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CONTINUING REGIONAL SOLAR ENERGY INFORMATION MINI-CENTER
ACTIVITIES AND UPDATING THE SOLCOST PROGRAM

Quarterly Report

By
Loren J. Lantz

MASTER

April 1979

Work Performed Under Contract No. EG-77-C-02-4643

Solar Environmental Engineering Company, Incorporated
Fort Collins, Colorado



U.S. Department of Energy

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Solar Energy

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Contract #EG-77-C-02-4643.A001

Prepared by

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April, 1979

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PROGRESS SUMMARY

Following is the progress made during February, March and April of 1979, for each task of the contract.

Task 1: Interactive SOLCOST Interface

The interactive SOLCOST interface has most recently finished its second iteration. The recent changes were those to incorporate the modifications made by Martin Marietta in their Version 2.0. The changes were primarily the facilitation of an interactive tank temperature method and the inclusion of simplified system components sizing. The letter code set was developed by SEEC employees. Upon receipt of Version 2.0, the SEEC staff proceeded to convert it to ANSI Standard FORTRAN as they had done with the previous SOLCOST version and then to update the interactive front end which offers two forms of interaction with the user: 1) interrogation for those who are uncertain of the proper inputs, and 2) short form answers for experienced users. Incidentally, the interactive front end program need not be used, for the SOLCOST program has free formatted input features. The experienced user may wish to, and can easily do so, construct the input file by directly creating it through punch cards or an interactive input file and then submitting it to the SOLCOST batch program. Approximately 10 copies of the previously created interactive front were released to the user community; primarily to institutions and large engineering firms for testing purposes. The early version is a subset of the more recently

created version and both versions operate in the same manner with respect to the user. There have been no significant user criticisms of the interactive version. However, it should be noted that it may not have received an absolute thorough test, which will be achieved by several months of operation in the user community. The reader is referred to Appendix A, which is an example of using the latest ANSI Standard FORTRAN version of SOLCOST. This particular example was designed to illustrate the detailed duct sizing methodology. However, the input file was created by the interactive front end.

Task 2: Energy Conservation - Solar System Optimization

It was stated in the previous quarterly report that this task was to be deferred and a task to assure the quality of the Solar Index project was to be substituted. The original task was to be picked up in a modification to the contract later on. Due to administrative procedures within the Department of Energy (DOE), this extension and modification has not materialized. However, it is expected that the modification will be included in the extension, which should be initiated within 60 days of this report. Consequently, as directed, the quality assurance work is at a standstill. Administrative and preliminary work have been reinitiated for the Energy Conservation - Solar System Optimization feature. The work that is under way at the current time is research into the best way to modify the SOLCOST program to facilitate this new methodology to ensure ease of operation and speed of execution.

Task 3. Detailed Duct Sizing

The software has been incorporated into the ANSI Standard FORTRAN version of SOLCOST and an interactive version has been created which creates input files for the SOLCOST program. The reader is referred to Appendix A which gives an example of the use of this methodology. Detailed reference literature is in the process of being created at the present time which provides the user with the necessary descriptions and input parameter default values for easy execution of this new section of SOLCOST. That manual is in its final editing at the present time and should be published within 2-3 weeks.

Task 4. Data Base (Extension of the SOLCOST Data Base)

Minimal effort has been done in this area during the reporting period. Primary contract work has been deferred to the code modification so that those pieces can be made available to the public. However, SEEC uses the data base frequently to obtain collector parameters for those individuals who submit SOLCOST jobs and who do not provide the necessary parameters. Several modifications to the data base are expected to be accomplished before the completion of this contract. Those are primarily to modify the code to facilitate ease of use and to reduce the possibility of errors. One modification has been done, however, during the reporting period, and that is to obtain tax incentive information from various sources which are destined to be included in the data base.

