Toward a National Plan for the Accelerated
Commercialization of Solar Energy

Agricultural and Industrial
Process Heat Market Sector

WORKBOOK

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**Toward a National Plan for the Accelerated
Commercialization of Solar Energy**

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Agricultural and Industrial Process-Heat-Market Sector

WORKBOOK

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ABSTRACT

This workbook summarizes the preliminary data and assumptions of the Agricultural and Industrial Process Heat Market Sector prepared in conjunction with the development of inputs for a National Plan for the Accelerated Commercialization of Solar Energy.

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AIPH MARKET SECTOR
WORKBOOK

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INTRODUCTION

This workbook contains preliminary data and assumptions used during the preparation of inputs to a National Plan for the Accelerated Commercialization of Solar Energy (NPAC).¹ The workbook indicates the market potential, competitive position, market penetration, and technological characteristics of solar technologies for this market sector over the next twenty years.

The workbook also presents projections of the mix of solar technologies by U.S. Census Region (see Figure 1). In some cases, data have been aggregated to the national level.

Emphasis of the workbook is on a mid-price fuel scenario, Option II, that meets about a 20 percent solar goal by the year 2000. The energy demand for the mid-price scenario is projected at 115 quads in the year 2000.

The workbook, prepared in April 1979, represents government policies and programs anticipated at that time. The data reflecting changes in government policy, energy costs, energy demands, and solar commercialization status may be periodically updated.

¹Toward a National Plan for the Accelerated Commercialization of Solar Energy:
Bennington, G., et al., The Implications of a National Commitment, MTR79W00004R-1, January 1980;
Miller, G., et al., Guidelines for Regional Planning, MTR79W00385, January 1980;
Rebibo, Kathy K., Price/Demand Scenarios and Projections of Solar Utilization under the National Energy Act, MTR-8057, May 1979. McLean, Virginia: The MITRE Corporation.

FIGURE 1
U.S. CENSUS REGIONS

THE SCENARIOS

U.S. energy consumption in 2000 was determined by using the three macroeconomic scenarios developed for the DPR.¹ The three scenarios are:

- o low-price oil/high end-use demand
- o mid-price oil/intermediate end-use demand
- c high-price oil/low end-use demand

For NPAC, the scenarios were subjected to further review. The fuel price/energy consumption projections in Figure 2 show that end-use demand will be 132, 115, and 105 quads for low-price, mid-price, and high-price scenarios respectively.

A scenario based on low-price oil assumes a high energy end-use demand. Conversely, high-price oil would drive the energy demand down. A mid-price scenario would imply an intermediate level of demand. The low-price oil scenario assumes that in the year 2000 a barrel of oil will cost \$18 (1976 constant \$) at the wellhead. The mid-price scenario calls for a price of \$25/barrel. The high-price is assumed to be \$32/barrel.

¹Rebibo, Kathy K. Toward a National Plan for the Commercialization of Solar Energy: Price/Demand Scenarios and Projections of Solar Utilization under the National Energy Act, MTR-8057. McLean, Virginia: The MITRE Corporation, May 1979.

*Price to industrial sector

FIGURE 2
U.S. ENERGY CONSUMPTION

The market sector was analyzed¹ for the three price/demand scenarios, and each price scenario was tested at four levels of incentives. The Reference Case includes the solar commercialization incentives in the National Energy Act (NEA), 1978.² Analysis of the NEA incentives indicates that solar technologies will displace approximately 14.5 quads of primary fuel in the year 2000. The three other levels of incentives would displace approximately 18, 22, and 25 quads of primary fuel in 2000.

COMMERCIALIZATION DEVELOPMENT CONCERNS

The workbook also identifies the principal commercialization development issues facing the market sector, participants, and apparent constraints to market development. These factors, including the expected impact of current federal programs, were included in the market penetration estimates.

The marketplace has four principal participants: property owner; architectural and engineering firms responsible for designing the solar energy system; financial or lending

¹Estimates of market penetration were made using the computer simulation model, SPURR. Rebibo, K., et al. A System for Projecting the Utilization of Renewable Resources: SPURR Methodology, MTR-7570. McLean, Virginia: The MITRE Corporation, September 1977.

²The Reference Case is referred to as the NEA Option.

institutions that may be investing in "new" technologies; and the manufacturer. Economic uncertainty of the solar technologies is the prevalent concern of this market sector and participants. Economic uncertainties include the high cost of solar systems, unavailability of financing, and relative insecurity of the investment. Federal RD&D programs are underway to lower the system cost. Congress has passed investment tax credits (ITC) and low-interest loans with extended repayment terms for the same purpose. To further lower systems costs potential federal programs include larger investment tax credits, more liberal depreciation schedules for solar equipment, federal cost sharing and federal grants, government purchases, and government loan guarantees.

Commercialization of solar technologies faces institutional and technical barriers. These include lack of confidence in system reliability and performance, lack of insurability, and low public awareness of the technology. Government RD&D programs also aim at removing these social/institutional barriers by increasing performance and reliability or by demonstrating the viability of solar installations. Other programs which may help remove these barriers include: establishing warranty requirements; providing federal insurance or federally guaranteed insurance; amending or rewriting building codes; removing aesthetic zoning code barriers; creating a uniform definition of "sun rights"; and public information dissemination programs.

A summary of the market sector workbook follows.

SUMMARY
AGRICULTURAL AND INDUSTRIAL PROCESS HEAT (AIPH)

ENERGY DEMAND

The process heat market sector differs from the residential and commercial/institutional buildings market sectors because it relies on the energy demand, rather than the number of installations, to define the market. Service demand is the end-use energy demand for delivering a specific service. Primary fuel demand is the fossil fuel required to meet a service demand.

The total process heat service demand for all scenarios was estimated on a regional basis. The East North Central and West South Central regions each account for 23 percent of the total service demand. The New England and Mountain regions have the lowest requirement for process heat service demand, accounting for 2.8 percent each. The demand in the other five regions--Mid-Atlantic, South Atlantic, East South Central, Pacific, and West North Central--ranges between 6 and 14 percent. It was assumed that the percentage used in each region will remain constant, although total demand will increase over time. Specific details of total process heat service demand for the various scenarios in selected census regions and annual market potential, i.e., the annual growth of the process heat market, are in the workbook.

ECONOMIC INCENTIVES

The AIPH market sector shares the same economic concerns as the other sectors. The sector will also benefit from the tax credits included in the NEA.

Estimates of additional tax credits parallel the analysis conducted for the other market sectors. The standard 10 percent industrial investment tax credit (ITC) was left in place through the year 2000 for the incentive levels. In the Reference Case, an additional 10 percent industrial process heat tax credit is available for the 1978 through 1982 period only. Option I assumes that a long-term solar industrial process heat subsidy will be in effect for the period after 1982. This subsidy is set at 5 percent above the standard ITC (a total of 15 percent) and is comprised of a long-term parity subsidy and a net national value subsidy.

The Option II commitment level is a 35 percent ITC, made up of a 15 percent front-end incentive for solar, a 10 percent NEA solar tax credit, and the standard 10 percent ITC. The solar incentives decline gradually through 1988 until the entire tax credit totals 20 percent, and this level remains in effect through the turn of the century.

The highest level of commitment, Option III, contains equivalent tax credits totaling 50 percent of systems costs in 1978. These decline to the 20 percent level by 1988 and remain in place through the turn of the century.

MARKET PENETRATION

These commitment levels produce different levels of market penetration. Factors in the market penetration analysis include the cost of installed system capacity; for ALPH, it was calculated in 1976 \$/sq. ft. of solar collector used. The 1985 cost per capacity for all price/demand scenarios and for all commitment levels ranges between \$25 and \$30 per sq. ft. This is expected to decline to about \$12 per sq. ft. by the year 2000.

The second factor considered in analyzing the market penetration in the process heat sector is the cost of delivered energy, in \$/MMBtu. For all price/demand scenarios and for each commitment level, the most dramatic decline in this cost occurs in the 1985 through 1990 period; this decline in solar cost occurs in all price/demand scenarios and across all four levels of incentives. Between 1990 and 2000, the cost/MMBtu declines more gradually. Solar technologies begin to satisfy significant amounts of process heat service demand in the early 1990s, with the trend to even greater contributions by the year 2000.

The cost per capacity, the cost of delivered energy, and the service demand supplied by solar by region and application is estimated over time for the three price/demand scenarios and for the various commitment levels. The installed capacity and the dollar value of sales (1976 \$) are estimated in a similar manner. Detailed estimates are in the workbook.

Energy savings are tabulated over time, by scenario and commitment level, for the new and the fuel savers market and measured in quads of fossil fuel displaced.

ADDITIONAL PROCESS HEAT TECHNOLOGIES

Two other sections of this workbook consider on-site industrial electric power generation and industrial combustion of biomass. The mid-price/demand scenario is the only scenario tested. The on-site electric power generation analysis includes wind, photovoltaic, and solar thermal electric technologies. The biomass analysis includes the four U.S. industries that are the principal users of biomass: food, lumber, furniture, and paper. This analysis shows that biomass utilization in these four industries will grow from a current level of 27.1 percent of primary fuel consumed in 1978 to 40 percent by the year 2000.

AIPH NEW MARKET TOTAL SERVICE DEMAND

o END-USE DEMAND (SERVICE DEMAND) IN QUADS

	SCENARIOS		
	MID-PRICE	LOW-PRICE	HIGH-PRICE
1978	7.235	7.235	7.235
1985	8.534	9.288	8.146
1990	9.603	11.102	8.867
2000	12.159	15.862	10.505

o AVERAGE ANNUAL GROWTH RATE (%)

1978-2000	2.4%	3.6%	1.7%
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SCENARIO DEFINITIONS AND ASSUMPTIONS

THERE ARE THREE SCENARIOS CONSIDERED FOR ANALYSIS. THESE ARE BASED ON ASSUMED PRICES OF OIL FOR THE YEAR 2000.

MID-PRICE SCENARIO: PRICE OF OIL IS \$25/BARREL (1976 \$)

HIGH-PRICE SCENARIO: \$32/BARREL

LOW-PRICE SCENARIO: \$18/BARREL

THE PRIMARY FUEL DEMANDS FOR PROCESS HEAT AND THE SERVICE DEMANDS WERE DETERMINED USING JUDGMENTAL FORECASTS.

DEFINITION OF TERMS

AIPH: REFERS TO A NEW MARKET OR NEW DEMAND FOR PROCESS HEAT.

FUEL SAVERS: A SOLAR AIPH FUEL SAVER SYSTEM IS A TECHNOLOGY IDENTICAL TO A REGULAR SOLAR AIPH SYSTEM EXCEPT THAT IT LACKS STORAGE AND IS A RETROFIT APPLICATION.

SERVICE DEMAND: THIS IS THE DEMAND AT THE END-USE LEVEL FOR DELIVERING A SPECIFIC SERVICE.

PRIMARY FUEL DEMAND: THIS IS THE FOSSIL FUEL EQUIVALENT OF THE PRIMARY FUEL REQUIRED AS INPUT TO MEET A SERVICE DEMAND. FOR EXAMPLE, THE SERVICE DEMAND FOR A SPECIFIC END USE MAY BE ONE kwh WHILE THE PRIMARY FUEL DEMAND FOR THE SAME END USE WOULD BE APPROXIMATELY 10,000 BTUs.

INCREMENTAL DEMAND/MARKET POTENTIAL: THE INCREMENTAL DEMAND INCLUDES GROWTH AND THE RETIREMENTS DURING A SPECIFIED YEAR.

COST/MMBTU: THIS IS THE ANNUALIZED LIFE-CYCLE COST PER DELIVERED MILLION BTUs FOR THE SYSTEM.

