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FINANCIAL BARRIERS TO THE USE OF SOLAR-INDUSTRIAL- PROCESS HEAT

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by:

✓
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EXECUTIVE SUMMARY

Industrial process heat (IPH) is a major user of energy. Efforts to commercialize solar as a source of IPH have met with little success thus far. Current figures show about 1½% of all solar collector shipments are for use in industry and this includes sponsored projects with external funding from the U.S. Department of Energy and other sources.

Industry energy managers and other executives reported to the study team that while they are sympathetic with all efforts to reduce energy consumption, there is little motivation to adopt solar. Return on investment is low vs. other investment choices, and solar is not likely to provide protection against fuel shortages.

Four cases were selected from among 30 potential solar IPH installations that had been carried through the design stage at plants scattered about the 12 Midwestern states. A typical case was an installation at an automotive plant with about 10,000 square feet of collectors at a system cost of \$411,400.

Each case was analyzed using discounted cash flow to determine what internal rate of return would be earned under current tax laws over 10 years.

None of the four cases showed any significant rate of return from capital invested in the solar installation. The highest was 6/10 of 1%. A typical rate of return expected by industry is 15% to 25% or more.

Several possible changes in the cost of solar equipment, its tax treatment or methods of financing were tested through computer simulation. A summary of results follows:

- 1) Reducing initial cost of the systems by 50%, as might happen with more production, will raise rate of return into the range of 4% to nearly 8% in the four test cases.
- 2) Reducing depreciation period from 10 years to 5 would have only a minor effect on solar economics considered independently. The principle here is that faster depreciation is of more benefit to an already profitable enterprise than to one that is marginal.
- 3) Initiating two tax changes would bring rate of return into a minimum acceptable range provided they applied only to solar and did not benefit energy projects that might compete with solar for capital.

These proposals are:

- a. Double the federal investment tax credit from its present 25% to 50%, and
- b. Consider as a deductible expense the cost of fuel not used because solar has been installed.

With these additions to present tax law and no other changes, rate of return on the four installations is estimated to be in the range from 14.6% to 20.6% and hence within the low part of the commonly acceptable targets.

- 4) Tax exempt bonds as a source of low-interest funds could provide some overall cost advantage compared with funds from other sources.

While a heavy load of extra tax incentives can certainly improve the return on an investment, the study team did not recommend action to achieve such steps here for two reasons:

- 1) Statistical reports on the national market, California and Wisconsin show virtually no evidence that solar IPH has been freely selected even where special state tax incentives have been high and fuel costs have been rising rapidly.
- 2) If heavy added tax incentives are effective, they run the risk of drawing capital away from applications such as conservation where the opportunity to improve the nation's energy dilemma is very great. Better economic justification for more solar IPH, via extra special incentives, may be un-economic for the nation as a whole.

Tax shelter financing through the limited partnership vehicle may be available to encourage some solar installation.

This method of financing uses the incentive of legal tax avoidance to attract capital into unusual or high risk situations. Details are beyond the scope of this report.

A 28-minute summary of the report is available on 3/4" videocassette.

I. INTRODUCTION

Solar energy has long been considered an attractive alternative to the use of fossil fuel, particularly gas and oil. Solar is now gaining acceptance in residential water and pool heating, but whether solar can make a substantial contribution to industry's needs for energy is an important and as yet unanswered part of the solar question.

In particular, the industrial question centers on the possible use of solar for industrial process heat (IPH) -- defined simply as thermal energy used in the preparation and treatment of goods produced by manufacturing processes.

Roughly speaking, IPH accounts for 50% - 70% of industry's energy usage and is therefore about 18% to 25% of total U.S. energy. Whether solar will make progress in this substantial slice of the national energy map depends on whether solar can contribute to industry's unrelenting drive for productivity or whether it is "economic."

The term "economic" as used by industry means, simply, the efficient and prudent use of capital resources. "Economic issues were overriding considerations in making decisions on energy," concludes a report on solar IPH prepared for the Solar Energy Research Institute (SERI) and appearing in draft form in late 1980.*

*Solar Industrial Process Heat Survey of Industrial Applications and Attitudes. Prepared by Insights West. SERI/TR-733-1015, October 1980.

Where these economic imperatives lead solar IPH is the purpose of this report. The report will deal with the present status of solar IPH and the financial barriers that stand in its way. Recommendations to overcome these barriers will be devised and then applied to site-specific cases where solar IPH installation had been surveyed in a preliminary way in Midwestern industrial plants. These case studies, prepared under contract to MASEC in 1980, were to bring generalizations about solar IPH down to the plant level. A partial investment analysis was made in these studies. It was left to the contract reported on here to determine if financial barriers could be identified and perhaps eliminated.

II. EXPLANATION OF IPH

Industrial process heat is an issue of economic importance in the 12 Midwestern states of the MASEC region simply because industry is so important. Within the region is some 40% of all U.S. manufacturing activity and the headquarters of many of the top 500 corporations.

Considerable effort has already been spent on determining the processes and industries where solar IPH might fit best. We accepted the work of others in order to avoid re-writing that particular book.

According to a recent report draft submitted to SERI, the leading solar candidates are:

"Most Likely" Industries For Solar-Augmented Applications

<u>SIC</u>	<u>INDUSTRY</u>
34	Metal Products Mfg.
20	Food Processing
37	Transportation Equipment
35	Machinery Manufacturing
33	Metals, Basic
28	Chemicals
36	Electrical Components
30	Rubber & Plastic Products
32	Concrete Products
38	Instrument Manufacturing

Source: Solar Industrial Process Heat Survey
of Industrial Applications and Attitudes.
Draft Report for Solar Energy Research
Institute, October 1980. Insights West.

The above industries use process heat in an enormous number of ways. High temperature metallurgy is a big user of energy in the region because of extensive iron and steel works in Illinois, Indiana, Michigan and Ohio. Those processes are, of course, mainly at temperatures well above what solar can provide.

550° F is generally considered to be the upper temperature attainable with commercial solar equipment now available in line focus, evacuated tube and flat plate technologies. SERI's recent booklet, "Putting the Sun to Work in Industry" includes a chart of IPH by temperature distribution. It is Exhibit 1 and shows simply that a large share of IPH can be provided by present solar technology, freely available, which can reach 550° F. That share is 27%. If pre-heating to 550° F for higher temperatures beyond is included, then 51% of IPH can be reached by solar.

Because solar can reach such a large portion of total IPH applications, it has been possible for the U.S. Department of Energy (DOE) to fund, or at least observe, installations in many applications. Solar is at work helping to dry lumber, sterilize gauze, dry onions and pasteurize beer--along with many other applications.

III. INDUSTRY ATTITUDES TOWARD INVESTMENT IN SOLAR

Solar is, in nearly all cases we have seen, a very uneconomic source of energy for IPH. In cases we saw, simple payback (initial cost divided by first year fuel saving) was seldom as low as 10 years and commonly 50 years or more.

In spite of dismal economic performance some companies are installing solar equipment. Why?

General Extrusions, Inc., of Youngstown, Ohio, manufactured and installed a semi-parabolic system designed specially for them. It was to gain experience in what could be a new product line for the company. Extruded aluminum, the company's main product, is a natural structural material for solar panels. Meanwhile, the test installation helps heat solutions for anodizing.

General Mills wishes to move in parallel with the national interest by finding ways to reduce oil consumption. They are also concerned about the price and availability of traditional fuels and therefore, will consider both solar and biomass.

There may be cases in which a highly polluted urban atmosphere could only absorb a new heat source that requires no combustion. We did not, however, encounter any such cases. In Brazil there are limitations of another sort. Plants are often put on a fixed allocation of fuel oil and can expand only through measures that will stretch their energy. Coca-Cola is considering solar for a Brazilian plant to help fuel a production expansion they would otherwise be hard pressed to make.

Most solar IPH installations, whatever the mixture of motivations, have gone forward because of government funding.

Solar Test Installations - Location

Solar IPH test installations, mainly government supported, have almost entirely ignored the great industrial Middle West. A map of solar IPH field tests (Exhibit 2) shows virtually all test installations are below 37° North Latitude, and therefore outside the Middle West. Industry is, of course, heavily concentrated in the Middle West. Some 40% of the manufacturing activity of the 10 most likely solar IPH users is in this area--the 12 states of MASEC. And the area is not exactly devoid of sun as insolation maps will show.

Direct normal daily solar radiation is highest at 26,000 kilojoules per square meter on an annual basis in parts of Arizona and inland California as seen on Exhibit 3. But, a band with 12,000 to 16,000 kilojoules per square meter on an annual basis sweeps up through Florida, the Carolinas and much of Texas, right up into southern Minnesota.

While more sunlight obviously benefits a solar collector, the difference is not nearly enough to make solar IPH economic in the Sun Belt, and not economic elsewhere.

Meanwhile, solar IPH tests will be more persuasive to northern industry if they are run in the north. It is too easy to discount results from the Sun Belt. If solar IPH is to gain any level of importance it must sell in the north, where industry is.

While this section of the report deals with industry's attitude toward solar, there are also attitudes in the other direction which should be considered.

People in the solar field often talk as though promoting solar is an end in itself. Industry is not interested primarily in promoting solar or any other one energy source. Industry is interested in all sources that can help provide required heat, given the problems of price and supply that may lie ahead.

Strangely enough, some of the conditions which appear to benefit solar are at the same time harmful to industry in general. Exhibit 4 lists 10 of these conditions, taken from a very useful analysis by SERI entitled, "Industrial Process Heat Case Studies."

