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DOE'S ROLE IN THE SOLAR ENERGY INDUSTRY, AND POSSIBLE ANTICOMPETITIVE TRENDS

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HEARING BEFORE THE SUBCOMMITTEE ON ANTITRUST, MONOPOLY AND BUSINESS RIGHTS OF THE COMMITTEE ON THE JUDICIARY UNITED STATES SENATE

NINETY-SIXTH CONGRESS

SECOND SESSION

ON

DOE AND THE SOLAR ENERGY INDUSTRY

NOVEMBER 14, 1980

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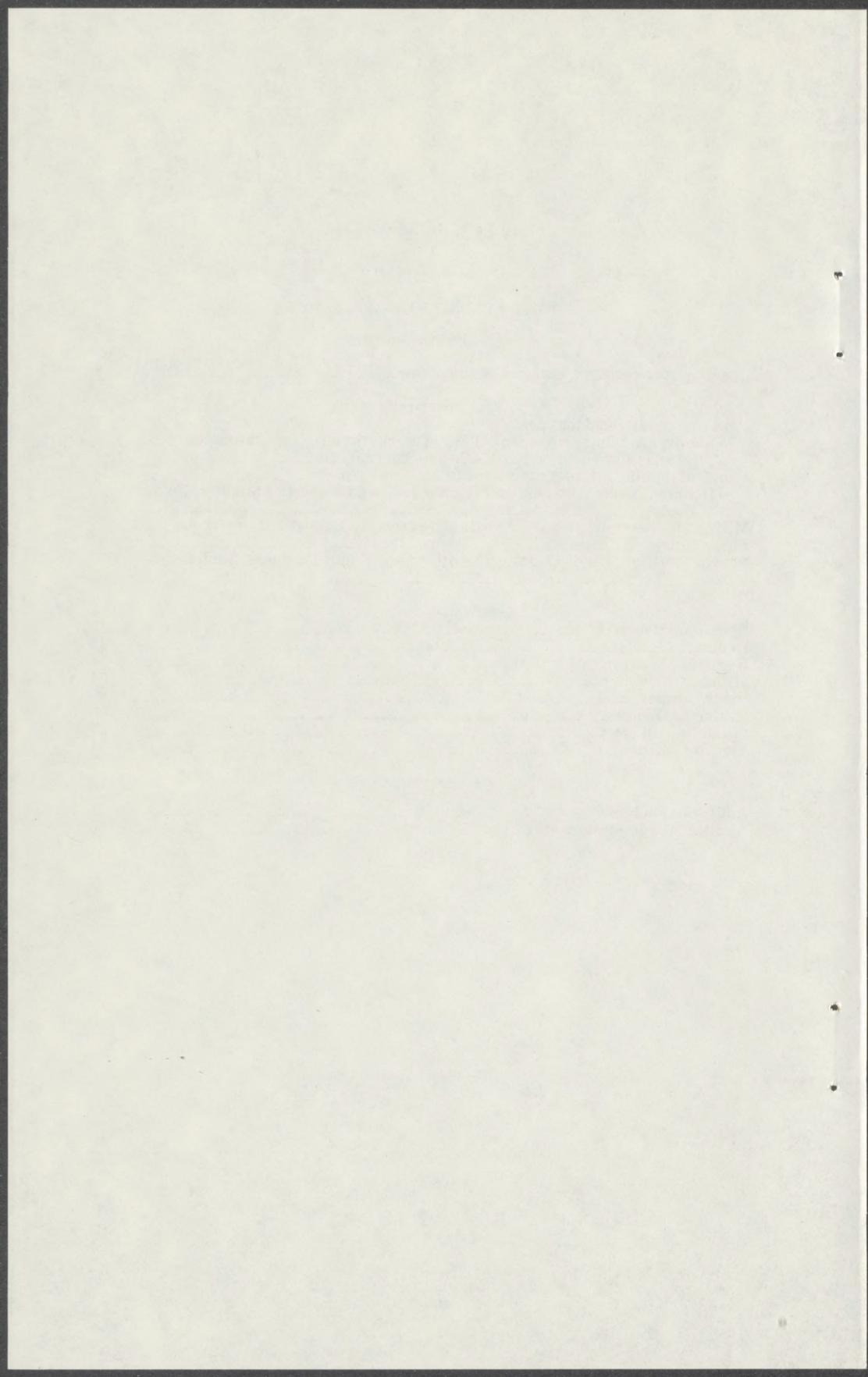
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DOE'S ROLE IN THE SOLAR ENERGY INDUSTRY, AND POSSIBLE ANTICOMPETITIVE TRENDS

FRIDAY, NOVEMBER 14, 1980

U.S. SENATE,
SUBCOMMITTEE ON ANTITRUST, MONOPOLY
AND BUSINESS RIGHTS,
COMMITTEE ON THE JUDICIARY,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:30 a.m., in room 2228, Dirksen Senate Office Building, Senator Howard M. Metzenbaum (chairman of the subcommittee) presiding.

Present: Senator Metzenbaum.

Also present: Bill Bradley, counsel; Gary Cohen, counsel; Marilyn Falksen, chief clerk, and Peter Chumbris, minority chief counsel.

OPENING STATEMENT OF SENATOR METZENBAUM

Senator METZENBAUM. The committee will come to order.

Today the Antitrust Subcommittee begins what may or may not be a comprehensive series of hearings on the competitive structure and future of the solar energy industry.

The solar energy industry has created a sense of excitement in this Nation and rightfully so, because it provides a whole range of new and old renewable resource technologies that are on the verge of making substantial contributions to our Nation's energy mix.

By the very nature of its source, the Sun, solar energy is not predisposed to monopolistic control and profiteering cartels, as are most of our conventional energy technologies.

Equally important is the fact that solar energy provides significantly more jobs per dollar of investment than any other energy option available to us.

As the Joint Economic Committee put it:

Jobs will be created in insulating and retrofitting homes with solar units, manufacturing and installing more efficient heating and cooling systems, making office buildings more energy efficient, producing and operating mass transit systems, producing and installing cogeneration devices, and recycling valuable materials.

The skills required will be similar to those required for conventional construction projects and heating system installation. As a consequence, work will be provided for sheet metal workers, carpenters, plumbers, pipefitters, construction workers, and production line workers of all kinds.

These jobs are desperately needed not only in my State of Ohio, but throughout the country. A summary of the Joint Economic Committee study will be inserted in the record.

Equally important is the fact that more than almost any other energy technology, solar is particularly suited to small business participation.

Most conventional energy technologies rely on power generating systems that are highly centralized and require large capital investments.

Solar energy, on the other hand, works best on a small decentralized scale. Its practical applications are chiefly on the individual and community levels, where small business functions most effectively.

Another great advantage that small business brings to solar energy is its proven record of innovation. As a historical phenomenon, the entrepreneurial success of small business in bringing new products to market is well-documented. Specific examples of this success in the solar energy field will be provided, I trust, to this committee by today's witnesses.

Solar's potential for more energy, more jobs, and more opportunities for small business is truly cause for excitement. Yet, I have very, very deep concerns about the competitive future of this industry.

It has become painfully apparent that this new and very promising industry is being increasingly dominated by a few large oil companies and other multinational giants.

For example, in solar photovoltaics—the most advanced of the solar technologies—9 of the 10 largest firms are owned by major corporations, and 6 are controlled by multinational oil firms. The top three firms are either partly or wholly owned by oil companies, and these three controlled over 90 percent of solar cell sales in 1979.

The top three firms which are partly or wholly owned by oil companies, actually controlled over 90 percent of the solar cell sales in the past year.

Big oil's participation in solar has not been primarily through its own innovation or new technology. Instead, the big oil companies have bought their way in—either acquiring small firms outright, or purchasing interests in, previously small, independent, imaginative firms which had achieved solar breakthroughs.

The chart over here exemplifies this very point.¹

On the left is a list of once independent solar firms. On the right is their corporate purchaser. What do we see?

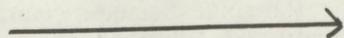
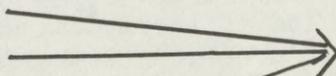
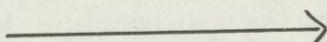
Standard Oil of Indiana has purchased into Solarex, the leading solar firm.

Arco has purchased three solar firms, and is now a leading factor in the industry. They purchased Solar Technology, Inc., Northrup Solar and Energy Conversion Devices, Inc.

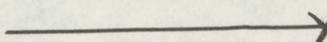
Exxon has also become a leader in the solar business through acquisition, buying into Solar Power Corp., of Massachusetts.

Mobil and Shell have also entered the industry by acquisition. Mobil now having a company, Mobil-Tyco, and Shell having a company, Solar Energy Systems.

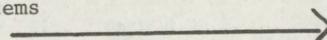
¹ See chart on next page.

ACQUISITIONS OF SOLAR FIRMSACQUIRED COMPANYACQUIRING COMPANYSolarex
(Maryland) (21%)Standard Oil Co.
of Indiana (Amoco)Solar Technology, Inc.
(California)Northrup Solar
(Texas)Energy Conversion Devices, Inc.
(Michigan)Atlantic Richfield
(ARCO)Solar Power Corp.
(Massachusetts)

Exxon Corporation

Mobil-Tyco
(Massachusetts)

Mobil Corporation

Solar Energy Systems
(Delaware)

Shell Oil

In many cases, the small acquired companies did not want to give up their independence. But a lack of capital forced them to sell out. To me, this is the essence of this hearing. We are talking about the free enterprise system, making it work. It is not suggested that it is illegal for the oil companies to be buying into the solar energy fields. The fact is that if the oil companies buy into the solar energy field and control that source, as well as controlling coal in this country, as well as controlling oil in this country, as well as controlling natural gas, uranium, and all of the other competitive aspects in the energy field, then the free enterprise system, almost by definition, cannot be expected to work.

The free enterprise system is founded on the concept of competitive forces working one against the others. Now how can you expect Exxon or Arco or Standard Oil of Indiana or whatever the company may be, to truly work as hard and as effectively as possible to develop solar energy, if by developing solar energy and truly making it usable, operable, and cost effective, they may destroy the value of their conventional energy sources. Their coal, oil, and uranium would have little value in a future energy field where solar has achieved such a level of development.

What I think about as I sit here this morning, about to open this hearing, is how this subject will be treated during the next 4 years. What we are really talking about is free competitive forces working. We are talking about the free enterprise system working.

I am frank to say that we will hear from representatives of the Department of Energy this morning. It is a reality of life that they have not been helpful to the small business community, in helping them to develop free competitive activities in this field.

Quite the contrary, they have slammed the door in the face of small business operators, and they have only wanted to do business with the largest of the oil companies.

So, I don't look forward, as one who happens to be on the short end of the stick, after last Tuesday, to something negative happening in this field because nothing positive has been happening in the last 4 years vis-a-vis the development of solar energy.

So, I am hopeful that the advocates and those who speak the loudest about change will produce a change for the better. Maybe we will see a change where the small business person and small business companies will have a better opportunity in the next 4 years than in the last.

I say this wishfully. I say it hopefully, but I say it as a matter of concern about one who has a strong interest in the availability of energy sources to this Nation. But, in addition to having a hopefulness about the energy sources, I believe it is particularly important that the free competitive forces be given an opportunity to work and that the small business person not be squeezed out of this economy of ours. Because, if he or she is, the system won't work. I am afraid we will be moving toward a doomsday kind of eventuality, not tomorrow, not next year, but some time along in the future.

I think the whole question of solar energy development relates very directly to the viability of the system which we operate in this country. I am hopeful that the new team will be more concerned about the viability than the old team has been.

Senator METZENBAUM. The prepared statement of Senator Kennedy will appear in the record at this point.

[The prepared statement of Senator Edward M. Kennedy follows:]

PREPARED STATEMENT OF SENATOR KENNEDY

Today's hearing of the Senate Antitrust Subcommittee is an important forum for both the solar industry and the nation.

America's greatest energy resource is the ingenuity of its citizens and businesses.

This hearing will determine whether this ingenuity will be stifled as corporate bureaucracies swallow up independent solar businesses or whether the Federal government will use its power to insure the development of a competitive independent solar industry.

Today's testimony from small business representatives in the solar field, among them, Mr. Robert Charlton from my home state of Massachusetts, as well as other advocates of a competitive solar marketplace, will improve our understanding of the many problems besetting the true innovators in the field. A key problem being addressed today is the unwritten but very real policy of the Federal government to allow large corporations to buy out and dominate the solar industry. Examples abound of actions taken to encourage this trend, from the channelling of nine-tenths of Federal R&D grants, contracts, and procurements to big business, to the selection by TVA in its Solar Memphis program of collectors only sold by large firms.

The testimony by today's witnesses underlines the urgency of this issue and the need to find better solutions than those we have reached so far. The answer to this challenge will be found only through measures that meet both the demands of our economy for a secure and diversified energy base and the demand of our society for a competitive and truly innovative energy sector.

This past August, I made sure that the Democratic Platform included language which advocated a moratorium on the purchase of solar companies by big oil companies. Also, I cosponsored a bill this past January which would have set aside 25 percent of the Department of Energy's solar money for small business. In response to these Congressional initiatives, DOE has promised increased participation by small business. A 23 percent set-aside by the Solar Energy Research Institute has been the only concrete evidence of this commitment. It is unacceptable that the agency entrusted with the mission of developing a new solar industry aggravates rather than assists the solar small businessman.

As Chairman of the Senate Judiciary Committee, I will fully support efforts by Antitrust Subcommittee Chairman Howard Metzenbaum to insure competition in the marketplace. As we have done in the airline, trucking, and rail industries, so, too, must we work to open up the energy marketplace so as to not let big business block out the sun.

I commend the Antitrust Subcommittee for its important role in this effort. This hearing will greatly contribute to the development of an integrated solar energy policy, one which will allow small businessmen to have an important and vital say in the future of the industry.

Senator METZENBAUM. We will call our first panel, which is a panel of small business persons. I think one of them may not have arrived as yet, but we will put Mr. Piper on at a later point

At this point, I will call Mr. Shahryar, president, Solec International, Inc., of Hawthorne, Calif., Mr. Robert E. Charlton, vice president, Solectro-Thermo, Inc., of Dracut, Mass.

PANEL OF SMALL BUSINESSMEN:

STATEMENTS OF ISHAQ SHAHRYAR, PRESIDENT, SOLEC INTERNATIONAL, INC., AND ROBERT E. CHARLTON, VICE PRESIDENT, SOLECTRO-THERMO, INC.

Mr. SHAHRYAR. Thank you, Mr. Chairman.

Senator METZENBAUM. I am very happy to welcome you gentlemen, at this time.

Mr. Shahryar, do you wish to proceed first?

Mr. SHAHRYAR. Yes; thank you very much.

Mr. Chairman, and subcommittee members, I deeply appreciate the opportunity to appear before you today to present my views on the topics of small business involvement in the photovoltaics industry and the impact of investment in and buy-ups of small firms by larger firms within this industry.

Solec International is a very small business. We currently have 22 employees and a total capitalization of less than \$1 million, nearly one-half of which is composed of long-term loans from the Small Business Administration.

Nevertheless, I believe that Solec is the largest firm active in the photovoltaic industry which has not accepted financing or ownership by a large corporation.

Despite our small size and lack of access to large amounts of capital, we have achieved steady and consistent growth since our founding in

March 1976. Our products have been tested and accepted as the equal in all respects of similar products produced by larger firms.

Small business involvement in solar energy development is of critical importance to the Nation, because in order to reach national objectives in solar energy, a continuing stream of innovative concepts in solar technology and marketing is essential. Small businesses are known for their ability as innovators.

The Department of Energy should therefore frame and administer its programs so as to encourage small business participation and support innovation by industry.

Although the Congress has clearly so directed the DOE, its response has fallen short of congressional intent and objectives.

I hope to present the subcommittee with information which will be of some value in understanding the reasons for this situation and in determining corrective action.

Senator METZENBAUM. Mr. Shahryar, I notice your statement is somewhat lengthy and we have a number of witnesses.

Mr. SHAHRYAR. Yes.

Senator METZENBAUM. If it is possible, speak to the issues of concern to you and we will put your entire statement into the record. That would make it much easier for us to proceed. We like to hold our witnesses to 10 minutes, maybe 15 minutes, at the most.

Mr. SHAHRYAR. Well, the summarization of my testimony, Mr. Chairman, is that the small business is facing the giant oil companies in this industry. Effectively competing with them is essential to progress in our business.

Senator METZENBAUM. In what way does that competition affect you?

Mr. SHAHRYAR. You indicated yourself the problems we are facing. No. 1, is the DOE contracts?

Senator METZENBAUM. The what?

Mr. SHAHRYAR. The DOE contracts.

As you indicated yourself, these largely go to the larger firms.

The other problems are one, the mental attitude of the Federal agencies, that bigger firms can do a better job, and two, the requirements for submitting proposals to the Federal agencies for getting contracts.

It takes a substantial amount of work and capitalization to draft a proposal, to submit a proposal to the agencies, to get a contract.

Senator METZENBAUM. How much would you say it would cost you just to submit the proposal?

Mr. SHAHRYAR. A minimum of \$10,000.

Senator METZENBAUM. A minimum of \$10,000?

Mr. SHAHRYAR. \$10,000.

Senator METZENBAUM. That is a substantial amount of money to a small business.

Mr. SHAHRYAR. Yes.

We have the technical capability. We can do the work as good as any of the larger companies, but we are handicapped by the fact that we cannot prepare a very comprehensive proposal to win the contracts.

Senator METZENBAUM. Have you been encouraged by the DOE to bid on contracts? Have you had contacts with them? What have they said?

Mr. SHAHRYAR. Well, the DOE has been helpful when talking to us. As far as getting contracts, their attitude is, there is nothing we can do about it. We have to fight the battles.

Senator METZENBAUM. They say there is nothing they can do about it? Do they give you any encouragement at all?

Mr. SHAHRYAR. That is right. The encouragement is very little.

Also, the belief by many is that they are spending too much money on research, paper work and studies rather than on actual hardware and application of photovoltaics.

So, I believe that there should be a program that should set aside some of these contracts for small business, and that we should have the opportunity to win these contracts.

Senator METZENBAUM. Are you operating at a profit?

Mr. SHAHRYAR. No, not at all; not at this time.

Senator METZENBAUM. How much is your volume at the moment?

Mr. SHAHRYAR. The volume of production at this time—we produce about half a million watts a year.

Senator METZENBAUM. Half a million dollars a year.

Mr. SHAHRYAR. Half a megawatt of solar energy.

Senator METZENBAUM. I am talking about your dollar volume.

Mr. SHAHRYAR. We are closing sales, rather booking sales, of \$2 million for this year. But, most of this has come from nongovernmental programs, from private applications both international and domestic.

Senator METZENBAUM. How long can you hold out if the Government turns its back on you? Do you think there is anything different about your procedures than some of the other company procedures?

Mr. SHAHRYAR. Well, one of the fortunate things as far as my company is concerned is we had an early entry into the field.

Senator METZENBAUM. When did you go in?

Mr. SHAHRYAR. In 1976. The individuals, including myself were the originals. We used to work in the space solar cells. Then we entered into the industrial application.

So, we have a strong technical group, and also the individuals having the pioneership in the field. It helped us to capture some of the private international and domestic business.

This has been one of the reasons why we are able to survive and hopefully, that we continue to survive.

Senator METZENBAUM. What do you think the DOE could or should do in order to help you?

Mr. SHAHRYAR. With regard to the oil companies, I don't mind their entry, but I definitely mind when DOE gives them funding for research and development. I think they can afford to do their own research and development.

Senator METZENBAUM. They are giving the big companies money for the research and development?

Mr. SHAHRYAR. That is correct.

Senator METZENBAUM. But they refuse to give the small companies research and development funds?

Mr. SHAHRYAR. Well, they haven't refused us. When competing for research and development funds, the amount of paper work and the work we will do and the great amount of time it takes makes us shy away from doing it.

I think because of the bureaucracy involved in submitting those proposals and for obtaining those contracts, we sort of stay away from them.

Senator METZENBAUM. Tell me how you dealt with the DOE. Did you just write them a letter? Did you go in to see them? What did you do?

Mr. SHAHRYAR. Well, we visited them. Most of the time we visited they asked us to submit an unsolicited proposal. So, we have submitted several proposals. These proposals go around for months and months and months of time before we get any contract.

Senator METZENBAUM. With whom did you meet at the DOE?

Mr. SHAHRYAR. I would say with all fairness that the present management of the DOE, and the DOE photovoltaic division, has been very encouraging and very helpful to us. But as far as getting any definite contracts, I have not been able to get them.

Senator METZENBAUM. Do you feel that—

Mr. SHAHRYAR. What I am trying to point out, to give you an example. In my company, we are innovators. For example, in this year, the price of silicon went tremendously high because the oil companies and the semiconductor industry have purchased most of the silicon in the industry. They purchased the raw material it is made of. We were in a bind.

What we did, we bought the wafers from the semiconductor industries and managed to set up a process to make solars from those wafers. This helped us to survive. We developed this process within 4 months.

We took that process and applied to DOE to get a contract for that process. We probably would have waited a year before we would have received a contract.

Senator METZENBAUM. If you do not have silicon or the reprocessing procedure that you are using, would you have been out of business?

Mr. SHAHRYAR. That's right.

Senator METZENBAUM. Have you found that the oil companies that control solar energy companies are not actually precluding you from buying the silicon, but that they have moved into the market sufficiently that they are controlling the supply by their ability to pay a higher dollar?

Mr. SHAHRYAR. Yes. For example, when the shortages of raw material started, they bought supplies for 2 or 3 years. We could only afford to buy for the next 2 or 3 months of silicon supply.

Senator METZENBAUM. Why do you think so many companies have been bought out by the oil companies?

Mr. SHAHRYAR. I think you will find the problem is the capital.

Senator METZENBAUM. Small companies did not have the capital?

Mr. SHAHRYAR. We have problems raising the capital. We were fortunate to be able to get the loans under an energy loan program from the Small Business Administration to help us a great deal. That helps us a great deal. Also, we were able to establish credibility with the bank so we can get a line of credit on a small scale.

If it weren't for the Small Business Administration loan and the credibility we established at the bank, we would have been in trouble.

Senator METZENBAUM. What is it that you actually produce at your plant?

Mr. SHAHRYAR. We produce everything that the large oil companies do. We produce solar cells. We produce solar panels. We do solar systems. We have in-house contracts from the Navy, from Edwards Air Force Base. We have some contracts within the governmental agencies.

But, the problem also there is, when we get a contract from the Government and we ship the systems, it takes about 90 to 120 days after the shipment before we get paid.

Also, there is a problem of payments with the Federal agencies. We suggest there should be a program, not only a set-aside for small business, but also progress payments that will give us the working capital.

With that we can survive and continue to operate.

Senator METZENBAUM. Is the capital that DOE might make available for the development of a market your major concern?

Is there an adequate market?

Mr. SHAHRYAR. I think the market is multiplying and tripling every year by itself. I was the first man in 1973 to go around the world trying to sell the concept of photovoltaic when I was with Spectrolab. From then on I have seen that the market, especially in the past 2 or 3 years, has been multiplying and has now tripled.

I think the market continues to be there. The oil companies are not helping it by selling it below their costs. So we have to compete very heavily for that. The market is there.

Senator METZENBAUM. Did you say it is below their cost?

Mr. SHAHRYAR. I am assuming that their prices are very, very competitive.

Senator METZENBAUM. But that does not mean it is below their cost.

Mr. SHAHRYAR. I don't know that.

Senator METZENBAUM. You said that.

Mr. SHAHRYAR. I assume that because of the prices at which they sell I don't know how they could justify selling for that price. For example, at this time some of them sell for \$7 and \$8 a watt. The actual price for a watt of photovoltaic energy is around \$10 or \$12.

So, on these contracts we have to compete very heavily.

Senator METZENBAUM. I want to come back to something else you said earlier. You said something about the fact that more recently the DOE, the Department having to do with solar energy, has been more helpful. Did I understand you to say that?

Mr. SHAHRYAR. They are very helpful as far as they go. I think one of the programs of the Department of Energy that helped us a great deal is the FPUP.

Senator METZENBAUM. The what?

Mr. SHAHRYAR. The Federal procurement utilization program. DOE is giving money to Federal agencies and the Federal agencies will take that money from them and buy photovoltaic systems. That has been of great help to us. We have several contracts in-house on that. I welcome this kind of program.

Senator METZENBAUM. Mr. Charlton, we will be happy to hear from you at this time.

Mr. CHARLTON. Thank you, Mr. Chairman.

Senator METZENBAUM. Again, your entire statements will be included in their entirety, in the record, at the conclusion of your oral

testimony. It would be helpful if you would just tell us what your problem is.

Mr. CHARLTON. All right. Senator, supposing you live in a home back in Ohio. You go to one of these companies that is listed on this chart and ask them to put in a photovoltaic system on the roof of your home, to provide you with solar electricity. They come up with a quote for you to give you the bulk of your electrical requirements. Say you live in a typical suburban home and your kilowatt hour consumption for the year is between 5,000 and 6,000 kilowatts.

That would mean that these solar photovoltaic firms owned fully or partially by the major oil companies will charge you anywhere from \$100,000 to \$125,000 to put in that photovoltaic array.

Now let's assume you have the money and you line your roof with solar cells and you are getting all the electrical requirement you need from that photovoltaic array, and you are saving between \$400 and \$500 a year on your electric bill. But your oil bill or your gas bill, for heating your house and providing domestic hot water is running \$1,200 to \$1,500 per year. You have a photovoltaic array taking care of your electric needs between \$400 and \$500, but then you have to go to your local oil dealer or utility and buy your oil or heating, gas to heat your house and your domestic hot water.

In the process, you are paying triple or quadruple, for your space heating and hot water needs. You can't put in a thermal-only system because your roof is completely covered with solar cells.

It makes no sense whatsoever.

If you get down to a 77-cent-peak watt cell by 1986, when New England and the rest of the snow belt States are down the tubes paying for high cost oil, the cost of that array would probably run between \$15,000 and \$20,000. It still will only provide for your electrical requirements.

What we are saying is that the proper approach to solar—its total energy. If you can put in a system that provides electricity, space heating, and hot water, in one installed functioning array, and pay \$15,000 for it, and get 35 to 50 percent of your electrical requirements from that system, at a minimum of 60 percent of your space heating and hot water needs from one installed array, then logic dictates that that is the way you have to go.

Senator METZENBAUM. How do you do that? How does that relate to the issue before us today? Are you saying that small business people can do that? Are you saying the Government should subsidize it? I am not quite sure of the point.

Mr. CHARLTON. What I am saying is that Solectro-Thermo is in a position to do that right now. Solectro-Thermo can do that. In fact, we have been doing that for the last 4 years.

We have put in eight proposals to the Department of Energy and its entities to fund a demonstration project to demonstrate the efficacy of a total energy system. All eight proposals were rejected.

Senator METZENBAUM. How much did it cost you to put those in, Mr. Charlton? Approximately?

Mr. CHARLTON. Well, the one at issue is an announcement that was made 2 years ago from which the Beverly High School photovoltaic project evolved. A \$2.7 million project, awarded to a solar

affiliate of a major oil company, to put up a 100 kilowatt peak system, 3,200 solar modules, 115,200 solar cells, to save that high school 116,000 kilowatts of electrical energy, at 5 cents a kilowatt hour. That is \$5,900.

In other words, we are spending \$2.7 million of tax money to save \$5,900. Now, Congress has mandated practicality for solar systems. They want reliability, durability, economy, and efficiency.

All photovoltaic projects that are currently being sponsored by the Department of Energy do not meet any one of those mandates.

SENATOR METZENBAUM. Let me ask you this. Your company creates total energy, solar energy projects. Is that the kind of a thing you are talking about?

Mr. CHARLTON. Our company is the only company in the Nation, large or small, that offers a total energy system, a total energy-tracking system that is currently available for the commercial and residential market.

The national photovoltaic program plan, multiyear plan, calls for a total energy residential system, that is a system that combines electricity and heat, to be commercially available in 1986.

We have it today. We don't think we can wait until 1986. But we, as a small company, are doing it on our own. We are just barely hanging in there. What we are looking for from the Federal Government is a chance to demonstrate this system.

Senator METZENBAUM. Let me ask you, when was your company formed?

Mr. CHARLTON. The company was formed in 1976.

Senator METZENBAUM. What kind of money has been put into the company?

Mr. CHARLTON. There has been approximately \$80,000 put into this company, right out of the pockets of the inventor of this system.

Senator METZENBAUM. Are you still operating?

Mr. CHARLTON. We are still operating, barely.

Senator METZENBAUM. How many people are working there now?

Mr. CHARLTON. We have six people, but we bring in people who moonlight, as needed, because we can't afford to hire them any other way.

Senator METZENBAUM. You are the only company operating with this total energy facility concept?

Mr. CHARLTON. As far as we know. We are the only one that offers an electric thermal tracking system that is in any way, shape, or fashion cost effective.

Senator METZENBAUM. You have been to the DOE eight times with proposals?

Mr. CHARLTON. DOE or its entities such as the region 1 DOE through the appropriate technology small grant program.

We have, right now, two modules at MIT, Lincoln Laboratories, under test.

Senator METZENBAUM. At whose expense?

Mr. CHARLTON. They pay for them.

Senator METZENBAUM. Has the DOE given you any help at all?

Mr. CHARLTON. That is hard to figure. I don't know. It appears in substance they have been more of an impediment than a help.

Senator METZENBAUM. How do you mean that?

Mr. CHARLTON. Because they are denigrating our system in public print.

Senator METZENBAUM. Do they have any backup? In what way have they denigrated it? Have they written and said that your system won't work? Is that what they said?

Mr. CHARLTON. No; they say our system is not efficient, electrically. They claim that our system is only 3 to 5 percent efficient in electrical energy, versus a flat plate system's 8 percent efficiency.

Senator METZENBAUM. What is different about your system and others?

Mr. CHARLTON. Well, we figure that is an obfuscation. Figuring solar cell efficiency by the gross area is misleading. We don't pack our 16-foot-square modules with solar cells.

One of the problems with solar cells, cheek by jowl, with a densely packed solar cell system like a flat plate system is ridding it of heat buildups. This is particularly true in the Sun Belt where the temperatures on roofs get above 140° F., sometimes they even reach 200° F. A solar electric array can sit there baking in the Sun. You get above 28 C., or 77° F. the operating output of that solar electric array can go down.

We space our particular cells so that a heat conductor, heat radiating, heat absorbing aluminum cone can sit over it. What that cone does, it operates much like a magnifying glass. Sunlight, entering this inner body of the reflector, which is polished aluminum, is focused down on to a solar cell. We are getting increased influx on to the cell of the ultraviolet light which is the only part of the solar spectrum that self converts.

With a simple, in-house three-position tracking mechanism, these concentrators tilt, much like a venetian blind, 30° east or south in the morning. It picks up the morning Sun. Then, as the Sun swings into the southern sky, it tilts due south. Then, in the afternoon, 30° west or south.

Senator METZENBAUM. It does that automatically?