Task 5. Portable FORTRAN Version

The second iteration of the portable FORTRAN version is completed and is being tested internally. When the portable FORTRAN version and the interactive front end have been thoroughly tested, and the manual is completed, the package will be released. It is expected that this release will take place within the next 2-3 weeks. International Business Services is working in coordination with SEEC in making a blanket news release of the code availability. The previous ANSI Standard FORTRAN version (which did not include the latest modifications) has been distributed to about 10 users in the using community. No significant problems have been observed other than the normal problems seen when taking code from one type of computer to another. These types of problems can be expected irregardless of the type of code. SEEC has been coordinating this activity with Martin Marietta in an effort to place this new code set on CYBERNET and the Boeing Computer Service. When Martin Marietta is again in a funded operation (expected date around July 1, 1979), this code set will be placed on CYBERNET. By that time the code set should have been thoroughly tested.

Task 6. Automatic Collector Parameter Subroutine

The software for this task was previously written and has been most recently modified to incorporate two new features: 1) modification of the collector parameters to include inlet and outlet manifold and supply line heat loss, and 2) air leakage for air collectors. This subroutine is being installed at the present time and will not be released in the current version of SOLCOST. It will be released in the next iteration which should take place mid-summer.

Task 7. The Solar Index

The daily management of the Solar Index effort is consuming much more time than originally anticipated. With the active solicitation of the primary consumer market areas by the Department of Energy and International Business Services, more requests than had been anticipated have been received from the media. At the present time, the Index effort is expanded to over 50 different weather areas around the country with several additional areas under review at the present time. These weather areas service over 75 cities. See Table 1, which is a list of most of the current metropolitan areas being serviced by the Solar Index effort with the corresponding collector area as used in the Solar Index software models. These models have been modified the last month to facilitate new software advancements in the SOLCOST program. The load is 80 gal/day, delivered at 120°F. It was assumed that the service supply temperature was 50°F; the collector was tilted at the latitude; in the south, a drain down system was assumed. By south it is assumed to mean areas where it very, very seldom freezes. By this definition, the northwest, Seattle and Portland, are also included. In the north it is assumed that a heat exchanger is in the collection loop. In the north, a two glazed collector is assumed; in the south, a single glazed collector. These collector areas were chosen so as to give an annual load fraction of 70-75%. One Index model may service several different metropolitan areas within a radius of 40-50 miles. So, the total number of cities will not correspond exactly with what is being disseminated by the Franklin Institute.

TABLE 1. COLLECTOR AREAS FOR SOLAR INDEX SITES

<u>City, State</u>	<u>Ft²</u>
Phoenix, AZ	30
Los Angeles, CA	35
Denver, CO	55
Washington, D.C.	70
Miami, FL	40
Atlanta, GA	50
Boise, ID	60
Pocatello, ID	65
Des Moines, IA	65
Chicago, IL	80
Fort Wayne, IN	75
New Orleans, LA	45
Portland, ME	65
Baltimore, MD	80
Amherst, MA	65
Boston, MA	70
Minneapolis, MN	80
Columbia, MO	60
Kansas City, MO	60
St. Louis, MO	65
Springfield, MO	60
Great Falls, MT	80
Lincoln, NE	60
North Omaha, NE	60

TABLE 1. COLLECTOR AREAS FOR SOLAR INDEX SITES (cont.)

<u>City, State</u>	<u>Ft²</u>
Albuquerque, NM	40
Binghamton, NY	90
Rochester, NY	70
Greensboro, NC	60
Raleigh, NC	45
Bismark, ND	75
Fargo, ND	75
Columbus, OH	75
Oklahoma City, OK	55
Portland, OR	90
Harrisburg, PA	70
Philadelphia, PA	65
Scranton, PA	70
Chattanooga, TN	60
Memphis, TN	55
Abilene, TX	35
Lubbock, TX	45
Salt Lake City, UT	50
Burlington, VT	90
Norfolk, VA	50
Seattle, WA	90
Walla Walla, WA	90
Green Bay, WI	75
Madison, WI	80
Lander, WY	55

In coordination with International Business Services and the Department of Energy, a technical paper is under development at the present time. This paper will include some of the quality assurance work that is in progress and a complete description of both the technical and the market subject concerning the Solar Index effort. It is to be a complete and comprehensive paper which is suitable for publication in trade journals such as Solar Engineering, Solar Age, and Solar Heating and Cooling. The paper, with modification, could be published in some of the meteorological journals.

