

Report on Alternative Energies in Alberta

ACTIVE SOLAR SYSTEMS

Alberta Department of Energy

Energy Efficiency Branch

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ACTIVE SOLAR

1) TECHNOLOGY

1.1) Description of Existing Technology

Active solar systems collect the sun's radiant energy and convert it to heat. This heat can warm pool water, air in buildings, and (most commonly) hot water for domestic and industrial uses.

These solar systems generally consist of three basic parts: collectors, storage component and heat transfer component.

A solar system circulates cold water from a pool or a storage tank to solar panel collectors on the roof or a sunny spot on the ground.

1.11) Collectors

There are three types of collectors: flat plate, evacuated tube, and concentrating. All collectors use the "greenhouse effect" in one way or another: they trap the sun's heat which causes their internal temperature to rise sharply. Many modern collector panels are capable of heating up to a useful temperature even when outside temperatures are below freezing.

Flat plate collectors are the cheapest, simplest, and the most common type of collector. A flat plate collector solar panel consists of a rectangular box a few inches deep with a transparent top (glass or plastic) sealing it closed. A flat plate, which is the focus point for the heat absorbed by the panel, lies at the bottom of the box, coloured black to retain the heat from the sun's rays. A series of parallel tubes are attached to the black plate. Air, water, or a water/glycol mixture (similar to that in an automobile's radiator) is heated by passing through these tubes.

Flat plate collectors have been designed with the tubes as part of the flat plate (in effect, holes are bored through the plate lengthwise). This simplifies construction and allows temperatures inside the tubes to get even higher.

Evacuated tube collectors consist of black pipes inside (larger) glass tubes. The space between the black pipe and the glass tube is evacuated - there is no air there. This way, the tubes can collect

more of the sun's heat than flat plate collectors and pass it on to the substance inside the black pipes. A smaller evacuated tube collector (or fewer collectors) can be used to give the same heat energy.

The collectors described above are meant to heat water (directly) or a water/glycol mixture which in turn heats the end-use water in a separate tank. The advantage of having a water/glycol mixture - used in "closed loop systems" - is that the system may continue to run in the winter without danger of freezing. Systems heating end-use water directly are more efficient in the summer but are also more prone to corrosion and must be thoroughly drained in the winter. In Alberta's climate, water/glycol systems are more common.

Some active solar systems heat air rather than water. In this case corrosion, freezing, and pipe-bursting are not problems. The collectors are entirely different, usually consisting of large slabs of sun absorbing material with perforations mounted on the building's wall. Air is drawn in through these holes and circulated behind the solar absorbers and then circulated into the building. Besides saving on heating bills, these systems can heat the air in a building more evenly than conventional systems, and provide more fresh air. Solar air heating is rare in residential applications, but is gaining popularity in industrial applications.

1.12) Storage

Industrial and domestic hot water heating systems use insulated tanks to store the hot water. Usually these tanks are larger than those used with gas or electric heaters because the water is only heated during the daytime and hot water must be available for morning and evening use. There are two types of tanks: pressurized (used in closed loop systems) and atmospheric vented (used in drain back systems).

In closed loop systems, the water in the tank is heated indirectly. The usable water runs through a heat exchanger where it absorbs the heat from the water/glycol mixture. When solar systems are retrofitted to a house, a second tank is usually added to the existing one. The original is used as a back up in the winter.

Both pressurized and atmospheric pressure tanks are virtually maintenance free (see Section 1.33 Problems).

In air heating applications, rock beds or cinder blocks are often used to retain heat. Air is circulated through the solar panels and down to the beds where the rocks are heated. Later (at night, for example) when hot air is needed, cold air is circulated around the warm rocks and then into the house. In industrial applications the warm air from the solar absorber is fed into a furnace as pre-heated air or is blown directly into the building. Storage is less of a necessity because the building is only used during the day.

1.13) Transfer, Distribution

How does the heated water or water/glycol get from the panels to the storage tank and back again? Electric pumps are sometimes used, but an increasingly common system is the simple "thermosiphon" system. The panels are mounted at an upward angle so that the water in them flows upward as it is heated. This upward motion keeps the water flowing from the tank to the panels through a sealed pipe system.

In crude systems, the sun heats the storage tank directly and no transfer system or panels are needed. The potential for such systems in Alberta is small since cold weather does not permit storage of water external to the building.

1.14) Piping, Insulation

Pool applications use either PVC or ABS plumbing while other applications use copper pipe. Hot chlorinated pool water tends to corrode copper and discolours. Expansion joints are commonly short lengths of rubber hose with gear clamps joining both ends.

Closed cell foam insulation is commonly used for pipes. Fiberglass insulation is used for both pipes and tanks - the rigid and sheet wool types respectively.

1.15) Control System

In closed loop systems, the system controller activates and deactivates the circulation pump maintaining the flow of usable water to the collectors. The controller is set off by a temperature differential (temperature sensors are considered part of the controller) between the stored water and the collectors. In drainback systems, the controller opens valves to drain fluid from the collectors and to close off the collectors when temperatures sink too low (usually 3 degrees Celsius) to avoid pipe and collector freezing. When the collectors are warm and the stored water is cold, the controller opens the valves and activates the circulating pump.

1.2) Technology in Alberta

Up-to-date technology is available in Alberta. Generally, the best equipment is used here because the climate requires it. The market is limited almost exclusively to closed loop water/glycol systems and the main manufacturer is ThermoDynamics of Nova Scotia, a firm having two distributors in Alberta. The technology for residential use is simple to install. Consultants and installers are not usually needed except for larger systems. For a more detailed description of the technology available, see Section 2.1 and the Appendix listing manufacturers and distributors.

1.3) Feasibility of the Technology

1.31) Performance

Besides freezing, solar water heaters may overheat. Automatic cut-off controls stop circulation of water to the panels when it is a hot day and little water is being used. If the panels heat water directly, then the collectors are drained when the temperature of circulating water falls below 3 degrees Celsius or over another preset temperature to prevent freezing and overheating.

The degree of household heating requirements met by a solar system vary with the climate and type of system installed. Good systems can meet on average 35 to 75% of the hot water needs of a family of 2 to 6 people, year round. For space heating, 30 to 60% of a well insulated house's needs can be met.

A traditional fireplace may serve as an efficient back up to solar systems. The water pipes can be run above the fireplace box.

1.33) Problems

The shortcomings of current products are critical in Alberta where there is a specific need for cold-resistant technology.

The overall problem facing the industry is to make active solar systems less costly and more effective. To do this, all components of the system can be improved upon, although collectors are the focal point of research. Below is a summary of the problems most often present in solar domestic hot water (SDHW) systems, as found in case studies.