Mr. CHARLTON. Automatically. Now, by doing that, we are able to get approximately three times the electric output of a cell as we would under a flat plate.

Mr. CHUMBRIS. How many of those do you put on a roof of that house? You have a picture here that you had in a magazine.

Mr. CHARLTON. The normal photovoltaic residential system consists of 10 modules, 160 square feet, which contains 330 solar cells and 330 contrates.

Senator METZENBAUM. Say that again, please.

Mr. CHARLTON. A normal residential array consists of 10 modules, 160 square feet. The modules are 4 by 4. They contain, that 10 module array contains 330 solar cells with a concentrator over it.

Senator METZENBAUM. And yours? How does yours differ?

Mr. CHARLTON. That is ours.

Senator METZENBAUM. That is yours?

Mr. CHARLTON. That is ours.

Senator METZENBAUM. The others?

Mr. CHARLTON. Just flat plates.

Senator METZENBAUM. Flat plates.

Mr. CHARLTON. With no concentrator over it.

Senator METZENBAUM. I see. So what you attempt to do is to provide this concentration. No one else in the field is attempting to provide that?

Mr. CHARLTON. Oh, no. They are providing concentrations with Fresno lenses and trowles.

What we are saying is this. A solar cell, say the run-of-the-mill solar cell, a low-cost cell, the theoretical top efficiency of that cell is only 22 to 24 percent, in converting sunlight to electricity.

That means that if we get to that 24-percent efficiency that still leaves upward of 75 percent of the solar spectrum hitting that photovoltaic array that is rejected by the cell. It can't convert it to electricity. What do you do with it? You capture it in some means to heat your house and heat your hot water. Yankee thrift, commonsense tells you, you don't let the Sun's thermal energy get away from you.

If you have a collector on your roof giving electricity and it is only 10- or 12- or 15- or 20-percent efficient in converting sunlight to electricity, don't let the rest of the thermal energy get away from you if you are buying oil. We are already spending \$60 to \$80 billion a year buying oil from that rathole over on the other side of the world.

Why not capture that heat and use it to heat your house or your domestic hot water?

Well, that is what this concentrator does. It captures the bulk of the solar spectrum that is not converting to electricity, captures it as heat energy, and that is what we use for space heating and hot water.

Senator METZENBAUM. It sounds logical to me, Mr. Charlton. I don't know the technology.

Mr. CHARLTON. It is simple.

Senator METZENBAUM. Let me ask you this question. What has DOE done to either impede or help the development of your operation?

Mr. CHARLTON. Through a certain learning process, we determined, and we may be wrong on this, but we determined that at the moment it is an exercise in futility to try to work with the DOE.

Big energy knows that the oil isn't going to last forever. The money they are getting on their excess profits, their super profits, is not going into looking for new oil. It is going into alternate energy resources that may strike out against the preeminence of oil.

When this country shifts to alternate energy, be it solar, biomass, alcohol, anything—they don't want to be left at the starting gate.

Now I don't care whether they say that oil is going to last 40 years or 300 years. It is not how long oil is going to last, it is how much it is going to cost the American consumer.

Senator METZENBAUM. Mr. Charlton, you have not answered my question.

Mr. CHARLTON. Yes, sir.

Senator METZENBAUM. What has DOE done to help you or to impede you? What you are saying, I am not questioning. I said that in my opening statement.

Mr. CHARLTON. Yes.

Senator METZENBAUM. What I want to know is, what has DOE done for you or to hurt you? Also, where do they get the 3- to 5-percent efficiency figure that you said they used in connection with your system?

Mr. CHARLTON. Well, that is basically correct. But that is not clarifying the whole story. They are using approximately three times to four times the number of photovoltaic cells to generate that 8 percent.

We are replacing expensive photovoltaic cells with inexpensive aluminum. In other words, we are replacing two expensive cells, but we are giving 7 watts of thermal energy for every watt of electricity.

Senator METZENBAUM. You are not answering my question.

Mr. CHARLTON. I am sorry. Let me see if I can address it.

Senator METZENBAUM. I just want to ask you simply. What has DOE done to impede the development of your system or what haven't they done that could help you? Answer either question, but explain actions DOE has taken toward you.

Mr. CHARLTON. Maybe it is a sin of omission, not commission. What we want to do is have the DOE underwrite an array of sufficient wattage to prove or disprove the efficacy of a total energy system.

Senator METZENBAUM. You said that you made eight separate applications?

Mr. CHARLTON. That's correct, Senator.

Senator METZENBAUM. Formally? Or just orally?

Mr. CHARLTON. No.

Senator METZENBAUM. Have you presented something in writing?

Mr. CHARLTON. This is a 100-page proposal that cost upward of \$50,000, addressing a photovoltaic project.

Senator METZENBAUM. Is that your proposal?

Mr. CHARLTON. That's a proposal that was made up with Solectro-Thermo joining up with a company in Bedford, Mass.

Senator METZENBAUM. You paid for part of that proposal?

Mr. CHARLTON. That's correct. There were 6 weeks of hard labor put into this.

Senator METZENBAUM. When was it submitted to the DOE?

Mr. CHARLTON. About 2 years ago.

Senator METZENBAUM. What has happened in connection with it? About 2 years ago?

Mr. CHARLTON. In 1978. We received a debriefing from Sandia Labs on why this particular proposal was rejected. The essence of the telephone debriefing was that DOE was limited in funds. Therefore they were looking for the best bang for their buck.

The best bang for their buck is that \$2.7 million photovoltaic array at Beverly High School.

Senator METZENBAUM. According to them?

Mr. CHARLTON. Yes.

Senator METZENBAUM. You are saying that sarcastically?

Mr. CHARLTON. That's correct.

Senator METZENBAUM. Our record does not indicate sarcastic inflection. [Laughter.]

Mr. CHARLTON. Well, that's one of the problems.

If we were to provide 116,000 kilowatts for the Beverly High School, it would have cost the Government about \$600,000, instead of \$2.7 million. But we would also have given that high school 750,000 kilowatts of heat energy at the same time.

Senator METZENBAUM. That is one of your proposals.

Mr. CHARLTON. Yes.

Senator METZENBAUM. You said you made eight. You made seven others? What happened with the other proposals?

Mr. CHARLTON. All the proposals didn't go directly to the Department of Energy. They went through their regional office, in Boston.

Senator METZENBAUM. That would be the Department of Energy wouldn't it?

Mr. CHARLTON. That's correct. The Department of Energy, Region 1.

Senator METZENBAUM. That was with your partner who is located up at Cambridge?

Mr. CHARLTON. The president of the company is Arthur Manelus, who is the inventor of this hybrid system.

Senator METZENBAUM. The president of your company.

Mr. CHARLTON. That is correct. The only announcement that we addressed with a bid out of Bedford was this particular 0038.

Senator METZENBAUM. Are there any negotiations still continuing with respect to your proposal and the DOE?

Mr. CHARLTON. No; it just costs us too much money. As I say, as we interpret it right now, it is an exercise in futility.

Senator METZENBAUM. So you associate yourself with Mr. Shahryar who says that the cost of trying to get money from the DOE has become a prohibitive factor and that your company, associated with another company, has already invested \$50,000, all to no avail. Is that a fair statement?

Mr. CHARLTON. If we can't do it with a \$50,000 top notch proposal, there is nothing much else we can do.

Senator METZENBAUM. Now were there some outside consultants or other experts used in preparing that proposal?

Mr. CHARLTON. That is correct.

Senator METZENBAUM. Do you have anything further to add, Mr. Charlton?

Mr. CHARLTON. Not at the moment.

Senator METZENBAUM. Is Mr. Piper here, yet?

[No response.]

Senator METZENBAUM. I think not.

Therefore, unless there is something further—

Mr. SHAHRYAR. I would like to add a couple of points.

Senator METZENBAUM. Yes.

Mr. SHAHRYAR. In all fairness, the Department of Energy has not been a hindrance to us at all. I think they have done a tremendous job in promoting photovoltaic.

As far as the commercialization of photovoltaics and providing support programs. A program like the jet propulsion laboratory which tests our panels just as well as they test everybody else's.

Senator METZENBAUM. Just as well as they test what?

Mr. SHAHRYAR. They test the oil companies' panels. They have done it very fairly. They have given us credibility. The list comes out. Solec International is listed along with the other companies. They have fairly tested all of our products and given us the necessary credibility. I think they have done a good job as far as commercializing, and as far as promoting the photovoltaic industry in this country.

But, what I am trying to point out is that some of the bureaucracy, it may not be the fault of individuals in DOE, should be cut down a little.

For example, the proposals submitted should not be as expensive and as comprehensive as they are required to be right now.

I propose programs that provide that some of the business should be set aside for small business. I have made suggestions to this effect.

There should be more participation for small businesses.

Senator METZENBAUM. I think those are constructive suggestions. Perhaps from these hearings the Department of Energy will get that message. I think it is a different message than Mr. Charlton's message. But we appreciate your testimony, Mr. Shahryar, and your testimony, Mr. Charlton. Thank you very much.

Mr. SHAHRYAR. Thank you, Senator Metzenbaum.

Mr. CHARLTON. Thank you, Mr. Chairman.

[The prepared statements of Messrs. Shahryar and Charlton follow:]

PREPARED STATEMENT OF ISHAQ SHAHRYAR

I deeply appreciate the opportunity to appear before you today to present my views on the topics of small business involvement in the photovoltaics industry and the impact of investment in and buy-ups of smaller firms by larger firms within this industry.

Solec International is a very small business. We currently have 22 employees and a total capitalization of less than 1 million dollars, nearly one-half of which is composed of long-term loans from the Small Business Administration. Nevertheless I believe that Solec is the largest firm active in the photovoltaic industry which has not accepted financing or ownership by a large corporation. Despite our small size and lack of access to large amounts of capital, we have achieved steady and consistent growth since our founding in March 1976. Our products have been tested and accepted as the equal in all respects of similar products produced by larger firms.

Small business involvement in solar energy development is of critical importance to the nation, because in order to reach national objectives in solar energy, a continuing stream of innovative concepts in solar technology and marketing is essential. Small businesses are known for their ability as innovators. The Department of Energy should therefore frame and administer its programs so as to encourage small business participation and support innovation by industry. Although the Congress has clearly so directed the DOE, its response has fallen short of Congressional intent and objectives. I hope to present the Subcommittee with information which will be of some value in understanding the reasons for this situation and in determining corrective action.

Let me begin by giving an example, taken from our own experience, of the sort of innovation which can be expected from a small business, and which benefits both the business and the national solar energy program.

The photovoltaic industry has historically purchased silicon wafers, its basic raw material, at prices much lower than those paid by manufacturers of transistors and integrated circuits. This has been possible because our industry was willing to accept material which did not meet the specifications of device manufacturers. When silicon is in short supply, as has been the case for the past two years, the supply of low-priced "solar grade" wafers dries up because device manufacturers are willing to accept out-of-specification material to keep their production lines running. Quotations for wafers to Solec have more than doubled in price over the last year.

Larger firms have responded by establishing their own operations for silicon crystal growing and slicing. This option is not feasible for a company of Solec's size. Such an operation would require additional capital investment of at least \$1.5 million.

Solec responded by developing processes for the reclamation of wafers which were spoiled at some stage of processing in the integrated circuits industry. In the past, these wafers were discarded. In order to utilize them, Solec had to develop new processing technology. We now have the ability to produce solar cells from

reclaimed material which are every bit as good as our competitors produce from material grown in their own plant to their own specifications, and our material costs are now about one-half of theirs.

Obviously this innovation was forced by necessity, and benefits Solec by providing us with an assured low cost source of supply for our basic raw material. It also benefits the nation. Most of the energy used in producing a solar cell is used in the processes of silicon purification, crystal growing and slicing. By using reclaimed material, Solec solar cells pay back the energy expended in their manufacture in about one year, while solar cells manufacturee from virgin material require about 10 years to pay back this energy.

Solec developed this new processing technology without government assistance. We completed our development work in about four months, while it would have taken about a year to obtain government assistance for the work.

Unfortunately, most innovations in photovoltaic processing and marketing require more time and capital investment. In order to obtain the necessary capital to develop and benefit from their innovations, small firms find it necessary to turn to large corporations, particularly the oil companies. So, ironically, it is the success of small businesses in generating innovations which leads to the "buy-up" problem.

Buy-ups have both good and bad effects on the industry and on the progress of photovoltaic technology. To the extent that the additional capital injected is used to advance technology and open up new markets, everyone benefits. Unfortunately, sometimes an important part of the additional funds are used to underwrite predatory pricing policies. Such policies are damaging to everyone, but that fact is not always apparent to firms which have access to large amounts of capital and are willing to use these funds to buy market share by selling products well below cost.

The most disturbing aspect of the "buy-up" problem is that small firms are being bought up at a very early stage of their development. I was employed in the semiconductor industry during its period of explosive growth, during the 1960's. Many new firms were formed during this period, and although most were eventually bought out by larger companies, the buy-up did not occur until the entrepreneurs and original investors had developed the company to the point where they made a considerable profit on their investment. This profit then served as a source of new venture capital for other firms just starting out.

Because venture capital from private individuals is nearly unavailable today for investment in high-technology, high-risk ventures such as the photovoltaic industry, small firms find that they must sell out early in their development on terms which do not replenish the capital sources which they drew upon to start their business. So, while in the past "buy-ups" created funds for investment in new start-ups, and so assisted in creating fertile ground for new innovation, today "buy-ups" do not perform this essential function.

The Congress should recognize that unwise changes in the tax laws since the 1960's have contributed to this situation. If I were a wealthy individual, I would not invest in the photovoltaics industry; I would invest in tax-sheltered investments such as real estate and oil well drilling programs.

The policies, pronouncement and objectives of the Department of Energy have also contributed to this situation. The DoE keeps its gaze firmly focused on the period 1986-2000, when photovoltaic modules will be dirt cheap (they think) and the major problems will be connected with their large-scale utilization. They have completely ignored the necessity for developing the industrial base which would make the attainment of their objectives possible. The DoE spends far more money on paper studies of how we can best utilize cheap modules 10 years hence, than on assisting the industry to exploit the opportunities for profitable and cost-effective uses of photovoltaic technology today. As a result of these pronouncements, private investors see the photovoltaic industry as one which will require enormous amounts of capital and which will not be profitable for a decade. This is not an attractive proposition. It is also completely false.

There are many opportunities available today for the exploitation of photovoltaic technology in cost-effective applications. Some of these opportunities exist within the United States; many more are in foreign countries. If these opportunities were effectively exploited, the photovoltaic industry could finance much of the new technology development required to meet DoE goals from its own earnings, thus reducing the amount of Federal money required. The industry would also develop the capability to expand to meet future requirements. Gov-

ernment policy does not now provide sufficient incentive for exploitation of these opportunities, in fact, in important ways DOE policies have discouraged firms from developing products for presently cost-effective applications and in seeking out new markets in foreign countries. The international photovoltaic development plan presented to the Congress last year by the DoE is not satisfactory, in our opinion.

I think it is worth-while to review the results of the solar market development strategy undertaken by the French government. The French initiated a government program in solar technology at about the same time we did. Unlike the United States, they focused their efforts on the development of systems to meet the most immediately cost-effective needs. In the area of photovoltaics, they sponsored the development of systems to meet immediate needs in their former West African colonies for electric power for communications and water pumping in isolated villages. Initially, they provided 100 percent funding and retained 100 percent control of the program. After systems had been developed and field tested in Africa with satisfactory results, they invited the West African countries to participate in the financing of larger-scale installations, on a cost-sharing basis which was attractive, particularly since these countries had observed that the systems would function effectively under the conditions which existed in their countries. In this way they were able to install a large number of systems, despite the fact that the total funding provided by the French government was very small compared to the U.S. solar program.

Today we find that the French are able to compete with us all over the world, despite the facts that their government's solar energy program is tiny compared to ours and that their systems are higher priced than ours. They can provide assurance of satisfactory performance based on years of field testing of systems in conditions typical of underdeveloped countries; we cannot. In Mexico, for example, the French have 16 solar energy projects now installed and in operation; we have none. Even the Germans, who started much later, have been able to reach agreement with the government of Mexico on specific system installations, while we are still negotiating.

This situation is important and bears on the problems addressed in these hearings. Solec and other small businesses active in the solar field are oriented towards supplying hardware to meet present needs. A U.S. Government program oriented towards the distant future is of little help to us. Only a very large firm with assured long-term cash flow, such as an oil company, can afford to invest in solar technology if the return on that investment is so far off. Unless the U.S. solar program is reoriented to provide more support for the immediately available applications of solar technology, only firms owned and financed by the oil companies can continue to exist.

I would like to conclude by summarizing my views on how the U.S. Government's policies impede the process of innovation in small business firms, and how the Congress might deal with this problem:

1. Access to capital is, without doubt, the number one problem for small businesses in a high-technology, rapidly developing industry. The Congress should consider this problem and adopt changes to present law which would encourage private individuals to invest in such enterprises. Otherwise, "buy-ups" of small companies in their infancy by large corporations will continue, and the possibilities of innovation by new firms will be lost.

2. Access to markets is, without doubt, the number two problem for small businesses. The most important markets are those for photovoltaic systems, not R&D contracts. Government orders for photovoltaic systems provide industry with opportunities to deliver systems and have them critically evaluated in actual operation. Successful performance then provides the essential basis for marketing of similar systems in foreign countries. I believe that small businesses such as Solec can compete on equal terms with large firms for such contracts. Nevertheless, I recommend that mandatory set-asides for small business, for this type of contracting, should continue and be expanded. Otherwise, DOE will tend to include provisions in the contract which are not essential to meet present requirements and which have the effect of discriminating against small businesses.

I would also like to mention certain DoE programs and policies which I have found to be very helpful to Solec. The DoE deserves to be commended for the efforts that they have made to be helpful to small business, and their successful programs and policies provide valuable models for the future.

The efforts of JPL (the Jet Propulsion Laboratory of the California Institute of Technology), the major DoE contractor in the photovoltaics program, deserve

commendation. JPL has always been willing to help Solec and other small business firms to learn about and make use of new photovoltaic technology, and the JPL engineering staff has been extremely helpful in providing calibration standards and in critiquing new product designs. JPL's role in establishing standards for photovoltaic module and system design has also been extremely helpful in providing an opportunity for small businesses to have their products tested and qualified to U.S. Government standards, thus making it possible for companies such as Solec to show prospective customers that our products meet the same performance standards as those of our larger competitors.

The Federal Photovoltaic Utilization Program (FPUP) should be commended because it is the first and only Federal program which provides useful support for the development of photovoltaic systems to meet immediate needs in the United States, and so which also serves to support development of foreign markets for similar systems. FPUP should be continued and expanded.

All of us at Solec have been amazed at reports in the newspapers that DOE plans to terminate this program at the end of this fiscal year, and that DOE also decided not to provide further funding for similar programs, in order to meet Administration ceilings on solar development funding. Even if solar funding must be reduced, we cannot understand how an effective program can be carried out without providing for installation, field testing and evaluation of photovoltaic systems. Without this program element, we feel that DOE programs in photovoltaic R&D will be ineffectual, and efforts to establish U.S. firms in overseas markets will also fail. Because of delays in contracting, only a small portion of FPUP funds have been committed and the beneficial effects on the U.S. photovoltaic industry have yet to be seen.

The funding provided under the Tsongas Amendment has been useful to smaller companies in the photovoltaics field. We are aware that personnel in DOE responsible for administration of contracts let under the Tsongas Amendment feel that the Government did not get as much, per dollar expended, as the Government expected. While we can understand the basis for this feeling, we believe that this is mainly the result of the fact that Tsongas Amendment funds were provided on a "one-shot" basis. We would recommend the establishment of a similar program on a continuing basis, with contracts limited to small business firms and with contract amounts limited to \$75,000 per contract. This would give small businesses in the solar photovoltaics field access to Government support for new technology development, without the long delays and burdens of red tape which now make it unprofitable for small businesses even to ask for Government support for technological innovations.

This concludes my prepared remarks. I would be most happy to answer any questions which the Subcommittee might have.

PREPARED STATEMENT OF ROBERT E. CHARLTON

The Preamble of the Constitution of the United States, reads:

"We, the People of the United States, in Order to form a more perfect union, establish Justice, insure domestic Tranquillity, provide for common defense, promote the general Welfare, and secure the blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution of the United States of America."

In 1980, We, the People are still concerned with the precepts of this Preamble; in particular the establishment of Justice, the promotion of general Welfare and thus secure the blessings of Liberty to ourselves and our Posterity.

Solectro-Thermo, Inc. (STI), in turn, is seeking Justice in order to promote the general Welfare of our Nation's people and we seek the blessings of Liberty by providing them with decentralized sources of renewable energy.

However, in order to funnel renewable energy into Big Energy's hands, we see the growth of Solar being hampered by claims that solar energy today is a long way from being practical. For example, Edison Electric Institute, in a recent national ad, stated: "Solar, hydropower . . . even wind power . . . these are exciting possibilities but a long way from providing electricity on a large scale . . . so we need to build coal and nuclear plants now."

The New England Electric System, which is jointly sponsoring the Beverly High School photovoltaic project, says: "Nuclear energy is being quietly and efficiently providing us electricity for the past 20 years and will, most likely, for the foreseeable future." I might note here there is nothing "quiet" about nuclear energy since Three Mile Island.

Boston Edison Co. tells us "the best known method to (provide solar electricity) is with the power tower which is a solar furnace on a tower surrounded by mirrors." It is "best" only in that it centralizes solar electricity at a prodigious cost which is passed on to the consumer.

Shell, Mobil, Exxon, Arco and other oil companies tell us that photovoltaics are, in effect, a long-haul proposition and proceed to prove their point in their DOE-funded photovoltaic (PV) demonstration projects.

How does an oil company prove its point that solar is a long way off? It does it by taking its super-profits and investing some of that money in purchasing solar cell manufacturing plants. Then the oil company uses its clout with the DOE to corner the DOE's photovoltaic demonstration grants—using tax dollars to erect, for example, a \$2.7 million PV array at a Massachusetts high school to return in electrical savings about 116,000 kWh per year. At 5¢ kWh, that's approximately \$6,000 in energy savings. If that solar scenario, which typifies current PV demonstration projects, is not enough to convince the American people that oil companies are correct in their contention that solar PVs are a long-haul proposition, I simply do not know what else is needed to convince them.

The oil companies maintain they are working to bring cell costs down to a point where they will become economically feasible. They are working towards the DOE's stated goal of a 70¢/peak watt solar cell price by 1986. On that basis, let us analyze the \$2.7 million Beverly (MA) High School PV project. This demonstration, according to the attached newspaper article, is comprised of 3,200 PV modules—installed on a 4-acre site behind the high school. Each module has 36 4-inch solar cells, or a total of 115,200 cells in this 100 kW/peak array.

Even if we work with a high price of \$10 per cell, we arrive at a \$1,152,000 cell cost in total. Subtracting total cell cost from the \$2.7 million DOE-outlay, we are left with over a \$1.5 million net attendant cost figure; (tying the cells together, testing, placement on module substrate, encapsulation, plant overhead, and installation together with the power conditioning.) This means if solar cells reach the projected 70¢/peak watt or 1¢ a watt—or grew on trees in your back yard—in view of the cost of a completely installed and functioning PV-only array, in relation to the electrical energy returned, the system would never payback in the lifetime of the array. That point is very plain to us and it is inconceivable to us that it wouldn't be as plain to the DOE and anyone else involved in photovoltaics.

When it takes a \$2.7 million funding to save a mere eight percent per year of a high school's electrical bill, clearly we have to use another approach!

Solectro-Thermo's approach is to employ a mild, heat-conductive, heat-absorbing aluminum concentrator to increase the electric output of a solar cell. With a simple, in-house, 3-position tracking mechanism which moves the concentrating cones in unison 30 degrees either side of noon, we are able to harvest approximately three times the electric energy out of our concentrated cell as would otherwise be generated out of a bare, flat panel cell.

Since the cell sees only about 10 percent of the solar spectrum and converts that small portion to electricity, we use our heat-radiating, non-imaging cone to capture the bulk of the thermal energy that registers on a PV array as a byproduct of the light energy of the sun. This is heat energy badly needed in New England and the rest of the Snowbelt areas for space heating and domestic hot water—energy that is dissipated and wasted by purely photovoltaic system like the Beverly project. SolectroThermo captures this heat energy by enclosing the cell/concentrator assembly in a sealed, weathertight housing with a transparent acrylic glazing—protecting the assembly from degradation and preventing upward heat loss.

Now if we had the \$2.7 million funding for the Beverly project, STI could install a 100 kW/peak hybrid array which would save the Beverly high school over \$125,000 in their "total energy" bills during the first year! More importantly, our system would show New Englanders that solar truly works, even in the Frostbelt!

From this, you would understand our feeling that it is this harvested thermal energy in conjunction with the increased electrical input generated by our concentrating cones that now presents a cost-effective picture. STI's hybrid array allows a New England homeowner or business person—or any individual in regions where heat is required along with electricity—to provide for the "total energy" needs of his structure.

But, according to the DOE's National PV Multi-Year Program plan¹ a PV total energy is not supposed to be here until fiscal year 1986. However, the "Proceedings" of the Annual DOE Solar Heating & Cooling Contractors Review Meeting of March 26-28, 1980 (CONF 800340) shows in Section 7 a number of "Special Projects" dealing with total energy systems. Here are a few excerpts from Section 7 of the "Proceedings".

Brookhaven National Laboratory Abstract: "Systems which utilize a combination of photovoltaic and thermal conversion in the same solar collectors (PV/T Systems) can have advantages over PV or thermal only systems in that the cost effectiveness of the collectors and their support structures may be improved; active cooling may allow the cells to run at low temperatures—hence higher conversion efficiencies, and space limitations on side by side collectors can be avoided."

Arizona State University Background reads: "Combined PV/T collectors which produce electric and thermal power can be designed to provide greater energy savings throughout the year than if a solar thermal system is used. In fact, Westinghouse Electric Corporation concluded that a total energy residential power system provides the most cost effective match between the solar energy incident on the roof of the residence and its electric and thermal loads." . . . The PV/T model is applicable to collectors where the solar cell output can be assumed to decrease linearly with local cell temperature."

Brown University Objective discloses: "The objective . . . is to produce a conceptual design of a combined PV/Thermal solar energy system for a small single-family residence. Except for the combination PV/T panels, the whole system is intended for commercialization when the price of PV cells drops to the levels envisioned by the DOE PV goals in the mid-1980s. The PV/T panels will use air as a heat transfer fluid . . . PV/T collectors are not commercially available as yet."

Now I refer you to the current Mother Jones Sept./Oct. issue. The "Solar Blackout" article in this issue reported a statement of a spokesman at DOE's photovoltaic division who denigrates the STI hybrid system by saying that Arthur Manelas, Pres. of Solectro-Thermo and inventor of the STI system, has a "barely competitive product" that does not represent the "technical edge" which the DOE is seeking in its commercialization program. This DOE official says our STI system is only 3 to 5 percent efficient compared to a flat plate PV array's 8 percent efficiency. What he fails to clarify is that he is talking about the gross area of STI's 16 sq. ft. module compared to a flat plate gross area of 16 sq. ft. What STI does, in fact, is replace expensive cell area with inexpensive aluminum reflective area. In the process, we are replacing two expensive cells with one inexpensive concentrator, and as indicated, getting the equivalent amount of electricity out of one cell as would be obtained from three cells in a flat panel PV array. So there is little need to pack solar cells on a flat panel that has difficulty in ridding itself of heat buildup under intense sun conditions.

We also employ circular cells because of the configuration of our concentrating cones. Flat square cells are not the answer in our system unless they are so cheap we cannot ignore them. Besides our heat-absorbing cones require the proper spacing over the cells within the module so we are using a far less number of expensive cells per square meter.

Thus our fixed concentrators under full sun would not show the gross area efficiency as a densely packed flat panel array. This ignores the fact that our concentrators can tilt 30 degrees either side of noon to capture upwards of 40 percent more electricity than the concentrator would in a fixed position. But the key point here is that our sealed, weathertight enclosure captures seven watts of thermal energy for every watt of solar electricity—meaning our "total energy" percentage can range from 60% in the winter to 70% in the summer when a flat panel PV array registers 8% or less.

¹ DOE/ET-0105-D of June 6, 1979—Page X reads, Tests and Applications (T&A).

"An increased emphasis will be placed on Residential systems . . . it is possible that a photovoltaic total energy Residential system (where the sun supplies both electrical and thermal energy), could achieve System Readiness in 1984. Commercial Readiness could be achieved in FY86 with system prices in the range of \$1.60-\$2.20/Wp, depending on sales volume achieved."

Note.—If the above can be interpreted as a peak-watt price for combined electricity and heat, STI already has a peak-watt installed price of \$1.85 within 25 miles of our plant. Furthermore, under mass production and addressing a volume market, the peak watt price could drop to under \$1.50!

It should be noted here, a low cost solar cell can still find its way under our concentrators. But there is a large question whether we can truly afford the "wait" for an envisioned low cost cell—not with the prospect of the OPEC nations expected drain of an estimated \$507 billion from the world's economy over the next five years!

Furthermore, we think it is just plain foolish to allow all that heat energy that hits a PV array in tandem with sunlight to a solar cell to be dissipated and wasted! This is particularly true in areas requiring depletable, expensive fossil fuels to space heat homes and to provide domestic hot water. Yankee thrift demands a solar collector producing electricity to capture the heat energy as well, particularly in the Snowbelt!

What good is a solar panel at any price that provides a household with solar electricity only—taking up the home's south facing roof and dooming the solar homeowner to complete dependence on his servicing oil dealer or gas utility for his space heat/hot water needs.

The bottom line is this! Even if a homeowner or businessman has the money and ground space facing south for a thermal system, can you picture this? A solar electric machine working at 10 percent efficiency on his roof while on his grounds a solar thermal array working anywhere from 30 to 60 percent efficiency. Is this the most cost-effective approach to solar?

The point everyone seems to be missing in considering solar is that we have to work with a series of constraints:

(1) Solar radiation is only so intense. If we are 93 million miles from the sun, we must understand that Old Sol is giving us only 1,000 watts per square meter at best. There is nothing we can do, now or in the future, to increase that solar radiation.

(2) Run-of-the-mill (hence relatively low cost) solar cells' top theoretical efficiency is only 22-24 percent. That means even if we get top efficiency, the cell will not generate enough energy to electrify and heat the home.

