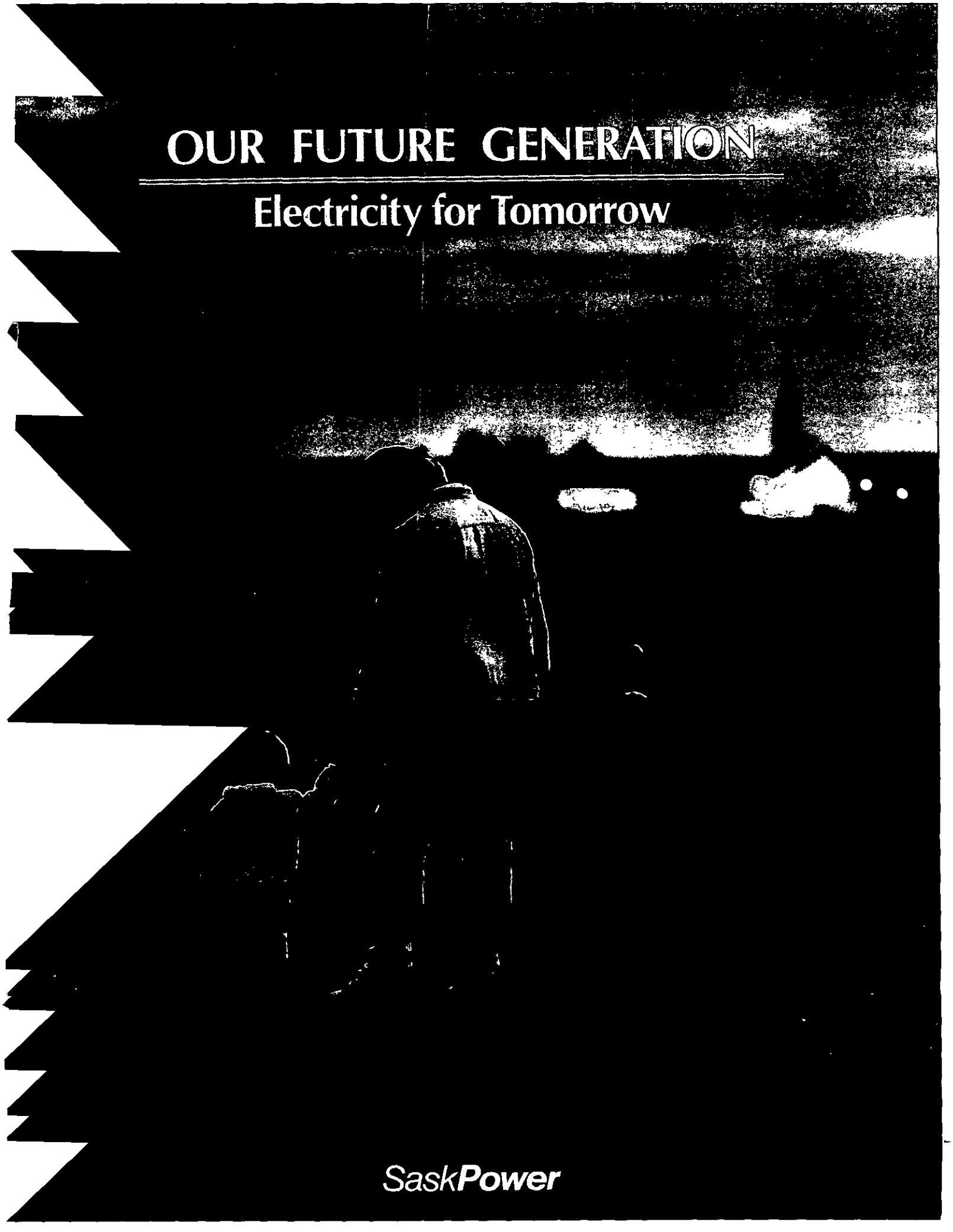
OUR FUTURE GENERATION

Electricity for Tomorrow



SaskPower

OUR FUTURE GENERATION

Electricity for Tomorrow

"Our vision for the future can only be painted in broad strokes, but 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 the options which will help us meet your electricity needs in the future. We invite you to consider these options and voice your opinions, so the ones we choose will reflect the values of Saskatchewan people. Future generations will be guided by the standards and principles we choose to follow today."

George D. Hill, QC
President and Chief Executive Officer
SaskPower

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OUR FUTURE GENERATION

Electricity for Tomorrow

CHAPTER 1

Making choices

When the first homesteaders came to Saskatchewan, they lit their homes with candles and coal-oil lamps. Through their labor and determination they built the foundation for modern life in Saskatchewan.

Life today is dramatically different, and one service is essential to the technology that our generation uses every day. That service is electricity.

Ever since electricity became available, people have used it in increasing amounts. SaskPower has kept one step ahead of this growth, to ensure that we have enough electricity for the province. But this does not happen automatically. We must predict future demand

The business world relies on electricity to speed the flow of information through computers, photocopiers, facsimile machines and telephones.

for power, and decide how best to meet that demand.

Our current predictions show that, if demand continues to grow, our present facilities will not keep up. According to our forecasts, demand will outstrip supply in the mid 1990s. To ensure that this does not happen, we must make decisions now. Both consumers and producers of electricity should be involved in the decision-making process.

Public opinion and environmental issues now play key roles in our planning process. Worldwide concern about acid rain, global warming, land use and other issues has prompted a re-evaluation of standards.

SaskPower has developed *Our Future Generation* to provide you with information about our forecasts for Saskatchewan's requirements for electrical power, and to outline the wide range of options for matching the need for electricity with the resources that are available to us.

This publication is about challenges, opportunities and decisions. Critical planning today will determine the options we use to close the gap between demand and supply. What can you do as an individual to help us close the gap?

Your views will help all of us make those choices. We hope that *Our Future Generation* will provide a basis for public discussion of the options available to us as we move responsibly into the 21st century.

Part of our everyday life

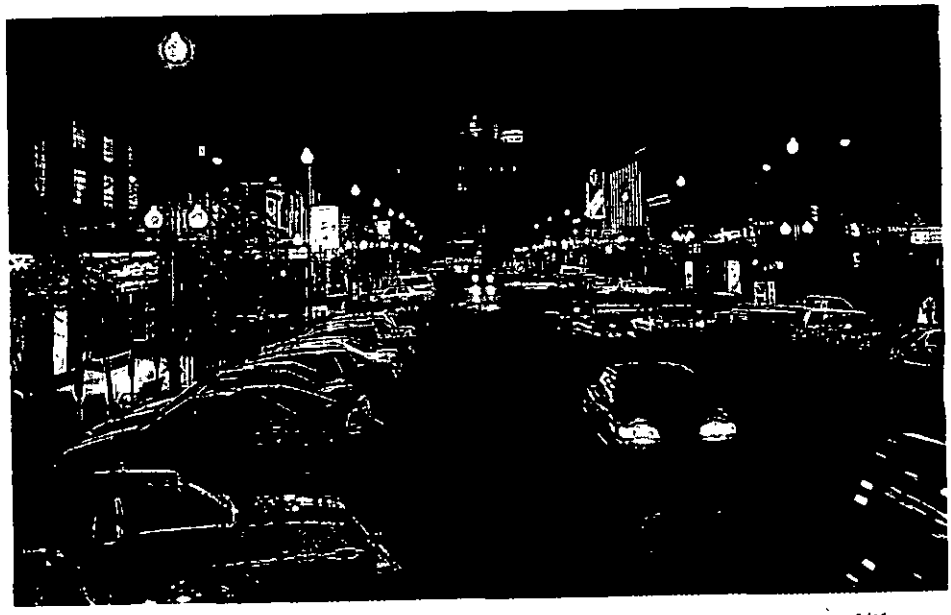
Twenty-four hours a day, from the moment your clock-radio comes on in the morning, and even after you turn off the last light at night, electricity is an essential part of your lives. People rely on it at home, at work, and at play.

It's hardly given a second thought, unless the power suddenly goes off.

Over the years, people in Saskatchewan, and indeed around the world, have used an increasing amount of electricity to make their work easier, their leisure more varied, and their lives more comfortable.

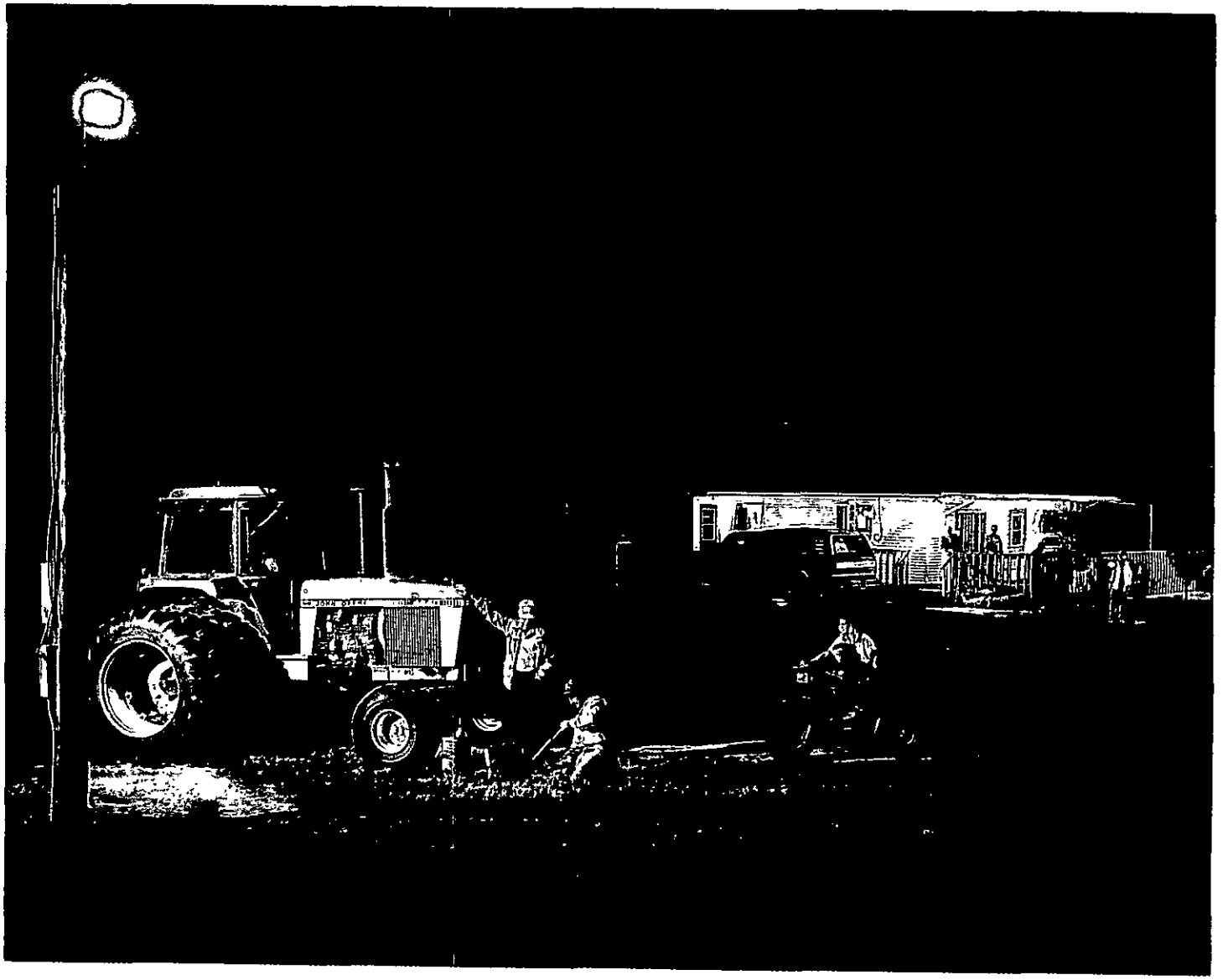
A typical resident of Saskatchewan consumes three times more electricity than a person in Japan or the U.S.S.R., and forty times China's per capita consumption. The harsh climate and our dependence on resource-based industries contribute to our high consumption, but so does our lifestyle.

The trend of increasing electrical consumption may change in the future, through the use of more efficient equipment and appliances and because of the choices each of us makes on how to use electricity. Many of these choices will be influenced by people's growing concern about the environment, as well as the cost of electricity.



Throughout the day, a reliable supply of electricity is essential to our modern way of life.