Collectors

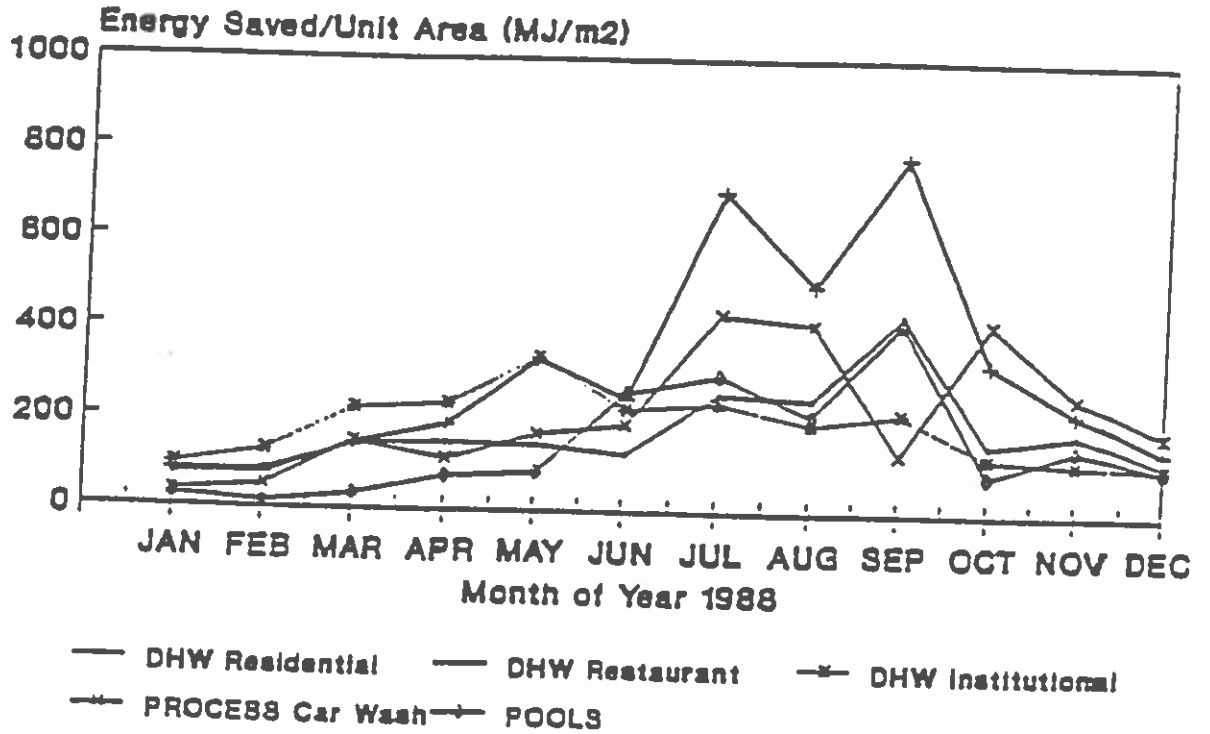
Rain leakage through glazing seals, air vent holes, and header pipe protrusions is a problem plaguing some flat plate collectors. Water inside the collector can result in corrosion and discolouration of the absorber fins, which in turn reduces their efficiency and eventually forces a collector replacement. Condensation on the inside surface of the cover glazing may also occur regardless of external conditions. This condensation affects the efficiency of the glazing. Deposits of dirt on the inside and outside of the cover glazing may further add to the problem, although maintenance (i.e. cleaning) on the part of the owner will help.

The most frequent problems in flat plate collectors are not serious and good collectors may be problem free for their expected lifetime (usually about 20 years - warranties last about half that time). The problems that do occur are not serious enough to cause downtime, but do reduce system efficiency. Evacuated tube collectors are generally maintenance free.

Storage Tanks

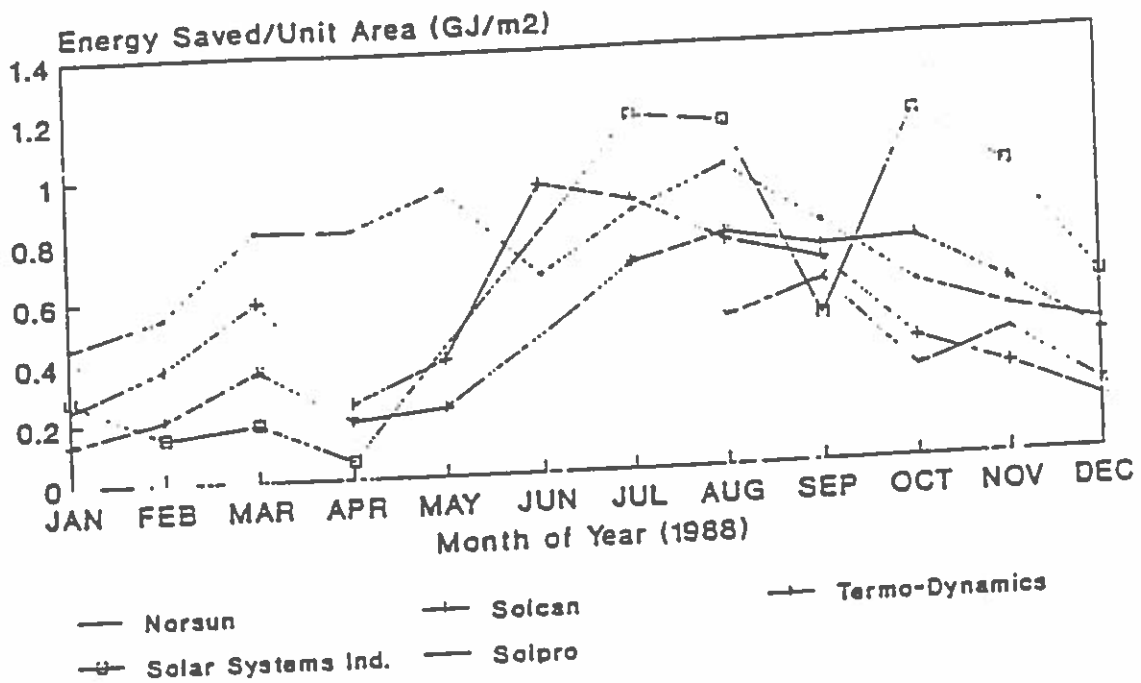
Leakage and exterior corrosion due to condensation on uninsulated pressurized tanks is an occasional problem. Plastic atmospheric tanks are also virtually maintenance free, although cracks at the pipe/tank connection (a minor problem) has been observed in some cases.

ENERGY SAVED VERSUS MONTH OF YEAR (Application)

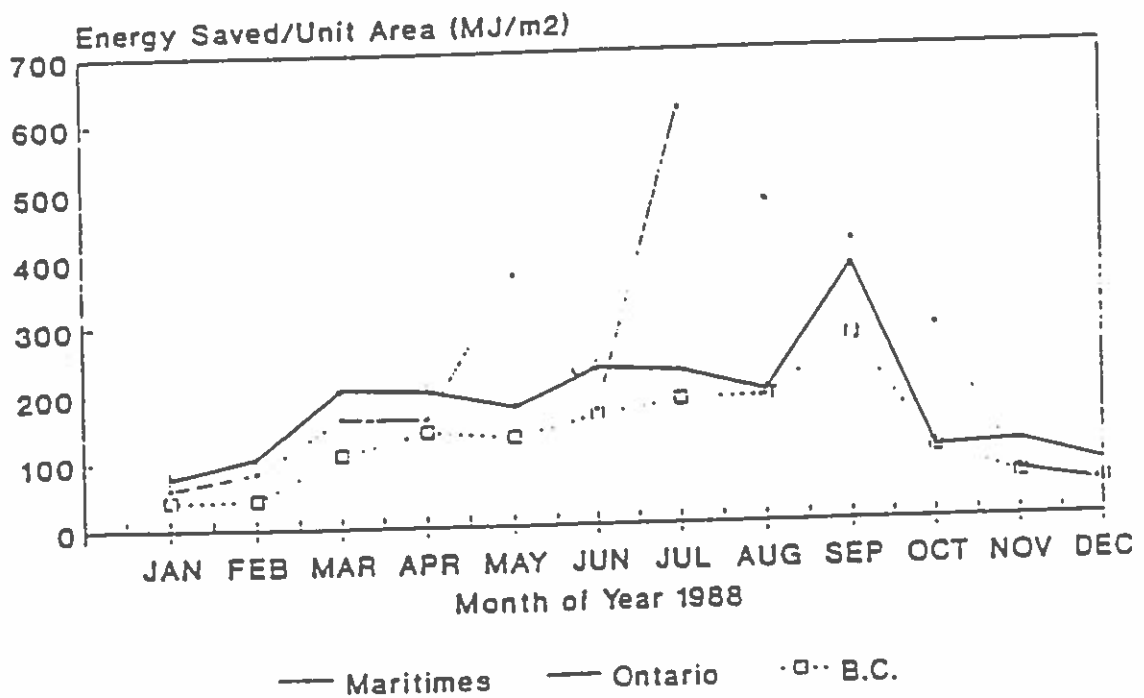


From: Monitoring of the Commercial/Industrial Solar Demonstration Program, by TES LTD. (1989)

ENERGY SAVED VERSUS MONTH OF YEAR (Collector Manufacturer)



ENERGY SAVED VERSUS MONTH OF YEAR (Location)



Control System

Simple electronic failures and hydro power surges have occasionally caused controllers to fail. Temperature sensors may also fail. In either case, the system may stop operating and the owner may not realize it for some time. Considerable energy losses or even collector damage may result.