"High and rapidly escalating fuel costs", first on the list, would result in far more damage to industry than solar IPH could possibly mend. Likewise "Uncertainties regarding fuel supplies" may, in some marginal way, encourage solar. However, there are few plants of consequence that could continue to operate if their usual energy sources were cut off. Other such factors and comment on them are found in the exhibit.

IV. INDUSTRY CONCERNS ABOUT SOLAR IPH

Even in the most sunny parts of the country, industry shows almost no willingness to invest in solar for IPH. Why?

The major reason simply is the high cost of heat from solar as opposed to heat from other more traditional sources. Actually, cost is important only when compared with savings in fuel brought about by solar and with the attractiveness of alternative investments. These points are the subject of much of the rest of this report. The important summary list of financial barriers that impede solar investment is in a later section.

Competition for investment capital is intense. Acquired from the outside it carries a high price. Generated internally it must earn a good rate of return or it will move out into the capital market where it can earn high rates.

While rate of return is the prime measure, one chief executive officer said that his capital spending priorities are in this order:

- 1) To stay in business
- 2) To fulfill mandates, such as in safety or pollution control
- 3) To increase production or market share
- 4) To conserve labor, materials or energy and obtain short-term payback on the investment

Industry people were found to have little expectation that solar could offer assistance in any of these four areas.

Productivity is another important objective. For many years when prices were relatively stable, industry could raise

employee compensation by some 3% annually and because of increased productivity still maintain level or even lower labor cost per unit on the average.

Recently, productivity has been at best level, and since 1973 has improved by as much as 3% only once. See Exhibit 5. Employee compensation, of course, has risen far more than productivity has improved. Thus labor cost per unit has increased.

Cost increases and a poor record of productivity both translate into pressure on corporate profits. Since retained profits are a major source of capital for improvements, every period of profit squeeze becomes a period of capital shortage. When capital is short it does not go into projects that offer indifferent rates of return and few contingent benefits.

Maintenance or operating cost is an important consideration in the purchase of any new equipment. Many industrial energy managers have studied solar very carefully, determined to put it to use. Some have decided to use it in a small way to gain experience in spite of poor economics, and particularly in spite of doubts about maintenance cost.

Quaker Oats, for example, was skeptical about available equipment and took pains to design a system especially for its own use. (See Exhibit 6) It continues to work well at a Quaker plant in Jackson, Tennessee, where it supplies about 1% of total energy with an estimated 10-year payback. There are now no plans to extend solar to any other Quaker plant.

Conservation meanwhile, has reduced energy consumption per unit of production by 24% in eight years. Biomass is getting considerable attention since Quaker products generate large amounts of agricultural waste.

Proctor & Gamble went through a similar development exercise on solar, but found no results even close to economic and so have made no solar installation. Their conservation efforts are well-organized and effective. Again, biomass is a significant energy source.

Suspicious about high cost in maintaining solar collector systems may be rooted in their development by some of the most successful space and nuclear laboratories, such as Sandia, NASA and Argonne. Some potential users said they could admire the skills of these high technology laboratories, but wondered if they could build simple systems easy to maintain. For example, state-of-the-art solar collector systems adjust the angle automatically as the sun moves higher and lower by seasons. An elegant solution, though one with added costs both initially and in maintenance. At General Extrusions, however, where the solar installation was largely self-financed, two maintenance men go up on the roof and adjust collectors about once a month during regular inspections.

Before buying any equipment, industry likes to have assurance that it is well designed, tested, easily available and well supported by the manufacturer and service facilities. Dr. John

Haaland of Pillsbury finds that lacking in solar equipment.

"There is a serious deficiency in the infra-structure of that industry. There's a lack of equipment and equipment warranties that back up equipment. There's a difficulty in repairing and maintaining the equipment. That does not provide a high incentive to enter into the solar area."

Another energy manager said he could take solar power seriously when he could find it in Sweets' Plant Engineering Catalog File, a standard reference for readily available equipment.

The financial side of industry's decision-making process on new equipment is found in the next section.

V. INDUSTRY DECISION PROCESSES AND FACTORS

Since the mid-1970's, industry has been investing heavily in new energy equipment. Much of this investment has been to enable plants to shift among several energy sources as protection against shortages or price jolts. Much investment also has gone into energy conservation, and with good results. To pick one example among thousands, an extended program of new equipment and operating methods has enabled a company called TRW to reduce energy consumption in recent years by 26%, even though production increased.

In judging proposed investments that will achieve savings or other objectives, the simplest form of analysis is a calculation of the payback period:

Total cost $\div$ annual saving = Payback period (in years)

Where payback will be quick, this method is often used and is adequate. Here are examples from companies reached during the project:

<u>Type of Firm</u>	<u>Payback Target</u>
Food Products	2 years
Food Products	3 years-might go to 7 or 8 for solar
Chemicals	3 years-but installed solar for tests
Meats	2 years-varies
Transportation	1 year
Average of 8 large firms in Northeast Ohio	3 years

Simple payback is not adequate to judge the relative merit of various investment options where the benefits develop over a longer period of years. For this, companies now very commonly use discounted cash flow. Under this approach, the outflow of funds to buy a piece of equipment is compared with the stream of earnings or savings that will result over a long period of years. Everything is reduced to a common measure-- the present value.

To understand discounted cash flow, it is necessary to remember that money promised for future delivery is worth less than money in hand. Interest, not inflation, is the reason. If a company had now, that dollar it expects to get next year, interest could be earned on it in the intervening period. Since the company doesn't get that dollar until next year, its present value is less than a dollar, by the amount it would earn.

Exhibit 7 shows what future dollars are worth if reduced to present value when the discount rate or expected earnings rate is 15%. For example, a dollar received 10 years in the future is worth only 25 cents in present value. These present value rates come from standard tables.

In comparing capital projects, a discount rate, or "hurdle rate" is set at a level that enables the company to earn what it believes is an adequate return on capital. Ideally, many projects should exceed the hurdle rate in earnings expectations. Others that fall below the hurdle rate are rejected, or might

in some cases be accepted if they have some other important features such as health, safety or legal reasons.

Exhibit 8 shows a hypothetical capital budget arranged in order of expected return on investment. Projects A, B, C and D, which range from \$1 million to \$4 million of investment each, are likely to be approved because they are expected to earn a return above 20%. If this 20% hurdle rate had been reduced to 12%, Projects E and F would have been accepted and the total capital budget would be \$15 million--\$4 million above the original figure.

Discounted cash flow analysis used to determine potential payback compared with cost, is done in a detailed and systematic way appropriate to the conditions in each company. Provision is made for taxes, special tax credits, subsidy, and any factors which will influence the rate of return.

Preceding the economic analysis there is, of course, a technical design analysis to determine that the project is practical and likely to measure up to expectations.

Effect of Tax Credits in Various States

States in the MASEC Region* have enacted a wide variety of tax provisions to act as incentives to promote solar energy and alternative energy generally. This legislation is often

* The 12-state MASEC Region consists of the following two of the nine groupings in which state statistical data commonly appear:

East North Central - OH, IN, IL, MI, WI
West North Central - MN, IA, MO, ND, SD, NE, KS

a response to public clamor for action and thus is aimed largely at residential users, though industrial applications are usually covered.

Exhibit 9 shows the results of state-by-state contacts made by the study team in early 1981 to determine exactly what state benefits are offered.

In Exhibit 10, credits are shown as they would apply to a theoretical \$100,000 investment in solar IPH equipment. Results show that the states provide a random hodge-podge mixture of credits that reflect no consistent approach to alternative energy.

Highest and lowest tax incentives among the 12 MASEC states are:

<u>Highest</u>	<u>Federal</u>	<u>State</u>	<u>Total</u>
Ohio	\$25,000	\$16,935	\$41,935
Indiana	25,000	12,500	37,500
 <u>Lowest</u>			
Minnesota	25,000	none	25,000
Missouri	25,000	none	25,000
South Dakota	25,000	none	25,000

California is shown on Exhibit 10 for comparison because of its history of using liberal tax incentives to push solar. Its incentives are, in fact, higher than any MASEC state, reaching \$50,000 (including federal) on the sample IPH \$100,000 installation.

After finding what tax provisions apply in each state, efforts were made to find how effective these incentives had been. This proved to be difficult either because states had not planned to follow up on solar credits or because there was simply little experience as yet on these matters. Two states, however, had prepared reports on the effect of solar credits. Neither report, summarized below, showed more than token response from industry.

California

Perhaps because it has the largest and most urgent program of solar benefits, California has the best documented results. A study by the California Energy Commission* shows the results of Solar Tax Credits from 1978, the second year of the new, higher level of solar credits. An earlier program with smaller credits began in 1976.

In 1978 about 17,000 taxpayers claimed solar credit. The California report says: "Although forty states have enacted various incentive programs, California's program has enjoyed the greatest success with respect to actual number of installations."

* Analysis of the California Solar Tax Credit-1978 Returns
Sacramento, California Energy Commission, August 1980.

A review of the report shows that virtually all credits appeared on personal tax returns. Most claims are for pools or spas (including hot tubs) and a great proportion were apparently passive solar installations such as pool covers.

A summary of the returns follows:

1978 California Solar Energy Tax Credits (\$000's)

	<u>Number</u>	<u>Total Cost</u>	<u>Total Credits</u>	<u>% of Cost</u>
Personal	16,801	\$31,410	\$11,156	35.5
Corporation	51	762	225	29.5
	16,852	\$32,172	\$11,381	

A tabulation of claims according to application showed:

Pools (or spas)	65%
Space	11%
Domestic water	11%
Solar electric	2%
Wind	-
Combined systems	<u>11%</u>
Total	100%

Detail on the 51 corporation returns showed that most were filed by construction and real estate firms that can claim credits on newly-built houses containing solar.