CHAPTER 2

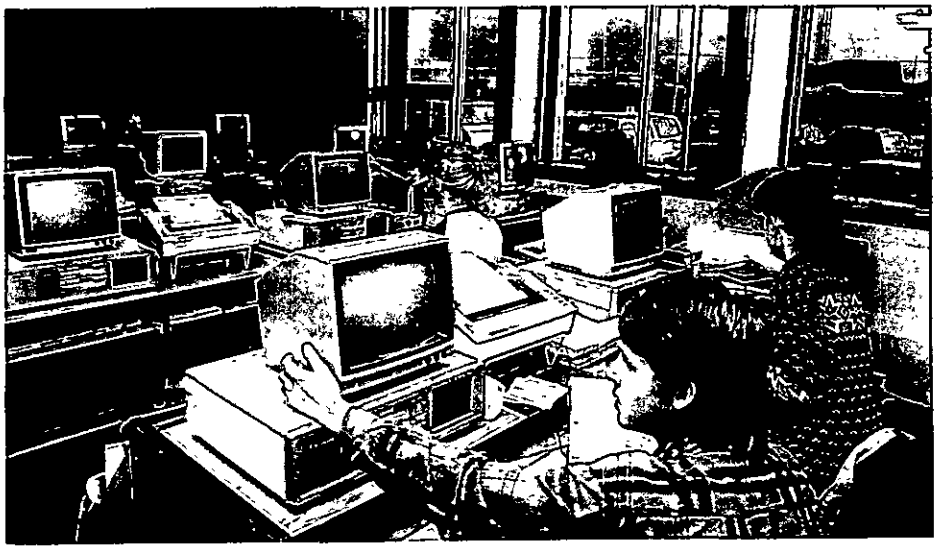


Where we are now

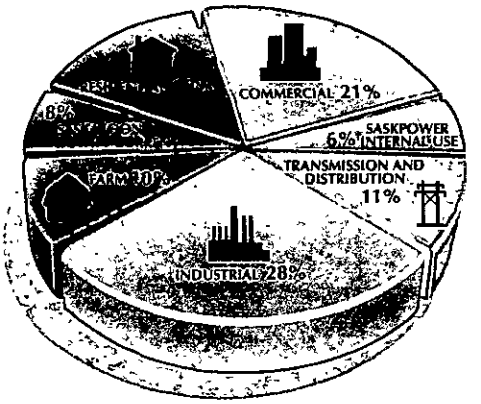
Using electricity today

Agriculture is still the backbone of Saskatchewan's economy. Today's farm family can have all the modern electrical conveniences, *and* use electricity to do much of the farm labor, too. Heated barns, milking machines, chick incubators, and crop irrigation all rely on electricity. Farming operations use about 10 per cent of the electricity generated by SaskPower.

Saskatchewan industries are essential to the economy of the province. They use approximately 28 per cent of the power we produce. These large users include the mining industry, oil production and processing,



Computers play an increasingly important role in our changing world – at work, at school and even at home.



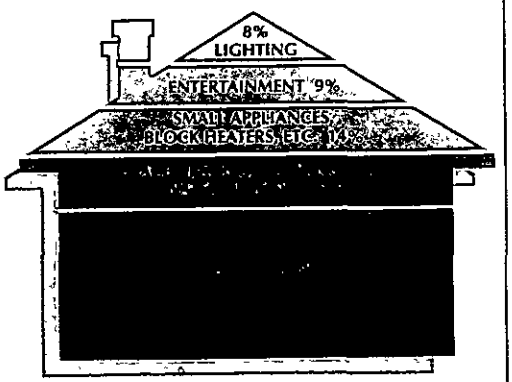
WHO USES ELECTRICITY

Two groups, the industrial and commercial consumers, use the majority of power produced.

pipeline pumping, steel manufacturing, chemical processing, and pulp and paper production.

Commercial businesses use about 21 per cent of Saskatchewan's electricity. What would our lives be without the variety of stores, offices, restaurants, financial institutions and service industries?

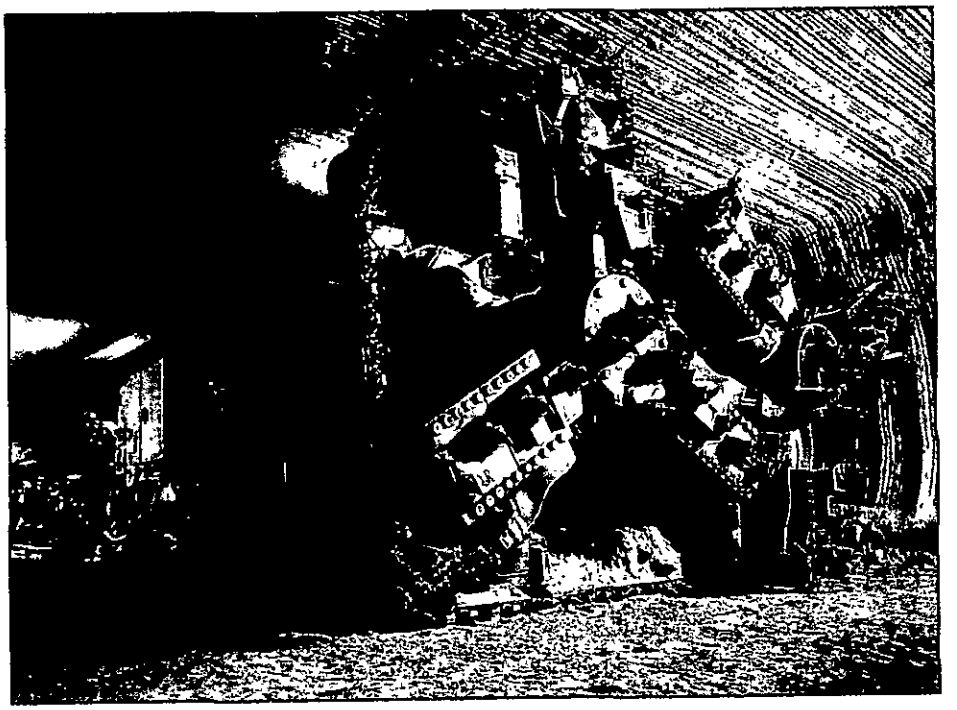
Our modern homes use electricity in every room – from the toaster and stove in the kitchen, the TV and stereo in the family room, to the car plugged in on the driveway. Residential customers use about 16 per cent of the power SaskPower generates.



AVERAGE ELECTRICITY USE IN THE HOME

Sales to municipal utilities which serve the cities of Saskatoon and Swift Current account for approximately eight per cent of the power we produce.

Of the total electricity generated, SaskPower uses about six per cent in its own operations, which include power stations, switching stations, and offices across the province. Finally, about 11 per cent of the power we produce is used in transmitting and distributing it from power stations to consumers.



Potash mines use large amounts of power to operate heavy machinery like this continuous miner. Mines and other industries rely on SaskPower to provide reliable and economical power. The province relies on industries to create jobs and diversify the economy.

Supper time usually creates the highest demand for power. In addition to the many kitchen appliances in use, business and industry are still using large amounts of power.

When electricity use is highest

Electrical use is measured in two ways: *demand* is the amount of power required at a point in time (measured in kilowatts -kW); *energy*. is the total amount of power used over a period of time (measured in kilowatt-hours – kW·h).

Our daily peak in demand usually occurs around supper time. Most people are home from work – they're using the stove or microwave, and probably some lights and the TV. At the same time, many stores are still open, and mines and heavy industries are hard at work.

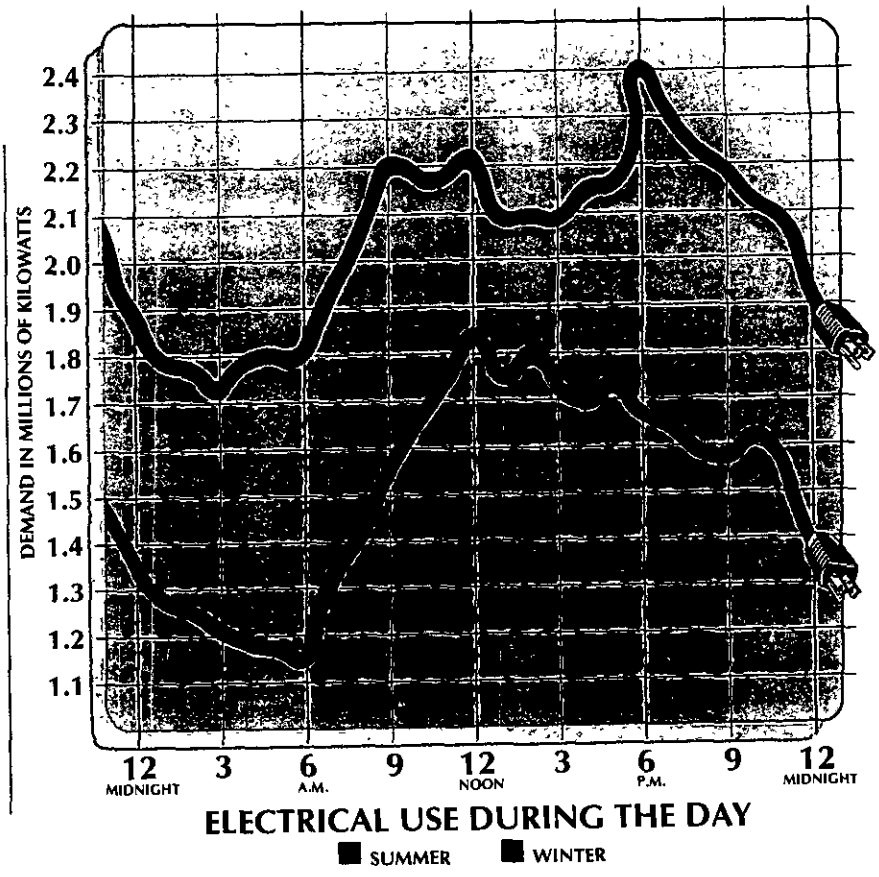
Our annual peak has always occurred in the winter, for several reasons. In addition to all the elements which contribute to a normal daily peak, winter brings more factors into play.

Because darkness comes early in the winter, by supper time lights are on all over the province. Electric space heaters are at work, and thousands of vehicles are plugged in to ensure they will start the next morning. Around Christmas time, even the small amount of power used by decorative lights adds up.

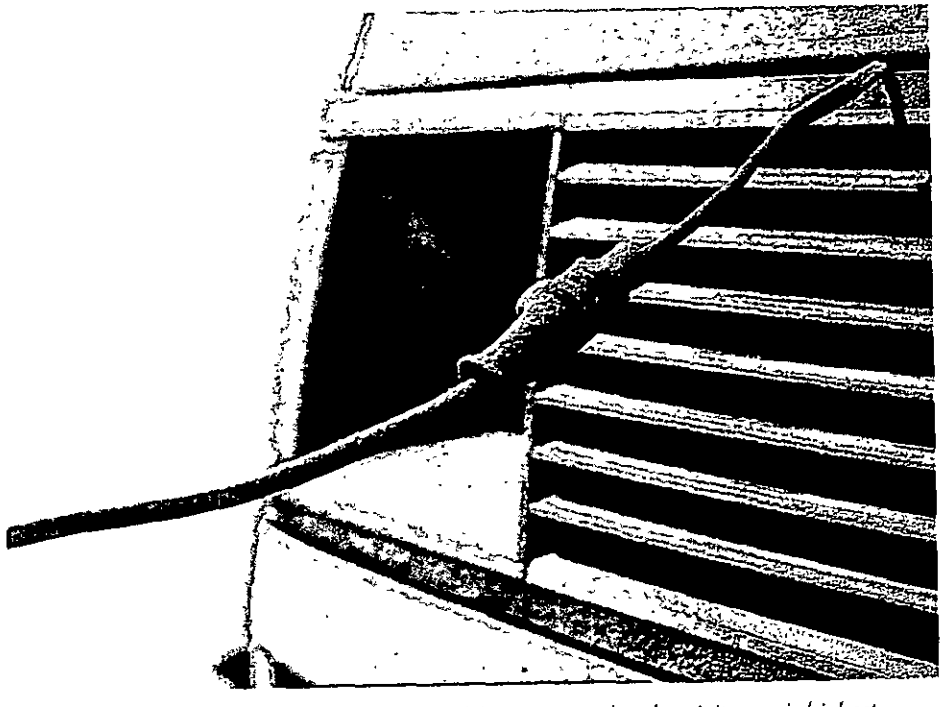
The weather has a significant effect on electrical use in summer as well. Energy use soars on a sweltering day, as air conditioners run longer, refrigerators make more ice cubes, and farmers irrigate their crops.

Electricity has to be there the instant you turn on a switch or plug in a cord. It cannot be generated in advance and stored.

SaskPower's system for generating and distributing power must be able to meet peak demands. Unlike city streets which meet average traffic flows, our power grid must be designed to handle peak electricity flows. People cope with rush-hour traffic and expect some delays. But when you turn on your stove to make supper, you expect it to heat up immediately.



Energy use fluctuates during the day, and is higher in winter than summer.

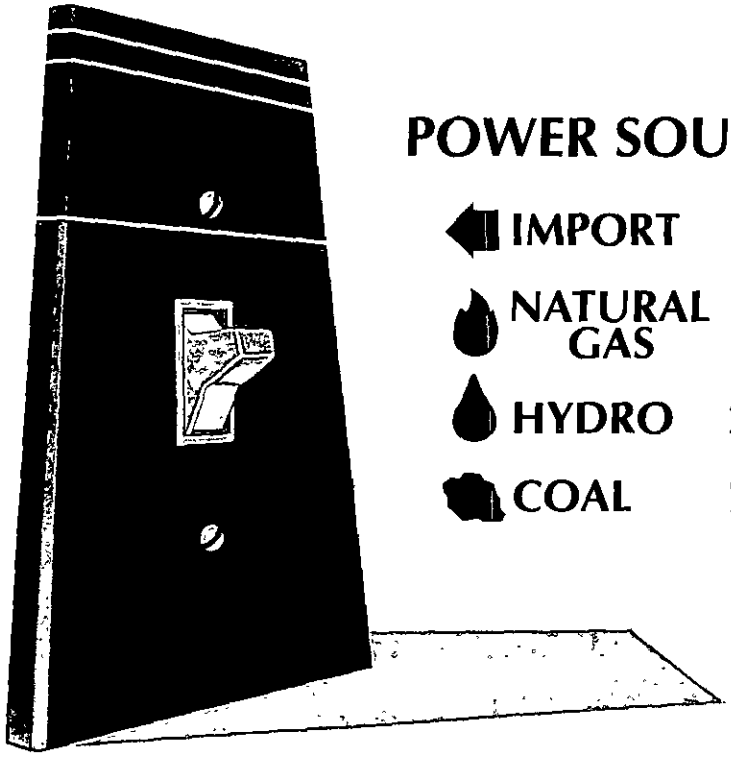


Block heaters and car warmers are just two of the reasons why electricity use is highest during Saskatchewan winters.