Piping, Insulation

Sagging pipes, leaking joints, and fluid/metallic incompatibility are possible pipe problems. The plumbing connections between individual collectors sometimes leak as the rubber hose/gear clamp expansion joints tend to loosen and leak over time. Loss of fluid is a problem for closed loop systems as loss of pressure may stop circulation. Sagging pipes result in trapped water and freeze ups in the winter. Hot water can cause copper pipes to creep over time.

Closed cell foam insulation - the most common type of insulation - may shrink and toughen over time due to heat. Sheet wool fiberglass (used for tanks) is often made without a vapour barrier and therefore becomes water saturated and less efficient. Rigid fiberglass (used for pipes) may become brittle and fall off.

1.4) Current Research (list of research agencies in Appendix)

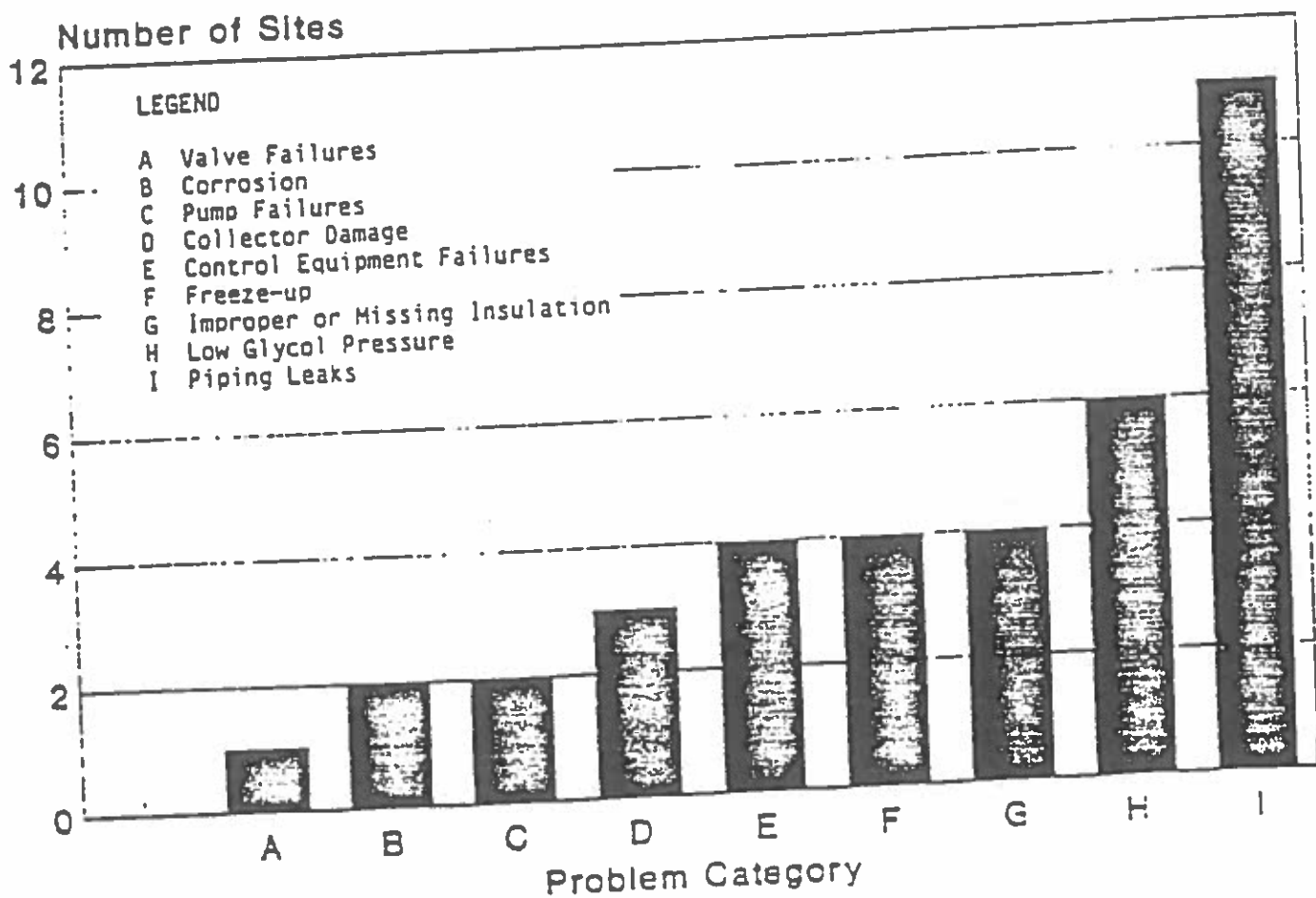
There is less research in the active solar industry than in either wind or photovoltaics. Generally, the technology is simpler and major breakthroughs are not on the horizon. Nevertheless, prices have dropped considerably in the last decade (see Section 2.2) at least partly because of research.

Current research is concerned with analysis of performance data of systems. This data indicates possible system efficiency improvements through altered designs. Cost effectiveness, quality, reliability, and performance of systems are topics of inquiry. All systems made in Canada must meet CSA standards, so this type of research is necessary in most cases.

Research is also concerned with finding cheaper materials and improved manufacturing methods since system costs are a large factor in feasibility. One of the dominant manufacturers in Canada, ThermoDynamics Ltd., has made substantial progress in this regard. The firm now makes collector absorbers with serpentine pattern copper/aluminum rather than with pure copper in grid pattern. The collector frame is now made with lightweight aluminum rather than with heavy extruded aluminum. The copper collector supply lines have been replaced with nylon supply lines jacketed with PVC.

In terms of design changes, Thermo Dynamics has developed a system using one circulator pump instead of two. The material changes and the design change have allowed considerable savings from reduced manufacturing time and lower material costs, making the Thermo Dynamics product more competitive (see Sections 2.1 and 2.2).

OPERATIONAL PROBLEM HISTOGRAM



From: Monitoring of the Commercial/Industrial Solar Demonstration Report, by TES Ltd. (1987)

Although corrosion in modern systems has been reduced to a minimum, any water or water mixture in a solar system always presents the possibility of corrosion. Research continues to address this problem, searching for better corrosion resistant designs and materials.

1.5) Future Directions

As mentioned in Section 1.1, heating water is the most common application of active solar systems. However, continuing expansion of applications provides challenges for researchers and systems designers. New uses for solar power are continually being found, especially as technology improves and becomes more cost effective. If the system can heat enough water, the generated energy can be used for almost anything. Fournelle Energy Technologies of Montreal has sold its evacuated tube units worldwide for many applications. Examples include a thermal pump capable of delivering 4,000 to 20,000 litres of water per hour, a 10 kW cooling unit for 5 large rooms, water purification and desalination units, and cooling power for 30 to 40 kg of fish per day (requiring only one evacuated tube).

In California, Luz Engineering Corp. has manufactured eight solar farms with active solar technology. Mirror arrays heat a synthetic fluid which, through a heat exchanger, heats water. This water (turned to steam) drives a turbine. It takes the firm less than a year to make one farm capable of producing 80 megawatts of clean electricity at a cost of eight to nine cents per kWh (\$US) - cheaper than nuclear power and only a little more expensive than the average cost of electricity (six cents per kWh). The eight plants represent more than 90% of the world's utility-connected solar energy.

It is true that the sun is generally not hot enough in Alberta to sustain many uses other than basic hot water heating. However, expansion of the industry can only have positive effects on the residential uses of solar systems. As the industry grows it accumulates capital and research funds to make better products and more effectively penetrate all solar markets.

Active solar systems will continue to become more cost effective as they decrease in costs and increase in efficiency. Already reasonably economical in residential applications, the use of these systems should grow as consumer awareness increases. Growing environmental concerns also play a large role in manufacturers' sales pitches.