Task 8: Operation of the SOLCOST Mini-Center

The daily operation of the SOLCOST Mini-Center is expanding slowly, but steadily. See Table 2 for a list of total SOLCOST utilization over the past several months. There was a lull in operations around the first of the year, which is to be expected because the same lull was experienced in the construction trade. Also notice that there is a small demand for the heat load analysis program. This particular heat load analysis program offers some concern due to the lack of detailed documentation. Also, to facilitate the use of the heat load software, a great deal of supporting software is required, primarily the MITAS preprocessor package with supporting libraries.

Another effort in the Mini-Center area is the constant attention to daily inquiries over the telephone and through the mail by SOLCOST users. Most of the inquiries are general in nature and are from people primarily requesting explanation of the input descriptions in the user's manuals. Also, many requests are received, without solicitation by either SEEC or International Business

TABLE 2. TOTAL SOLCOST ANALYSES

<u>Month</u>	<u>SOLCOST</u>	<u>Heatload</u>
August, 1978	20	
September	7	
October	2	
November	1	
December	6	
January, 1979	10	2
February	11	2
March	19	1
April	18	1

Services, about the availability of the software. Many individuals would like to have the software available so that it could be easily implemented on minicomputers. At the present time, that is not possible without a great deal of modification by the purchaser. The SOLCOST program is intended for operation on large resident computers such as IBM, CDC, and UNIVAC.

One presentation on the SOLCOST program was made during the reporting period and that was to the Georgia State Corrections Institution. This particular trip was made in conjunction with a trip to the East Coast. The Georgia Corrections people were primarily interested in a training program to institute the solar technology in their institution. After conversing with the individuals concerned, it was observed that they were capable of buying natural gas at approximately \$.10 per 100,000 Btu. This is an incredibly cheap rate and would not facilitate an economic consideration of including solar in their institutions, unless it was possibly for the purpose of training inmates so that they could enter the consumer market after release as trained installers. These individuals were referred to the NAHB program through International Business Services in an effort to gain access to the appropriate training materials. It is not anticipated that they will be able to use the SOLCOST program except for possibly later on in a training environment.

APPENDIX A

SOLCOST Duct Sizing Example

T

AIR SYSTEM COMPONENT SIZING EXAMPLE

1,	7	7	7	7	7	7	7	7
	7	7	7	7 *				
	# SOLAR SYSTEM TYPE FLAGS BY MONTH							
4,	2	2	2	2	2	2	2	2
	2	2	2	2 *				
	# REFERENCE SYSTEM FUEL TYPE							
6,	2							
	# SOLAR AUXILIARY ENERGY FLAG							
10,	8							
	# COLLECTOR TYPE FLAG							
13,	.5500E+02 *							
	# COLLECTOR TILT ANGLES, DEGREES							
23,	.8000E+02							
	# COLLECTOR MODULE SIZE (SQ. FT.)							
25,	55							
	# SITE LOCATION CODE							
40,	2							
	# BUILDING LOAD COMPUTE METHOD FLAG							
42,	.7100E+01							
	# BUILDING HEAT LOSS FACTOR (BTU/DEG-DAY-SQ.FT)							
43,	.1500E+04							
	# BUILDING FLOOR AREA (SQ.FT)							
49,	.9000E-01							
	# LOAD FOR WATER HEATING, ETC. (MIL BTU/DAY)							
55,	.5000E+03							
	# SOLAR SYSTEM FIXED COST, DOLLARS							
56,	.3000E+02							
	# COST OF SOLAR SYSTEM, DOLLARS /SQ.FT							
59,	.6000E-02							
	# SOLAR SYSTEM MAINTENANCE (FRACTION OF INIT COST)							
65,	1							
	# FINANCIAL SCENARIO FLAG(RES,BUS,NFO): 1,2, OR 3							