Producing electricity today

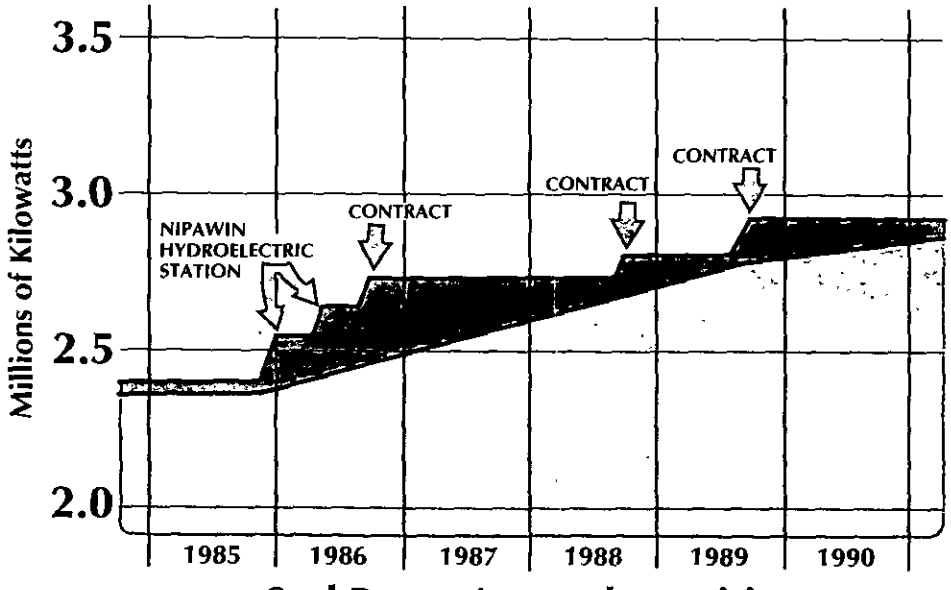
SaskPower operates 14 power stations across the province. Currently, we generate about 70 per cent of our electricity by burning coal, about 25 per cent from water, and the remainder by natural gas, imports, and a tiny fraction by diesel oil.

Heavy snow and rain in the mountains of Alberta are good news for SaskPower, because as that water flows down through Saskatchewan, we use it several times to generate power. We operate our four main hydro stations when we can most effectively use water instead of coal or other fuels. There is enough water for three small hydro stations near Uranium City to operate continuously, supplying power to the communities and mines served by the Athabasca Transmission Line in northern Saskatchewan.



POWER SOURCES

IMPORT	2%
NATURAL GAS	3%
HYDRO	25%
COAL	70%



SaskPower's supply position

☐ Electricity required ▩ Electrical supply available

▽ Electrical supply increase

As business, industry and individuals use more power, the total demand for power has increased steadily. SaskPower's capacity to provide electricity increases in steps as we add new generating facilities to our system, or sign contracts with other utilities to provide power. We must always have the capacity to meet peak demands.

In an average year, we generate about three per cent of our electricity from natural gas. Our gas-fired generators are used to meet peak demands, during emergencies or extreme weather, and when main hydro and coal-fired generating units are out of service for maintenance.

To deliver electricity from our power stations to our 410,000 customers, we maintain more than 140,000 km of transmission and distribution lines, enough to circle the earth 3 1/2 times.

We also have transmission lines connecting us with utilities in Manitoba, Alberta and North Dakota which allow us to buy and sell power. We have some long-term contracts with these utilities – for example, we take power in winter from North Dakota when our needs are greatest, and provide power to them in the summer when they need it most.

On a daily basis, each utility assesses whether it can purchase power more economically than generate it. We also use these connections to meet peak demands and emergencies. In a typical year, we buy about two per cent of our total electricity, and sell about one per cent.

If all our power stations could run all the time, we would need just enough generating capacity to meet our most likely peak demand. However, we must make allowances for regular maintenance and occasional equipment failures. We also must be able to meet unusual peak requirements caused by unseasonable weather.

Therefore, to ensure truly reliable service, we have a safety margin of between 15 and 20 per cent, which is called "generation reserve capacity." When this reserve capacity is not needed in Saskatchewan, we can use it to produce electricity to sell to other utilities.

Where our electricity comes from

Coal stations

1. Poplar River
   592,000 kW
2. Boundary Dam
   875,000 kW
3. Estevan
   65,000 kW
4. Shand
   300,000 kW (under construction)

Hydro stations

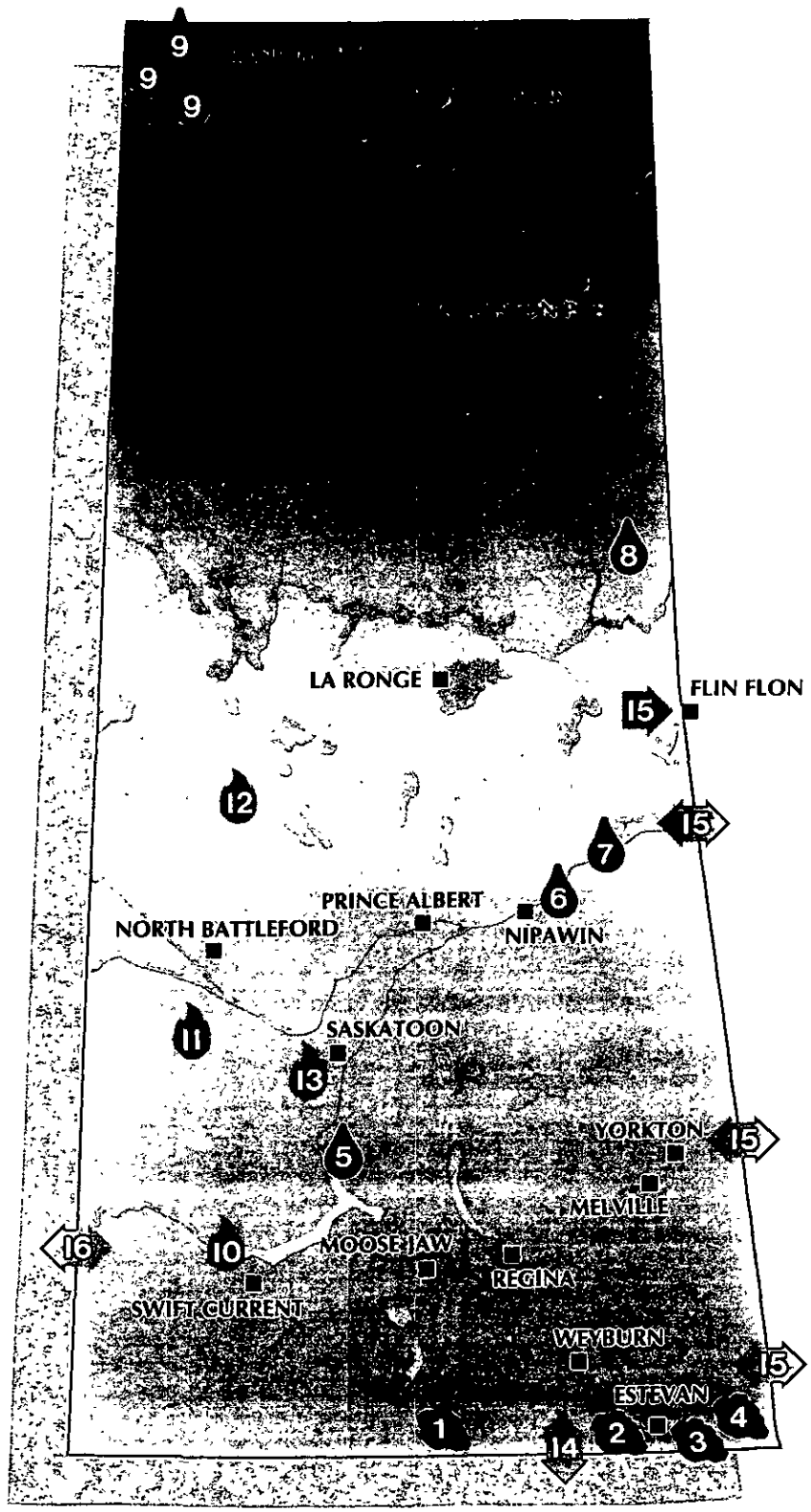
5. Coteau Creek
   186,000 kW
6. Nipawin
   255,000 kW
7. E.B. Campbell
   288,000 kW
8. Island Falls
   95,000 kW
9. Athabasca Hydro System
   23,000 kW

Natural gas stations

10. Success
    30,000 kW
11. Landis
    60,000 kW
12. Meadow Lake
    46,000 kW
13. Queen Elizabeth
    232,000 kW

Interconnections

14. North Dakota
15. Manitoba
16. Alberta



CHAPTER 3

Using electricity in the future

As society relies more and more on technology, it also increases its reliance on electricity. As long as current trends continue, we can expect to need more electricity in the future. Even if the amount of power required remains constant, we need to plan for new sources of electricity because our existing power stations will not last forever. For example, coal-fired plants generally have a useful life of 30 years. Sometimes we can extend this, but eventually they must be retired. Our Estevan Generating Station, which has been producing power since 1949, is scheduled to be closed in 1992.

Users of electricity expect it to be reliable and affordable. Increasingly, they also want to know that it is generated and delivered in an environmentally responsible manner. That is why SaskPower is inviting you to become involved. We welcome your opinions about the options that can be used to meet future needs and where future demand may be different than our current predictions.

Planning today will ensure an economical and environmentally sound supply of electricity for us and for future generations.

Predicting tomorrow's needs

SaskPower's planners use a variety of information sources for economic forecasts, provincial development strategies, population projections and other factors likely to affect electrical use in the future. Most of these factors cannot be firmly predicted.

SaskPower's planners are looking well into the 21st century to anticipate how much electricity will be needed. They must plan well ahead because it takes 10 years or more to plan and construct a major power station. The stages in developing a power station include conducting feasibility, design and environmental impact studies, seeking various approvals, and finally building the plant and the transmission lines to incorporate it into the power system.

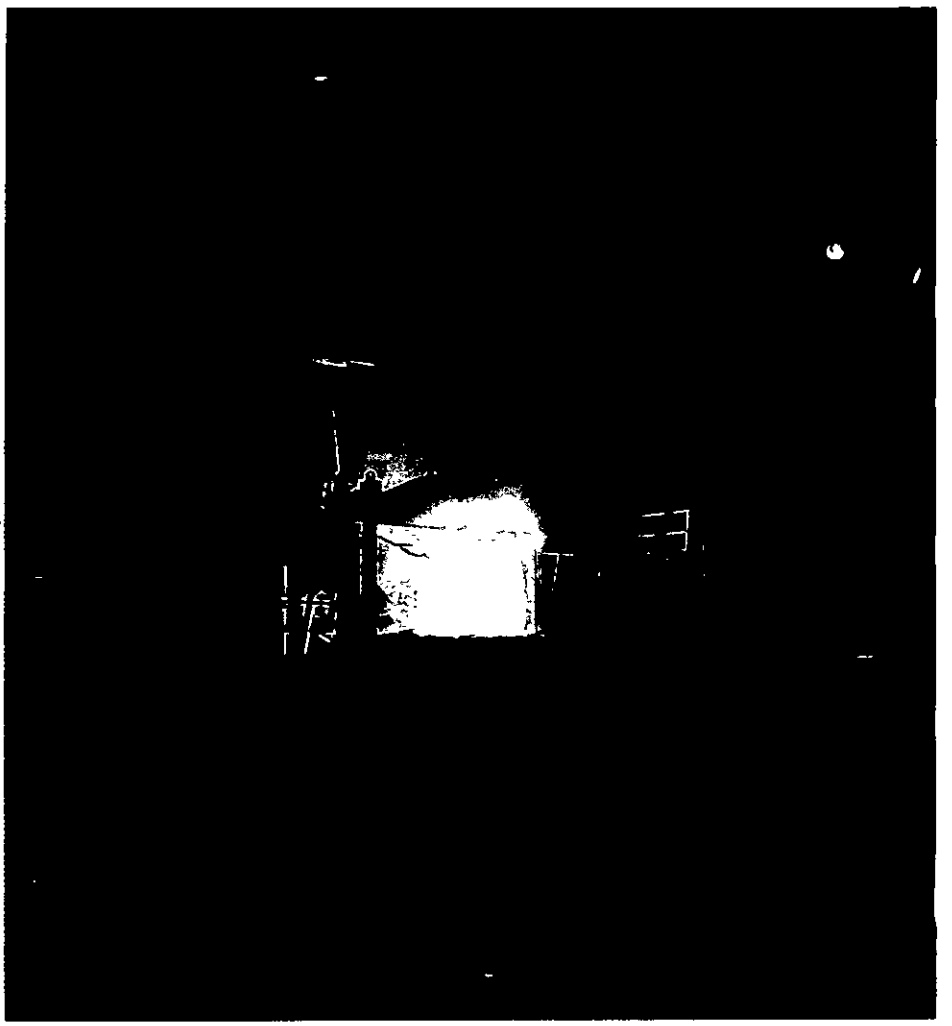
Although there are many uncertainties in forecasting, we must be prepared to meet the most likely future needs. If we underestimate, there may not be enough power. But, if we forecast too high, we may build facilities before they are needed.