ThermoDynamics, for example, expects to further increase the efficiency of the system mentioned in 1.4. A new heat exchanger (whose exact features are still secret) to replace the old Swedish made Coval side arm exchanger presently used is expected to boost thermal performance by 25%. At this efficiency level, some 80% of an average household's hot water needs could be met by the solar system.

2) PRODUCTS

2.1) Overview - Products Available

Below is a general overview of the majority of active solar products available in Alberta. Most of these products are for residential use, although industrial applications commonly use the same technology in a revised system design. For more detailed information, see the Energy Matters Product Sheets listing specific products (available from the Energy Efficiency Branch).

If additional information is needed, manufacturers or distributors can be contacted directly concerning a specific product. See attached appendix for addresses.

2.11) Collectors

Fournelle Energy Technologies in Montreal is a leader in evacuated tube technology. Of interest to Albertans is the Fournelle EER-100 Solar Collector, specially designed to collect heat in cloudy and cold weather. The EER-100 collector consists of a series of heat-pipe evacuated tubes assembled on a solid frame and an overhead insulation box to protect the header pipe. The EER-140 has 14 tubes mounted on a frame of anodized aluminum connected to a copper header pipe. The assembly is surrounded by fiberglass insulation. Both models use the Fournelle FET-361 evacuated tube. These tubes have fluid within a pipe enclosed in a glass envelope. A heat exchanger clamp connects the pipe with the working fluid (the latter is therefore guarded against any sort of contamination).

Thermomax of Great Britain (with a branch in Victoria, B.C.) also manufactures evacuated pipe collectors. The MS20 and MS30 are 20 and 30 tube collectors, fairly lightweight, for residential or industrial use. The tubes are similar to the Fournelle ones and can be bought with different liquids in the pipe so as to limit the temperature reached by the tube heating the usable water passing through the manifold and heat exchanger in the closed system. This acts as a safety feature, keeping water from getting too hot for domestic use. Thermomax may open a dealership in Calgary.

2.12) Complete Systems

Conserval Engineering in Ontario manufactures "Solarwall," a heat absorbing wall installed on the outside of a building's existing south wall. Air circulates through and behind the small holes in the Solarwall and then into the building. The wall reduces heating costs and improves the quality of the air in the building and the evenness of heating. The firm sells glazed, canopy, and high performance metal Solarwalls. Conserval also makes Energy Jet air make-up systems, Humidair industrial humidification systems, Jones air-to-air exchangers, and Cain flue gas-to-water heat exchangers. The Solarwall and circulation system is installed and priced on a case-by-case basis, and is intended primarily for industrial applications, but can be adapted to residential use.

Thermo Dynamics Ltd. of Nova Scotia is a dominant manufacturer of complete solar domestic hot water systems. The "Solar Boiler" system is one of the least expensive and most reliable on the market. This relatively simple system can be installed by the homeowner. The firm sells four types of flat plate collectors, each in various sizes. It also sells solar fluid handling modules, two storage tanks in four sizes (180 L to 272 L), collector installation kits, tempered solar glass (five sizes), and miscellaneous hardware. Some customers buy Thermo Dynamics parts to make (and sell or use) their own solar products. For this reason, Thermo Dynamics sells its solar collector absorbers, sunstrip solar fin and tube in shell heat exchangers and not just finished products. The firm sells abroad and

believes that it has a virtual monopoly on the Canadian market. In Alberta, Dirk and Price Engineering and Solar Innovations (both in Calgary) carry Thermo Dynamics products.

Sunglo Solar of Ontario (with distributors in Manitoba and B.C.) makes pool heating flat plate collectors, specifically made to resist chlorine, algae, and other pool chemicals. Sunglo provides other accessories needed for a pool heating system (such as filters, timers, etc.) and provides engineering and site plan assistance and follow-up.

Solcan Ltd. of Ontario manufactures flat plate collectors for commercial and industrial use. The 2100 model has low-iron tempered glass glazing and aluminum heat absorber fins surrounding the copper tubes through which the water passes. Insulation is provided by a foam board and aluminum foil around the back and sides of the box. The 3001 collector can be used in closed-loop, draindown, and thermosiphon systems. Solcan sells "pre-engineered" complete systems (including tanks, pumps, lines, and regulators) to reduce up-front engineering and design costs.

2.13) Other

Bubble Action Pumps Ltd. out of Ontario makes non-mechanically operating pumps for solar systems. "Sol-Perpetua" is maintenance free and will serve two 4' X 8' panels. It can replace an electric motor, pump, controllers, wiring, valves, and expansion and/or draindown tank. The pump is a glass enclosed vertical assembly with various copper tubes; the heat of the sun drives the liquids through it. It cannot run backwards, freeze or pump cold fluids.

Sol-Perpetua has been undergoing testing at Queen's University Solar Laboratory where it has been running constantly and maintenance-free since 1987. Bubble Action Pumps also intends to begin selling a heat exchanger which is being tested at the same laboratory. The company also makes a space heating distribution system. A bubble pump brings heat from solar panels and/or a chimney on a wood fire down through a hydronic heating system and stores excess heat in a cistern for later use.

2.2) Economic Analysis

2.21) General

There is a large initial cost for an active solar system. The system can provide substantial savings. System prices have fallen substantially (over 50%) in the last eight years, thereby increasing the feasibility of active solar.

2.22) Typical Residential Installation

Listed below are the components for a complete Thermo Dynamics "Solar Boiler" system.

This is the most basic closed loop system one can buy. The Fluid Handling module includes motor, pump, and controller. The system fits onto an existing hot water tank.

Component	Product #	Qty.	Retail \$
Solar Boiler Fluid Handling Module	SB56M	1	849
Micro Flo Panel with Sensor (4' X 7')	S28A	1	562
Micro Flo Panel (4' X 7')	S28B	1	508
Flush Roof Mounting Kit	K1055	1	42
Life Line Tubing and Interface Kit	K1060-50	1	28
Total Systems Cost			\$ 1989

Although the individual components of the system together cost \$1989, if they are bought as a package Thermo Dynamics will sell the system for \$1,095. This is at present one of the most inexpensive systems available. Naturally, it is sometimes necessary to buy more expensive systems.

The above system can be installed by the homeowner. Professional installation will add \$500 to the system cost, according to Thermo Dynamics.

2.23) Savings, Payback

Thermo Dynamics believes that a system such as the above will save its owner \$325 to \$400 per year. At this rate, the owner-installed system would take three years and four months to pay for itself. (The Solar Boiler system is estimated to supply 65% of an average household's hot water needs.)

A survey done by Buchan, Lawton, Parent Ltd. in conjunction with Energy, Mines and Resources Canada of owners of various brands of domestic solar systems showed that in 1987, average yearly savings were \$252. Given that many systems cost \$2,000 plus, a more common payback period (at least at present) would be eight years.

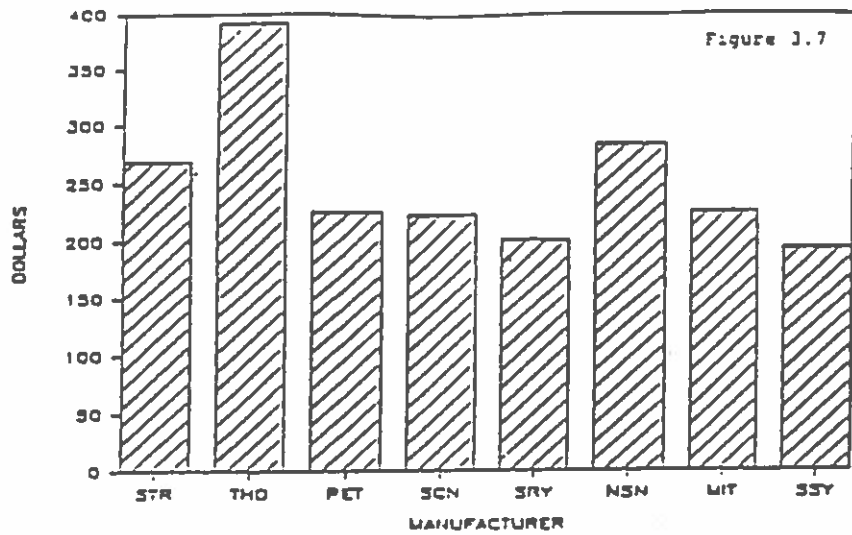
Many of the owners surveyed likely had active solar systems because they were in areas not serviced by gas and would have to use propane or electricity to heat their water without solar systems. The savings figure of \$252/yr. is therefore higher than it would be for the average homeowner in Alberta who likely spends \$100/yr. on gas for water heating. With 65% of household

hot water needs met by a solar system, the payback period would therefore be at least $\$1,095 / \$65 = 16.8$ years and possibly $\$2000 / \$65 = 30.7$ years. If one is in an area not serviced by gas, then hot water heating costs can be triple. The payback period would be between 5.6 and 10.2 years.