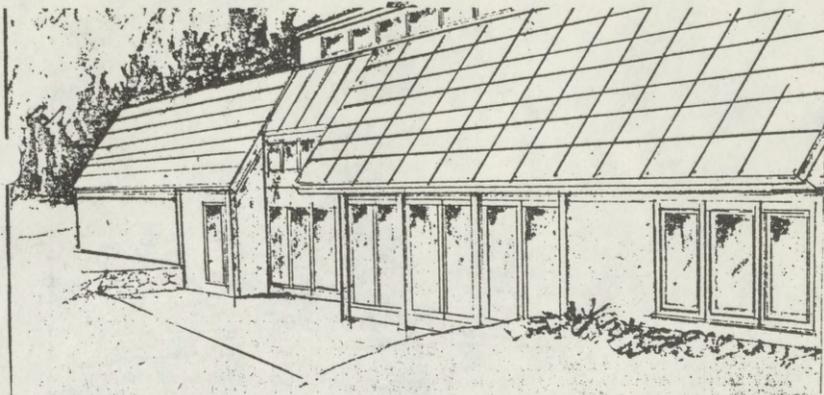
(3) Standing homes in New England and throughout the whole Northern tier of states lack sufficient roof space facing south for two types of collectors, one for electricity; the other for heat, to accommodate the "total energy" needs of the residence.

That is why we agree with Brookhaven, Arizona State and Brown University that a total energy system offers the Snowbelt homeowner and businessman with the greatest potential for fossil fuels displacement.

Solectro-Thermo, Inc. has the only functional-operating hybrid tracking system on the commercial and residential markets today! We have been in this unique position for the past four years and have sustained ourselves, almost miraculously, on our own endeavors—without a penny of funding from our federal government! In Justice, our STI system merits the support of the Dept. of Energy so that the American people can have the opportunity to invest in decentralized "total energy" for their renewable energy needs.

In summation, Mr. Chairman, what Solectro-Thermo solicits is a second opportunity to install and demonstrate a 100 kW/peak hybrid system on the roof of a federal facility in the Northeast. In other words, we want the funding that was denied us under PRDA-EM-78-D-04-0038—the same Announcement through which the Solar Power Corporation, a division of EXXON Enterprises, received a \$2.7 million funding for the counter-productive Beverly High School project. Through this funding, we aim to show the American people as well as the Dept. of Energy the efficacy and cost-effectiveness of a "total energy" system.

Mr. Chairman, I am including a PV story from the Boston Herald American plus a technical treatise on STI's hybrid system which I wish to have included as part of the record.



Photovoltaic energy:

By JEAN COLE
Staff Writer

It looks like solar energy may work as well in Boston, Mass. as it does in Biloxi, Miss.

At least the Department of Energy thinks so. It's not spending its millions in experimental energy money just for places where the sun shines longest.

In the past week, two projects of great significance to New England, where winter winds blow cold and the sun disappears for days, were unveiled by DOE.

Ground breaking took place last week for the first of the projects at Beverly High School where the city operates a costly year-round school program and wants to get partial freedom from its high annual electric tab.

Announcement of the second project, of special interest to future home-owners, took place yesterday in Carlisle where DOE is sponsoring the building of a single-family dwelling totally electrified by solar energy.

Beyond having the sponsorship of DOE in common, both the Beverly and Carlisle projects are centered around photovoltaic solar power.

Solar photovoltaic is a process by which sunlight is converted into direct current electricity.

It is accomplished through the use of photovoltaic solar cells, which are made primarily of silicon, one of the most abundant elements in the earth's crust.

In a technical description of the process for Beverly High School students, Dr. Richard R. Addiss Jr., of the Solar Power Corp., an affiliate

of Exxon, prime contractor for the school project, put it this way:

"Solar photovoltaic cells are large wafers sliced from single silicon crystals. The wafers are chemically treated so that the upper layer has a deficiency of electrons (positive silicon) while the lower layer has an excess of electrons (negative silicon.) As the sunlight is absorbed into the cell, direct current electricity is produced."

And, the third similarity between the projects is that each will sell a portion of the electricity it produces to the local utility company in its area.

For Beverly High School, that's Mass. Electric, a subsidiary of New England Electric, which is cooperating in the project.

When the Carlisle Project is finished on Lot 28, Munroe Hill Road, power produced in excess of that needed for the family living in the residence, will be fed back to the Boston Edison Co. for distribution through its power network.

Those who worked many months getting the sponsorship of DOE's National Photovoltaic program on both projects, hailed the start of building as a milestone toward energy freedom for New Englanders.

Roy C. Smith, vice-president of Builders Collaborative of Acton, chosen to be project manager by MIT's Lincoln Laboratory which was assigned the experiment by DOE, said the dream of millions of Americans to produce their own electric power and sell a portion to a utility company, would become a reality in Carlisle.

Production of the cells for home

Boston Herald American
Sept. 4, 1980

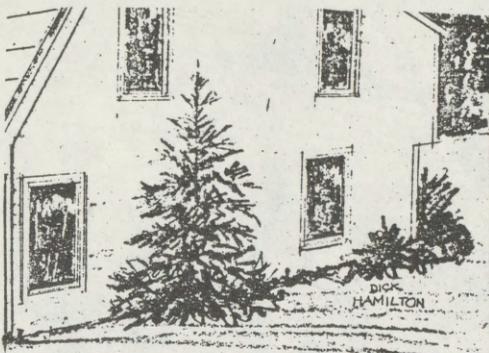
power will become cost competitive by 1984 to 1986, according to Steven J. Strong, award-winning solar architect-engineer, of Canton, who designed the eight-room, three-and-a-half bathroom, Carlisle home.

"If the next national administration carries forward on current energy projects, all studies and predictions indicate photovoltaic power can compete with conventional sources by that time," he told the Herald American.

In Beverly, U.S. Congressman Nicholas Mavroules, who campaigned for the \$2.7 million DOE school energy grant, said, "the development of new energy sources, like photovoltaics, will do more over the long haul to fight inflation than any one-shot budget cutting measure."

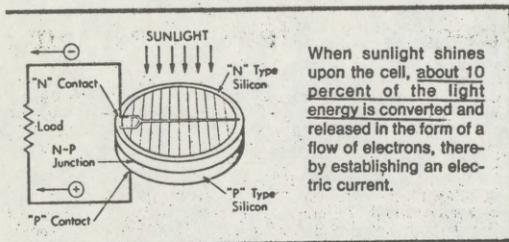
Mavroules pointed out that New England presently relies on oil for 80 percent of its energy needs, almost twice the national average.

"This makes our fuel bills disproportionately higher than the nation's," he said, adding that solar systems like the one starting in Beverly "could cut our oil consumption by 78 million barrels of oil



Single family dwelling in Carlisle will depend on solar energy.

N.E.'s answer?



each year or about 8 percent of the school's electrical usage.

It can produce 100 peak kilowatts of direct current (DC) electricity which will then be converted to 480 volts, three-phase alternating current (AC) electricity by an inverter.

In Carlisle, according to Strong, 126 solar panels containing the photovoltaic cell modules, will be arrayed on the south-facing roof of the house, pitched at 45 degrees for optimum solar exposure.

The system will provide the electricity to run a pump that will supply all the energy needs of the house except for its hot water which will be supplied from solar-thermal collectors also placed on the south roof.

The Carlisle house on Munroe Hill will not be small, according to its designer, Strong. It will have approximately 2,400 square feet of living space, including a living room, dining room, kitchen, den, four bedrooms and three and a half bathrooms.

It is located on a two-acre lot on the side of a hill where there is lots of sunlight and an excellent view into Boston, according to banker Curtis.

The site is ideal for the field demonstration of residential photovoltaic electricity use, Roy Smith said. Upon completion, the home will be sold to a family with two or three children, he said. The family must agree to provide access to the home and recording equipment for study and monitoring for a period of not less than five years.

And for anyone interested in buying it upon completion, banker Curtis says the sale price will be \$225,000.

annually and meet the electrical needs of 22 million households by the year 2000."

David W. Curtis, official of the Co-operative Bank of Concord, which is providing construction and mortgage loans for the Carlisle project, said the bank plans to actively promote awareness and understanding of photovoltaics.

A model of the home will be on display on a rotating basis at the bank's six branch offices from now until November when it is expected the house will be completed, he said.

In both projects, the solar-energized power systems, are based on the same principles, if of different sizes.

Beverly's system, to be completed by January 1981, will consist of an array of 3,200 photovoltaic solar modules, arranged in solar panels and installed on a four-acre hillside.

Each module will contain 36 photovoltaic cells of 4-inch size, wired together in sets.

The system will provide about 116,000 kilowatt hours of electricity

SOLECTRO - THERMO, INC.

1934 LAKEVIEW AVENUE
DRACUT, MASSACHUSETTS 01826

MANUFACTURERS OF:
Total Solar Energy Systems

TELEPHONE:
617-957-0028



Solcetro-Thermo, Inc. (STI) is a small solar manufacturer located in an old woolen mill complex at 1934 Lakeview Avenue, Dracut MA. STI offers the American public the only functional operating, technically efficient, electric/thermal solar energy "tracking" system currently available on the commercial market today.

This solar hybrid system--researched, developed, tested, demonstrated, commercialized and patented in the 1970s is now ready to present a solid solar answer to our slavish dependence on fossil fuels resources for electricity and heat energy for households and business enterprises in the 1980s.

A hybrid system, as indicated, is one that provides electricity and heat from the same installed collector array--the electricity being used to power commercial and household lighting systems, in-house telephone lines, small appliances, computer terminals and electric typewriters. The thermal energy generated in conjunction with the solar electricity is used to space heat a home or business as well as provide hot water.

(see reverse)

STI is a trail-blazer in the "total energy" field with the 1980s solar thrust beginning to coalesce around hybrid systems. A recent Citizens' Conference in Washington told the Dept. of Energy that "hybrid systems make the most sense." A Special Report from Europe stressed PV/hybrid systems are gaining favor because "one of the most economic methods of harnessing solar energy for residential purposes is a hybrid photovoltaic and heat collector system."

A spokesperson for Westinghouse Electric Corporation, at a DOE Annual Photovoltaic Program Review in April, 1980 stated: "for residential solar energy applications, total energy systems offer the greatest promise." A Brookhaven National Laboratory "Proceedings" Paper discloses, "systems which utilize a combination of photovoltaic and thermal collection in the same solar collectors (PV/T systems) can have advantages over PV or thermal systems in that the cost effectiveness of the collectors and their support structures may be improved; active cooling may allow the cells to run at a low temperature--hence higher conversion efficiencies, and space limitations on side by side collectors can be avoided."

Yet STI has the only commercially available and privately sold "total energy" solar system on the market today!

* * * * *

Sollectro-Thermo, Inc. was founded in 1976 by Arthur J. Manelas, president of STI and inventor of this unique hybrid system. Prior to his establishment of STI, Mr. Manelas was a laboratory director at Space Tac, Bedford MA, where he supervised the fabrication of photovoltaic arrays to power both manned and unmanned space satellites. It was his experience in aerospace photovoltaics that provided insight into cost effective applications of solar electric cells in terrestrial settings. This insight led to the conclusion that solar electricity must be combined with solar thermal energy so as to provide a true solar alternative. Herein lies the solar answer!

The STI hybrid system combines three technical concepts: (1) the intensification of the sun's energy impinging on the active surface of a solar cell by means of a simple, low cost, reflective concentrator, (2) conversion of this high density energy to direct electrical power by photovoltaic means and (3) capturing the thermal energy produced as a byproduct of the sun's radiation.

With state-of-the-art technology, solar cells are relatively expensive; provide low voltage (.4-.8 volts) and have low efficiency (10% to 14%). A typical "flat plate" panel which provides 60 peak/watts (5v @ 12 amps) will require about 900 sq. in. of solar cell active area. The STI modules (4 ft by 4 ft) with an equivalent daily watt-hour reading require about 27% of the equivalent (watt-hour rating) flat panel cell active area. In the STI system, expensive cell area has been replaced by inexpensive areas of heat absorbing reflective materials.

The STI module (collector)

The heart of the STI hybrid system is the energy conversion solar cell. Many research programs are devoted to new technologies in solar cell design in order to reduce cost and improve efficiency. Silicon cells are the only cells with proved reliability and are commercially available from several solar companies. The STI system uses these existing cells which, however, have been optimized for use at mild intensity sun levels. Therefore, STI concentrator/reflectors have been restricted to a concentration (gain) ratio of less than five (suns.)

Electric power output of a solar cell is related to the magnitude of incident sunshine power density and to the angle of incidence. Terrestrial sunshine has a standard value of 100 milliwatts per square centimeter of surface area. This is de-

fined as "one sun" illumination density. If a concentrator has a concentrating ratio of five, then the solar cell illumination density is called "five suns." Solar cells optimized for use with concentrators have a 10-12% conversion efficiency and the power output will be linear with illumination density. A typical 4-inch diameter solar cell, optimized for a concentrator, will provide 0.7 watt (1.8 ampere @ 0.43 volt) at one sun and 2.7 watts at a five sun level. On a cost comparison, the price of one STI concentrator/reflector is about one-third the cost of a mild concentrator cell. Thirty-three solar cells and 33 concentrators are housed within a sealed, weathertight 4 ft by 4 ft housing, protecting the cell/concentrator assembly from the elements. The enclosure is made of aluminum with the glazing (not shown in the cone/cell illustration) made of acrylic or fiberglass.

The solar cells are kept cool by means of forced air (at 512 CFM) through a typical 10-module (160 sq. ft.) household array. Each reflective cone has 85 sq. in. of heat-absorbing, heat-conductive, heat-radiating aluminum. Thus, 33 concentrators making up each 4 ft by 4 ft module has a total area of 2,805 sq. in. The 16 sq. ft. substrate beneath the solar cell/concentrator assembly has another 2,305 sq. in., which means air drawn from storage and passing through the array has a total of 5,110 sq. in.; an expansive surface that provides a repository for heat energy generated in tandem with the solar electric input. Forced air from storage passing through the modules wipes this huge surface area free of solar Btus and returns this thermal energy to storage.

Flat plate collectors simply do not have this total sq. in. of surface area to "hold" solar Btus. As a result, a higher percentage of this heat energy, particularly in colder climates, escape to the outside ambient. Flat plate systems generally have a double glazing to retard reradiation which also serve to inhibit solar radiation.

Specifics on the STI concentrator/reflector

Sunlight entering the STI concentrator at its 7½ in. outer diameter opening is "bounced" at a 60° angle off the polished aluminum inner surface down onto a photovoltaic cell through its 3½" inner diameter opening. Sunlight not absorbed by the solar cell is reflected back at 60 degrees to the inner body of the cone. On each bounce, the sunbeam loses about 30% of its energy as heat to the heat-absorbing aluminum reflector. Thus, by bouncing several times within the body of the cone, practically all of the solar Btus, not absorbed by the cell to create electricity, is captured by the concentrator as well as the solar electric "motherboard" beneath the cells. This minimizes reradiation. The solar influx is trapped in the lower third of the concentrator where it is harvested by the circulating forced air and passed to thermal storage. Because of the focused energy away from the glazing surface, the STI system requires only one sheet of glazing, regardless of climatic conditions.

The innovative aspect of the STI concentrator is clearly seen in that it is a focusing device for "locking" the sun's energy away from the glazing while also serving as a huge heat sink for the "sunlocked" thermal energy.

To facilitate cooling of the solar cell for optimum operating efficiency, the reflective cones sit on "legs" one-half inch high which allows cooling air to pass under and around the concentrators and over the cell itself, giving the cell its own "breezeway"; assuring long life operation.

One STI 16 sq. ft. electric/thermal module, under NASA standards of 1,000 watts per square meter illumination density at 28°C is 75 watts. For every watt of electricity, the STI hybrid system generates seven watts of thermal energy. It is this combination of electricity and heat energy that now presents a cost-effective photovoltaic picture.

The unique features of the STI system are protected under US Patent Number 4,080,221; issued on March 21, 1978.

STI has a number of in-place PV/hybrid arrays and is the only solar firm currently engaged in commercializing a photovoltaic system. All other PV projects have been underwritten by the US Dept. of Energy. Recent STI installation include:

A 40-module system on the roof of Granite Place Apts., Quincy MA, solar powering nine pumps on a 6,500 sq. ft. flat panel hydronic array providing domestic hot water for a 270-unit elderly housing complex.

Quincy Mutual Fire Insurance Co. - a 20-module STI hybrid array is providing electric power for the firm's in-house telephone service. The system's thermal energy is pre-heating water in a 200 gal. pre-heat tank, with a portion of the sun's input mixed with the makeup air feeding the insurance company's boiler.

Two banks in New York State have an STI array. The Westchester Federal Savings array is solar powering computer terminals and lighting the main chandelier in the lobby with the solar thermal energy heating the bank lobby. This array features azimuth tracking. The Syracuse Savings Bank, Onondaga Hills, NY has a 16-module array inplaced in the roof of the branch so that the glazing is flush with the roof line. Because of the in-roof installation, the system incorporates an altitude tracking mechanism for automatic seasonal adjustment of the concentrators within the STI module.

STI has solar equipped the first two homes in an envisaged 36-home solar village of Madaquecham on Nantucket Island which, along with propane generators and a wind mill farm, makes the village homes independent of utility power.

Below is listed STI collector performance data under listed conditions:

Open Circuit Voltage	16.5 volts	
Short Circuit Current	4.8 amps	<u>Collector Efficiency (16 ft²)</u>
Maximum Power	57.57 watts	ELECTRICAL: (%)
Amps at Max. Power	4.202 amps	Gross area - 3.874
Direct Normal Insolation	985 w/m ²	Net area --- 4.49
Total Horizontal Insolation	617 w/m ²	Concentrator
Flow Rate	36.5 CFM	Area - 6.655
Input Temperature	51.5°F	THERMAL: (%)
Output Temperature	112.5°F	Gross area - 48.45
Maximum Thermal Output	720 watts	Net area - 56.20
Outside Temperature	38.5°F	Dimensions of Concentrator:
Wind Speed	18 mph	Large end - 41.26 cm ²
		Small end - 12.56 cm ²
		Geometric ratio - 3.28 to 1
		Net Geometric ratio - 2.25 to 1
		Reflectivity - 70%

END

Senator METZENBAUM. Our next witnesses will be a panel of representatives from public interest groups, Scott Denman, Citizens Energy Project and Mr. Barrett Stambler, Solar Lobby, Washington, D.C.

PANEL OF PUBLIC INTEREST REPRESENTATIVES:

**STATEMENTS OF SCOTT DENMAN, CITIZENS ENERGY PROJECT AND
BARRETT STAMBLER, SOLAR LOBBY**

Senator METZENBAUM. I will ask each of you gentlemen to make your remarks relatively brief. I think you heard my suggestion to the previous witnesses.

I am not sure who this lady is. We are happy to have her at the witness table.

Mr. STAMBLER. This is Joanne Shorrey. Joanne and I have been working on this project, competition, and small business involvement in the industry for some time.

Senator METZENBAUM. We are happy to have her with you at the table.

Ms. SHORREY. Just wanted you to have some woman here. I thought it would be a good idea.

Senator METZENBAUM. We are delighted. We have equal rights in this subcommittee, I hope.

Mr. DENMAN, do you want to proceed, first?

Mr. DENMAN. That is fine.

Senator METZENBAUM. I would suggest that you confine your remarks to about 10 minutes.

Mr. DENMAN. Fine.

Thank you very much for the opportunity to articulate the concerns of Citizens' Energy Project and its constituents regarding the question of competition within the emerging solar industries.

As a voting resident of the State of Ohio, I certainly appreciate the chairperson's interest and his action in establishing these important hearings.

Senator METZENBAUM. Thank you.

Mr. DENMAN. I will summarize my remarks and move forward with some suggestions that I think will enhance competition in the solar energy industry.

At present, 9 of 10 photovoltaic firms are either owned or controlled by multinational corporations. Six of those are oil companies.

Ninety-nine percent of domestic copper production, essential for making solar thermal equipment, is owned or controlled by the oil industries.

In the first half of 1980, the Department of Energy determined that there are now 223 manufacturers of solar thermal collectors, 25 fewer than the number of similar companies in the previous reporting period.

Furthermore, the 10 leading manufacturers of low-temperature thermal collectors produce 94 percent of that equipment.

Similarly, the 10 leading manufacturers of high-temperature or concentrating collectors produce 99 percent of that equipment.

Corporate giants Exxon, Grumman, General Electric, Asarco, Gulf, Arco, are among the leading and most highly capitalized solar thermal equipment manufacturers.

Ostensibly, the energy-related conglomerates are also moving with deliberate speed to firmly establish themselves in the infant alcohol fuels industry and the rejuvenated windpower industry.

It should be noted that many of the same corporations that are increasing their investments in solar by buying out the smaller firms have long decried the economic viability of solar energy and have often, in their media campaigns, referred to solar in exotic, futuristic, and uneconomic terms.

In each of the last 5 years, big businesses have received no less than 87 percent of the Government's prime solar contracts; this occurs despite the fact that 85 percent of all solar businesses are small firms.

This condition persists in spite of numerous studies, including one by the National Science Foundation, showing that small businesses are many times more cost-effective than big businesses in developing new technologies.

Given the investment prerequisite for quick returns, major corporations eschew development of new technologies without heavy Government subsidies.

Major firms also receive approximately 75 percent of all Government windpower R. & D. contracts. Ironically, the DOE contracted Rockwell International to manage the Government's small wind systems program.

Biased contracting does not happen accidentally. A new Citizens' Energy Project survey of the top 165 DOE administrators shows that of the 97 respondents, 33 percent of these individuals were formerly employed by major multinational corporations—many of which are energy conglomerates and many which receive substantial Government contracts for all types of energy R. & D.

The data seems to indicate that if the backgrounds of all the top administrators were made available, approximately 50 percent or more would be shown to have been previously employed by big businesses.

Unfortunately, this revolving door seems to only service big business and Government officials. The survey shows less than 5 percent and possibly less than 2 percent of the 165 DOE administrators have been previously employed by small businesses.

Senator METZENBAUM. Mr. Denman, I am going to make a suggestion to you. Some of the things that you are saying are very, very important to this hearing. But in your anxiety to move so rapidly and read your statement so rapidly, you are losing its impact.

I would just like to suggest to you that I am interested in what you are saying.

Mr. DENMAN. Fine.

Senator METZENBAUM. But I am having trouble just following you.

Mr. DENMAN. OK. I was concerned with the amount of time.

Senator METZENBAUM. I understand that, but it would be better to have a little that is more effective, than a lot that is totally lost. Even the official reporter is having difficulty keeping up with you.

Mr. DENMAN. Thank you very much. I will certainly slow down.

Indeed, the DOE is purposefully handing the solar market to the large corporations on a silver platter. One only needs to read the DOE's 1979 semiannual report to Congress to confirm this.

The report states:

Though the solar energy industry at present consists mainly of small businesses, the majority of Government funds channeled into the industry have been in the areas of research and development, and therefore have been directed to large corporations and educational institutions.

Citizens' Energy Project contends that this policy not only helps to destroy competition within the solar energy industry but is an economic insult to our country's small businesses—the sector of our economy that provided 98.3 percent of all new jobs between 1969 and 1976.

These are not isolated, bureaucratic abuses. The Government's solar contracting policy, patent policies, solar standards, and equipment procurement practices handcuff small solar businesses, giving the major energy corporations an unfair competitive edge.

I think central to this theme, it has been mentioned by both representatives of the small businesses here this morning, is the lack of capital for small businesses. The small firms are unable to acquire the needed capital for development for various reasons.

As evidenced by the growing concentration in the solar market, many of the small firms, unsuccessful in securing the funds necessary for product development, sell out or go under.

This action further reduces competition by simply diminishing the number of companies operating in the solar market.

Thus, you have a vicious cycle created when the small businesses sell out or go under. This enhances the market for the major firms who are involved and have the capital to continue their involvement in solar energy.

Citizens Energy Project concurs with your colleague, Senator Hart, when he posed the rhetorical question, "Could it be that Exxon," and I would say all oil companies, "hopes that solar stays under wraps until the world's fossil fuel markets are exhausted."

Usually, a business is not interested in competing against itself. The major energy conglomerates have heavy investment in conventional fuel and nuclear energy.

Therefore, it stands to reason that the major energy firms would seek to maximize their profits on their investments in these areas, while holding alternative, potentially competitive energy development in abeyance.

Inasmuch as energy development has now become a national security issue, Citizens' Energy Project feels that Congress should create legislation that would encourage competition within the industry, and between the renewable and nonrenewable energy resources.

In the effort to promote and implement positive, constructive policy steps that will help insure the rational, just, and economically sound development of solar energy, Citizens' Energy Project proposes the following policy suggestions for congressional consideration:

One, prohibit firms from investing in more than one area of energy development. Through horizontal divestiture, sever those once-independent solar firms from the corporate webs of the multinational energy firms.

Two, simultaneously, provide incentives that encourage financial institutions to make the capital available for these small companies to

develop and market their solar innovations. That can reduce our dependence on foreign oil and unsafe energy sources.

Three, split the Department of Energy into two departments. One should be delegated the responsibility of researching and developing renewable, nonnuclear energy resources; the other would oversee conventional and nuclear development.

The renewables department should be staffed by qualified individuals with development of renewable energy as their only vested interest.

A solar congress with representatives from each region of the country could determine the types of projects to be undertaken by the new renewable energy department and the level of funding for each project.

I would add, I think that should be a Cabinet level position as well.

Four, increase staff and budgets of the FTC's Bureau of Competition and the Department of Justice's Antitrust Division and mandate that these agencies aggressively monitor big business involvement in solar energy and pursue litigation where necessary.

Five, mandate at least 46 to 48 percent, which is essentially the annual contribution of small businesses to the gross national product, of all Government solar project contracts, and equipment procurements be made from small solar businesses. "Small" is to be defined as 100 employees or less, rather than the current definition of 500 employees.

Additional recommendations are presented in the report which I will submit for the record.

Senator METZENBAUM. It will be inserted in the record at the conclusion of your oral testimony, without objection.

Mr. DENMAN. Citizens' Energy Project also calls for the formation of a national coalition of solar business representatives, solar activists, national, State, and local energy officials, and similarly committed citizens to encourage Congress to make these legislative and institutional initiatives law.

Regardless of the path taken, only a strong, concerted effort will reestablish competition—which is vital to the development of solar energy.

It must be made clear to the oil industry and others that the promise of a solar society will be neither diminished nor deferred by selfish interests.

Oligarchical control of the Nation's energy supply has no place in the future of our democratic society. The ominous trends to the contrary can be reversed. However, we must act now if we are to ever witness the dawn of the solar age. Thank you very much.

Senator METZENBAUM. Thank you, Mr. Denman. I will have some questions for you and there we will hear from Mr. Stambler, after we take a 10-minute recess. There is a rollcall vote on the floor at the moment.

[A short recess was taken.]

Senator METZENBAUM. The committee will come to order.

Mr. Stambler. 10 minutes.

Mr. STAMBLER. First of all, on the matter that Mr. Miller was talking about, about the individual decisions that are made on renewable resources and the need to get this technology out to the people of this country.

We feel that that is exactly the reason why we must encourage small business involvement. We feel that getting the funding out to those small businesses in the local area, that can work with the people in that community and develop solar in the community, is crucial.

Furthermore, about the subcontracting question, we are very concerned about the Department of Energy's ability to monitor those subcontracts. In fact, recently, I went over to the Office of Competition and found that they are in the process of developing reports on the photovoltaic industry.

In talking to the people at the Department of Energy, it became very clear that they do not have a very good grasp of where those subcontracts are going.

The House Small Business Committee report recently stated that they believe that a lot of the funding is going to janitorial services, printing and other nonsolar small businesses. We don't think that is utilizing the innovative qualities that the small businesses can provide to the solar energy industry.

Several reports have come out about innovativeness of small businesses. One of those recent surveys by the Office of Management and Budget said most of the recent technological innovations have come from small business.

So, we feel it is very important that funding from the Department of Energy go to those small businesses.

The solar lobby is also very concerned with competition in the solar industry. I concur with your fears about Exxon's and Mobil's statement.

In fact, I would like to read a recent quote from C. C. Garvin, Jr., chairman of the board of Exxon Corp., which he made on May 15, 1980, at the annual meeting of shareholders.

What he said is:

There is no doubt that solar and other nondepleting or renewable energy forms are the ultimate energy source and the main hope of meeting the energy demands projected for the 21st century and beyond.

But it is highly doubtful that this technology can be much help in the decades immediately ahead, even though the Government and many companies, including Exxon, are working hard on the problems.

Now, how do you juxtapose this statement with the President of the United States stating it is definitely attainable to get 20 percent of our energy needs from renewable resources by the year 2000 and a recent Harvard Business School report that said that renewable resources is the main solution in the near term.

We are also concerned with just how to get capital to those small businesses to develop the industry.

There is one program that is in existence right now that does provide some of that venture capital for solar small businesses, and that is the small business energy loan program. It provides direct and guaranteed loans to solar small businesses.

But, although it has been successful, the problem has been that the Government funding has not been high enough. Last year, the direct loan portion of the program was funded at \$15 million.

Quite frankly, that funding was gone in less than half the year.

This year, I am happy to say, the Senate Appropriations Committee has doubled that figure to \$30 million. The House has maintained that \$15 million level, which we don't think is adequate.

Soon, this will go to conference. I encourage your committee to support the Senate higher funding for this program.

We also have some suggestions on ways to bring funding to those small businesses that so desperately need the venture capital.

One possibility is to have a photovoltaics research and development grant program.

Another idea that we have been discussing is the idea of having at the Department of Energy, a venture capital advisory board. Let's get some experts who know about venture capital. Let's get them to start a board. What will happen is the Department of Energy will set aside a certain amount of money that will just go to venture capital for small businesses.

This advisory board will evaluate the needs of these small businesses and the program plans, and then, will in turn fund those promising small businesses.

Another area of major concern for us is the fact that this is a new industry. It is a young industry, but all the trends seem to show a tendency toward concentration. This is especially true in the photovoltaics industry, where a few companies are dominate.

We feel it is very important that we do not delay in watching and monitoring this industry. At the moment, neither the Justice Department, the Federal Trade Commission, nor the Department of Energy has an on-going research project to collect this data.

In fact, in talking to the Office of Competition, they were not sure how many companies were actually manufacturing photovoltaics. He said, "Oh, it is somewhere between 12 and 15 companies."

So, we recommend to this committee that it support excess funding for the Federal Trade Commission to begin an ongoing project.

Senator METZENBAUM. Do you think that would fly very far in this Congress or in the next Congress?

Mr. STAMBLER. Well, that's a good question. That it is—I think that what we have to do is give a mandate to the Federal Trade Commission that there should be an ongoing research project. The Department of Energy has an Office of Competition. They have the funding to hire some more people. In fact, I was shocked to find out that the individual who was hired to monitor the solar and conservation competition issues left over a year ago. They still haven't replaced that person.

So, I think that it may be better if some of the funding allocated to the Federal Trade Commission in this Congress be reallocated to do some preventive work in a new industry like the solar industry.

I think we have learned from the past what will happen if we don't keep a close eye on what happens in some of these industries. I think it is proper that some of these funds be reallocated to the Federal Trade Commission or to the Justice Department.

Senator METZENBAUM. Mr. Stambler, as a friend of the FTC, this Senator isn't going to recommend that I or any other Senator go to the floor with any amendment that might be subject to amendment because I think we would do more harm than good.

Frankly, I think the suggestion about reallocation of funds, in view of the political tenor of this Congress and the incoming one, is unrealistic, frankly speaking.

