. Checking the following areas will ensure your home is energy efficient this winter.

The Heating System

• The age, type and efficiency of your heating system, as well as the kind of energy it uses.

Replacing an old heating system can improve energy efficiency up to 50 per cent.

Air Leakage

• Moisture damage to walls and attics, uncomfortable drafts and 20 to 30 per cent heat loss can be attributed to air leakage.

Ensure doors and windows are properly caulked and weather stripped.

Insulation

• In older homes, or when purchasing a new home, assess the insulation level in the ceilings, attics, walls, basements and crawl spaces.

An attic should have ten inches of insulation. If there is less than six inches of insulation, it would be cost efficient to add more.

"We want to be part of that progress on our own terms to accommodate our own principles."

goes ahead, Buckley Belanger, mayor of Ile-a-la-Crosse told the panel during his presentation at Buffalo Narrows.

"No northern development should proceed without direct involvement and direct endorsement of the people of that region, whether they're native or non-native," Belanger said.

The social problems that exist in most northern native communities must be dealt with if energy-intensive development is to continue in the north, the panel was told at a number of public meetings.

Problems such as almost universal unemployment, poverty, sub-standard housing, alcohol and substance abuse problems, and discrimination and a lack of opportunity for natives in most communities must be considered when planning energy options, the panel was told.

"Why is it that we have a large number of industries coming to Northern Saskatchewan, yet all these native northern communities are faced with 80 to 90 per cent unemployment?" Belanger asked during his presentation.

The native population rarely benefits from northern developments, whether in terms of job creation or money being spent in their communities, translator Ed Benoanie told the panel in Wollaston Lake.

"Our economy is poor. There's 98 per cent [of] people on welfare here, and about 25 miles away there's a mine that employs 400 people," Benoanie said. "How many people do we have working there? Five at the most."

Residents of northern communities need an integrated package of benefits from any development projects that affect them, Louis Bear, mayor of Sandy Bay said during his presentation to the panel.

"Before development takes place we need training to train people to go to work so that they're not being told that they can't work," Bear told the panel in Sandy Bay. "They can work if their training takes place before development."

Northerners recognize and accept the growing need for electrical energy, Gene Chovin told the panel during his individual presentation in La Ronge.

"We realize there's a real need for energy. We need energy ourselves and we don't expect progress to stop south of the tree line," Chovin said. "We do, however, want to be part of that progress on our own terms to accommodate our own principles."

Energy Options Worth Considering

The Electrical Energy Options Review Panel, during meetings across Northern Saskatchewan, heard what people there are saying about how to best meet the province's future electrical needs.

Community leaders, school children, interested individuals, and industry representatives voiced their concerns and suggestions for future energy options.

Conservation, hydroelectric power, and nuclear power generation are all options worth considering when planning for the future, say residents of Northern Saskatchewan.

Conservation Encouraged by Northern Individuals

Echoing fellow Saskatchewan people, residents of Northern Saskatchewan are telling the panel that conservation and demand-side management of the province's electrical power must be part of the ultimate solution to meeting Saskatchewan's increasing energy needs.

"I think in Northern Saskatchewan conservation is something that we want to see happen," Buckley Belanger told the panel during his presentation in Buffalo Narrows.

"Until we come up with cleaner ways to provide energy, we have to look at wind, solar, and nationally conserving all types of energy," Belanger said.

Conservation and greater energy efficiency are part of the solution to stopping environmental damage caused by coal-fired generating plants and hydroelectric dams, said Jamie Kneen, a biologist who spent two years working with the Hatchet Lake Band on environmental protection, policy analysis and community work.

Conservation and efficiency are an essential part of developing a sustainable future– one in which economic and environmental considerations are fully integrated, the panel heard in La Ronge.

"Our energy planning priorities and investments must shift dramatically and rapidly," Bert Weichel, a member of the Saskatchewan Round Table on Environment and Economy, told the panel during his presentation.

"As a minimum interim strategy, I'm suggesting that conservation and efficiency and renewable energy technology should both be placed on an equal footing with conventional energy mega-projects," Weichel said.

Under such a strategy, Weichel said, for every dollar spent on conventional energy mega-projects, a dollar would be spent on conservation and efficiency measures and a dollar would also be spent on the development of renewable energy technologies.

"We'll see which investment proves the greatest return, not only in terms of energy production but also in terms of societal benefits and change in societal conditions, " Weichel said.

Hydroelectricity Still a Possibility

There is still room for further hydroelectric development in the province's north– providing it is on a smaller scale and with more sensitivity to local people, say northern residents.

"I think there is a place for hydro power, but on a much smaller and more local scale than we've gotten used to," said Kneen during his individual presentation. People don't want to see a repeat of the destruction of traditional fishing and trapping grounds that has happened with mega-projects like the Island Falls hydro station, said Louis Bear during his presentation in Sandy Bay.