See attached graphs from the survey for more details.

3) INSTALLATIONS IN ALBERTA

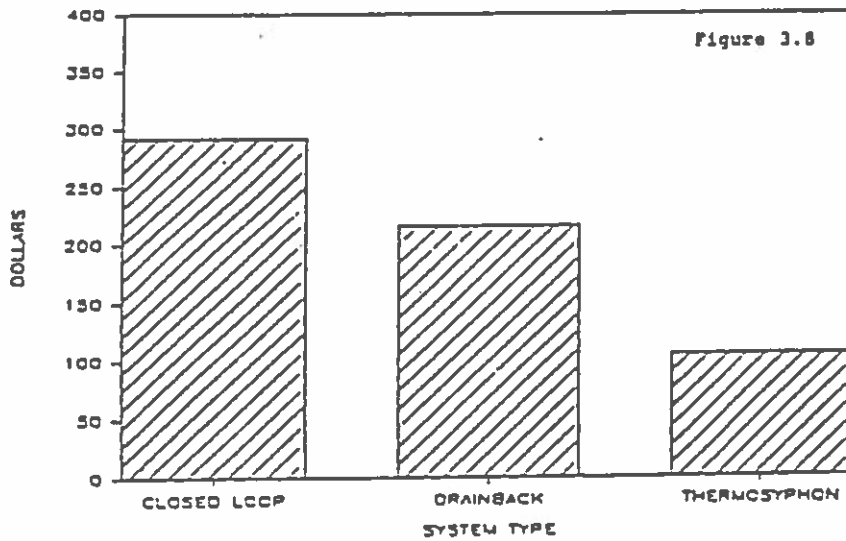
See attached information sheets from the survey done by TES Ltd. in conjunction with Energy, Mines, and Resources Canada.



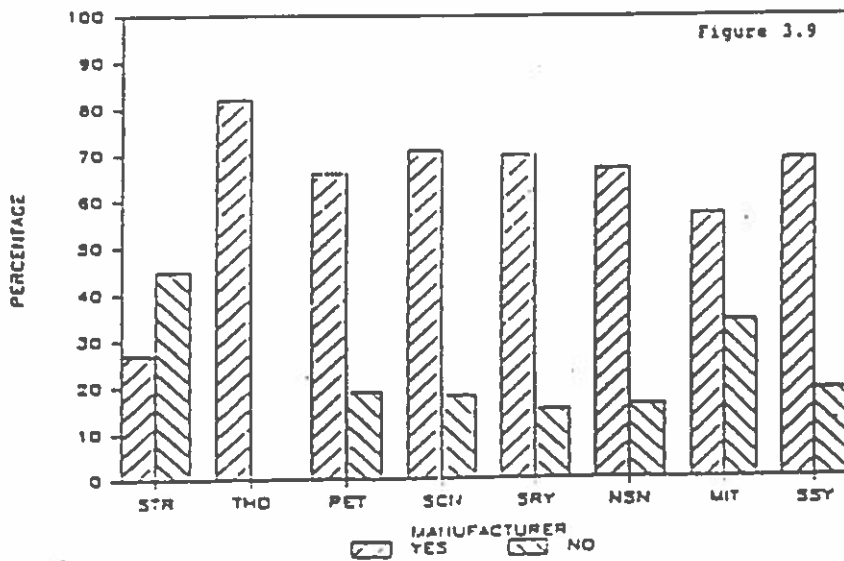
INTERPRETATION OF ABBREVIATIONS

Manufacturer	
STR	Soltroc
THD	Thermo Dynamics
PET	Petro-Sun
SCN	Solcon
SRY	Sun Ray
NSN	Norsun
MIT	Mitchell Industries Ltd includes Amherst and Sci-
SSY	Solarsystems
SQU	Sunquest
DP	Dirk and Price
ARIK	Ark Solar

SAVE EACH YEAR FROM SYSTEM



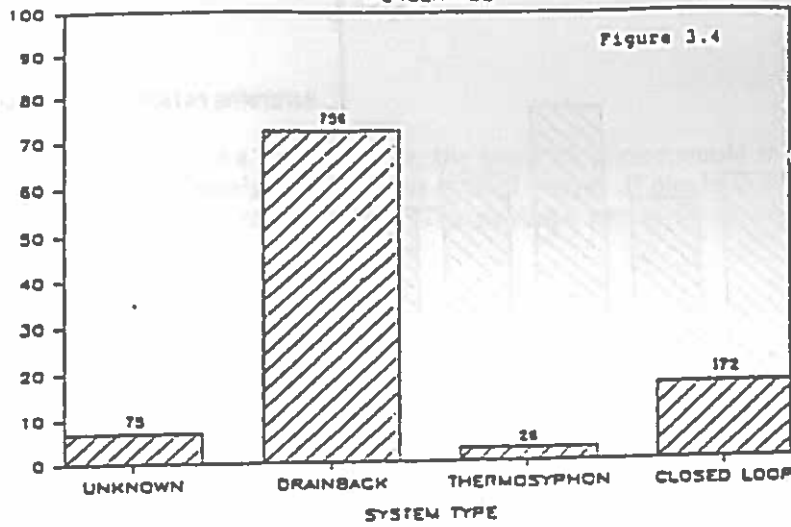
ENERGY SAVINGS JUSTIFY COSTS



From: Evaluation of Response to Solar DHW System Questionnaire,
By Buchan, Lawton, Parent Ltd. (1987)