I think what the FTC can do, they should do. But, I think that you also have to be realistic about the temper of the times.

Mr. STAMBLER. I agree with you.

Senator METZENBAUM. Do you want to finish up?

Mr. STAMBLER. Yes; I would just like to cover one other area I would like to touch on. That is the Department of Energy's contracting procedures.

Solar Lobby has been talking to individuals and small business people outside of the industry, outside of the Government, and within the Government, to find out if those contract procedures are geared to encouraging small business.

What I found is that most small business people say that they have given up on applying to the Department of Energy for funds. The solicitation process is cumbersome. Both Mr. Shahryar and Mr. Charlton recently testified that they would have to hire an extra employee just to deal with these contracting procedures.

We feel that the solution may be that small business should receive special treatment because they cannot afford to hire extra people to deal with these procedures.

We feel very strongly about this, and we thank you for the opportunity to testify on this issue.

Senator METZENBAUM. Mr. Denman.

Mr. DENMAN. Yes.

Senator METZENBAUM. You heard my questions to Mr. Miller about why you and he are saying different things.

Mr. DENMAN. Yes. Correct.

Senator METZENBAUM. I think you are both honest men. Why the contradiction?

Mr. DENMAN. I think there are a couple of points which need to be brought out with regard to this contradiction. Mr. Miller seemed to be addressing himself to 1980 figures, in particular. I did not address myself to 1980 figures. In terms of what money had gone toward contracts, I addressed myself to the last 5 years, 1975 through 1979.

My figures come from the Senate Small Business Committee. Dr. Corey Rosen, a staff member of the committee, made these statistics available to me and went over those statistics with me. So, I feel very comfortable that these statistics, as Mr. Miller said, are "scrubbed."

In the report that I submitted for the record, I have those statistics outlined in the addenda.

Senator METZENBAUM. Are you receptive to meeting with Dr. Miller, as I suggested?

Mr. DENMAN. I certainly am.

Senator METZENBAUM. I think, since you took your figures from Dr. Corey Rosen—is that his name?

Mr. DENMAN. Yes.

Senator METZENBAUM. I gather all you are in a position to do is to say, "I received them from Dr. Corey Rosen." Perhaps, you ought to have him there at the same time.

I think this committee is entitled to some further clarification. And really, to paraphrase that TV program of many years ago, and which you were probably too young to hear, "We just want the facts." If we get the facts we will be all right.

Mr. DENMAN. I appreciate that.

Mr. Rosen reported to me that his statistics were developed during the hearings that were held by the Senate Small Business Committee. He worked with the Department of Energy to come up with those figures that I gave earlier.

I am very concerned that while there may be some slight policy changes in 1980, the overall trend has had a serious impact on the developing solar energy industry and a serious impact on small solar businesses.

Senator METZENBAUM. You suggest the big oil companies may retard the growth and development of solar energy. Do you have any evidence that they are doing that or that they intend to?

Mr. DENMAN. Inasmuch as they have advertised, and in some cases continue to do so, by delegating solar to an exotic or futuristic or even uneconomical status, I think that they have inhibited the interest of the millions of individual decisionmakers, as Mr. Miller brought up before, through their involvement with solar energy.

I think also, as I mentioned in my testimony, that the natural occurrence with a horizontally integrated corporation, when it has a number of different energy components under its corporate umbrella, is a tendency not to compete between those components, but to exploit the market with that energy source that is most profitable at the time.

My understanding of the operations of major corporations in the United States today is that they have to find a quick return on their investment. This is one of the reasons why innovation in the big corporations is at such a low, according to the National Science Foundation.

Senator METZENBAUM. Have you done any independent research on the question of DOE or its funding policies, other than that which we gained from the Senate Small Business Committee and Dr. Rosen's testimony? Have you done anything at the DOE itself?

Mr. DENMAN. Yes; I think it is very important to look at the most comprehensive review of the Department of Energy's funding policies and energy development policies. There was a domestic policy review which was held in 1978, and, with information I will submit for the record, and information I have made available to your staff already, in draft documents that were not released to the public, they bring forth a number of points.

One of them states, and I quote:

In the absence of antitrust enforcement and other regulatory activity by the appropriate agencies, the potential exists in the solar industry for monopolistic pricing, restrictions of supply, delays or reductions in technological innovation and product development and a Government-induced decline in competition in the industry.

It goes on. The domestic policy review draft documents go on to talk about the procurement problems, the redtape that small businesses face and a host of other problems, like patent procedures and policies which inhibit small businesses.

Senator METZENBAUM. Mr. Stambler, you talked about the fact that small businesses apparently get a relatively small share of the DOE solar funds. But you mention a loan program in the Small Business Administration as being very helpful. Why do you think the SBA program has been so much more effective?

Mr. STAMBLER. I think the key to that program is that it provides venture capital. There are no strings attached to that funding. Look, there is a solicitation from the Department of Energy, and you have to meet certain requirements under the Department of Energy.

In contrast, this loan program is a direct and guaranteed loan program. This money is loaned to them with no strings attached.

I think that this is much more appetizing to a small business because they do not run the risk of surrendering their patent rights. Under a Department of Energy program they might be required to give up patent rights. That would take away one of the unique capabilities of small businesses; the ability to come up with new inventions.

This loan program allows them to maintain their independence and keep their patents. It has just been very successful. I think we should encourage that type of loan program.

Senator METZENBAUM. Do you think the loan program is better than the grants program?

Do you think that helps small business people to get a loan that has to be repaid, when they sometime have difficulty just keeping operating capital?

Mr. STAMBLER. Well, I think you need a mixture. The problem with the guaranteed loan portion of the Small Business program is that they must go through conventional banks, lenders in their community. Many times that bank does not want to take a chance, even though it is guaranteed. Only 90 percent of that loan is guaranteed. Upon default, to get the money back requires excessive paperwork.

So, banks are very hesitant to provide funding through conventional means even under the guaranteed loan program.

So, I think the Small Business energy loan program is one solution, but I definitely do not think it is the only solution.

I like the idea of a grants program. In fact, I would also recommend that this committee hold some hearings in some of these cities and really get some of these lenders together with the solar small businesses to find out where the difficulties are. Let's try to decentralize this process. I think it would be very helpful. I think you will find that a lot of the bankers and conventional lenders are a little skeptical but, if they could see each other eye to eye, it would be very beneficial to both the small business person and the banker.

Senator METZENBAUM. Thank you very much, Mr. Denman and Mr. Stambler.

Mr. STAMBLER. Thank you, Mr. Chairman.

Mr. DENMAN. Thank you, sir.

[The prepared statements of Messrs. Denman and Stambler follow.]

PREPARED STATEMENT OF BARRETT STAMBLER

Thank you very much for the opportunity to appear before your committee on the issue of competition and small business' involvement in the solar industry.

We are here to represent the Solar Lobby, an organization that was formed in 1978 and now has grown to over 40,000 members. The Solar Lobby promotes the accelerated use of renewable resources and, in particular, the development of a competitive solar industry that fosters innovation and price reductions.

We have seen what control of an industry by a few corporations has meant to the consumer in the past. Raised in Los Angeles, I can't help but mention how the actions of several powerful companies permanently polluted the air. Your committee played an important role in documenting how General Motors, Standard Oil of California and the Firestone Tire Company joined hands to

dismantle the high-performance electric trolley that efficiently traversed Southern California. (It had 3,000 cars within a 75-mile radius.) In the 1940s, these three companies were behind the replacement of the trolley system by the much-inferior petroleum-driven bus and automobile. In place of the trolley, a mindless maze of freeways now spread sacross the smog-filled L.A. Basin. In March 1949, when a Chicago Federal Court finally figured out what had happened, General Motors was fined a paltry \$5,000.

Although nothing of this magnitude has yet plagued the solar industry, it is worth noting that General Motor's scheme was not revealed until the damage had been done. At the Lobby we see how important it is to take a hard look at the solar industry and to begin to administer some "preventive medicine" to assure its health over the long term.

In the photovoltaic industry, oil companies already control much of the market. In fact, a study recently released by the American Petroleum Institute states that three companies control 77.3 percent of the photovoltaic market. Two out of the three are owned totally by oil companies: Arco and Exxon. The third is Solarex, which was a 100 percent solar firm until Amoco recently bought approximately 20 percent of the company. Solarex's owners had often voiced their intentions to maintain complete independence and, in fact, were probably forced to sell part of the company to Amoco because there was no other source of capital.

We cannot fault the oil companies for entering the solar industry. But we must question their motives. Do the oil companies really see a solar future or are they just investing enough in the solar industry to maintain a foothold? Time and again oil companies' statements have been at odds with their internal and external actions. For example, consider the statement that C. C. Garvin, Jr., Chairman of the Board of Exxon, made at the Annual Meeting of Shareholders on May 15, 1980:

"What is important now is not so much to convince people of the reality of the problem but to convince them that there are no easy solutions . . . Too many people count on a quick fix, typically involving solar energy and other clean, cheap and inexhaustible energy forms . . .

"There is no doubt that solar and other nondepleting or renewable energy forms are the ultimate energy source and the main hope of meeting the energy demands projected for the 21st century and beyond. But it is highly doubtful that this technology can be much help in the decades immediately ahead, even though the government and many companies, including Exxon, are working hard on the problems."

Now, how does this statement mesh with the President of the United States' firm belief that renewable resources can provide 20 percent of our energy needs by the year 2000? Or with Harvard Business School's well-reasoned contention that solar and conservation are the best energy sources to exploit in the near term? Furthermore, the Department of Energy has claimed that photovoltaics will be cost-effective by or before the year 1986. So, while Exxon funnels millions of dollars into photovoltaics, the Chairman of the Corporation is publicly downplaying the potential of solar energy.

But we are not here solely to outline the potential problems. Part of our aim is to come up with some concrete solutions. In preparation for the hearing today, we have spoken to many individuals—both within and outside the government who are very concerned with the development of the solar industry. With these conversations in mind, we have identified what the Solar Lobby believes are the key issues.

One step we see as crucial to the development of a competitive industry is maintaining and encouraging small business' involvement. Photovoltaics and other solar technologies are particularly suitable for on-site installations, and their size, decentralized nature, and other characteristics make them especially appropriate for small business to manufacture, sell, or install. Small business is well equipped to at least share in the production and application of photovoltaics; and in cases where the module manufacturing takes place away from the site, small business entrepreneurs can mount, interconnect, and install the photovoltaic systems.

This in mind, the DOE's current emphasis on such balance-of-system programs makes good sense. However, DOE's contract and procurement structure does not always facilitate the involvement of small business. The applications for DOE funding are over and over again criticized as unduly cumbersome. Fare too much time elapses between funding requests and funds dispersal, and the

many programmatic changes within DOE and the Congress cannot help but destabilize such a young industry. Several companies we contacted expressed the belief that DOE solicitation procedures were geared primarily to those companies used to dealing with NASA and to handling large-scale aerospace contracts. One small businessman from New England said he had given up on Federal funding because it was too difficult to understand the solicitation procedure because he could not afford to hire an extra person just to deal with Federal contracts. Certainly, DOE has supported large-scale grant appropriations and applications, and many of these have been ill-suited to small business' needs and strengths. But beyond that, small companies simply do not have the in-house expertise and funding that large companies do and that handling involved procedures requires. This means that fair treatment for small business may mean special treatment. Why not, as has been suggested, make the red tape of an application proportional to the size of the firm making the grant application?

Another widely felt and legitimate concern is that we don't get caught in a numbers and percentages game. Several times DOE has announced increases in the percentage of contracts going to small business. We can only commend DOE's recent efforts to increase small business participation in their programs, which—according to a recent GAO report—increased to about 14.5 percent of the Department's solar budget in 1980.

Yet, a large portion of DOE's funding to small business takes the form of subcontracts. And as a recently released House Small Business Committee report emphasizes: "DOE must acknowledge that subcontracting does not promote the total answer to the small business role in solar energy development, because it does not utilize fully the innovative qualities of small business."

At the moment, DOE's records of contracts do not reveal who gets subcontracts. Quite possibly, many small business subcontracts go for nontechnical services such as printing, janitorial services, etc. Noting that the Office of Management and Budget recently concluded that over half of all technological innovations come from small companies, it is essential that detailed records are kept, so we can maximize small business' unique capabilities to develop the solar industry.

During the past two years, the Solar Lobby has pushed hard for the passage of the Photovoltaic Research Development and Demonstration Act, for increased support of the Federal Photovoltaic Utilization Program (FPUP), and for higher authorizations and appropriations for DOE's photovoltaic programs. In addition, we have testified on the regulations for the FPUP program, asking for set-aside provisions for small business participation. In short, we whole-heartedly believe that government procurements represent an appropriate funding source for the development of small business markets.

The Federal Photovoltaic Utilization Program (FPUP) establishes such a marketing plan. At the same time, the amendment to the Small Business Act (PL 95-507), which stresses small-business participation in government procurements, provides a significant impetus to this FPUP program. However, neither DOE nor the Administration has supported authorizations established by this legislation, and a significant opportunity for the photovoltaic industry and small business is being forfeited.

We urge your committee to bring this program to the attention of DOE and the Administration. Further, we ask you to stand behind any Congressional action to reinstate support for the FPUP funding. This is not to say that we believe that developing a competitive solar industry is the sole responsibility of the Department of Energy. In terms of small business' need for venture capital, we have gathered evidence of several significant roadblocks both inside and outside the Department of Energy.

First, diversified energy companies can utilize profits from other lines or subindustries to develop new products such as photovoltaics. This is definitely not the case for small businesses in the solar industry. Second, traditional sources for capital are not available to small businesses in a new industry with no track record. Our conversations with small businessmen in the solar industry reveal that banks are most reluctant to provide loans to a new industry. The risks strike them as too high. The message seems clear: New sources of capital must be made available to small solar businesses.

One program that has provided some funding assistance is the Small Business Energy Loan Program. However, this special loan program has itself been substantially underfunded. Fifteen million dollars was appropriated for the direct loan portion of this program in FY '80, and that amount did not last even six months. Initially FY '81 did not promise much more in terms of funding for this

loan program. But before it recessed, the Senate Appropriations Committee submitted a \$30 million budget for this special program—the only existing program that speaks directly to the supply side of the solar market. Clearly, if we are serious about maintaining a competitive industry, this loan program deserves a much stronger commitment.

Of course, a single program is not enough. We must continue to look for new and innovative approaches to provide capital to solar-related small businesses. One possibility is a small-business grants program for photovoltaic research and development. Another is the development of a Small Business Investment Company (SBIC) to finance solar development. This institution would take a matching funds approach: For every \$1 private investors can provide, the government will provide \$2. Under this plan, everybody wins. The solar small businesses get the venture and debt capital they desperately need, the investors make a profit, and the government gets its money plus a dividend back.

There are other approaches as well. One idea is to increase the business energy investment tax credit, which is now 15 percent for small businesses. One venture capitalist from New York highly recommended manipulating tax incentives to promote the solar industry's development. Another possibility would be to establish at the Department of Energy an advisory board made up of venture capitalists. This board would handle a certain amount of money set aside for developing solar small business. Interested businesses would submit a program plan covering a set number of years. The Venture Capital Advisory Board would evaluate the proposals and award capital to the most promising small businesses.

The third roadblock is psychological. Rapport between local lenders and small businesses is essential but sadly lacking. To make amends, the Solar Lobby recommends that this committee hold hearings in several cities to investigate the potential for local lenders to provide capital to businesses in their area. We must begin to develop in many localities a cadre of lenders who are sympathetic to the needs of solar small businessmen and who want to work with them.

Given the promise held out by these schemes, the Solar Lobby plans to continue to investigate innovative approaches to provide small businesses capital they so desperately need. Meantime, the Lobby strongly recommends that the Federal agencies quickly become attuned to this potential competition crisis in the solar industry. Forewarned, they can perhaps avoid the need for future legislative reforms or lengthy legal battles.

At this point, neither the Department of Energy and the Department of Justice nor the Federal Trade Commission systematically collects information and closely surveys competition in the photovoltaic industry or other solar fields. In fact, we were shocked to hear that DOE's Office of Competition has failed to fill the vacancy created when its sole researcher on solar and conservation left over a year ago. The Solar Lobby strongly recommends that this Committee should work with the Federal Trade Commission to provide the impetus and funding for an ongoing research project that closely tracks the solar industry.

In conclusion, if we are serious about developing our renewable energy resources, then we must encourage competition in the industry. The solar transition will stimulate business development and increase job opportunities. But we must enact incentives now that will enable small businesses to maintain their independence and, therefore, their unique ability to come up with needed innovations.

Again, thank you for the opportunity to appear today. We certainly support your committee's interest and hope to work with you closely in the future.

PREPARED STATEMENT OF SCOTT DENMAN

Mr. Chairperson and Members of the Committee: Thank you for the opportunity to articulate the concerns of Citizens' Energy Project and its constituents regarding the question of competition within the emerging solar energy industry. I would also like to congratulate the Chairperson for his action in establishing these important hearings.

The findings of Citizens' Energy Project's 18 month study entitled: Big Business & Renewable Energy Sources are particularly pertinent to the thrust of this Committee's investigation. For the sake of time, I will address the highlights of that report and submit a copy of it for the record.

THE RENEWABLE ENERGY INDUSTRY

At present, 9 of the 10 major photovoltaic firms are either owned or controlled by multinational corporations; six of those firms are oil companies. These companies include: Exxon, Arco, Amoco, Mobil, Shell, Chevron, Dyneer Corporation, Hughes Corporation, Libby-Ownes-Ford, and Motorola. Exxon's Solar Power Corp, Arco Solar, and Solarex (app. 50 percent owned by Amoco and other multinationals), alone account for 77.3 percent of the photovoltaics marketed, according to the American Petroleum Institute.

Ninety-nine percent of domestic copper production, essential for making solar thermal equipment, is owned or controlled by the oil industry. In the first half of 1980, the Department of Energy (DOE) determined that there now are 223 manufacturers of solar thermal collectors, 25 fewer than the number of similar companies in the previous reporting period. Furthermore, the 10 leading manufacturers of low-temperature thermal collectors produce 94 percent of that equipment. Similarly, the 10 leading manufacturers of high-temperature (concentrating) collectors produce 99 percent of that equipment. Corporate giants Exxon, Grumman, General Electric, Asarco, Gulf, Arco, are among the leading, most highly-capitalized solar thermal equipment manufacturers.

Ostensibly, the energy-related conglomerates are also moving with deliberate speed to firmly establish themselves in the infant alcohol fuels industry and the rejuvenated windpower industry. It should be noted that many of the same corporations that are increasing their investments in solar by buying out the smaller firms have long decried the economic viability of solar energy and have often, in their media campaigns, referred to solar in exotic, futuristic terms.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government is significantly contributing to the increased concentration of the renewable energy industry. Consequently, the government is assisting the inhibition of competition within the emerging industry and, most importantly, between the renewable and non-renewable energy industries.

For example, in each of the last five years, big businesses have received no less than 87 percent of the government's prime solar contracts; this occurs despite the fact that 85 percent of all solar businesses are small firms (less than 500 employees). This condition persists in spite of numerous studies, including one by the National Science Foundation, showing that small businesses are many times more cost-effective than big businesses in developing new technologies. Given the investment prerequisite for quick returns, major corporations eschew development of new technologies without heavy government subsidies.

Major firms also receive approximately 75 percent of all government windpower R. & D. contracts. Ironically, the DOE contracted Rockwell International to manage the government's small wind systems program.

Biased contracting does not happen accidentally. A new Citizens' Energy Project survey of the top 165 DOE administrators shows that of the 97 respondents, 33 percent of these individuals were formerly employed by major multinational corporations—many of which are energy conglomerates and many of which receive substantial government contracts for all types of energy R. & D. The data seems to indicate that if the backgrounds of all the top administrators were made available, approximately 50 percent or more would be shown to have been previously employed by big businesses. Unfortunately, this "revolving door" seems to only service big business and government officials. The survey shows less than 5 percent and possibly less than 2 percent of the 165 DOE administrators have been previously employed by small businesses.

Indeed, the DOE is purposefully handing the solar market to the large corporations on a silver platter. One only needs to read the DOE's 1979 Semi-Annual Report to Congress to confirm this. The report states:

"Though the solar energy industry at present consists mainly of small businesses, the majority of government funds channeled into the industry have been in the areas of research and development, and *therefore* have been directed to large corporations and educational institutions." (Emphasis added.)

Citizens' Energy Project contends that this policy not only helps to destroy competition within the solar energy industry but is an economic insult to our country's small businesses—the sector of our economy that provided 98.3 percent of all new jobs between 1969 and 1976.

These are not isolated, bureaucratic abuses. The government's solar contracting policy, patent policies, solar standards, and equipment procurement practices handcuff small solar businesses, giving the major energy corporations an unfair competitive edge.

COMPETITION AND THE LACK OF CAPITAL

Central to the problem of diminishing competition in the solar energy industry is the inability of small solar firms to acquire the needed capital for development, etc. This is one of the fundamental problems facing the small solar entrepreneur. The major corporations, particularly the oil giants, are "capital rich," skilled in grantsmanship, and as noted earlier, have many friends in the upper echelons of the DOE and within the financial community. Therefore, capital acquisition is not as significant a problem for the major corporations as it is for the small solar firms.

Because they often do not have an established credit record, can not obtain government contracts, and are considered high risk investments, small solar businesses are often denied access to capital by financial institutions. Even with federal loan guarantees, many financial institutions require prohibitive amounts of initial capital investment by the small business before assisting the company. Consequently, the small solar organization must decide between struggling against the odds for economic survival or selling out to the major conglomerates. As evidenced by the growing concentration in the solar market, many of the small firms, unsuccessful in securing the funds necessary for product development, sell out or go under. This action further reduces competition by diminishing the number of companies operating in the solar market. Thus, a vicious cycle is created as the smaller companies are slowly squeezed out of the market.

All of this activity is played against a rather dubious backdrop. Several U.S. Senators, including Gary Hart (D-CO), Lloyd Bentsen (D-TX), and Don Stewart (D-AL), have questioned the underlying interests of the big energy conglomerates movement into the solar industry. Northern Business Intelligence, an independent market research firm in New York City, for example, conducted an in-depth analysis of Exxon's solar activities and concludes that Exxon is holding back on large-scale solar manufacturing and marketing expansion until the market strengthens. According to data collected, Citizens' Energy Project concurs with Senator Hart when he posed the rhetorical question: "Could it be that Exxon hopes that solar stays under wraps until the world's fossil fuel markets are exhausted?" Usually, a business is not interested in competing against itself. The major energy conglomerates have heavy investments in conventional fuels and nuclear energy. Therefore, it stands to reason that the major energy firms would seek to maximize profits on their investments in these areas while holding alternative, potentially competitive, energy development in abeyance.

RECOMMENDATIONS

In as much as energy development has now become a national security issue, Citizens' Energy Project feels that Congress should create legislation that would encourage competition within the industry and between the renewable and non-renewable energy resources. In the effort to promote and implement positive, constructive policy steps that will help to insure the rational, just, and economically sound development of solar energy, Citizens' Energy Project proposes the following policy suggestions for Congressional consideration:

Prohibit firms from investing in more than one area of energy development. Through horizontal divestiture, sever those once-independent solar firms from the corporate webs of the multinational energy firms.

Simultaneously, provide incentives that encourage financial institutions to make the capital available for these small companies to develop and market their solar innovations.

Split the DOE into two departments. One should be delegated the responsibility of researching and developing renewable, non-nuclear energy resources: the other would oversee conventional and nuclear development. The renewables department should be staffed by qualified individuals with development of renewable energy as their only vested interest. A 'solar congress' with representatives from each region of the country could determine the types of projects to be undertaken by the new renewable energy department and the level of funding for each project.

Increase the staff and budgets of the FTC's Bureau of Competition and the Department of Justice's Anti-Trust Division and mandate that these agencies aggressively monitor big business involvement in solar energy and pursue litigation where necessary.

Mandate that at least 46 percent to 48 percent (the annual contribution of small businesses to the GNP) of all government solar contracts and equipment procurements be made from small solar businesses where "small" is defined as 100 employees or less rather than the current definition of 500 employees.

Additional recommendations are presented in the report which I have submitted for the record.

Citizens' Energy Project also calls for the formation of a national coalition of solar business representatives, solar activists, national, state, and local energy officials, and similarly committed citizens to encourage Congress to make these legislative and institutional initiatives law.

Regardless of the path taken, only a strong, concerted effort will re-establish competition—vital to the development of solar energy. It must be made clear to the oil industry and others that the promise of a solar society will be neither diminished nor deferred by selfish interests. Oligarchical control of the nation's energy supply has no place in the future of our democratic society. The ominous trends to the contrary can be reversed. However, we must act now if we are to ever witness the dawn of the solar age.

Senator METZENBAUM. Dr. Miller, we will be glad to hear from you at this time.

STATEMENT OF DR. BENNETT MILLER, DEPUTY ASSISTANT SECRETARY, DEPARTMENT OF ENERGY

Senator METZENBAUM. Dr. Miller, I think you heard me state previously that we ask our witnesses to try to confine their statements to about 10 minutes, and do it orally. You can do it reading part of your statement or just ad libbing the entire statement and we will insert the entire statement in the record at the conclusion of your oral testimony, whichever you prefer.

Dr. MILLER. Fine. Thank you, Mr. Chairman. I do appreciate your consideration. I also appreciate the consideration of the other witnesses. It is one of those things that happens. I have just got to get it taken care of.

I appreciate the chance to testify here this morning. I would like to summarize my testimony and submit the formal copy for the official record, if that is agreeable to you.

Senator METZENBAUM. Excellent. Your statement will be inserted into the official record at the conclusion of your oral testimony, without objection.

Dr. MILLER. Thank you.

What I would like to do is very briefly address several topics. One is the issue of small business participation in the solar program.

The second is the recent General Accounting Office "Report on Small Business Participation," and then, finally, a brief summary of the status of the photovoltaic industry, because I recognize that is of immediate and continuing concern to you.

To put this in context, I think it is important to recognize that the Department of Energy is a decentralized operation. A fair amount of our work is done by Government-owned contract or operated laboratories. They assume management responsibility for many of our programs.

In particular, we use the Regional Solar Energy Centers and the Solar Energy Research Institute as major contractors for solar programs.

We have worked very hard to insure that the small business component of our program is in fact not only a real program, but a real contributor to the overall Federal solar energy program.

In fact, SERI's 1980 goal was that 23 percent of its procurements would be for small business. I am pleased to tell you that that goal not only been met but exceeded this past year.

The fiscal 1981 goal is estimated to be 30 percent of the procurement dollars at the Solar Energy Research Institute.

In addition, in the passive products area, a recent award had 50 percent of the awards going to small business. This program will continue into fiscal 1981.

In our solar design program for commercial buildings, almost 75 percent of the awards will go to small business.

In the program that includes passive and hybrid solar programs for builders of manufactured or prefabricated buildings, almost 25 percent is for small business, and on and on.

We have a significant small business—

Senator METZENBAUM. Dr. Miller, how do you relate these facts? We just heard a witness who used totally different figures.

Can you reconcile his testimony with your testimony? Because, on the basis of your testimony, it would appear that the DOE is truly giving tremendous emphasis to small business.

I think he said that based on his experience, 75 percent of the total procurement contracts are going to major oil companies or their subsidiaries. I am not certain that that is exactly his testimony, but certainly his emphasis was just exactly the opposite of your testimony.

Dr. MILLER. Yes.

Senator METZENBAUM. I am not smart enough to understand how you can come before us and say one thing and he can come before us and say another thing. Maybe I am not hearing what you are saying, and perhaps he is saying it in a different way.

Nevertheless, I think it is important that it be clarified.

Dr. MILLER. Indeed, I will be glad to. The figures that I have provided you with, and the figures in my testimony are based on an exhaustive study of all of the contracts in the solar energy program.

We went back over the past year and surveyed the disbursement of \$530 million of procurements in the fiscal 1980 budget. We unraveled these down to what I call the third tier, so that we would sensibly reflect business participation.

In the overall disbursement of \$530 million, almost 14½ percent of those funds, over \$75 million went directly to small businesses.

Now, of that 14½ percent, almost 90 percent of it went for research and development activities.

That does not contradict what the previous witness testified to, it simply suggests that there is another side of that coin.

I do quarrel with some of those figures about 75 percent of our money going to big business. That is not true. We have major portions of our monies going into Government-owned contract or operated laboratories.

SERI, SANDIA, Argon National Laboratory and other of the contractor laboratories that the Department of Energy gives—

Senator METZENBAUM. How are they spending their money?

Dr. MILLER. Well, we unraveled. What we did was go one tier below the GO codes, and that is how we got the data that I presented a moment ago, the 14½ percent.

A lot of their money is spent in-house, because they have major capabilities themselves.

Senator METZENBAUM. Let's take a look. You say that 23 percent of SERI's procurement obligations, \$21.9 million, went to small business. Does that leave \$70 million? Does that leave 77 percent? How do these figures tie together?

Dr. MILLER. I think it is nonsmall business. Now a fair amount of that money is work that is done by SERI, in-house. They are a research laboratory and do a fair amount of that work internally.

But certainly, in a very simple fashion, if there is 23 percent directly in small business, it means there is 77 percent that is not directly in in small business.

Senator METZENBAUM. Well, the next one you talk about in your statement is a small program for marketable passive products and you are talking about \$3 million. That really isn't a very significant amount of money under any circumstances.

Dr. MILLER. No; I was not, rather I did not mean to present that as if it were a major part of the effort. It is there simply to indicate that program by program we have taken a positive approach to the involvement of small business and have made a conscious effort to involve small business in the Department of Energy's solar effort.

Senator METZENBAUM. The third one you talk about is the agreement with 33 firms that provides solar design costs for commercial buildings. You do not indicate the dollar amount, and you talk about the fact that small business participation in this program is estimated to be 75 percent.

What are you talking about there?

Dr. MILLER. I will have to provide for the record, the precise dollar levels, but it is somewhere around \$10 or \$12 million. I don't have the exact figures in front of me.

Senator METZENBAUM. Who is getting those contracts?

Dr. MILLER. It is a whole range of small businesses in the solar area, design firms, A. & E. firms, some of the manufacturers. I don't have that list. I will be glad to provide it for you, but I don't have the list in front of me.

Senator METZENBAUM. In the next item you mention builders of manufactured or prefabricated buildings to help with designing, manufacturing, and marketing buildings that include passive or hybrid solar features. This program, continuing in fiscal year 1981, has approximately 25 percent small business participation.

There also, you do not show a dollar figure, but you say it is about 25 percent small business participation, which would mean 75 percent large business.

Dr. MILLER. Yes; 25 percent small business and 75 percent large; yes, indeed.

Senator METZENBAUM. Then you say the procurement automated source system, computer system, identifies small business for DOE requirements.

You do not say where the bottomline is on that.

Dr. MILLER. Well, in the interest of time, I did not feel that was something we needed to explore in depth, but basically, the Department has not had a system of identifying small business firms that we, on the program side, can use when we go out on solicitations.

This is an attempt that was started about a year and a half ago, to provide program managers with a specific list of small businesses and a way of accessing the small business community in a way that we had not done in the past.

