CANADA

TODAY / D'AUJOURD'HUI

3 : 82

Sun, Wind and Sawdust

We still use oil or natural gas to heat homes and burn coal to make electricity, but as the price of fossil fuels goes up, some Canadians are turning to other, natural energy resources.

Hundreds of buildings are now heated by sunlight, factories are run with water or sawdust, and wind and technology make toasters pop in the Magdelan Islands.

In this issue of CANADA TODAY/D'AUJOURD'HUI we report on the pursuit of new energy sources and triumphs and difficulties met along the way.

Sun

The sun makes it possible for man to survive.

The sun's by-products, coal, oil and wood, have made it possible to survive in 20th century comfort.

As fossil fuels become less abundant and more expensive, we are turning directly to the sun for the extra warmth.

The sun does not always shine in Canada (in some settled places it is out only six hours a day in December), but in a year it deposits the equivalent of 150 watts on an average flat, square metre. This sunshine could heat every home in the land. Most of it is wasted, but since 1978 federal and provincial programs have sponsored or inspired hundreds of active or passive solar buildings, and many problems have been solved along the way.

The most effective form is passive—buildings designed to capture and retain the sun's energy. A large, properly insulated window facing south takes in a great deal more than it lets out.

Active solar heating is more expensive and less reliable. Air, water or a freeze-resistant fluid is piped through solar panels and warmed by the sun. Air may be pumped directly into the house or its heat transferred for storage to beds of rocks. Water is piped to radiators for immediate use or used to heat additional water stored in tanks. The heat from circulating chemical fluids is also stored in water tanks.

Sun Fish

The solar-heated experimental fish hatchery at Gunton, Manitoba, can produce up to two million genetically selected rainbow trout fingerlings a year.

It gets 70 per cent of the heat needed to warm the hatchery water and the building from forty-eight panel collectors on its roof. They cover 1,340 square feet, face 10 degrees west of south and are tilted at a 45-degree angle.

The sunlight on the roof heats a propylene glycol solution which flows through a copper and stainless steel solar loop, heating water stored in twelve 1,400-litre tanks. The panels also heat the twenty tons of water needed to flush and clean the system each week. (A new water recycling process has reduced the amount of heated water needed in the hatcheries by 90 per cent.)

The project was founded and is operated by the federal Department of Fisheries and Oceans. The hatchery staff installed the collectors.

The hatchery began work in 1980 and was an immediate success. It provides the energy to heat the tank water to the 12° to 15°C that trout need to reproduce, for all but a few winter days (when there is not enough sunshine). On one day when the outside temperature was −10°C the water in the holding tanks was 35°.

The holding tanks keep water hot for two to three days in the winter and for four to five days in the summer. Electrical heaters provide backup.

The hatchery will eventually produce 500 to 1,000 pounds of fish a month, some six tons a year, for commercial use. Similar hatcheries are under construction at the Cardigan Fish Culture Station, St. Andrews, New Brunswick, and at the Institute of Ocean Sciences, Pat Bay, Sidney, British Columbia.

The Beginning

The government's solar energy program began in 1975 with six demonstration projects. Some stored heat in water, one in paraffin, some used combinations of solar heat and wind power. In one project, waterheating demonstration collectors were mounted on the Manitoba Legislature Building in Winnipeg.

The National Research Council's Division of Building Research sponsored fourteen more pioneer solar homes in 1977, and the next year the Council's new Solar Energy Project arranged for solar systems in multi-unit homes, low-rise apartment buildings and row houses.

The first projects often produced more light than heat, but lessons were learned even when systems broke down.

The Ark

The most dramatic demonstration of all was the launching of the Ark in Prince Edward Island.

It is an imposing structure of glass, wood and concrete at Spry Point, near the ocean's edge. Built with federal funds by the New Alchemy Institute, it was the world's first bio-shelter, a home where, in theory, one family could supply its own heat, power and food. It had thirty-six vertical collector panels along the roof and seven slanted ones below, a wood-burning backup stove and a greenhouse. Water flowed through pipes in the panels,

Cover Photo: The world's largest vertical axis wind turbine is whirling on a Magdalen Island in the Gulf of St. Lawrence.

absorbed heat and transferred it to storage tanks in the basement. Other panels heated air which was pumped through floor registers. Garbage and sewage would fall directly into a fibreglass composting chamber to be decomposed by nature's own microorganisms. The design also called for four windmills to supply electricity for lights.

The Ark had its triumphs. It focused international attention on the possibilities of families applying science on a small scale to gain a measure of self-sufficiency. The passive heat system and the combination greenhouse and fish hatchery worked admirably. The heat collected in the greenhouse was stored in rocks and fish ponds and on sunless days blown through the building. The coldest temperature recorded in the greenhouse was 7°C (44.6°F), and its energy costs were less than half of those for conventional greenhouses. It produced an abundance of tomatoes, lettuce, broccoli and other vegetables for both the residents and the market. The first attempts to raise a species of fish called tilapia failed, but the Ark and its residents later raised thousands of rainbow trout.

The Ark also had its failures. Only one windmill was built and it failed to live up to expectations, the solar panels demanded more sophisticated maintenance than they initially received, salt water seeped from the nearby ocean into the house's fresh ground water supply, and two successive families found the steady stream of visitors and tourists more than they could bear.

"There was an incredible amount of publicity," Phil Wood, PEI's Director of Research for Tourism, Industry and Energy, says, "and there was no way a family could function as a family."

The project passed from the supervision of the New Alchemy Institute to a joint federal and provincial management committee and then to PEI's Institute of Man and Resources, which used it as a laboratory rather than a dwelling place.

It is now empty and up for sale.

It was, Mr. Wood says, "very successful," but, as he points out, demonstration projects have short lives. The Ark contributed to its own demise by laying the foundation for advances in solar techniques. "At this point it is no longer 'state of the art,'" he says. "It's definitely a dinosaur."

Mr. Wood hopes some practical person like an experienced greenhouse operator will buy it and keep its virtues intact.