TYPES OF SYSTEMS

PERCENTAGE

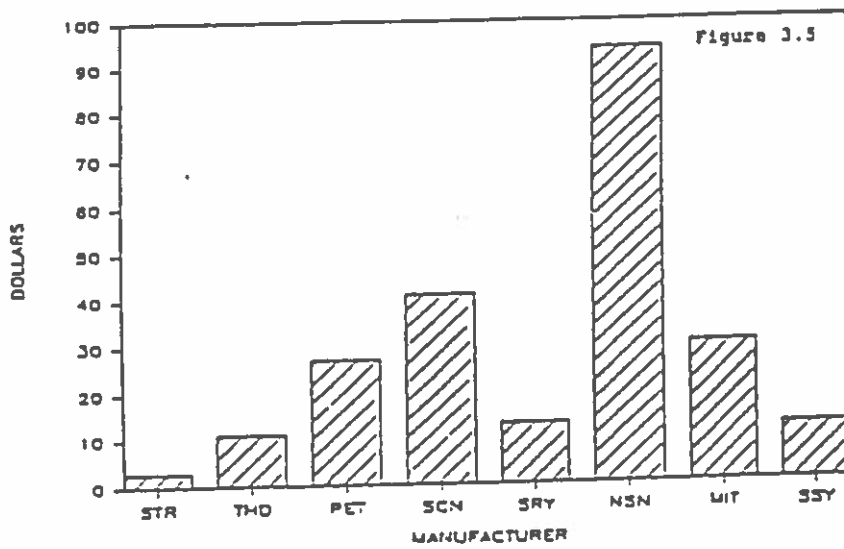


INTERPRETATION OF ABBREVIATIONS

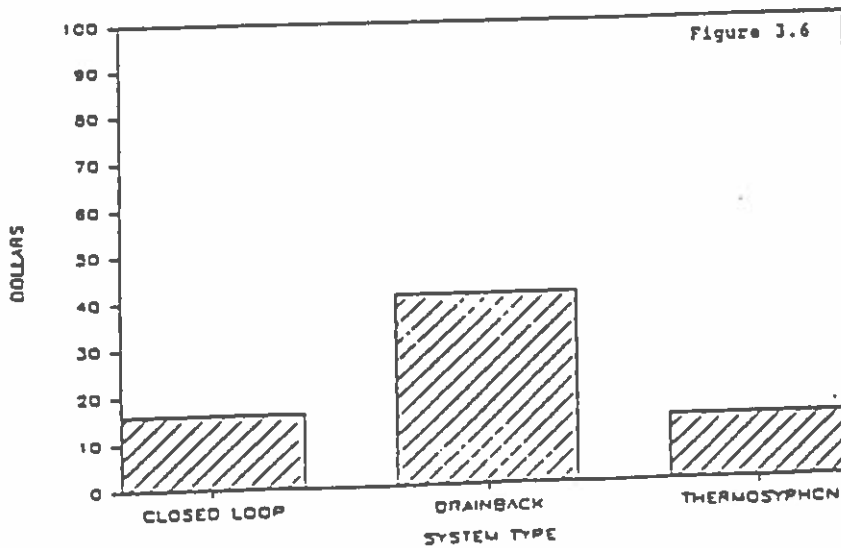
Manufacturer

STR	Soltroc
TMD	Therma Dynamics
PET	Petro-Sun
SCN	Solecas
SRY	Sun Ray
NSN	Norsun
MIT	Mitwell Industries Ltd includes Amherst and Se
SSY	Solarsystems
SQU	Sunquest
DP	Dirk and Price
ARK	Ark Solar

SPEND TO OPERATE AND MAINTAIN



SPEND TO OPERATE AND MAINTAIN

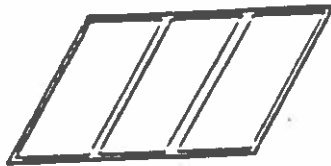


LEGEND FOR SYSTEM SCHEMATIC DIAGRAMS

From: Monitoring of the
Commercial/Industrial
Demonstration Program,
By TES Ltd. (1989)



DRAINDOWN VALVE



COLLECTOR ARRAY



PUMP



FLOW METER



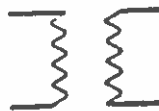
HEAT METER



TEMPERATURE SENSOR



INTERNAL
HEAT EXCHANGER



EXTERNAL HEAT EXCHANGER



OVERFLOW TO DRAIN



MAINS WATER SUPPLY



PREHEAT WATER



SWIMMING POOL



POOL HEATER/FILTER SYSTEM



HEAT METER WITH INTEGRAL FL
METER AND COLD TEMPERATURE



DIVERTER VALVE

Custom Woolen Mills
Carstairs, Alberta

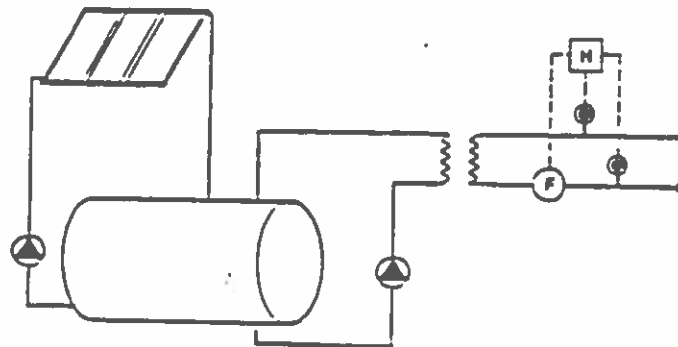
SYSTEM NOTES

A year round drainback solar energy system providing preheated process water for a commercial mill. This system was designed by Dirk and Price Engineering Ltd.

The system consists of a 30 Petro-Sun CIM-2-C flat plate collectors with a total glazed area of 90 m².

The heat meter had failed in January. The site has been dropped from the monitoring program in 1988.

SYSTEM SCHEMATIC



THERMAL PERFORMANCE DATA

MONTH OF YEAR	DATA VALIDITY 1 = VALID 0 = INVALID	ACTUAL HOT WATER USAGE (m ³)	PREDICTED HOT WATER USAGE (m ³)	ACTUAL SOLAR ENERGY DELIVERED (GJ)	PREDICTED SOLAR ENERGY DELIVERED (GJ)	SIMULATED SOLAR ENERGY DELIVERED (GJ)	RATIO OF MEASURED VERSUS SIMULATED ENERGY DELIVERED
JAN	1	186.3	422.0	7.80	18.6	4.79	1.63
FEB	1	169.0	381.0	7.84	18.6	7.92	0.99
MAR	1	184.7	422.0	14.00	25.7	12.27	1.14
APR	1	176.4	409.0	15.00	21.3	16.58	0.90
MAY	1	161.9	422.0	12.40	25.0	14.30	0.87
JUN	1	236.1	409.0	19.09	25.6	14.57	1.31
JUL	1	238.0	422.0	19.79	28.0	19.43	1.02
AUG	1	244.7	422.0	21.92	30.7	20.86	1.05
SEP	1	237.0	409.0	8.92	25.7	15.62	0.57
OCT	1	153.9	422.0	12.16	24.4	11.06	1.10
NOV	1	243.3	409.0	10.46	18.4	5.02	2.08
DEC	1	140.3	422.0	7.63	12.1	3.51	2.17
1986 TOTAL	12	2371.6	4971.0	157.01	274.1	145.93	1.08
JAN	1	215.6	422.0	11.00	18.6	5.06	2.17
FEB	1	158.2	381.0	9.31	18.6	8.77	1.06
MAR	1	168.4	422.0	12.26	25.7	9.80	1.25
APR	1	173.1	409.0	12.75	21.3	12.81	1.00
MAY	1	165.3	422.0	14.95	25.0	17.53	0.85
JUN	1	151.3	409.0	14.49	25.6	14.19	1.02
JUL	1	109.4	422.0	9.09	28.0	13.55	0.67
AUG	0		422.0		30.7		
SEP	0		409.0		25.7		
OCT	0		422.0		24.4		
NOV	0		409.0		18.4		
DEC	0		422.0		12.1		
1987 TOTAL	7	1141.3	2887.0	83.85	162.8	81.71	1.03
JAN	0		422.0		18.6		
FEB	0		381.0		18.6		
MAR	0		422.0		25.7		
APR	0		409.0		21.3		
MAY							
JUN							
JUL							
AUG							
SEP							
OCT							
NOV							
DEC							
1988 TOTAL	0	0.0	0.0	0.0	0.0		

Scott Residence
Calgary, Alberta.

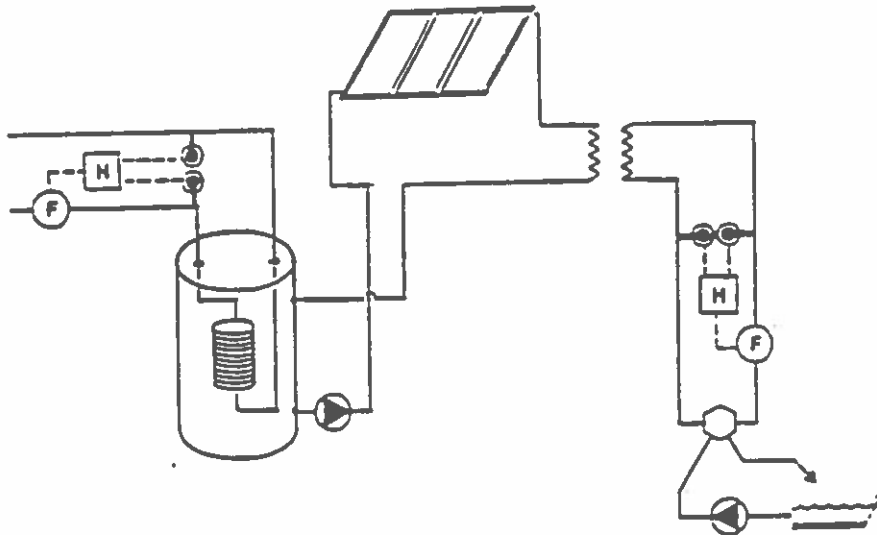
SYSTEM NOTES

A year round drainback solar combination Residential and Pool energy system providing preheated domestic hot water as well as preheated pool water for Scott Residence in Calgary, Alberta. This system was designed by Dirk and Price Engineering Ltd.