Our current 10-year forecast predicts that overall consumption of electricity will increase by between 2.4 and 3.1 per cent per year. By comparison, in the past 10 years, energy requirements grew an average of 3.8 per cent annually.

The lower increases predicted in the decade ahead include the anticipated effects of conservation and improved efficiency of industrial equipment and home appliances. For example, new refrigerators now being manufactured in Ontario and the United States will use 35 per cent less electricity than older models. New freezers will use 30 per cent less power, as a result of improved efficiency standards.

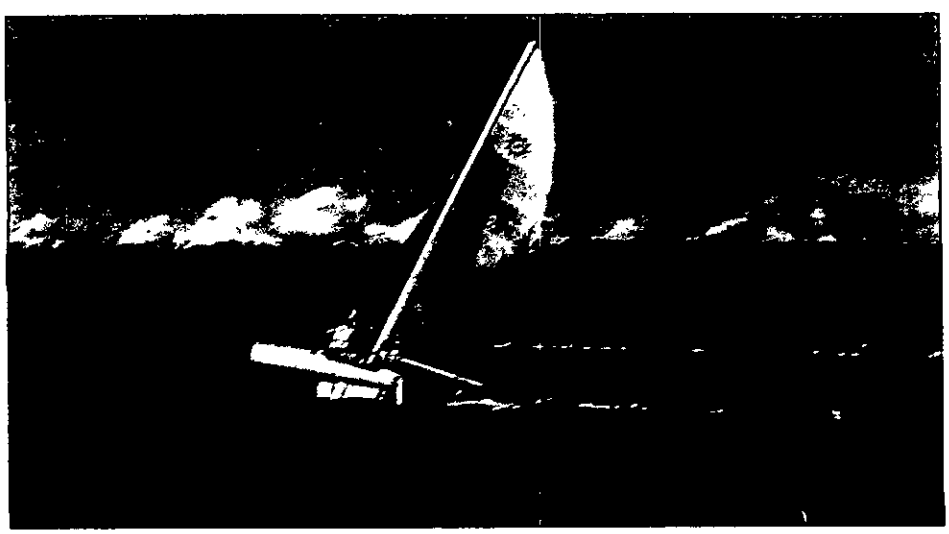
Notwithstanding improved efficiencies, we predict that consumption will continue to increase annually in every user category, ranging from 1.3 per cent for the farm sector, up to 4.4 per cent for industrial consumers.

Electricity plays a key role in scientific and technological advancements.



This electric arc furnace produces molten metal at IPSCO's steel refinery, Regina. Forecasts show that industries and businesses will have the highest rates of increased electrical consumption.

Life in northern communities became more convenient when reliable hydro power replaced expensive diesel generated power. Families can now use appliances like electric ranges and dryers, not permitted before.



Environmental protection is a responsibility SaskPower takes seriously.

We anticipate that northern Saskatchewan will see the greatest increase in electrical use. Restrictions on electrical use were lifted in communities where diesel generated power was phased out. Residents there can now use electric heat and appliances not permitted before. Diesel generation will be replaced in several more communities within a few years. In addition, more mining is expected to take place in the north.

Population changes have a significant effect on electrical demand. Lifestyle changes may also affect electrical use. Current 10-year predictions suggest a modest growth in the number of households based on forecasts of the provincial population and the average size of households. And, although home appliances are becoming more efficient, their numbers continue to grow. As a result, we expect the electrical use per household to increase.

The agricultural outlook is for fewer farms in Saskatchewan, but each farm is likely to use more power. Electric pumps will provide irrigation on more farms. Farmers will use an ever-expanding selection of labor-saving electrical equipment to improve the efficiency of their operations.

The largest increases are forecast for the commercial and industrial categories. If economic diversification and industrial development continue in the province, a reliable and cost-effective supply of electricity will be essential. Based on predictions of continued growth, we expect to serve more businesses in these categories, and each will probably use more electricity. For example, as offices and factories become more and more automated, they will rely on more electricity to improve their productivity.

Incorporating environmental concerns in our planning

Today, when deciding how best to meet the province's growing need for electricity, SaskPower's planners must include

environmental factors that were not considered decades ago.

In the past, most people were not aware of how their actions affected the environment. Today we are all beginning to understand some of the long-term implications of our actions.

People around the world are now concerned about global warming, acid rain, ozone depletion and many other environmental issues. These now play a major role in deciding how electricity is used and produced.

For example, if the government of Canada introduces restrictions on carbon dioxide (CO_2) emissions to help reduce global warming, it will have a dramatic effect on how SaskPower generates electricity. We may have to retire some of our current coal-fired plants and find new sources of generation.

Individuals also affect the environment through the choices they make about using electricity. To protect the environment, people will have to change their lifestyles or their traditional ways of doing business.

These changes may in turn have consequences for SaskPower. For example, a large industry could convert from burning fuel to using electricity in order to meet their energy needs and at the same time comply with air emission standards. This would increase the amount of power we would have to produce, and could mean that we would have to burn more fuel. In effect, it would just move the source of emissions from the industry to SaskPower.

Whether we speak of SaskPower or of consumers, making changes to protect the environment can happen quickly or over a longer period of time. There may be monetary costs to adapting quickly, and environmental costs to doing it more slowly.

Collectively, we must meet the challenge of providing and using electricity in a responsible manner, balancing environmental, social and financial considerations.

The decisions we all make now will affect life for future generations.

CHAPTER 4

Weighing our options

There are several ways to close the gap between the amount of power needed in the future, and the amount of power we can produce. We can reduce the amount needed, increase the amount produced, or do a combination of both. First, we will look at ways to reduce the demand for power.

Reducing demand

If less power is consumed, less power has to be generated. That saves the resources that would have been used as fuel, and reduces the amount of wastes that must either be dealt with or released into the environment.

In the long term, reduced demand also means SaskPower will be able to defer building new generating facilities, which will postpone not only the cost of building and operating the facilities, but also the need for materials that would have gone into them.

Demand side management

Demand side management is an option in which the utility promotes changes in the way consumers use electricity. These changes can result in lower electrical consumption through conservation, lower peak demand, or both.

Consumers are the key to demand side management programs. In most cases they must make the decisions to change how they use electricity.

Some individuals and businesses have been practising conservation for years. In the past, the main motivation for conservation was to save money, but more recently people also have begun to consider the environmental benefits of conservation.

Demand side management programs can include such things as information campaigns promoting efficient equipment and lighting, rebates to encourage customers to purchase energy-efficient equipment, and rate structures which provide financial incentives to conserve electricity.

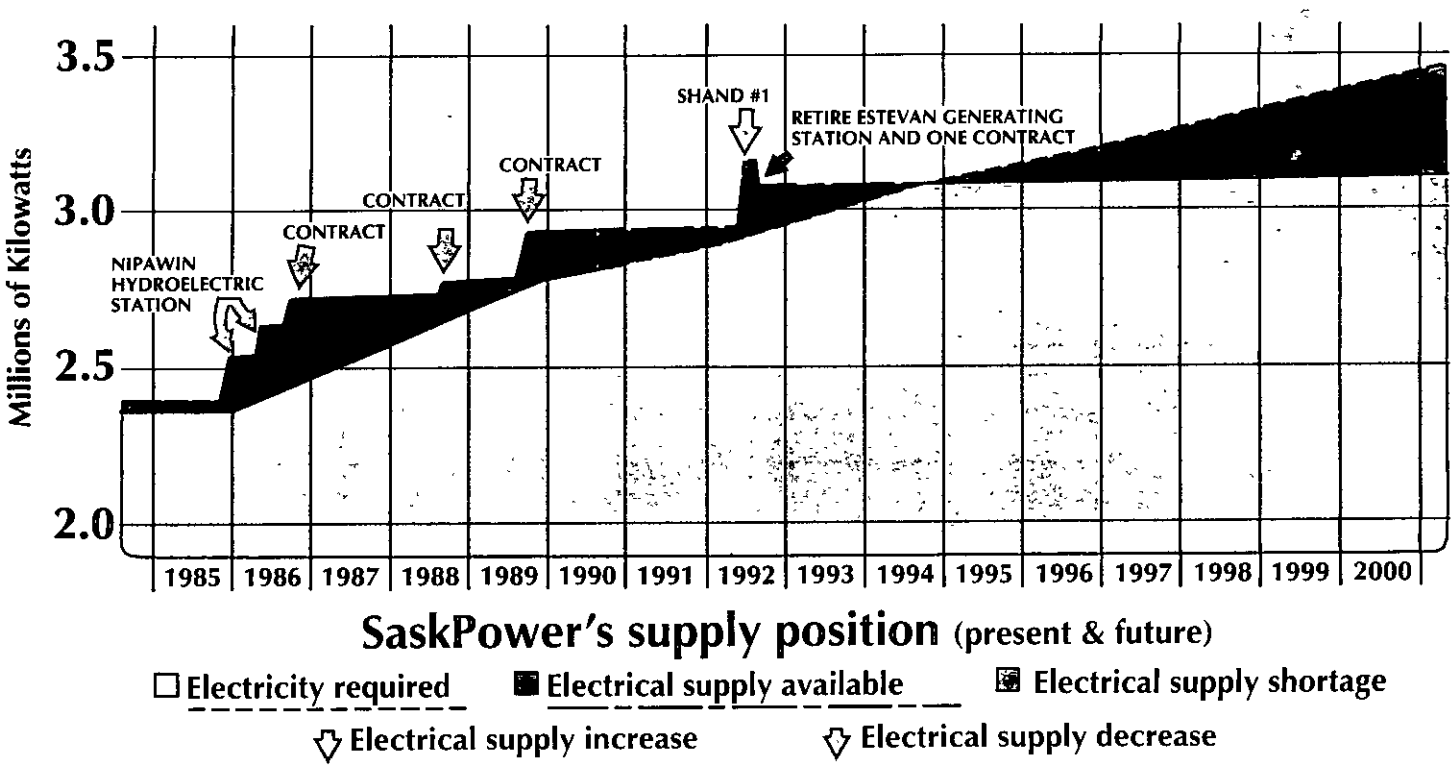
Utilities could enforce demand side management programs by making them conditions for service. Governments could legislate demand side management through such things as mandatory efficiency standards for electric motors and household appliances.

Large industrial and commercial consumers including SaskPower can help reduce peak loads in two ways. They can reduce their load during peak demand periods, which is called peak clipping. Or they can alter their pattern of use by shifting their demand for power to times when demand on the electrical system is low. This is called load shifting, and can be done by concentrating production in a factory when overall demand is low, typically late at night or early in the morning.

The greatest potential for demand side management is in the industrial and commercial sectors, because they have large, continuous power requirements for lighting and motors.

Demand side management programs are cost effective when the cost to the utility for promotion and financial incentives, plus the cost to the consumers for retrofitting or changing their operations, is less than what it would cost to provide additional power.

Demand side management is most



Our current forecasts show that in the mid 1990s, demand will outstrip our ability to provide power. Well before that occurs, we must take actions to either reduce demand or increase supply, or a combination of both.

appropriate when demand for power is increasing rapidly. If the demand for power is decreasing or increasing at relatively modest rates, demand side management would contribute to higher electrical rates because the utility would have to continue to pay for its existing facilities, even if they were not being used.

There are limits to the amount of economic demand side management that is available to a utility.

Opinions vary widely on the potential for demand side management savings in Saskatchewan. By the year 2000, SaskPower forecasts reductions of 150,000 to 200,000 kW from the growth that would have occurred without demand side management. A recent study by a consultant suggested a potential for an additional reduction of 200,000 kW in demand growth. Making such large savings through demand side management would require either substantial investment by consumers or significant changes in lifestyle.

The greatest potential for demand side management is in the industrial and commercial sectors.

Increasing supply

There is no perfect source of electricity. There is a wide variety of ways to produce electricity, and each one has its own set of environmental, technical, social and economic advantages and disadvantages.

The methods used in Saskatchewan in the future will depend in part on the resources available here. What will work well in some areas of the world may not be a practical solution in others. The mix of power sources chosen will depend on the assessment of their short- and long-term economic, social and environmental impacts. In choosing this mix, SaskPower wants to reflect the values of Saskatchewan people.

This section will outline some of the major options available, and describe them in relation to their generally recognized advantages and disadvantages, as well as their potential for meeting Saskatchewan's future electrical needs. Fuel cells, fusion and using hydrogen as fuel are not included here, as they are not considered viable options to produce significant amounts of power within the next 10 to 15 years.

Burning fuels to produce electricity

Electricity can be generated by burning fuel to create steam or heat which spins a turbine generator to produce electricity. We will describe a variety of fuels in the following section.

To a large extent, the advantages and disadvantages of each option depend upon which fuel is used. In evaluating these options, we must consider not only the fuel itself, but the environmental impacts of obtaining, processing and transporting the fuel, and the by-products of burning it.