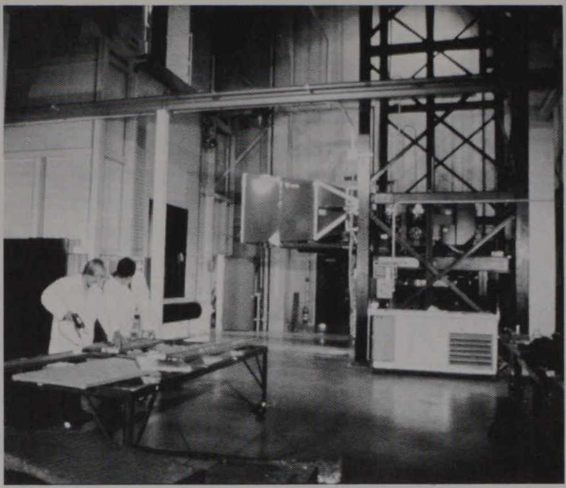
Testing, Testing

In 1979 the National Research Council commissioned Ontario Research to build a $1.3 million National Solar Test Facility at Sheridan Park.

It opened in February, 1981, and is one of the most advanced in the world. It has four self-contained, computerized mobile test frames which can make tests indoors and out in the same day. The outdoor tests use the sun. The indoor ones use a sun simulator—a large horn lined with mirrors which reflect light from two 125 kW argon-arc lamps. The simulator is the most powerful single light source in the world. Developed by Vortek Industries Ltd., of Vancouver, B.C., it could light up an entire football stadium. The mirrors provide a uniform illumination very close to natural sunlight.

The facility tested over eighty collectors in its

The Ark



The National Solar Test Facility has the strongest unnatural light in the world.

first eight months. More solar development test centres will soon be set up in British Columbia and Quebec.

How to Put June in January

Heat is hard to store.

The basic problem with solar heating is that sunshine is most abundant when it is least needed. In Canada June's share is twice the annual average and December's is less than a third.

Solar heat has been stored most often in tanks of water or bins of rocks and, less often, in containers of paraffin. Effective storage with these methods is usually limited to a few days.

Here are some other materials that can be used for storage:

Salts and Sulphates

Heat can be stored for relatively long periods in eutectic salts, such as Glaber's, which store heat as they change from a solid to a liquid. (Ice does the same as it melts but not very effectively.) The Saskatchewan Minerals Corporation manufactures and markets heat storage trays using sodium sulphate.

Zeolite

Zeolite, crystals composed of silicon, oxygen and aluminum, can store heat indefinitely and, if present research efforts at Carleton University bear fruit, it may make solar and other forms of alternative heating practicable on a broad scale.

When heated, zeolite dries out. When exposed to moisture, it absorbs it and releases the heat it has been holding. Synthetic zeolite is now used as a catalyst in petroleum processing and as a general drying agent.

The process for storing heat is simple. The zeolite is first heated, then kept in a dry place. When heat is needed, it is simply moistened. There is no need for insulation. Since humidity, and not outside temperatures, controls the exchange, it will store heat efficiently and indefinitely as long as it is kept dry. A cubic metre can store almost one million BTUs.

Zeolite could be used without elaborate household equipment. Blocks could be heated at a central solar collector, and rented to householders. They could be activated by applying measured amounts of moisture and, when their heat was exhausted, they could be returned to the station for reheating.

The work is still in an early stage but Bryan Hollebone, Ronald Shigeishi and Cooper Langford, three scientists working on zeolite at Carleton University, are optimistic.

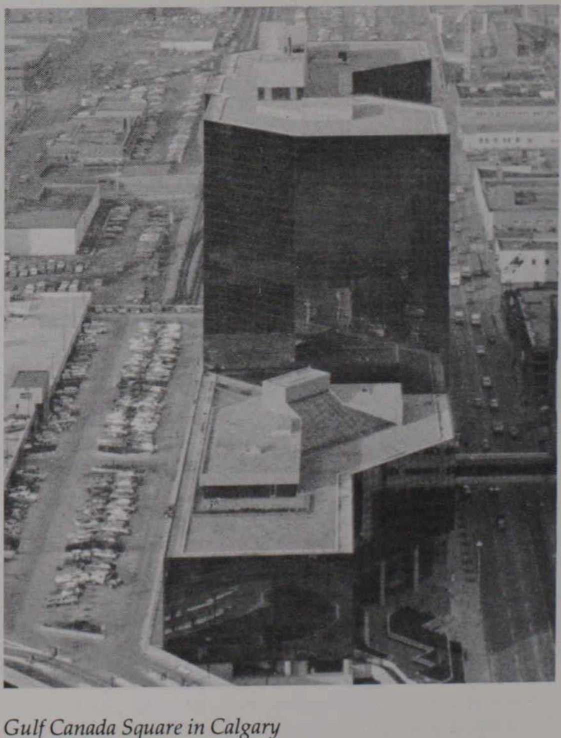
Conservation

Conservation—the saving of fuel through insulation and other forms of ingenuity—is still the most effective way to cut heating bills. The federal and provincial governments have encouraged it through a variety of tax incentive programs. Here are four success stories, three private, and one a government experiment in Saskatchewan.

Snuggling up to the Xerox

Gulf Canada Square, a two-block development in downtown Calgary, is probably the most energy efficient building complex in the world.

It heats and cools itself winter and summer at a cost of 10 cents per square foot. Other Calgary



Gulf Canada Square in Calgary

buildings average around 40 cents. Since Gulf Canada Square has two million square feet, that adds up to an annual saving of some $600,000.

Its heating system is not solar—indeed, its outer skin blocks out most of the sunshine. It has neither furnaces nor conventional air conditioning.

The system is based on the fact that any building with a million or more square feet of space generates enough waste heat to supply its own energy needs. The heat comes from the body heat of its occupants, from light bulbs and copiers, typewriters and other electrical equipment.

In winter most large buildings have to cool interior space while heating their outer edges. At Gulf Canada Square (as at the pioneer Hydro Place complex in Toronto) heat generated in the interior is circulated throughout.