The system consists of 6 Petro-Sun flat plate collectors with a total glazed area of 18 m². The monitoring equipment consists of a Valmet heat meter and a Valmet flow meter.

The system was dropped from the monitoring program in 1988.

SYSTEM SCHEMATIC



August, 1990

ACTIVE SOLAR AND ACCESSORIES CONTACT LIST

* Denotes a dealer and/or manufacturer who already has one or more Product Files in the Energy Matters database.

1) CONSULTANTS AND PROJECT MANAGERS

Ascent Engineering Ltd.
6075 West Saanich Road, RR5
Victoria, BC V8X 4M6
(604) 652-0108 Gil Parker

Design, analysis, and management services.

Bert Van Leeuwen Industrial Design Ltd.
11 Princess St.
Amherst NS B4H 1W5
(902) 667-3464

Buchan, Lawton, Parent Ltd.
5370 Canotek Rd.
Ottawa, ONT K1J 8X7
(613) 748-3762

Bydand Solar Centre
8815 - Selkirk Street
Vancouver, B. C.
V6P 4J7

Manufactures "Sunspot" collectors, made from a synthetic rubber material. Distributes for Grundfos and Taco. Offers consulting services on system design.

CBCL Ltd.
1496 Lower Water St.
Halifax, NS B3J 2R7
(902)421-7241 J. Storrington

Dirk and Price Engineering
3415-3rd Ave NW
Calgary, AB T2N 0M4
283-4323 Chuck Price
Armen Mehoulter

Consultants, distributor for Solarex Panels and Thermodynamics SDHW products. Moving late June 1990. Establishing branch in Kelowna, C. Price 766-4096. Company name may change.

Enermodal Engineering, Ltd.
368 Phillip St., Unit 2
Waterloo, ONT N2L 5J1
(519) 884-6421 Stephen Carpenter

Computer analyses of solar products, design of solar heating systems.

FJ Quail & Assoc.
44 Bearbury Dr.
Etobicoke, ONT M9C 2G9
(416) 621-3821 FJ Quail

Groupe-Conseil Thermeca Inc.
1026 St-Jean, Ste. 403
Quebec, QUE G1R 1R7
(418) 692-0321 Guy Turgeon

H & B Plumbing Ltd.
Box 6598
Drayton Valley, Alberta
T0E 0M0

Designs active solar domestic hot water systems. Also designs photovoltaic systems and is working with the oil industry on photovoltaic applications. Holds a patent on a solar gate. Also distributes for E.G.S. controls.

Kenrush Ltd.
801-185 Ontario St.
Kingston, ONT K7L 2Y7
(613) 544-4855 Ken Rush

Consulting, engineering analysis and testing of systems.

NRG Consultants Ltd.
14 Victoria Ave. N.
Hamilton, ONT L8L 5E1
(416) 522-4132 Richard Higgins

Heat pump systems.

Solace Micropower Engineering Ltd.
201-1226 Homer St.
Vancouver, BC V6B 2Y5
(604) 681-4548 John McKay

Systems design and sales; also active in PV.

2) ACTIVE SOLAR DISTRIBUTORS, PROJECT MANAGERS, AND INSTALLERS (SYSTEM DESIGNERS)

AG Technology
Olds, AB
556-8779

Alternative and Retrofit
Energies Incorp.
1700 Varsity Estates Dr. N.W.
Calgary, AB T3B 2W9
Jorg Ostrowski
(403) 239-1900

Ark Solar Products Ltd.
2676 Quadra St.
Victoria BC V8T 4E4
(604) 386 7643

Systems designer and distributor (Thermodynamics products). Has found market slow, done 12 or so jobs in the past year (SDHW). Serves only Victoria area; some commercial, industrial. Will look to U.S. suppliers for new products.

Energy alternatives Ltd.
RR #4 East Victoria
Amherst, N.S.
B4H 4B8

Distributes for Thermodynamics.

*EH Price Sales, Ltd.
8830 Yellowhead Trail
Edmonton, AB T5B 1G1
477-9231

Distributor for Maid O' Mist.

First Co-Operative Solar Co. Ltd
685 - Erskine Street
Peterborough, Ontario
K9J 5T7
Ernest Jenkins

Builds mainly solariums and pool heating systems, using "Techno-solis" systems.

H & B Plumbing Ltd.
Box 6598
Drayton Valley, Alberta
T0E 0M0

Distributes for Photron and E.G.S. controls. Also a consultant.
Jenkin's Solar Designs
685 Erskin Ave.
Peterborough, ONT K9J 5T7
(705)745-9480

MacLeod & Grant Ltd.
Box 809, 106 MacKay St.
Stellarton, NS B0K 1S0
(902) 752-5532

Matrix Energy Systems
4826 Arthur
Dollard des Ormeaux, QUE H9G 2M8
(514) 624-0481 Brian Wilkinson

Mayerson Solar Sales Ltd.
15-1455 Youville Dr.
Orleans, ONT K1C 6Z7
(613) 837-8030 Bill Mayerson

Solway, Sunglo, Heliotrope, Arco, Soltex, Thermodynamics.

PSP Equipment
517-36 Ave SE
Calgary, AB T2G 1W5
243-3276

Radiant Design and Supply
1814-3 St. NW
Calgary, AB T2M 2Y2
(403) 230-4545 John Fricker

Ram Contracting Ltd. 1136 Commercial Street
New Minas, Kings County
Nova Scotia
B4N 3E8

(902) 678-5234
Cecil Lockhart

Installs domestic hot water systems made by Thermodynamics.

Solar Electric
175 Cascade Ct.,
Rohnert Park, CA 94928

May also be a manufacturer. Distributes Arco and Savonics products (probably only active in photovoltaics).

*Solshine Energy Systems Ltd.
Solar and Radiant Heat
4723 - 91 Avenue
Edmonton, AB T6B M7
Dennis Tindall
(403) 465-9251

Pool heating. Manufacturer: Bio-Energy.

Soltek Solar
Vancouver: (604)431-0766
Victoria: 727-7720

Dealer in accessories. Also active in PV, R&D.

United Westburne Inc.
13145-149 St.
Edmonton, AB
452-0340

WD Lowe Sales, Co. Ltd.
1145 -J- 44th Ave. SE
Calgary, AB
243-1518

Solar Innovations Inc.
515 - 17 Ave SW
Calgary, AB T25 0A9

Also a supplier.

Solarsystems Industries Ltd.
2-11771 Horseshoe Way
Richmond, BC V7A 4S5
(604) 271 2621

Sunstrip International Inc.
1501 Ampere St.
Boucherville, QUE J4B 5Z5
(514) 641-1015 Michel Sicotte

Burgess Plumbing, Keating, & Electric Ltd.
36 N Broadway St.
Williams Lake, BC V2G 1B9
(604) 392-3301

Kerr Solar Sysyems
RR1
Chatham, ONT N7M 5J1
(519) 354-4127

Mayerson Solar Sales Ltd.
Box 4959 Stat. E
Ottawa, ONT K1S 5J1
(613) 824-1040

Radiant Design & Supply
By Sun Energy Design Science
1814 - 3rd Street N.W.
Calgary, AB T2M 2Y2
John Fricker
(403) 230-4545

Systems design, installation. (Mfr?)

Solar Quip Heating Systems Ltd.
RR2
Richards Landing, ONT P0R 1J0
(705) 246-2894

Sun Ross Solar Systems Ltd.
Box 502, 109 Rose St.
Port Hawkesbury, NS B0E 2V0
(902) 625-1539 John Ross

...see also attached.

3) ACTIVE SOLAR MANUFACTURERS

Arco Solar
Box 6032
Camarillo, CA 93010
(805) 482-6800

Also involved in PV. See Energy Alternatives, and 1990 Canadian Solar Energy Catalogue.