People who use land for their livelihood should be compensated if the land is flooded as part of a hydroelectric development, Bear said.

"People are not opposing some of these projects like hydro, but they're concerned about the environment and concerned about what benefits they get out of destroying the environment, especially the traditional users: the trappers, the fishermen, the tourist operators," Bear said.

Large corporations could find it more rewarding to concentrate their developments with consideration to local populations rather than just paying attention to their balance sheets, Torance Tornquist told the panel in Sandy Bay.

"The need to be extremely sensitive about local aspirations can provide real opportunities," Tornquist said.

He mentioned aquaculture and fisheries programs, and enhanced sport and commercial fishing as examples of complimentary development that can occur along with small-scale hydroelectric development.

People don't want to see a repeat of the destruction of traditional fishing and trapping grounds that has happened with mega-projects.

Nuclear Energy a Possibility in the North

While public opinion on the nuclear power option is divided, the Electrical Energy Options Review Panel is hearing that the vast uranium reserves of Northern Saskatchewan make it the ideal site for the province's first nuclear power station.

Constructing a Candu-3 nuclear reactor in Saskatchewan would provide the electrical power that could diversify the province from a supplier of raw materials to an area that can attract industry, the panel was told.

"We'll never be anything more than a two-bit province as long as our economy depends on the rain or the snow or the wind or the hail, or on foreign markets," science teacher Gene Chovin said during his presentation in support of nuclear energy in La Ronge.

David Bock, Western Canadian representative for Atomic Energy of Canada Ltd. (AECL), also stressed the economic advantages of building a nuclear reactor in Saskatchewan.

"We should be building our future on our vast and rich uranium resource," Bock told the panel in La Ronge. "We need a more diversified base if we're going to keep our young, educated people in the province."

Opponents of nuclear energy cite the high cost of constructing a nuclear power plant, the cost of storing nuclear wastes indefinitely, and the potential for disaster as reasons to avoid the nuclear energy option.

"I would not want to see nuclear power used," Terry Daniels told the panel in Wollaston Lake. "I hate seeing uranium being taken out of the ground and being a threat to everybody's health."

Others dismiss the nuclear industry's claim that nuclear energy is cleaner and safer than other fossil fuels such as coal or natural gas.

"Once the massive activities of mining and refining uranium, building reactors, and dealing with the everlasting byproducts are taken into account, the nuclear option represents no benefit at all," Jamie Kneen told the panel at Wollaston Lake.

Western Projects Development Associates (WPDA), an organization formed to build a nuclear reactor in Saskatchewan, aims to raise funds from the private sector to build a Candu-3 reactor in the province.

"Canada's nuclear power technology is second to none in safety and reliability," WPDA president Ken Dillen told the panel in Buffalo Narrows. "Of all the forms of electrical generation, nuclear is by far the safest and most environmentally benign."

"The time has come to place AECL technology to the ultimate test– the test of investor confidence," Dillen said.

"Any nuclear power project should be able to pass the market test of private sector participation."

If Saskatchewan people support the nuclear energy option in public opinion polls, Dillen said, they should be prepared to support it with investment dollars.

The ultimate test of technology: the test of investor confidence.

For information, or to express your views, contact:

"Saskatchewan Electrical Energy Options"

2025 Victoria Avenue
Regina, Saskatchewan
S4P 0S1
Phone: (306) 566-3501

Appendix 8

Press Releases Issued by the Panel

FOR IMMEDIATE RELEASE
Friday, January 18, 1991

OPEN MEETINGS WITH ELECTRICAL ENERGY OPTIONS REVIEW PANEL BEGIN

The Electrical Energy Options Review Panel will begin its schedule of open meetings Wednesday and Thursday, January 23 and 24, in Regina. All members of the public are encouraged to attend the open meetings, observe presentations and submit questions and concerns to the panel. "Difficult choices are going to have to be made in meeting our electricity needs of the future and it is essential that we hear the views and concerns of the public," said Roy Billinton, Panel Chairman.

SaskPower, at the invitation of the panel, will open the Regina meeting with a review of their present operations. Presentations will also be heard from the City of Regina, Atomic Energy of Canada Limited, The Saskatchewan Natural History Society, The Canadian Nuclear Association, the International Uranium Congress and many more individuals, industry representatives, businesses and groups.

Billinton emphasizes, "It is not our job to make specific recommendations. It is our job, however, to communicate with the people of Saskatchewan in order to discover how the province's future demand for electricity might be met." The panel's findings will be reported back to SaskPower and the people of Saskatchewan. "The information will be very important in enabling SaskPower to consider the views of Saskatchewan people when planning for the future," Billinton said.