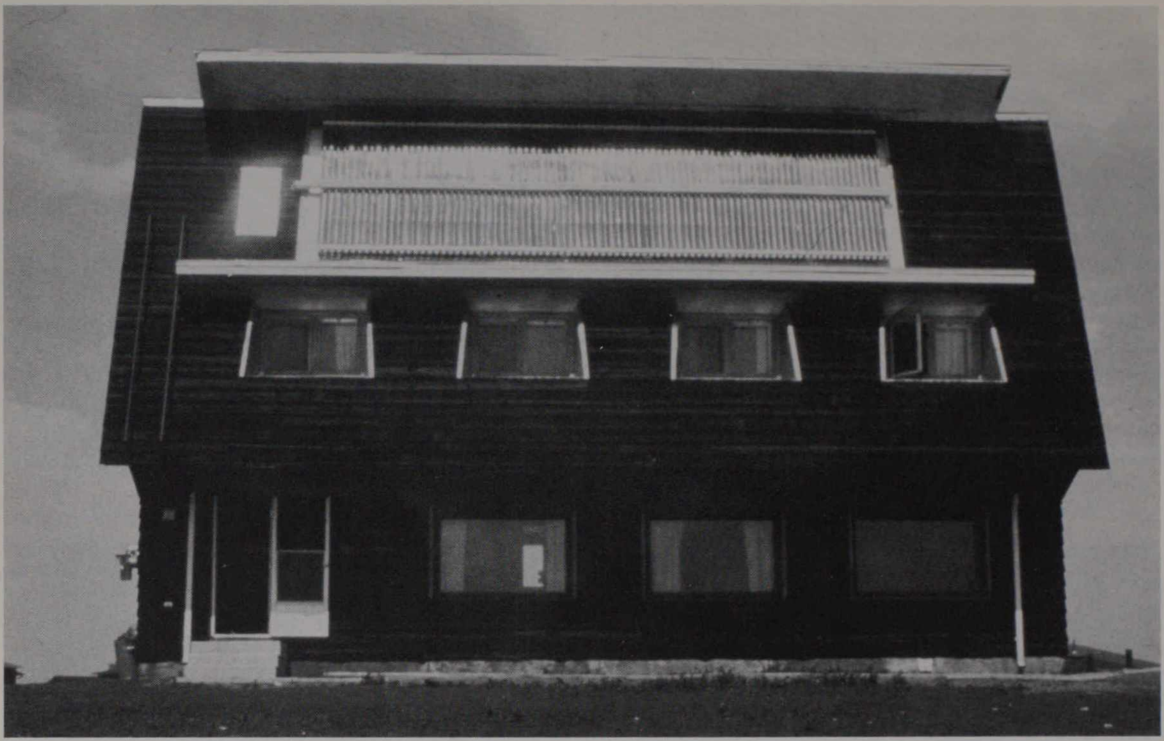
Insulation is very efficient. Patented silver-treated, double-glass curtained walls reflect 85 per cent of solar heat with little colour distortion of natural light.

Air is distributed behind the outer walls. The buildings have a low-energy, high-quality, coffered lighting system. A fully integrated ceiling recycles the heat from the building through heat pumps to either cool or heat water in four 250,000 gallon storage tanks in the basement.

An operator at the central computer controls the system, and sensors monitor temperatures and adjust them automatically every twenty minutes.

In the Calgary system some 5,000 pounds of waste collected in the buildings are burned each day, providing enough additional energy to supply all the hot water needed in the buildings and to provide 33 per cent of the energy required to cool the buildings in the summer.

Inside Gulf Canada Square



Conservation House

Conservation House

The Saskatchewan Research Council built a Conservation House in Regina in 1977.

It combined passive solar heating, active solar heating and heat generation from people and the use of electrical equipment. There was also a backup electrical system.

The house was heavily insulated and had an air-to-air heat exchanger for ventilation. It was intended to provide comparative data, and it served as a basic model for 300 other conservation homes in the province (including the Lange home described below.)

A family of four moved in in 1979, and the house's performance was monitored from June 30 of that year to June 30, 1980.

The house proved to be highly energy efficient when compared with one fully heated by electricity.

Most (70.9 per cent) of the electricity used was for lighting and appliances, a sizeable fraction (16.8 per cent) for hot water heating and a smaller part (12.5 per cent) for backup space heating.

The overall annual electrical bill was $511.92, compared with $1,296.29 for a similar, fully electric house. The cost of space heating alone was $62.96, compared with $844.63 for the fully electric house. (The comparison with a house entirely heated by natural gas is much less striking since natural gas is cheap in Saskatchewan and electricity is not. The cost of backup electricity alone was more than the cost for a full gas system.) The passive solar heating system and the use of insulation proved much more efficient than the active system.

A Snug Home in Regina

Leland Lange, a founding partner in Enercon Holdings, Ltd., lived in his company's prototype house for three years.

In his first eight months—which included the last weeks of one of Saskatchewan's worst winters—he spent a total of $40 heating his 1,760-square-foot home.

After that, Mr. Lange estimates, his house's heating needs were about 80 per cent below normal.

Heating costs are normally cheaper in Saskatchewan than in many places, but the normal cost of heating a house that size for a full year still runs about $125.

Mr. Lange and his brother David had worked in the Saskatchewan Office of Energy Conservation, and they adapted lessons learned at Conservation House.

The house combines heavy insulation with a simple passive solar system. It has no collector panels on the roof and no fluids circulating through pipes.

It faces south, and the sun comes in through a large, insulated window to heat the air in a plant-filled alcove of the living room.

An exhaust fan sends the heated air down through a grille, to a heavily insulated basement storage room, which is filled with sealed plastic bottles of water. The water stores the heat until a thermostat turns on a fan which circulates the warm air through the house.

The solar system is, however, an almost incidental part of the system.