U.S. CENSUS REGIONS

FUEL COSTS, 1976 \$/MMBTU

Application	1978			1985			1990			2000		
	Mid-Price	Low-Price	High-Price	Mid-Price	Low-Price	High-Price	Mid-Price	Low-Price	High-Price	Mid-Price	Low-Price	High-Price
Electricity	9.28	9.28	9.28	10.30	9.68	11.03	11.10	9.97	12.48	12.88	10.59	15.98
Heat Pump	9.28	9.28	9.28	10.30	9.68	11.03	11.10	9.97	12.48	12.88	10.59	15.98
Gas	1.42	1.42	1.42	3.20	2.63	3.13	3.55	2.78	3.72	4.37	3.10	5.24
Oil	2.17	2.17	2.17	3.33	2.78	3.47	3.68	2.91	4.06	4.48	3.18	5.56
Coal	1.10	1.10	1.10	1.70	1.32	1.75	1.83	1.38	1.97	2.13	1.51	2.49
Synfuels	3.60	3.60	3.60	4.14	3.86	4.43	4.57	4.06	5.13	5.57	4.48	6.90

REGIONAL COST FACTORS

	New England	Mid- Atlantic	South Atlantic	East North Central	East South Central	West North Central	West South Central	Mountain	Pacific
Electricity	1.17	1.3	.97	1.07	.85	1.2	1.14	1.28	.62
Heat Pump	1.17	1.3	.97	1.07	.85	1.2	1.14	1.28	.62
Oil	1.00	.97	.98	.98	.97	1.03	.94	1.05	.98
Coal	1.15	.90	1.05	.87	.98	.82	.85	.68	1.01
Gas	1.10	1.02	.94	1.0	.92	.97	1.01	.96	1.07
Synfuels	1.11	1.04	.97	.97	.97	.97	.97	1.25	1.04

AIPH APPLICATION CLASSIFICATION

Temperature Range and Working Fluid	Representative Application	Generic Solar Design	Market Entry Date	Initial Cost 1976\$/f ²
40 - 60°C Water	Process Water for Uranium Mill	Solar Pond with Concrete Bunker Water Storage	1975	48.55
60 - 80°C Water	Textile Process Water	Aluminum Flat Plate, Black Single-Glazed, Fiberglass Tank Hot Water Storage	1978	48.55
80 - 100°C Water	Can Washing System	Aluminum Flat Plate, Selective Single-Glazed, Steel Tank Hot Water Storage	1983	55.96
50 - 100°C Air	Grain Drying	Aluminum Flat Plate, Black, Single-Glazed, or Evacuated Tube, Rock Bed in Concrete Bunker Storage	1975	36.57
100 - 150°C Air	Plastic Curing	Evacuated Tube, Rock Bed in Concrete Bunker Storage	1975	49.81
>150°C	Metal Finishing	Line Concentrator, Rock Bed in Concrete Bunker Storage	1975	54.85
100 - 150°C Steam	Concrete Block Curing	Parabolic Dish, Oil/Rock Storage	1981	36.24
>150°C Steam	Total Energy System	Parabolic Dish, Salt/Rock Topping Oil/Rock Storage	1983	53.47

TYPICAL APPLICATION - GRAIN DRYING

50°-100°C AIR SYSTEM

LOCATION: KANSAS
INSOLATION: 625,000 BTU/f²/YR

LOAD FACTOR: 100% (24 hour) May-December
30% (8 hour) January-April

Auxiliary Equipment:
- 100 Recirculating Fans
- 25 Reoperator Tube & Sheet Heat Exchangers (600,000 Btu/hour)

QUADS OF TOTAL SERVICE DEMAND BY APPLICATION

Year Application	1978			1985			1990			2000		
	Mid- Price	Low- Price	High- Price	Mid- Price	Low- Price	High- Price	Mid- Price	Low- Price	High- Price	Mid- Price	Low- Price	High- Price
Air 50°-100°C	.206	.206	.206	.218	.228	.215	.246	.273	.232	.311	.390	.275
Air 100°-150°C	.295	.295	.295	.321	.335	.314	.362	.400	.342	.458	.573	.404
Air > 150°C	1.519	1.519	1.519	1.352	2.039	1.758	2.085	2.440	1.913	2.641	3.486	2.265
Water 40°-60°C	.097	.097	.097	.102	.107	.100	.116	.126	.110	.146	.183	.129
Water 60°-80°C	.121	.121	.121	.128	.134	.126	.145	.160	.137	.183	.230	.162
Water 80°-100°C	.121	.121	.121	.128	.134	.126	.145	.160	.137	.183	.230	.162
Steam 100°-150°C	2.189	2.189	2.189	2.519	2.715	2.419	2.836	3.249	2.631	3.591	4.642	3.116
Steam > 150°C	2.675	2.675	2.675	3.260	3.590	3.094	3.671	4.295	3.366	4.648	5.136	3.988
TOTAL	7.235	7.235	7.235	8.534	9.288	8.146	9.603	11.102	8.867	12.159	15.862	10.505

QUADS OF TOTAL SERVICE DEMAND SUPPLIED BY REGION

Region	1978			1985			1990			2000		
	Mid-Price	Low-Price	High-Price	Mid-Price	Low-Price	High-Price	Mid-Price	Low-Price	High-Price	Mid-Price	Low-Price	High-Price
New England	.206	.206	.206	.218	.228	.215	.246	.273	.232	.311	.390	.275
Mid-Atlantic	1.033	1.033	1.033	1.220	1.327	1.165	1.446	1.589	1.268	1.757	2.269	1.50
South Atlantic	.826	.826	.826	.972	1.058	.929	1.152	1.266	1.011	1.386	1.809	1.197
East North Central	1.661	1.661	1.661	1.953	2.123	1.866	2.316	2.544	2.030	2.785	3.634	2.405
East South Central	.619	.619	.619	.733	.798	.701	.870	.955	.762	1.046	1.365	.903
West North Central	.413	.413	.413	.486	.529	.465	.576	.634	.505	.694	.905	.598
West South Central	1.661	1.661	1.661	1.953	2.123	1.866	2.316	2.544	2.030	2.785	3.634	2.405
Mountain	.206	.206	.206	.218	.228	.215	.246	.273	.232	.311	.390	.275
Pacific	.610	.610	.610	.716	.780	.685	.850	.933	.745	1.021	1.333	.882

PERCENT TOTAL SERVICE DEMAND
1978, ALL SCENARIOS

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ANNUAL MARKET POTENTIAL

o SERVICE DEMAND, 10^{12} BTUs

	SCENARIOS		
	MID-PRICE	HIGH-DEMAND	LOW-DEMAND
1978	470	470	470
1985	554	602	529
1990	624	718	576
2000	791	1023	681

o AVERAGE ANNUAL GROWTH RATE (%)

1980-2000	2.4%	3.6%	1.7%
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ANNUAL MARKET POTENTIAL, 10^{12} BTUs

Year Application	1978			1985			1990			2000		
	Mid- Price	Low- Price	High- Price	Mid- Price	Low- Price	High- Price	Mid- Price	Low- Price	High- Price	Mid- Price	Low- Price	High- Price
Air 50°-100°C	14	14	14	14	15	14	16	18	15	20	25	17
Air 100°-150°C	19	19	19	21	22	20	24	26	23	30	37	26
Air > 150°C	98	98	98	120	132	114	135	158	124	172	225	147
Water 40°-60°C	6	6	6	7	7	6	8	8	7	10	12	8
Water 60°-80°C	8	8	8	9	9	8	9	11	9	12	15	11
Water 80°-100°C	8	8	8	9	9	8	9	11	9	12	15	11
Steam 100°-150°C	142	142	142	163	176	157	184	210	171	233	299	202
Steam > 150°C	174	174	174	211	233	201	258	277	217	303	395	259
TOTAL	470	470	470	554	602	529	624	718	576	791	1023	681

OPTIONS INCENTIVES

NEA OPTION

- 10% Standard Investment Tax Credit, 1978-2000
- 10% Solar Investment Tax Credit, 1978-1982
- Continuation of DOE Agricultural/Industrial Process Heat Program
 - FY 80 - 18.3 million dollars (constant, 1978)
 - FY 81 - 21.0 million dollars "
 - FY 82 - 16.2 million dollars "
 - FY 83 - 16.0 million dollars "
 - FY 84 - 16.0 million dollars "
 - FY 85-2000 - 16.0 million dollars (constant, 1978).

OPTION I

Option I is defined as

- \$.20/MMBtu subsidy, based on parity, equivalent to 1.3% Investment Tax Credit (ITC), 1978-2000
- \$.70/MMBtu subsidy, based on net national value, equivalent to 4.6% ITC, 1978-2000
- \$.90/MMBtu total subsidy, 1978-2000, equivalent to 5.9% ITC, 1978-2000
- Continuation of current DOE Agricultural/Industrial process heat program, as specified in the NEA option.

OPTIONS INCENTIVES (Continued)

OPTION II

Option II is defined as

- \$.80/MMBtu subsidy, based on parity, equivalent to a 5.2% ITC
- \$.80/MMBtu subsidy, based on net national value, equivalent to a 5.2% ITC
- \$1.60/MMBtu total subsidy, equivalent to a 10.4% ITC

Option II incentives are

- The NEA, 1978-1982
- An additional 10% ITC, 1978-1982, for solar IPH systems, for a total ITC of 30%
- A declining ITC, 1982-1988, from 30%-21% the parity level of subsidies
- A solar AIPH loan program, offering solar loans at a 5% interest rate
 - 1978-1983 - 50 million dollar annual level of funding
 - 1984-1988 - 125 million dollar annual level of funding
- Continuation of current DOE Agricultural/Industrial Process Heat Program, as specified in the NEA Option.

OPTIONS INCENTIVES (Continued)

OPTION III

Option III is defined as

- \$1.00/MMBtu subsidy, based on parity, equivalent to a 6.5% ITC
- \$.90/MMBtu subsidy, based on net national value, equivalent to a 5.9% ITC
- \$1.90/MMBtu subsidy, equivalent to 12.4% ITC

Option III incentives are

- The NEA, 1978-1982
- An additional 15% ITC, 1978-1982, for a total solar AIPH ITC of 35%
- A declining ITC, 1982-1988, 35%-23%, the parity level of subsidies
- Accelerated write off of solar systems, 1978-1988, in the form of a three year SYD accelerated depreciation
- A solar AIPH loan program, offering solar loans at a 5% interest rate -
1978-1983 - 50 million dollar annual level of funding
- 1984 through 1988 - 150 million dollar annual level of funding
- An increase in RD&D and educational programs by a factor of three over NEA levels of funding

FY 80 - 18.3 million dollars (constant, 1978)

FY 81 - 42.0 million dollars " "

FY 82 - 40 million dollars " "

OPTIONS INCENTIVES (Concluded)

OPTION III

FY 83 - 40 million dollars (constant, 1978)

FY 84 - 40 million dollars " "

FY 85 - 30 million dollars " "

FY 86 - 25 million dollars " "

FY 87 - 20 million dollars " "

FY 88 - 16 million dollars " "

FY 89-2000 - 16 million dollars (constant, 1978)

LEVELS OF INCENTIVES
(% equivalent ITC)