The independent panel, convened by SaskPower, is served by individuals that bring unique abilities and insight to the process. They are: Panel Chairman, Dr. Roy Billinton, Associate Dean of Graduate Studies, College of Engineering, University of Saskatchewan, Saskatoon; Ann Coxworth, Program Coordinator, Saskatchewan Environmental Society, Saskatoon; Roland Crowe, Chief of the Federation of Saskatchewan Indian Nations and farmer, Piapot Reserve; Vicki Dutton, farmer and commercial seed cleaner and horticultural consultant, Paynton; Russ Pratt, coordinator, Energy and Chemical Workers Union and President, Canadian Council on Working Life, Regina.

Regina open meetings are scheduled for Wednesday and Thursday, January 23 and 24, in the Wellington Room, Regina Inn from 9:00 a.m. to 9:00 p.m.

The mandate of the independent panel is to seek opinions from the people of Saskatchewan and increase the understanding of electrical energy options for the future.

Contact: Carmen L. Dybwad
Secretary to the Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

ELECTRICAL ENERGY OPTIONS REVIEW PANEL
MEDIA BACKGROUNDER

RATIONALE

For years we have taken electrical power generation for granted. It was relatively inexpensive and readily available, with few people aware of the consequences associated with various methods of generation.

Today electrical energy production occurs within a complex framework of increasingly stringent governmental legislation along with a heightened global awareness of the effects of generation on the environment, plus concern over costs of production and even the dependability of resources.

Against this backdrop lay other urgent considerations. SaskPower predicts that, given the growing rise in demand for electrical power, current levels of production will be insufficient to meet demand by the mid 90's. This, coupled with the long lead times necessary to build power plants and generators, forces the immediacy of any decision making process to the forefront.

Established to provide the public with electricity in a safe, economical, reliable, efficient and environmentally responsible manner, SaskPower realizes that the views, suggestions and advice of the public are crucial to discussion on meeting future energy demand. These views must be taken into consideration.

MANDATE

The Panel was convened by SaskPower to seek opinions from the Saskatchewan people, to enhance overall awareness of current energy issues, and to raise an understanding of future electrical energy options.

Once accomplished the above information will be prepared and forwarded to SaskPower and the Saskatchewan public for review.

METHODOLOGY

To realize this goal, SaskPower asked its engineering, research and planning group to assemble information the public would need to comprehend and evaluate the current energy demand situation and thus be able to provide input to the Panel.

This initiative led to the publication and distribution of "Our Future Generation - Electricity For Tomorrow". The 30 page discussion paper provides information about SaskPower's forecasts for electrical power requirements in Saskatchewan and details the wide range of options for matching the demand for electricity with available resources.

The publication is intended as an information source to help stimulate awareness during the open meeting process.

PANEL MEMBERS

The Panel, appointed by SaskPower, is comprised of knowledgeable individuals with divergent backgrounds and perspectives regarding electrical energy issues. The mix ensures a healthy blend of varied backgrounds and educational experiences.

Chairman Dr. Roy Billinton, Saskatoon, is a native of England who immigrated to Canada in 1952. He earned both an undergraduate and graduate degree in Electrical Engineering from the University of Manitoba, and a Ph.D. and D.Sc. from the University of Saskatchewan. Currently he is C.J. MacKenzie Professor of Engineering and Associate Dean of Graduate Studies, Research and Extension, College of Engineering, University of Saskatchewan.

Aside from impressive academic achievements (some 350 publications on Power System Analysis, Stability, Economic System Operation, etc.), and industry recognition (elected member of IEEE in 1975 & awarded Sir George Nelson Award by Engineering Institute of Canada), he is a consultant to more than a dozen North American public and private boards and companies.

Ann Coxworth, Saskatoon, is Program Coordinator for the Saskatchewan Environmental Society. A native of England, she earned a Bachelor of Science from the University of Durham, England and possesses an M.A. from Smith College, Massachusetts. With a M. Sc. degree from the University of California, her past work experience includes both research in nuclear chemistry and adult community education.

Ann Coxworth also serves as chair of the Saskatchewan Branch Steering Committee, of the Canadian Environmental Network. Ann's family is part of a small land management cooperative involved in conservation and small scale agriculture and woodlot management.

Ann Coxworth offers an extensive array of volunteer experience including work with the Saskatoon Open School, the United Nations Association (Education Committee) and the Canadian Peace Research Institute.

Roland Crowe is Chief of the Federation of Saskatchewan Indian Nations (FSIN) and a farmer from the Piapot Reserve (North of Regina). He received his education in Piapot and Marieval.

In 1972 he became a councillor for the Piapot Band and was elected Chief of his band in 1978. In 1982 Chief Crowe was elected to the Executive of the FSIN and four years later was elected Chief of the FSIN. He was re-elected two years later.