68, .9000E-01
\$ MORTGAGE INTEREST RATE, PERCENT/YEAR
74, .3500E+00
\$ INCOME TAX RATE, (FRACTION)
82, .7500E-01
\$ INFLATION FACTOR FOR MAINT, INSUR, PROP TAXES
91, .4300E-01 .2000E+03 .3600E-01 .1000E+07 .9000E-01 \$
\$ ENERGY COST SCHEDULE-ELECTRICITY
190, 1
\$ FLAG TO EXECUTE SUBSYSTEM SELECTION/SIZING ROUTINES
192, 1
\$ FLAG FOR CROSSFLOW AIR-LQ (OR LQ-AIR) HX IN COL LOOP
193, 1
\$ FLAG TO INCLUDE COMPONENTS IN SYSTEM COSTS
204, .6500E+02
\$ TOTAL PIPE OR DUCT LENGTH IN COLLECTION LOOP
RUN

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USER TITLE

AIR SYSTEM COMPONENT SIZING EXAMPLE

SOLCOST STANDARD FORTRAN VERSION 1
LAST MOD---APRIL 1979
THE PROGRAM IS MAINTAINED BY THE
SOLCOST SERVICE CENTER
2524 EAST VINE
FT. COLLINS, CO 80524

-----LISTING OF USER INPUTS AND SOLCOST DEFAULT VALUES-----

LOCATION --DENVER,CO LATITUDE = 39.8 TILT ANGLES 55.0
 AIR SOLAR SYSTEM WITH 50.0 LBS OF ROCK STORAGE PER SQ FT OF COLLECTOR
 COL. EFFIC. INTERCEPT = .52
 COL. EFFIC. = .21 AT DEL T/FLUX = .5 HT-F-SQ FT/BTU
 INPUT SPACE HEAT U-VALUE = 7.10 BTU/(F-DAY-SQ FT) FLOOR AREA= 1500. SQ FT
 INPUT SER. HOT WATER LOAD= .090 MILLION BTUS/DAY
 AUXILIARY ENERGY IS ELECTRIC LENGTH OF ANALYSIS 20.0 YEARS

		SOLAR SYSTEM	REFERENCE SYSTEM
INITIAL COST,	\$ FIXED	500.00	0.00
INITIAL COST,	\$/SQ FT	30.00	
DOWN PAYMENT,	% OF IN. COST	10.0	10.0
LOAN TERM,	YEARS	20.0	20.0
INTEREST RATE,	%	9.0	9.0
DISCOUNT RATE,	%	9.0	9.0
INCOME TAX RATE,	%	35.0	35.0
PROP. TAX RATE,	% OF IN COST	0.0	0.0
INSURANCE RATE,	% OF IN COST	.5	.5
MAINTENANCE RATE,	% OF IN COST	.6	.5
GEN INFLATION,	% PER YEAR	7.5	7.5

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	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOLAR SYSTEM TYPE	7	7	7	7	7	7	7	7	7	7	7	7
TRANSPORT EFFIC.	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
COL. INLET TEMP.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.
REF. FUEL TYPE	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC	ELEC
REF. SYSTEM EFFIC.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DAILY LOAD-MIL BTU	.46	.43	.39	.28	.18	.12	.09	.09	.13	.23	.36	.43
MEAN MIN TEMP., F	16.	19.	24.	34.	44.	52.	59.	57.	48.	37.	25.	19.
MEAN MAX TEMP., F	44.	46.	50.	61.	70.	80.	87.	86.	78.	67.	53.	46.
PERCENT POSS. SUN	67.	67.	65.	63.	61.	69.	68.	68.	71.	71.	67.	65.
DAILY HOR. INSOL.	940.	1127.	1530.	1879.	2135.	2351.	2273.	2044.	1727.	1301.	884.	732.
HEATING DEG. DAYS	1088.	902.	868.	525.	253.	80.	0.	0.	120.	408.	768.	1004.
BLDG. USE-DAYS/MON	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.