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AIPH NEW MARKET PENETRATION

- o INCREMENTAL MARKET FOR SOLAR PROCESS HEAT TECHNOLOGIES IS DETERMINED AS A FUNCTION OF PROCESS HEAT DEMAND GROWTH RATE, THE RETIREMENT RATE FOR PROCESS HEAT EQUIPMENT, AND A SUITABILITY FACTOR. THE FUEL SPLITS FOR EACH YEAR'S INCREMENTAL MARKET IS FOUND THROUGH A LINEAR INTERPOLATION OF FUEL SPLITS BETWEEN THE INITIAL AND THE FINAL YEAR OF SIMULATION.
- o THE MARKET PENETRATION OF SOLAR TECHNOLOGIES IN EACH OF THE INCREMENTAL MARKETS FOR FUELS--COAL, OIL, GAS, ELECTRICITY, HEAT PUMP, AND SYNTHETIC FUELS--IS DETERMINED BY A MARKET PENETRATION FUNCTION. THIS FUNCTION IS GOVERNED BY TWO PARAMETERS--THE TIME CONSTANT AND THE FIGURE OF MERIT. THE FIGURE OF MERIT, IN TURN, IS DEFINED AS THE RATIO BETWEEN THE LIFE-CYCLE COSTS OF CONVENTIONAL AND SOLAR PROCESS HEAT TECHNOLOGIES.
- o ASSUMPTIONS
 - LIFE-TIME OF PH CAPITAL: 20 YEARS
 - SUITABILITY FACTOR GROWS LINEARLY FROM 1% IN 1970 TO 30% IN 2000
 - THE YEAR OF INTRODUCTION OF NEW TECHNOLOGIES:
 - 1) HIGH-TEMP AIR - 1983
 - 2) MID-TEMP STEAM - 1981
 - 3) HIGH-TEMP STEAM - 1983
 - 4) LOW-TEMP AIR - 1975
 - 5) MID-TEMP AIR - 1978
 - 6) WATER - 1975
- o SOLAR COSTS FOR PARABOLIC DISH, TROUGH, AND LOW-TEMPERATURE FLAT PLATE COLLECTORS ARE ASSUMED TO BE ON AN 80% LEARNING CURVE.
- o THE ULTIMATE UNIT COSTS ARE ASSUMED TO BE ONE-THIRD OF THE INITIAL COSTS.

AIPH MARKET DEVELOPMENT CURVE

AIPH MARKET SECTOR
WORKBOOK

SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, CGST/CAPACITY, 1976 \$/ft²

MID-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	18.47	18.27	17.45	16.30	12.59	12.16	11.04	9.74	7.70	7.70	7.70	7.70
Air 100°-150°C	18.47	18.27	17.45	15.30	12.59	12.16	11.04	9.74	7.70	7.70	7.70	7.70
Air > 150°C	44.27	43.77	42.02	39.06	20.88	19.84	17.35	14.41	13.50	13.50	13.50	13.50
Water 40°-60°C	13.91	13.76	13.14	12.28	9.49	9.16	8.31	7.32	5.80	5.80	5.80	5.80
Water 60°-80°C	18.95	18.74	17.90	15.72	12.92	12.48	11.32	9.97	7.90	7.90	7.90	7.90
Water 80°-100°C	20.87	20.64	19.71	18.42	14.23	13.74	12.47	10.98	8.70	8.70	8.70	8.70
Steam 100°-150°C	40.99	40.53	38.91	36.16	19.33	18.37	16.07	13.34	12.50	12.50	12.50	12.50
Steam > 150°C	42.30	41.82	40.15	37.32	19.95	18.96	16.58	13.77	12.90	12.90	12.90	12.90
Average	28.60	28.35	27.28	25.82	17.87	17.09	15.16	12.85	11.97	12.00	12.05	12.08

SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, COST/CAPACITY, 1976 \$/f²

LOW-PRICE SCENARIO

Region	Year		1985			1990				2000		
	NEA		Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II III
Air 50°-100°C	18.54		18.36	17.62	16.60	12.68	12.25	11.18	9.86	7.70	7.70	7.70
Air 100°-150°C	18.54		18.36	17.62	16.60	12.68	12.25	11.18	9.86	7.70	7.70	7.70
Air > 150°C	44.24		43.74	42.00	39.22	20.72	19.66	17.29	14.27	13.50	13.50	13.50
Water 40°-60°C	13.97		13.83	13.27	12.51	9.55	9.23	8.42	7.43	5.80	5.80	5.80
Water 60°-80°C	19.02		18.84	18.07	17.04	13.01	12.57	11.47	10.11	7.90	7.90	7.90
Water 80°-100°C	20.95		20.74	19.90	18.76	14.33	13.84	12.63	11.14	8.70	8.70	8.70
Steam 100°-150°C	40.96		40.50	38.89	36.31	19.19	18.21	16.01	13.21	12.50	12.50	12.50
Steam > 150°C	42.27		41.79	40.13	37.48	19.80	18.79	16.52	13.63	12.90	12.90	12.90
Average	29.16		28.91	27.85	26.54	17.91	17.09	15.22	12.82	11.95	11.98	12.029

SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, CCST/CAPACITY, 1976 \$/f²

HIGH-PRICE SCENARIO

Year	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	18.41	18.20	17.17	15.97	12.50	12.06	10.82	9.51	7.70	7.70	7.70	7.70
Air 100°-150°C	18.41	18.20	17.17	15.97	12.50	12.06	10.82	9.51	7.70	7.70	7.70	7.70
Air > 150°C	44.24	43.73	41.56	33.59	20.83	19.79	17.14	14.22	13.50	13.50	13.50	13.50
Water 40°-60°C	13.86	13.71	12.93	12.03	9.41	9.09	8.15	7.16	5.80	5.80	5.80	5.80
Water 60°-80°C	18.88	18.67	17.61	16.38	12.82	12.38	11.10	9.76	7.90	7.90	7.90	7.90
Water 80°-100°C	20.80	20.56	19.40	18.04	14.12	13.63	12.23	10.75	8.70	8.70	8.70	8.70
Steam 100°-150°C	40.96	40.49	38.48	35.73	19.29	18.33	15.87	13.16	12.50	12.50	12.50	12.50
Steam > 150°C	42.27	41.78	39.72	36.88	19.90	18.91	15.38	13.59	12.90	12.90	12.90	12.90
Average	26.28	28.03	26.71	25.24	17.76	16.99	14.54	12.65	11.97	12.00	12.05	12.08

SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, COST/CAPACITY, 1976 $\$/f^2$
MID-PRICE SCENARIO

YEARS

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SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, COST OF DELIVERED ENERGY, 1976 \$/MMBTU

MID-PRICE SCENARIO

Year	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	10.27	9.45	7.73	6.89	7.00	6.29	5.05	4.48	4.32	4.02	3.55	3.56
Air 100°-150°C	8.90	8.06	6.34	5.58	6.06	5.37	4.17	3.71	3.74	3.43	3.94	3.96
Air > 150°C	22.86	20.81	16.69	14.67	10.72	9.38	7.10	5.94	6.90	6.37	5.52	5.55
Water 40°-60°C	14.68	13.88	12.09	10.94	9.96	9.22	7.79	6.89	6.20	5.93	5.52	5.51
Water 60°-80°C	13.74	12.68	10.47	9.32	9.34	8.45	6.85	6.08	5.85	5.48	4.89	4.90
Water 80°-100°C	12.77	11.79	9.72	8.67	8.67	7.83	6.34	5.62	5.38	5.03	4.48	4.49
Steam 100°-150°C	17.34	15.79	12.70	11.16	8.14	7.16	5.46	4.60	5.35	4.96	4.34	4.36
Steam > 150°C	20.77	19.13	15.79	14.01	9.68	8.59	5.68	5.50	6.29	5.89	5.25	5.26
Average	14.53	13.32	10.82	9.65	8.72	7.73	5.01	5.12	5.83	5.43	4.79	4.82

SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, COST OF DELIVERED ENERGY, 1976 \$/MMBTU

LOW-PRICE SCENARIO

Application	Year		1985			1990			2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	10.40	9.59	7.86	7.04	7.09	6.38	5.34	4.63	4.34	4.05	3.71	3.64
Air 100°-150°C	9.05	8.21	6.47	5.72	6.16	5.47	4.47	3.87	3.78	3.47	3.11	3.05
Air > 150°C	23.13	21.08	16.86	14.83	10.75	9.41	7.47	6.04	6.94	6.41	5.78	5.65
Water 40°-60°C	14.71	13.91	12.14	11.03	9.93	9.19	7.96	6.94	6.05	5.79	5.47	5.31
Water 60°-80°C	13.79	12.75	10.54	9.40	9.31	8.43	7.10	6.16	5.70	5.35	4.92	4.76
Water 80°-100°C	12.88	11.91	9.84	8.82	8.72	7.89	6.63	5.76	5.33	5.00	4.60	4.49
Steam 100°-150°C	17.47	15.94	12.79	11.23	8.11	7.13	5.69	4.64	5.29	4.91	4.47	4.36
Steam > 150°C	20.94	19.30	15.90	14.12	9.65	8.55	6.91	5.63	6.20	5.81	5.34	5.21
Total	14.83	13.61	11.04	9.86	8.74	7.75	6.27	5.19	5.77	5.38	4.92	4.80

SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS, COST OF DELIVERED ENERGY, 1976 \$/MMBTU

HIGH-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	9.90	9.10	6.82	6.11	6.72	6.04	4.74	4.16	4.17	3.88	3.40	3.38
Air 100°-150°C	8.51	7.69	5.41	4.78	5.77	5.10	3.87	3.39	3.59	3.29	2.78	2.77
Air > 150°C	21.95	19.95	14.45	12.82	10.28	8.99	6.66	5.50	6.65	6.12	5.24	5.21
Water 40°-60°C	14.38	13.59	11.25	10.21	9.74	9.01	7.51	6.60	6.09	5.83	5.40	5.37
Water 60°-80°C	13.33	12.29	9.35	8.38	9.05	8.17	6.51	5.72	5.70	5.33	4.72	4.68
Water 80°-100°C	12.34	11.38	8.55	7.76	8.36	7.55	5.99	5.26	5.22	4.88	4.31	4.28
Steam 100°-150°C	16.68	15.18	11.06	9.81	7.84	6.89	5.15	4.29	5.18	4.79	4.14	4.12
Steam > 150°C	20.77	18.47	14.03	12.55	9.36	8.30	6.34	5.27	6.12	5.72	5.06	5.03
Total	13.92	12.75	9.45	8.49	8.39	7.43	5.67	4.79	5.65	5.25	4.59	4.58

TOTAL SERVICE DEMAND SUPPLIED BY SOLAR APPLICATIONS, 10^{12} BTUs

MID-PRICE SCENARIO

Year	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.4	.5	.9	1.5	2.4	3.0	5.1	8.9	24.0	28.6	42.0	63.2
Air 100°-150°C	.4	.5	.9	1.6	3.0	3.9	6.7	12.1	34.7	42.0	62.5	95.8
Air > 150°C	.1	.1	.2	.4	3.1	4.1	7.6	15.7	86.6	108.1	171.3	272.8
Water 40°-60°C	.1	.1	.2	.3	.7	.8	1.3	2.3	7.7	9.1	13.3	19.5
Water 60°-80°C	.2	.2	.3	.6	.9	1.1	2.0	3.5	10.2	12.4	18.6	27.8
Water 80°-100°C	.2	.2	.3	.6	.9	1.2	2.1	3.7	11.0	13.4	19.9	30.0
Steam 100°-150°C	.5	.6	1.1	2.1	8.9	11.7	21.4	42.1	174.6	213.7	326.1	507.9
Steam > 150°C	.2	.2	.4	.7	6.0	7.8	14.2	29.2	164.9	202.2	311.0	494.7
TOTAL	2.0	2.4	4.3	8.6	26.0	33.7	60.6	117.2	513.7	629.5	964.8	1511.7