Vicki Dutton, Paynton, holds a certificate in Horticulture specializing in Landscape Design and Planning from the University of Guelph, Ontario. She and her husband operate a farm and a commercial seed cleaning/processing plant near Paynton, Saskatchewan.

Vicki also operates Paper Birch Nursery, is a freelance writer and performs mediation work for the Young Offenders Program. She serves as a board member of the Saskatchewan Agricultural Implements Board, and as Secretary to the Paynton Wheat Pool Committee.

Russ Pratt, Regina, is Coordinator of the Health, Safety and Industrial Relations Training Fund for the Energy and Chemical Workers Union and also serves as President of the Canadian Council on Working Life.

In 1983, Mr. Pratt was selected to be a member of the Governor General's Study Conference, and in 1985 was appointed to SaskPower's Asbestos Review Committee. Mr. Pratt has also served as Vice-President of the Saskatchewan New Democratic Party.

TERMS OF REFERENCE

- To obtain through open and public hearings the opinion, feelings and conscientious input of the people of Saskatchewan on any matter related to the future demand for electricity or the alternative means whereby demand can be changed or met.
- To use "Our Future Generation - Electricity For Tomorrow" and any other relevant information as a starting point for understanding and to encourage discussion on this issue.

The Panel will not formulate or provide recommendations based on its findings, but will collect, compile and prepare briefs and submissions into a comprehensive report reflecting informed public opinion. The Panel will then present the report to SaskPower and the people of Saskatchewan.

PROCESS

To accomplish its objectives the Panel will hold a number of open meetings in various communities throughout Saskatchewan.

All businesses, individuals, industry and special interest groups are encouraged to submit briefs, make presentations, or, attend the presentations.

FOR IMMEDIATE RELEASE
Friday, March 8, 1991

ELECTRICAL ENERGY OPTIONS REVIEW PANEL UNDER WAY

Saskatchewan's Electrical Energy Options Review Panel is under way with a series of public meetings in communities across the province.

The independent panel was convened by SaskPower to seek opinions from the people of Saskatchewan on how best to meet the province's future demand for electricity and to enhance public awareness of current energy issues.

The panel is made up of members with a broad range of skills and expertise. Panel members include: Panel Chairman, Dr. Roy Billinton, Associate Dean of Graduate Studies, College of Engineering, University Saskatchewan, Saskatoon; Ann Coxworth, Program Coordinator, Saskatchewan Environmental Society, Saskatoon; Roland Crowe, Chief of the Federation of Saskatchewan Indian Nations and farmer, Piapot Reserve; Vicki Dutton, farmer, commercial seed cleaner and horticultural consultant, Paynton; Russ Pratt, coordinator, Energy and Chemical Workers Union and President of the Canadian Council on Working Life, Regina.

To date, the panel has heard from businesses and industries like Canadian Nuclear Association and Dove Industries, special interest groups such as Saskatchewan Homebuilders' Association and the Sierra Club of Western Canada in addition to concerned individuals from across the province.

Input from individuals and groups is welcomed and encouraged. Meetings run to mid June, 1991. A copy of the schedule is attached for your information.

Contact: Carmen Dybwad
Secretary to the Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

ENERGY PANEL HAS MANDATE TO LISTEN

"We need to promote conservation to control our demand for electricity." " We need to develop nuclear power, more natural gas or wind generated energy."

These are among the suggestions Saskatchewan's Electrical Energy Options Review Panel has heard since its public meetings began in January.

The independent panel is presently holding public meetings across Saskatchewan to gather information from individuals, industry representatives, businesses and special interest groups on how best to meet the province's future demand for electricity and to increase public awareness of today's energy issues.

"Difficult choices are going to have to be made in meeting our electricity needs of the future and it is essential that we hear the views and concerns of the public," said Roy Billinton, panel chairman.

The panel won't make specific recommendations on alternative energy or conservation, rather, it will report its findings to SaskPower and the people of Saskatchewan. "The information will be very important in enabling SaskPower to consider the views of Saskatchewan people when planning for the future," Billinton said.

Contact: Carmen Dybwad
Secretary
Electrical Energy Options Review Panel
Bus: (306) 565-3501
Fax: (306) 566-3565

SUPPORT FOR WIND ENERGY GROWS IN SASKATCHEWAN

The use of renewable and nonpolluting resources, such as the wind, to supplement existing sources of electricity should be encouraged and supported by the province, say people making presentations to public meetings on energy options in Saskatchewan.

The Electrical Energy Options Panel, as it makes its way across the province gathering public input on energy options for the future, is hearing people's suggestions on clean, safe ways of meeting future demands for electricity.

People are concerned about the high cost and environmental impact of constructing more hydroelectric dams or coal-fired power plants. Most individuals making presentations to the panel are largely against the construction of a nuclear power plant in Saskatchewan and they want Saskatchewan to develop safe alternative energy supplies.