Canadian
Participation
Energy Expo 82
Knoxville

Participation
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Energy Expo 82
Knoxville

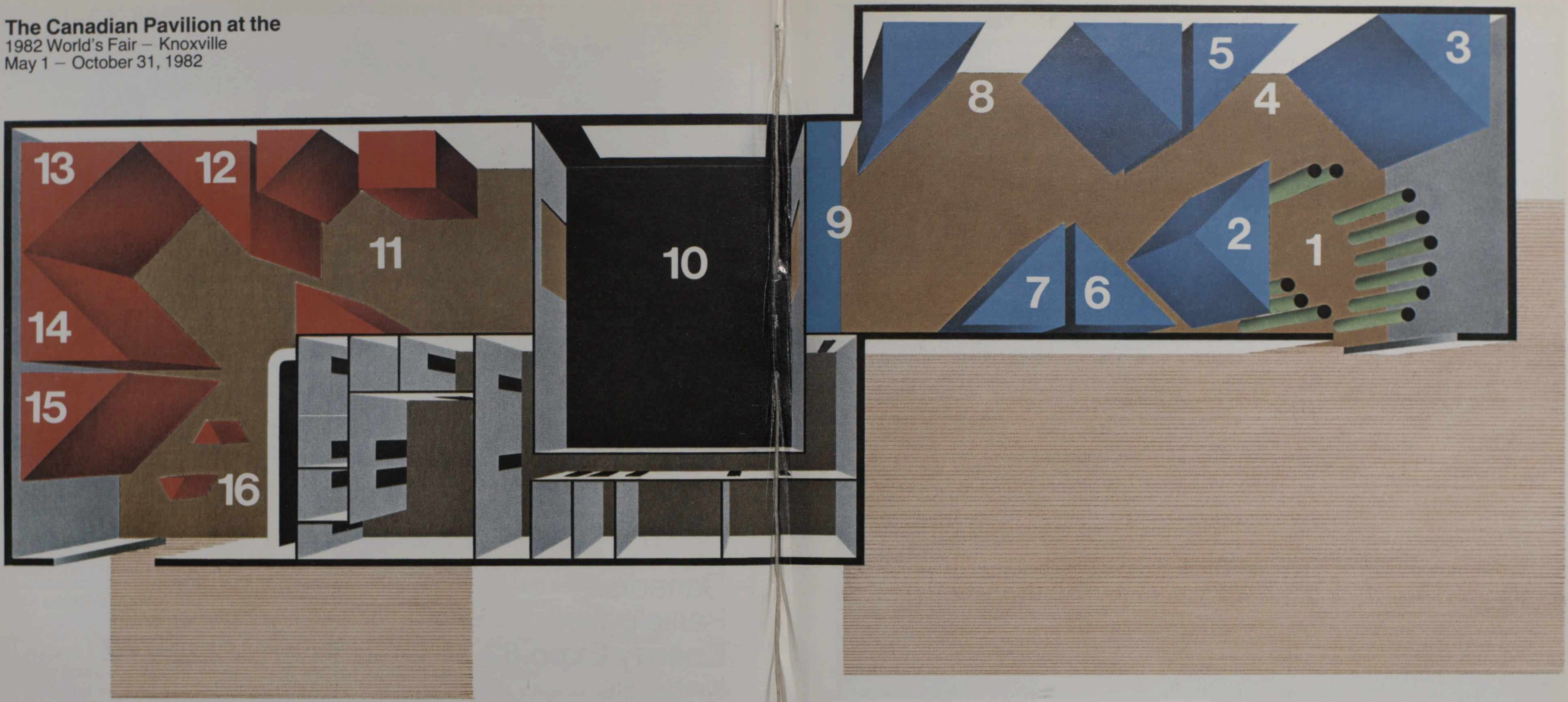
Canada is delighted to participate in the 1982 Knoxville International Energy Exposition and to have an opportunity to display its achievements in the field of energy.

Energy plays a significant role in our everyday life and is an important dimension in our bilateral relationship with the United States. For example, Americans benefit from relatively inexpensive supplies of secure Canadian electricity and natural gas. Canadians are one of the biggest consumers of American coal. The Alaska Natural Gas Transportation System is the largest privately financed project in the world. The scope for further cooperation in energy transportation systems, energy related research and trade is enormous and events such as Energy Expo 82 provide all of us with an opportunity to focus on the future challenges in the energy field.

I hope you will visit the Canadian Pavilion at the 1982 World's Fair and see, at first hand, some of the exciting things that are taking place on Canada's energy frontier.

Allan Gotlieb
Ambassador

The Canadian Pavilion at the
1982 World's Fair – Knoxville
May 1 – October 31, 1982