TOTAL SERVICE DEMAND SUPPLIED BY SOLAR APPLICATIONS, 10¹² BTUs

LOW-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.4	.5	.8	1.4	2.1	2.7	4.3	7.3	21.8	26.5	38.9	59.1
Air 100°-150°C	.4	.5	.9	1.6	2.7	3.4	5.8	10.5	32.6	39.8	59.0	91.7
Air > 150°C	.1	.1	.2	.4	2.9	3.8	6.9	14.3	78.1	98.6	153.5	248.7
Water 40°-60°C	.1	.1	.2	.3	.6	.7	1.1	1.8	6.4	7.7	11.0	16.1
Water 60°-80°C	.1	.2	.3	.5	.7	.9	1.6	2.7	8.6	10.6	15.9	23.6
Water 80°-100°C	.1	.2	.3	.5	.8	1.0	1.7	3.0	9.6	11.8	17.5	26.6
Steam 100°-150°C	.5	.6	1.1	2.2	8.2	10.8	19.0	38.1	160.9	199.2	300.6	475.6
Steam > 150°C	.2	.2	.4	.7	5.7	7.5	13.1	26.9	151.8	188.0	285.3	459.0
Total	1.9	1.9	4.1	7.5	23.7	42.4	53.3	104.6	469.8	582.5	881.8	1400.4

TOTAL SERVICE DEMAND SUPPLIED BY SOLAR APPLICATIONS, 10^{12} BTUs
HIGH-PRICE SCENARIO

Year	1985				1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.4	.5	1.0	1.7	2.7	3.6	6.0	10.3	23.9	28.1	41.4	62.8
Air 100°-150°C	.4	.5	1.1	1.9	3.3	4.4	7.8	13.9	34.3	40.9	61.0	93.8
Air > 150°C	.4	.1	.2	.4	3.3	4.5	8.7	17.9	86.0	105.7	167.8	271.2
Water 40°-60°C	.1	.1	.2	.4	.8	.9	1.6	2.7	7.8	9.1	13.4	20.0
Water 50°-80°C	.1	.2	.4	.7	1.0	1.4	2.4	4.2	10.4	12.5	18.9	28.5
Water 80°-100°C	.2	.2	.4	.7	1.1	1.5	2.5	4.4	11.2	13.2	19.9	30.3
Steam 100°-150°C	.5	.7	1.3	2.4	9.7	13.2	24.4	47.8	172.4	207.7	317.4	499.8
Steam > 150°C	.2	.2	.4	.7	6.4	8.7	15.9	32.7	161.7	195.4	301.1	484.3
Total	2.1	2.5	4.9	9.0	28.4	38.2	69.3	134.0	507.6	612.8	940.7	1490.8

AIPH SERVICE DEMAND SUPPLIED BY SOLAR, YEAR 2000

AIPH MARKET SECTOR
WORKBOOK

TOTAL SERVICE DEMAND SUPPLIED BY SOLAR, BY REGION, 10¹² BTUs

MID-PRICE SCENARIO

Year		1985			1990				2000			
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	.1	.1	.1	.2	.7	.9	1.7	3.3	13.5	16.7	26.1	41.0
Mid-Atlantic	.2	.3	.5	.9	2.9	3.8	7.0	13.5	54.6	68.0	107.2	166.7
South Atlantic	.3	.3	.6	1.1	3.9	5.1	9.1	17.5	69.8	85.2	129.1	202.9
East North Central	.3	.4	.7	1.4	5.0	6.1	11.0	21.6	89.7	111.7	176.5	275.5
East South Central	.1	.2	.3	.5	2.0	2.6	4.8	9.4	40.4	49.9	77.5	121.6
West North Central	.1	.1	.2	.4	1.5	2.0	3.5	6.0	29.5	36.3	55.8	87.7
West South Central	.5	.6	1.1	2.0	7.4	9.6	17.0	32.8	144.2	175.5	265.3	416.8
Mountain	.1	.1	.2	.3	1.2	1.6	2.8	5.4	21.9	26.3	39.0	60.9
Pacific	.2	.3	.5	.9	3.5	5.0	8.0	15.3	63.6	76.7	114.0	183.4

TOTAL SERVICE DEMAND SUPPLIED BY SOLAR, BY REGION, 10¹² BTUs

LOW-PRICE SCENARIO

Year		1985			1990					2000		
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	.1	.1	.1	.2	.6	.8	1.4	2.8	10.3	14.7	22.6	36.3
Mid-Atlantic	.2	.3	.5	.8	2.4	3.1	5.4	10.9	41.5	56.1	86.0	135.0
South Atlantic	.3	.3	.6	1.1	3.4	4.4	7.7	15.4	53.1	80.9	121.4	196.6
East North Central	.3	.4	.7	1.3	3.7	4.9	8.7	17.6	68.2	93.3	143.7	227.1
East South Central	.1	.2	.3	.5	1.7	2.2	4.0	8.0	30.7	45.3	70.0	111.6
West North Central	.1	.1	.2	.4	1.3	1.6	3.0	5.8	22.4	32.2	48.9	78.5
West South Central	.5	.6	1.1	.9	6.3	8.1	14.2	28.1	109.6	161.0	240.6	387.7
Mountain	.1	.1	.2	.3	1.1	1.4	2.3	4.6	16.6	24.3	35.8	57.3
Pacific	.2	.3	.5	.9	3.0	4.0	6.8	13.5	48.4	73.7	108.5	174.3

TOTAL SERVICE DEMAND SUPPLIED BY SOLAR, BY REGION, 10¹² BTUs

HIGH-PRICE SCENARIO

Year		1985			1990					2000		
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	.1	.1	.1	.2	.7	1.0	1.9	3.6	13.2	16.2	25.2	40.0
Mid-Atlantic	.2	.3	.6	1.0	3.1	4.0	7.6	14.7	53.5	66.2	104.6	165.1
South Atlantic	.3	.4	.7	1.3	4.1	5.3	9.6	18.3	66.2	80.3	121.6	192.0
East North Central	.4	.4	.9	1.6	4.9	6.4	12.0	23.5	82.2	109.4	178.6	273.7
East South Central	.1	.2	.3	.6	2.1	2.8	5.2	10.0	39.1	48.1	74.6	118.3
West North Central	.1	.1	.3	.5	1.6	2.1	3.8	7.4	28.1	34.5	53.0	84.0
West South Central	.5	.6	1.2	2.3	7.7	9.8	17.9	34.4	136.3	165.0	249.2	394.0
Mountain	.1	.1	.2	.4	1.2	1.7	2.9	5.5	20.2	24.2	35.9	56.4
Pacific	.2	.3	.6	1.1	3.6	4.7	8.4	15.9	60.1	72.1	106.6	167.4

PERCENT OF TOTAL SERVICE DEMAND SUPPLIED BY SOLAR, YEAR 2000

AIPH MARKET SECTOR
WORKBOOK

MID-PRICE SCENARIO

AIPH SERVICE DEMAND SUPPLIED BY SOLAR, BY REGION, YEAR 2000

MID-PRICE SCENARIO

ANNUAL SALES OF SOLAR AIPH SYSTEMS, $10^6/\text{ft}^2$

MID-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.6	2.0	1.3	2.3	2.8	3.5	5.9	10	16.1	18.8	26.0	37.4
Air 100°-150°C	.7	2.0	1.6	3.0	4.0	5.1	8.8	15.3	25.6	30.0	42.0	61.1
Air > 150°C	.2	.5	.6	1.1	5.8	7.8	15.0	30.9	74.5	91.5	140.1	211.1
Water 40°-60°C	.2	.6	.4	.6	.9	1.2	1.9	3.3	6.6	7.6	10.4	14.8
Water 60°-80°C	.3	.9	.6	1.1	1.3	1.7	3.0	5.2	9.2	10.8	15.5	22.0
Water 80°-100°C	.2	.8	.5	.9	1.2	1.6	2.7	4.5	8.2	9.7	13.7	19.6
Steam 100°-150°C	.9	2.2	2.1	4.0	12.3	16.4	30.6	60.5	114.0	137.4	202.7	299.1
Steam > 150°C	.4	.7	.8	1.6	9.2	12.2	22.7	46.9	115.3	139.7	208.6	313.4
Total	3.6	9.7	7.8	14.6	37.6	49.6	90.7	176.7	369.4	445.5	659.0	978.4

ANNUAL SALES OF SOLAR AIPH SYSTEMS, 10⁶/f²

LOW-PRICE SCENARIO

Year	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.6	1.8	1.2	2.1	2.8	3.6	5.8	10.3	20.4	24.1	33.6	49.7
Air 100°-150°C	.7	2.0	1.5	2.9	4.0	5.3	8.9	16.3	33.0	39.3	55.0	82.4
Air > 150°C	.3	.5	.6	1.1	6.2	8.4	15.5	33.7	87.7	109.7	166.0	255.9
Water 40°-60°C	.2	.5	.3	.5	.9	1.1	1.7	3.0	7.2	8.4	11.4	15.6
Water 60°-80°C	.3	.8	.5	.9	1.2	1.6	2.7	4.8	10.2	12.3	17.4	24.5
Water 80°-100°C	.2	.7	.5	.8	1.2	1.5	2.5	4.5	9.6	11.6	16.4	23.7
Steam 100°-150°C	.9	2.2	2.1	4.0	13.0	17.5	31.5	65.7	137.7	168.9	247.3	373.1
Steam > 150°C	.4	.7	.9	1.7	10.0	13.3	23.9	51.4	137.3	168.6	248.6	378.8
Total	3.5	9.3	7.7	14.2	39.3	52.2	92.6	189.8	443.1	542.9	795.7	1203.6

ANNUAL SALES OF SOLAR AIPH SYSTEMS, $10^6/\text{ft}^2$

HIGH-PRICE SCENARIO

Year		1985			1990					2000		
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.6	2.1	1.5	2.6	2.9	3.6	6.0	10.1	14.2	16.4	22.7	32.9
Air 100°-150°C	.7	2.1	1.8	3.4	4.0	5.2	8.8	15.3	22.4	26.1	36.3	53.2
Air > 150°C	.3	.5	.6	1.2	5.8	7.8	15.1	31.3	65.4	81.1	123.7	188.3
Water 40°-60°C	.2	.7	.4	.7	1.0	1.2	2.1	3.5	5.9	6.8	9.3	13.3
Water 60°-80°C	.3	1.0	.7	1.3	1.4	1.8	3.2	5.5	8.3	9.8	13.9	19.9
Water 80°-100°C	.3	.8	.6	1.1	1.3	1.6	2.8	4.9	7.4	8.6	12.2	17.5
Steam 100°-150°C	1.0	2.2	2.4	4.6	12.4	16.5	30.9	60.7	101.0	121.1	177.9	264.8
Steam > 150°C	.4	.7	.9	1.8	9.2	12.1	22.7	46.9	102.0	122.9	182.9	277.2
Total	3.8	10.1	9.1	16.8	38.0	49.9	91.6	178.2	327.5	392.8	578.9	867.1

ANNUAL SALES OF SOLAR AIPH SYSTEMS, MILLIONS OF 1976 DOLLARS

MID-PRICE SCENARIO

Application	Year NEA	1985			NEA	1990			NEA	2000		
		Opt. I	Opt. II	Opt. III		Opt. I	Opt. II	Opt. III		Opt. I	Opt. II	Opt. III
Air 50°-100°C	11	37	23	37	35	43	65	97	124	145	200	288
Air 100°-150°C	13	37	28	49	50	62	97	149	197	231	323	470
Air > 150°C	19	22	25	43	121	155	260	445	1006	1235	1891	2850
Water 40°-60°C	3	8	5	7	9	11	16	24	38	44	60	86
Water 60°-80°C	6	17	11	18	17	21	34	51	73	73	85	122
Water 80°-100°C	4	17	10	17	17	22	34	51	84	84	119	171
Steam 100°-150°C	37	89	82	145	238	301	492	807	1718	1718	2534	3739
Steam > 150°C	17	29	32	60	244	231	376	646	1487	1802	2691	4043
TOTAL	103	275	213	377	672	848	1375	2271	5346	5333	7941	11819