Only three returns (with total solar cost of a mere \$71,361) were from manufacturing firms. Probably they were systems for water heating, though the data are not clear. At any rate it is apparent that in spite of available incentives, solar IPH has made no impact on California industry. Test installations financed by the Department of Energy would not show up on this analysis since they would probably not qualify for the California tax credits. Informal questions about recent results turned up no evidence that there is any more solar IPH being installed now than there was in 1979.

Wisconsin

Wisconsin has issued a report* of 1979 results on its alternative energy assistance program which began in 1978. It shows about 300 active solar applications for the year, divided as follows:

Space and domestic hot water	35%
Domestic hot water	29%
Swimming pool	19%
Space heating	17%
	<u>100%</u>

For its whole 1979 program, Wisconsin paid just under half a million dollars in direct refunds or income tax credits. Corporations received in credits some \$89,000 which was 18% of the total. Virtually all of this was for two waste wood systems which are apparently very successful. They cost a total of \$1.1 million and are said to save \$442,000 annually. Another two small corporate systems were used for space heating. No solar thermal IPH appears in the report. Results for 1980 will be available shortly. They are on a par with 1979.

Summary of State Incentive Programs

Tax credits have, so far, been ineffective as a spur to adoption of solar IPH. This is true in California where high credits and various environmental pressures favor solar. It is also true in Wisconsin where conditions are not as favorable.

All the MASEC states (through tax or energy officers) were asked in early 1981 for reports with evidence of solar IPH application. No other reports were available.

* Annual Report for 1979 on the Alternative Energy Income Tax Credit and Direct Refund Program for the State of Wisconsin.
Department of Industry, Labor and Human Relations. Madison, January 1980.

Contacts with energy managers at state manufacturers' associations in California, Ohio and Wisconsin provided no evidence of solar IPH adoptions beyond the subsidized tests or the token number in the printed reports.

California industry has particular problems in environmental requirements and high energy costs that have caused many plants to move out of state. Even so, the Manufacturers Association did not see or expect any significant amount of solar IPH. An exception may be in Kern County where solar is expected to play a part in providing steam for tertiary recovery of heavy crude.

Detail on contacts with various state energy and tax officers is in Appendix A. Note that these contacts deal with positive incentives intended to encourage solar IPH. No examples were found of regulations (zoning, etc.) which act to stifle industrial use of solar.

Detail on some federal programs to assist solar is in Appendix C. Again, no examples were reported of regulations that would tend to hamper solar development.

Total U.S. Solar Market

Contact with state tax, energy and industrial agencies produced the limited data on industrial solar IPH reported above. National market data are also in a report from the U.S. Department of Energy*. It reports collector manufacturing and is issued quite promptly after the end of each six month reporting period. The report is well regarded by solar industry people.

* Solar Collector Manufacturing Activity, Energy Information Administration, U.S. Department of Energy. Issued twice a year.

In the most recent 12 months of data through mid-1980, the report shows that 257,000 square feet of collectors were destined for industrial processing. That was 1½% of the total and included subsidized projects. Data do not show the size of individual projects, but it would take 32 projects similar to the ones reported in Exhibit 11 to equal the year's industrial total.

Pool heating dominates the solar industry according to the report, with 62% of recent 12-month shipments going to that application. Exhibit 17 shows the details.

VI. APPLYING THE ECONOMICS OF SOLAR IPH

In order to explore what uses there are for solar IPH in the Midwest, MASEC set two contractors out to gather up case studies of potential applications. Covering all 12 states of the MASEC region, these contractors found 35 plants where management was sufficiently interested in solar to cooperate in a rather detailed analysis of some possible use.

All 12 of the states were covered. Subject plants were in a variety of industries where temperature, volume, schedule and other characteristics made solar worthy of close study.

Western Reserve Associates received 29 completed case studies for use in its analysis of financial barriers that might impede solar IPH. One group of 20 cases is summarized in Exhibit 11.

If all of these projects went forward, the total cost would be \$6,359,000. That would buy 160,000 square feet of collectors with an average cost of \$39 per square foot.

Together, the solar heat provided by these 20 plants would contribute an estimated 40.5 billion Btu's per year.* At a typical cost figure of \$3 per million Btu's, the estimated total value of fuel saved the first year is \$121,500. How attractive an investment is this?

By simple division, the payback on these 20 projects combined would be: $\$6,359,000 / \$121,500 = 52$ years.

* This figure does not allow for boiler efficiency losses, which would increase the gross saving in fossil fuel. A 70% efficiency factor is used in a later example. It in no way changes conclusions.

No one of the 20 projects rates better than about 30 years, making them all economically unattractive by this method of analysis.

A far better way to compare potential investments is by Discounted Cash Flow. With this method, earnings over the life of a project are estimated for each year. These dollar figures are then each reduced to present value by using a discount factor. The factor is based on the company's objective for internal rate of return. Since all projects are expected to at least achieve this level, it is called the "hurdle rate." If the hurdle rate is 15%, for example, discount factors for five years are: 1.00, .870, .756, .658 and .572. Discount factors for various periods and return rates come from standard references. If the sum of earnings at present value equals the original investment, then the hurdle rate has been met.

Analyses of this sort can be done manually, but more and more companies are doing them with the aid of a computer. The programming is not difficult and it makes it easier to incorporate many "What if?" variations.

The program used in this report is based on the familiar SOLCOST* model, which was used by the Ionic Solar Team, one of MASEC's contractors on obtaining case studies. With the modified program, results could be reduced to one page per project, including several options. Four feasibility projects were selected for analysis. The team determined the cash inflow elements and then made the calculation of the actual internal return rate achieved for comparison with the hurdle rate.

* Maintained by Martin Marietta Corporation of Denver.

Using 15% as a discount hurdle rate, the total net cash inflow over 10 years was computed, including the effect of all applicable state and federal tax incentives. These results are shown on Exhibit 12, Page 1, on the line labeled "Basic - Current Laws." If the hurdle rate had been met, the Combined Total, 10-year sum at present value would be equal to or greater than the system cost. Actually, it is \$132,082, which is 66% of the system cost of \$199,372. Thus the project falls well below the hurdle rate.

In each of the other three cases, the net cash inflow after 15% discount also falls below the system cost. The levels are: 72%, 65% and 64% of the system cost as can be seen on Page 1 of Exhibit 12. With these results there is confirmation of the simple payback calculation which was below usual expectations.

Since rate of return was found to be unsatisfactory under current conditions, consideration turned to additional incentives that might be used to favor solar. Two widely suggested items were chosen:

Proposal A - Additional 25% Federal Investment Tax Credit

Proposal B - Phantom Fuel Credit

Proposal B means that the value of fuel saved by installing solar would continue to be considered as a cost of doing business. It is a way of making a non-cost appear for tax purposes as a real cost. Hence the nickname, "Phantom Fuel."

The effect of each proposal was calculated and reduced to a present value basis after applying all the same factors as before including predicted price increases and taxes. Note that Investment Tax Credit is taken at full value and not diminished over time because it is presumed to be available to the taxpayer in the year of system installation.

Results for the Mid America Dairymen case show the following:

<u>Cash Outflow</u>	<u>Cash Inflow</u>
\$ 199,374	Basic \$ 132,082
	Proposal A 49,843
	Proposal B 28,983
	\$ 210,908

Thus with the application of the two proposed incentives, this project would exceed the rate of return established by the 15% hurdle rate. Exhibit 13 shows these relationships graphically. Exhibit 12, Page 1 shows corresponding relationships for all cases. All would, with the two proposals, come near or above the hurdle rate.

Some additional options appeared on Exhibit 12. They will be described later.

Exhibit 14 shows the complete computer tabulation for one case -- Mid America Dairymen.

Fuel Cost Projections

Estimating future energy costs is an enigma that has blocked many analyses of solar. The study team makes the following points:

- 1) Fossil fuel prices have moved up so sharply since the early 1970's that some effect on solar should already be apparent. Exhibit 15 shows dramatic increases which, for example, carried oil from about 30 cents per million Btu's in 1968 to \$2.20 ten years later. These are figures from the electric power industry.
- 2) Future fuel prices will always be a subject of great speculation. Certainly for the 20 year, or 10 year period over which projections of solar equipment are normally made.
- 3) All price projections that show a high rate of price increase are likely to be in part self-fulfilling, and therefore, are best avoided.
- 4) People in industry speak of using estimated energy price increases of 15% or 17½% or 20% per year, without stating a period to which the rate might apply.
- 5) Prices of fuels interact one with another and with conservation and new energy sources. Such interaction may restrain prices.

In the four case study analyses reported in the text and in Exhibits 12, 13 and 14, the following price forecasts were used:

Fossil energy price increases
20% per year for first 5 years
12% per year for next 5 years

General inflation for costs
such as maintenance

9.3% per year

These rates of increase were acceptable not because the study team believed them (they appear to be high), but because they provide a generally acceptable basis for projection.

Additional Variations

On the second page of Exhibit 12 are results of some further variations in the cost pattern and another tax policy proposal.

There is frequent discussion in the solar industry about mass production of equipment and its possible effect on system cost. For illustration, two case studies were re-computed with original installed cost of the solar equipment reduced by about 50%. Results showed:

	<u>Rate of Return</u>	
	<u>Case 1</u>	<u>Case 2</u>
Full cost	6/10 of 1%	Negative
Reduced by 50%	6.3%	4.3%

It appears that a reduction in system cost by itself would not put these cases into the acceptable range.