Since public hearings began in January, wind energy has been advocated as a popular alternative to other resource-depleting or environmentally damaging sources. In fact, it is second only to that of conservation among individuals making presentations to the panel.

Industry representatives and private individuals agree that while wind-generated energy can't replace existing sources of electricity, it can help reduce demand in some areas of Saskatchewan and ease the province's dependence on nonrenewable resources for electricity.

"Solar and wind power would be useful in certain areas of the province. While it may only satisfy local power demands, it would reduce demand on the whole electrical grid system," one person told the panel.

Strong and consistent wind makes southern Saskatchewan an ideal area for the provinces's first wind farm.

A wind farm in southeast Saskatchewan could produce energy up to 75 per cent of the time, which makes it a viable source of supplemental electricity, says Orlando Martins of Dove industries.

Wind power is clean and inexpensive, but because supply depends on the weather, it could prove to be an unpredictable source of electrical power, the panel has been warned.

Also, if the province decides to pursue the idea of setting up wind farms in southern Saskatchewan, it may have to import the technology because the Canadian wind industry is still in its infancy.

A California firm was recently awarded a provincial government contract to establish Alberta's first wind farm. However, local labour is expected to be used for construction and operation of the wind farm near Pincher Creek, Alberta.

The panel expects to hear more on the wind energy subject as it continues to hold public meetings this year. The panel will then report its findings to SaskPower and the people of Saskatchewan.

"The information gathered by this panel will be very important in enabling SaskPower to consider the views of Saskatchewan people when planning for the future," said Dr. Roy Billinton, panel chairman.

Contact: Carmen Dybwad
Secretary
Electrical Energy Options Review Panel
Bus: (306) 565-3501
Fax: (306) 566-3565

NUCLEAR ENERGY COULD SUPPLY ELECTRICITY IN SASKATCHEWAN

Proponents and opponents of nuclear energy continue presenting their views to the Electrical Energy Options Panel at public meetings on energy options for the future.

Industry representatives from Atomic Energy of Canada Ltd. (AECL) and the Canadian Nuclear Association told the panel that nuclear energy is an environmentally sound solution to meeting the world's energy situation.

"Nuclear energy is the only option available which has the potential to provide [the] vast amounts of energy that will be required without causing environmental damage," says Dr. Stan Hatcher, president of AECL.

He also told the panel that increased world demand for nuclear energy will mean increased demand for uranium—the nuclear fuel used in power reactors. That could mean increased economic opportunities for the uranium industry in Saskatchewan.

It has been estimated that one CANDU-3 nuclear reactor could supply between 20 and 25 per cent of SaskPower's total capacity of 2,800 megawatts.

Since public hearings began in January, questions about safety have topped the list of nuclear energy concerns.

Many speaking against nuclear energy say that they are worried about public safety in the event of a nuclear accident. However, Hatcher says strict licensing and operation standards in Canada make accidents like Chernobyl unlikely at a CANDU facility.

Others say the province must be sure that its demand forecast is accurate before building a capital intensive project like a nuclear power plant.

"I'm concerned about spending a billion dollars to build a nuclear facility to meet a demand we may never see," one person told the panel.

The panel hopes to gather more public input on the subject of nuclear energy. AECL plans to make a series of presentations to the panel on issues ranging from the environment and safety to waste management.

The Electrical Energy Options Review Panel is expected to wrap up public meetings this year and report its findings to SaskPower and the people of Saskatchewan.

Contact: Carmen Dybwad
Secretary to Panel
Bus: (306) 565-3501
Fax: (306) 566-3565

CONSERVE NOW, CONTROL FUTURE ELECTRICITY DEMAND

Using less electricity now and increasing the efficiency of existing power supplies will reduce demand for electricity, say people speaking at public meetings on energy options for the future.

Demand could be reduced so much that future power stations won't have to be built, say some conservationists.

The Electrical Energy Options Panel has received many suggestions from people on how controlling the demand for electricity would be cheaper and less harmful to the environment than increasing the supply of electricity.

SaskPower could control demand for electricity by increasing its rates to encourage energy conservation, say a number of presenters. They acknowledge that such a move would be unpopular at first but the results would be well worth it.

"I probably would be screaming along with the rest of the people," one person told the panel. "But I think people would see they are getting a benefit by being forced to conserve."

As consumers of about half of the province's electricity, industrial and commercial users have the greatest potential to conserve electricity. This can be done by "load shifting" to off-peak hours and increasing the overall efficiency of manufacturing processes.

If conservation measures were mandatory in Saskatchewan, as they are in some areas of the United States, energy efficiency would increase so much that fewer power plants would have to be built, the panel has been told.