ANNUAL SALES OF SOLAR AIPH SYSTEMS, MILLIONS OF 1976 DOLLARS

LOW-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	11	33	21	35	36	44	65	102	157	186	259	383
Air 100°-150°C	13	37	26	48	51	65	100	161	254	264	424	634
Air > 150°C	13	22	25	43	128	165	268	481	1184	1481	2241	3455
Water 40°-60°C	3	7	4	6	9	10	14	22	97	113	66	90
Water 60°-80°C	6	15	7	15	16	20	31	49	81	97	137	194
Water 80°-100°C	4	15	9	15	17	21	32	50	84	101	143	206
Steam 100°-150°C	37	89	82	145	249	319	504	868	1721	2111	3091	4664
Steam > 150°C	17	29	36	64	188	250	701	701	1771	2175	3207	4887
Total	102	269	214	377	704	892	1409	2433	5295	6504	9564	14515

ANNUAL SALES OF SOLAR AIPH SYSTEMS, MILLIONS OF 1976 DOLLARS

HIGH-PRICE SCENARIO

Year		1985			1990					2000		
Application	NEA	Opt. I	Opt. II	Cpt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	11	38	26	42	36	43	65	96	109	126	175	261
Air 100°-150°C	13	38	31	54	50	63	95	146	173	201	280	410
Air > 150°C	13	22	25	46	121	154	259	445	896	1095	1667	2542
Water 40°-60°C	3	10	5	8	9	11	17	25	34	39	54	77
Water 60°-80°C	6	19	12	21	18	22	36	54	66	77	110	157
Water 80°-100°C	6	16	12	20	18	22	34	53	64	75	106	152
Steam 100°-150°C	41	89	92	164	239	302	490	799	1263	1514	2224	3310
Steam > 150°C	17	29	36	66	183	229	372	637	1316	1585	2359	3576
Total	100	283	243	424	675	848	1369	2254	3920	4714	6976	10475

CUMULATIVE SALES OF SOLAR SYSTEMS, 10⁶/f²

MID-PRICE SCENARIO

Year	1985				1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	1.6	.8	3.4	6.0	10.2	12.9	21.7	37.4	106.5	128.0	188.4	282.9
Air 100°-150°C	1.6	.9	3.8	7.1	13.3	17.1	29.7	53.5	162.2	196.6	293.6	449.7
Air > 150°C	.4	.3	.8	1.6	13.5	18.0	33.7	69.4	399.5	499.2	793.2	1262.9
Water 40°-60°C	.5	.2	1.0	1.6	3.4	4.2	6.7	11.4	41.1	49.0	71.3	105.1
Water 60°-80°C	.8	.4	1.6	2.8	4.9	6.2	10.7	18.4	57.6	70.6	107.3	159.1
Water 80°-100°C	.6	.3	1.3	2.4	4.3	5.4	9.4	16.4	51.7	62.9	94.7	142.4
Steam 100°-150°C	1.7	1.2	3.8	7.4	31.8	42.0	77.1	152.9	666.1	819.2	1261.8	1964.9
Steam > 150°C	.6	.5	1.2	2.3	21.5	28.2	51.3	105.3	623.3	767.5	1188.8	1888.3
TOTAL	7.8	4.5	17.0	31.2	102.9	133.8	240.4	454.6	2108.2	2593.0	3999.2	6255.2

CUMULATIVE SALES OF SOLAR SYSTEMS, 10⁶/f²

LOW-PRICE SCENARIO

Application	1985			1990					2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	1.5	.7	3.1	5.4	9.8	12.5	20.7	36.2	123.9	151.0	220.8	339.0
Air 100°-150°C	1.6	.9	3.6	6.6	13.3	17.2	29.3	54.0	193.3	237.4	351.4	551.9
Air > 150°C	.4	.3	.8	1.6	14.4	19.2	34.7	73.9	457.9	579.3	899.8	1467.3
Water 40°-60°C	.5	.2	.9	1.3	3.1	3.8	6.0	10.1	43.0	51.7	73.8	107.1
Water 60°-80°C	.7	.3	1.4	2.4	4.4	5.6	9.5	16.4	60.9	75.7	112.9	167.7
Water 80°-100°C	.6	.3	1.2	2.1	4.0	5.1	8.6	15.2	56.9	70.3	104.6	159.3
Steam 100°-150°C	1.7	1.2	3.8	7.3	33.0	43.7	78.0	160.0	770.8	960.0	1452.5	2313.5
Steam > 150°C	.6	.5	1.3	2.4	23.0	30.2	53.4	112.9	721.1	896.4	1360.0	2197.6
Total	7.6	4.4	16.2	29.1	105.0	137.3	240.2	478.7	2427.9	3021.9	4575.8	7303.4

CUMULATIVE SALES OF SOLAR SYSTEMS, 10⁶/f²

HIGH-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Cpt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Cpt. I	Opt. II	Opt. III
Air 50°-100°C	1.7	.8	4.0	7.0	10.7	13.4	23.2	39.7	9.29	118.5	174.7	264.1
Air 100°-150°C	1.7	.9	4.4	8.1	13.7	17.5	31.5	56.0	149.7	180.4	269.2	413.6
Air > 150°C	.4	.3	.9	1.7	13.6	18.0	34.7	71.6	370.4	460.5	731.6	1178.7
Water 40°-60°C	.6	.3	1.1	1.8	3.6	4.4	7.4	12.6	39.2	46.5	67.9	101.2
Water 60°-80°C	.8	.4	2.0	3.4	5.3	6.7	12.0	20.6	55.6	67.5	102.8	154.4
Water 80°-100°C	.7	.3	1.6	2.8	4.6	5.8	10.2	17.9	49.0	59.3	89.4	135.7
Steam 100°-150°C	1.8	1.2	4.4	8.3	32.4	42.6	80.3	158.4	616.5	754.5	1161.9	1826.6
Steam > 150°C	.6	.5	1.3	2.5	21.4	28.0	52.3	107.3	572.9	702.4	1088.2	1746.3
Total	8.2	4.7	19.7	35.6	105.3	136.4	251.6	484.1	1952.6	2389.9	3685.8	5820.6

ANNUAL MARKET POTENTIAL SUPPLIED BY SOLAR, 10^{12} BTUs

MID-PRICE SCENARIO

Year Application	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.2	.2	.3	.6	.7	.9	1.5	2.5	4.0	4.7	6.5	9.3
Air 100°-150°C	.2	.2	.4	.7	1.0	1.2	2.1	3.6	6.1	7.1	10.0	14.5
Air > 150°C	.1	.1	.1	.3	1.4	1.9	3.0	7.4	18.1	22.2	33.8	51.0
Water 40°-60°C	0	.1	.1	.1	.2	.2	.4	.7	1.4	1.6	2.2	3.1
Water 60°-80°C	.1	.1	.1	.2	.3	.3	.6	1.0	1.8	2.1	3.0	4.3
Water 80°-100°C	.1	.1	.1	.2	.3	.4	.6	1.1	1.9	2.3	3.2	4.6
Steam 100°-150°C	.3	.3	.6	1.2	3.7	4.9	9.0	17.6	33.3	39.9	58.2	86.0
Steam > 150°C	.1	.1	.2	.5	2.7	3.6	6.7	13.8	34.1	41.1	60.8	91.6
TOTAL	.9	1.2	2.0	3.8	10.2	13.5	24.5	47.7	100.6	120.9	177.5	264.3

ANNUAL MARKET POTENTIAL SUPPLIED BY SOLAR, 10^{12} BTUs

LOW-PRICE SCENARIO

Year	1985				1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.1	.2	.3	.5	.7	.9	1.5	2.6	4.0	6.1	8.4	12.4
Air 100°-150°C	.2	.2	.4	.7	1.0	1.3	2.1	3.9	6.1	9.4	13.1	19.6
Air > 150°C	.1	.1	.2	.3	1.5	2.0	3.7	8.1	18.1	26.8	40.4	62.5
Water 40°-60°C	.0	.0	.1	.1	.2	.2	.4	.7	1.4	1.8	2.4	3.4
Water 60°-80°C	.1	.1	.1	.2	.3	.3	.6	1.0	1.8	2.5	3.5	5.0
Water 80°-100°C	.1	.1	.1	.2	.3	.4	.6	1.1	1.9	2.8	3.9	5.7
Steam 100°-150°C	.3	.4	.6	1.2	3.9	5.2	9.3	19.3	33.3	50.2	72.9	110.4
Steam > 150°C	.1	.1	.3	.5	3.0	.4	7.1	15.2	34.1	50.8	74.6	114.6
Total	1.0	1.1	2.0	3.7	10.8	14.3	25.3	51.9	100.0	150.3	219.3	333.7

ANNUAL MARKET POTENTIAL SUPPLIED BY SOLAR, 10^{12} BTUs

HIGH-PRICE SCENARIO

Year	1985				1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Air 50°-100°C	.2	.2	.4	.7	.7	.9	1.5	2.5	3.5	4.1	5.6	8.2
Air 100°-150°C	.2	.2	.4	.8	1.0	1.2	2.1	3.6	5.3	6.2	8.6	12.6
Air > 150°C	.1	.1	.1	.3	1.4	1.9	3.6	7.5	16.1	19.6	29.8	45.3
Water 40°-60°C	.0	.1	.1	.2	.2	.3	.4	.7	1.2	1.4	1.9	2.7
Water 60°-80°C	.1	.1	.1	.3	.3	.4	.6	1.1	1.6	1.9	2.7	3.8
Water 80°-100°C	.1	.1	.1	.3	.3	.4	.7	1.1	1.7	2.0	2.8	4.1
Steam 100°-150°C	.3	.4	.7	1.3	3.7	4.9	9.0	17.5	29.3	34.9	50.7	75.4
Steam > 150°C	.1	.1	.3	.5	2.7	3.6	6.7	13.7	29.9	35.9	52.9	80.3
Total	1.0	1.2	2.3	4.3	10.3	13.5	24.6	47.8	88.7	105.9	155.0	232.4

PRIMARY FUELS DISPLACED BY SOLAR IN QUADS

	NEA		OPTION I		OPTION II		OPTION III	
	Quads Displaced	% Total Demand	Quads Displaced	% Total Demand	Quads Displaced	% Total Demand	Quads Displaced	% Total Demand
Mid-Price								
1985	.004	0.1	.004	0.1	.008	0.2	.014	0.4
1990	.046	0.6	.059	0.8	.104	1.4	.200	2.7
2000	.850	5.2	1.036	6.5	1.571	16.1	2.460	16.7
Low-Price								
1985	.003	0.1	.004	0.1	.007	0.2	.012	0.3
1990	.039	0.5	.051	0.6	.087	1.1	.169	2.2
2000	.769	4.5	.952	5.5	1.430	8.5	2.261	14.3
High-Price								
1985	.064	0.1	.004	0.1	.009	0.5	.016	0.5
1990	.046	0.7	.060	0.8	.108	1.6	.206	3.2
2000	.782	5.7	.948	6.9	1.456	10.9	2.264	18.2

AIPH MARKET SECTOR
WORKBOOK

AIPH FUEL SAVERS*
TOTAL SERVICE DEMAND

o SERVICE DEMAND IN QUADS

	MID-PRICE	LOW-PRICE	HIGH-PRICE
1978	6.653	6.653	6.653
1985	7.133	7.642	6.890
1990	7.597	8.438	7.064
2000	8.281	10.286	7.425

o AVERAGE ANNUAL GROWTH RATE (%)

1978-2000	1%	2%	0.5%
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*AIPH Fuel Savers are retrofit applications of solar industrial process heat systems that do not have storage.