Cost of maintenance and insurance of the solar plant appears in the basic computations at 1% annually. (5/10 of 1% for each) This was the rate used by Ionic Solar. Further research showed that the 5/10 of 1% for insurance is reasonable, according to four insurance people to whom the question was presented. They could see no unusual risks in the solar equipment. Maintenance, however, may be much higher than the nominal 5/10 of 1%. Estimates

have gone to as high as 5%, but there is little actual data. Users and equipment manufacturers were reluctant to provide estimates though they indicated that 5/10 of 1% would be low. To gauge the effect of possible higher rates, parallel cases were analyzed at 1% and at 2% for the combined cost of maintenance and insurance. In each case the higher maintenance figure reduced internal rate of return by about two percentage points. (See Exhibit 12, Page 2) Because maintenance is such an unknown, a change in this range would probably not alter a buying decision one way or the other. A change of much greater magnitude might.

Accelerated depreciation is intended to make all capital investment more attractive. Basic computations seen in Exhibit 14 used a normal sum-of-the-years' digits (SOYD) depreciation rate over 10 years.* For comparison, a 5-year SOYD depreciation schedule was used because it is in line with the highly favored 10-year, 5-year, 3-year plan now being considered by Congress and quite likely to go into effect.

Results of using 5-year depreciation are shown for all four case studies on Page 2 of Exhibit 12. The pattern of results may be seen in the summary table here, which refers to one of the cases, American Motors.

	<u>Rate of Return</u>	
	<u>Under present laws</u>	<u>With Proposals A & B</u>
Standard 10-year depreciation	6/10 of 1%	20.6%
Proposed 5-year depreciation	9/10 of 1%	28.7%

* Line 3 of Exhibit 14 shows how this works. The sum of 10+9+8 etc. to +1 is 55. First year depreciation is therefore $10/55$ of initial system cost. $10 \div 55 = .182$. Second year depreciation is $9 \div 55 = .164$, etc. The sum of all ten yearly depreciation factors is 1.000.

Results above show that accelerated depreciation increases the internal rate of return where it is already high (20.6% increases to 28.7% in the example) but does very little if the internal rate of return is low. Thus from a theoretical point of view, fast depreciation would help solar if it were combined with Proposals A (extra investment tax credit) and B (phantom fuel credit). By itself it would do very little.

A very recent analysis of accelerated depreciation in the Wall Street Journal* comes to very similar conclusions. That is, companies or industries that are already profitable and better able to afford investment are benefited by shorter depreciation. For marginally profitable companies it makes very little difference.

Whatever may be the fate of tax proposals to benefit solar alone, sentiment in Congress favors some sort of faster depreciation. It is an issue that will affect all U.S. industry.

Tax Exempt Bonds

Mention should also be made here of financing solar through low-interest, tax exempt bonds. Discussion with an investment banker, as well as county and state financing authorities, indicate that industrial revenue bonds and pollution control bonds could probably be used to cover solar installations. Each case would have to be discussed with those who deal in such financing.

*"Doubtful Benefit: Fast-Depreciation Bills Stir Much Criticism Even at Needy Firms. Many See Only Slight Gain to Low-Profit Concerns that Pay Minimal Taxes." Wall Street Journal. March 9, 1981. Page 1.

For example, in Ohio the sources would include:

Investment Bankers

McDonald & Company
Prescott Ball & Turben

Pollution Control Agencies

Ohio Air Quality Development Authority
Ohio Water Development Authority

Supporting Development Authorities

Various local government agencies
Small Business Administration

By using the tax exempt bonding route, funds may be obtained at interest rates well below the market price. Further, the public agencies that support these programs provide various guarantees that make the bonds attractive to the market.

The effective rate of capital raised this way was around 8% in 1980 and is at about 12% in 1981. Both rates are well below those for the usual sources of funds.

Bonds are generally very limited in their purpose and must be discussed with the issuing authorities.

Tax exempt bonds will make a very small difference in the economic standing of a solar investment. Estimates of return on investment used in this report are for internal rates of return, assuming funds are internally generated. This is in line with usual corporate practice.

If borrowed funds are to be used, the same kind of comparison must be made to determine which capital projects will offer the best return.

Computations of such return on the form shown in Exhibit 14 would be a little different using borrowed funds. Cash outflow would be stretched over the period of the loan, making total present value lower than for a single payment. Interest is a new expense, but is tax deductible. The effect of time payments is to make a measurable improvement in internal rate of return. The same improvement, however, would apply to any other competing proposed projects. Thus for simplicity here and generally in industry, projected return assumes that capital comes from within, rather than from outside sources where repayments are made over several years in the future.

VII. CONCLUSIONS AND RECOMMENDATIONS

It appears possible, as shown in the previous section, to bring the estimated internal rates of return on solar IPH installations up to at least minimum acceptable levels. To do this requires some combination of new tax incentives with the incentives already in place. This is not too surprising since the record already shows that with 75% or more outside financing, some large projects of solar IPH will go ahead. The 50,000 square foot, \$2.9 million installation of USS Chemicals in Haverhill, Ohio (Exhibit 16) now under construction, is an example.

It is, however, the conclusion of this report that it would not be desirable from a policy standpoint, and perhaps not effective on a broad basis to increase greatly the available incentives if limited only to solar.

To summarize the discussion of financial barriers:

Financial Barriers to Solar IPH

- 1) High initial cost when related to savings. Solar IPH is a capital intensive investment and return on that capital is low.
- 2) Uncertainties about maintenance. Though figures on maintenance cost are difficult to pin down, the expectation that it may be high is a barrier to many potential users.
- 3) Limited savings on fuel costs.
- 4) No protection against cut-offs of other fuels. Solar power can only provide a small part of any plant's IPH needs, and so cannot be seen as a full alternative to other fuels.

The financial barriers are sufficiently high that the study team did not find in its contacts any case of an industrial concern that had experience with solar and expected to expand its use. In addition, there were few, if any, without solar experience who expected to make any significant commitment unless financed with a high proportion of outside funds.

While industry people found virtually no incentive to move them toward solar, they continue to work very hard on energy conservation, on redesigning processes to reduce heat requirements and on finding diversity in energy sources. To approach industry with the phrase, "rapid commercialization of solar" as an objective by itself, draws no supportive response. Industry energy managers have little incentive to commercialize solar or any other single energy source. Rather, their objective is to maintain the most available and cost-effective mix of energy that will run their plants.

Because of the financial barriers and the negligible response of industry, the recommendations that follow are divided into negatives and positives.

Negative Recommendations

- 1) No added investment tax credit to favor solar only. Increasing only the solar investment tax credit over its current 25% level would be ineffective in stimulating solar investment; it would tend to distort the flow of capital away from more productive investments.
- 2) No fast depreciation for solar only. The move toward faster depreciation on all industrial investment is encouraged.

- 3) No tax deductible status for the value of fuel displaced by solar. Also known as the phantom fuel credit, it would be extremely difficult to determine and administer.
- 4) Fewer DOE sponsored demonstration projects. Demonstrations have not apparently, been effective in promoting the sale of solar to industry.

On the positive side, the study team provides this list of some things that should be done.

Positive Recommendations

- 1) Encourage conservation. Conservation is the best "alternative energy" right now. It is solar's toughest competition, especially since it's a better use of scarce capital.
- 2) Tax shelter financing. Tax-sheltered funds--the investment of high-tax-rate dollars of high-income individuals may have promise. Proposals for combined fuel-solar heat plants might provide both financial and functional innovations worth encouraging.
- 3) Continue limited support for solar R & D. Developments in solar technology could make it more competitive.
- 4) Design simple systems and standard components. These two steps would make solar more attractive both technically and financially.
- 5) Solar in new plants. New plants should be encouraged to include a small amount of solar; let solar carry a small part of the energy load.
- 6) Multi-fuel strategy. Gas, coal, electricity, and oil should compete with each other as widely as possible, with solar power slowly becoming a part of this competition. A diversity of energy supplies will help guard against shortages or unchecked price increases in any one fuel category.

VIII. RECOMMENDATIONS FOR FURTHER STUDY

While the wide commercial use of solar thermal IPH seems many years off, there are promising areas for the action by the skilled groups now supporting solar. Some examples are:

- 1) Encouraging biomass. Factories such as food products operations that have burnable biomass see the opportunity to get needed energy while at the same time disposing of waste products which would otherwise accumulate. Many are moving ahead with biomass use. Problems of intermittent supply, changing characteristics, storage, location of material compared with place of use, and possible financial barriers remain.
- 2) Solar thermal can be designed into new construction to provide heat to makeup air or feedwater on what should be an acceptable cost basis. Studies could help determine the best equipment and the best way to encourage its use.
- 3) Design work and economic analysis should be done on a multi fuel central heat source using a shifting combustion of traditional fuels, biomass and solar. This would be an independent unit designed to provide heat on an as-needed basis to one plant or several in a small area. Sweden has some interesting precedents.
- 4) Develop and present seminars for MASEC industry with the theme of maintaining a competitive edge through

energy planning and cost control. Solar would play a small part in such seminars. Encouraging the use of solar will be more successful if it is positioned within an overall energy program. Industry people find it difficult to relate to programs that represent solar IPH as the most important element.

IX. NOTES ON METHODOLOGY

Upon receipt of the contract, a work plan was written and discussed with MASEC at a review session called for the purpose of launching the project. This provided an opportunity to discuss with MASEC personnel the background of the project and the status of solar industrial process heat. Frequent exchanges of information were made as the project progressed.

Before further work was launched, a careful time budget was drawn up showing the functions each staff person was expected to accomplish. Parallel to the time budget was an expense budget by function. Both budgets were followed closely.

This project was carried out in a manner typical of marketing assignments. Great emphasis was put on contacts with users of the product, solar IPH, to see why they bought it. Likewise, contacts were made with those who were known to have rejected solar, and the largest group--those who had not accepted or rejected.