Most available fuels are not renewable resources. Burning non-renewable fossil fuels not only depletes their supply, but can also contribute to several environmental problems, including acid rain, global warming, and pollution of land, air and water.

Technological solutions have been developed to reduce or eliminate some of the environmental impacts of burning fuels. For example:

- Scrubbers or other technology can reduce sulphur dioxide (SO_2) emissions from coal-fired plants which contribute to acid rain.
- Specially designed burners can reduce nitrous oxide (NO_x) emissions which also contribute to acid rain as well as to ground level ozone production which contributes to smog.
- Electrostatic precipitators can capture fly ash before it leaves power plant chimneys.
- To prevent cooling water from degrading the quality of water sources, power plants can use air for cooling, or use closed-loop water cooling systems where no water is allowed back into the environment.
- After mining or harvesting fuel, land can be restored for agricultural use or wildlife habitat.
- CO_2 is one of the normal and unavoidable consequences of burning any carbon-based fuel. However, there are ways to help offset the environmental impact of burning such fuels. One way is to grow more trees, because they absorb CO_2 and help "clean" the air. Another is to capture CO_2 and use it elsewhere.

Biomass

When used in the context of generating electricity, biomass includes such things as wood, peat, and even municipal garbage, which can be burned to generate power. Most of these fuels are renewable resources. The cost of producing power using biomass varies greatly, depending mostly on the cost of the fuel.

Peat is one of the early stages in the formation of coal. It is technically feasible to use peat for electric power generation. Several areas across central Saskatchewan have potential for developing this fuel source. Saskatchewan Energy and Mines estimates that 30 to 100 million tonnes of peat can be economically harvested. This could be used as a 30-year fuel supply for a 100,000 to 300,000 kW generating station.

Peat must be processed to remove water

before it can be burned. It produces less heat than an equivalent weight of lignite coal. Currently, power plants in Finland, Ireland and the Soviet Union use peat as fuel. The Soviet Union has more than 80 peat-fired power plants.

There are several places in the world which burn garbage in large incinerators to produce power.

Decomposing garbage in existing landfill sites creates gas with a high methane content, which can also be burned to produce electricity. If garbage or landfill gas could be used effectively it could solve two problems — providing power and disposing of garbage and landfill gas which may otherwise contaminate the environment.

Natural gas

Natural gas could be called the fast food of electric generation. It's more expensive than our regular energy sources of coal and water, but it's convenient to use occasionally to meet peak demand.

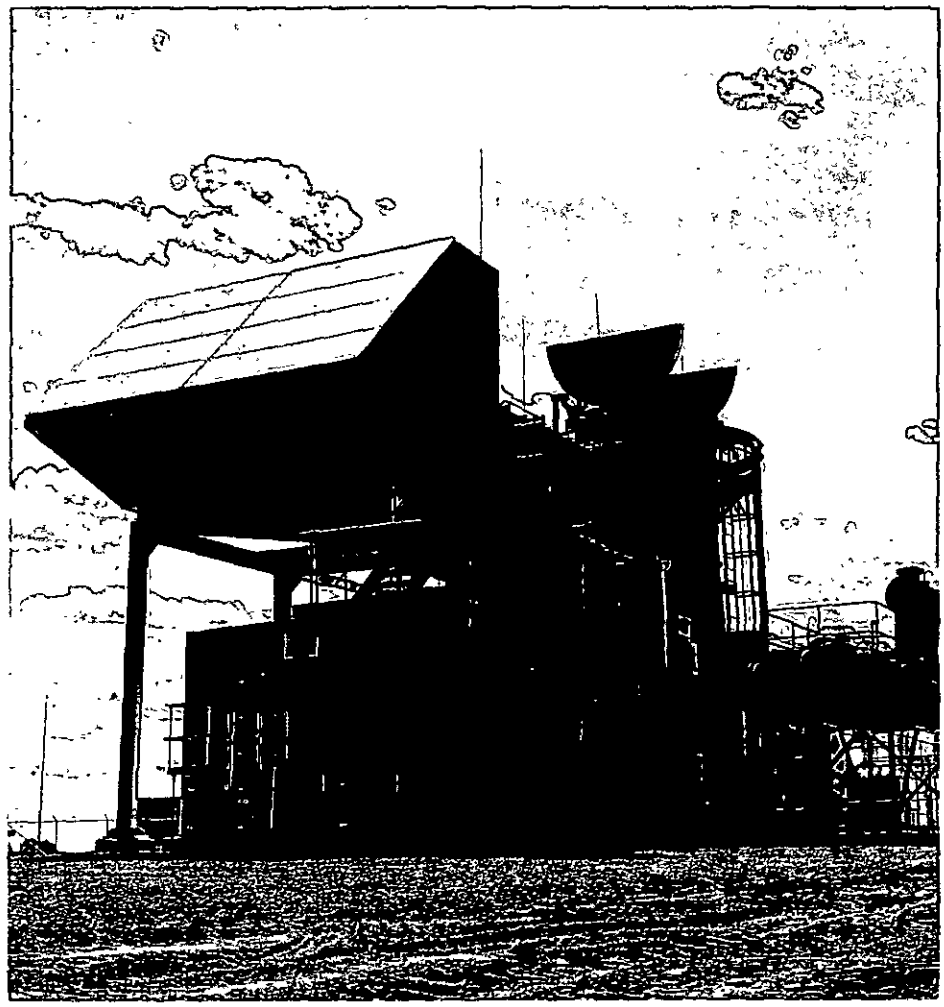
Building a gas turbine costs less than building a coal-fired or hydroelectric station. It also takes less time. But the cost of natural gas makes them more expensive to operate. Also, we cannot be assured of a long-term supply of economically priced natural gas.

Compared to coal, natural gas produces only about one half the amount of CO_2 to generate an equal amount of electricity.

There is another opportunity to use natural gas on a smaller scale in Saskatchewan. When companies drill for oil, they often find natural gas mixed with the oil. When there is not enough gas to sell economically, the common practice has been to flare, or burn it off.

There would be environmental and economic benefits to using this flared gas to produce electric power. It would add value to a non-renewable resource that is currently being wasted.

Forecasts show continued oil production in Saskatchewan for many years. Therefore, there is good potential for generating electricity using natural gas which would otherwise be flared.



The Meadow Lake Power Station burns natural gas, and is operated primarily to meet peak demands or during emergencies.

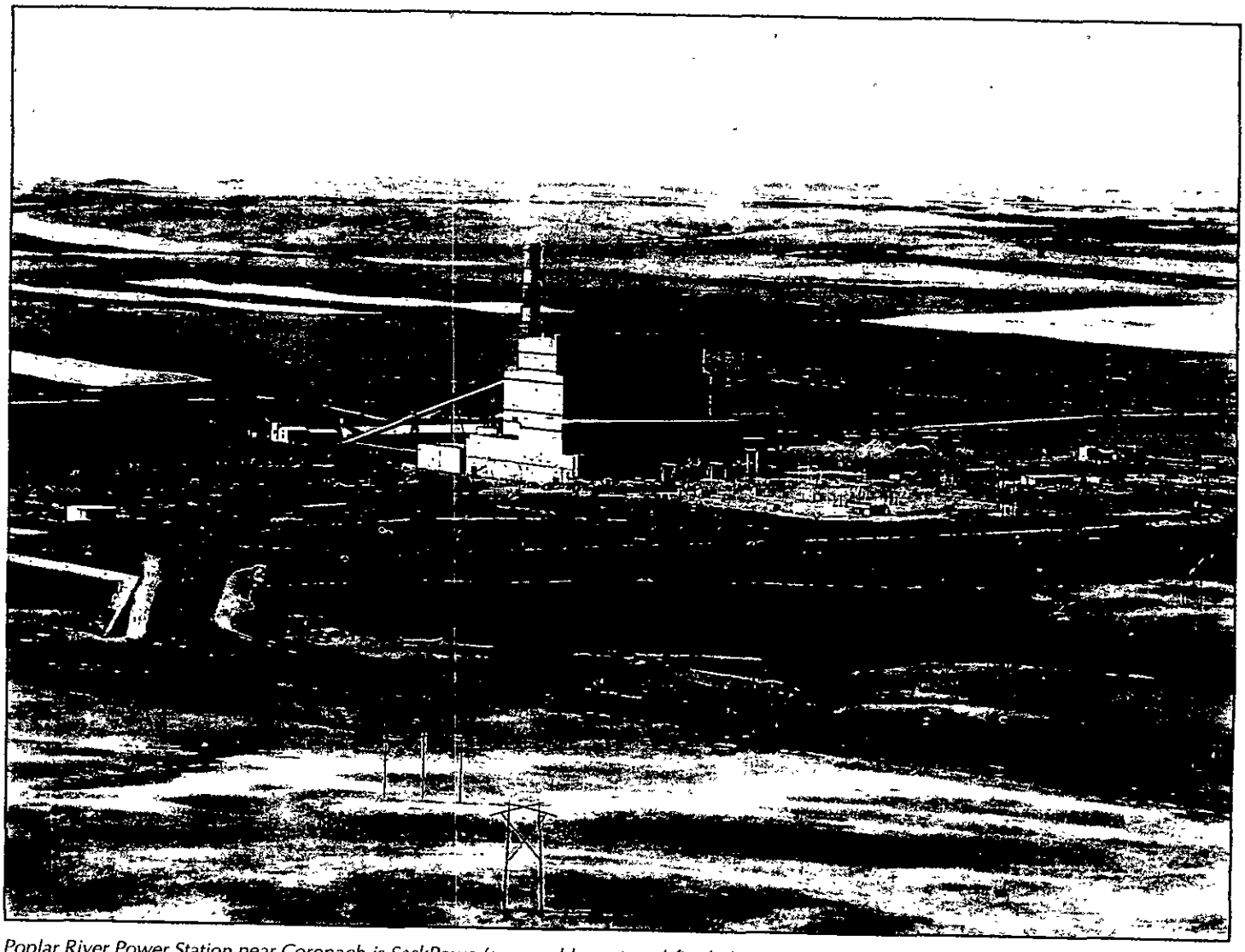
Diesel and fuel oil

Diesel and fuel oil can be burned to generate power. However, most utilities, including SaskPower, have been moving away from these fuels as they are significantly more expensive than other available fuels, and offer no particular environmental benefits.

Conventional coal generation

Saskatchewan is the third largest producer of coal in Canada. This resource is found close to the earth's surface in several areas along the southern boundary of the province. Based on known reserves, and at current levels of use, Saskatchewan has enough coal to generate electricity for at least 200 years.

The lignite coal found in Saskatchewan



Poplar River Power Station near Coronach is SaskPower's second-largest coal-fired plant.

has a low sulphur content but still contributes to acid rain.

A conventional coal-fired plant uses about seven per cent of the electricity it produces, for its own internal operations.

Clean-coal generation

Since coal is available in large quantities, it is expected that it will play a continuing role in meeting the world's future energy needs.

In response to new environmental challenges, the coal and electric power industries are examining the feasibility of integrated coal gasification combined cycle technology. Known as clean-coal technology, it can be used to burn ordinary coal cleanly and more efficiently.

The process converts coal to gas, which first burns relatively cleanly in a combustion turbine. Then the surplus heat from this turbine is recovered in a boiler to make steam to produce more electricity. This could improve its efficiency by up to 30 per cent over conventional steam generation.

CO_2 and the gases that produce acid rain can be captured more easily using clean-coal technology than using conventional technology. This CO_2 may be used to produce more oil through enhanced oil recovery.

Feasibility studies are underway in western Canada to determine the technical and environmental appropriateness of clean-coal technology.

Though still in the developmental stages, this process is expected to be more costly than conventional coal-fired generation. It would use between 10 and 12 per cent of the power generated for internal operations.

Generating electricity without burning fuels

Other options to generate power are methods which do not involve burning fuels. The main environmental advantage of these options is that no air emissions are created by operating the generator.

Solar

The energy from the sun can be captured and converted to electricity in two different ways.

The solar thermal method uses the sun's heat to create steam which is used in a conventional system to generate electricity. Technology is available for solar thermal power plants in the 10,000 to 80,000 kW range. This is sufficient power to serve between 2,000 and 16,000 homes.

Solar panels (photovoltaic cells) convert solar radiation directly into electricity. Photovoltaic solar energy is now commonly used in many consumer goods such as wrist watches and calculators, to produce tiny amounts of power.

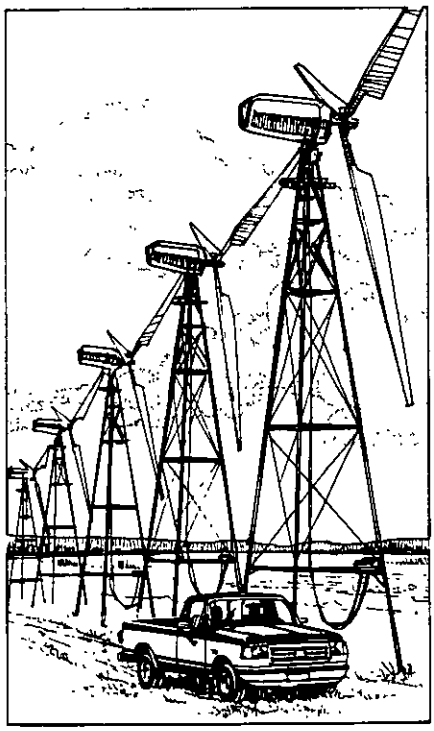
There are a number of experimental photovoltaic power plants in the United States with peak outputs in the range of about 5000 kW. This would meet the needs of 1000 average households, during daylight hours. Using current technology, electricity generated by photovoltaic methods in Saskatchewan would require about five acres to produce 1000 kW.