AIPH MARKET SECTOR
WORKBOOK

TOTAL SERVICE DEMAND, 10^{12} BTUs

	Mid- Price	1973 Low- Price	High- Price	Mid- Price	1985 Low- Price	High- Price	Mid- Price	1990 Low- Price	High- Price	Mid- Price	2000 Low- Price	High- Price
Water < 100°	58.2	58.2	58.2	62.4	66.8	60.2	65.5	738	61.8	72.4	89.9	64.9
Steam 100°-162°C	2052.5	2052.5	2052.5	2200.6	2357.7	2125.4	2312.8	2603.1	2179.1	2554.7	3173.1	2290.5
Steam > 162°C	376.2	376.2	376.2	403.3	431.1	389.5	423.9	477.1	399.4	468.2	582.5	419.8
Air < 100°	8.5	8.5	8.5	9.1	9.8	8.8	9.6	10.8	9.0	10.6	13.2	9.5
Air 100°-162°C	231.6	231.6	231.6	298.3	266.0	239.8	260.9	293.7	245.8	288.2	358.0	258.4
Air > 162°C	3926.5	3926.5	3926.5	4209.7	4510.3	4065.9	4424.4	4979.7	4168.6	4687.2	6070.1	4381.7
Total	6653.2	6653.2	6653.2	7133.1	7642.5	6889.5	7469.9	8437.9	7053.5	8281.2	10285.6	7424.7

AIPH MARKET SECTOR
WORKBOOK

TOTAL SERVICE DEMAND, BY REGION, 10¹² BTUs

	Mid- Price	1978 Low- Price	High- Price	Mid- Price	1985 Low- Price	High- Price	Mid- Price	1990 Low- Price	High- Price	Mid- Price	2000 Low- Price	High- Price
New England	115.2	115.2	115.2	123.6	132.4	119.3	129.9	146.2	122.4	143.4	178.2	128.6
Mid-Atlantic	997.3	997.3	699.5	1069.3	1145.6	1032.8	1123.8	1264.8	1058.8	1241.3	1541.8	1113.0
South Atlantic	699.5	699.5	699.5	750.0	803.6	724.4	788.2	887.2	742.7	870.7	1081.5	780.6
East North Central	1749.1	1749.1	1749.1	1875.2	2009.1	1811.2	1970.9	2218.2	1856.9	2177.0	2704.0	1951.9
East South Central	579.7	579.7	579.7	621.5	665.9	600.3	653.2	753.2	615.5	721.6	896.2	649.9
West North Central	295.2	295.2	295.2	316.5	339.1	305.7	332.7	374.4	313.4	367.5	456.4	329.5
West South Central	1510.0	1510.0	1510.0	1618.9	1734.6	1563.7	1701.5	1950.0	1603.2	1879.5	2344.4	1685.1
Mountain	179.1	179.1	179.1	192.0	205.7	185.5	201.8	227.2	190.2	222.9	276.9	199.9
Pacific	528.1	528.1	528.1	566.2	606.7	546.9	595.1	669.8	560.7	657.3	816.5	589.4

SOLAR AIPH FUEL SAVER SYSTEM COSTS,
ALL SCENARIOS AND OPTIONS, 1976 \$/f²

	1978	1985	1990	2000
Water < 100°	35.0	6.17	6.17	6.17
Steam 100°-162°C	39.96	7.48	7.48	7.48
Steam > 162°C	49.93	13.01	13.01	13.01
Air < 100°	32.01	5.65	5.65	5.65
Air 100°-162°C	35.96	6.73	6.73	6.73
Air > 162°C	49.83	13.01	13.01	13.01

SOLAR MARKET PENETRATION

ANNUAL SOLAR MARKET PENETRATION, 10^{12} BTUs

MID-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	.8	1.0	1.2	1.6	1.5	1.7	1.9	2.0	1.6	1.6	1.5	1.3
Steam 100°-162°C	27.1	31.5	41.3	52.8	50.2	57.2	63.8	64.7	48.2	50.0	46.1	35.6
Steam > 162°C	.5	.6	.8	.9	.8	.9	.9	.7	.4	.5	.4	.2
Air < 100°C	-	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
Air 100°-162°C	4.4	5.1	6.7	8.7	8.2	9.3	10.4	10.7	7.3	7.6	6.9	5.3
Air > 162°C	2.9	3.3	4.2	4.9	3.7	4.2	4.5	4.0	2.3	2.4	2.2	1.7
Total	35.8	41.6	54.4	69.0	64.4	73.3	81.5	82.2	60.0	62.0	57.1	44.1

ANNUAL SOLAR MARKET PENETRATION, 10^{12} BTUs

LOW-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	.7	.8	1.0	1.3	1.2	1.4	1.5	1.7	1.5	1.5	1.5	1.4
Steam 100°-162°C	17.1	20.6	25.9	33.4	27.8	31.8	35.0	33.1	20.5	22.3	20.4	13.4
Steam > 162°C	.3	.3	.4	.4	.2	.3	.3	.2	.1	.1	.1	-
Air < 100°C	-	-	-	-	-	-	-	-	-	-	-	-
Air 100°-162°C	.2	.4	.5	.6	5.5	6.3	7.0	6.9	4.5	4.8	4.5	3.5
Air > 162°C	2.4	2.2	2.8	3.2	2.4	2.7	3.0	3.0	2.0	2.2	2.1	1.6
Total	23.9	27.8	36.3	44.9	37.2	42.5	46.9	44.9	28.5	31.2	28.8	20.0

ANNUAL SOLAR MARKET PENETRATION, 10¹² BTUs

HIGH-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	.9	1.0	1.3	1.7	1.8	2.0	2.2	2.4	2.0	2.0	1.9	1.7
Steam 100°-162°C	26.1	30.4	39.8	50.8	55.6	63.2	70.9	73.1	66.7	67.5	62.7	52.5
Steam > 162°C	.5	.6	.7	.9	.9	1.0	1.1	.9	.9	.9	.8	.5
Air < 100°C	-	.1	.1	.1	.1	.1	.1	.1	.2	.2	.1	.1
Air 100°-162°C	4.3	5.0	6.5	8.5	8.9	10.1	11.3	11.8	97.0	98.2	90.1	75.1
Air > 162°C	2.9	3.3	4.2	4.9	4.5	5.1	5.4	4.9	3.5	3.6	3.1	2.4
Total	34.7	40.4	52.7	66.9	71.7	81.6	91.1	93.3	83.0	84.0	77.7	64.7

SOLAR MARKET PENETRATION BY APPLICATION 10^{12} BTUs
MID-PRICE SCENARIO
YEAR 2000

AIPH MARKET SECTOR
WORKBOOK

ANNUAL SOLAR MARKET PENETRATION BY REGION, 10¹² BTUs

MID-PRICE SCENARIO

Year		1985			1990				2000			
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	.6	.6	.8	1.0	.8	.9	1.0	.9	.6	.6	.5	.4
Mid-Atlantic	1.1	1.3	1.6	1.9	1.6	1.8	1.9	1.8	1.2	1.2	1.1	.9
South Atlantic	3.8	4.4	5.7	6.9	5.9	6.7	7.1	6.3	3.8	3.9	3.3	2.0
East North Central	6.1	7.1	9.3	11.6	10.3	11.8	12.9	12.4	8.2	8.6	7.6	4.9
East South Central	3.1	3.7	4.8	5.9	5.3	6.0	6.5	6.0	3.9	3.9	3.5	2.1
West North Central	.7	.3	1.0	1.1	.8	.9	.9	.7	.4	.4	.3	.1
West South Central	12.5	14.5	19.0	24.5	23.2	26.5	29.7	30.3	22.2	23.2	21.4	15.6
Mountain	1.5	1.8	2.3	3.1	3.1	3.6	4.1	4.6	3.8	3.9	3.8	3.5
Pacific	6.4	7.5	9.9	13.1	15.2	15.2	17.5	19.4	15.9	16.4	15.9	14.6

ANNUAL SOLAR MARKET PENETRATION BY REGION, 10¹² BTUs

LOW-PRICE SCENARIO

Year		1985			1990				2000			
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Cpt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	.3	.4	.5	.6	.4	.5	.5	.5	.4	.4	.4	.4
Mid-Atlantic	.7	.8	1.0	1.2	1.0	1.2	1.3	1.4	1.1	1.2	1.2	1.0
South Atlantic	2.3	2.7	3.4	3.9	2.7	3.1	3.2	2.7	1.4	1.6	1.5	1.1
East North Central	3.9	4.5	5.9	7.1	5.4	6.2	6.6	5.8	2.7	2.9	2.4	1.3
East South Central	2.0	2.4	3.0	3.6	2.7	3.0	3.2	2.7	1.6	1.6	1.5	1.2
West North Central	.3	.4	.5	.5	.3	.3	.3	.2	.1	.1	.1	.1
West South Central	8.5	9.9	12.9	16.1	13.2	15.2	16.6	15.3	8.1	8.7	7.4	3.8
Mountain	1.1	1.4	1.8	2.3	2.3	2.6	3.0	3.3	2.8	3.0	3.0	2.5
Pacific	4.8	5.6	7.4	9.6	9.2	10.6	12.2	13.1	10.5	11.5	11.3	8.6

ANNUAL SOLAR MARKET PENETRATION BY REGION, 10¹² BTUs

HIGH-PRICE SCENARIO

Year		1985			1990				2000			
Region	NEA	Opt. I	Cpt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	.6	.7	.8	1.0	1.0	1.2	1.3	1.1	1.0	1.0	.8	.6
Mid-Atlantic	1.1	1.3	1.6	1.9	1.9	2.2	2.3	2.2	1.7	1.7	1.5	1.2
South Atlantic	3.3	4.4	5.7	6.9	7.1	8.1	8.8	8.1	7.2	7.3	6.4	4.4
East North Central	6.0	7.0	9.1	11.4	11.8	13.5	14.9	14.7	13.0	13.3	12.2	9.4
East South Central	3.1	3.5	4.6	5.8	6.1	6.9	7.5	7.3	6.5	6.6	5.9	4.2
West North Central	.6	.7	.9	1.0	1.0	1.2	1.2	.9	.9	.9	.7	.4
West South Central	11.9	13.8	18.1	23.2	25.2	28.7	32.3	33.5	30.8	31.3	29.4	24.8
Mountain	1.5	1.7	2.2	2.9	3.3	3.7	4.3	4.8	4.1	4.1	3.9	3.7
Pacific	6.3	7.3	9.6	12.7	14.2	16.2	18.5	20.7	17.9	17.8	16.9	16.0

ANNUAL SOLAR MARKET PENETRATION, $10^6/\text{ft}^2$

MID-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	3.4	3.9	5.1	6.5	6.0	6.8	7.6	8.0	6.3	6.4	6.0	5.3
Steam 100°-162°C	77.8	90.5	118.3	149.3	139.1	158.4	175.4	173.4	125.9	130.6	118.9	88.1
Steam > 162°C	1.3	1.5	1.9	2.1	1.7	1.9	2.0	1.6	.9	1.0	.8	.4
Air < 100°C	.2	.2	.3	.3	.3	.3	.4	.4	.3	.3	.3	.2
Air 100°-162°C	17.6	20.5	26.9	34.8	32.4	36.9	41.3	42.2	28.3	29.7	27.2	20.9
Air > 162°C	10.8	12.5	16.0	18.5	14.2	16.1	17.0	15.6	9.1	9.4	8.5	6.7
Total	111.1	129.1	168.4	211.5	193.7	220.5	243.6	241.2	171.3	177.3	161.8	121.6