Project staff members visited companies in Minneapolis, Cleveland, Chicago, Toledo, Youngstown, Detroit, Milwaukee, St. Louis and Columbus in the MASEC area. Visits were also made in Atlanta and Houston. Numerous telephone contacts were made with other companies that are knowledgeable about solar. In all cases, extensive interviews were held (and reports written) to determine where each organization stands on solar IPH, and what might move it one way or another. A list of these contacts is in Appendix B.

Further, informal contacts were made with the financial officers of eight major companies that operate nationally from headquarters in Northeast Ohio. They provided information on their objective internal rates of return, and on the approval forms used in preparing proposal investments.

The project director attended the Solar Industrial Process Heat Conference in Houston in December, 1980. This proved to be an excellent opportunity to obtain a review of work being done in the field, and to meet a large share of the people who are doing it. It proved to be significant that virtually no industry users or potential users attended.

Contact was made with several equipment manufacturers to estimate the success of their products, their selling methods and their outlook for the business.

A literature search was conducted mainly in the Public Documents collection at the Cleveland Public Library, where, for example, a large number of SERI publications were identified. Many publications were borrowed or acquired. A subscription to Solar Age was obtained early in the project and each issue was reviewed as it arrived. Further contact was made with other publication editors and with trade associations.

Data on tax incentive programs were available in printed sources, but these were not sufficiently detailed nor up-to-date for purposes of this work. Therefore, telephone discussions were held with each tax department in the 12 MASEC states and California.

It was necessary to obtain the best available measure of market size and major market sectors. This proved to be available in a USDOE report issued twice a year showing collector shipments. Among the individual states, reports from California and Wisconsin were the only ones found that related the degree of solar IPH usage through records of tax incentive usage.

While the major effort was to gather information and distill it into a point of view, a parallel effort was to create the visual material for the video tape summary report also required by the contract.

Filming was done at many sites, including stills and motion pictures. Special art was created and a script prepared. Studio footage was taped at Cleveland State University. Finally all these elements were brought together in an edited tape made at the CSU facility. The tape is 3/4" on a UCA 30 Video-cassette. It runs about 28 minutes.

The written report was drafted in the same general order and with the same conclusions as the tape, but with the addition of much other material as required by the contract.

The project was carried out by the following team: Baird Tenney was Project Director. Others making significant contributions were John Brandt, Joseph Chadbourne, Wendell Johnson, Jagannndham Kottha, Aerielle Reyne, Marjorie Reedy, Keith Richards, Mary Roberts, Roberta Schnell, Neil Somos, Dr. Helen Tien (CSU) and Sheldon Thorpe..

MASEC staff provided considerable assistance from the beginning of the project. Comments and suggestions from Carl Glewwe and Janet Adams were particularly valuable in making revisions on the report draft.

EXHIBITS

Temperature Distribution of IPH Energy Consumption

SOLAR IPH FIELD TESTS

● Locations as reported July 1980

EXHIBIT 3

FACTORS FAVORING SOLAR IPH WHICH ARE
DAMAGING TO INDUSTRY GENERALLY

Factor: High and rapidly escalating fuel costs

Comment: Such price action could severely damage many industries and solar could offer very little offset.

Factor: Uncertainties regarding fuel supplies--such as interruptible natural gas contracts

Comment: If fuel supplies are cut off, the damage to industry could be severe. The interrelationships among industries are such that the few locations where solar might be well used could not work effectively because of shutdowns elsewhere.

Factor: Sufficient capital to finance investments in a solar energy system

Comment: Industry is not looking for capital to finance solar, but rather for capital with which to make a continuous stream of needed improvements. Solar stands in line with everything else, based on the capital return that each item can earn.

Factor: Long payback periods or demand for low rates of return on energy investments

Comment: Same as previous comment

Factor: High federal, state, or local tax incentives for solar investments

Comment: Industry people are skeptical of incentives intended to favor an investment that appears to be otherwise uneconomic. Uniform incentives for all types of industrial investment are attractive.

Factor: Energy-intensive industrial operation and energy costs representing a large fraction of value added

Comment: An energy-intensive operation is the one most vulnerable to energy price increases. The potential damage would generally be far greater than any possible aid from solar.

Factor: All economical energy conservation measures already incorporated

Comment: The economics of energy conservation measures depend on the price of fuels. If fuel prices rise, more conservation measures become economic.

Factor: Cheap land or a strong roof available close to the delivery point of the required energy; salt available at little or no cost, if a salt pond is a solar option.

Comment: The value of land is based on what can be done with it. Each use is rated in terms of the return it would earn. A strong roof makes solar placement easier. If the roof must be build specially, that is part of the cost of solar. We have no information on the price of salt.

Factor: Low labor costs--because solar installations are labor intensive

Comment: May be considered favorable, but probably would favor installation of all new equipment or conservation methods which compete with solar for capital.

Factor: New plant--allowing a solar system to be incorporated from the beginning

Comment: Installing solar in new construction to take a small part of energy load may be the best way to put solar into use in the near future.

Source: Factors from Industrial Process Heat Case Studies, SERI publication TR 323, May 1980. Comment from Western Reserve Associates.

Solar IPH Unit at Quaker Oats
Installed February 1980, Jackson TN
1000 Square Feet of Collector

MASEC STATE TAX INCENTIVES
SOLAR IPH INSTALLATIONS

STATE	INCOME TAX	FRANCHISE-BUSINESS ACTIVITY TAXES	PROPERTY TAX	SALES TAX
Illinois	-	-	Exemption	-
Indiana	25% credit of total cost. Max. of \$10,000	-	Exemption	-
Iowa	-	-	Exemption	-
Kansas	Lesser credit of 30% of total cost. \$4500 or year's tax bill	-	Exemption	-
Michigan	-----First year credit against Single Tax Business Tax base -----		Exemption	Exemption
Minnesota	-	-	-	-
Missouri	-	-	-	-
Nebraska	-	-	-	Rebate of tax on purchases
North Dakota	5% credit of total cost per year for two years	-	Exemption-5 yrs.	-
Ohio	---10% credit of actual cost---		Exemption through 1985	Exemption through 1985
South Dakota	-	-	-	-
Wisconsin*	-	-	Exemption through 1985	-
California	25% credit of total cost- no maximum	-	May now be ex- empt.	-

*Wisconsin also has a grant rebate program which would
provide \$10,000 on a \$100,000 solar IPH investment.

Source: Western Reserve Associates

SOLAR IPH INVESTMENT CREDIT SUMMARY
INDUSTRIAL APPLICATIONS
\$100,000 SYSTEM INSTALLATION

MASEC STATES	Maximum Federal Income Tax Credit	MAXIMUM STATE INCENTIVES				Combined Federal & State
		Income Taxes	Franchise & Business Activity Taxes	Property Taxes First Year	Sales Taxes	
Illinois	\$ 25,000	\$ -	\$ -	\$ 2,000	\$ -	\$ 27,000
Indiana	25,000	10,000 (Max.)	-	2,500	-	37,500
Iowa	25,000	-	-	2,200	-	27,200
Kansas	25,000	4,500	-	2,700	-	32,200
Michigan	25,000	←- 2,350 -→		2,650	4,000	34,000
Minnesota	25,000	-	-	-	-	25,000
Missouri	25,000	-	-	-	-	25,000
Nebraska	25,000	-	-	-	3,000	28,000
North Dakota	25,000	10,000	-	1,200	-	36,200
Ohio	25,000	←- 10,000 -→		1,435	5,500	41,935
South Dakota	25,000	-	-	-	-	25,000
Wisconsin	25,000	10,000*	-	1,900	-	36,900
California	25,000	25,000	-	-	-	50,000

*This is a grant rebate

Source: Western Reserve Associates

TWENTY CASE STUDIES
 SOLAR INDUSTRIAL PROCESS HEAT
 PROPOSED SYSTEMS

	<u>TOTAL SYSTEM COST</u>	<u>COLLECTOR SIZE SQ. FEET</u>	<u>SOLAR CONTRIBUTION BILLION BTU/YEAR</u>
American Can Company Pevely, Missouri	\$467,600	11,200	2.31
Armour Pharmaceutical Co. Kankakee, Illinois	212,520	5,280	1.6
Stokely-Van Camp, Inc. Indianapolis, Indiana	442,400	10,560	3.0
Mid-America Dairymen, Inc. El Dorado Springs, Missouri	567,840	13,440	3.1
Armour Food Company St. Joseph, Missouri	397,750	10,750	2.4
Hallmark, Inc. Leavenworth, Kansas	233,290	5,363	1.7
Vulcan Materials Company Wichita, Kansas	415,800	10,080	2.7
Ford Motor Company Saline, Michigan	282,273	7,013	1.9
Firestone Tire & Rubber Co. Decatur, Illinois	435,960	10,080	2.3
Western Food Products, Inc. So. Hutchinson, Kansas	490,000	11,200	3.0

TWENTY CASE STUDIES (CONT'D)

Page 2

	<u>TOTAL SYSTEM COST</u>	<u>COLLECTOR SIZE SQ. FEET</u>	<u>SOLAR CONTRIBUTION BILLION BTU/YEAR</u>
Marsco Manufacturing Co. Chicago, Illinois	\$ 80,080	2,240	0.4
Borden Company Plymouth, Wisconsin	173,849	4,043	1.1
American Crystal Sugar Co. Moorhead, Minnesota	446,880	13,440	3.1
Dickson Forest Products Sturgis, South Dakota	126,490	3,640	0.8
Pan-O-Gold Baking Co. Fargo, North Dakota	103,040	2,240	0.4
Crystal Tissue Company Middletown, Ohio	176,400	5,040	1.0
American Motors Corp. Kenosha, Wisconsin	411,400	9,680	2.7
CF Industries, Inc. Fremont, Nebraska	332,500	10,640	3.0
Viracon, Inc. Owatonna, Minnesota	142,725	3,300	0.9
Ralston Purina Company Iowa Falls, Iowa	420,420	10,780	3.1
	<u>\$6,359,217</u>	<u>160,009</u>	<u>40.51</u>

Source: Case studies prepared by Industrial Solar Associates of Florissant, Missouri under contract to MASEC.