ENERGY COST DATA
 ELECTRIC \$.043 PER UNIT FOR FIRST 200. UNITS
 ELECTRIC \$.036 PER UNIT FOR NEXT .100E+07 UNITS
 ESCALATION RATE = 9.00 PERCENT

+++++DUCT AND FAN INPUT SUMMARY FOR AN AIR SYSTEM

COLLECTOR FLOW RATE	2.00 SCFM/SQFT-COL
COLLECTOR HEAD LOSS	.50 INCHES OF WATER
DUCT DESIGN AIR VELOCITY	700.00 FEET/MINUTE
ROCK BED HEAD LOSS	.15 INCHES OF WATER
CROSS FLOW HEAT EXCHANGER HEAD LOSS	.20 INCHES OF WATER
TOTAL DUCT LENGTH	65.00 FEET
DUCT COST	4.00 DOLLARS PER FOOT
INSULATION FRICTION FACTOR	1.15
SITE ELEVATION	3000.00 FEET
NUMBER OF DAMPERS	4
NUMBER OF TURNS	6
COST OF A DAMPER	25.00 DOLLARS
COST OF A TURN	25.00 DOLLARS
EQUIVALENT DUCT LENGTH AT D=12IN-DAMPERS	.75 FEET
EQUIVALENT DUCT LENGTH AT D=12IN-TURNS	.50 FEET

FAN TABLE

NUMBER	FAN HEAD(IN OF WATER)	FLOW RATE(CFM)	COST(\$)
1	0.00	149.00	25.00
1	.20	135.00	25.00
1	.40	121.00	25.00
1	.50	114.00	25.00
1	1.04	0.00	25.00
2	0.00	525.00	55.00
2	.20	475.00	55.00
2	.40	415.00	55.00
2	.50	387.00	55.00
2	1.15	0.00	55.00
3	.30	865.00	60.00
3	.40	825.00	60.00
3	.50	760.00	60.00
3	.60	660.00	60.00
3	.70	520.00	60.00
4	1.00	291.00	80.00
4	2.00	231.00	80.00
4	3.00	156.00	80.00
4	4.00	0.00	80.00
5	1.00	530.00	85.00
5	2.00	475.00	85.00
5	3.00	415.00	85.00
5	4.00	335.00	85.00
5	5.00	160.00	85.00

6	.13	1100.00	100.00
6	.25	1000.00	100.00
6	.38	890.00	100.00
6	.50	800.00	100.00
6	.75	475.00	100.00
6	1.00	0.00	100.00
7	1.50	1848.00	175.00
7	1.75	1735.00	175.00
7	2.00	1610.00	175.00
7	2.25	1457.00	175.00
7	2.50	1288.00	175.00
7	2.75	1047.00	175.00
8	.50	2100.00	180.00
8	.75	1980.00	180.00
8	1.00	1460.00	180.00
9	1.00	1200.00	210.00
9	2.00	1137.00	210.00
9	3.00	1069.00	210.00
9	4.00	1011.00	210.00
9	4.50	937.00	210.00
10	1.00	2137.00	330.00
10	3.00	1927.00	330.00
10	5.00	1711.00	330.00

+++++INPUT SUMMARY FOR CROSS FLOW HEAT EXCHANGER

(AS USED IN THE AIR HEATING SYSTEM)

CROSS FLOW HEAT EXCHANGER UA VS COST TABLE

NUMBER-----UA(BTU/HR-DEGF)-----COST(\$)