ANNUAL SOLAR MARKET PENETRATION, $10^6/f^2$

LOW-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	2.9	3.4	4.4	5.6	5.0	5.7	6.4	5.5	5.8	6.2	6.2	5.5
Steam 100°-162°C	49.1	57.1	74.3	90.7	72.7	83.3	90.6	73.2	48.1	52.3	46.9	29.2
Steam > 162°C	.6	.7	.8	.9	.5	.6	.6	.6	.2	.2	.1	.1
Air < 100°C	-	-	-	.2	.1	.2	.2	.1	.2	.2	.2	.2
Air 100°-162°C	13.5	15.8	20.6	26.0	22.2	25.4	28.3	22.7	18.8	20.2	19.4	15.4
Air > 162°C	7.1	8.2	10.5	12.3	9.4	10.7	11.9	10.8	7.9	8.7	8.5	6.4
Total	73.3	85.2	110.7	135.8	109.9	125.8	137.9	113.0	80.9	87.8	81.2	56.8

ANNUAL SOLAR MARKET PENETRATION, $10^6/f^2$

HIGH-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Cpt. II	Opt. III	NEA	Opt. I	Opt. II	Cpt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	3.6	4.2	5.5	7.1	7.3	8.2	9.1	9.9	8.2	8.1	7.5	6.9
Steam 100°-162°C	75.1	87.4	114.2	144.0	156.2	177.8	197.7	199.4	183.4	186.1	171.4	138.9
Steam > 162°C	1.2	1.4	1.8	2.0	2.1	2.4	2.5	2.0	2.5	2.1	1.7	1.1
Air < 100°C	.2	.2	.3	.3	.4	.4	.5	.4	.6	.6	.5	.4
Air 100°-162°C	17.2	20.0	26.2	33.9	35.4	40.2	45.2	47.1	38.1	38.5	35.6	29.4
Air > 162°C	10.8	12.5	16.0	18.7	17.1	19.4	20.6	19.2	13.5	13.7	12.1	9.6
Total	108.2	125.7	164.0	205.9	218.5	248.5	275.7	278.0	246.0	249.1	228.9	186.2

ANNUAL SALES OF SOLAR SYSTEMS, MILLIONS OF 1976 DOLLARS

MID-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	17.9	21.0	27.1	34.6	30.9	35.2	39.5	33.9	35.8	38.3	38.3	33.9
Steam 100°-162°C	581.9	676.9	884.9	1116.8	1040.5	1184.8	1312.0	1297.0	941.7	976.9	889.4	659.0
Steam > 162°C	21.3	19.5	24.7	27.3	22.1	24.7	26.0	20.8	11.7	13.0	10.4	5.2
Air < 100°C	1.1	1.1	1.7	1.7	1.7	1.7	2.3	2.3	1.7	1.7	1.7	1.1
Air 100°-162°C	118.4	134.6	181.0	234.2	218.1	248.3	277.9	284.0	193.8	199.9	183.1	140.7
Air > 162°C	140.5	162.6	208.2	240.7	184.7	209.5	221.2	203.0	118.4	122.3	110.6	87.2
Total	861.1	1015.7	1327.6	1498.0	1704.2	1878.9	1841.0	1303.1	1303.1	1352.1	1233.5	927.1

ANNUAL SALES OF SOLAR SYSTEMS, MILLIONS OF 1976 DOLLARS

LOW-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	21.0	24.1	31.5	40.1	37.0	42.0	46.9	49.4	38.9	39.5	37.0	32.7
Steam 100°-162°C	367.3	427.1	555.8	678.4	543.8	623.1	677.7	547.5	359.8	391.2	350.8	218.4
Steam > 162°C	7.8	9.1	10.4	11.7	6.5	7.8	7.8	7.8	2.6	2.6	1.3	1.3
Air < 100°C	0.0	0.0	0.0	1.1	.6	1.1	1.1	.6	1.1	1.1	1.1	1.1
Air 100°-162°C	90.9	102.3	138.6	175.0	149.4	170.9	190.5	152.8	162.5	135.9	130.6	103.6
Air > 162°C	92.4	106.7	136.5	160.0	122.3	139.2	154.8	140.5	102.8	113.2	110.6	83.3
Total	579.4	669.3	872.9	1066.3	859.6	984.1	1078.8	898.6	667.7	683.5	631.4	440.4

ANNUAL SALES OF SOLAR SYSTEMS, MILLIONS OF 1976 DOLLARS

HIGH-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	22.2	25.9	33.9	43.8	45.0	50.6	56.1	61.1	50.6	50.0	46.3	42.6
Steam 100°-162°C	561.7	653.8	854.2	1077.1	1168.4	1329.9	1480.3	1491.5	1371.8	1392.0	1282.1	1039.0
Steam > 162°C	15.6	18.2	23.4	26.0	27.3	31.2	32.5	26.0	26.0	27.3	22.1	14.3
Air < 100°C	1.1	1.1	1.7	1.7	2.3	2.3	2.8	2.3	3.4	3.4	2.8	2.3
Air 100°-162°C	115.8	134.6	176.3	228.1	238.2	270.5	304.2	317.0	256.4	259.1	239.6	197.9
Air > 162°C	140.5	162.6	208.2	243.2	222.5	252.4	268.0	249.8	176.9	178.2	157.4	124.9
Total	856.9	996.2	1297.7	1619.9	1703.7	1936.9	2143.9	2147.7	1885.1	1910.0	1750.3	1421.0

CUMULATIVE SOLAR MARKET PENETRATION, 10¹² BTUs*

MID-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	2.9	3.3	4.4	6.0	9.2	10.4	12.7	15.3	25.9	28.2	30.8	32.2
Steam 100°-162°C	76.2	87.2	117.5	157.0	285.4	327.8	398.9	466.3	828.5	918.1	991.9	978.6
Steam > 162°C	1.4	1.6	2.2	2.6	4.9	5.9	6.6	6.7	11.1	12.4	12.8	10.8
Air < 100°C	.2	.2	.2	.3	.5	.6	.7	.8	1.5	1.6	1.7	1.5
Air 100°-162°C	13.0	14.9	20.1	27.3	47.1	54.1	66.2	78.6	132.8	147.1	159.8	159.3
Air > 162°C	9.2	10.4	13.9	17.3	26.9	30.6	36.4	39.5	58.2	64.6	69.4	66.7
Total	102.9	117.7	158.4	210.6	374.1	429.2	521.6	607.2	1058.0	1172.0	1267.4	1249.1

*Indicates energy produced in 1985, 1990, and 2000 by all systems installed, 1980-2000.

CUMULATIVE SOLAR MARKET PENETRATION, 10^{12} BTUs

LOW-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	2.1	3.0	4.0	5.4	7.7	8.7	10.8	13.2	21.9	24.3	27.3	29.3
Steam 100°-162°C	52.5	59.9	80.6	105.7	175.6	201.9	245.0	277.3	432.4	488.0	530.4	498.2
Steam > 162°C	.7	.8	1.1	1.3	2.0	2.1	2.7	2.6	3.5	4.0	4.1	3.5
Air < 100°C	0	.1	.1	.2	.2	.3	.3	.4	.7	.7	.8	.8
Air 100°-162°C	10.4	11.9	16.0	21.4	34.4	39.6	48.4	56.2	87.6	98.7	108.3	106.6
Air > 162°C	6.5	7.3	9.8	12.3	17.7	20.2	24.4	27.7	40.7	46.0	51.3	51.4
Total	72.7	82.9	111.6	146.2	237.6	237.0	331.7	377.4	588.8	661.6	722.3	689.9

CUMULATIVE SOLAR MARKET PENETRATION, 10^{12} BTJs

HIGH-PRICE SCENARIO

	1985				1990				2000			
	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100°C	3.1	3.5	4.7	6.4	10.3	11.7	14.2	17.2	31.9	34.3	37.0	39.0
Steam 100°-162°C	74.0	84.7	114.2	152.6	295.4	338.7	441.4	481.5	988.2	1082.5	1162.0	1156.7
Steam > 162°C	1.4	1.6	2.1	2.5	5.2	5.9	6.9	7.1	15.3	16.8	17.1	14.2
Air < 100°C	.1	.2	.2	.3	.6	.7	.8	.8	2.1	2.3	2.4	2.1
Air 100°-162°C	12.7	14.6	19.7	26.7	48.3	55.5	67.7	80.7	153.5	168.3	181.8	183.4
Air > 162°C	9.2	10.5	13.9	17.4	29.1	33.2	39.4	42.8	73.1	80.2	84.6	80.1
Total	100.6	115.0	154.8	205.9	388.6	445.0	540.4	630.1	1264.1	1384.5	1484.9	1475.6

CUMULATIVE SOLAR MARKET PENETRATION BY REGION, 10¹² BTUs

MID-PRICE SCENARIO

Year		1985			1990					2000		
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	1.7	1.9	2.5	3.2	5.4	6.2	7.3	7.9	12.7	14.0	14.8	13.7
Mid-Atlantic	3.3	3.7	4.9	6.1	10.3	11.8	14.0	15.3	24.9	27.4	29.3	28.7
South Atlantic	11.1	12.7	17.0	21.8	37.4	42.8	51.2	55.7	89.1	99.1	104.2	93.4
East North Central	17.9	20.4	27.5	36.1	62.4	71.6	86.5	98.4	163.5	181.9	194.9	183.0
East South Central	9.1	10.4	13.9	18.3	32.0	36.6	44.1	49.5	81.7	90.6	96.0	88.4
West North Central	1.8	2.1	2.8	3.3	5.8	6.6	7.6	7.6	11.6	12.8	13.1	10.8
West South Central	35.2	40.3	54.4	72.9	131.8	15.2	185.0	21.7	383.5	426.0	461.7	451.8
Mountain	4.4	5.0	6.7	9.3	16.9	19.4	23.9	29.5	55.6	61.0	67.2	72.6
Pacific	18.5	21.2	28.8	39.7	72.1	82.7	102.1	126.1	235.5	259.2	286.0	306.6

CUMULATIVE SOLAR MARKET PENETRATION BY REGION, 10¹² BTUs

LOW-PRICE SCENARIO

Year		1985			1990					2000		
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	1.1	1.2	1.6	2.0	3.0	3.5	4.1	4.6	7.1	7.9	8.8	9.1
Mid-Atlantic	2.2	2.5	3.3	4.3	6.6	7.5	9.2	10.9	17.9	20.1	22.4	23.5
South Atlantic	7.3	8.3	10.7	13.8	20.7	23.7	28.2	29.9	40.9	46.1	50.0	46.7
East North Central	12.2	13.8	18.6	23.9	37.3	42.8	51.6	56.5	78.7	88.9	95.5	86.3
East South Central	6.2	7.1	9.5	12.1	18.9	21.6	25.8	27.9	39.8	44.6	48.1	45.4
West North Central	1.0	1.1	1.4	1.6	2.4	2.7	3.2	3.1	4.1	4.5	4.9	4.3
West South Central	25.1	28.6	38.6	50.7	84.0	96.7	117.3	132.0	197.4	223.3	240.0	217.0
Mountain	3.4	3.9	5.3	7.3	12.6	14.5	18.0	22.1	40.3	45.4	50.8	52.7
Pacific	14.4	16.4	22.3	30.5	52.1	60.1	74.4	90.4	159.7	180.7	201.7	204.8