SUMMARY DATE - DISCOUNTED CASH FLOW
FOUR SOLAR IPH CASE STUDIES
UNDER CURRENT LAWS & WITH VARIOUS PROPOSALS

	<u>Mid-America Dairymen Nebraska</u>	<u>American Motors Wisconsin</u>	<u>American Crystal Sugar Minnesota</u>	<u>Swift & Company Indiana</u>
Type	Line Focus	Evac. Tube	Flat Plate	Flat Plate
Area - Square Feet	3,948	9,680	13,440	10,320
System Cost	\$ 199,374	\$ 411,400	\$ 446,880	\$ 495,000
Cost/Sq. Ft.	\$ 50	\$ 42	\$ 33	\$ 48
1st Year Fuel Saving	\$ 6,085	\$ 8,100	\$ 9,300	\$ 10,059
Payback-Years				
Cost/1st Yr. Savings	\$ 33	\$ 51	\$ 48	\$ 49

TEN YEAR PROJECTIONS

NET CASH INFLOW AFTER 15% DISCOUNTING

Basic - Current Laws	\$ 132,082	\$ 300,157	\$ 292,274	\$ 318,502
Percent to System Cost	(66%)	(72%)	(65%)	(64%)
Proposal A-Extra ITC-25%	48,843	102,850	111,720	123,750
Proposal B-Phantom Fuel	<u>28,983</u>	<u>41,506</u>	<u>51,280</u>	<u>49,728</u>
TOTAL	\$ 210,908	\$ 444,513	\$ 455,274	\$ 491,980
Percent to System Cost	(105%)	(108%)	(102%)	(99%)

SUMMARY DATA - DISCOUNTED CASH FLOW
FOUR SOLAR IPH CASE STUDIES
-continued- UNDER CURRENT LAWS & WITH VARIOUS PROPOSALS -continued-

	<u>Mid-America Dairymen Nebraska</u>	<u>American Motors Wisconsin</u>	<u>American Crystal Sugar Minnesota</u>	<u>Swift & Company Indiana</u>
<u>Calculated rates of return on total system cost</u>				
<u>Basic - Current Laws</u>				
System Cost - Full	3/10 of 1%	6/10 of 1%	Negative	Negative
" - 50%	7.7%	6.3%	4.0%	4.3%
<u>Basic Plus Proposals A & B</u>				
With maintenance/ insurance --1%	18.1%	20.6%	16.1%	14.6%
" --2%	16.2%	18.5%	14.4%	12.5%
<u>Five Year* Depreciation Effects</u>				
<u>& Full System Cost, Maintenance/ Insurance @ 1%</u>				
Basic - Current Laws	4/10 of 1%	9/10 of 1%	Negative	Negative
Basic + Proposals A&B	22.8%	28.7%	21.8%	19.6%

*All other results based on 10 year depreciation

SOURCE: Case study data -- American Motors, American Crystal Sugar from Industrial Solar Associates. Mid-America Dairymen and Swift & Company from Ionic Solar Team. Original format from Ionic Solar Team and WRA. Based on SOLCOST.

**PRESENT VALUE COMPARISON
AT 15% DISCOUNT RATE
MID-AMERICA DAIRYMEN**

SOURCE: DATA FROM IONIC SOLAR TEAM. ANALYSIS BY WRA.

DISCOUNTED CASH FLOW ANALYSIS
CASE STUDY-PROPOSED SOLAR HEAT INSTALLATION
INCLUDING EFFECTS OF CERTAIN TAX POLICY OPTIONS

COMPANY: <u>Mid-America Dairymen Inc. - Nebraska</u>												
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Combined Total
1. Fuel Savings	\$ 0	\$ 6,085	\$ 7,302	\$ 8,762	\$10,515	\$12,618	\$14,132	\$15,828	\$17,727	\$19,854	\$22,237	\$135,061
2. Maintenance & Insurance	0	1,994	2,179	2,382	2,603	2,845	3,110	3,399	3,715	4,061	4,439	30,728
3. Depreciation - SOYD %	0.000	0.182	0.164	0.145	0.127	0.109	0.091	0.073	0.055	0.036	0.018	1.000
\$	0	36,286	32,697	28,909	25,320	21,732	18,143	14,554	10,965	7,177	3,589	199,372
4. Pre-Tax Book Profit or Loss	0	32,194	27,574	22,528	17,409	11,959	7,121	2,126	(3,046)	(8,616)	(14,210)	95,039
5. Benefit from Tax Savings												
a. Federal	0	14,809	12,684	10,363	8,008	5,501	3,276	978	(1,401)	(3,963)	(6,536)	43,718
b. State	0	1,320	1,131	924	714	490	292	87	(125)	(353)	(583)	3,897
6. Investment Tax Credit (or equivalent)												
a. Federal	49,843											49,843
b. State	0											0
7. Net Cash Inflow Equals Line 1 + 5 + 6 - Line 2	49,843	20,221	18,938	17,667	16,633	15,764	14,590	13,493	12,486	11,477	10,679	201,791
8. a. Present Value Factor	1.000	0.870	0.756	0.658	0.572	0.497	0.432	0.376	0.327	0.284	0.247	0.000
b. \$	49,843	17,592	14,317	11,625	9,514	7,835	6,303	5,074	4,083	3,259	2,638	132,082

Line 8b shows combined present values (\$132,082), equal to 66 % of system initial cost.

EFFECT OF TAX POLICY OPTIONS

9. Extra Federal ITC of 25%	49,843											49,843
10. Solar Fuel Tax Benefit												
a. at 50.1%	0	3,049	3,658	4,390	5,268	6,322	7,080	7,930	8,881	9,947	11,141	0
b. Present Value	0	2,652	2,766	2,889	3,013	3,142	3,059	2,982	2,904	2,825	2,752	28,983
11. Combined Present Value												

VALUES USED IN THIS ANALYSIS

\$199,372	Total Initial Cost of System	25%	Federal Investment Tax Credit
\$ 6,085	Fuel Savings First Year	0	State Investment Tax Credit
	Inflation Rate: 20% First 5 yrs.	0	State Investment Tax Limit
	12% Second 5 yrs.	15%	Discount Rate
1.0%	Maintenance & Insurance Cost	25%	Extra Federal ITC
9.3%	Yearly Inflation Rate	50.1%	Solar Fuel Saving Tax Benefit
46.0%	Federal Tax Benefit		
4.1%	State Income Tax Benefit		

WHILE FUEL COSTS SHOT UP, STARTING IN 1970.....

Cents per
million BTU

SOURCE: U.S. Department of Energy, 1978; Conventional Fossil-Fueled Steam Electric Plants. U.S. weighted average.

USS CHEMICALS SOLAR IPH INSTALLATION AT HAVERHILL, OHIO
(under construction)

SOLAR COLLECTOR MANUFACTURE
BY END USE 1979 - 80
THOUSANDS OF SQUARE FEET

<u>APPLICATION</u>	<u>First Half 1980</u>	<u>Second Half 1979</u>	<u>Total 12 Months</u>	<u>First Hal 1979</u>
Pool Heating	6,069	4,018	10,087	4,533
Hot Water	1,576	1,723	3,299	1,235
Space Heating	786	911	1,697	811
Space Cooling	91	115	206	117
Industrial Processing	159	98	257	135
Agricultural Processing	24	118	142	45
Other	<u>125</u>	<u>368</u>	<u>493</u>	<u>25</u>
Total Reported	8,829	7,350	16,179	6,901

Note: Sum of components may not equal total because of independent rounding.

SOURCE: SOLAR COLLECTOR MANUFACTURING ACTIVITY, January thru June, 1980;
U. S. Department of Energy; DOE/EIA - 0174 (80/1)

NOTES & SOURCES ON EXHIBITS

EXHIBIT NO.

- 1 Putting the Sun to Work in Industry, SERI/SP-34-175R. Golden CO: Solar Energy Research Institute.
- 2 Same as Exhibit 1
- 3 Hooker, Douglas W.; May, E. Kenneth; West, Ronald E.; 1980. Industrial Process Heat Case Studies. SERI/TR-733-323. Golden CO; Solar Energy Research Institute, APPENDIX C -- Exhibit shows average daily direct normal solar radiation on an annual basis in kilojoules per square meter. The following conversion from p.99 of same source as shown above for Exhibit 3:

$\text{kJ/m}^2\text{-dy}$	kWh/m^2	$\text{Btu/ft}^2\text{-dy}$
26,000	7.2	2,290
10,000	2.8	881
- 4 Same source as Exhibit 3, p.77.
- 5 Economic Indicators; Supplement 1980. 1967=100. U.S. Dept. of Commerce. Figures for 1978, 1979, 1980 are slightly different in various versions of this series.
- 6 Photo from Quaker Oats Co. Solar plant designed especially for plant in Jackson, Tennessee. Full size. The highest point of collectors is about seven feet from the ground.
- 7 Present value of \$1 at a large range of discount rates available from standard tables. Some other rates for 10th year are:

1%	\$.905
5	.614
10	.386
20	.162
32	.062
- 8 Weston, J. Fred; Brigham, Eugene F. 1969. Managerial Finance. 3rd Edition. New York: Holt, Rinehart & Winston, Page 173.
- 9 Derived from various printed materials on tax incentives and telephone contact by WRA with each tax state department.