The panel expects to hear more about conservation as it continues to hold public meetings and receive written submissions from interested individuals and groups across the province.

The panel will then report its findings to SaskPower and the people of Saskatchewan.

"The information gathered by this panel will be very important in enabling SaskPower to consider the views of Saskatchewan people when planning for the future," says Dr. Roy Billinton, panel chairman.

Contact: Carmen Dybwad
Secretary to Panel
BUS: (306) 566-3501
FAX,. (306) 566-3565

FOR IMMEDIATE RELEASE
Monday, April 22, 1991

PEAT, WOOD WASTE COULD FUEL NORTHERN POWER STATIONS

Generating electricity in biomass facilities is clean, inexpensive and would create much needed jobs in northern communities say industry representatives and community leaders.

The Electrical Energy Options Panel has received many suggestions from people on how abundant renewable resources such as peat and wood waste could be used to generate electricity.

Cogeneration power plants fuelled by biomass materials are integrated systems that can provide more than just electricity, according to projections made by NCB Holdings Inc.

Harvested peat lands can be reclaimed for forests or commercial crops and northern greenhouses can be established to use the waste heat and carbon dioxide created in a cogeneration plant.

Advocates of biomass technology say it's an energy option that has been successfully used for over 30 years by countries such as Finland, Brazil, the Soviet Union and the state of Maine. "We would not be experimenting at this because we could benefit from their experience," the panel has been told. It's also an option that doesn't require capital investment on the part of SaskPower or the province.

Private companies are "chomping at the bit" to get biomass plants underway says an industry spokesman. He says the companies just need permission from SaskPower to sell their power to the grid at a reasonable price.

Last year, NCB Holdings Inc. of Meadow Lake negotiated a 25 year agreement with SaskPower to generate 15 megawatts of power at a peat-fuelled generating plant near Jans Bay, Sask.

After an environmental assessment is completed, the company plans to build a $30 million peat-fuelled power plant just east of Jans Bay that could be generating power by 1993.

According to SaskPower estimates, northern Saskatchewan will see the greatest increase in electrical use in the province and representatives from northern communities speaking to the panel support the construction of electrical power plants like the Jans Bay project.

The panel will hear more about this and other energy options for the future as it continues to hold public meetings and receive written submissions from interested groups and individuals across the province.

After wrapping up public meetings this year, the Electrical Energy Options Panel will review all submissions before reporting its findings to SaskPower and the people of Saskatchewan.

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Secretary to Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

FOR IMMEDIATE RELEASE
Monday, April 22, 1991

HYDROELECTRICITY A RENEWABLE ENERGY OPTION

Regina—Saskatchewan's undeveloped hydroelectric potential could help meet the province's future energy demands without causing more damage to the environment, say people making presentations at public meetings on energy options in Saskatchewan.

The Electrical Energy Options Review Panel, as it makes its way across the province, is hearing people's suggestions on ways of meeting future demand for electricity.

Since public hearings began in January, renewable energy options like solar, wind, hydro and biomass, have been strongly supported by a large number of individuals and groups in communities across Saskatchewan. None of these options burn carbon-based fuels that can contribute to global warming and acid rain.

Like wind and solar energy, hydroelectric stations are fuelled by nature. However, unlike the other methods, hydro does directly impact the environment. Reservoirs created for hydroelectric stations raise water tables, flood land and can destroy fish and wildlife habitat.

Small-scale hydroelectric plants have much less of an environment impact, the panel has been told. Hydro production plants with a generating capacity of less than 5 megawatts are considered small-scale.

Northern community leaders are also supporting small-scale hydro developments at public meetings. Some see it as a way of meeting their energy needs without altering the way of life in their communities.

"Not a dam that disrupts the environment, not a dam that brings hardship to a small community," is how one man described the kind of small-scale hydro development his community would support.

A number of presenters stressed the importance of thorough environmental impact assessments in planning future hydro developments. "Before any new hydroelectric projects are undertaken, there should be a rigorous environmental impact study," one person told the panel.

The Electrical Energy Options Review Panel expects to hear more on the subject of hydroelectricity before it wraps up public meetings this year. It will then review all written submissions and transcripts of public meetings before reporting its findings to SaskPower and the people of Saskatchewan.

Contact: Carmen Dybwad
Secretary to Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

FOR IMMEDIATE RELEASE
May 13, 1991

NATURAL GAS COULD SUPPLY MORE ELECTRICITY IN SASKATCHEWAN

REGINA—Utility customers, the public and taxpayers would benefit from increased interaction and cooperation between electric and gas utilities, says a gas industry representative who made a presentation at public meetings on energy options for the future.

"By working together, SaskEnergy Incorporated and SaskPower can effectively fulfill the energy needs of this province in a safe, cost-effective manner," Garry Winslow, vice-president of operations with SaskEnergy told the Electrical Energy Options Review Panel.

