DOE/CS/30612--T10

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SEIA

MASTER

DOE/CS/30612--T10

DE82 008632

SURVEY AND ANALYZE THE BUSINESS CONDITIONS OF THE
SOLAR INDUSTRY

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TASK I

Report Submitted Under
U.S. Department of Energy
Grant No. DE-FG03-80CS30612

April - May 1981

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TASK ONE:

In accordance with the Task One statement of work, SEIA held a series of regional seminars for the purpose of studying the impact that the Residential Conservation Service (RCS) has had on the market in those regions, its advantages and disadvantages, as well as what benefits can be derived from the program.

The seminars entitled "Making Market Regulations Work For You" covered in addition to the RCS discussions, the rating and certification of solar collectors. The attendees at the session were high quality industry members.

Specifically:

All attendees agreed that the RCS Program, if instrumented properly, on the state level, would be of great value to both the industry and the consumer. There are some fundamental problems with the audit form that need to be corrected, if the RCS Program is to gain wide spread support from the contracting industry.

Presently the contracting industry feels the RCS Program is in poor shape which is why in our summation, the industry has not given the support that SERI and DOE both thought would get. The audit form as it currently exists does not reflect the original intent of the program. With corrections, made, specifically on the cost breakdown detailed in the audit, the amount of energy, the annual cost, and the percent of the total consumer cost, the audit form will be more realistic in its evaluation. With this done, the Program will lend guidance to the consumer in making some preliminary decisions as to what measures they should seek further information on. The audit form should also list available tax credits.

Currently, the contractors, and solar experts in the field feel that the program leaves the utilities the option to either provide customers with a list of certified contractors the customer could contact to perform any work, or to become involved as general contractors themselves.

Audit Form: The tax credit is essential if the customer is going to be able to truly judge the financial impact of taking any of the measures indicated. As previously stated, the current audit form does not allow for tax credit information.

The title of the column which contain the auditors estimates should be clearly marked estimates. The consumer should know that the auditors are not trained to know the exact costs to the consumer for these fuel losses.

In addition, the audit form should clearly state a disclaimer disavowing the audit as a final estimate. The utility companies are not contractors and are not qualified to make job bids and quotations. The audits are not exact enough to be able to be used as bids on any given installation.

The disclaimer ought to have a notice advising the customer that eligibility must be met concerning tax credit eligibility, and advising that a brochure outlining these requirements are available from the utility companies.

Finally, the audit form should have ranges on sizing and performance. You cannot give an absolute value. Systems, sunshine, loads all vary. If the program is to work, the utilities must not engage in the wholesaling and installing of equipment if the industry is to cooperate with RCS.

There were approximately 30 industry members in attendance at the week-long series. All agreed that RCS needed to be pursued, and that more industry involvement into the program was needed.

AUDIT RESULTS

YOUR PRESENT ANNUAL ENERGY COSTS

END USE	DOLLARS	% TOTAL
1. HEATING		
2. COOLING		
3. HOT WATER		
TOTAL COSTS		

WHERE YOUR MONEY GOES

END USE	FUEL USED	MMBTU ENERGY	ANNUAL COSTS	% TOTAL COSTS
1. HEATING				
Air infiltration				
Ceiling loss				
Wall loss				
Floor loss				
Window/door loss				
Chimney/flue loss				
Duct/pipe loss				
TOTAL HEATING COST				
2. COOLING				
Air infiltration				
Ceiling loss				
Wall loss				
Floor loss				
Window/door loss				
Chimney/flue loss				
Duct/pipe loss				
TOTAL COOLING COST				
3. HOT WATER				
Useful heat				
Tank loss				
piping loss				
TOTAL HOT WATER COST				

PAGE TWO

ENERGY CONSERVATION PRACTICES

THESE SIMPLE STEPS CAN REDUCE YOUR FUEL BILLS. THEY COST LITTLE OR NO MONEY. YOU SHOULD PRACTICE THEM IF POSSIBLE.