Senator METZENBAUM. What percentage of procurement dollars are going to oil companies or oil company-owned solar energy or partially-owned solar energy companies?

Dr. MILLER. Well, let me deal with the hardest data which I have, which is for fiscal 1978-79 and 1980, if I may. Let me deal with the photovoltaic program, because I think that is the one that concerns you most.

In 1978, of the total photovoltaic budget that was available for big business or small business there was \$1.2 million, out of \$50 million, that was provided in one way or another as R. & D. kinds of contracts to oil companies involved in photovoltaic research or about 2½ percent.

In 1979, the number rose to about 4.8 percent.

In 1980, to 5 percent.

So, of the total amount of money that we have available for businesses, both big and small, in the photovoltaic program, our figures show no more in 1980, than 5 percent going directly from DOE into oil company research and development programs.

Senator METZENBAUM. Where does the previous witness then come up with his figures, which have been published, as to the amount of DOE dollars going into oil company owned or partially owned solar energy facilities?

Did he just make them up?

Dr. MILLER. Mr. Chairman, I do not know. I have not reviewed those figures with the previous witness. I cannot comment on the source of that data. All I can do is to provide you with the direct data at the Department of Energy as we have it here.

Senator METZENBAUM. Dr. Miller, we are really trying to get just the facts. Now, were those figures known to you before you appeared this morning?

Dr. MILLER. No, sir, they were not.

Senator METZENBAUM. You never read them anywhere?

Dr. MILLER. I did not see those figures. It may be that they were around. I have not seen those figures. We did not have a copy of Mr. Denman's testimony, so I did not, I was not aware of what or where they came from.

My guess, and this is conjecture, my guess is that there is a distinction between direct DOE dollars that are contracted to oil companies that currently are involved in photovoltaic R. & D. and the total involvement of oil companies in photovoltaic R. & D.

For example, there are companies that have made massive investments in R. & D. without any Federal dollars. For example, the Shell effort, with the University of Delaware and a company called SES, is non-DOE funded. And, although I do not have the precise figures, my guess is they put in about \$20 million over the past few years.

Now, if you take those numbers and add those up against the total involvement, the percentages may rise. But those are not DOE dollars.

Senator METZENBAUM. Let me read you what he says:

For example, in each of the last 5 years, big businesses have received no less than 87 percent of the Government prime solar contracts. This occurs, despite the fact that 85 percent of all solar businesses are small firms, less than 500 employees.

Now, that is a very flat out statement. I have no way of knowing whether it is accurate or not. Either your testimony is correct or his testimony is correct—but they are in obvious, total contradiction of each other.

Dr. MILLER. Mr. Chairman, I would be glad to provide for the committee, for any witnesses here, a contract-by-contract listing of every single one of the contracts totaling \$530 million of solar disbursements in fiscal 1980. I will let that record stand for itself.

It goes down to contracts as small as \$2,000 and \$3,000. It was a massive effort on our part. I do not know where the previous witnesses have received their information. All I can attest to is what we have done in the way of trying to outline the small business participation in the solar program. Those numbers have been looked at by our colleagues in the Small Business Committee, here in the Senate, and your colleagues on the Small Business Committee in the House. I do not know of any challenge to them, Mr. Chairman.

Senator METZENBAUM. The record will remain open for you to submit that information.

The record will remain equally open for Mr. Denman or Mr. Stambler who may wish to address himself to that subject. We have not heard his testimony, yet, to offer a basis for comparison of their testimony. I am not familiar with Mr. Stambler's testimony on this point.

But in addition to that, it would seem to me that it isn't only what goes into our record that is important, it is important that the Department of Energy be receptive to the concerns expressed by those who are in public interest groups involved in solar energy.

I would suggest very strongly, Dr. Miller, that you invite the previous witness, and Mr. Stambler, if he has similar testimony, in to meet with you because I think it is important that the American people not be confused. I think Mr. Denman's figures have been published. I think I saw them in a magazine article. I think that whatever the facts are, they ought to be clarified. The figures presented here are diametrically opposite.

I would therefore recommend, Dr. Miller, before you leave, that you work out some arrangements to meet with them. Let's get this matter clarified, not alone for this committee hearing, but for the people of this country. I think they to have a concern.

Dr. MILLER. Mr. Chairman, I will be delighted to do that. I will take that as a personal charge from the committee. We will reconcile those figures.

Senator METZENBAUM. As a matter of fact, in the September 20, 1980, GAO report, it indicates that DOE's goal is to have about 20 percent small business participation in its overall energy program in 1980. Nonetheless, it estimates that small business will receive only

14½ percent of the Department's solar budget. I am sure you are familiar with that. That also is contradictory.

Dr. MILLER. No, sir, that is not. That is precisely the figures that are presented in my testimony here, and in fact, the General Accounting Office has used our data to come to its conclusion.

The General Accounting Office is not a group, I think, as we all know, that is one to take figures lightly and not to scrub them carefully. Those numbers are the ones that we have developed. They are accurate. We will stand by them. I think the General Accounting Office will stand by them as well. I have no quarrel with their numbers.

Senator METZENBAUM. But they are saying that only 14½ percent of the Department's solar business, solar budget is going to small business.

Dr. MILLER. Yes, that is exactly right. That does not mean that the remaining 86 percent goes to big business, because the Department's budget goes to organizations other than big business and small businesses. It goes to universities, it goes to nonprofit organizations, it goes to contractor-owned, Government-owned contractor-operated laboratories.

Only when you subtract out those other entities can one find out the distinction between big and small business. It is not simply the difference between 14½ percent and 100 percent. That may be the source of the discrepancy with the previous witness.

Senator METZENBAUM. It is a difference between 14½ percent and 20 percent which is DOE's own announced goal, isn't it?

Dr. MILLER. Yes. Look. I said that is absolutely true. I do not claim to have met that particular goal. But I think we have made a conscious effort to target our efforts at small business.

We expect in 1981, to come much closer to the 20-percent figure, and I wouldn't be surprised if we exceeded it.

Senator METZENBAUM. Now, GAO also says that small business received only about 4.7 percent of DOE's direct funding in fiscal year 1980, and that the only way you reach the higher 14½ percentage figure results in small business hiring as subcontractors.

Dr. MILLER. That is indeed the case.

Senator METZENBAUM. Now does DOE play any role in the selection of subcontractors?

Dr. MILLER. The way in which the Department has operated over the past few years is in a highly decentralized mode. We assign program management responsibility to a number of our major contractors.

In one particular case, which I think is useful to examine, is the Solar Energy Research Institute. We provide them with guidelines as to what we expect to see in the way of small business participation.

In 1980, SERI exceeded that particular guideline. I expect it will go up in 1981.

But, we do not make the choices at headquarters, of what small business contracts will be let. No, sir, we do not do that. We do not have either the staff, nor I think, the capability of doing that. These kinds of contract activities must be done in the field.

Senator METZENBAUM. Well, Dr. Miller, since you don't really involve yourself in the actual subcontracting, is it appropriate for DOE to include those figures in their numbers? Isn't it also the fact that some of these funds that you are including as going to small

business, are going to companies that do plumbing work, other mechanical labors, or vending companies? What we are really talking about is the dollars that DOE has available for those who are involved in the field of photovoltaics and those who are involved in other aspects of solar energy. You are including the subtrades that are normally just not contemplated by Congress when we are talking about small contractors.

Dr. MILLER. I understand the issue, Mr. Chairman. I appreciate that. In fact, we were concerned about that, as well. When we went through this survey, this highly detailed survey, we made a distinction, a formal distinction, between your local plumbing supply house and an R. & D. firm. Of that \$75 million that we identify as small business participation, \$66 million of it is going into research and development activities.

So, there was a conscious appreciation on our part of that concern. It is reflected in the data that we have presented here and which again, I will be more than happy to provide in all its detail to the committee and to anyone else.

Senator METZENBAUM. Let me ask you this. Do you consider anything less than 500 employees to be small business?

Dr. MILLER. The definition we have used is the SBA definition. That was what we charged our people to work from. You cannot identify a single target for small business, because it depends upon which sector you are dealing with. Small business is defined differently as you move across different product areas, different manufacturing categories.

We have tried to use uniformly, the accepted SBA definition of small business involvement.

Senator METZENBAUM. Very well. You may proceed and finish your testimony.

Dr. MILLER. I think we pretty well covered the overall issue of small business. Let me just spend a few minutes now and talk about the current status of the photovoltaic industry.

I think, as you know, it is a relatively new industry. Although the industry is new and has achieved less than \$30 million in sales in 1979, there are about 15 U.S. firms currently producing flat-plate silicon modules.

It has been a successful development effort on the part of a number of these firms. In fact, we are very proud of the role that the Department has played in assisting those businesses to develop some of their current product line.

Back in the early 1970's, a fair amount of the DOE program was devoted to providing support of that sort.

We now see companies joining up with some bigger outfits, and, in fact, with some oil companies, as you have indicated. We don't make a value judgment on whether that is good or bad.

Senator METZENBAUM. What are your intermediate goals? The President targeted solar energy to provide us with more than 20 percent of our energy consumption by the year 2000. Are we on target?

Dr. MILLER. I think we are probably ahead of schedule in terms of some of the cost figures that we are currently seeing.

Senator METZENBAUM. What are your goals for 1985?

Dr. MILLER. In 1985, it is for \$2.80-a-watt system. That means a total system price, \$2.80, for each watt. That could be compared, and

I think it is important to get or to understand the comparison, with about \$1.50 a watt for a conventional, fossil fuel powered system.

On the other hand, because of the nature of that market in 1985, it is a residential market, and given the escalation in the other conventional sources, we think a \$2.80 watt will make those systems competitive in the residential market.

We expect then, in 1985, to begin to see a much broader penetration of photovoltaic systems into the Nation's energy economy.

Senator METZENBAUM. Dr. Miller, I will now be personal. I have a lovely new apartment that I have constructed, my own suite, in Cleveland. I went to the largest plumbing company in the community. I went to my architect. I went to Ohio State University, which had some experts in this field. I said, "I would like to have some of the energy needs met by solar energy."

I live on the top floor. I would like to have it done. I said I was willing to pay more if it wasn't even cost effective. I would just feel proud to have a solar energy facility in my apartment.

I am a U.S. Senator. I have access to more things, more people, and enjoy greater receptivity, than the average homeowner. I got absolutely nowhere. Even having said I was willing to pay more, and that I wasn't worried about the cost effectiveness, I got nowhere.

Now, that being the case, what does the average homeowner do? How do we go about getting solar energy to the public. You know, we have ads, we have programs, we have TV advertisements telling us all about solar energy.

So, I wanted it. I couldn't get it, even though I was willing to pay for it. Those who had it said, "Don't put it in." I was willing to use it just for the hot water, if that would be the best approach.

Query: How are we going to convert Americans who want to use solar energy? They may think the cost effectiveness will come into play 5 or 10 years from now, but they would be willing to make the installation now.

What are we going to do about that? What is the DOE doing about it?

Dr. MILLER. Let me respond first, by telling you a little bit about a survey that was recently completed by the Solar Energy Research Institute and CEO because it supports precisely what you are saying.

What we found was that of all of the energy supply technologies, the public is very enthusiastic about solar energy. They know about it. They understand more about it than I thought in terms of the broad nature of the technologies.

At the same time, a very high percentage said they would not put solar systems on their homes. The reason for that, I think basically is the lack of capable installers around the country, who the average citizen has access to. It is a very, very difficult problem.

The Department's programs of information dissemination have been aimed at trying to get that message out. But it is a massive problem. We are dealing with hundreds of millions, if you like, of individual decisions when we talk about solar.

It is very different from talking about putting in a big fossil fuel powerplant. All you need to do is to convince the chairman of the board, the board of directors, and perhaps the stockholders that they ought to invest \$1 billion to put up a new plant.

When you talk about \$1 billion of solar systems, you are talking about individual homemakers making those decisions. That, in one sense, is the great advantage, the great value of solar energy. It is also its biggest problem, because every one of those individuals have to be convinced.

I want to echo your statement, because I wanted to put a solar system on my house. I probably know as well as anybody else who to go to. I decided I wouldn't go to the people I knew. I would just start with the phonebook. And, it is very, very difficult.

By the time you find either an architect who understands it and is willing to put something up and to spend the time, or find a contractor who will put something on your house that you feel comfortable with it is a hard job.

Over a period of the last several years, the Department has had a fairly sizable information dissemination program. But, it is a difficult, difficult problem.

Senator METZENBAUM. Dr. Miller, you have a tooth that is aching. You are going to go take care of it. You have a problem in solar energy; people want to have the facility and can't get it. You have made that point here today. You are the head of this Department. You have the money that Congress has provided you with.

There is an aching pain with respect to the inability to make solar energy available to the American people. I suggest that just as you take care of your own personal pain, that you take care of your public pain as well.

I think it is your responsibility to find the answer. You previously testified that some of the negative advertising about solar energy put out by big oil firms such as Exxon and Mobil, have hindered our efforts to move solar forward. We will put an example of that into the record.

[Advertising material referred to above follows:]

EXXON ANSWERS QUESTIONS ABOUT ONE OF THE NEWEST SOURCES OF ENERGY UNDER THE SUN—THE SUN!

Exxon is putting its years of energy experience to work to turn sunlight into a practical form of energy. We've learned a lot about its potential and its limitations, and we'd like to answer a few questions people have asked.

"What kind of energy do we get from the sun?"

Two kinds—heat and light. The heat can provide energy for heating, cooling and hot water systems. The light can be turned directly into electricity.

The basic technology for using the sun's warmth is known. In fact, solar energy is already being used to heat buildings and homes—almost always along with conventional systems.

Our photo shows an example of a solar project initiated by the Bay State Gas Company. The solar panels on the roof of this Massachusetts house capture the sun's rays for heating and hot water.

"What does it cost to heat a house with the sun?"

Right now a solar heating system can cost you anywhere from \$8,000 to \$20,000. This is in addition to the conventional heating system you'd also need, which would cost about \$2,600 for the average-size house. An auxiliary system is necessary because no one has perfected a way to store enough solar heat to get you through several cloudy days.

"How much do solar systems cost to heat water for sinks, tubs and washers?"

Around \$2,000—about three times more than conventional systems. They would be particularly suitable for people who live in high energy cost areas.

"Why don't more people use solar heating?"

The systems and storage facilities are still expensive to manufacture. And there are other problems.

For instance, installers, maintenance people and distributors have to

be established and trained. Financing methods and warranties have to be worked out. Building codes have to be adapted. And cities have to deal with "sun rights." (What happens if someone builds a tall building that overshadows a smaller one?)

"How much does electricity from the sun cost?"

Systems that turn sunlight directly into electricity are not as widely used as solar heating systems. Because the solar cells required are costly to make, the electricity they produce is quite expensive. At current prices, solar electricity costs roughly \$1.00 to \$3.00 per kilowatt-hour. Compare this to the 2¢ to 6¢ you may now be paying for conventional electricity.

"When will solar power become a major source of energy?"

Possibly in the next century. That's because a considerable amount of technology still has to be developed.

But you may not have to wait that long to get solar heat. Exxon is working to make solar heating systems more economical and available within the next few years.

"Why is Exxon involved in solar energy?"

Because we're more than just an oil company. We've been conducting productive research for over 50 years. During that time, we've gained experience, expertise and management skills in energy technology. And we're putting it to work today so that you can put solar energy to work in your home someday.



Senator METZENBAUM. Are you doing anything to offset it? That is your job. That is what we are giving you congressional appropriations for.

I know there are times, in this Congress, when certain programs become so popular that you just want to throw money at it. The solar energy field is one of those areas where, at one point, anybody who said it was solar energy could get a congressional appropriation for it.

At another point in this Congress, if you said it was gasohol, you could get an appropriation for it.

Now, the money is there. Why aren't you doing something about it?

Dr. MILLER. The money for the kinds of programs that you are talking about, information dissemination programs, is not the largest part of the solar budget. The appropriated dollars are for technology development, research, and development, not for information dissemination.

Senator METZENBAUM. How much is appropriated for that?

Dr. MILLER. For information dissemination, in its broadest sense, it is probably no more than \$15 million. I would have to provide an exact figure, but my guess is that is the appropriated level.

Senator METZENBAUM. What have you done with that \$15 million?

Dr. MILLER. We have run workshops all around the country.

Senator METZENBAUM. What is the use of a workshop if you and I can't buy it?

Dr. MILLER. Well, the people are buying them. All I am saying is it is a difficult problem when you are dealing with millions of individual decisionmakers.

The fact that people know about solar energy and that there is a recognition factor of almost 80 percent, I think in some sense is testimony to at least the effectiveness of these programs over the past few years. There is just more to do.

What we have to do is to get people to say, "Yes; I want to put one on my house," and that they feel comfortable doing it.

Senator METZENBAUM. I said, "Yes." You said, "Yes." Neither of us were able to do it. We were in particularly advantageous positions.

Now don't you really have some responsibility to do something about it? Don't you think you ought to go to the next budget request and say:

Let's knock off 500 employees in the DOE. They aren't doing anything anyhow. The new President says maybe we ought to eliminate the whole department. Maybe we ought to knock off 500 and use that money to do something in order to make solar energy available.

It is not enough just to convince people that they would want it or that they want to go out and buy it, there also has to be a way to go out and buy it. I found myself unable to do it and you found yourself unable to do it.

Without being particularly critical of you as an individual, I am saying that the Department is failing to meet its responsibility in this area.

Dr. MILLER. I understand the concern, Mr. Chairman.

Senator METZENBAUM. Thank you, Dr. Miller.

Dr. MILLER. Thank you.

[The prepared statement of Dr. Miller follows:]

PREPARED STATEMENT OF DR. BENNETT MILLER

I appreciate the opportunity to be here this morning to assist with your review of questions regarding competition in the Solar Industry, specifically Small Business participation in Department of Energy Solar programs.

My testimony today will review several key aspects of this subject, including competition in the Photovoltaic Industry and the recent General Accounting Office report on Small Business. Before I address these topics individually, I would like to take a few minutes to summarize our most recent efforts at Small Business participation.

With our decentralized solar activities, it is very important that the regional centers, especially the Solar Energy Research Institute, set goals for small business participation. SERI's fiscal year 1980 goal was 23 percent of its procurement obligations, or \$21.9 million. I am pleased to report that this goal has not only been met, but exceeded. This year SERI awarded approximately 26 percent of its procurement obligations to small businesses. The fiscal year 1981 goal has been estimated at 30 percent of procurement dollars.

A new solicitation for marketable passive products has resulted in awards to 22 firms with approximately 50 percent of the awards going to small businesses. This program will carry over into fiscal year 1981, with funding estimated at \$3 million.

We have negotiated agreements with 33 firms to provide solar design costs for commercial buildings. Some or all of the projects will be selected for help with construction costs, up to \$500,000 per building in fiscal year 1981. I am pleased to note that Small Business participation in this program is estimated to be 75 percent.

In fiscal year 1980 DOE has also funded builders of manufactured or prefabricated buildings to help with designing, manufacturing and marketing buildings that include passive or hybrid solar features. This program, continuing in fiscal year 1981, has approximately 25 percent small business participation.

The Procurement Automated Source System (PASS) is a computer system used to identify small businesses for DOE requirements. Following an in-depth analysis, SERI has refined a key word thesaurus covering solar technologies which will significantly improve PASS capabilities. SERI recently provided it to the Small Business Administration for incorporation into the PASS system. SERI is also in the process of installing a computer terminal to access the PASS system.

As you are aware, the General Accounting Office recently completed a study, released September 29, 1980, entitled, "Small Business Participation in the Department of Energy's Solar Programs." This report is currently being reviewed internally and a formal DOE response is expected to be available by the end of this month. The GAO noted that it is very difficult to obtain realistic data on small business participation due to the decentralized approach to management of the national solar program with DOE field organizations and laboratories and other Federal agencies. A more accurate picture would follow federal funds down to at least two levels below the prime award or interagency agreement. We are attempting to obtain as much data from field organizations as we can in order to get a realistic picture.

Earlier this year, we conducted an extensive internal study to determine, to the greatest extent possible, where DOE solar funds were channeled and how much was expected to go to small businesses. On April 30, I presented testimony before the Senate Select Committee on Small Business which reviewed the findings of this study.

The exercise involved the entire solar budget for 1980 with the exception of that for Field Operations and International Programs which amounts to less than 10 percent of the overall solar effort. The base used was that funding available to each technology for procurements, exclusive for the most part of equipment, construction and certain institutional support for the Assistant Secretary for Conservation and Solar Energy.

Secondly, a three level approach was adopted to identify small business activities. Federal funds result in contract awards through essentially four different paths: through our field offices; through our national laboratories, the so-called GOCO's—government owned, contractor operated laboratories; through other Federal agencies and finally regional solar energy centers and state and local governments. The money that is channeled to each of these organizations is considered the first level. Funds which are then contracted out by these organizations are referred to as the second level. Finally, from prime contracts at the second level money may be subcontracted again. This is the third level. In terms of our investi-

gations of small business participation, we drew the line at the third level—namely, the level below the contracts that were issued through major funding arms of the Department. No effort was made to go below the third level since it was felt that at that point the establishment of a direct relationship between DOE policy and small business participation could not be insured. Of course, there are contracts which would be with small businesses at those levels. As a result, the numbers we obtained through the study underestimate the total amount of the small business participation. Additionally, it should be noted that they do not include direct grants to small companies and individuals through the Appropriate Technology/Small Grants Program or the Energy-Related Inventions Program.

Each DOE funding organization for solar was requested to supply a complete listing down to the third level of all small business contracts. Furthermore, they were asked to distinguish between those small business contracts that were essentially for service of a non-R&D nature from those which were of a direct research and development character.

In the study, we surveyed the disbursement of \$529,926,000 of available procurement funding in the fiscal 1980 budget. Of that amount \$75,255,000 was earmarked as either going to or being set aside for small business, a total of almost 14½ percent. This number can be supported on a contract-by-contract basis down to contracts as small as a few thousand dollars. In total dollars the amount of small business activity is largest in the active and passive heating and cooling program which has about 20 percent of its total budget in small business, followed closely by the solar thermal energy systems program with about 13 percent of its budget in small business and the photovoltaic program which has 12 percent of its funding in small business. Both the wind and oceans program have over 16 percent of their budgets in small business contracts.

Of the total budget, we were able to break out a number of firms doing substantive R&D business with us. That number amounts to more than 830 separate small businesses doing direct and innovative R&D type work with a contract value of \$65,850,000 and a total percentage of our budget of almost 12½ percent. These figures represent the most comprehensive data that DOE has of small business participation in solar energy programs. It is data that has been assembled by a careful review down to the third level of the entire contracting process.

We believe these figures represent a sizable small business participation both in total dollars and percentages of our activities. Furthermore, we believe that this study supports our stated commitment that we have made a conscious and determined effort to involve small business in the solar program and to involve small, innovative R&D firms in our activities.

I know the Committee is especially interested in the current status of the Photovoltaic Industry. Although the industry is new and has achieved less than \$30 million in sales in 1979, there are about 15 U.S. firms currently producing flat-plate silicon modules. These firms are competing with European and Japanese firms. Price competition and competition for markets appear intense, with many firms currently sustaining losses in the hope of eventual success. Existing firms range from small independent businesses to subsidiaries of very large corporations. Module production appears to be very competitive. Several new ventures have recently entered, or are preparing to enter the market and some small businesses—including Solarex, the largest producer—have met with success.

DOE's cost goals for photovoltaic systems assist small business in the PV area. These goals represent what systems could be produced for if technological advances were made through the current aggressive R&D program. Cost goals allow small business to understand what future competing cost will be, thus enabling them to take fewer risks such as making long-range capital investments that could be detrimental to their company if market conditions changed in the future. Note that the goals are cost goals. The actual selling price of photovoltaic systems will depend on market conditions such as demand for systems, price of competing fuels, expectation of price changes in the future and so forth. DOE's cost goals provide market information which has the economic effect of reducing barriers to market entry and stimulating competition.

One potentially important obstacle to photovoltaic industrial growth is the possibility of a shortage of refined, semiconductor grade, polysilicon material. Some polysilicon is produced by wafer manufacturers, but most is supplied by chemical firms. Demand for silicon wafer is rising rapidly. However, producers are reluctant to install new refinement capacity now because new technologies that will allow major cost reductions (by a factor of six) are nearing readiness for scale-up to commercial production. Thus, a decision to invest in current technology now could result in capacity that is obsolete by the time it comes on-line

three to five years hence. As a result of that situation, the polysilicon and photovoltaic industries anticipate a shortage of silicon wafers in the early 1980's. This could have the effect of reducing competition and restricting entry into the industry.

The Committee has expressed concern that competition in the photovoltaic industry is becoming restricted, that is, large companies are acquiring control of PV manufacturers, pushing small businesses out of the market and perhaps establishing a monopolistic system that will retard the early development of PV systems. The effect of these recent acquisitions upon the structure of the industry is not clear, however, for at least two reasons. First, PVs will not compete with petroleum-derived fuels for central station use in the near future. The primary current use in which PVs are good substitutes for petroleum appears to be in remote applications where PVs could replace small diesel-fuel fired generators, for example. However, the extent of this overlap is so small that the oil companies have no incentive to "withhold" or retard PV technology. Secondly, when the wide-spread commercial feasibility of PV Technology is achieved, we believe there is likely to be new entrants in the field rather than a contraction and concentration, because the capital requirements to enter PV production are relatively small (on the order of \$10 million) and because the current government program is providing an opportunity for a large diversity of companies to develop a familiarity with PV technology.

Moreover, the PV market is international and the domestic producers can expect to encounter vigorous competition from Japan and other foreign producers. Furthermore, if domestic producers attempt to price PVs at above competitive levels, this will encourage additional foreign competition.

In analyzing the Photovoltaic Industry, it is important to review the significant contributions of small businesses. Examples of small businesses receiving funds from DOE that are making key contributions to Photovoltaic Technology include:

Solarex, which is number one in the world market with world wide marketing and automated technology, was funded by DOE in a joint venture to develop semicrystal silicon for a low cost array option.

Solenergy: This small silicon-array producing company, formed less than two years ago by a former Solar Power Corporation employee, is already a profitable venture with approximately \$1 million in yearly sales.

Solec International is a small firm producing arrays that are competitive in performance and cost with the large firms.

Spire Corporation, Massachusetts, has developed, under DOE sponsorship, a number of PV advancements, including continuous fully automated cell processing and is selling services and equipment throughout the world.

The innovation rate in both large and small photovoltaics firms is impressive. DOE's Photovoltaics Program is actively encouraging small and minority businesses to participate and contribute in this new and rapidly growing program. The Photovoltaics Program is taking several positive steps toward meeting its goals for contracting with small and minority businesses:

The "set-aside" principle is being applied where appropriate. For example, total funds authorized in Cycles 1 and 2 of the Federal Photovoltaic Utilization Program (FPUP) are set aside for small and minority businesses.

Small and minority business goals are employed in some instances. In the \$20 million photovoltaics systems experiment PRDA effort, a 20-percent goal has resulted in 22 percent of the funds going to small and minority firms.

Special workshops have been conducted to stimulate interest and encourage small and minority business participation in solar programs, including photovoltaics. These have been given good publicity resulting in substantial attendance.

Within the Advanced R & D subprogram, a special Innovative Concepts endeavor has been established, the purpose of which is to fund new and promising technical efforts of merit to stimulate submission of proposals by small and minority entrepreneurs. Proposals (less than fifteen pages each) are collected every six months. This effort, which is administered by the Solar Energy Research Institute, is renewed every six months on an "open book" or de novo basis.

Close contact is maintained with the Solar Energy Industries Association (SEIA) in order to maintain contact with small, new firms and the entrepreneurial element in general.

Through a \$1.2 million contract with the San Bernadino Development Corporation, a special minority photovoltaic educational program is training minorities in the technical principles of photovoltaics, including both the developmental and the applications aspects of this expanding technology.

The foregoing efforts to promote and maintain small and minority participation reinforce each other in diverse ways, and contribute to the overall successes achieved to date.

Senator METZENBAUM. Mr. Piper, we are happy that you arrived, sir. Prior to your coming, the Chair had sort of indicated that we would like our witnesses to confine themselves to 10-minute presentations. Your entire statement will be included in the record. But, if you can orally tell us the problems, if any, you have had as a small business person in the solar field and tell us a little bit about your company, we would be very pleased to hear from you.

**STATEMENT OF JAMES R. PIPER, PRESIDENT,
PIPER HYDRO, INC.**

Mr. PIPER. Senator, I realize that you wanted a 10-minute presentation, so I wrote one that would take 10 minutes.

Sitting there, listening to Dr. Miller this morning, I have never seen somebody that I would like to debate as much as that man. [Laughter.]

I can tell you that my company has done the largest space and water heating solar system in the world. It has been the first one that cost no more than a conventional system. It did the first one in Iraq. It did the first one in Mexico. I am scared to death of that man and his Federal bureaucracy.

Senator METZENBAUM. Tell us about it.

Mr. PIPER. I fear them.

Senator METZENBAUM. Tell us why.

Mr. PIPER. When you hear my statement, I think you will understand why.

Senator METZENBAUM. All right.

Mr. PIPER. In 1973, in a speech before a professional engineering association, I made the prediction that the lifestyle of the American public was going to decline due to the cost, not the unavailability, of energy.

Now, 7 years later, that prediction is coming true. Inflation, with energy costs as its engine, is eating away at the American lifestyle and the public faces a shock in the short term. Within 3 to 5 years, utility bills in many areas of the United States will reach \$1,000 a month.

When this occurs a good portion of the American public will have lost their ability to pay. Their disposable income will be gone, and comfort, the state of being warm and clean will have become a luxury.

If this situation becomes widespread the result will be dislocations in the political area. Government, reacting, will not be able to solve the problem by merely subsidizing those who cannot discharge their utility costs because the sums involved will progressively become so massive that Government, just like the public, will lose its ability to pay.

For those of you who do not believe this can happen, I refer you to the newspaper accounts of the two meetings held in Palm Springs, Calif., in August and September 1980. Over 700 Southern California Edison customers met with a public utility commissioner to tell him that in their geographical area it had already happened.

When you read the Los Angeles Times account, you will note the commissioner was presented with a petition containing over 10,000 ratepayer's signatures protesting their utility bills.

One lady, Zelda Segall, displayed her \$1,044 home electric bill. Another, representing Yucca Valley homeowners asked "Where are they gonna get the money. They're too old to go out and rob a bank."

You will note that the utility has another change in store for them. That is after four rate increases so far in 1980, Edison will ask for a 40 percent increase in December. Zelda's utility bill would then rise to \$1,466 a month.

The utility spokesman blames the 8-cent-per-kilowatt rate on the high cost of OPEC oil which is the fuel for 44 percent of the utilities electricity.

He also notes that 23 percent is made from natural gas and 4 percent from nuclear.