CUMULATIVE SOLAR MARKET PENETRATION BY REGION, 10¹² BTUs

HIGH-PRICE SCENARIO

Year		1985			1990				2000			
Region	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
New England	1.7	1.9	2.6	3.3	6.0	6.4	8.1	8.9	17.2	18.8	19.5	14.1
Mid-Atlantic	3.3	3.7	4.9	6.2	11.4	13.0	15.3	16.7	31.7	34.6	36.1	26.9
South Atlantic	1.13	12.6	16.9	21.8	40.7	46.7	55.7	61.3	120.9	133.0	139.1	98.9
East North Central	17.7	20.2	27.2	35.7	66.0	75.7	91.4	104.4	205.4	226.0	241.2	176.1
East South Central	8.8	10.1	13.6	17.9	33.6	38.5	46.3	52.2	104.0	114.2	120.4	86.6
West North Central	1.8	2.0	2.7	3.2	6.3	7.2	8.3	8.3	16.7	18.3	18.3	12.2
West South Central	33.8	38.7	52.2	70.0	134.1	154.0	187.5	220.4	450.0	494.8	533.6	391.7
Mountain	4.2	4.9	6.6	9.0	17.1	19.6	24.0	29.7	59.8	64.8	70.6	55.1
Pacific	18.1	20.8	28.1	38.8	73.4	84.2	103.7	128.2	257.7	279.9	306.0	238.0

CUMULATIVE SOLAR MARKET PENETRATION BY REGION, 10^{12} BTUs
MID-PRICE SCENARIO
YEAR 2000

AIPH MARKET SECTOR
WORKBOOK

CUMULATIVE SOLAR MARKET PENETRATION, $10^6/\text{ft}^2$

MID-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100° C	12.1	13.8	18.5	25.1	37.3	42.3	52.0	62.9	104.8	114.4	125.3	131.9
Steam 100°-162°C	218.2	249.7	336.0	444.3	806.1	925.4	1121.1	1290.2	1161.9	2509.1	2698.7	2607.5
Steam > 162°C	3.4	3.9	5.1	6.1	11.4	13.1	15.2	15.3	25.2	28.0	28.7	24.0
Air < 100°C	.5	.6	.8	1.0	1.9	2.1	2.5	2.6	5.2	5.6	5.9	5.3
Air 100°-162°C	52.5	60.1	81.1	109.8	188.4	216.3	264.3	313.3	526.4	582.9	633.1	632.4
Air >162°C	34.8	39.4	52.3	65.5	101.5	115.6	137.8	150.1	222.3	246.6	265.9	256.9
Total	321.6	367.4	493.8	651.2	1146.6	1314.9	1592.9	1834.5	3145.9	3486.7	3757.6	3658.2

CUMULATIVE SOLAR MARKET PENETRATION, $10^6/\text{ft}^2$

LOW-PRICE SCENARIO

Year		1985			1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100° C	11.0	12.4	16.8	22.9	32.0	36.5	45.3	55.5	89.9	100.2	112.4	119.8
Steam 100°-162°C	145.5	165.9	222.9	228.6	474.7	545.4	658.6	732.4	1106.8	1251.5	1353.1	1249.6
Steam > 162°C	1.6	1.8	2.4	2.7	4.5	5.1	5.9	5.7	7.6	8.5	8.9	7.4
Air < 100°C	.3	.3	.4	.5	.9	1.0	1.2	1.4	2.4	2.7	2.9	3.1
Air 100°-162°C	42.1	48.1	64.9	86.6	138.8	159.5	194.9	227.1	357.0	401.7	442.4	440.4
Air >162°C	24.7	27.9	37.2	47.1	68.0	77.6	94.4	107.6	159.6	180.2	201.3	202.4
Total	225.3	256.5	344.6	448.6	718.8	852.2	1000.2	1129.8	1723.3	1944.9	2121.2	2022.8

CUMULATIVE SOLAR MARKET PENETRATION, $10^6/\text{ft}^2$

HIGH-PRICE SCENARIO

Year	1985				1990				2000			
Application	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III	NEA	Opt. I	Opt. II	Opt. III
Water < 100° C	12.9	14.7	19.7	26.8	42.3	48.0	58.7	71.4	129.9	139.9	151.7	161.3
Steam 100°-162°C	212.3	242.7	326.7	432.1	838.6	962.3	1163.7	1341.1	2758.8	3025.7	3229.0	3147.9
Steam > 162°C	3.2	3.7	4.8	5.8	12.2	13.9	16.1	16.2	35.2	38.6	38.9	31.8
Air < 100°C	.5	.6	.8	1.0	2.1	2.4	2.8	2.9	7.3	8.0	8.1	7.2
Air 100°-162°C	51.5	58.9	79.5	107.7	194.1	222.6	271.7	323.0	610.7	669.0	722.1	728.2
Air >162°C	35.0	39.6	52.7	65.2	110.3	125.6	149.3	163.1	278.6	305.8	323.5	309.0
Total	315.4	360.2	484.3	639.6	1199.6	1374.7	1662.3	1917.8	3820.4	4187.0	4473.3	4385.5

MID-PRICE SCENARIO

AIPH MARKET SECTOR
WORKBOOK

PRIMARY FUELS DISPLACED BY SOLAR IN QUADS

		NEA	OPTION I	OPTION II	OPTION III
Mid-Price	1985	.151	.173	.232	.309
	1990	.548	.629	.763	.887
	2000	1.545	1.711	1.850	1.820
Low-Price	1985	.146	.129	.174	.227
	1990	.345	.424	.515	.584
	2000	.946	1.069	1.166	1.110
High Price	1985	.150	.171	.231	.307
	1990	.574	.659	.6798	.929
	2000	1.850	2.027	2.173	2.156

DISPERSED ON-SITE INDUSTRIAL ELECTRIC POWER GENERATION

o ELECTRICITY DEMAND IN QUADS

	MID-PRICE	LOW-PRICE	HIGH-PRICE
1978	2.024	2.178	1.945
1985	2.170	2.516	2.001
1990	2.281	2.789	2.043
2000	2.520	3.430	2.128

o AVERAGE ANNUAL GROWTH RATE

1978 - 2000	1.0%	2.0%	0.5%
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AIPH MARKET SECTOR
WORKBOOK

QUADS OF TOTAL ELECTRICITY DEMAND BY REGION*

	MID-PRICE SCENARIO			
	1978	1985	1990	2000
New England	.076	.081	.085	.094
Mid-Atlantic	.277	.297	.312	.345
South Atlantic	.287	.308	.324	.358
East North Central	.470	.504	.530	.586
East South Central	.271	.291	.306	.338
West North Central	.095	.102	.107	.118
West South Central	.212	.217	.228	.252
Mountain	.070	.075	.079	.087
Pacific	.269	.288	.303	.335
TOTAL	2.024	2.170	2.281	2.520

*All analysis of on site electric power generation was conducted using only the Mid-Price scenario fuel prices and one set of energy demands.

ALPH MARKET SECTOR
WORKBOOK

COST/CAPACITY, 1976 \$/MMBTU

	1985	1990	2000
Wind Energy Conversion Systems	-	-	-
Photovoltaics	-	10.15 - 21.85	10.15 - 14.35
Solar Thermal Electric	-	6.45 - 18.70	2.15 - 9.30

AIPH MARKET SECTOR
WORKBOOK

TOTAL ELECTRICITY DEMAND
SUPPLIED BY SOLAR APPLICATIONS, 10^{12} BTUs, YEAR 2000

	WECS	PV	STE
New England	-	-	0.45
Mid-Atlantic	-	0.28	1.82
South Atlantic	-	-	2.33
East North Central	-	0.35	2.99
East South Central	-	-	1.35
West North Central	-	0.32	0.99
West South Central	-	0.51	4.81
Mountain	-	0.04	0.73
Pacific	-	0.07	2.12

PRIMARY FUEL DISPLACED BY SOLAR MARKET PENETRATION, 10^{12} BTUs

	1985	1990	2000
Wind Energy Conversion Systems	-	-	-
Photovoltaics	-	0.1	6.6
Solar Thermal	-	0.6	52.8

AIPH MARKET SECTOR
WORKBOOK

INDUSTRIAL BIOMASS SERVICE DEMAND IN FOUR SICs
10¹² BTUs

	1978	1985	1990	2000
SIC 20 Food	648.3	828.2	928.4	1136.2
SIC 24 Lumber	201.7	254.5	277.1	322.6
SIC 25 Furniture	40.0	53.7	65.7	90.7
SIC 26 Paper and Allied Products	1507.9	2004.7	2368.4	3226.4
TOTAL	2397.9	3141.1	3693.6	4775.9

PERCENT OF BIOMASS UTILIZATION BY REGION

AIPH MARKET SECTOR
WORKBOOK

CURRENT AND PROJECTED USE OF BIOMASS IN FOUR SICs
SERVICE DEMAND, MID-PRICE SCENARIO
10¹² BTUs

	1978	1985	1990	2000
SIC 20 Food	12.2	15.6	17.5	21.4
SIC 24 Lumber	30.3	38.2	41.6	44.5
SIC 25 Furniture	1.5	2.0	2.5	3.4
SIC 26 Paper and Allied Products	591.6	786.6	929.3	1296.8
TOTAL	635.6	842.4	990.9	1339.1

AIPH MARKET SECTOR
WORKBOOK

CURRENT USE OF PRIMARY FUEL IN FOUR SICs
10¹² BTUs, 1978

	OIL	GAS	COAL	ELEC	BIOMASS	OTHER	TOTAL
SIC 20 Food	174.4	626.5	95.2	151.8	40.7	--	1088.6
	16.0%	57.6%	8.7%	13.9%	3.7%	--	100%
SIC 24 Lumber	66.5	114.2	4.3	79.2	50.6	--	314.8
	21.1%	36.3	1.4%	25.1%	16.1%	--	100%
SIC 25 Furniture	10.3	32.7	3.8	18.0	2.5	--	67.3
	15.3%	48.6%	5.6%	26.8%	3.7%	--	100%
SIC 26 Paper and Allied Products	571.4	463.6	231.8	150.6	971.5	77.0	2462.5
	23.2	18.8	9.4%	6.1	39.3	3.1	100%
TOTAL	822.6	1237	335.1	399.6	1065.3	77.0	3933.1
	20.9%	31.5%	8.5%	10.2%	27.1%	2.0	100%

AIPH MARKET SECTOR
WORKBOOK

CURRENT AND PROJECTED USE OF PRIMARY FUEL IN FOUR SICs
MID-PRICE SCENARIO
10¹² BTUs

	1978		1985		1990		2000	
	PRIMARY FUEL USE	% BIOMASS	PRIMARY FUEL USE	% BIOMASS	PRIMARY FUEL USE	% BIOMASS	PRIMARY FUEL USE	% BIOMASS
SIC 20 Food	1088.6	3.7	1233.4	4.2	1335.3	4.4	1431.7	5.0
SIC 24 Lumber	348.0	16.1	387.2	16.5	438.0	15.8	555.3	13.4
SIC 25 Furniture	67.2	3.7	74.6	4.6	80.0	5.1	91.0	6.3
SIC 26 Paper and Allied Products	2462.2	39.3	2567.5	44.9	2632.3	52.2	2698.8	65.1
TOTAL	3932.8	27.1	4261.7	29.9	4485.6	33.5	4776.8	40.0

AIPH MARKET SECTOR
WORKBOOK

POTENTIAL IMPACT OF GOVERNMENT INCENTIVES
ON BIOMASS UTILIZATION IN SIC 26

	NEA Reference Case			Retirement Tax Credit			Option II Level of Incentives and Retirement Tax Credit		
	1985	1990	2000	1985	1990	2000	1985	1990	2000
Service Demand Supplied by Biomass in Quads	.787	.929	1.270	1.128	1.349	1.775	1.264	1.489	1.912
Consumption of Primary Biomass Resources in Quads	1.155	1.328	1.758	1.655	1.928	2.458	1.855	2.128	2.648