RECCOMENDED PRACTICE	BEING USED	NOT BEING USED
Clean and adjust combustion efficiency of gas or oil furnace by:		
Replace air filters		
Lower bonnet temperature to 80		
Repair/adjust oil burner		
Turn off gas pilot in summer		
Clean furnace & ducts		
Lower nightttime thermostat setting to 55 degrees in winter.		
Lower daytime thermostat setting to 68 degrees in winter.		
Raise thermostat setting to 78 degrees in summer.		
Reduce water flow in showers and faucets with flow limiting devices.		
Reduce hot water temperature by lowering thermostat setting to 120 degrees and reduce the use of heated water for clothes washing.		
Reduce energy use when away from home.		
Plug leaks in attics, basements, and fireplaces.		
Seal leaks in pipes and ducts.		
Use shades and drapes to allow sunlight to enter and keep out the cold.		

COMMENTS:

.....
.....
.....

PAGE THREE

CONSERVATION & RENEWABLE RESOURCE MEASURES

*****AUDITOR'S ESTIMATES*****

MEASURES	STATUS	SELF- INSTALLED	CONTRACTOR INSTALLED	FIRST YEAR SAVINGS	TAX CREDIT POSSIBLE
1 CAULKING					
2 WEATHERSTRIPPING					
3 CEILING/ATTIC INSULATION					
4 WALL INSULATION					
5 FLOOR INSULATION					
6 WATER HEATER INSULATION					
7 DUCT/PIPE INSULATION					
8 STORM/THERMAL WINDOWS/DOORS					
9 HEAT RELECTIVE/ABSORBING MATERIAL					
10 CLOCK THERMOSTAT					
11 ELECTRIC LOAD MANAGEMENT DEVICES					
12 REPLACEMENT FURNACES, BOILERS, HEAT PUMPS					
13 REPLACEMENT OIL BURNER					
14 VENT DAMPER					
15 ELECTRIC IGNITION SYSTEM					
16 REPLACEMENT CENTRAL AIR CONDITIONERS					
17 SOLAR WATER HEATER					
18 SOLAR HEATING SYSTEM					
19 COMBINED SOLAR WATER & HEATING SYSTEM					
20 REPLACEMENT SOLAR SWIM- MING POOL HEATER					
21 DIRECT GAIN GLAZING SYSTEMS					
22 INDIRECT GAIN SYSTEMS					
23 SOLAR GREENHOUSE					
24 WINDOW HEAT GAIN RETARDANT DEVICES					
25 WIND ENERGY SYSTEM					

Your utility company auditor is not a qualified contractor. His cost & savings estimates are not to be construed as quotations or bids. Only qualified contractors can provide you with an accurate quotation. This quotation may vary up or down from the auditor's estimate which is based on an average installation. You must meet certain eligibility rquirements to be eligible for tax credits. A phamphlet describing the eligibilty requirements may be obtained from your utility company.

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COMMENTS:

- 1 LOCATION
- 2 LOCATION
- 3 LOCATION
- 4 TOTAL WALL AREA, THICKNESS, AND TYPE
- 5 INSULATED AREA, THICKNESS AND TYPE
- 6
- 7 DUCTS OR PIPES
- 8 WINDOWS, DOOR, NUMBERS, AND SIZE
- 9 ORIENTATION IN SQ FT, MEETS% OF COOLING NEED
- 10
- 11 TYPE OF DEVICE AND ANNUAL MAINTENANCE COST
- 12 ANNUAL MAINTENANCE COST
- 13 ANNUAL MAINTENANCE COST
- 14
- 15
- 16
.....ROOF NEEDS INSPECTION BEFORE SOLAR INSTALLATIONROOF APPEARS NORMAL
- 17 COLLECTORTO.....SQ FT. STORAGE.....TO.....GALS. GIVESTO.....% SOLAR FRACTION.
- 18 COLLECTORTO.....SQ FT. STORAGE.....TO.....GALS. GIVESTO.....% SOLAR FRACTION.
- 19 COLLECTORTO.....SQ FT. STORAGE.....TO.....GALS. GIVESTO.....% SOLAR FRACTION.
- 20 COLLECTORTO.....SQ FT. STORAGE.....TO.....GALS. GIVESTO.....% SOLAR FRACTION.
- 21 MEETS.....TO.....% ANNUAL NEED. @ SIZE OFX.....
- 22WATER WALL.....TROMBE WALL.....THERMOSYPHON AIR PANEL @ SIZE OFTO.....
MEETS.....TO.....% ANNUAL NEED
- 23 SIZE OF.....X.....X..... MEETS.....TO.....% ANNUAL NEED
- 24AWNINGROLL-UP SHADES MOVEABLE INSULATIONFILMS
SIZED @.....SQ FT; OFFSETS% COOLING LOAD.
- 25 SEE WIND ENERGY FORM

Your utility company auditor has furnished the above size and performance estimates based on average systems operating in an average sunshine year. Actual performance estimates on any given system can only be provided by a qualified contractor familiar with the system and its performance parameters. The above estimates are not a warranty of performance.