Representatives from SaskEnergy Inc. and the Canadian Gas Association have told the Electrical Energy Options Review Panel that natural gas can be used in combination with existing generation methods to meet Saskatchewan's future electricity needs.

"We believe that natural gas, when used with other sources of energy, will be the key to ensuring that these future needs are indeed met," Winslow says.

The need for new electrical generating facilities could be eliminated if natural gas use increases, says Ian MacNabb, president of the Canadian Gas Association.

Natural gas, which is presently used only during peak demand periods or during emergencies, can be used in both demand side and supply side management, he says. Switching to natural gas furnaces, water heaters and stoves substantially reduces demand for electricity.

Other benefits include a short lead time for power stations fuelled by natural gas, as well as efficient burning and environmental advantages other fossil fuels can't match.

Individuals speaking to the panel are voicing concerns about the cost and long-term supply of natural gas. However, MacNabb says known natural gas reserves in North America will last for decades.

Others are questioning the wisdom of using a multipurpose fuel like natural gas to generate electricity when other fuels, like coal, are more abundant.

"I fail to see why natural gas, which has so many other uses, should be doing a job which coal could be doing," one person told the panel.

The panel will hear more about this and other energy options for the future as it continues to hold public meetings and receive written submissions from interested groups and individuals across the province.

After wrapping up public meetings this year, the Electrical Energy Options Review Panel will review all submissions before reporting its finding to SaskPower and the people of Saskatchewan.

Contact: Carmen Dybwad
Secretary to Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

FOR IMMEDIATE RELEASE
May 21, 1991

RELIABLE ELECTRICITY ESSENTIAL FOR INDUSTRY IN SASKATCHEWAN

REGINA—To achieve sustained industrial growth, Saskatchewan must have a reliable source of economically priced power, say people making presentations at public meetings on energy options for the future.

"If economic diversification and industrial development is to continue in Saskatchewan, a reliable and cost effective supply of electricity is essential," Jim Yule of the Saskatchewan Chamber of Commerce Economic Development Committee told the Electrical Energy Options Review Panel.

John Comrie, corporate counsel for the Regina-based steel company IPSCO, agrees. "It is really, really difficult to overestimate the importance of reliable energy supply at a competitive price."

Comrie made specific recommendations to the panel on behalf of IPSCO, the single largest consumer of electricity in the province.

Options such as demand side management, buying power from non-utility generators and improved transmission connections between neighbouring utilities should be considered to meet the province's short-term electricity needs, says Comrie.

A presentation by the vice-president and general manager of Saskatoon Chemicals, the second largest single consumer of electricity in the province, supported energy conservation over the construction of new power generating facilities.

"Energy conservation is a good idea under any circumstances, both for the utility and for the consumer," Larry Hanna, vice-president and general manager of Saskatoon Chemicals told the panel. "Because it saves money and reduces environmental impact, everyone wins."

The Electrical Energy Options Review Panel expects to hear more about this and other energy options for the future as it continues to hold public meetings and receive written submissions from interested individuals and groups from across the province.

After wrapping up public meetings this year, the panel will review all submissions before reporting its findings to SaskPower and the people of Saskatchewan.

Contact: Carmen Dybwad
Secretary to Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

FOR IMMEDIATE RELEASE
June 3, 1991

COAL CAN MEET SASKATCHEWAN'S FUTURE ENERGY NEEDS

REGINA — Saskatchewan's abundant coal reserves make continued reliance on coal-fuelled electrical generation a top option to meet the province's future energy needs, say people and coal industry representatives making presentations at public meetings on energy options for the future.

"Let's not look at more expensive and possibly more dangerous alternatives when the answer is right here in front of us. Coal is the answer," Roy Ludwig of the United Mine Workers of America, local 7606, told the Electrical Energy Options Review Panel.

At present, about 70 per cent of the province's electrical needs are met by coal.

"Coal-fired plants are known to provide the cheapest power, though they are prone to environmental problems," Ed Hinz of the Association of Consulting Engineers of Saskatchewan told the review panel.

Environmental problems associated with the mining and burning of coal include land reclamation, pollution from stack emissions, and sulphur and carbon dioxide emissions.

Progress has been made in the first two areas, one man told the panel. Now ways to further reduce and, ultimately eliminate, sulphur and carbon dioxide emissions must be developed.

The coal industry has been pursuing new technology for coal-fired electrical generation that can reduce coal's emissions. Integrated gasification combined cycle, or IGCC, could be the solution to the problem of how to burn coal cleanly and efficiently.

This technology uses gas converted from pulverized coal and steam produced from waste heat to generate electricity.

"An IGCC plant produces no particulates, requires less land, uses less coal, and uses less water than conventional plants," Giacomo Capobianco, president and chief executive officer of the Calgary-based Coal Association of Canada told the panel.