Operating a solar-powered generator does not create any waste products.

Sunshine is free but its availability is limited by darkness and heavy clouds. Saskatchewan has abundant sunshine in the summer. However, in winter, when energy use historically has been highest, the sun provides about one half of the solar energy available during the summer.

Wind

Since ancient times, people have harnessed the power of the wind for such things as sailing ships and grinding grain. More recently, they learned to convert wind power into electricity. The first windmill to drive an electrical generator was used in Denmark in the late nineteenth century.



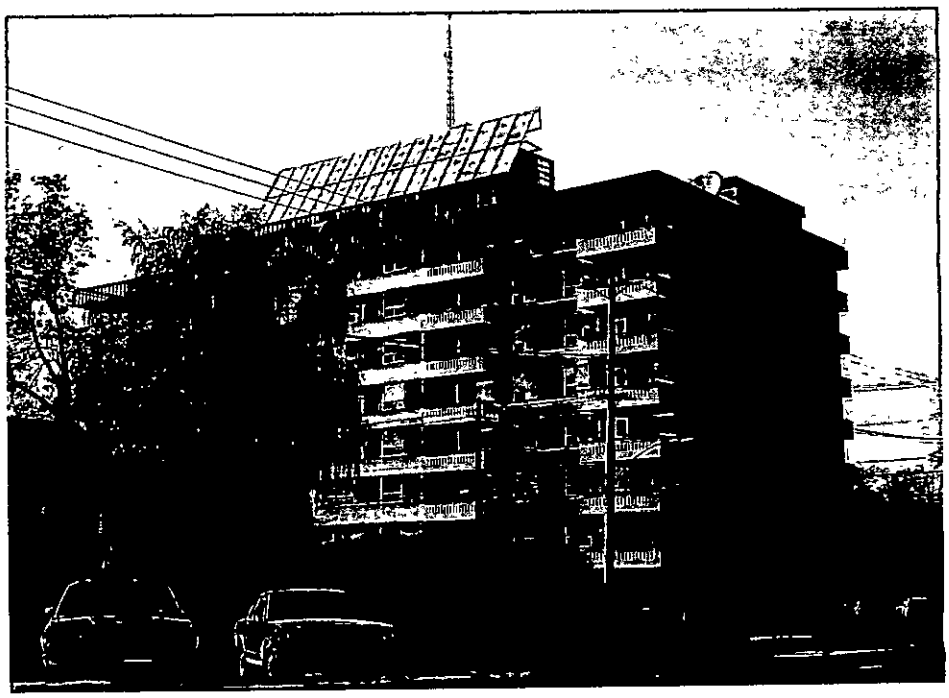
Windmills on a wind farm.

In theory, a wind turbine is capable of converting up to 60 per cent of the total available wind power into electricity. However, in practice, efficiencies in the range of 30 to 40 per cent have been achieved. Wind turbines typically operate in winds between 20 and 70 kilometres per hour. On average, they can produce electricity about 20 to 30 per cent of the time.

Currently, most commonly used windmills are in the 100 to 200 kW range, while larger machines, 1000 to 4000 kW, are still in the developmental stages.

In California, high-tech windmills fill huge fields called "wind farms." Typically, a windmill will require one acre of ground in a suitable location to produce between 35 and 60 kW.

Wind generation produces no waste products, and the wind provides a free source of energy. However, the supply is unpredictable.



These solar panels produce hot water for the apartment residents.

Geothermal

Geothermal energy uses the earth's interior heat. This is the same heat that produces volcanoes, lava flows, hot springs and geysers. Geothermal energy is most viable in areas where this heat is close to the earth's surface, like the Yellowstone area of the United States. Under suitable conditions, this heat can be harnessed to generate electricity.

The geologic zones below most of Saskatchewan are not hot enough to make steam to turn an electric generator. A project at the University of Regina found water well below the boiling point. It may, however, be possible to use this lower heat for space heating and thereby replace or supplement other heating methods.

Nuclear

In the late 1930s, the discovery of nuclear fission led to a new source of electric power. Canadian nuclear technology is well developed, and has been used for 33 years in six countries around the world. Close to half of Ontario's electricity is now produced by nuclear power plants. Quebec and New Brunswick also use nuclear power.

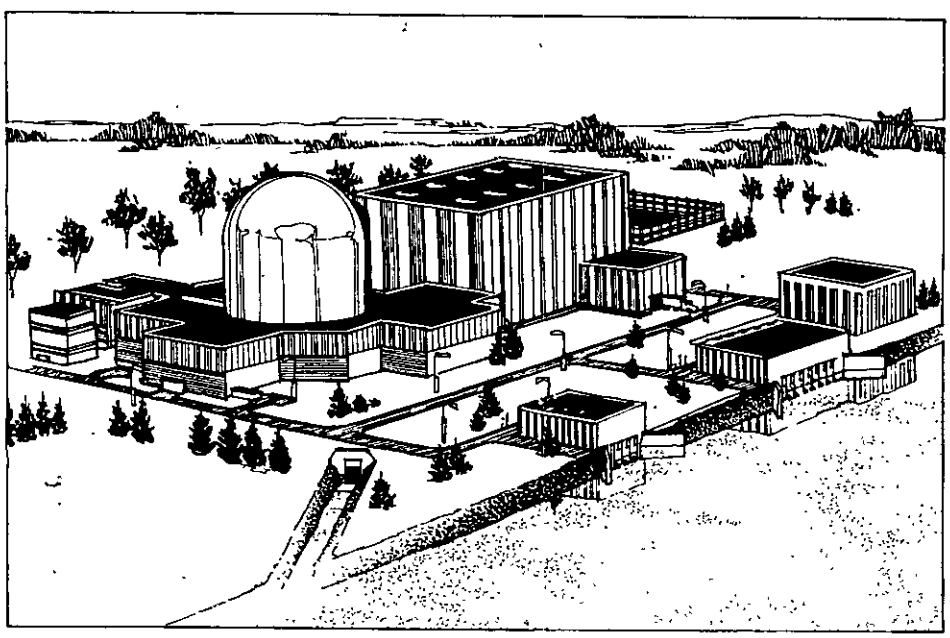
Canada is the world's leading uranium producer, and more than half of Canada's uranium is located in Saskatchewan. At current rates of production, Canada's known and speculative reserves are sufficient for approximately 150 years .

The main barrier to developing nuclear power has been low public acceptance. People have concerns about health effects, safety and long-term waste management.

To ensure safety for employees and the public, nuclear development in Canada is strictly regulated and requires several back-up systems to reduce the risks of mechanical failure or human error.

Recent research has suggested that used nuclear fuel can be stored safely in specially designed containers buried deep in the Canadian Shield.

A nuclear power station requires a large supply of cooling water. Building a nuclear power station is a capital intensive project, but once built, it has relatively low operating costs. It uses between seven and eight per cent of its power for internal use. There may be significant costs associated with retiring a nuclear power plant.



A CANDU 3 nuclear power station would resemble this illustration.

Hydro

People have harnessed the energy of rivers for centuries. Even before the Industrial Revolution, water wheels were used in flour mills. Later, falling water was used to spin the turbines of electric generators.

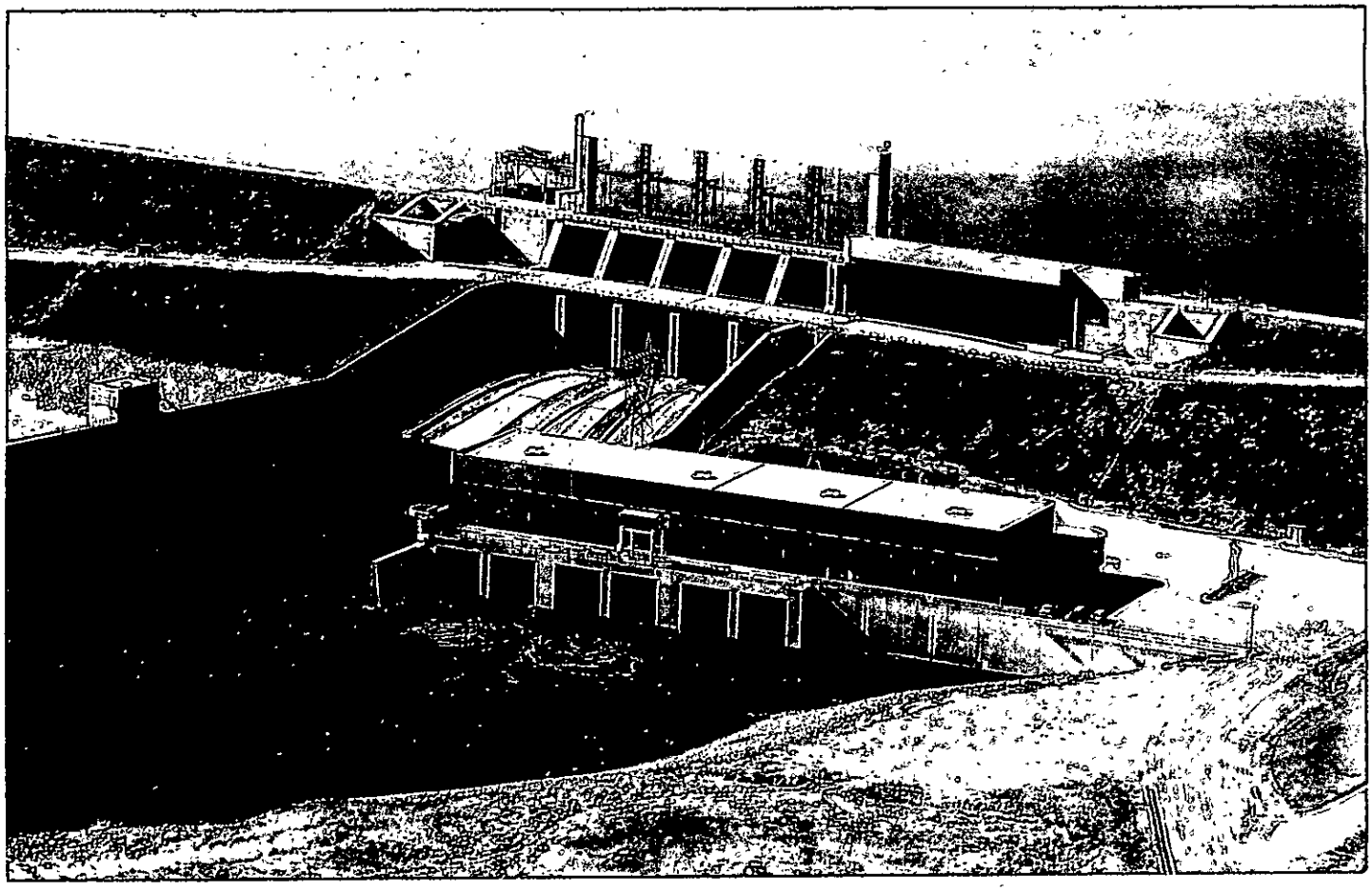
The estimated undeveloped hydroelectric potential on the major river systems in Saskatchewan is 1,500,000 kW. Of this total, 1,000,000 kW is on the Saskatchewan River system in central Saskatchewan. In the north, the potential is 400,000 kW for the Churchill River and 100,000 kW for the Lake Athabasca drainage area.

Small hydro production uses plants with a generating capacity of 50,000 kW and below. The potential for small hydro is primarily limited to northern Saskatchewan. Other than on the Saskatchewan River system, water flows on streams in the south vary too much from season to season and year to year to operate hydro plants reliably.

It is more expensive to build a hydro station than either a coal-fired or natural gas plant. However, once it is built, operating a hydroelectric station is relatively economical. It uses a renewable resource, but the supply varies with the weather. It uses less than one per cent of the power generated for its own operations.

Building a hydroelectric station affects the environment by creating a reservoir. This could eliminate farmland and alter wildlife habitat. The dams may block natural fish migration. Operating the station causes water levels to fluctuate.

On the other hand, the reservoir may provide water for irrigation, new wildlife habitat and recreational opportunities. As well, dams can protect downstream communities from flooding during high river flows.



The Nipawin Hydroelectric Station on the Saskatchewan River is our second largest hydro station.

Buying electricity from other producers

From neighboring utilities

One way to meet consumers' needs is to buy electricity.

Through existing and future interconnections with neighboring utilities, we can purchase power and assist each other during emergencies.

As part of our long-term plan for supplying electricity, we invite proposals from other utilities who may wish to sell power. We evaluate these proposals, and weigh the cost of purchasing power against the cost of building new facilities and generating our own. Reliability of supply is also a factor.

We can consider the environmental advantages and disadvantages of the sources of this imported electricity compared with the generation options within Saskatchewan.

Society may also consider the implications of economic development which may result from building a new power station in the province.

From other generators

SaskPower will consider proposals to buy electricity from non-utility generators, which may be private investors, businesses or industries.

Biomass generation may be attractive to industries which produce waste products that can be used as fuel for power production. For example, a paper company could burn waste wood and generate power, either for its own use or to sell to SaskPower.

In co-generation, both electricity and useful steam or hot gases are produced simultaneously. The steam or heat are used elsewhere in the operation. Co-generation offers the advantage of improving overall energy efficiency by generating electricity using heat that would otherwise be wasted. This can also improve the economic viability of the business.