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SEIA

ADMINISTRATIVE ANALYSIS OF SOLAR SYSTEM PRODUCT CERTIFICATION
STANDARDS AND CODES

TASK II

Report Submitted Under
U.S. Department of Energy
Grant No. DE-FG03-80CS30612

April - May 1981

TASK TWO:

I. Introduction:

This document is the seventh in a series of reports required under the U.S. Department of Energy Grant No. DE-FG03-80CS30612. The reports deals with the administration and analysis of solar system product certification..

II. Purpose:

The function of this report is to present the results of SEIA's analysis of the technical competency of the solar standard being promulgated by SRCC.

III. Discussion:

The document, which is known as "Test Methods and Minimum Standards for Certifying Solar Collectors", was given wide distribution within the industry. This distribution procedure varies from that which was stated in the previous deliverable. The reason for this departure is due to the fact that the SEIA Standards Committee has not been formally maintained. It became evident to this office that a wider distribution of the document would be necessary to receive an adequate review. This was done.

Besides the members of the SEIA Active Heating & Cooling Division, copies of the document were sent to members of SEIA's various state chapters.

The following, therefore, is a summary of the comments which were received by this office which relate to the technical competency of the standard.

IV. Presentation of Results:

Generally speaking the results of the mailing were quite favorable. There were no serious complaints with the tests required or with the manner in which the tests were to be conducted. One must keep in mind that the collector standard that the SRCC is promulgating is not a serious departure from anything that has previously been used or developed by HUD, NBS, ASHRAE, etc. Therefore, the comments which were made were of a specific nature and related to individual aspects of tests. The most specific complaints dealt with the rating portion of the document itself.

One test which was called into question was the 30-day stagnation requirement. A provisionally accredited laboratory, Shock Hydrodynamics, made the following comments.

The requirements of the 30-day stagnation test do not contain a "correction factor" which compensates for the failure of the test to be performed in an average ambient temperature of 80°F. The correction factor used by the California Energy Commission is calculated out to be very close to 1.0 BTU/ft²hour for each degree Fahrenheit below 80°F. This correction factor is an adequate compensation, according to Shock Hydrodynamics, for ambient temperatures below 80°F.

The absence of this mechanism will have the effect of limiting the number of days during which this test can be conducted. This would then result in a higher cost, longer down time, and a prolonging of the entire certification test.

Another point that was raised was the requirement that the highest temperature for which a rating is to be desired is 126°F above ambient. Although this is only an option that the manufacture may choose should he wish to do so, there was discussion that this is unrealistically high.

The requirement that the test be run at 126°F above ambient would require a pressurized heated tank rather than an open tank which is acceptable, according to ASHRAE 93-77. For those laboratories which operate at high altitudes, this temperature would be close to the boiling point. This, then, would require a special design test stand and apparatus.

The fact that the SRCC calls for the use of English Units raised some problems with the solar community. It was pointed out that the future industrial technical is towards metric units by Congressional edict and since the scientific journals all require metric units, such as Solar Energy, the Journal of the International Solar Energy Society, the use of metric units is the most logical approach.

The static overpressure test requirements were viewed by some as being a distinct improvement over what is called for in the NBSIR 78-1305A report. By not allowing a static overpressure of $1\frac{1}{4}$ times the maximum rated when using a pneumatic test for liquid collectors, the SRCC document differs from its NBS counterpart. The SRCC method clarifies pressure requirements of products that have confused many manufacturers, according to one test lab.