As little as 10 years ago, the wholesale price for that gas was slightly over 20 cents per 1,000 cubic feet. Edison's supplier, the Southern California Gas Co., has a current 1980 marginal or new gas cost of \$4.58 per 1,000 cubic feet out of Canada or Mexico, and Algeria wants \$8. That's 40 times the 20 cent cost.

If Mrs. Segall is upset right now, wait until Edison buys \$8 gas and burns it to make electricity for Mrs. Segall's home.

Or, wait until Edison gets the next nuclear reactor on line at San Onofre. That electricity will cost Mrs. Segall about twice that current 8 cents per kilowatt, which does not include the nuclear waste storage costs or reserves for future nuclear plant deactivation.

Those costs may be as high as the initial construction costs were which will dramatically increase the future billings.

I grant you in Palm Springs, I have picked an atypical situation to use as an example. It is atypical because it combines a high summer load, a nearly all electric area, a medium high electric rate, and people with an above average ability to pay.

But, it is a forerunner of what is in store for large portions of the country. It just happened in Palm Springs first.

Let me contrast that scenario with another real one, also unfortunately atypical. Ventura del Sol is a 254 unit apartment project, utilizing a conserving hydronic space and water heating system fed by a combination of natural gas and solar.

It cost no more to build than did the energy wasting systems in Palm Springs. The gas utility bills for the year 1979 averaged \$5.41 per unit, per month.

With the rapid escalation in gas prices in 1980, the average bill is now just over \$8. Of course that \$8 includes the heating of the community swimming pool, the spa, 9,000 square feet of recreation buildings and the three laundries.

At Ventura del Sol, approximately 80 percent of the energy consumed by the tenants is supplied by this system. The other 20 percent is electricity for lighting, small appliances, and auxiliary uses.

In today's dollars, the total solar-gas-space-water-pool-laundry heating systems at del Sol would cost slightly under \$3,000 per dwelling unit installed.

No grants. No gifts. No Government contracts. No financial incentives except the tax credits.

If you compare that with the Department of Energy's pet solar project, the Power Tower, you will find it cost \$140 million to supply the electrical energy for 6,000 homes. That is \$23,333 per home for just a small portion of the total energy load, the electricity.

Why?

When the country is faced with disastrous utility bills, why is the Department of Energy spending \$23,000 per house on an unproven technology that will provide only a minority of the energy and completely ignoring proven technologies that produce a majority of the energy costing one seventh as much?

Why is the public's tax money being funneled out to aerospace corporations to develop what Dennis Hayes, the head of the Solar Energy Research Institute, described on "60 Minutes" as a "gold-plated turkey."

Why did DOE's undersecretary, Dale Myers, announce to the press in 1979 that "solar heating was not ready for commercialization," when "60 Minutes" was pointing out that Ventura del Sol was working in the marketplace and the solar technologies DOE was supporting, like the Power Tower, were not?

Last December, when I appeared before the Senate, I asked for an investigation of the DOE solar program.

Both GAO and OTA have now completed that investigative process. OTA, I believe, answers any above questions succinctly. They said:

There is a pervasive believe within and without side the DOE that senior DOE management does not really care about the conservation and solar energy programs, and that the quality of management has been inadequate as well as transient.

If I received a report from an agency I trusted that described some of my employees in this manner, I would fire them.

I suggest you do the same.

In the private sector, I must respond to my board of directors and stockholders. In the public sector, you must respond to the voters.

I ask you now to consider what your response will be when the voters find out that the DOE has been distributing their tax money to a "good old boy network" for research and for development of solar technologies that can not solve the utility bill crisis.

What will the public do when they discover that the solar technologies that could help reduce those \$1,000 bills have been ignored, demeaned or opposed by these bureaucrats distributing their tax money?

If I were a member of the political establishment, this thought would give me pause.

And the public certainly will find out.

Yesterday, in Colorado Springs, there was a solarbration that included the groundbreaking for The Neighborhood at Palmer Park, a 192 unit condominium project being developed by Projects Unlimited.

It is total solar, which is to say it uses a combination of solar and natural gas for both space heating and domestic hot water.

By carefully arranging the pricing of the solar system and the dwelling units to the public, Harry Watson, the developer, has created a combined tax credit of \$7,000, per unit, \$4,000 Federal and \$3,000 State.

The minimum down payment is approximately \$3,000 or less than one half the tax credits. The units are priced at \$55,900.

The same developer has already had an outstanding success with a 240-unit total solar development in San Marcus, Calif. and has about 20 similar projects committed to this technology.

One of these, a 468-acre project in Colorado Springs, begins early next year, and will become the world's largest solar development.

When Mrs. Segall compares her lot in life with those in Autumn Heights, that is San Marcos, the Neighborhood of Palmer Park or Solar Village, in Colorado Springs, do you think she will have a kind, benevolent feeling for the DOE and their solar programs?

I believe the time for positive action within our Government is now. I also believe, as I have stated before, that Congress is the only real hope for that action.

The President, any President, comes under unbelievable pressures from an energy industry with tremendous interests in the status quo.

The bureaucracy responds not to the public, but to the vested interests—with which they deal. It is the Congress that must and can respond.

I sound this warning today in the spirit that the Congress will do so. They have in the past, and I am confident they will in the future.

Please, I beseech you, do not allow the business as usual approach with DOE bureaucrats, one of whom you have seen this morning, giving Congress half-baked excuses for their failures in the energy area to continue.

Straighten out this area and staff it with people who believe in promoting the soft energy technologies for the good of the American public, private enterprise and the free world.

I thank you for inviting me today and I will be glad to answer any questions about this statement.

Senator METZENBAUM. Thank you, Mr. Piper. Your testimony is certainly interesting, provocative, and obviously well thought out.

You have suggested in previous testimony, a broad based program for making use of the current solar technology. Will a large amount of capital be necessary to do this?

Mr. PIPER. I think the numbers that go with any energy technology if it is widespread are staggering. It is easy to lose count of the zeros, but the amount of capital required to do the program that I have suggested before with solar and conservation, true conservation, technical conservation, is much less than any other form of energy at this time.

It is certainly, in comparison, dramatically less than would be required with nuclear, for example, and synfuels.

Senator METZENBAUM. Mr. Piper, what does Piper Hydro, Inc., do?

Mr. PIPER. We are a manufacturer of equipment and a designer of a patented system. We design that system for new buildings that are yet to be built. We sell the equipment to franchised dealers who do the sales, installation and service of that system.

Senator METZENBAUM. Is Mr. Watson using your system in his new facilities?

Mr. PIPER. Yes, he is.

Senator METZENBAUM. Why aren't other developers doing the same thing? It would appear to be just simple mathematics. If you can get a \$7,000 tax credit and you only put down \$3,000, it has to be very marketable, particularly when the Government has helped somebody to go into this kind of a facility and helped the developer to market it.

Why aren't others doing it?

Mr. PIPER. First, I will say, it was the Congress that put in place those tax credits which is the incentive for Harry Watson to go out and do what he is doing.

Senator METZENBAUM. I am not criticizing you.

Mr. PIPER. OK.

I am actually complimenting Congress when I say that, because they have done more with that one move than the DOE has done with everything.

If you asked the normal developer in your area to provide you with a solar system for your new apartment on the top floor, which I heard you describe earlier, he doesn't know a system like ours exists.

We are not the only people that can do something like this, but obviously, we think we are the best, just like everybody does.

Senator METZENBAUM. What about Mr. Charlton's approach, did you hear his testimony?

Mr. PIPER. Yes, I did.

Senator METZENBAUM. Is his different than yours in more than degree, or is the concept the same; that is proenergy, utilization through solar energy.

Mr. PIPER. Yes; actually I believe that Ron Lipton, who represents the State of California, recently gave a speech on this. He is the head of Solar-Cal, in California. It is a State agency.

He made the remark in his speech that to make solar widespread, the Government ought to fire 95 percent of the bureaucrats in the DOE and use the money to sell solar like corn flakes.

Senator METZENBAUM. It is a good political statement. It is a good applause line, but now fill in the gaps.

Mr. PIPER. Right now—

Senator METZENBAUM. "Sell solar power like cornflakes."

Mr. PIPER. Well, right now, the Department of Energy has a flier out. Your staff has a copy of that flier. We received it. It had a hotline. It said, "Call this hotline for information on solar."

So, I asked my secretary to call that hotline and pretend she was a secretary of a developer.

Senator METZENBAUM. Don't tell me the results. I am afraid to hear it. Go ahead.

Mr. PIPER. I think your staff called them. At least, I suggested that they did. They said, "Solar? Oh. Well, we really don't have any information on that." [Laughter.]

Senator METZENBAUM. I was afraid I was going to hear something like that.

Mr. PIPER. She went further and said, "I represent a developer here in California. We have heard that someplace in California there is a solar system that will provide you with space heating and domestic hot water and the first cost of that solar system is no more than a conventional system. Surely you know about that system."

They said, "No, we have no information on it at all."

She said, "Can you tell me, who has done the biggest residential solar project in the world?"

The voice on the other end said, "I am sorry. We just don't have any information about that." "We have a report," he went on to say, that they had a report on DOE activities, which, when it was available, he would forward.

Now, if DOE really wants to promote solar, they will but people in that area of the DOE, conservation and solar, who are advocates. They will tell the gentleman who runs the administrative part of DOE not to provide desks with no chairs, and telephone wires with no telephones, and typewriters that don't work, to that portion of the DOE, which is what occurs now.

Senator METZENBAUM. Do you have a copy of the fier? We don't have one in our file. We would like to put it into the record.

Mr. PIPER. I think we sent you one. If we didn't, we will send you one.

Senator METZENBAUM. It hasn't arrived yet. The Postal Service isn't working too well, either. [Laughter.]

Mr. PIPER. DOE's cousin.

Senator METZENBAUM. Let me just ask you, you seem to have done fairly well with your business both here and abroad. What kind of volume is your business doing now?

Mr. PIPER. We are at about \$1 million in annual sales. We have about a \$4 million backlog.

Senator METZENBAUM. Apparently you have attempted to make some sales abroad. Did you have good assistance from the Department of Commerce in that effort?

Mr. PIPER. The Department of Commerce went to the Iranian Government and said, "Why are you buying solar equipment from this little company in California? Why don't you buy from Grumman, instead."

Senator METZENBAUM. Do you know who did that?

Mr. PIPER. I just know it was the Department of Commerce's representative in Tehran in 1978.

Senator METZENBAUM. You do not know the name of that representative?

Mr. PIPER. No; I don't. I got a call from Dr. Gahare who represented the Gale Corp., which is the princess' business interest, immediately after that occurred.

Senator METZENBAUM. What did he say?

Mr. PIPER. He said what I just told you, and I asked him if he had made a reply. He said, "Yes; we made a reply." I said, "Could you tell me what it was?" He said, "Yes. We said Grumman makes solar panels. We can buy solar panels cheaper and better from the Israel firm. The company in California has the technology. That is what we want. We want the distribution system technology. That is the reason we are dealing with them."

The Department of Commerce representative then asked him, "Well, what do we tell Grumman." Gahare said, "Tell them to talk to Piper." [Laughter.]

Senator METZENBAUM. We will inquire of the Department of Commerce for their response. We will quote your testimony to them. We will send the Secretary of Commerce a letter to that effect and ask him what reports or information they have on the situation.

Mr. PIPER. I can give you another example in the foreign market. We did the Minister of Housing and Public Works offices on a competitive bid, with a conventional system, in Mexico City.

The Mexican Government was very interested, because here was a system that worked.

The French and the Germans were also trying to sell systems to the Mexican Government at that time, but we sold the first one. It was installed and it worked.

The Mexican Government made an inquiry of our Government. I don't know of who, but I know the inquiry was made wherein they said, "Can you tell us about Piper Hydro?"

Our Government said, "Who?" We never did another system in Mexico.

The French and Germans are in there now with an inferior system by I think anybody's standards.

Senator METZENBAUM. How do you know what the Department of Commerce said? If they said, "Who."

Mr. PIPER. I just know that a relatively high-placed Mexican official repeated to me, and I don't know if it was the Department of Commerce. They contacted, officially contacted, our Government someplace. I asked him who and he didn't answer me.

Senator METZENBAUM. Well, I think that is maybe a little bit unfair. It is hard for me to believe that the Mexican Government proceeded just on the basis of somebody in Government not knowing who Piper Hydro was, since I am certain if I asked somebody in the Mexican Government who some particular company was in Mexico, they wouldn't necessarily know. But I think I would say to them, "Well, can you do a check for me, and find out who they are?" And, "Something about them."

I think that would be a normal businessman's way of doing business.

Mr. PIPER. I believe that was the process. I shortened it for the description.

We have had now, I would say, a relatively spectacular success with Ventura del Sol. We have had nine foreign governments send official contingents to look at that project.

So far we have had two people from our Government come look at it.

We offered it to the Department of Energy when it was under construction, for nothing, to monitor.

The developer, Bill Spriggs, offered to build them a building to put their equipment in, to monitor the system. They said, "We are very interested." We never heard another thing.

The Urban Land Institute invited Bill Spriggs to become a member, after he finished Ventura del Sol, because he was now one of the major developers in the solar area, having done the largest project in the world.

A little over a year ago a representative of the Department of Energy stood before a panel that Bill Spriggs is a member of and said, "This solar technology really doesn't work. We are lucky that people have not died from ingesting heat transfer fluids et cetera. The program is really a mess. It just doesn't work."

Bill said, "Well, what about my project? You know, I have that project in Ventura." The representative from the DOE said, and I am now paraphrasing, "Well, that's in California." As if that made some difference.

This is the type of background that has existed continually with us over the last 7 or 8 years.

I received a letter from the Department of Energy about a little over a year ago telling me that I had to report to them how many

square feet of solar collectors I made, who I sold it to, and for how much.

I wrote them back and said I would be glad to supply you that information, but I want it on a confidential basis.

They called me on the phone and said, "Well, everything that we collect like that is confidential." I said, "Fine. Put it in writing and tell me that I have confidentiality if I send you my business records, and I will send them to you."

They said, "No. We won't put it in writing."

Now, from my point of view, what they were doing was setting me up for industrial espionage. I believe that there were people in the Department of Energy who had previously worked for Exxon or Westinghouse, who would have access to that information.

So, I refused to send it to them.

The next thing I knew, they offered to put me in jail and fine me \$40,000.

I finally struck a bargain with them by having my attorney, who at one time was the counsel for the Select Committee for Small Business, negotiate with the Department of Energy. I would send that information to one person in the Department that I trusted, who would then read it into the computer and put it in his safe where people could see that is was my information.

Now I was willing to risk being prosecuted for that because that is how much I don't trust them.

I think that the most virulently antisolar group in the world is the Conservation of Solar Energy division, in the Department of Energy. It is not a conclusion I have come to lightly.

Senator METZENBAUM. Who was the spokesperson for the Department of Commerce or was it the Department of Energy, who was on the program with Mr. Spriggs?

Mr. PIPER. I can't remember. I will get you the name.

Senator Metzenbaum. Fine.

Mr. PIPER. I later was invited to the White House to watch the President inaugurate the solar system. I had his name at that time. I discussed it with Mr. Schlesinger, who said, "Who is that?" I said, "I don't know. He works for you."

Senator METZENBAUM. That is as far as it went?

Mr. PIPER. That's as far as it went.

The same thing is occurring on a daily basis, right now. The people in the Department of Energy who are charged with the responsibility of promoting this technology have a PR program that my 9-year-old daughter could outdo.

Senator METZENBAUM. Mr. Piper, thank you very much. We will follow through with some of the comments you made, to explore what is occurring and why it is they are so antiyour facility.

I am very impressed with what you are saying is being done in the residential developments. Perhaps we will make some arrangements to take a look at those and explore them as well, not at Government expense. Maybe we can get somebody out there to take a look for us.

Mr. PIPER. I'd love to have you any time.

Senator METZENBAUM. Thank you very much.

Are they both near Los Angeles?

Mr. PIPER. We have several projects all over the Western United States. Several large projects, all the way from Colorado Springs to Utah, to southern California.

Senator METZENBAUM. Thank you very much.

Mr. PIPER. You are welcome.

[Statement follows:]

PREPARED STATEMENT OF JAMES R. PIPER

In 1973, in a speech before a professional engineering association, I make the prediction that "the lifestyle of the American public was going to decline due to the cost, not the unavailability, of energy".

Now, 7 years later, that prediction is coming true. Inflation, with energy costs as its engine, is eating away at the American lifestyle, and the public faces a shock in the short term. Within three to five years, utility bills in many areas of the United States will reach \$1,000 a month.

When this occurs, a good portion of the American public will have lost their ability to pay. Their disposable income will be gone and comfort, the state of being warm and clean, will have become a luxury.

If this situation becomes widespread, the result will be dislocations in the political area. Government, reacting, will not be able to solve the problem by merely subsidizing those who cannot discharge their utility costs, because the sums involved will progressively become so massive that government, just like the public, will lose its ability to pay.

For those of you who do not believe this can happen, I refer you to the newspaper accounts of the two meetings held in Palm Springs, California in August and September, 1980. Over 700 Southern California Edison customers met with a public utility commissioner to tell him that in their geographical area it had already happened. When you read the Los Angeles Times account, you will note the Commissioner was presented with a petition containing over 10,000 ratepayer's signatures protesting their utility bills.

One lady, Zelda Segall, displayed her \$1,044 home electric bill. Another, representing Yucca Valley homeowners asked "where are they gonna get the money? They're too old to get out and rob a bank."

You will note that the utility has another change in store for them. After four rate increases so far in 1980, Edison will ask for a 40 percent increase in December. Zelda's utility bill would then rise to \$1,466 for one month.

The utility spokesman blames the 8 cents per KWH rate on the high cost of OPEC oil which is the fuel for 44 percent of the utilities electricity.

He also notes 23 percent is made from natural gas and 4 percent from nuclear. As little as 10 years ago, the wholesale price for that gas was slightly over 20 cents per 1,000 cubic feet. Edison's supplier, the Southern California Gas Company, has a current 1980 marginal (or new) gas cost of \$4.58 per 1,000 cubic feet (out of Canada or Mexico) and Algeria wants \$8. That's 40 times the 20 cents cost.

If Mrs. Segall is upset right now, wait until Edlson buys \$8 gas and burns it to make electricity for Mrs. Segall's home. Or, wait until Edison gets the next nuclear reactor on line at San Onofre. That electricity will cost Mrs. Segall about twice that current 8 cents/KWH which does not include nuclear waste storage costs or reserves for future nuclear plant deactivation. Those costs may be as high as the initial construction costs were which will dramatically increase the future billings.

I grant you that in Palm Springs I have picked an atypical situation to use as an example. It is atypical because it combines a high summer load, a nearly all electric area, a medium high electric rate, and people with an above average ability to pay. But, it is a forerunner of what is in store for large portions of the country. It just happened in Palm Springs first.

Let me contrast that scenario with another real one, also unfortunately atypical. Ventura del Sol is a 254 unit apartment project, utilizing a conserving hydronic space and water heating system fed by a combination of natural gas and solar.

It cost no more to build than did the energy wasting systems in Palm Springs. The gas utility bills for the year 1979 averaged \$5.41 per unit per month.

With the rapid escalation in gas prices in 1980, the average bill is now just over \$8. Of course that \$8 includes the hearing of the community swimming pool, the spa, 9,000 square feet of recreation buildings and the three laundries.

At Ventura del Sol, approximately 80 percent of the energy consumed by the tenants is supplied by this system. The other 20 percent is electricity for lighting, small appliances and auxiliary uses.

In today's dollars, the total solar/gas space-water-pool-laundry heating system at del Sol would cost slightly under \$3,000 per dwelling unit installed.

No grants. No gifts. No government contracts. No financial incentives except the tax credits.

If you compare that with the Department of Energy's pet solar project, the Power Tower, you will find it cost \$140 million to supply the electrical energy for 6,000 homes. That is \$23,333 per home for just a small portion of the total energy load, the electricity.

Why?

When the country is faced with disastrous utility bills, why is the Department of Energy spending \$23,000 per house on an unproven technology that will provide only a minority of the energy and completely ignoring proven technologies costing one seventh as much that produce a majority of the energy?

Why is the public's tax money being funneled out to aerospace corporations to develop what Dennis Hayes, the head of the Solar Energy Research Institute, described on 60 Minutes as a "Gold Plated Turkey."

Why did DOE's undersecretary, Dale Myers, announce to the press in 1979 that "solar heating was not ready for commercialization" when 60 Minutes was pointing out that Ventura del Sol was working in the marketplace and the solar technologies DOE was supporting (like the Power Tower) were not?

Last December, when I appeared before the Senate, I asked for investigation of the DOE solar program.

Both GAO and OTA have now completed that investigative process. OTA, I believe, answers any above questions succinctly. They said there is a pervasive belief within and outside the DOE that senior DOE management does not really care about the conservation and solar energy programs, and that the quality of management has been inadequate as well as transient."

If I received a report from an agency I trusted that described some of my employees in this manner, I would fire them.

I suggest you do the same.

In the private sector I must respond to my Board of Directors and stockholders. In the public sector, you must respond to the voters.

I ask you now to consider what your response will be when the voters find out that the DOE has been distributing their tax money to a "good old boy network" for research and for development of solar technologies that can not solve the "utility bill crisis". What will the public do when they discover that the solar technologies that could help reduce those \$1,000 bills have been ignored, demeaned or opposed by these bureaucrats distributing their tax money?

If I were a member of the political establishment, this thought would give me pause.

And the public certainly will find out. Yesterday, in Colorado Springs, there was a Solarbration that included the groundbreaking for "The Neighborhood at Palmer Park", a 192 unit condominium project being developed by Projects Unlimited. It is total solar, which is to say it used a combination of solar and natural gas for both space heating and domestic hot water. By carefully arranging the pricing of the solar system and the dwelling units to the public, Harry Watson, the developer, has created a combined tax credit of \$7,000, (\$4,000 federal and \$3,000 state). The minimum down payment is approximately \$3,000 or less than half the tax credits.

The same developer has already had an outstanding success with a 240 unit total solar development in San Marcos, California, and has about 20 similar projects committed to this technology. One of these, a 468 acre project in Colorado Springs, begins early next year, and will become the world's largest solar development.

When Mrs. Segall compares her lot in life with those in Autumn Heights (San Marcos), the Neighborhood (Palmer Park) or Solar Village (Colorado Springs), do you think she will have a kind, benevolent feeling for the DOE and their solar programs?

I believe the time for positive action within our government is now. I also believe, as I have stated before, that Congress is the only real hope for that action. The President, any President, comes under unbelievable pressures from an energy industry with tremendous interests in the status quo. The bureaucracy responds not to the public, but to the vested interests with which they deal. It is the congress that must and can respond.

I sound this warning today in the spirit that the congress will do so. They have in the past, and I am confident they will in the future.

Please, I beseech you, do not allow the business as usual approach with DOE bureaucrats giving Congress half baked excuses for their failures in the energy area to continue. Straighten out this area and staff it with people who believe in promoting the soft energy technologies for the good of the American public, private enterprise and the free world.

Senator METZENBAUM. Our last witness is Mr. Milton Stewart, chief counsel for advocacy, Small Business Administration.

STATEMENT OF MILTON STEWART, CHIEF COUNSEL FOR ADVOCACY, SMALL BUSINESS ADMINISTRATION

Mr. STEWART. Mr. Chairman, if I may, I would like to offer my statement, for the record. I will limit my remarks to a very few, because I think the most critical things that need to be said in response to the question you have put to me have been said already.

In your letter to me, you asked expressly whether the Department of Energy's involvement in the solar energy industry is contributing to potential concentration in that industry.

My answer, unequivocally, is yes. It is based, I have to tell you, not on the kind of profound economic data that one would introduce in an antitrust proceeding in a court of law. It is based on direct discussion with literally hundreds of solar business people across the country.

It is based also, on day-to-day contact with the Department of Energy, by my staff people, particularly Christopher Burke, our Associate for Energy who is with me. And, it is based on a reading of the periodicals that cover the various aspects of the energy industry.

What I would like to do in my opening remarks, for just a few minutes, is to reminisce with you, sir, and recall that this is the fifth time in our lifetime that the Federal Government has made a massive intervention in the private economy, three times to fight wars. World War II, Vietnam, Korea, and twice for other national purposes, the space program and now energy.

We have had literally billions and tens of billions of dollars, taxpayers dollars, taken from the citizens of this country and put to work in ways that were determined, ostensibly, in accordance with the laws passed by Congress, but really in accordance with the preferences and desires of people in executive branch agencies, and lobbyists with whom they dealt. Lobbyists that were properly employed to pursue the legitimate interests of large enterprises, by and large.

The solar industry is simply the exposed nerve of a deep-rooted Federal Government sickness. It goes back a long way.

The sickness has other symptoms. The assumption that if you want something done quickly, the best way to do it is to throw large gobs of money at it in the form of big ticket research and development grants to major corporations.

That characterized much of what we did in World War II, and much of it was successful.

It has been, in my own opinion, of diminishing success in the four succeeding efforts by the Federal Government to guide the development of industry in directions required by national policy.

What has been missing throughout this is adequate oversight by the Congress of the United States to determine and to see to it that the missions are not discharged in a way that destroys the basic structure of this economy of ours and the diversity within it.

Congress must clearly, in the case of the Department of Energy, go far beyond what I read as an unequivocal directive to foster competition in industry.

I believe that has been flouted by the Department of Energy, from its initial establishment.

Let me say in defense of the poor souls who work there, we are dealing with institutional problems, not individual ones.

You heard a few minutes ago, someone express a preference for an SBA program, an SBA loan program to a DOE loan or grant program.

I have tried 20 times to explain to people that, with all its limitations, one of the saving graces of the Small Business Administration is that it only has 4,600 employees, the same number it had 10 years ago.

The Department of Energy has 20,000. It was stacked against small business from the day it was created. It was created out of other pieces of the bureaucracy, all of them gaited in effect with anti-small business directions, not because of conspiratorial preferences, but because of institutional factors, atomic energy requirements, Department of Defense requirements, Federal Power Commission regulatory requirements, and others.

From the day ERDA was established and from the day the Department of Energy was established, the Congress, in my opinion, has totally allowed those agencies to exercise the authority they have on the assumption that what they did would achieve what the Congress mandated as national policy goals, without destroying the basic competitive structure of this economy.

Let me advert, if I may, to three points made in the White House Commission Report on Small Business. I am quoting from page 13, from a document called, "American Small Business Economy, Agenda for Action." It was published in April 1980.

One, small business must play a larger role in national economic activity and should account for 50 percent of the gross national product by the end of the decade.

Two, policymaking units such as the economic policy group, and it lists some others, and the regulatory agencies, should recognize that small enterprises form a distinct economic structure within the national commerce and should develop distinct policy approaches for the small business economy. That is the basic sin in the energy area.

The Department of Energy exists for the large industry portion of the private sector.

Three, Federal policymakers should adopt supply side economic measures to fight inflation by encouraging Americans to save, invest, and produce.

We are here in effect, in the dying days of one administration, anticipating the arrival of another. With respect to the last point I just read, I can't emphasize too strongly, that it doesn't matter what economic theories you follow, the need to accommodate separately the potential of the small business sector of the economy, as well as the large business sector is going to be there.

I think we need a fresh look at the whole energy matter. A new beginning. It is not just a question of policy statements or bureaucratic organization. It is a question of reconciling two essential national goals.

We must achieve energy independence, and if we have to, take a lot of things from the Federal Government to do it.

We must also not pay a price for the achievement of that energy independence, the destruction of a substantial portion of the small business sector of the economy.

Let me say, while your hearing is on solar energy, we have in our normal day-to-day work, had to deal with the Department of Energy's impact on small gas stations, on small R. & D. companies, on independent wholesalers, on producers of energy, independents, wildcatters, independent refiners, and the rest.

In every instance it is an uphill fight, dealing with an Agency which is gaited in one direction and has been from the day it was founded.

The only way, I believe, to overcome it is a fresh start. How it is to be taken, whether through the enactment of a new basic statute, a reorganization of the Agency, the appropriation process, is for the Congress to decide.

Any of these will work if the people who are given the mission to do the job are genuinely committed to seeking to utilize both sectors the private economy.

I think that will do for me, Mr. Chairman, I will be happy to answer any questions you have.

Senator METZENBAUM. It is always a pleasure to have you appear before your committee, Mr. Stewart. You are incisive. You state your position. Everybody knows what you are saying. You do it in a relatively moderate amount of time and very effectively.

I also want to say that I am glad you didn't make your trip, although I am sorry for you, but I would guess that there are reasons for that.

On numerous occasions I have heard a similar litany of problems with respect to DOE, that they are anti-small business, pro-big business and unresponsive to continued public and congressional requests for change.

What would you suggest we do at this point?

Mr. STEWART. I really believe, as I have tried to indicate, Mr. Chairman, we need a fresh start. We have informally been discussing the desirability of the Congress perhaps going at this through a statute, which we call among ourselves the Small Business Energy Act, to really institutionalize small business utilization.

If it can be in the Department of Energy, well and good. If not, put it some place else. It may be asking too much of flesh and blood to ask people to deal with both the large business sector and the small business sector in this area.

That, I think, is a beginning point that I would consider.

Without a doubt, I tried to indicate again, I do not believe that the leadership of that department now or in the past, and there are distinguished and outstanding people in business and Government, has been held properly accountable for their impact on the structure of the economy.

Senator METZENBAUM. The Chair shares your view, I might say.

Do you have specific information on oil company buyouts and other types of oil company involvement in the solar industry?

Mr. STEWART. Mr. Chairman, only what we referred to in our statement. There has been a report by the industry, by the oil industry's trade association itself, the American Petroleum Institute, called the U.S. Solar Energy Industries and the Role of Petroleum Firms, that lists the firms that have been acquired and the firms that are doing the acquiring.

I would like to also offer for the record, if I may, a list of solar development and small business studies, by the Department of Energy, and a brief summary of what those reports say.

Senator METZENBAUM. That material will be inserted in the appendix to the hearings.

Am I correct in noting that the report of the "U.S. Solar Industries, Energy Industries, and the Role of Petroleum Firms," which is a report of the API, released March 12, 1980, concludes:

The photovoltaics industry is currently highly concentrated. These firms lead the market with combined market share of 77.3 percent.

They are Arco, Solar—Arco-Solar, Exxon's Solar Power Corp. and Solarex.

Is that correct?

Mr. STEWART. Yes, sir. That is an exact quotation. I have no reason to doubt the discussions that I hear about through the marts of trade.

I come out of the venture capital business and still know many people in the research and development field, and I keep hearing about further efforts on the part of major companies, the oil industry and elsewhere, to acquire solar firms.

Senator METZENBAUM. In your statement you refer to the problem of cumbersome DOE contract and procurement regulations as an obstacle to greater small business participation.

Could you provide the committee with greater detail as to the extent of this problem?

Mr. STEWART. I have already suggested, Mr. Chairman, that you let us put in the record a list of studies, among them is one, for example, by the House Small Business Committee. It is a report which specifically identifies these problems. Requests for procurement are long and complicated. The time in awarding contracts is lengthy. The bias of contracting officers is apparently toward big business, according to this report.