During the process, up to 99 percent of the sulphur is removed from the gas and is then burned in combustors that reduce nitrous oxide emissions.

Carbon dioxide can be recovered and liquefied for use in enhanced oil-recovery projects. Coal ash left behind as an inert slag can be used in paving road, while sulphur has agricultural and industrial applications.

The first coal gas-fired plant is expected to be built and on stream in Western Canada by 1993, Capobianco says.

The Electrical Energy Options Review Panel expects to hear more on the coal option before it wraps up public meetings this year. It will then review all written submissions and transcripts of public meetings before reporting its finding to SaskPower and the people of Saskatchewan.

Contact: Carmen Dybwad
Secretary to Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

FOR IMMEDIATE RELEASE
June 7, 1991

ELECTRICAL ENERGY OPTIONS REVIEW PANEL HEADS NORTH

REGINA — The Electrical Energy Options Review Panel continues its province-wide public meetings this month as it tours northern Saskatchewan.

The independent panel will hear submissions from area residents, businesses, individuals and special interest groups on how best to meet the province's future demand for electricity.

Members of the public are encouraged to attend the meetings and participate in the discussions on energy options for the future.

"Difficult choices are going to have to be made in meeting the province's electricity needs in the future," says panel chairman Roy Billinton. "It's essential to consider the views and concerns of the public when planning for the future."

Since public meetings began in January, options such as promoting energy conservation, developing cogeneration and biomass energy sources, and the feasibility of building a nuclear power plant in Saskatchewan have been discussed before the review panel.

After concluding public meetings this summer, the panel will review all transcripts and written submissions before reporting its finding to SaskPower and the people of Saskatchewan.

Although the review panel won't make specific recommendations on energy options for the future, Billinton says the information will be very important in enabling SaskPower to consider the views of Saskatchewan people when planning for the future.

Meetings will be held in the following locations during the week of June 17 to 21:

June 17	Buffalo Narrows 10:00 a.m. to 5:00 p.m. Lakeview Complex Gym	June 18	Stony Rapids 10:00 a.m. to 5:00 p.m. Community Hall
June 19	Wollaston Lake 10:00 a.m. to 5:00 p.m. Northern Hamlet Hall	June 20	Sandy Bay 10:00 a.m. to 5:00 p.m. School Drama Room

June 21 La Ronge
9:00 a.m. to 4:00 p.m.
Legion Hall

Contact: Carmen Dybwad
Secretary to Panel
Bus: (306) 566-3501
Fax: (306) 566-3565

FOR IMMEDIATE RELEASE
July 9, 1991

ELECTRICAL ENERGY OPTIONS REVIEW PANEL PRESS RELEASE

The Electrical Energy Options Review Panel has now completed the public consultation segment of its mandate to review the options available to SaskPower in order to satisfy or alter the future electrical energy requirements in the province. The Panel has heard a wide range of proposals and suggestions for altering the electricity demand by conservation and efficiency strategies and for adding additional generating capacity. There has been virtually unanimous agreement on the need to practice conservation and to promote efficient use of electrical energy. Considerable differences exist, however, on the degree to which this can be accomplished. The Panel has heard considerable concern expressed on environmental issues such as $C0_2$ production and the possible risk of global warming due to the greenhouse effect.

The Panel has not yet completed its studies and deliberations on the demand/supply side alternatives and therefore no overall comments can be made at this time.

One area, however, in which the Panel is in unanimous agreement is in regard to the use of coal for electrical energy generation. Saskatchewan has abundant reserves of low cost, low sulphur coal and has used this resource to excellent advantage in the past to generate a major portion of its electrical energy requirements. Saskatchewan should continue to take advantage of this resource but in a more environmentally responsible manner. This cannot be done using conventional coal technologies. SaskPower should therefore actively pursue the utilization of clean coal technologies such as pressurized fluidized bed combustion and integrated gasification combined cycle facilities.

The Panel appreciates that "clean coal technologies" are not totally clean in regard to making "zero" contribution to the atmosphere. They are, however, a significant improvement on conventional coal technologies and should be regarded as viable options for Saskatchewan at this time. In addition to new sources of generation, these technologies offer the possibility of plant life extensions and modifications at other provincial coal fired plants resulting in overall decreases in $C0_2$ emissions. These technologies are also important in a global sense and their development and utilization in a practical utility context here in Saskatchewan may lead to more environmentally friendly utilization of coal reserves in the third world countries.

The Panel expects to complete its work and report on a complete set of options and alternatives by October of this year.

For more Information:

Carmen Dybwad, Secretary to the Panel **or**
Dean Krauss, Information Officer to the Panel
Phone: 566-3501
Fax: 566-3565

NOTES