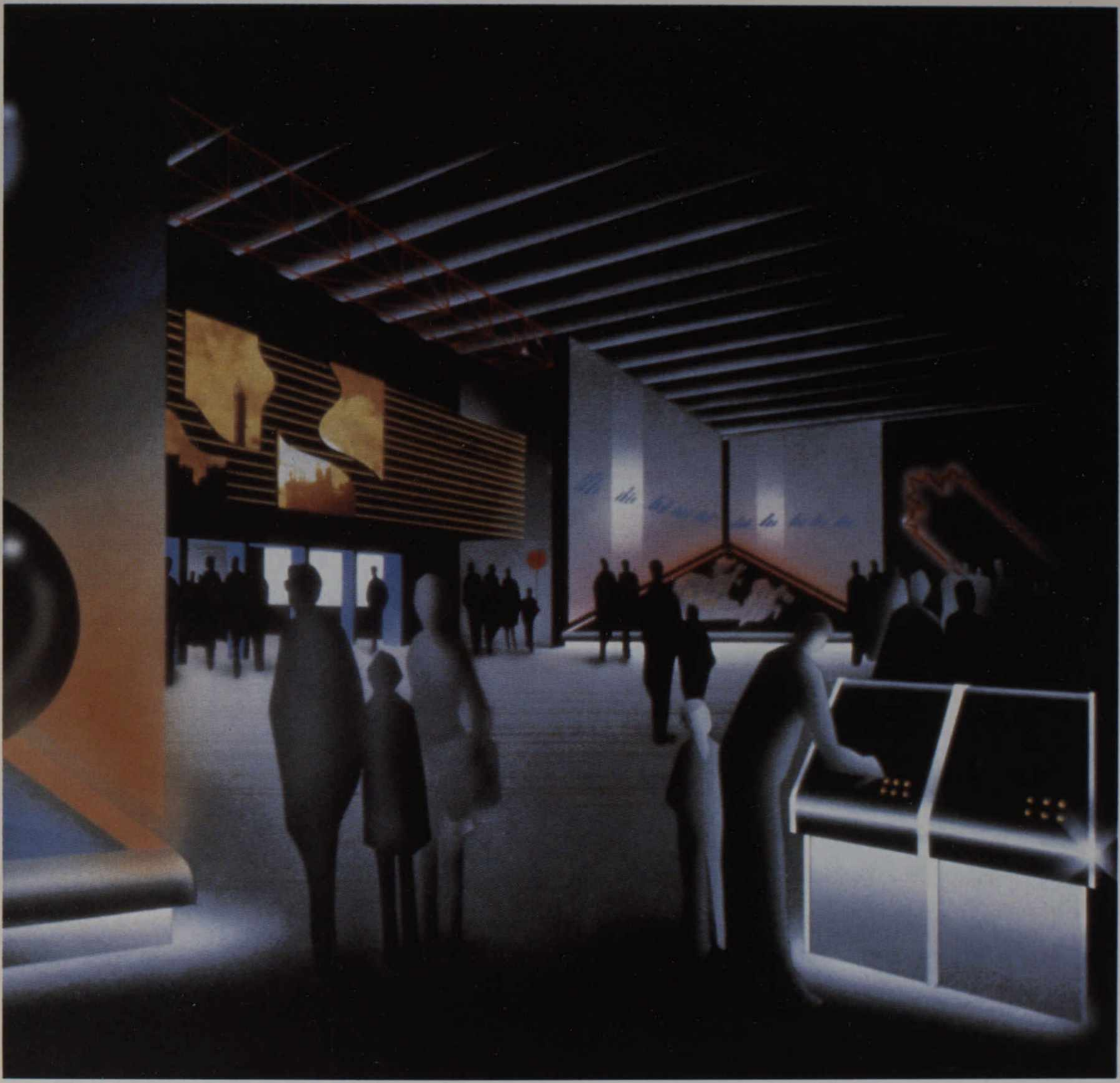


Theme: Resource Management Through Exploration, Innovation and Conservation

The Pavilion is divided into three main areas — Canada's energy megaprojects, a cinema and energy alternatives. Three-dimensional exhibits, film and video introduce visitors to the diversity of Canada and its needs and plans for the future.

The Canadian Pavilion has been produced by the Government of Canada in cooperation with the Provinces of Alberta, British Columbia, Ontario and Saskatchewan.

1. CANADA'S TEN PROVINCES AND TWO TERRITORIES
2. CANADA'S GEOGRAPHIC RELATIONSHIP TO THE WORLD
3. ENERGY RESOURCES AND TRANSMISSION SYSTEMS
4. TELIDON ENERGY DATA BANK
5. ARCTIC AND OFFSHORE OIL & GAS EXPLORATION AND TECHNOLOGY
6. THE OIL SANDS
   The Province of Alberta
7. HYDRO ELECTRICITY
8. NUCLEAR ENERGY IN MANY FORMS
   The Province of Ontario
9. TRANSPORTATION OF ENERGY
   The Province of British Columbia
10. THE CINEMA — An Animated Special
11. ONE-TO-ONE — CANADIANS DISCUSS ENERGY
12. THE ENERGY EFFICIENT BUILDING
13. ENERGY ALTERNATIVES FROM THE NATIONAL RESEARCH COUNCIL OF CANADA
14. ENERGY CONSERVATION
    The Province of Saskatchewan
15. THE CAR AND ALTERNATIVE FUELS
16. THE INFORMATION CENTRE



Canada's Pavilion at the 1982 World's Fair will tell the energy story in broad strokes that encompass the challenging geography and extremes of climate, the demands to seek new sources of energy and the skill and technology inherent in innovation.

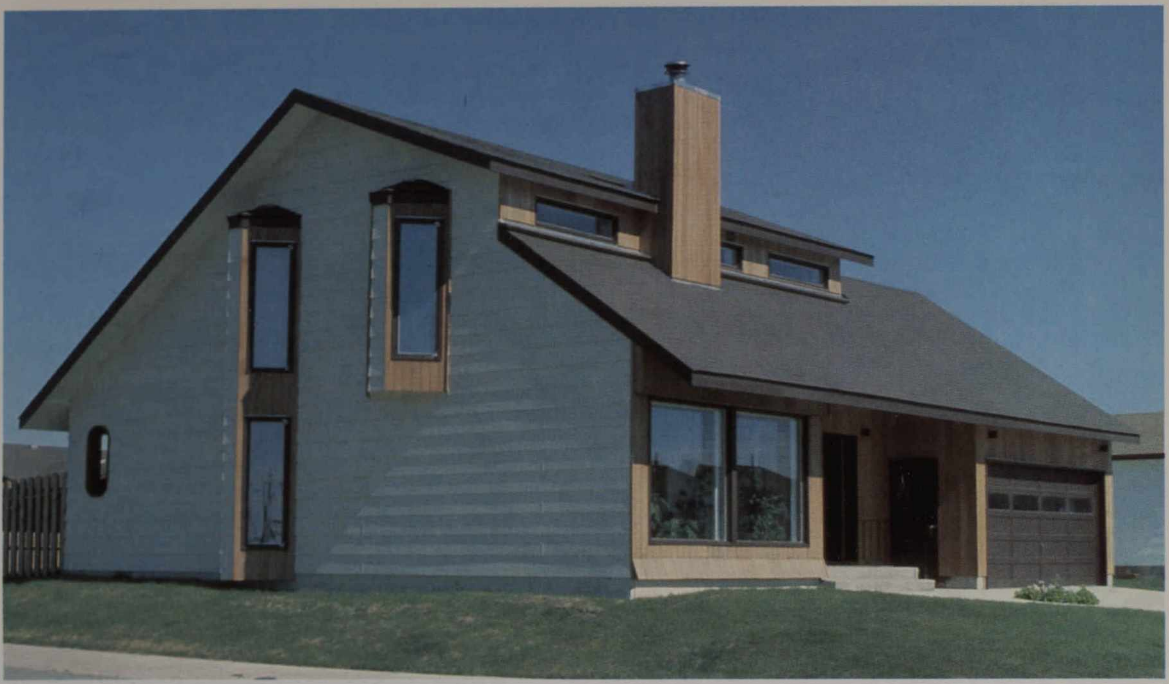
Exhibits can tell only part of the story, particularly when dealing with the immensity of Canada's energy megaprojects. Through the medium of television,visitors will be taken beyond the exhibit confines and see development of some of the megaprojects.