The drawback of the standard with respect to this test, as

one manufacturer pointed out, is that it requires two tests to be run; one before the unit undergoes any testing and one before the unit undergoes the thermal performance test. This adds unnecessary costs, according to this manufacturer, since if the unit is going to leak it will do so 90% of time when the unit undergoes the first static pressure test.

One source complained that the location of the static pressure gauge was required to be at the exit port and that the pressure was to be applied at the inlet port. Since these are static tests these requirements seem unnecessary. This commentator felt that the NBS procedure was perfectly acceptable and adequate.

The failure of the thermal performance rating method to receive 100% acceptance was by no means a shock. There were several comments which were raised questioning the validity of the approach that SRCC plans to take. One manufacturer in Arizona pointed out that the ratings play little resemblance to reality, at least as far as his situation is concerned. The sun angles called for assume a low sun angle in the winter and a high sun angle in the summer. For the solar manufacturer in Arizona, he installs his collectors true south with an angle of inclination of about 50°. This provides heat in the winter, when Phoenix area pools need heat. Therefore, his collectors have a high sun angle in winter, not low, and a low sun angle in summer, not high. This manufacturer also raises the question of how the angle between the direction of sunlight and the ground govern collector output except as it affects air temperature and attenuation by the atmosphere.

In addition, a manufacturer of pool collectors pointed out that on a clear day, uninsulated collectors can provide heat for the pool if the air temperature is higher than 20°F below the pool temperature, or a Ti-Ta of +20°F. Occasionally it has been this manufacturers observation that heat from a solar pool heater is demanded when the air tempreature is as much as 40°F above pool temperature, or a Ti-Ta of -40°F.

Since the SRCC's rating category for pool collectors would likely be recognized as the +9°F (Ti-Ta) cell, this would then represent only 30% of the expected operating temperature range of uninsulated pool heating collectors in that manufacturer's area.

Furthermore, Dr. George Löff has raised several questions about the validity of assessing, measuring or rating the thermal performance of a solar collector without accounting for load, location, and end-use application. Appendix A is a report which Dr. Löff submitted to SEIA for use by the Rating Methodology Committee in their deliberations.

Also, Messrs. Elmer Streed and D. Waksman wrote a report for the National Bureau of Standards entitled "Uncertainty in Determining Thermal Performance of Liquid-Heating Flat-Plate Solar Collectors". Their report stated that measurement error is one of the major, if not the major, contributing factor to the "within" test site variability (repeatability), and environmental effects a significant factor influencing the slope (loss coefficient) data obtained "between" test sites (reproducibility).

Most striking about the report was the observation that

there were variations in collector thermal output over the course of an all-day test from ± 17 to ± 68 percent for specific winter operating conditions.

All of this points to the "lack of faith" that one can have in relative performance ratings. This fact was mentioned by several manufacturers as a reason for dropping this aspect of the program.

Finally, several manufacturers were concerned about the technical validity of the Final Disassembly and Inspection Test. The concerns were basically what was to be used as the basis for determining what constitutes a failure condition.

The bulk of the comments appeared to be that the test described here lacked definition as to the criteria for the disassembly and final inspection and that this can lead to varied interpretations. It was recommended by several individuals that simple visual inspection can unusually determine most of the problems.

The laboratories took acception to the test procedure as written because it placed the responsibility for determining what was in fact a condition which would warrant the collector not passing the certification testing. This was a responsibility which the laboratories neither wanted nor felt was appropriate.

(It should be pointed out that the wording of this section was changed so as to remove any responsibility from the laboratories for determining whether a tested unit passed the Disassembly and Final Inspection Test.)

V. Conclusion:

From the reports which were submitted to SEIA on the "Test Methods and Minimum Standards for Certifying Solar Collectors" it is fairly obvious that the document is not universally acceptable. In fact, there are items which cause some sections of the solar industry some problems. These problems do not appear to be insurmountable.

The bulk of the problems, however, appear to fall within the arena of thermal performance rating for solar collectors. The rest of the tests appear to fall within the accepted practices of the solar community. The only departure which should be watched carefully is the 30-day stagnation test. It appears that ASTM will be finalizing an alternative to the NBS method within the next few months. This method will be a truly consensus procedure and will, therefore, be closely looked at by the SRCC. It is expected that it will be adopted by the SRCC for substitution for the existing method.