DOE's long-range plans are obscure.

What these add up to if you are a small entrepreneur, with limited resources, is that you decide, as an earlier witness suggested, finally, that the DOE is not for you. You simply can't deal with its cumbersome procedures.

Senator METZENBAUM. Very well. I have about 2 minutes more to conclude this hearing. I will ask you a couple of questions and ask you to respond briefly.

You state in your prepared remarks that another problem for small business is the funding and development by DOE of technologies which compete with private sector technology.

Could you give me any examples of this practice?

Mr. STEWART. One example is the black liquid solar collector involving a man named Harlan Anderson, of Burnsville, Minn. We will furnish an account of what happened to his invention.

Senator METZENBAUM. Could you give us more specific information on any competitive problems with the RCS program?

Mr. STEWART. Specifically, Mr. Chairman, that is a program which is apparently working to make the maximum of utilization. We have a fact sheet here about that. Utilities across the country, at the expense of small firms in the plumbing, heating and air-conditioning, and contracting business are involved.

Senator METZENBAUM. Thank you very much, Mr. Stewart. We always appreciate hearing from you. We are glad to have you accompanied with a figure who is not unfamiliar to us. We are happy to welcome him to this committee as well.

Mr. CHUMBRIS. On the Republican side, we enjoyed your remarks. Mr. Stewart is always a great witness.

Mr. STEWART. Thank you very much, Mr. Chairman.

Senator METZENBAUM. That is pretty good. Keep in good with them; it may help save your job. [Laughter.]

[The prepared statement of Mr. Stewart follows:]

PREPARED STATEMENT OF MILTON D. STEWART

I. INTRODUCTION

Mr. Chairman, it is a pleasure to appear today before the Subcommittee to discuss the subject of small business participation in solar energy. The Office of Advocacy at the Small Business Administration (SBA) firmly believes that small business will play a leading role in development of a competitive, efficient, and innovative solar industry.

My statement today reflects my views as Chief Counsel for Advocacy and not those of SBA or the Administration.

This Administration, working with the Congress, has made significant progress towards the goal of enacting a comprehensive national energy policy. With specific regard to solar energy, President Carter has established a goal of 20 percent solar energy use by the year 2000. Attaining this goal will very much depend upon the degree to which we can tap the innovative and other unique capabilities of the small business sector.

Today I would like to focus my comments in three areas: (1) the crucial role small business must play in the development of a viable solar industry in America; (2) the impact of government programs on small business participation in solar energy development; and (3) what steps need to be taken to ensure development of a competitive, efficient and innovative solar industry.

II. SMALL BUSINESS INNOVATION AND SOLAR ENERGY DEVELOPMENT

Solar energy represents literally an entirely new frontier for small business and the national economy as a whole. As such, solar energy will require the innovative resources of all sectors. As the unsurpassed leader in innovation, small business must play a key role.

The Office of Advocacy has looked carefully at the history of innovation in America, as part of an attempt to seek improvements for small business in the Nation's current innovation programs. What is striking, particularly in the energy field, is the clear leadership role small business plays in spurring technological innovations. For example, the National Science Foundation surveyed 500 leading technological innovations introduced into the market between 1953 and 1973 and found that small firms (up to 1,000 employees) produced twenty-four times as many innovations per Research and Development (R&D) dollar as large firms (Science Indicators 1976). In the energy field, Professor Enos of the Massachusetts Institute of Technology studied the seven major innovations in the petroleum refining industry since 1945 and found that all had been developed by small businesses and none by major oil companies. These types of studies are not definitive, but they are illustrative of the fact that small business' record in innovation is unsurpassed.

The innovation necessary to get us off our current dependency on nonrenewable fuels will not occur as one breakthrough in one major corporate or government laboratory. On the contrary, it will most likely be achieved in a piecemeal

fashion by a variety of separate entities. Neither big business nor big government was able to prevent, or even anticipate our present energy vulnerability. The basic energy industries—oil, gas, coal, nuclear—have made enormous capital investments in existing energy technologies. Corporate managements in these industries are dedicated to recovering capital investments in existing technology for as long as possible. Therefore, I believe it is unlikely that we will be liberated from our present energy dependency by institutions that are so reliant upon the status quo.

In the past the development of, and transition to any new technology has usually occurred through the birth and expansion of small businesses, not by large existing institutions. For example, the growth in the forties and fifties of the electronics industry, or the recent growth of the semi-conductor, computer, and telecommunications industries have all been spurred by new, innovative small businesses.

While efficient solar energy development will require the innovative talents of small business, the clear beneficial economic effects of such development are often overlooked by the business community.

Solar comes in many forms and requires a range of technologies—many decentralized—to harness. The development, production and sales of these various technologies offer tremendous growth potential to the Nation's small firms. Solar energy development is also labor-intensive. As the largest single source of new jobs and the most labor intensive economic sector, small business will clearly benefit from solar development.

Solar energy is also essentially free as a fuel source, and it is this single characteristic that makes it a leading candidate to replace our existing energy sources. While costs of conventional energy sources are skyrocketing, costs of generating electricity from solar are rapidly declining. The possibility of cheap, virtually unlimited energy from the sun represents perhaps the greatest single deterrent to continuing energy price increases and monopolistic or cartel price-setting in the energy industries.

III. SMALL BUSINESS PARTICIPATION IN SOLAR ENERGY DEVELOPMENT

According to the best information we have available almost 85 percent of the nearly one thousand solar firms in America are small businesses. Unfortunately the role small business plays in terms of market shares and shares of government solar funding are not commensurate with the numerical dominance of small businesses.

In fact, the solar industry is rapidly becoming dominated by big business. Two-thirds of the top fifty solar firms are subsidiaries of Fortune 500 companies. These large firms are not only large; due to their enormous capital availability, international scope, and marketing power, we call them "government-size business," meaning that they are larger than many state and national governments. The most oft-cited example is oil company involvement, especially in the photovoltaic industry. Nine of the ten largest photovoltaic firms are large firms and six are controlled by oil companies. Upwards of 90 percent of the 1979 sales of photovoltaic technology were made by affiliates of oil companies.

It is clear that the current trends threaten the development of a competitive, efficient, and innovative solar industry. What is disturbing from our viewpoint about this big business domination of solar development is: (1) it is inconsistent with the historic development of new innovative industries and (2) the Federal government appears to be encouraging this trend toward concentration rather than encouraging a diversified industry.

In the past, small firms have traditionally been on the cutting edge of new technological developments and pioneering of new products. Many of these small firms have grown rapidly with the new industry and grew large as the industry grew large. One of the best examples of this is the growth of the semi-conductor industry, in which General Electric and Westinghouse, for example, tried to compete, but ultimately do not today play a major role in the industry. On the other hand, firms that started small like Texas Instruments, have, in less than ten years, become large companies with significant contributions to innovation and the national economy.

In the photovoltaic industry the reverse appears to be happening. Small firms are being bought out by large companies at a very early stage of their development. Once a small firm is taken over by a large firm, the company seems to be

more eligible for Federal support. An example of this occurred recently when Amoco bought approximately 20 percent of Solarex and soon afterwards the Department of Energy (DOE) announced the company would receive a \$7 million research grant. Prior to Amoco's participation, Solarex had been turned down for DOE assistance.

Thus the small company is forced to sell out, in most cases to raise capital. After the buy-outs, the firm is then eligible for Federal assistance. If Federal assistance was more available to small firms, I believe we would not be seeing the premature buy-outs that are now taking place in the solar industry.

Consequently, Federal solar research, development, innovation and assistance programs are having a significant effect on the structure of the solar industry. The bottom line of Federal solar funding is that small business receives a disproportionately low share of the funds and large institutions receive a disproportionately high share of government R&D funds. The General Accounting Office (GAO) has recently released a report, "Small Business Participation In The DOE's Solar Energy Programs," which shows that 4.7 percent of DOE's direct funding in fiscal year 1979 for solar R&D went to small businesses. In fiscal year 1980 DOE predicts this small business figure will rise to 14.5 percent.

On the other hand, large businesses account for fourteen of the top fifteen solar contracts. Even though small business has been shown to be much more innovative than large firms, it appears that small business continues to receive token amounts of DOE solar funds.

Part of the problem lies with design and scope of DOE's research and development programs. DOE's photovoltaic program, for example, is research-oriented and market development efforts are only now coming into play. Small business traditionally must depend on both R&D and marketing to survive. When small firms cannot get access to DOE research funds, and cannot sell their product due to an undeveloped market, they either sell out or go out of business. The option of effective, expeditious Federal support for a small solar business in need of capital is very limited.

The Office of Advocacy has identified a number of significant obstacles to increase small business participation in Federal solar programs. These problems must be addressed as part of any effort to improve opportunities for small business:

1. Lack of sufficient data on small business participation in DOE solar programs.
2. Lack of understanding and lack of adequate training for DOE program managers on small business' capabilities.
3. Overly complex and cumbersome DOE contract and procurement procedures.
4. Lack of funding for unsolicited proposals from small business.
5. Lack of seed money available to small firms to serve as means of attracting private capital, and a general lack of capital and credit to proceed in the field.
6. Lack of an independent Office of Small and Disadvantaged Business Utilization to review contract applications, and lack of subcontracting plans by large firms obtaining prime contracts of \$500,000 or over, all contrary to the provisions and intent of Public Law 95-507.
7. Funding for capital-intensive, centralized high-cost, high-technology projects by large firms which far exceeds funding for decentralized lower cost projects appropriate for small business.
8. Funding of National Laboratories to perform services available in the private sector, thus reducing opportunities for small businesses.
9. Funding and development of technologies in competition with technologies developed by the private sector.
10. Lack of a formal small business participation plan with clear objectives and goals with the means to achieve them.

In addition to government R&D programs, other government policies are having an adverse impact on small business participation in solar energy. For example, under the Residential Conservation Service (RCS) program, DOE is approving state plans for utility energy auditing, conservation financing, and, in some cases, solar installation. The Office of Advocacy has intervened in this rule-making to ensure that adequate competitive safeguards, as required by law, are incorporated into each plan and DOE's regulations.

These concerns are far from new. In the past most, if not all, of the above problems have been identified and analyzed, and efforts to address them have been promised. What is clearly needed is continuing oversight and improved accountability to ensure that the intent of Congress is carried out in this area. In particular, Congress should demand more than lip-service from Federal officials on their intent to bring about small business participation in solar up to the levels in their own rhetoric.

CONCLUSIONS AND RECOMMENDATIONS

The continuing needs for improving small business participation in Federal solar programs, and the goal of development of a competitive, efficient and innovative solar industry go hand in hand.

The role of government must be to permit the private sector to perform the functions it performs best, and provide assistance or intervention only when helpful. Unfortunately, Federal R&D assistance in solar development has acted to enhance the competitive advantages of large firms at the expense of smaller firms. Federal R&D dollars have served to assist those who need assistance the least, i.e. larger firms, while providing the least assistance to those that need it the most, i.e. small firms. The first step towards development of a competitive, innovative and efficient solar industry is to correct this imbalance by developing solar programs that respond to the needs of small firms.

More importantly, though, and I want to emphasize this point strongly, the entire policy of the Federal government toward solar energy in general, and small business participation in R&D in particular, is in need of overhaul from top to bottom. Congress must decide if it is serious about this issue, and if so, must itself address and require DOE to address and remedy each of the concerns I have just outlined. Without that commitment, we cannot hope to develop a competitive, innovative solar industry.

Senator METZENBAUM. The committee stands adjourned.

[Whereupon, at 12:30 p.m., the hearing was adjourned, subject to the call of the Chair.]

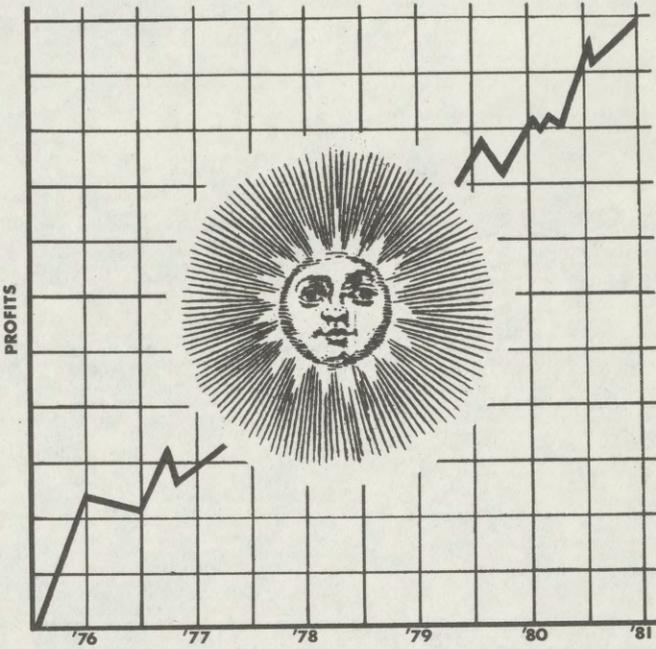
APPENDIX

Additional Submissions of Scott Denman

BIG BUSINESS & RENEWABLE ENERGY SOURCES

AN ANALYSIS OF THE CORPORATE CONNECTION

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BIG BUSINESS & RENEWABLE ENERGY SOURCES

AN ANALYSIS OF THE CORPORATE CONNECTION

By Scott Denman and Ken Bossong

Today, all combined renewable solar energy sources—including direct sunlight, wind, hydroelectric, and biomass—provide 6 percent of our nation's energy. In comparison, nuclear power contributes approximately 3½ percent of our total energy supply. More than 200,000 American homes utilize solar energy for space, hot water, and pool heating. The Harvard Business School's report, *Energy Futures*, points to a tenfold increase in solar equipment sales between 1975 and 1977 as indication of the industry's growth. In 1975 there were 22 solar manufacturers. Today, according to government figures, 929 firms produce some 17,000 solar devices. "Approximately, 85 percent of all solar businesses are small." However, Alabama's freshman Senator Don Stewart laments, "two-thirds of the top solar firms are part of companies with over \$100 billion in annual sales."

Back in the early days of the solar movement, it was not uncommon to hear an idealistic solar enthusiast declare: "Sunshine is free; no one can own the sun!" That naive has evaporated as the oil industry, aerospace firms, public utilities, and other corporate giants have maneuvered into solar development.

Major corporate interests, particularly the petroleum multinationals, now have secured a lion's share of the young-but-booming industry in solar photovoltaic cells. Nine of the 10 largest photovoltaic companies are owned by major corporations, and six are controlled by multinational oil firms. Exxon and Atlantic Richfield have a firm grip on nearly half the solar cells industry. In February, 1980, ARCO announced that it had moved even deeper into the photovoltaic market by signing a \$25 million contract with maverick solar inventor and entrepreneur Stanford Ovshinsky. ARCO's interest apparently was fueled by reports of a scientific breakthrough by Ovshinsky's firm, Energy Conversion Devices, Inc., which slashes the production costs of its amorphous silicon solar cell. ARCO markets other solar devices through its subsidiary, ARCO Solar.

Solarex Corporation of Rockville, Maryland, the world's largest producer of solar cells, is an excellent case study of the oil interest's movement into the solar field. Solarex, long the standard bearer for successful, independent, and small solar businesses was partially purchased by AMOCO (Standard Oil of Indiana) last summer. Although AMOCO only controls an approximate 25 percent of Solarex, the move is typical of the oil conglomerates' involvement in the industry. Solarex officials announced that AMOCO's investment will be rewarded by grants, research contracts, and solar cell demonstration projects from the federal government. Other conglomerates have acquired solar divisions under their corporate umbrellas, including Gulf, Texaco, Mobil Oil, United Nuclear, General Electric, Westinghouse, A, and Coors Beer.

The movement of multinationals into the solar field has not been limited by national boundaries. Shell Oil now owns controlling interest in Solahart-Australia

which produces 87 percent of the solar energy systems bought in Australia. Furthermore, the oil industry either owns or controls more than 99 percent of domestic copper production. Copper is the essential element in making solar equipment. The energy conglomerates are also moving into alcohol fuels production, wind systems (Rockwell International is in charge of DOE's small-scale wind program), geothermal energy production, and Ocean Thermal Energy Conversion.

Despite their substantial investments in solar technologies, these mega-businesses (while simultaneously promoting conventional energy sources) have publicly downplayed solar's potential contribution to our nation's energy supply. "The warm feelings generated by Sun Day . . . won't substitute for Science!" proclaimed a recent Mobil Oil ad campaign. Similar Exxon advertisements prompted U.S. Senator Gary Hart (D-Colo.) to raise the rhetorical question: "Could it be that Exxon hopes that solar stays under wraps until the world's fossil fuel markets are exhausted?"

"The problem", warns Tom Braden of the *Los Angeles Times*, is that these companies are already doing very well in the oil business, are investing heavily in nuclear power, and regard the solar business as something to be put off until the next day."

Similarly, U.S. Senator Edward Kennedy (D-Mass.) has charged that "the prospect for cheap solar is jeopardized since petroleum companies have entered this market through the acquisition of solar energy development interests." Kennedy has called for horizontal divestiture of the oil industry as the only way to insure that solar will be able to blossom to fulfill its economic potential in the world's energy markets.

"If the oil companies control substantial amounts of substitute fuels, and they may slow the pace of production of alternate fuels in order to protect the value of their oil and gas reserves, any decision an oil company makes concerning the production of substitute fuels would logically take into account existing oil and gas reserves and related capital assets", warns Alfred Dougherty, director of the Federal Trade Commission's Bureau of Competition.

Utility Involvement

Big Oil has been joined by the nation's utilities in the solar marketplace. A 1978 survey by the Electric Power Research Institute indicated that 165 utilities were engaged in solar projects. An identical study completed by the Institute in 1979 shows that more than 180 electric utilities are currently engaged in 750 solar energy research programs and are spending an estimated \$19 million on those efforts. While utility investments in solar have ranged across the full spectrum of renewable energy technologies, they have demonstrated a particularly strong interest in capital-intensive, centralized solar systems such as "Power Towers", huge wind generators, and solar power satellites.

A study published by the American Gas Association in early 1978 revealed 45 member companies involved in the testing and installing of solar hardware. In some instances, these programs merely involve the monitoring of solar installations to judge their impacts on utility load peaks. In other cases, though, the programs involve the purchase, financing, sale, installation, and/or maintenance of solar heating equipment. For example, the Long Island Lighting Company has initiated a program to install, at cost, 600 domestic solar water heating systems in customers' homes.

In general, the utilities have mimicked the oil companies' disclaimers that solar technologies are commercially unviable. Keith Turley, president of Arizona Public Service Company (a past recipient of solar R & D funds) has observed, "... in my lifetime, I don't envision solar having a marked effect on our generating capacity." "Nuclear power is the way to go for now -- for the immediate future", echo officials of Boston Edison. Ironically, while dismissing any serious near term-impacts from solar development, the utility industry has aggressively sought approval of new rate structures that charge higher prices for solar users (who need electricity for back-up service). In Missouri, Colorado, New York, Washington, D.C., and elsewhere, local utilities have warned state utility regulatory commissions that solar commercialization would undermine the integrity of utility service -- not to mention utility profits.

The problems posed by large company involvement in the solar marketplace are several. First, the financial strength of the large firms could be sufficient to undercut small solar businesses and drive them out of the marketplace; this might be particularly true for utilities which have monopolies in their given service area (and while subject to state regulation, the quality of this regulation varies substantially from state to state). Monopolization of the solar market by a few large firms, in turn, threatens increased product prices and lessens innovation. Further, most of the large firms with solar investments have publicly indicated strong doubts about the near-term viability of solar equipment; consequently, domination of the solar market by less-than-enthusiastic companies threatens a slow-down in the rate of commercialization. Finally, the hardware that has been produced to date by the big companies has tended to be highly-engineered and expensive (i.e. - "gold-plated") and thus available only to middle and upper income customers.

Notwithstanding these potential problems, the Bureau of Competition in the Federal Trade Commission and the Anti-Trust Division of the Department of Justice have allocated only small amounts of funding and staff time to solar competition problems. Likewise, the work done by the U.S. Department of Energy on the issue is similarly of a very limited nature. Ironically, the DOE has commented (in its July 21, 1978 draft of its "Domestic Policy Review of Solar Energy") that:

"In the absence of anti-trust enforcement and other regulatory activity by the appropriate agencies, the potential exists in the solar industry for monopolistic pricing, restrictions of supply, delays or reductions in technological innovation, and product improvement, and a government-induced decline in competition in the industry."

The problem is likely to worsen in light of the 1978 National Energy Act which direct the nation's large utilities to provide information to their customers on solar hardware, its projected costs and energy savings potential, local sources of the equipment, a way to finance solar purchasers. While the NEA specifically limits utility financing of solar installations to \$300 loans (in limited instances), the Carter Administration has recently proposed mandating utility companies to directly finance solar installations for their service area.

Legislation does now exist that could be used to combat problems of unfair competition. For example, the Sherman Anti-Trust Act prohibits contracts, combinations or conspiracies to restrain trade as well as monopolies. The Clayton Act forbids anti-competitive mergers, interlocking directorates, price discrimination, and exclusive dealing or tie-in arrangements. And the Federal Trade Commission Act prohibits unfair methods of competition or unfair or deceptive acts or practices. Aggressive enforcement of this legislation in the solar marketplace, however, is lacking. One of the correct solutions is to beef up FTC and Justice Department funding and incentive for work in this area and to back up anti-trust actions with strong White House support.

The Congress has the option to authorize such increases in funding as well as to strengthen existing anti-trust statutes as they may apply to the solar marketplace. Congress and state legislatures could also provide increased funding to state utility regulatory commissions to more closely monitor utility involvement in solar projects to minimize anti-competitive behavior. And state governments could use their own anti-trust statutes to more closely regulate intrastate solar commerce activities that may impact upon competition.

Solar Contracts & the DOE Budget

Juxtaposed with the less-than-enthusiastic approach of big business toward rapid solar commercialization is the Federal government - virtually handing the solar market to the corporate giants on a silver platter. So pervasively have the large corporations dominated the federal solar grant and contract scene that, in each of the last five years, big businesses (those with more than 500 employees) have never received less than 87 percent of the government's solar research, development, and demonstration funds. Even the Energy Department's 1979 Semi-Annual Report to Congress reflects that agency's lack of confidence in small businesses: "Though the solar energy industry at present consists mainly of small businesses, the majority of government funds channeled into the industry have been in the areas of research and development, and therefore have been directed to large corporations and educational institutions." (Emphasis added.)

In 1975, for example, big businesses captured the lion's share of Federal R & D funds for solar -- 89%. Three energy conglomerates alone secured 20% of that year's solar research budget.

The nation's major nuclear power plant manufacturers, General Electric and Westinghouse, took 8th and 9th respectively in the 1977 "top ten" solar research money-getters. G.E. designed solar equipment reflecting the company's attitude toward solar: it is expensive and highly technical. "G.E. is reproducing the Cadillac of the solar market!", charged Skip Latimer, director of Iowa Community Action Research Group, during

a federal hearing on solar policy held in 1978. Laitner claimed it was ridiculous to continue to invest U.S. solar research dollars in the large firms that are outplating" the solar market.

Honeywell, a major R & D firm with an interlocking directorate of executives from the nuclear, oil, natural gas, and banking institutions, was another big winner in the 1977 Federal solar grant sweepstakes. Honeywell was funded to develop the Transportable Solar Laboratory (TSL) which would travel about the country to explain the techniques and virtues of solar energy through public workshops. However, the TSL was used by Honeywell to discourage interest in solar systems, especially low-cost, passive solar designs. The California State Energy Commission was furious and "strongly recommended" to the DOE that the tour of the TSL be "stopped immediately and never started again." The Commission further decried the TSL's "misleading analysis techniques lack of dedication to clear and accurate education of the public and a manifest lack of knowledge." Nonetheless, the TSL program was continued under Honeywell's auspices.

Dr. Corey Rosen, staff rep. for the Senate Small Business Committee reported that small businesses received only 12.5% of the DOE solar contracts in 1979. This fact is indicative of the continuing trend within DOE to pour its solar R & D money into the coffers of the multinational energy conglomerates.

Interestingly, while the federal Solar Heating & Cooling Demonstration Act (42 U.S.C. 5912) calls for realistic and adequate opportunities for small business participation, considerations of competition and anti-trust consequences are not included in the grant/contract awards process by DOE, HUD, and other solar program agencies.

"The Department of Energy's record can be criticized," argues Chris Burke, assistant advocate for the Small Business Administration, "because it indicates how the DOE's policies are slanted in favor of big business. The basic problem is an attitudinal problem. . . . DOE does not feel comfortable with small organizations." Noting that a National Science Foundation study concluded that small businesses were 24 times more cost effective than big businesses in developing new technologies, Burke charges, "The DOE is squandering taxpayers' dollars when it gives money to the less innovative large firms." Solar R & D dollars ostensibly are granted to the private sector in proportion to the size of the company involved. The larger the corporation, the greater the contract size. While small solar firms have found relatively few government dollars tossed their way, Texas Instruments, for example, recently received a \$14 million unsolicited grant for photovoltaic research.

Early in the FY '81 budget deliberations, the Small Business Administration had its highly successful small solar businesses assistance programs cut from \$15 million to zero. The program provided much needed guaranteed loans to small businesses unable to secure financing through normal private channels. Only last minute, intense lobbying by the programs' advocates saved it from total obliteration and reinstated the original appropriations figure.

Solar equipment produced by the large corporations often is two to five times more expensive and more technically complicated. Several hearings before the Senate Small Business Committee have shown a wide pricing gulf

between the cost of similar solar units manufactured by different sized companies. Harry Thomason, one of the world's solar pioneers, frets that the government has reinforced the 'goldplating' of the solar market by "giving the impression you can't have reliable solar without spending \$15,000 to \$20,000 for it. It's just not true." Thomason's solar collector system generates about two-thirds of the water and space heating required by an average home at a cost of approximately \$7,500. Piper-Hydro of California, another small solar concern, is installing its unit for the cost of an equivalent conventional heating system--about \$2,000.

Lavish government subsidies of nuclear, petroleum, coal- and now, synfuels- have simultaneously kept the interests of the energy conglomerates in the driver's seat and solar development in tow. Despite annual increases in the solar budget, "the solar share is still the pauper's share," says a concerned Richard Munson, coordinator of Solar Lobby in Washington, D.C. Calculated in actual dollars, the fiscal 1981 solar budget of the Department of Energy was sliced by 3 percent. The conservation R & D program funding dropped by 12 percent when adjusted for inflation. Thus, solar programs remain the bastard child of the national energy effort, while nuclear R & D will receive twice as much as solar next year and synfuel programs are slated for a staggering increase of 500 percent--up to \$2.2 billion.

Procurement Practices

Access by small businesses to federal solar dollars is further restricted by existing government procurement policies. Small firms will frequently confront government procurement guidelines that require compliance with prevailing business codes, license regulations, product standards and the like. Since many of these codes, regulations, and standards preclude many alternative and innovative technologies, the procurement guidelines will prevent their acquisition by the government. Smaller firms will find it more difficult to submit low bids on large government contracts or to satisfy registration requirements to qualify as approved vendors. And large-scale purchases of hardware by government agencies can favor the firms that win contracts while financially disadvantaging those that do not.

Federal guidelines that call for at least minimum purchases from "small businesses" have been ineffective for several reasons: (1) the guidelines do not necessarily distinguish between primary and secondary purchasers; if a large firm with a government contract purchases from a small firm, then that firm is counted by the government in satisfying its quota of small firms even though there may not be any control by the government over the primary contractor regarding how the small firm is chosen; and (2) the definition of "small business" by the Small Business Administration isn't very suitable when distinguishing between "small" and "large" solar companies; a small business is defined as one having 500 or fewer employees--a figure that will include even the solar division of many corporate giants.

Paperwork requirements associated with most federal (and many state) requests for proposals (RFP's) for government grants or hardware purchases are frequently cumbersome, complex, and time-consuming. For example, the RFP process typically includes a 30-90 day response period following the publishing of the RFP in the "Commerce Business Daily". A subsequent 2-6 months of processing through the federal procurement is then needed before funds are obtained. Documentation required for

the procurement process is also cumbersome and includes forms to specify how various agency forms are being met (such as OSHA, EPA, etc.). The result is that many small firms are unable to compete effectively or else are discouraged from applying.

In its 1978 Domestic Policy Review on Solar Energy, the DOE has observed that:

"Current procurement procedures and grant programs can require extensive documentation and entail considerable costs for application submittals, progress reports, and subsequent evaluations . . ."

"Although federal guidelines affect large and small firms alike, it is typically the smaller firms which are least able to understand federal processes and cope with delays in scheduling or late payments."

The ability of a major business to undersell or underbid a smaller competitor has had a significant impact on the solar equipment procurement programs of federal agencies. In 1977, for example, nearly 70 percent of the \$6 million solar demonstration program operated by the Department of Housing and Urban Development went to seven large corporate solar manufacturers. Lengthy delays in the contract process, voluminous paperwork, and the inability to match the skilled grantmanship of the major corporations severely tax the limited resources of small businesses.

An investigation of its own Office of Solar Applications by the Department of Energy's internal watchdog, the Inspector General, found that of the grants, contracts, and procurements reviewed, 80 percent were made on an unjustified noncompetitive basis. The Inspector General also uncovered questionable management practices, misrepresentation of ability to perform contractual obligations, and misrepresentation of whether contracted firms actually performed a unique and otherwise unavailable service. Frequent budget overruns cost the taxpayers a full 100 percent more than the original contracts stipulated. Delays in fulfillment of contract schedules resulted in the loss of additional and as yet untold millions.

The General Accounting Office released a report in November 1979 which charged the DOE with uncompetitive contracting procedures. The report cited inadequacies in the DOE's handling of contracts once they had been awarded. It is interesting to note that only 70 corporations do 80 percent of all the research and development work for the federal government.

Centralized, High-Tech Orientation

In perspective, the Energy Department's big business bias is no accident. For years, the government's energy establishment has been well-supplied with personnel from the energy industry and vice-versa. The flow of top and middle level energy administrators, technicians, consultants, lawyers, and scientists between the large corporations and the federal energy agencies (the 'revolving door syndrome') has been a constant focus of criticism by small entrepreneurs and solar activists.

Given this array of top federal energy policymakers, it comes as no surprise to solar enthusiasts that DOE approaches solar technologies in much the same way as the major energy interests; that is, concentrate on tech-

nically complex, expensive, and centralized technologies. Rather than emphasizing smaller-scale, localized solar technologies that could be manufactured, retained, and installed by small businesses, the Energy Department developed a research and development program that might correctly be termed "solar in the nuclear mold".

As an example, the centerpiece of the DOE's solar thermal program is the 10 megawatt "Power Tower" under construction in Barstow, California, at a cost of \$183 million. The Power Tower, as designed, receives reflected sunlight from hundreds of computer-focused mirrors and transports that thermal energy to an on-site steam turbine, thus generating electricity. The Power Tower, scheduled for completion in 1981, was described by Science magazine as typical of the government's preference for centralized solar systems and its habitual use of major corporations to develop and perpetuate its programs. The White House Office of Science and Technology considers the Power Tower "economically unpromising."