The audiovisual medium is also used in the "Theme Wall" where Canada's experience in the transportation of energy resources as well as energy efficiency in transportation is introduced.

And in the cinema meet Nelson Permafrost, hero at large and Rollo the dog who, joining forces, defeat the evil of energy waste in an animated film produced especially for the Canadian Pavilion.

Alternative forms of energy are also explored with emphasis on the home, the car, the office and individual Canadians seeking solutions to their energy problems. Special video shows, in sculptural environments, will introduce Pavilion visitors to their northern neighbours.

The Information Centre will offer a comprehensive selection of literature about the subjects seen in the Canadian Pavilion. Those seeking more advanced knowledge can make use of the Resource Centre containing special documentation as well as films and videotapes.



Enercon's model house

The house is basically designed to conserve heat. The exterior walls are a foot thick, insulated to triple the usual standard. The extra insulation costs only $1500 to $2000. They have a vapor barrier of continuous triple-thickness polyethylene, with no gaps anywhere. At night nylon shades coated with a film that reflects heat inward roll down between the double panes of the alcove window.

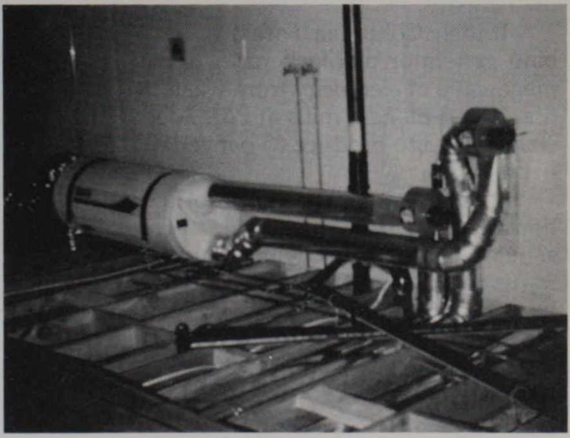
The house's essential feature is an air-to-air heat exchanger which takes care of the high humidity that automatically builds up in a heavily insulated house. The exchanger (adapted from a design developed at the University of Saskatchewan) transfers 90 per cent of the heat from the humid air leaving the house through one plastic pipe, to the drier air flowing in through another. It also prevents the buildup of dangerous gases, formaldehyde, nitrous oxides and even radon.

Enercon has since built more than 100 energy efficient houses across Canada. Some lack the passive solar system but have the heavy insulation and the heat exchanger. These still reduce heating costs by an estimated more than 60 per cent.

The total extra cost runs only to about 6 percent, and most of Enercon's Regina houses sell for $65,000 to $85,000 and heat for under $150 a year.

Leland Lange is now living in another experimental house designed and built by Enercon.

Don and Glynis Granger of Freelton have the first of forty "double wall" Saskatchewan-type houses planned in rural Ontario. Between last August and January their heating bill totaled $11.48. Their model is among the more sophisticated, and theoretically the heat given off by human bodies and appliances can keep it comfortable.



The fresh air heat-exchanger transfers heat from the warm, wet air going out to the cold, dry air coming in.

Biomass

Biomass, in the broadest sense, includes all living things and their wastes, residues and by-products.

Dry biomass includes logs, twigs, dry straw and the stumps of chopped-down trees.

Wet biomass, which contains at least 50 per cent moisture, includes manure and municipal garbage.

Either can be converted to solid, liquid and gaseous fuel.

In Canada the best source of biomass fuel is wood—trees, stumps and the wood chips and

PHOTO: OMNIFUEL

Fluidized – bed gasification converts wood waste to inflammable gas.

sawdust produced in the cutting and processing of lumber.

Canada's huge lumber industry now provides most of the fuel it needs to power its mills from its own wastes.

British Columbia Forest Products Ltd.'s turbine generator at Mackenzie, B.C., produces 20 megawatts of electricity from waste wood, and the MacMillan Bloedel mills at Port Alberni, B.C., use waste wood to produce 65 per cent of their energy needs.

Last December the Ontario Energy Corporation and Canertech Inc., both Crown corporations, signed an agreement with Omnifuel Gasification Systems Ltd., which, it is hoped, will speed the broader application of the company's technology. An excellent example of this technology's sophisticated use of waste is described below.

Sawdust

The world's largest biomass fluidized-bed gasification system is in operation at the Levesque Plywood mill at Hearst, Ontario.

It uses gasified wood waste from the plywood mill instead of natural gas to supply all the plant's energy needs, and the money saved by the switchover will pay for the system's installation, it is estimated, in two years.

Here's how it works:

Wood waste is fed into an airtight, oxygenless tank at the bottom of which is a bubbling bed of high temperature sand. The heat decomposes the wood rapidly, resulting in a combustible gas. The gas moves through 200 feet of pipe to fuel heaters at four different locations in the veneer and particle board plants.

The system at Levesque was the first commercial gasifier produced by Omnifuel. It was started up in March, 1981 and monitored during the summer. It is now in full operational use.

It can handle fuel with a moisture content of up to 40 per cent (the average is about 27 per cent) and can produce 80 million BTUs an hour. The trial run showed it converting 98 to 99 per cent of the wood's carbon content to gas, and it has a thermal efficiency of 84.3 per cent.

Time and Tide in Fundy Bay

The tides in the Bay of Fundy are the highest in the world—the range between high and low water can be 53 feet.

They are also remarkably regular; there are two of almost identical magnitude, every 24 hours and 50 minutes.

Their harnessing has been discussed for decades, but when oil, gas and coal were cheap it was not practical.

Now the time has come to take the plunge into the chill waters. Nova Scotia's Tidal Power Corporation is building a generating station at a narrow point on the Annapolis River in the Bay's Cumberland Basin. The cost is $46 million, of which the federal government is putting up $26 million. It is being constructed by Dominion Bridge-Sulzer Inc. of Montreal.

The station will make use of a radically new and relatively inexpensive turbine based on a system conceived by an American engineer, Leroy F. Harza, and manufactured by Escher Wyss of Switzerland. Most turbines are vertical—water must be pumped high in order to fall. The Escher Wyss turbine is horizontal and will be flat in the water (protected by cement caissons), and the water will flow straight through its sluices. The relative simplicity means that construction and installation costs will be much lower than normal.