PHOTOVOLTAICS

The growth in the worldwide photovoltaic market in 1980 must be considered significant. The market doubled and more so in both dollar value and product volume over the market of 1979. The number of participants seems to be growing exponentially as word of the potential future of this market begins to spread.

The dollar value of the worldwide photovoltaic module shipments in 1980 is currently estimated at \$39 million. This represents a 99% increase over the value of shipments in 1979, estimated at \$19.6 million. This significant increase occurred at the same time that the worldwide average selling price (ASP) declined an estimated 11%. The ASP for 1980 is currently estimated at \$12/Wp, down from approximately \$13.50/Wp in 1979.

An even more significant growth rate was experienced in the volume of module shipments. Current estimates indicate that this volume will reach 3.25 MWp in 1980. This is equivalent to a 124% increase over the 1979 shipment volume of 1.45 MWp. This growth was supported to a large degree by shipments to the U.S. Government to support DOE's market development programs. However, significant commercial growth did occur which further boosted the 1980 total. Estimates of the dollar value, ASP's and the volume of module shipments in the worldwide photovoltaic market place from 1977 through 1981 are shown the following table:

YEAR	SHIPMENTS (kwp)	ASP (\$/Wp)	DOLLARS (\$M)
1977	450	19.00	8.6
1978	950	14.70	14.0
1979	1,450	13.50	19.6
1980*	3,250	12.00	39.0
1981*	5,000	10.00	50.0

An analysis on a geographic basis shows that 85% of the 1979 shipments were made by U.S.-based organizations with the remaining 15% coming from companies in Europe and Japan. While a major shift in this breakdown is not expected in 1980, recent moves being made by the European and Japanese manufacturers and governments would indicate that the percentage of shipments from the Non-U.S. areas will tend to increase as the 80's progress. The increasing number of joint ventures being started in the Non-U.S. regions by U.S.-based manufacturers would also tend to support this trend. Recent announcements by the French, German Italian and Japanese governments would indicate that government support for manufacturers in these regions will also be increasing. The EEC program to implement 15-18 pilot projects requiring approximately 1.3 MWp of photovoltaic modules in 1982 is one dramatic example of this increasing Non -U.S. government support.

Many technological changes were also made during 1980. While heralded by many as breakthroughs these changes would more accurately be defined as major evolutionary steps.

In single crystal technology, small but significant improvements were made during the year in cell and module output based on better understanding of the basic cell operating mechanisms and optimization of manufacturing techniques. Advanced Cz technology got a significant boost with the introduction of new, more efficient and automated manufacturing techniques by many of the major suppliers.

Polycrystalline Cz technology referred to as "semicrystalline" Cz technology by two of the principal users, was moved from the laboratory stage to the pilot production stage during the year. Both AEG-Telefunken and SEMIX announced the construction of major manufacturing facilities which will move this technology into the full production stage in the near future.

Thick film technology moved forward on two fronts during 1980. The Japan Solar Energy Company and Mobil-Tyco both of whom are developing photovoltaic modules based on the EFG ribbon silicon technology, commenced the sale of commercial modules during the year. Westinghouse has been developing another thick film technology based on its WEB ribbon silicon approach. This company completed

construction of a 50kWp pilot plant during the year and, in addition announced a joint venture with two California utilities to implement larger scale production facilities in the near future. Both Mobil-Tyco and Westinghouse delivered prototype systems for evaluation during the year and JSEC has reportedly delivered a significant amount of production product for various remote applications in the Near East.

In the Thin Film area, significant advances were made in both DcS and Amorphous Silicon Technology. Both of these organizations involved in the commercialization of CdS technology, SES and Photon Power, announced new manufacturing capacities. SES, with its capacity already on line began commercial shipments during the year. Photon Power has concentrated its efforts on the construction of a new, 5MWp production facility which will begin shipping product early in 1981. Record efficiency levels were also announced during the year by the Institute for Energy Conversion and Boeing, both of whom are doing basic research in CdS technology.

With regard to Amorphous Silicon technology, Sanyo increased its production capacity of Amorphous Silicon chips for watches and calculator applications during the year, and Fujitsu Electric announced that it was beginning production for similar applications. RCA, the leading U.S. based company in Amorphous Silicon research achieved

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record efficiency and cell size levels during the year, but as yet, has not announced plans for any pilot production facilities.