EXHIBIT NO.

- 10 Same as Exhibit 9
- 11 Cases prepared by Industrial Solar Associates of Florissant, MO. under contract to MASEC, 1980.
- 12 Prepared by WRA from data in the four case studies provided by MASEC.
- 13 From data in Exhibit 12.
- 14 Complete computerized data of case. Prepared by General Systems, Inc.
- 15 Weighted US average cost of fuel paid by Steam Electric Utilities. From U.S. Department of Energy. "Cost & Quality of Fuels for Electric Utility Plants -- 1978 and earlier editions.
- 16 USS Chemicals solar installation at one corner of their Haverhill, Ohio plant. 50,000 square feet of line forms collectors. Drawing provided by Columbia Gas. Cost shares:
US DOE	75%
USS Chemicals	12½%
Columbia Gas	12½%
- 17 Solar Collector Manufacturing Activity, January through June, 1980. US Department of Energy, DOE/EIA-0124(80/1), October, 1980.

This periodic report is well regarded in the industry. Data are adjusted for non-respondents. Results are published remarkably soon after the close of the period covered.

APPENDIXES

STATE TAX PROVISIONS ON SOLAR IPH

The contract calls for a comprehensive listing of state tax provisions that either assist or impede solar industrial process heat in the MASEC region.

Direct contact was made with tax departments in each of the 12 states. Information obtained was used to supplement the various printed summaries that are available. National Solar Heating and Cooling Information Center has a series which was very helpful, as was the MASEC booklet, "Programmatic and Financial Solar Incentives."

Results of the tax incentive analysis were summarized in Exhibits 12 & 13, which are part of the main report. This appendix includes notes from conversations with each state to confirm details and check for any new information not yet published.

PROJECT 017 - MASEC
Field Call notes - 1/9/81

Illinois Dept. of Revenue
325 W. Adams
Springfield, IL 62706
David Fraser 217-782-6330

Since 1975 Illinois law has provided an "exemption" from Illinois property tax for solar energy systems. This is applicable to industrial IPH installations according to D. Fraser. David Fraser estimated an average annual tax avoidance value of about \$2000 (2%) would apply to a new \$100,000 solar system.

Mr. Fraser was unaware of any data surveys which had been made of industrial or other solar installations since 1975 in Illinois.

Illinois has no other state tax incentives for solar energy system installations.

PROJECT 017 - MASEC
Field Call Notes - 1/9/81

Indiana Dept. of Revenue
202 State Office Bldg.
Indianapolis, IN 46204

Beth Dawson - Income Tax	317-232-2240
Wayne Pruitt - Property Tax	317-232-3775

Since 1974, Indiana has exempted solar energy systems (residential and industrial) from its property tax. For a new \$100,000 industrial IPH solar system, the average Iowa Exemption would be worth about \$2500 per year or 2½%.

In 1980, a new state income tax credit was created which covers industrial IPH solar systems. For industrial building the credit equals 25% of expenditures to a maximum of \$10,000. Credit exceeding tax liability may be carried forward until exhausted. Expenditures must be made by 12/31/82.

No data surveys have been made of industrial installations so far.

Indiana levies a 3% tax on adjusted corporate gross income and another 3% for its Supplemental Corporate Net Income Tax. Gross sales and some other receipts are also subject to a Corporate Gross Income Tax ranging from .3375% to 1.35%.

PROJECT 017 - MASEC
Field Call Notes - 1/9/81

Iowa Dept. of Revenue

Larry Ormel - Property Tax Division 515-286-3018

William Thompson - Energy Policy Council 515-281-6485

Iowa (for 1979-1985) provides an exemption from property tax for installations of solar energy systems. This exemption is applicable to industrial as well as residential. At the average Iowa effective tax rate of 2.2% a \$100,000 new solar installation would avoid Iowa property taxes of about \$2,200 per year for five years.

Mr. Thompson was unaware of any data surveys about actual solar industrial installations or tax claims.

PROJECT 017 - MASEC
Field Call Notes - 1/9/81

Kansas State Department of Revenue

P.O. Box 692

Topeka, Kansas 66601

Steve Montgomery - Income tax

913-296-3909

Robert Badnock - Property tax

913-296-2365

1980 law changes were made in both tax areas according to Steve Montgomery who will be sending a copy of revised statutes. The revised sales tax credits are:

1) A solar energy installation on business property now receives a credit equal to 30% of the system's cost, \$4500, or that year's income tax bill, whichever is the least amount. This applies to active or passive systems including solar IPH.

2) New active residential and industrial solar systems now qualify for 100% property tax exemption. The \$100,000 system example would have property tax avoidance of about \$2700 or 2.7%. Interestingly, the prior law (35% reimbursement if the solar system supplied 70% of energy for heating and cooling) was liberalized considerably since Kansas had only 25 applications for solar reimbursements in 1977-1979.

Project 017 - MASEC
Field Call Notes - 1/13/81

Michigan Dept. of Treasury
State Tax Commission
State Capitol Building
Lansing, Mich. 48922

James Massa, Special Property Appraiser 517-373-0500

Thomas Hoatlin, Administrator, Single Business Tax-517/373/2856

Since 1976, Michigan has provided three tax incentives for industrial solar IPH installations. These are:

1. Exemption for real and personal property tax. On a \$100,000 installation; tax avoidance equals about \$2650 or 2.65%.
2. Exemption from excise-sales tax. At 4%, this is worth \$4000 on a \$100,000 solar system cost.
3. Basic investment credit against the Single Business Tax (combination of prior income and business activities taxes). A \$100,000 installation cost in the first year would be worth 2.35% or \$2350. In subsequent years, annual depreciation of this new asset would require an equal addition to the company's tax base and attract the 2.35% tax on these additions. Note: This first year credit applies to all business additions; not just solar.

Mr. Massa, who reviews all solar credit applications could find no industrial applications in his files for 1978, 1979 or 1980. In 1980 all tax credit applications were residential. In 1978 only four commercial applications were made among the total number of applications. Note: From our GM contacts, we do know of one flat plate installation at GMI in Flint.

Note: These credits and exemptions are effective through 1984.

PROJECT 017 - MASEC
Field Call Notes - 1/9/81

Minnesota Energy Agency
980 American Center Building
150 E. Kellogg Blvd.
St. Paul, Minn.

Ms. Joene Wawaluk 612-296-5120

Income tax credits and property tax exemptions apply only to residential solar installations. Industrial solar installations get no tax relief.

Corporate income tax rate is 12% of reported Federal adjusted income which is further adjusted by 20 different additions & credits per Minnesota laws.

Project 017 - MASEC
Field Call Notes - 1/14/81

Missouri Dept. of Revenue
Corporate Tax Section
P.O. Box 700
Jefferson City, MO 65105
Denny Hodges, Corporate Auditor 314-751-4541

Missouri currently has no positive tax incentives for any alternate energy system. Also, Mr. Hodges indicates no such energy incentive programs are being discussed in the Legislature.

In fact, federal investment tax credits for solar increase Missouri income taxes since the Missouri credit for federal taxes paid is reduced by solar ITC thereby causing Missouri income taxes to be higher than if no federal credit was given.

PROJECT 017 - MASEC
Field Call Notes - 1/9/81

Nebraska State Dept. of Revenue
301 Centennial Mall South -
Lincoln, Nebraska 68509
402-471-2971
Dale Carter

Nebraska provides a sales tax rebate to residential and industrial purchasers of solar alternate energy systems. This rebate will apply to 1980-1983 installations. The base state sales tax rate is 3%. Seven cities also have an extra 1% sales tax.

Dale Carter indicates the proposed real estate tax exemption was not approved in the November 1980 election.

Nebraska's corporate income tax rate is:

3.75% of first \$25,000 of pre-tax income

4.125% over \$25,000 of pre-tax income

PROJECT 017 - MASEC
Field Call Notes-1/9/81

North Dakota State Tax Commission
Income Tax Division
Capitol Building
Bismarck, N.D. 58505
Don Yasely - Income Tax 701-224-3450
Barry Hasty - Property Tax 701-224-2770

The law provides an income tax credit (corporate or individual) for solar energy devices (including IPH). The credit is 5% per year for two years or 10% in total.

Solar heating systems in any building are exempt from the property tax for five years after installation (including IPH). For a \$100,000 system cost, the annual exemption is worth about \$1200.

Mr. Yasely said the Legislature is considering a liberalization of the income tax credit to 10% per year for three years.

Project 017 - MASEC
Field Call Notes - 1/16/81

Ohio Dept. of Energy
30 E. Broad Street
Columbus, 43215

Ohio Dept. of Taxation
1030 Freeway Drive
Columbus, 43229

Eunice Stang, Dept. of Energy (800) 282-9234

Donald Swepston, Tax Dept. (614) 466-6750

Ohio has three tax benefits for a new solar IPH industrial installation. Assuming such a \$100,000 installation; these benefits include:

- 1) Corporate Franchise - income tax credit (\$10,000)
10% of cost up to corporate tax liability for first year
There is no carry-over of any excess to future years
- 2) Real Estate Exemption (\$1,435 average per year)
This type of new property is exempted through 12/31/85 from Ohio's property tax. The average Ohio county millage of \$41.00 x 35% assessment level (industry and residential) equals 1.435% of cost effective rate.
- 3) Sales Tax Exemption (\$5500)
Both sales of materials for solar systems and sales of complete solar systems are exempt from Ohio's sales tax. At the January-June 1981 State rate of 5.5%, this avoids \$5500 in tax. This exemption is worth a greater amount in counties where an extra levy exists.