By mid-1983 the station will generate 20 megawatts (four times the power produced by any similar turbine operation) and will replace energy generated by burning imported oil. It is intended to demonstrate the practicality of further tidal power development in the upper reaches of the Bay.

There are many who feel its potential is enormous. In November, 1977, a major study recommended that a $3 billion (1,085 mW) project be built on the Cumberland Basin.

Tidal power stations have been in use in Europe where energy costs have been historically higher than in North America. A number of Escher Wyss turbines are in use there.

CANDU

It is assumed that at least two-thirds of Ontario's electrical power will be generated by nuclear reactors by the year 1990.

The experience of Ontario Hydro, the provincially owned utility, supports the forecast.

In 1980 its nine reactors produced 35,579,000,000 kW/hours of electricity at an average cost of 1.22 cents a kW/hour at its Pickering generating station and 1.40 cents a kW/hr at its Bruce station, and they have had an unsurpassed record for safety and reliability. The utility has three more stations under construction with four reactors each.

The reactors are CANDU models, which are fueled by heavy water and natural unenriched uranium.

Patrick McTaggart-Cowan, former Executive Director of the Science Council of Canada, said recently that "To my mind, the CANDU is the safest power-producing device ever built. In concept, it is also the simplest and most reliable reactor."

Here's how it works:

Each reactor has a horizontal tank filled with deuterium oxide (heavy water). Several hundred tubes containing uranium oxide pellets run through the tank, immersed in the water. The pellets radiate neutrons, bombarding the water, which acts as both a coolant and a moderator, slowing the neutrons down enough to allow fission to take place. It also transfers the heat produced to ordinary water which then turns into steam, drives turbine generators and produces electricity.

Each reactor holds 4,680 fuel bundles, and several of these are used up and replaced each day.

The spent fuel contains numerous radioactive elements; some decay in seconds, some have half-lives of thousands of years. The spent fuel takes relatively little space and is stored in special areas at the plants. Eventually it will probably all be stored in chambers excavated in the solid rock of the Canadian Shield.

All of Canada's power-producing reactors are operated by Ontario Hydro, although there are reactors under construction in Quebec and New Brunswick.

Can Did

Ontario Hydro's CANDU reactors took the first four places among 114 monitored for efficiency in 1980. Four others finished in the top twenty-five.

The reactors, in thirteen countries, were measured for actual operating performance compared with designed capability.

The top four positions were taken by Ontario Hydro's Bruce 2, Pickering 3, Bruce 3 and Bruce 1.

These photos taken at high and low tides at Parrsboro, N.S., show the daily range in the Bay of Fundy.

West Germany's Unterveser reactor was in fifth place, followed by France's Bugey 1 and the USA's Nine Mile Point-1.

Fusion

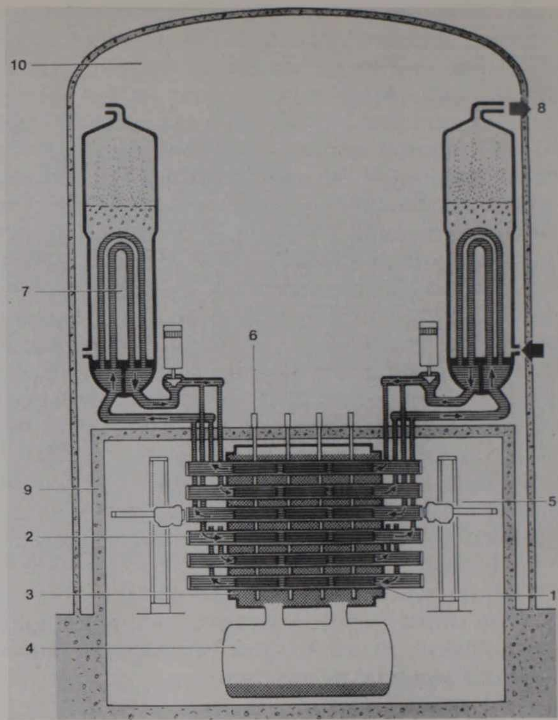
Nuclear power can be produced by fission—as in present reactors—or by fusion.

Fusion of atoms has significant advantages: its principal fuel, hydrogen isotopes, is inexhaustible and easily accessible. It would apparently produce fewer problems of waste disposal.

It is, however, extraordinarily difficult to achieve and sustain—the process requires temperatures of about 100,000,000 degrees Centigrade.

Research in the United States, particularly at the Princeton Plasma Laboratory, has focused on the use of magnetic fields. Temperatures of over 70 million degrees were achieved in 1978, and since then unprecedented yields of fusion have been obtained.

Canada is pursuing research in certain areas with vigour. The National Research Council will spend $37.9 million in a five-year program, which will rely heavily on international collaboration and will include experiments in both magnetic and laser beam control systems and in the development of construction materials and engineering skills.



A CANDU reactor

1 – Uranium fuel bundles
2 – Horizontal pressure and calandria tubes
3 – Heavy water moderator within the calandria
4 – Moderator dump tank
5 – Fueling machine
6 – Reactor shutoff rods
7 – Steam generator or boiler
8 – Steam line to the generator turbines
9 – Concrete containment of the reactor vault
10 – Containment building

Hydrogen—The Ultimate Fuel

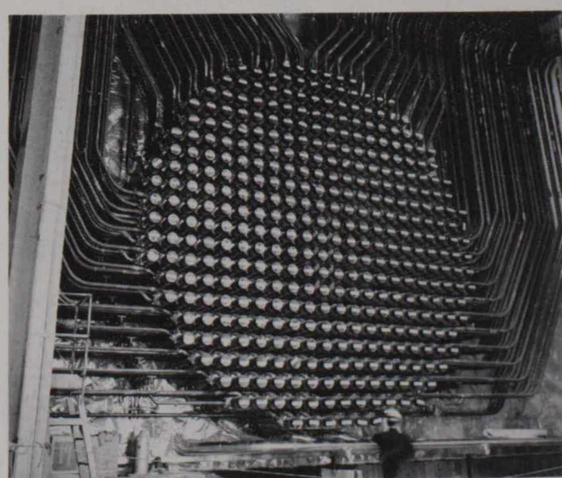
Hydrogen gas is almost universally available. Water can be split and the hydrogen that results can be burned in internal combustion engines.