*A. Y. McDonald MFC Co.
Box 508
Dubuque, IA
52004-0508
(319) 588-0720

Water pumps.

*Bio-Energy Systems Co.
Box 191
Ellenville, NY 124 ?
(914) 647-6700

"Solaroll" heats pool water through collector tubes. No cost on file.

Bubble Action Pumps Ltd.
4 Cataraqui St.
Kingston, ONT K7K 1Z7
(613) 542-4045 Wilfred Sorenson

Circulating pump and 1 pipe vapour (heat) delivery system, solar DHW systems. Products have been sold to Solcan. Information sent.

*Cambrian Eng. Group Ltd.
119-105 St. E
Saskatoon, SAS S7N 1Z2
(306) 374-8242

Solar pump, solar water pumper, remote locations (freezing). No price on file.

*Conserval Engineering Inc
200 Wildcat Rd.
Downsview, ONT M3J 2N5
John Hollick, Pres.
Gord Bennett
(416) 661-7057

Solar walls for air heating of large buildings. Cost varies with job done. Primarily industrial applications (best economic returns for the company are with large jobs, and both management and labour like the air heaters since they save money and create a more comfortable work place), although some possibilities for residential use if rock storage is used (Hollick has an installation in his home made by Conserval). Conserval sells to any part of the country and has never encountered significant problems of installation in terms of shading, lack of sun, etc.

*Controlex Inc.
Francetown. TNPK
New Boston, New Hampshire
U.S.A. 03070
(603) 487-5512

Also a distributor. Makes instrument to measure solar energy, meteorological instruments and controls, PV "perpetual battery" for remote location instrument powering.

*Eaton Corp.
Controls Div.
Energy Control Products
191 East North Ave.
Carol Stream, ILL 0188

Freeze protection valve. Distributor: Solway Solar Energy.

*Epply Laboratory, Ltd.
12 Sheffield Ave.
Newport, Rhode Island 02840
(401) 847-1020

Manufactures solar radiation detection devices.

*Fournelle Energy Technology Inc. (headquarters)
4343 Hochelaga
Montreal QUE H1V 1C3
(514) 251-0396 (FAX 514-251-0398)

Also conducts research and development (cost effectiveness, quality and reliability, performance of evacuated tubes FET-361), has international offices. Makes evacuated tubes (no prices on file). See literature

*GNB Batteries (Canada) Inc.
4436 - 97 Street
Edmonton, Alberta
T6E 5R9
Andy Rodgers
437-4660

*Grundfos
2555 Clovis Ave.
Clovis, CA 93612
(209) 299 9741

Pumps.

Heliopower
Box 5089
Culver City, CA 90231

Active in PV, may also be involved in active solar. See Energy Alternatives catalogue.

*Heliotrope General
3733 Kenora Drive
Spring Valley, CA 92077
Mark Albert
(619) 460-3930

Systems monitors, valves, inverters, temperature controls. Active solar and PV. Products in Energy Alternatives catalogue.

*Inco Selective Surfaces
Inco Alloys International Inc.
Huntington, WV 25720
(304)526-5449

Accessories, solar collector material. No price on file.

KSH Canada Inc.
7521 Tranmere Drive
Mississauga, ONT L5S 1L4
Ron McCurdy
(416) 673-3345

Used to sell a solar panel, but no more. Future in the solar industry uncertain.

*Maid-O'-Mist
3217 North Pulaski Road
Chicago, ILL 60641

Automatic air vent, no cost on file. EH Price distributes.

*Marine Solartechinics
360 Centre St.
Bangor, ME 04401
(207) 947-2909

Uses Thermomax evacuated heat pipe collector to make a solar panel.

Oboe Engineering
404-251 Laurier Ave. W.
Ottawa, ONT K1P 5J6
(613) 727-6263

Developed and sells active solar systems which dry crops such as grain and cocoa. All sales have been to developing countries and for industrial use. Use in Alberta (eg. for agriculture) not possible because the growing season is too short, and the temperatures too low compared to those of most developing countries. Besides this, oil here is abundant and relatively cheap. (The president of Oboe estimates that the price of oil would have to be \$25/bbl before active solar becomes very economically feasible in Canada.) Oboe's sales abroad are not supported by government subsidies.

*Solar Industries
A Div. of Aquatherm Industries Inc.
1985 Rutgers University Blvd.
Lakewood, NJ 08701
(201) 905-0440

Solar pool heating.

*Solcan Ltd.
885 Sarnia Rd.
R.R. 3
London, ONT N6A 4B7
Bob Swartman
(519) 473-0501

Collectors, flat plate. Drainback system with collector (for hot water heating), antifreeze system, thermosiphon. Some components bought from Bubble Action pumps. Solcan distributes to any area and has sold some units in the Carribean. Information sent.

*Solway Energy Corporation
30 - 942 S.W. Marine Drive
Vancouver, B.C. V6P 5Z2
J.L. Richardson
(604) 324-3327

Manufactures collectors, hot water tank (prices not released). Distributes "passive pipe" for DHWH and other products (eg. Eaton).

Sunglo Solar Ltd.
35 Citron Crt.
Concord, ONT L4K 2S7
(416) 738-0300 Kevin

Manufactures pool heating systems. Also a distributor and has distributors in Manitoba, Ontario, Saskatchewan, and B.C.

*Sunmaster Corp.
35 West William St.
Corning, NY 14830
(607)937-5441

Vacuum tube panels, makes on order basis only.

Sun Ray Solar Systems Ltd.
2429 Seminole St.
Windsor, ONT
N8Y 1X2
(519) 253 1182

A few years ago, manufacturerd solar panels with the help of government grants, but no more. Now only makes insulated glass and materials for solariums and greenhouses.

*Thermodynamics
Halifax, NS
(902) 468-1001 Tony Maskin
1003 FAX

Leading manufacturer of active solar components in North America, and claims to have a monopoly in Canada. SDHW system made from "best technology available." Some direct sales, some sales to distributors (in Alberta, Chuck Price @ 283-4323 and Mark Fournier of Solar Innovations @ 228-1988, both in Calgary). Some buyers use Thermodynamics components to make their own solar systems. By the end of 1990, Thermodynamics may have some involvement in PV as well.

*Thermomax Industries Ltd.
Box 6220
Victoria, BC V8P 5L5
(604) 721-4328 Patrick Spearing
(FAX: 604-721-4329)
Victoria: 604-388-6275
Vancouver: 604-438-2333

Evacuated heat pipe solar collectors, R&D in some areas (have literature for evacuated tubes). No prices on file.

*Zomeworks
Box 25805
1221 Edith Ave.
Albuquerque, NM 87125
(505) 242-5354

Glazing material. PV: tracker mounts for panels. Distributor: Ag Technology, Olds AB.

4) ACTIVE SOLAR RESEARCH, DEVELOPEMENT AND INFORMATION

ABL Technologies Inc.
919 Fort St., Suite 202
Box 5550 Station B
Victoria BC V8R 6S4
(604)383-1123

Energy and economic analysis, solar energy and environmental engineering, energy management systems, systems integration, computer engineering.

Canadian Solar Industry Assoc.
67a Sparks Street
Ottawa, ONT K1P 5A5
(613) 237-7000

Passmore Assoc. International.
135 York St.
Suite 209,
Ottawa ONT K1N 5T4
(613) 234-3602 (FAX 613-234-0895)

Project management, consulting, marketing, technology transfer for all renewable energy applications.

Solar Energy Society of Canada
101 Ave, 117 St.
Edmonton, AB
482-6570

TES Ltd.
Box 9372
Ottawa, ONT K1G 3V1
(613) 741-9402 Bob Macluaghlin

Analysis of data on wind turbines. Four year active solar monitoring report: feasibility of active solar systems based upon data observed over four years.

Queen's University
Kingston, ONT
Canadian Solar Calorimetry Laboratory.
(613) 545-2000 (general number)

Also does research in PV.

5) ACTIVE SOLAR - OTHERS (classification unknown)

Savonics

PV modules for marine, RV use. In Energy Alternatives catalogue.