1	197.00	45.00
2	295.50	50.00
3	394.00	55.00
4	492.50	63.00
5	591.00	77.00
6	788.00	84.00
7	886.50	85.00
8	985.00	100.00
9	1773.00	128.00
10	1940.00	140.00
11	3546.00	192.00

+++++THIS IS AN AIR SYSTEM

COLLECTOR AREA	80.	160.	240.	320.	400.	480.	560.	640.
DUCT DIAMETER (INCHES)	8.00	11.00	13.00	15.00	17.00	18.00	19.00	21.00
SYSTEM HEAD LOSS (INCHES)	.93.	.92	.92	.91	.91	.91	.91	.90
SUBCOMPONENT COST	510.	510.	510.	510.	510.	510.	510.	510.
FAN COST (DOLLARS)	80.	85.	175.	175.	175.	330.	180.	180.
FAN SELECTION (NUMBER)	4	5	7	7	7	10	8	8
CROSS FLOW HX UA (BTU/DEGF-HR)	70.	141.	212.	285.	357.	431.	505.	580.
CROSS FLOW HX COST (\$)	45.	45.	50.	50.	55.	63.	77.	77.
CROSS FLOW HX EFFECTIVENESS	.300	.300	.300	.300	.300	.300	.300	.300
CROSS FLOW HX SELECTION	1	1	2	2	3	4	5	5

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SOLAR SYSTEM COST SUMMARY TABLE

COLLECTOR AREA	80.	160.	240.	320.	400.	480.	560.	640.
STORAGE SIZE	2.	4.	6.	8.	10.	12.	14.	16.
COMPONENT								
COSTS(DOLLARS)	635.	640.	735.	735.	740.	903.	767.	767.
STORAGE COSTS(\$)	100.	200.	300.	400.	500.	600.	700.	800.
COLLECTOR								
COSTS(DOLLARS)	2400.	4800.	7200.	9600.	12000.	14400.	16800.	19200.
FIXED COSTS(\$)	500.	500.	500.	500.	500.	500.	500.	500.
TOTAL COSTS(\$)	3635.	6140.	8735.	11235.	13740.	16403.	18767.	21267.

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SYSTEM PERFORMANCE AND COST SUMMARY FOR 55.0 TILT ANGLE

COLLECTOR AREA (SQ.FT.)	SOLAR ENERGY FRACTION	SOLAR SYSTEM COST \$	RATE OF RETURN ON EQUITY %	NET PRESENT WORTH OF SOLAR SAVINGS \$ (SEE NOTE 2)	LIFETIME COST SAVINGS (UNDISCOUNTED) \$
80.0	.075	3635.00	0.0	-1283.97	-3036.60
160.0	.196	6140.00	0.0	-999.48	-1654.16
240.0	.292	8735.00	0.0	-1238.35	-1709.81
320.0	.367	11235.00	0.0	-2043.45	-2981.75
400.0	.445	13740.00	0.0	-3020.95	-4337.49
480.0	.489	16403.00	0.0	-4777.59	-7779.23
560.0	.543	18767.00	0.0	-6092.46	-10152.71
640.0	.596	21267.00	0.0	-7529.31	-12791.94

ENERGY BALANCE BY MONTH FOR 160.0 SQ. FT. COLLECTOR

MONTH	FRACTION BY SOLAR	AVERAGE USEFUL SOLAR PER DAY (BTU/DAY-SQ FT)	TOTAL USEFUL SOLAR ENERGY (MIL BTU/MO)	AUXILIARY ENERGY (MIL BTU/MO)	CONVENTIONAL SYSTEM ENERGY (MIL BTU/MO)
1	.083	239.8	1.19	13.19	14.38
2	.113	305.9	1.37	10.76	12.13
3	.128	309.4	1.53	10.50	12.03
4	.168	290.7	1.40	6.90	8.29
5	.251	277.3	1.38	4.11	5.48
6	.455	337.0	1.62	1.93	3.55
7	.683	384.0	1.90	.89	2.79
8	.698	392.4	1.95	.84	2.79
9	.564	467.4	2.24	1.73	3.98
10	.301	433.0	2.15	4.99	7.14
11	.116	262.5	1.26	9.62	10.88
12	.076	207.4	1.03	12.45	13.48
ANNUAL	.196		19.01	77.91	96.92