How close are we to practical use? Maybe pretty close.

Hydrogen-powered test vehicles have been tested successfully and hydrogen aircraft are planned. Although hydrogen has had an unfortunate reputation since the German dirigible *Hindenburg* caught fire in New Jersey some five decades ago, it is actually a safer fuel than natural gas, gasoline or diesel fuel.

In Canada large industrial organizations, including Ontario Hydro and Hydro-Québec, are interested in the development of hydrogen technology. The principal drawback today is cost—natural gas is cheaper. Dr. Martin Hammerli, of Atomic Energy of Canada Ltd., says, "It is competitive in certain circumstances today, when power (for the electrolysis of water) is available at special rates in off-peak load periods, but considerable development work must be done. There's no question about the future of hydrogen. That's why the big boys all over the world are suddenly interested." Large research projects are underway in the U.S., France, West Germany, Switzerland, Japan and Canada.

Professor David Scott, head of the University of Toronto's Mechanical Engineering Department, where much of Canada's research is centred, says the world-wide use of hydrogen energy is "inevitable." He sees the combination of CANDU nuclear reactors and hydrogen as a prime way to replace energy systems using fossil fuels.



One of four Ontario Hydro reactors at Pickering B.

Water

Canada has more water and more hydro power than any other country in the world. Seventy per cent of its electricity comes from waterfalls and dammed-up rivers.

La Grange complex on the edge of James Bay, near the top of the Province of Quebec, will produce 10 million kilowatts by 1985. The James Bay hydro system, if it is fully developed, could produce over 35 million kilowatts.

The $15 billion project is one of the greatest construction operations in history, a vast network of dikes, roads, powerhouses and dams. Water from huge reservoirs turns turbines housed in man-made caverns chisled out of granite 450 feet below the ground.

In addition to James Bay, Canada has great hydro stations at Churchill Falls in the Labrador part of Newfoundland (5.2 million kilowatts) and at the Nelson River Project in Manitoba (4 million kilowatts when completed).

Wind

Windmills have been turning for centuries. The Danes have used them to produce a considerable part of their electricity needs since 1908.

Canada is a breezy place. High wind potential exists in the Maritimes, on the west coast of Hudson Bay and, to a lesser extent, in the southern prairies.

An NRC study suggests that 200,000 windmills with 100-foot blades could produce more power than James Bay.

In Canada the National Research Council and Hydro-Québec have the world's largest vertical axis wind turbine whirling away on the Magdalen Islands in the Gulf of St. Lawrence, and they intend to build a much bigger one at another site and have it operating next year.

The designs of both are similar—two curved strips of metal attached at both ends to a vertical axis. Since they are vertical, the structure does not have to be turned to face a shifting wind.

The model on the Magdalen Islands produces 250 kilowatts in a 35-kilometre-an-hour wind and supplies power for lighting and appliances to fifty houses. An earlier model set up on the Island in May, 1977, fell over in July, 1978. It had been disconnected from its main disc brake the day before. The turbine accelerated in a strong wind until the blades began striking support cables. The cable turnbuckle broke and the rotor flew off. The rebuilt model has an improved brake system and stronger supports.

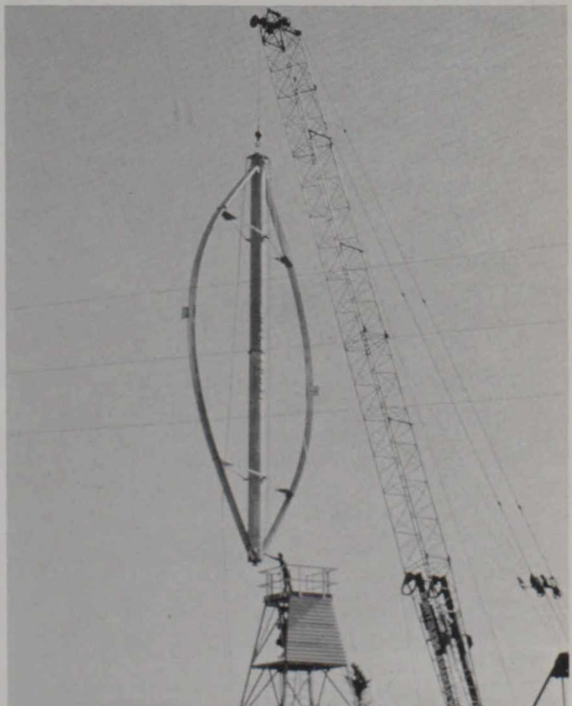
The one planned for 1983 will be called Aeolus, it will have a vertical axis 110 metres high and it will be capable of generating up to 3.8 megawatts, enough to supply the non-heating requirements of 600 to 700 homes. It will cost an estimated $20 million and will be partly financed by Hydro-Québec.

Why Bigger Is Better

Windmill power is expensive.

When the wind blows at less than 10 km/hour, the blades of the average household size turbine do not move. It is not until the wind reaches 35 km/hr that they reach their full productivity, and that productivity does not rise as the wind rate goes up. At 60 km/hr the vibrations and stresses become such that the turbine must be shut down.

The energy supplied by a 1,000-watt turbine would usually cost four or five times as much as that bought from the average utility company. In isolated places, however, where no power grid is available and fuel must be shipped in, they may be cost-efficient. As the size of the turbines increases, the cost per kilowatt goes down. It is believed that electricity produced by a "farm" of Aeolus-sized turbines would be as cheap as conventional electricity and, in time, cheaper. The NRC and the Science Council of Canada forecast a billion dollar domestic market for turbines by the year 2000.



Small and medium sized windmills can serve specific household or industrial purposes. This middling one, producing 55 kilowatts, generates electricity which is fed into the hydro-electric grid in Newfoundland.

PHOTO: CANADA SQUARE CORPORATION

Hydro Place, headquarters of Ontario Hydro, was the first northern office building in the world built without a furnace. The heat generated by people and machines warms and cools the building.

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