While no surveys exist of industrial installations so far, Mrs. Stang did mention the General Extrusion system at Youngstown as a previously approved tax credit.

PROJECT 017 - MASEC
Field Call Notes-1/9/81

South Dakota Dept. of Revenue
Capitol Lake Plaza
Pierre, S. D. 57501
Dennis Hanson - 605/773-3311

South Dakota's property tax credits for solar installations are not applicable to IPH applications. Mr. Hanson said S.Dakota's present law covers only space cooling and heating for residential, commercial and industrial buildings.

PROJECT 017 - MASEC
Field Call Notes - 1/12/81

Wisconsin Dept. of Industry, Labor & Human Relations
201 East Washington
Rm. 101, Safety & Buildings Division
Madison, Wisconsin 53702
William Dosch, Staff Engineer 608-266-1149
Leslie Gaubertier, Dept. of Revenues 608-267-7788

W. Dosch confirmed that new solar IPH would be covered by the new Wisconsin statute and would receive the 10% (of the first \$1,000,000) rebate plus property tax exemption through 1995. So far in 1980 he has processed only one small farm crop drying IPH application. He will send me a copy of their 1980 activity report which covers all alternate energy functions.

Ms. Gaubertier indicated the latest year average effective property tax rate was 1.9% of cost. Accordingly, one year's exemption would be worth \$1900 on a solar IPH installation costing \$100,000.

Wisconsin's corporate income tax rate is 7.9% of reported Federal income over \$6,000.

PROJECT 017 - MASEC
Field Call Notes - 3/14/81

California Energy Commission
Sacramento, CA

William Woods, Fuel Assessment Office 916-920-7737
Solarcal Council, Sacramento 916-920-7621
San Diego Gas & Electric Co.
San Diego, CA

Carl Lower, Planning Manager 714-425-3060

- 1) Solar IPH installations with a cost in excess of \$12,000 can receive a 25% state incentive tax credit. Such commercial or industrial installation also may qualify for a maximum federal incentive tax credit of 25%, for a combined state and federal tax credit of 50% of the solar system cost.
- 2) For residential solar installations, the combined federal and state incentive tax credit is 55% of the system cost up to a maximum credit of \$3,000.
- 3) California also has developed other incentives to favor increased solar applications such as low interest loans by utility companies and administered pricing of natural gas vs equivalent crude oil costs per BTU. We did not research these other items in depth because of their complexity, and because California is not a MASEC state.

LIST OF PARTICIPATING ORGANIZATIONS

The consulting group wishes to thank the following industrial and other organizations who contributed to this project. Visits or telephone calls were made to each of these organizations, with multiple contacts in several cases. The assistance of these organizations is greatly appreciated. Responsibility for any misinterpretation of their views rests with the study team.

Abitibi-Price Corp.
Birmingham MI

Gold Bond Building Products
Kalamazoo MI

American Motors Corp.
Detroit MI

Hallmark Cards
Kansas City MO

Anheuser-Busch Companies
St. Louis MO

Houston Lighting & Power Co.
Houston TX

Borden, Inc.
Columbus OH

Industrial Solar Associates
Florissant MO

California Manufacturers
Association
Sacramento CA

Jos. Schlitz Brewing Company
Milwaukee WI

The Coca-Cola Company
Atlanta GA

Kinetico, Inc.
Newbury OH

Columbia Gas System
Columbus OH

Libby-Owens-Ford Co.
Toledo OH

Dow Chemical Corp.
Midland MI

Marsco Manufacturing Co.
Chicago IL

Ford Aerospace & Communi-
cations
Detroit MI

Masonite Corp.
Chicago IL

Ford Motor Company
Dearborn MI

McDonald & Company
Cleveland OH

General Mills, Inc.
Minneapolis MN

Miller Brewing Company
Milwaukee WI

General Motors
Detroit MI

NASA-Lewis Research Center
Cleveland OH

General Solar Systems Div.
General Extrusions, Inc.
Youngstown OH

Northern States Power
Minneapolis MN

Ohio Air Quality Development
Authority
Columbus OH

Participating Organizations

Ohio Manufacturers Association Columbus OH	TRW Equipment-TRW, Inc. Cleveland OH
Oscar Mayer & Company Madison WI	Troy-Miami County Public Library Troy OH
Pabst Brewing Company Milwaukee WI	USS Chemicals, US Steel Pittsburgh PA
Pepsi-Cola/Seven-Up Bottling Company of Springfield Springfield MO	Union Carbide Corp. Parma Technical Center Parma OH
Pet Incorporated St. Louis MO	Universal Foods Corp. Milwaukee WI
Pillsbury Company Minneapolis MN	Youngstown Steel Door Co. Youngstown OH
Pillsbury Co./Green Giant LeSueur MN	
Proctor & Gamble Co. Engineering Division Cincinnati OH	
The Quaker Oats Company Chicago IL	
Ralston Purina Company St. Louis MO	
Research Products Corp. Madison WI	
Reuther Mold & Mfg. Co. Cuyahoga Falls OH	
ROM-AIRE Solar Corporation Avon Lake OH	
The Stouffer Corp. Solon OH	
TRW Energy Systems Group Redondo Beach CA	

FEDERAL ASSISTANCE AND LOAN PROGRAMS
WITH POSSIBLE APPLICATION
TO SOLAR INDUSTRIAL PROCESS HEAT

The following outline contains brief descriptions of present Federal assistance and loan programs for various types of solar-alternate energy activities. These programs are described in greater detail in a booklet, Programmatic and Financial Solar Incentives, published by MASEC in August, 1980.

This review indicates that not many of these financial assistance programs would be readily available for solar IPH user applications. Federal tax incentives are the main support for solar IPH.

Some additional potential funding sources are available to firms producing, selling, and servicing solar installations under the Alternate Fuels Cooperative Agreements and under SBA Energy Loans.

1. URBAN DEVELOPMENT ACTION GRANT PROGRAM (UDAG)

- A. Purpose - Private developments creating new jobs and additions to community tax base in "distressed cities, urban counties, and other communities."
- B. Limits - No limits to grant size.
- C. Private capital must be at least \$2.50 vs each UDAG dollar.
- D. UDAG grants cannot be used for working capital.
- E. Quarterly "biddings" by cities in January, April, July and October.
- F. Key screening criteria -- Number of new permanent jobs for low income and minority persons.

-- Tax revenue to distressed city.

- G. Alternate energy projects may qualify if they conserve and displace scarce fuels.

2. ALTERNATIVE FUELS FEASIBILITY STUDIES AND COOPERATIVE AGREEMENTS

- A. Energy Security Reserve of \$19 billion created to stimulate domestic commercial production of alternative fuel.
- B. FY 80 - \$2.2 billion available to DOE previously.
- C. P.L. 96-304 - provided \$100 million for project development feasibility studies with \$10 million maximum for each award.
- D. \$200 million for commercial scale development of facilities (\$25 million maximum for each award)
- E. Cooperative agreements funded to move projects from feasibility studies to actual production stage.

3. APPROPRIATE ENERGY TECHNOLOGY PROGRAM

- A. For development of ideas, devices and system demonstrations.
- B. Small-scale energy technology appropriate to local needs and skills.
- C. FY 80 fund of \$12 million. Maximum per client \$10-25,000.

4. SMALL AND/OR DISADVANTAGED BUSINESS UNSOLICITED PROPOSALS
 - A. For investigations of various "worthy" purposes.
 - B. DOE has set aside \$300,000 for FY 81.
5. U.S. DEPARTMENT OF AGRICULTURE
 - A. Farm Facility Loans - up to \$50,000. May include solar grain dryers.
 - B. Business and Industrial Loans - to create and maintain rural employment. May include solar retrofit.
6. SMALL BUSINESS ENERGY LOANS
 - A. SBA program to help small businesses to enter, continue or expand in manufacturing, selling, installing, and servicing specific energy measures. Includes active and passive solar thermal equipment.
 - B. Maximum permitted - \$350,000 for direct loan and \$500,000 for 90% SBA guarantee loan from private loan institution.
7. SOLAR ENERGY & CONSERVATION BANK
 - A. P.L. 96-294 effective 6/30/80 creates Bank under HUD.
 - B. Assistance for solar and conservation improvements in residential, commercial, and agricultural buildings. Not industrial.
 - C. Bank delivers "up front" lump sum payments to lenders who will pass on the subsidy to borrowers. Bank option to reduce interest and principal of the loan.
 - D. Final regulations due out by March 27, 1981.
 - E. No Federal Energy Tax Credits claimable on system cost portion financed by this type of loan.
8. SOLAR ENERGY BANK
 - A. Subsidy provided for active or passive solar including wind for single or multi-family housing. Limit \$5,000 or less per unit.
 - B. Subsidy for agricultural and commercial buildings - 40% of solar system cost up to \$100,000.
 - C. No subsidies available to buildings used in the manufacture of agricultural products as opposed to buildings on a farm used for crop drying.
 - D. Does not appear applicable to industrial IPH.
9. FEDERAL TAX INCENTIVES
 - A. Residential tax credits can go as high as \$4,000 (40% of \$10,000) for eligible renewable energy equipment such as solar or wind.
 - B. Business credits are:
 - 15% of expenditure up to 100% of Federal tax liability. Covers active, not passive solar.
 - 10% of expenditure as regular Investment Tax Credit.

C. These two items are the main direct supports for solar IPH.

SOURCE: Programmatic and Financial Solar Incentives. MASEC R-80-001/R3.
Minneapolis: Mid-American Solar Energy Center, 8/80.