NOTE 1 CONV. ENERGY AND SOLAR AUXILIARY ENERGY ARE GROSS VALUES
(I.E. THEY INCLUDE TANK INSULATION AND/OR COMBUSTION LOSS)

NOTE 2 NET PRESENT WORTH OF SOLAR SAVINGS = PRESENT WORTH OF NET CASH,
FLOWS (FOR A 9.0 % DISCOUNT RATE) MINUS THE DOWN PAYMENT
COLLECTOR TYPE = AIR, FLAT PLATE, 2 COVERS, PAINT

COLLECTOR SIZE OPTIMIZATION BY SOLCOST

BEST SOLAR COLLECTOR SIZE FOR TILT ANGLE OF 55. DEGREES IS 160. SQ. FT.
FINANCIAL SCENARIO--RESIDENCE

\$\$\$ CASH FLOW SUMMARY \$\$\$

YR	(A) FUEL/UTILITY SAVINGS	(B) MAINT. +INSUR.	(C) PROPERTY TAX	(D) ANNUAL INTEREST	(E) TAX SAVINGS	(F) LOAN PAYMENT	(G) NET CASH FLOW
1	201.	68.	0.	497.	1602.	605.	-614.
2	219.	73.	0.	488.	171.	605.	1130.
3	238.	78.	0.	477.	167.	605.	-288.
4	260.	84.	0.	465.	163.	605.	-277.
5	283.	90.	0.	453.	159.	605.	-266.
6	309.	97.	0.	439.	154.	605.	-253.
7	336.	104.	0.	424.	148.	605.	-239.
8	367.	112.	0.	408.	143.	605.	-224.
9	400.	120.	0.	390.	137.	605.	-207.
10	436.	129.	0.	371.	130.	605.	-189.
11	475.	139.	0.	350.	122.	605.	-168.
12	518.	150.	0.	327.	114.	605.	-146.
13	564.	161.	0.	302.	106.	605.	-122.
14	615.	173.	0.	274.	96.	605.	-96.
15	670.	186.	0.	244.	86.	605.	-66.
16	731.	200.	0.	212.	74.	605.	-35.
17	796.	215.	0.	177.	62.	605.	0.
18	868.	231.	0.	138.	48.	605.	38.
19	946.	248.	0.	96.	34.	605.	80.
20	1031.	267.	0.	50.	17.	605.	126.
TOTALS	10263.	2925.	0.	6582.	3733.	12100.	-1640.

SOLAR INCENTIVE INCLUDED IN YEAR 1 TAX SAVINGS 1428.00 DOLLARS

PAYBACK TIME FOR FUEL SAVINGS TO EQUAL TOTAL INVESTMENT ... 14.4 YEARS

PAYBACK TIME FOR NET CASH FLOW TO OFFSET DOWN PAYMENT5 YEARS

NET PRESENT WORTH OF SOLAR SAVINGS -999.48 DOLLARS

RATE OF RETURN ON NET CASH FLOW..... 0.0 PERCENT

ANNUAL PORTION OF LOAD PROVIDED BY SOLAR ... 19.6 PERCENT

ANNUAL ENERGY SAVINGS WITH SOLAR SYSTEM ... 19.0 MILLION BTUS

TAX SAVINGS = INCOME TAX RATE X (C + D)

NET CASH FLOW = A - B - C + E - F

ABOVE PAYBACK TIMES BASED ON UNDISCOUNTED DOLLARS