Although significant evolutionally advances were made during the year in cell and material technology, developments in systems technology did not move apace. The level of funding for research in control and power conditioning in the U.S. appears to be significantly behind that being supported in Europe. The total worldwide level of funding for this work remains only a fraction of that applied toward material and cell development. With the costs of the Balance of System capability approaching that of the photovoltaic arrays much additional work remains to be done in this area.

THE FUTURE

The Solar Energy Industries Association in concert with Strategies Unlimited of Mountain View California has recently concluded work conducted under contract to the Department of Energy intended to provide "Industry's Perspective on Federal Photovoltaic Programs. The following represents excerpts taken from the final draft of the report recently submitted to the Department of Energy. The recommendations and conclusions reached are those of a blue ribbon industry review panel. The conclusions neither represent the views of the staff of the Solar Energy Industries Association or the staff

of Strategies Unlimited.

A carefully orchestrated federal plan can insure that federally funded programs facilitate industry efforts in the most efficient manner. The blue ribbon industry review panel created such a plan in which it recommends that federal photovoltaic activities simultaneously address market, technical and political objectives. The market objective insures that photovoltaic systems which are developed satisfy national but energy requirements. The technical objective provides for development of photovoltaic systems in a timely manner. The political objective insures that the photovoltaic industry is competitive and not dependent on continuing federal support.

A fundamental conclusion of the panel was that federal efforts should be directed to facilitate utility use of photovoltaic power systems. Although there are numerous off grid applications where photovoltaic systems are cost effective today, photovoltaic systems will make a significant contribution to national energy supplies only when providing cost-effective power to utility grids. There are several factors which discourage utilities from aggressively utilizing photovoltaic systems and which can be mitigated through appropriate federal measures.

Photovoltaic systems will become cost effective at an earlier date and photovoltaic production capacity will expand faster, if the federal government takes steps to aid industry in managing the risk of photovoltaic

investments. The second strategy thus focuses on measures which reduce the technical risk of photovoltaic hardware and the market risk of photovoltaic systems in new applications. The goal of this strategy is not to eliminate risk. Rather it is to permit industry to manage risk, much of which is rooted in various government policies, so that private investment is encouraged.

Finally the political strategy seeks to limit federal involvement in photovoltaic development by establishing a variety of market-based unbiased incentives and policies. The goal of these incentives and policies is to retain a maximum number of decisions in the hands of the producing industry and the using consumer, thereby minimizing the need for large governmental programs and reducing the opportunities for special-interest influence.

REGULATORY INITIATIVES

In order to promote utility use of photovoltaic systems, changes are needed in the ways in which utilities are regulated, either to reduce the risk (e.g. more liberal allowance for expensing) or to reward (allow a bonus rate of return) the use of new technologies.

SYSTEM EXPERIMENTS

The federal government should financially support the cost of at least one utility connected experimental photovoltaic system with a peak output of greater than 2 megawatts. The procurement schedule for the required

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photovoltaic modules should be designed to constructively stimulate photovoltaic production capacity without creating an unreasonably large, short term demand. This procurement should be consistent with that described in the subsequent tactic on procurement.

PATENT POLICIES

Patent policies for firms involved in federal research and development programs are inconsistent between federal agencies and are, in general, not adequately supportive of industrial needs to encourage an optimal share of private investment. More liberal patent provisions would encourage more widespread participation in federal programs and would encourage private investment in co-sponsored research and development efforts.

TAX POLICIES.

The 15 percent special investment tax credit, created as part of the "Windfall Profits Tax" bill, should be extended beyond 1985 if it is to be meaningful benefit to photovoltaic development. Public utilities should be permitted to qualify for this same tax credit so that they are on an equal footing with non-utility firms. Tax incentives which encourage capital investment and research and development expenditures in general (such as the 10-5-3) plan are also desirable since photovoltaic systems are highly

capital intensive to purchase and require large research and development expenditures to develop. A careful review of tax policies should be made to ensure that capital intensive energy systems are treated in tax policies on the same basis as currently expensable energy consumption.