Non-utility generators, like any power producers, must comply with all federal and provincial environmental regulations and safety standards.

We have received a number of proposals for non-utility generation, ranging in size from less than 100 kW to 50,000 kW. If

the proposed projects can be integrated into our system effectively, we may be able to defer construction of some of our future generating stations.

The price we pay for non-utility power is based on many factors, including the size of the project, the length of the contract, and when the electricity would be available to SaskPower.

Things to consider for each generating option

Transportation and transmission

As we weigh the advantages and disadvantages of each option for generating electricity, we must consider where the resource is located in relation to where the power will be used. Unless the resource and the population centre are in the same place, we must either transport the fuel from its source or transmit the electricity to where it is needed.

For example, in the past we have found it more economical to build most of our coal-fired power plants close to the coal fields, and thereby reduce our transportation costs. Transmission lines connect these power plants to the major population centres, most of which are located in the southern half of the province.

Because only a small amount of fuel is needed for nuclear power plants, transportation costs are not a major factor influencing where they can be located, but the availability of cooling water is a factor.

Hydro plants can only be developed where the resource exists. The farther these sites are from population centres, the longer the transmission lines must be.

Transmission lines are an additional expense, generally about 20 per cent of the cost of building a generating facility. In addition, the longer the line, the more power is lost as it is transmitted.

Building a transmission line alters the landscape and may change wildlife habitat or land use. The possible effects of electric and magnetic fields produced by transmission lines are another public concern. Electric and magnetic fields are also produced by distribution lines and household appliances. The potential environmental and health effects of these fields are still being researched.

The electricity which lights up the night sky can be produced by a variety of methods. Each method has advantages and disadvantages to consider.

Alternate uses

We must also consider whether generating electricity is the most appropriate use of the resources available to us. Most sources of electricity have more than one possible use. For example, natural gas is particularly suited for space heating and chemical processing, and diesel oil is used for transportation.

We must also consider possible alternate uses for the land which would be required for each generation and transmission option.

Environmental issues and uncertainties

When weighing the options, we must consider not only the direct environmental impacts of generating power, but impacts which may result from manufacturing the generating equipment and in mining or harvesting the fuel. Manufacturing anything uses natural resources and consumes energy.

We cannot be sure of all the potential environmental impacts which may be discovered in the future relating to generating options which are chosen today. If new problems are discovered, we may have to take additional steps to correct them. The costs of these corrective actions cannot be predicted at this time.

Conversely, if cheaper methods are developed in the future to solve problems which we have addressed using current technology, we will still have to pay our capital costs. This would make our power less cost-competitive than power generated by a utility which is able to use the new, less expensive methods.

Nor can we predict public response to environmental issues in the future which may affect our operations in many ways.

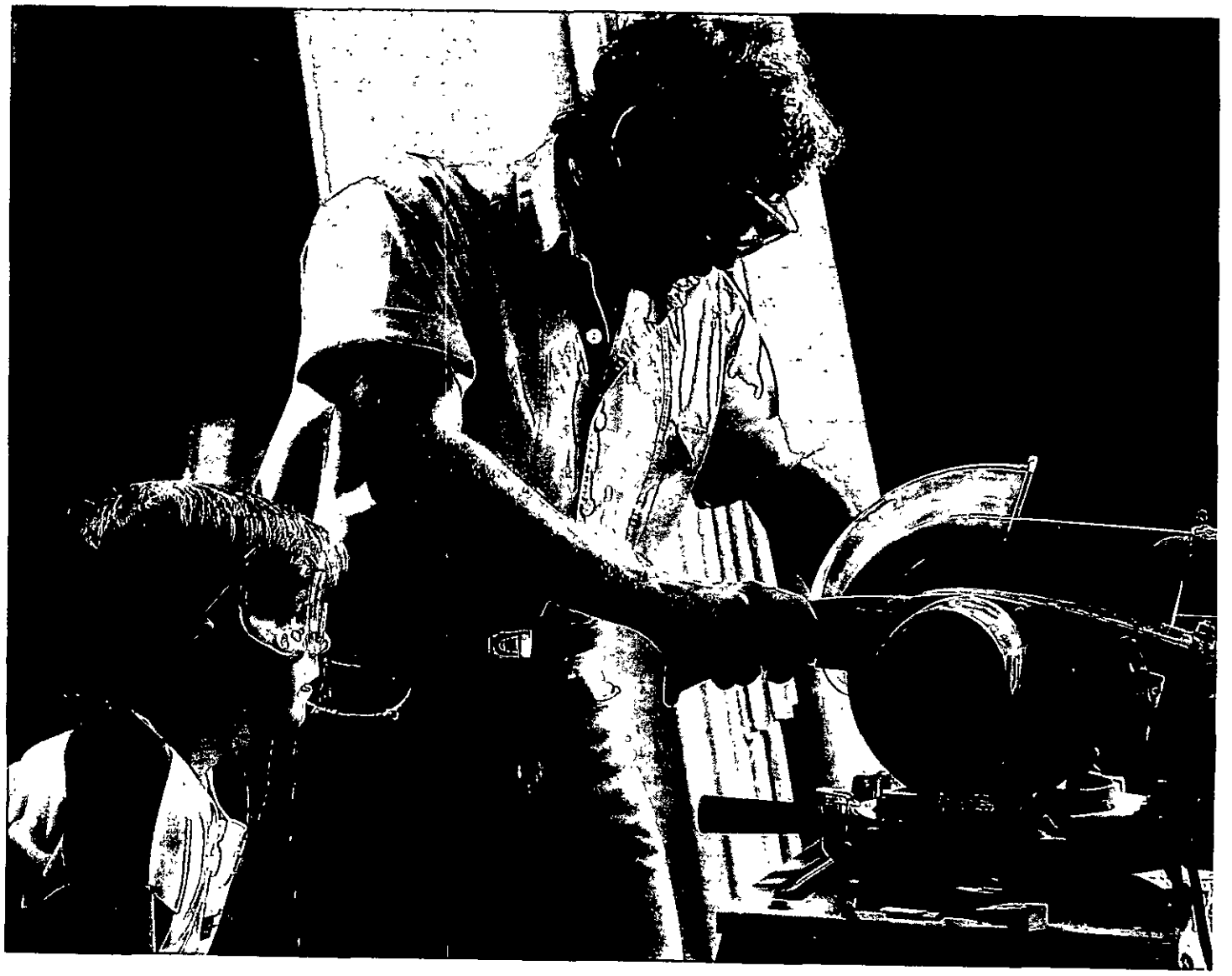
Cost factors for methods of generating electricity

This table lists various methods available to generate electricity. It compares them in terms of the useful life span of a generating facility, costs to build and operate it, and the potential for development in Saskatchewan.

Capacity Cost Installed *is the initial investment required to construct a generator, divided by its generating capacity.* Levelized Cost *is the cost of generating one kilowatt-hour, considering the initial investment and operating and maintenance costs.* MW *is a megawatt, equal to 1000 kilowatts.*

OPTION		Useful Life (yrs)	Capacity Cost Installed ($/kW)	Levelized Cost (cents/kW·h)	Potential
Coal (Conventional Method)		30	1370 - 1760	4.5 - 5.5	Adequate reserves for 200 years at current consumption rates
Clean-Coal (Gasification Combined Cycle)		30	2300	6.5	
Nuclear		40	2770	7.5	450 MW per site, limited by available sites
Major Hydro		50	1350 - 2950	4.0 - 13.5	1500 MW
Small Hydro (less than 50 MW)		50	2500 - 4400	7 - 13	600 MW
Solar Power (thermal)		30	3300 - 3700	16 - 22	Undetermined
Wind Power		15	1590	12 - 14	Undetermined
Natural Gas	Gas Turbine	25	400 - 500	8.0 - 15.5	Limited by fuel supply
	Combined Cycle	25	1150 - 1250	7.0 - 8.5	
Biomass	Waste Wood	30	Not available but are expected to be similar to coal	Will vary depending on fuel costs	Undetermined
	Peat	30			300 MW
	Garbage	30			20 MW
	Landfill Gas	25	500 - 800		2 MW
Geothermal		30	Undetermined	Undetermined	No capacity for electric generation

CHAPTER 5



SaskPower's initiatives

To balance supply, demand and the environment

If the demand for power continues to increase, and as some of our power stations are shut down due to their age or new environmental regulations, there will be a gap between the amount of electricity required and our capacity to generate power.

As stated earlier, there are three ways to close this gap – increase supply, reduce demand, or both.

SaskPower has initiatives in both directions as first steps towards closing the gap.

Demand side initiatives

During the past 10 years, demand side initiatives have resulted in a reduction of about 400,000 kW in potential demand growth, and 600 million kilowatt-hours of energy. We expect that through ongoing demand side management, we can continue to slow the rate of growth of electrical consumption in Saskatchewan.

In the next 10 years, current demand side management programs and those planned for the future are expected to reduce growth by 150,000 to 200,000 kW from the growth that would have been expected without such programs. These figures also include the anticipated continued results of more energy-efficient equipment becoming available. Our recent and on-going demand side initiatives are outlined here.

We have special time-of-use rates for large industrial and commercial customers, to encourage them to use less power during peak demand periods and more power in off-peak hours from 10 p.m. to 7 a.m.

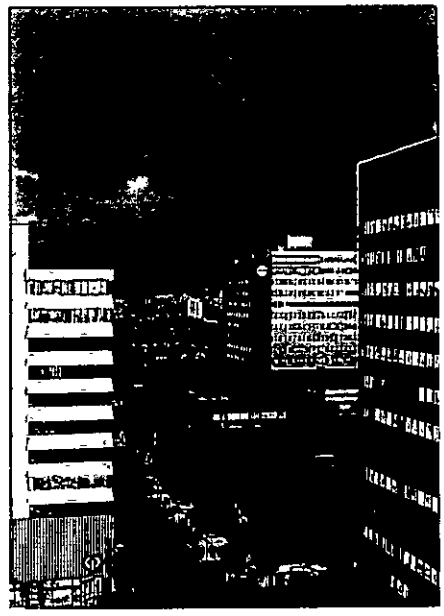
Two large industrial consumers and several irrigation operations have contracts for interruptible rates. This allows SaskPower to reduce power if necessary during our peak periods.

A three-year street light conversion program to replace all existing mercury vapor street lights with more efficient, high pressure sodium vapor lights will be completed this year. The new lights use half as much power to produce an equivalent amount of light. Many municipalities have chosen to increase the amount of lighting to improve safety in their communities, while significantly reducing their electrical use. Street lights always contribute to our peak load, so SaskPower will benefit both by reduced consumption and lower peak demand.

A similar program for farm yard lights will save 5,000 kW and more than 20 million kW h, if just half the yard lights in the province are converted.

In 1983, SaskPower introduced a program to expand natural gas service to rural areas. At that time, SaskPower provided both electricity and natural gas. This program is continuing, and as natural gas becomes available in more areas, more rural households may choose to convert to natural gas for space heating, rather than turning to electric heat. This will reduce SaskPower's future electrical requirements.

We estimate that, over the life of the natural gas program, these consumers represent potential demand side management savings of 330,000 kW, compared to the situation if they had all used electric heat. This is twice the demand of the city of Saskatoon.



Choices consumers make are the key to successful demand side management.

Thousands of Saskatchewan farms, including this one, have recently received natural gas service. The natural gas program has the potential to save about 723 million kilowatt-hours annually, which is more power than the Island Falls Power Station generated in 1989.

PowerWise programs

Through a variety of PowerWise programs, SaskPower provides consumers with information and advice on how they can use energy wisely. Our staff visit industrial and large commercial users to make them aware of ways they can operate more efficiently with electricity.

Our staff carefully explain how consumers are billed for their electrical use. They also tour facilities to identify possible ways to reduce electrical costs. For example, an industry could reduce its demand by staggering the times electric motors are operated, rather than running them simultaneously.

We present seminars to specific target groups such as hotel, restaurant, skating and curling rink operators, to demonstrate energy-efficient equipment and procedures relevant to their operations.

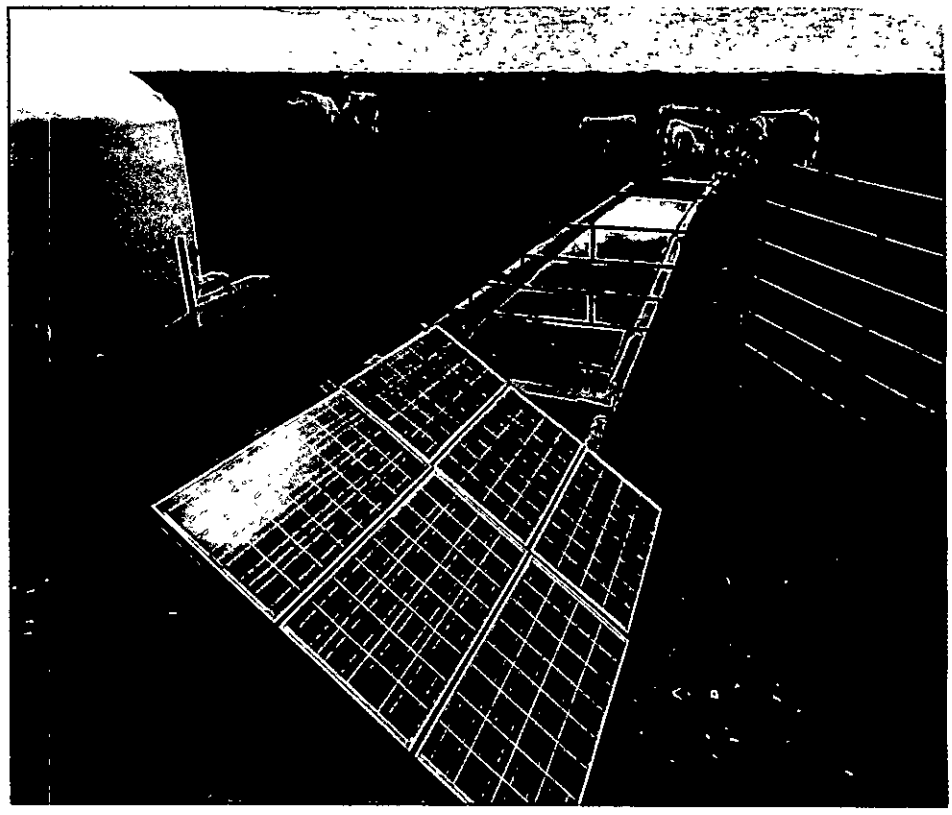
Low-interest loans are available to skating and curling rink operators to encourage them to install more energy-efficient equipment.