PROCUREMENTS

The federal government should ensure that each federal agency, through its normal procurement processes, utilizes photovoltaic systems wherever cost effective. Such procurements should be on a competitive basis subject only to the standard rules of commercial procurements by the government. If non-cost effective procurements are made by the federal government, a variety of procurement mechanisms (e.g. block purchases and grants) should be utilized in order to encourage maximum industry participation. Such procurements should be price-based and unbiased with regard to technology (e.g. concentrator or flat plate: thin film or silicon), supplier characteristics (e.g. large or small firm), and free of political manipulation.

DOE OPERATIONS

On balance, the DOE photovoltaic program has had a significant, positive impact in advancing photovoltaic technology. However given the resources at its disposal the program could be even more effective. Program shortcomings generally arise because of a continuous tendency to expand governmental activities into areas

that are the purview of the photovoltaic industry. In addition coordination among the numerous federal agencies and laboratories which implement photovoltaic programs has been ineffective. That has contributed to wasteful duplication of effort and competition for jurisdiction. For these reasons, the photovoltaic industry feels that the scope of some of government programs could be reduced and the funds more productively used in other photovoltaic programs.

In addition to this recommended system of objectives, strategies and tactics, the industry panel identified several policy issues which should be followed in implementing federal photovoltaic programs.

Price goals for photovoltaic systems have been too dominant in shaping federal photovoltaic programs. These goals have little economic significance and have become counterproductive by encouraging buyers to wait for future lower prices.

Photovoltaic systems should not be touted as a vehicle to decentralize energy systems, since they could well be implemented in a centralized mode. Development of this desirable technology should be independent of this philosophical debate.

Photovoltaic systems will likely do little to promote national security by displacing imported oil because their widespread use could occur well after such

oil is replaced by other domestic alternatives. This does not reduce the desirability of continued development of this technology.

The DOE photovoltaic program is planned around five program elements: Advanced research and development (AR&D), technology development (TD), Systems Engineering and standards (SES), tests and applications (T&A), and market development (MD). Budget allocation for each element is shown in the following table for 1980 and 1981. The budget recommended by this industry panel for 1982 is also shown.

	HISTORICAL		RECOMMENDED
	1980	1981	1982
ADVANCED RESEARCH & DEVELOPMENT	30	31	27
TECHNOLOGY DEVELOPMENT	39	38	57
SYSTEMS ENGINEERING & STANDARDS	10	9	7
TESTS AND APPLICATIONS	15	9	9
MARKET DEVELOPMENT	6	13	0
	100%	100%	100%

The most significant changes in this recommended budget are a phasing out of market development activities. This recommendation reflects both the inherent low value of government activities in these market-related areas and the ineffectiveness of these programs.

The activities that have been carried out as part of the market development program element are those which are

generally inappropriate for the government to undertake. They are activities which business must do themselves as a part of natural company development. By their nature, they inevitably reflect company personality and perspective so that theoretical government work in this area tends to be irrelevant. The products of AR & D and TD efforts are transferable, but the products of MD efforts tend to be of most value only to those who performed the work since the process is as important as the product.

Compounding these criticisms, or perhaps in part because of them, there is considerable dissatisfaction with the groups doing market development work in such organizations as SERI, NASA Lewis and the regional solar energy centers..

A lack of coordination in government programs manifests itself through redundancy and competition between governmental labs. The proliferation of photovoltaic programs within these labs has encouraged intergovernmental conflicts, a process which does no one any good. The industry feels that the far ranging photovoltaic programs of the DOE should be consolidated into perhaps four organizations: JPL, Sandia, SERI and DOE headquarters. The photovoltaic activities of NASA Lewis, Lincoln Lab and Aerospace should be transferred to these other four organizations at the same time that research and development activities are consolidated, so program management should be more centralized to permit better coordination. In particular, the program management functions of the JPL and SERI lead centers should be transferred to a centralized management such as DOE

headquarters.

Federal photovoltaic programs have been, and can continue to be a positive factor in promoting the development of photovoltaic systems. These contributions can continue to be realized even as the role of industry naturally grows and matures while that of government stabilizes and even diminishes. The guideline presented herein will ensure that both industry and the government fulfill their roles with a maximum of efficiency and effectiveness. To accomplish this the industry is eager to work with the government in implementing these recommendations.