Another PowerWise program offers rebates to individuals who purchase efficient electric water heaters, and to retailers for each efficient water heater sold. The rebate to retailers will encourage them to stock these water heaters for the convenience of home-owners.

Commercial and industrial consumers can request an energy audit. These audits assess the nature of energy consumption by the business, and identify opportunities for cost-effective increases in energy efficiency.

SaskPower is also studying the feasibility of heat pumps for space and water heating in homes and small commercial businesses. Heat pumps are much more efficient than conventional electric heat, and can be less expensive than separate furnace and air conditioner units.

SaskPower is a co-sponsor of Power Place in Regina, which has a ground-source heat pump for space and water heating. Ground-source heat pumps absorb heat from the earth, and deliver it to a warmer space, in this case the house or water heater. We are evaluating these heat pumps to determine if they will be a more efficient substitute for conventional electric heating under Saskatchewan conditions.



Cattle on the Millie Community Pasture near Maple Creek rely on solar energy to power the pump for their watering trough. Solar power is well suited for this type of small load, located away from the main distribution system.

We produce a variety of printed materials to promote energy efficiency in the residential and farm sectors.

We also work closely with agencies such as the Canadian and Saskatchewan Electrical Associations to promote energy-efficient technologies. The CEA sponsors programs which recognize and encourage energy conservation in the agricultural and industrial sectors.

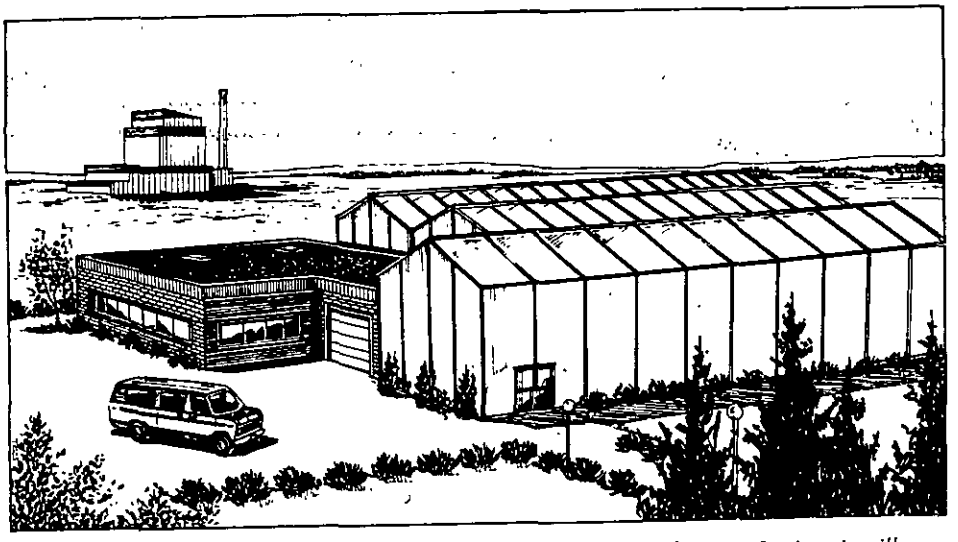
Supply side initiatives

We estimate that our fossil-fired plants release approximately 12 million tonnes of CO_2 into the atmosphere annually. SaskPower is participating in and funding research into clean-coal technology, as well as capturing CO_2 for enhanced oil recovery.

We are considering a proposal from a private developer to test the economic and technical feasibility of using flared natural gas to produce electricity in southeast Saskatchewan.

Farmers can economically use solar or wind-powered water pumps to water livestock in areas not served by SaskPower's distribution network. It is cheaper to install a solar or wind-powered generator to produce a small amount of power, than to build a long distribution line to serve one pump.

To minimize the impact of hydro plants on fish stocks, we have built fish rearing ponds at Nipawin, where fingerlings are raised to stock lakes and rivers.



We are building a $2 million greenhouse connected to the Shand Power Station. It will use waste heat and CO_2 to produce a variety of trees, shrubs and native grasses, which will be used for land reclamation, soil conservation, animal habitat and beautification.

When completed in 1992, Shand will be the most environmentally advanced coal-fired station in Canada.

Minimizing the effects of using coal

Technological solutions have been developed to reduce or eliminate some of the environmental impacts of burning coal. SaskPower is using many of these solutions as part of our commitment to protect the environment. For example:

- We are using LIFAC technology to reduce SO_2 emissions at our Poplar River Power Station, and also plan to use it at Shand Power Station, under construction near Estevan.
- Low NO_x burners will be used at Shand to reduce emissions which contribute to acid rain.
- We use electrostatic precipitators at Boundary Dam Power Station and Poplar River, and will use them at Shand. Some of the captured fly ash is now sold to be used in making concrete.
- We will use a closed-loop system for cooling water at Shand, and are currently designing a recirculation system at Boundary Dam to eliminate the discharge of water from ash lagoons into Long Creek.
- We've been restoring land after coal mining for almost 20 years. We level the land, replace the topsoil, and plant legumes and grasses to prevent soil erosion, or trees and shrubs to restore natural habitat. About 500 acres of mined land are reclaimed each year.

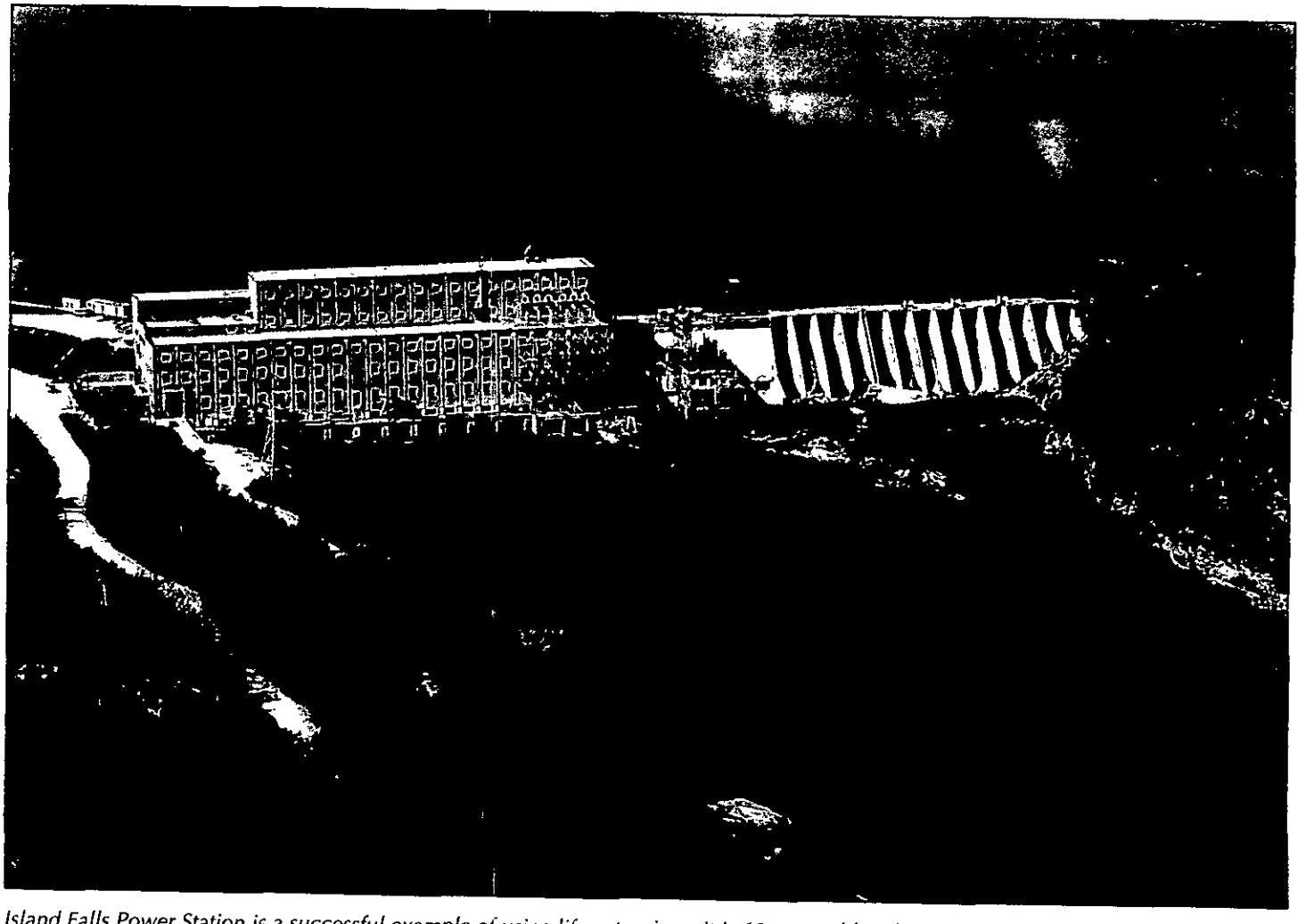
Life extension

In some ways, a power plant is like your family car. It won't last forever, but you may be able to keep it running longer if you give it regular maintenance and an occasional major overhaul.

SaskPower is now evaluating whether we should continue operating two coal-fired plants which are nearing the end of their useful life. These plants have a total generation capacity of about 260,000 kW of power. This is about the amount of power required to meet the peak demand of 50,000 homes.

We have a choice between replacing these plants, or giving them an extensive overhaul and continue operating them for many more years. We call this option "Life Extension."

In many cases, it is more economical to upgrade aging power plants. In extending the life of an existing plant, we continue to create some of the same environmental impacts that we have in the past, but avoid building a new facility – with all its associated environmental impacts.



Island Falls Power Station is a successful example of using life extension - it is 60 years old and still producing hydro power.

Our collective challenge

Making choices for our future generation

Thank you for becoming involved. Now, where do we go from here?

Through the public consultation process, you'll have an opportunity to submit briefs or comment before an independent panel that will hold meetings in various Saskatchewan communities. Details will be announced in local newspapers. If you'd prefer, you can mail your comments to the panel, care of SaskPower at the address on the back cover.

The panel will present a comprehensive report, summarizing the views and suggestions raised by the public. Public input will then become an integral part of the planning for demand/supply options needed by the mid 1990s and into the 21st century. The choices we make now will affect our lives in Saskatchewan, and the lives of future generations.

Everyone who uses electricity has a role to play. We'd like to hear from you.

GLOSSARY

Acid rain is 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.

Capacity is the greatest load that can be supplied by a generating unit, power station, or entire provincial grid system.

Carbon dioxide (CO_2) is a gas resulting from the burning of organic materials.

Coal is 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 are power stations which burn coal to generate electricity.

Co-generation is the production of electricity along with useful steam or hot gases. The steam or gases are used for industrial purposes.

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.

Demand is the amount of electricity required at a point in time.

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

Energy is the amount of electricity consumed over a certain period of time, usually measured in kilowatt-hours.

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

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

Greenhouse gases include methane (CH_4), carbon dioxide (CO_2), nitrous oxide (NO_2), chlorofluorocarbons (CFCs) and other trace gases which trap heat in the atmosphere. This contributes to global warming.

Grid is a network of transmission lines and interconnections.

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

Interconnections are transmission lines connecting one utility to another, allowing power to be exchanged between utilities.

Kilowatt (kW) – 1000 watts.

Kilowatt-hours – 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 stands for **L**imestone **I**njection in the **F**urnace and **A**ctivation of the unreacted **C**alcium. It is a process used to reduce SO_2 emissions from coal-fired plants.

Load shifting is when consumers shift electrical use from peak demand periods to off-peak hours.

Megawatt – 1,000,000 watts.

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.

Nuclear power plants use a controlled nuclear reaction to generate electricity.

Peak demand is the maximum amount of power required at a particular point during a period of time, for example, daily peak.

Peaking capacity is provided by generating stations which are usually operated to provide electricity during peak demand periods.

Reserve capacity is the extra generating capacity needed over and above the expected peak load. It is needed to ensure reliable supply when some generation facilities are not in service due to regular maintenance or repairs, or during unexpectedly severe weather.

Uranium is a radioactive mineral which is used as fuel in nuclear power production.

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Our Future Generation

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