Jerry Braun, DOE's amiable director for Thermal Systems (which oversees the Power Tower effort) admits that "those most committed to solar have benefited least from federal funding." But, what he meant to do with Power Tower," insists Braun, "is to give the R & D to those firms which are going to ultimately handle the production of the technology." When questioned about the appropriateness of virtually handing one or a few firms what amounts to a technological monopoly, Braun responded "I think it's fair." Major contractors for the program include McDonnell Douglas, Martin-Marietta, General Electric, and Southern California Edison. Coincidentally, Braun was the head of solar development at Southern California Edison prior to his government appointment.

Looming on the horizon is the prospect of a national program to commercialize solar power satellites (SPS). The SPS program proposal would place 60 satellites, each larger than Manhattan Island, into orbit 22,500 miles above the Earth's surface. The satellites, covered with photovoltaic cells, would convert sunlight into electricity and beam it to Earth in the form of microwaves. A three-year, \$25 million preliminary feasibility study will be completed in November of 1980. If approved, the SPS concept would be expanded into a 30-year program costing a minimum of \$500 to \$800 billion (in other words, an expenditure of two to three times the entire fiscal 1980 DOE budget). Energetic promoters already are lobbying Congress to win substantial funding increases for "technical verification" of SPS. Legislation promoting further government subsidies of SPS R & D utilizes the same terminology in describing what the additional money would be used for. Robert A. Frosch, NASA administrator was asked during public hearings on SPS what "technical verification" meant. Bemused, Frosch replied: "I really can't tell you."

SPS backers have created several organizations to help further their designs. The membership of one such organization, the Sunsat Energy Council, resembles a who's who in the space and power industries, including representatives from Grumman Aerospace, Westinghouse, General Electric, Southern California Edison, Boeing, RCA, and others.

Again, in its Domestic Policy Review on Solar Energy even the DOE admitted:

"In the long run, it is likely that the more expensive, centralized, large-scale solar technologies, such as OTEC and solar power satel-

lites, will continue to be owned and operated by a few large entities, either private or governmental. These large-scale solar systems could lead to the creation of natural monopolies due to scale economies, high capital costs relative to sales, and geographic or natural resource limitations."

Solar Performance Standards

The predominance of big industries in the solar marketplace is attributable to more than the active support given to large-scale, centralized energy technologies. Existing solar standards, for example, simply are not applicable to such simple and proven technologies as "breadbox" water heaters and "Trombe" wall solar collectors. Nonetheless, conformance with the standards generally is a prerequisite for receiving certain government support grants. Even those small solar companies whose devices might satisfy the established standards frequently cannot afford the cost of having their system tested (the cost of testing a solar collector to determine if it meets standards can cost more than \$1,500). Consequently, federal support as well as funding from the private financial community is being restricted to the more expensive solar hardware produced by larger firms.

Harlan Anderson, an independent solar researcher in Burnsville, Minnesota, claims: "There are more rules put on solar than any other industry except the nuclear industry. It would cost me \$250,000 to satisfy the National Bureau of Standards' criteria for my black liquid solar collector fluid (Anderson's invention) to be put on the market. The standards are ahead of the state of art." Anderson says a moratorium should be placed on such standards until the new solar industry can economically cope with them.

Solar Patents

When seeking to develop a creative solar concept, small businesses are caught in a Catch-22 situation. Without government support, they frequently cannot afford to carry out their plans. But with government support, they lose the patent rights (by law) that would make it economically feasible to eventually commercialize the hardware. Large businesses, on the other hand, have the capital to utilize their government grant to develop a large portion of their solar research work and then use their own money to complete and patent technologically 'key' parts of the system. The number of solar patents assigned to major corporations has skyrocketed since the late 60's.

Current federal patent policies can be divided into two categories: (1) patents for privately-developed inventions, and (2) patents for inventions resulting from work performed under government contracts. The former would appear to pose fewer legal constraints to the small entrepreneur than the latter.

The major legal hurdles the private inventor must clear in securing a patent are (1) satisfying the basic patent requirements of uniqueness, commercial worth, and first-in-time; and (2) incurring the expenses of forming a patent search (to insure uniqueness and novelty) and to file for a patent. This can result in substantial legal expense if counter-claims or conflicts arise. However, for the most part, securing a patent should not prove an insurmountable hurdle for the small appropriate technology inventor and entrepreneur.

However, current patent policy as it applies to small inventors who have completed development of a technology idea with the aid of a government grant raises a number of problems. The U.S. Department of Energy's nonnuclear patent policies are based on the Federal Nonnuclear Energy Research and Development Act of 1974 and the accompanying regulations codified in C.F.R. Part 9-9 (42 F.R. 36120-36145) effective July 13, 1977. Section 9(a) of that Act states that DOE will take "title" to any inventions developed in the course of federally-funded research, development, and demonstration. If normal DOE patent policy is followed, the inventor or contractor may retain a revocable or irrevocable, non-exclusive, paid-up, royalty-free license to use the patent. Since the government takes title to the invention, it also receives the right to sue for infringement, and this right is exclusive. This fact, coupled with the non-exclusive nature of the license (as compared to the usual type of patent which awards a 17-year monopoly to the patent-holder) tends to disadvantage companies participating in federal R & D vis-a-vis their competitors.

That is, most firms which receive government contracts have already invested heavily in the research area; contracts usually just enable the recipient to complete the work. Conversion of prototype solar designs developed under federal contracts requires substantial subsequent investment of private industry personnel and resources that are generally much greater than the small profits realized on a government contract. However, the non-exclusive nature of the license awarded makes it difficult if not impossible for a small firm to recoup an investment in commercializing the product since other firms will also be able to use the patented idea. Further, products or design ideas developed under federal contract are frequently based on technology earlier independently developed and patented by the contractor. Most firms understandably object to having their competitors permitted to use a technology developed under a contract that was based in part on privately developed background research and patents.

Small solar research companies are the most reluctant to risk substantial investments in either preliminary research or subsequent commercialization efforts without assurance of exclusive licensing. Large businesses, on the other hand, utilize their government grants to develop a large portion of their solar research work and then use their own money to complete and patent 'key' items within the project. Hence, the corporate giants become the primary beneficiaries of the socialized research market. Further, the fact that government contractors' licenses are revocable at any time may also reduce the incentive to make large investments in commercializing inventions subject to government patents.

The U.S. Department of Energy has acknowledged this problem. In a draft of its Domestic Policy Review on Solar Energy report prepared in the summer of 1978, the agency observed:

"In general, DOE's patent policies (and red tape) tend to hurt small businesses more than large. And uncertainty about the meaning and application of DOE's patent policies discourages participation by all firms."

The Nonnuclear Act authorizes the Secretary of Energy to waive all or part of the rights to an invention developed under a DOE contract if he/she determines that the interests of the U.S. and the general public

will be served by such a waiver. Such waivers are permissible when the Secretary determines that they would hasten the commercialization of the technology and competition in the marketplace would be enhanced.

However, current regulations do not provide clear standards governing the issuance of a waiver. Consequently, contractors may find it necessary to invest great amounts of time and money to negotiate a waiver and often the decision is not known until the time the actual contract is signed. Since small firms do not have the resources of time or money to press their requests for a waiver, large firms are again the beneficiaries of present DOE patent procedures.

Instituting the necessary reforms is being slowed somewhat by advocates of socialized research who are concerned that exclusive licensing could foster monopoly status in areas of the solar market by those companies that perform government contract research for profit. They argue that non-exclusive licensing can insure competition in the development of solar innovations from the prototype to the market-ready stages.

Options for addressing this problem include having the DOE develop much more detailed and explicit guidelines for the issuance of waivers. Exclusive licenses could be awarded to government contractors to use solar (and other) inventions for fixed periods of time; during that time, the contractor must expend diligent efforts toward commercialization of their inventions. At the end of a fixed period, a review would result in (1) termination of the exclusive rights, (2) renewal of the exclusive period, or (3) grant of irrevocable exclusive rights depending on the contractor's performance and success during the initial exclusive period.

The criteria to be used in such a review would include (a) the efforts by the holder of the license to commercialize rapidly the innovation (or legitimacy of reasons given for holding back on early commercialization); and (b) the general impact on solar market competition the grant of an exclusive license might have. With the latter point in mind, special preference may be given to smaller firms when considering applications for award of an exclusive license.

Bureaucratic Obstacles

Even when small businesses and individual entrepreneurs succeed in obtaining patent rights for solar devices and/or processes, they may face other obstacles. Harlan Anderson began investigating, in 1972, the potential for developing a new collector fluid for an active, heat-pump-assisted residential solar unit. Successfully concluding his research in October 1975, Anderson reports, "I got the patents on the 'black liquid' . . . and the government turned around and awarded Battelle Research Institute \$125,000 to develop the same fluid!" The Anderson system, inspected by White House representatives seeking to solarize the presidential swimming pool, was functional. And, he claims, the government knew of his working system when it funded Battelle for "just a simulated system." "The government has retarded the development of black liquids for solar collectors, contributed to patent violation, and from a personal standpoint, made it impossible for me to get into the business," Anderson says. "No financiers would back me because they considered the government's grant to someone else to be a sign of 'no confidence' in my design."

These and other government policies are encouraging the influx of major oil, utility, aerospace, and other firms into the solar market, but few efforts are being made by the agencies responsible to use existing anti-trust statutes to keep the solar market. The Justice Department's Antitrust Division and, especially, the Federal Trade Commission's Bureau of Competition have an interest in this issue. But inadequate staffs and budgets, coupled with the current anti-regulation mood on Capitol Hill and the threatened shutdown of the FTC, insure that the effectiveness of any efforts initiated by these agencies will be stifled.

On the other hand, the Energy Department has allotted only one staff member of its General Counsel's office to handle problems of solar competition--and that is limited to a part-time assignment. In an internal study never publicly released, the DOE noted that while the federal Solar Heating and Cooling Demonstration Act called for realistic and adequate opportunities for small business participation, considerations of competition and antitrust consequences were not included in the grants/contracts award process by DOE, HUD, and other agencies with solar programs.

Alcohol Fuels & Big Business

Since the earliest days of alcohol fuels--at the beginning of the twentieth century--there has been a perceived or actual rivalry between the big oil companies and the proponents of alcohol fuels.

Historically, many early automobiles were designed to run on alcohol instead of or in addition to gasoline. However, by the time that Henry Ford's first Model A¹ were becoming popular, the oil companies were already dominant force in the American economy; the Standard Oil Company, for example, had become prominent in the energy marketplace by the mid-1870's. By comparison, the nation's alcohol fuel industries were largely small, scattered, family-run businesses that lacked the financial and political clout of their oil company rivals.

Early congressional and White House support for alcohol fuels was based, in part, in an effort to stem the growing influence of the oil industry. In 1906, for example, President Teddy Roosevelt supported congressional efforts to lift the 40¢/gallon liquor tax on industrial alcohol in order to make it more competitive with gasoline. Such actions failed to have their desired impact as new oil fields were discovered and large supplies of inexpensive gasoline kept alcohol fuel use restricted to a very small share of the total market.

While continuing in use through the 1920's, alcohol fuels constituted little threat to gasoline. However, the alcohol fuels movement received a massive shot in the arm from the crash of the stock market in 1929 which sent farm commodity prices plummeting. Midwestern farmers and politicians resumed their active support for converting farm crops into alcohol fuels to help stabilize commodity prices. The reawakened alcohol fuels movement was further supported by the Chemical Foundation (which helped finance alcohol production) and William Jay Hale, a chemist and alcohol fuels lobbyist supported by Henry Ford. They openly labeled their efforts as intended to help farmers and others break the stranglehold of the major oil companies had on the energy market. The oil companies were depicted as pushing a product that was environmentally unsound and dangerous to human health as well as ultimately likely to result in dependence upon foreign oil imports.

The oil companies responded as might be expected. The industry denounced alcohol fuels in their trade publications and to their affiliated service stations. The American Petroleum Institute eventually joined the cause and widely distributed information and helped coordinate activities designed to block legislative efforts underway in a number of states to mandate the blending of alcohol with gasoline. For example, in Nebraska such legislation was introduced in 1939, 1941, and 1943 to require all motor fuel in the state to contain a blend of 10% or more domestic alcohol. However, each time the bill was defeated—twice by only one vote. According to Lester Sorrell, the son of the legislator who sponsored the bills, most of the opposition to the legislation was organized by the "Big Boss" oil interests; these interested oil representatives reportedly even tried to bribe Sorrell several times to get him to "forget he ever thought of the idea."

More underhanded techniques were also resorted to by the oil company interests in their campaign to discredit alcohol fuels. For example, in the late 1930's, a large number of traveling "experts" began visiting service stations that sold alcohol/gasoline fuel blends (called "Agrol"); these experts sought to convince the stations' proprietors that alcohol/gasoline blends would undergo separation in a car motor causing stalling. They demonstrated this "fact" by mixing some alcohol & gasoline in a test tube which they first rinsed out with water; the water droplets in the tube would cause the two fuels to separate (even though a similar condition would not likely be found in a car engine).

A more serious threat to alcohol fuels occurred toward the end of the Great Depression decade when a whispering campaign spread the incorrect rumor that the Wilson Agrol Plant in Kansas (a major area producer of alcohol fuels) used imported blackstrap molasses as its feedstock instead of local farm crops. Since the area's farmer cooperatives were then the primary distributors of alcohol/gasoline blends, support for the plant and its product quickly dissipated.

Similarly, in Omaha, the largest grain alcohol plant in the world opened in February 1944 amidst strong oil industry opposition. The plant was opened by the Defense Plant Corporation of the U.S. War Production Board but was operated privately by the Farm Crops Processing Corporation. The plant daily processed 26,000 bushels of grain into 65,000 gallons of alcohol. However, the regents of the University of Nebraska, which was providing funding for the plant, proceeded to budget the program 67 percent below the actual recommendations of the plant's advisory committee. Supporters of the plant claimed that the real reason for the reduction was the influence of regent Vincent Haskell who had represented the oil interests in legislative testimony against Assemblyman Sorrell's pro-alcohol bills. The withdrawal of funds resulted in the plant's closing and with it the Nebraska alcohol fuel program (and much of the rest of the nation's alcohol fuel efforts) went into an eclipse for the next twenty years.

Ironically, while Big Oil was fighting alcohol in the U.S. during the 1930's and 1940's, in Europe, the companies were proclaiming the virtues of "the most perfect motor fuel the world has ever known—a blend of 2/3 gasoline and 1/3 British alcohol" which Standard Oil of New Jersey had developed with the English Distillers Company.

Lingering interest in alcohol fuels was kept alive indirectly by the automobile industry through a number of research programs they maintained as well as through the use of methanol in race cars. For example, in 1954, Chrysler Corporation had built a prototype of a turbina-engine passenger car which was able to run on any type of liquid fuel including alcohol fuels. In 1962, the company announced it would enter the consumer market and built fifty test cars to be used in a consumer research program. By January 1966, the cars had been successfully driven more than a million miles and were ready for refinement before marketing. At that time, the Rockefeller family (which built its fortune on the Standard Oil Company), bought into the company, put a key man on its board of directors, and suppressed further development of the turbine car.

However, interest in alcohol fuels continued elsewhere. For instance, Dr. Thomas Reed spearheaded research into the use of methanol fuels at the Massachusetts Institute of Technology in the early 1970's. When Reed found that 10 percent methanol improved mileage and performance as well as reduced air pollutants, he began publishing his results in science magazines (11-29-74). And he began planning the most ambitious research program up to that time on alcohol fuels that would have involved testing his methanol/gasoline blends in 200 faculty and student cars. However, the publicity that began to accompany his work caused his grant money, including \$1 million from Ford and Exxon, to begin drying up. An associate on his staff began labeling his work inadequate and another Exxon scientist, E.E. Wigg, wrote an article refuting his results in Science (11-21-75). Wigg argued that methanol's fuel economy and emission benefits seem restricted mostly to older cars built before modern pollution control equipment was introduced.

A more obvious effort by the oil interests to suppress a renewed interest in alcohol fuels was evident in California where Chuck Stone (director of that state's Synthetic Fuels Program of the California State Legislature) began advocating a full-scale testing of alcohol fuels in automobiles. Stone reported that his early efforts resulted in his being cursed, cursed, and condemned by many of the oil companies. In fact, one lobbyist even told him: "If you don't watch yourself, you're liable to catch a bullet someday." Similarly, State Assemblyman Daniel Boatwright (the legislative sponsor of Stone's research project) reported several instances of being verbally abused by Al Schultz, the Sacramento lobbyist for Chevron's parent company, Standard Oil of California. In one instance, Shultz reportedly trailed Boatwright through the corridors of the California state house after Boatwright had testified before a senate subcommittee on the benefits of alcohol fuels and called him "a liar who is misleading the people." Early legislative efforts to support alcohol fuels, such as a measure to require gasohol to be sold at filling stations by 1980, were killed through the efforts of oil company lobbyists in the state.

And in Nebraska, according to Charles Fricke, administrator of the state's Alcohol Products Industrial Utilization Committee, the major oil companies were having a negative influence on that state's pioneering gasohol programs. The companies were dead set against proposals to mandate gasohol in the state; they argued that distributing the alcohol-blended fuels on the state level would be a major administrative obstacle.

One should note, however, that the companies with local distribution systems did not oppose the introduction of alcohol fuels. The oil firms were engaged in low-keyed lobbying efforts as well; Nebraska congress members reported receiving quiet calls from the representatives of the Nebraska Petroleum Marketers urging them to oppose gasohol proposals. Subsequently, in 1977, Jack Anderson began the first of a series of columns promoting alcohol fuels. The columns were greeted by Chevron and Mobil Oil launching a public relations campaign to discredit Anderson's statements. According to Anderson, the Chevron officials sent 2,000 letters to its employees at the Chevron refinery in Richmond, California which stated, in part: "If Rolands claims to relieve gas, what will relieve gasohol?" The company urged its employees to write their congressmembers and tell their representatives to oppose alcohol fuels.

The growing congressional interest in alcohol fuels, characterized by the enactment of the 1977 Agricultural Act's provisions for constructing four alcohol fuel demonstration facilities, intensified oil company efforts to discredit the fuel. For instance, John Freeman, senior environmental engineer at Sun Oil in Philadelphia began publicly stating that while alcohol is an excellent fuel, the economics of the production make it an unrealistic alternative; when reminded on one occasion that Volkswagen found that alcohol and gasoline fuels mix well, Freeman responded "German gasoline is slightly different."

Other oil company lobbyists began trotting out the full range of arguments against alcohol fuels (many of which had already been discredited). In one situation, Phillips Petroleum's J.W. Davison argued that: "Since if (ethanol) comes from farm products, we'd practically have to give up eating corn, wheat, and potatoes if we went the gasohol route."

Mobil Oil ran an advertisement in many of the nation's major newspapers in mid-1978 which noted, among other things that "the average car will not run or control emissions as well with gasohol" and that gasohol fuels could be price competitive only at taxpayer expense". The ad drew a quick and negative response from some two dozen congressmembers who issued a strong refutation of Mobil's claims. And in testimony before a House Subcommittee, Mobil spokespersons argued that "it would be particularly unwise for government to encourage production of grain alcohol by current technologies since it would actually increase the use of petroleum by the nation. A much more sensible energy strategy is to speed up the production of energy sources that are both technically and economically viable today, such as conventional oil and gas, nuclear energy, and the use of coal for direct burning." Congressman Dan Glickman essentially rejected the Mobil arguments with the observation: "We recognize that Mobil Oil profits could be affected if we develop this energy resource."

Other oil industry interest groups such as the American Petroleum Institute argued that gasohol was not economically feasible, would increase air pollution, would adversely affect the driveability of automobiles, or would require far more research before it could be introduced into the commercial marketplace. It's consequently not surprising that alcohol advocates saw the major oil companies as greater barriers to gasohol's commercialization than any economic, environmental, or technical problems. For example, a news report re-

leased by Congresswoman Virginia Smith of Nebraska noted that "more than three-fourths of the respondents to her annual survey say they believe that the federal government and/or the big oil companies have tried to prevent the development and marketing of gasohol."

However, as alcohol fuels have made major political advances during the past year at the federal and state levels, the oil companies have quietly changed their strategy from one of all-out opposition to one of moving into the marketplace. For example, in late 1978, Gulf Oil Chemicals Company testified before a Senate Energy Subcommittee in support of alcohol fuels; left unpublished was the fact that Gulf was, at the time, developing a pilot plant that converts solid waste into alcohol.

Similarly, Mobil, with the aid of several large federal contracts, totaling \$1.5 million, has developed a process of converting coal into gas, then into methanol, and then into unleaded gasoline at a \$10 million plant in Paulsboro, New Jersey. An analogous research program has been undertaken by Exxon which is constructing a large-scale coal-to-methanol-to-gasoline plant in Baytown, Texas. Exxon has also been recruiting researchers to head up a new biomass energy program; an ad appearing in the January 24, 1978 issue of the *Wall Street Journal* noted, in part: "Exxon Research and Engineering Company is starting a new research activity in the manufacture of fuels and chemicals from marine and agricultural materials."

More significantly, Amoco began marketing gasohol at a limited number of its service stations throughout the midwest in June 1979. The company advertised the "Amoco feels that if gasohol can make a successful contribution to meeting U.S. energy needs, it should be developed and marketed." Likewise, in early 1980, Texaco launched a major gasohol advertising campaign in the Washington, D.C. metropolitan area that announced, in part: "Good News, Washington; Texaco Lead-Free Gasohol is Here!" The ad went on to say that "the addition of ethanol increased the octane rating of lead-free Texaco gasoline. This improvement in anti-knock performance may be especially beneficial for customers whose cars need a higher octane lead-free fuel. At Texaco, we're doing our best to stretch our gasoline supply by making use of renewable natural resources." By spring 1980, Texaco planned to have gasohol on sale at 500 of its stations from Baltimore to Richmond; gasohol is now sold at about 600 Texaco stations in nine other states as well.

Finally, at least two major oil companies have quietly removed their restrictions on permitting the use of their credit cards to buy gasohol that does not carry their brand names. Gulf Oil announced that it will honor its credit card for the purchase of gasohol at all service stations that sell Gulf brands of fuel. A similar policy statement has been issued by Exxon.

The rapid change of heart of the major oil companies toward alcohol fuels raises many questions about the underlying motives. A primary concern is that Big Oil now sees alcohol fuels as inevitable and hence the appropriate strategy is to move in quickly and capture the market. Evidence supporting this theory can be found in several cases. For example, ARCO, which has been selling gasoline with 5 to 7 percent alcohol since 1969 to enhance engine performance (called ARCONOL), reportedly sought to buy into a small

alcohol fuels research company directed by Chuck Stone of California. And in early 1980, Texaco announced that it was entering into a letter of intent with CPC International to consider conversion of CPC's corn processing plant in Pekin, Illinois to ethanol production with an ultimate capacity there of 60 million gallons of ethanol annually.

In the mid-1970's, workers at CONOCO's research facilities in Ponca City, Oklahoma were conducting tests on methanol-powered Fords and Volkswagens. A report of research findings issued by CONOCO in 1975 concluded that "we believe that the properties of methanol as an automotive fuel deserve serious consideration. Its availability from a very large indigenous energy source, ease of handling, low emission potential, and high Btu efficiency contribute to make methanol a logical contender for the fuel of the future." Notwithstanding this conclusion, though, CONOCO apparently terminated this particular research program following the release of the report. Moreover, while CONOCO argues that it sought to actively publicize its findings at the time, it seems probable that few of the nation's motorists ever learned of the project or its results.

More recently (i.e. August 1980), CONOCO launched a program through its subsidiary, Douglas Oil Company of California, to provide methanol for a fleet of California state-owned vehicles participating in a two-year evaluation of alcohol fuels. The tests are being geared to provide CONOCO with data on the marketability of methanol derived from coal; incidentally, CONOCO owns extensive coal resources through another of its subsidiaries, Conoco Coal Development Co. It would thus appear that CONOCO, like its other oil industry colleagues, is seeking to carve out a segment of the profitable alcohol fuels market. However, in addition to the potential problems of big business involvement in this emerging industry, the CONOCO program also raises environmental concerns about basing future alcohol production on coal resources.

Of equal concern are the possibly misguided efforts of some legislators to force the oil companies into a dominant role in the marketing of alcohol fuels. For example, in early 1979, Senator Frank Church introduced S. 750, a bill to "put the burden of production and distribution of renewable resource-derived alcohol where it belongs, directly on our oil refiners. Unfortunately, forcing the oil companies to develop alcohol fuels or any other renewable energy resource will, as history shows us, only serve to impede the widespread acceptance of safe alternatives to conventional energy sources.

Windpower & Big Business

The persistent power of the wind has, for centuries, served humankind as an unrelenting beast of burden. It has powered the world's fleets for several millennia, may have been employed to irrigate Babylonian gardens, and won Holland's age old battle with the sea by pumping billions of gallons of water off the coastal lowlands, thus reclaiming thousands of acres of potential farmland. At the turn of the century, approximately \$10 million worth of windmills were sold every year. In the early 1900's, 6 million American windmills pumped water, ground grain, generated electricity, and provided mechanical energy for a host of physical chores.

The advent of rural electrification in the 1930's, of fossil fuels, and the movement toward centralized electric power stations all but annihilated the once prosperous windpower industry. As thousands of small generators collected rust, it wasn't long before wind came to be referred to as an 'exotic' energy source.

Steep rises in all types of fuel costs and the growing sentiment for more local and individualized control over energy production has initiated somewhat of a renaissance in wind systems development and usage. More government money in terms of contracts and equipment procurement has increasingly been poured into windpower programs. This resurgence of government interest coupled with the fact that the Department of Energy (DOE) is particularly disposed to creating very highly technical, capital intensive, large-scale wind systems has perked Big Business' interest in this form of energy generation as well.

According to a study done by Lockheed-California, windpower could supply 19 percent of our nation's energy by 1990. William Heronemus, professor of engineering at the University of Massachusetts, has proposed a scheme whereby offshore windmills could supply 159 billion kwh - all of New England's projected 1990 projected energy needs - for a capital investment of \$22.4 billion. By comparison, after 50 years and more than \$100 billion invested in research and development, nuclear power provides the nation with only 3.5 percent of our energy. Heronemus is no idle dreamer; he was one of the designers of the "Nautilus", the first nuclear powered submarine and its ill-fated sister, "Thresher". Another study, conducted by Bent Sorensen, professor of physics at Denmark's Niels Bohr Institute, found that wind systems with 24 hour storage capacity could provide electricity more reliably than nuclear power plants.

In 1973, something no less than a revolution took place in the wind industry, making the normal need for extensive battery storage systems virtually a thing of the past. As with most innovations, this technological breakthrough came about because of the efforts of a small research firm. Windworks, a Wisconsin-based company, created the "Gemini Synchronous Inverter", an ingenious device which changes the electricity generated by a windmill into the same type of current that passes through utility lines and thereby allows a consumer to both stay 'on-line' while the wind machine is operating and put excess electricity into the utility grid system. Needless to say, the utility industry was resistant to allowing these systems to plug into the grid and was even more opposed to the concept of paying for the surplus electricity generated by consumers. When Windworks first tried to hook an inverter-equipped windmill into the grid, Wisconsin Electric refused to allow it. Eventually, the utility permitted the windmill to feed excess electricity into the grid but, at that time, the utility still refused to buy the excess power.

In New York City, when members of a tenant housing cooperative installed a 2-kw windmill on their roof, Con Edison threatened to disconnect service to the building. Richard N. Arcari, director of Con Edison's central commercial services, said a feedback of windmill power could create "adverse effects on Con Edison's transformers and computerized control equipment, and even pose a hazard to repair crews working elsewhere in the same grid. However, the New York Public Service Commission ordered Con Edison to buy surplus power from the wind generator and, ostensibly, the Con Edison system has remained unharmed by this.

The sell-back problem has been somewhat mitigated by the 1978 National Energy Act. The Public Utilities Regulatory Policies (PURPA) section of the Act, signed into law by President Carter on November 9th of that year, stipulates that utilities must buy and sell energy produced from a qualified small power producer at

a rate that is just and equitable and in the public interest. There is, however, much variation in what the utilities perceive as "just and equitable" and this is causing controversy because the rate structures change the economic viability of the wind system. Buy-back rates are based on different factors in different areas. Some utilities allow meters to be run backwards when the consumer is pumping wind-produced electricity into the grid system. Many other utilities instead only pay small producers a token amount based on each utility's rate structure. Some small electricity producers are even required to pay a surcharge for use of the system.

Utility buy-back from small producers, now insured by PURPA, recently received a boost in Oregon as two utilities decided to purchase customer generated electricity at retail residential rates. Their new retail buy-back "tariff" has sparked a surge of customer inquiries. The utilities believe that if small power producers proliferate, it will actually keep costs to the utilities down. This may be true in this instance because the utilities had projected the need for additional generating capacity. And if they can encourage a sufficient number of customers to begin generating excess power, they will not need more central generating plants. The utilities calculate that it is cheaper to have customers build small plants and generate the needed extra capacity than to expand their own capacity.

In 1973, at the time of the Arab Oil Embargo, the federal government was spending a mere \$200,000 per year on wind research—a figure so small in comparison to the multimillion dollar R & D program budgets in other areas that it could not even be considered an "insignificant" amount. Realistically, the U.S. had no wind budget. By 1976, however, \$24 million in federal expenditures were going toward wind programs. Many felt that this level of funding represented nothing more than lip service. When President Carter proposed a \$40 million wind budget for 1979, Ben Wolf, formerly of Windworks and now president of the American Wind Energy Association, and a few other wind advocates succeeded in convincing Congress to up the wind budget to \$60 million. Carter requested \$67 million for the FY '81 wind research budget. Congress may authorize up to \$100 million. "Basically," Wolf says, "we're getting very good support from Congress but very little support from the Department of Energy or the executive branch."

"Tight-fisted funding is but one indication of federal indifference to wind's potential," asserts NEW AGE investigative reporter Preston Gralla. The General Services Administration (GSA), for example, which is responsible for the construction and maintenance of federal buildings and installations, purchases gasoline-driven generators to create electricity at rural sites. Ben Wolf argues that buying windmills for that purpose would not only benefit the wind industry but would also reduce GSA's budget.

Wolf points out that under the DOE's Wind Energy Conversion System Program small wind businesses "probably received no more than 25 percent of the total contracts let." Indeed, the emphasis of DOE research is clearly focused on large systems which, not so coincidentally, are also the focus of the major energy-related corporations interested in wind energy. This approach toward wind systems is outlined in a July, 1980 Energy Fact Sheet, released by NASA:

"The Department of Energy Wind Energy Conversion

System Program is aimed at demonstrating the public utility use of reliable, cost competitive, large-scale systems with lifetimes of 20 to 30 years."

The NASA pamphlet goes on to briefly mention that DOE program "also includes" smaller wind systems for "irrigation water, pumping, rural electricity production and other uses." (Emphasis added.) Ostensibly, the DOE does not consider small-scale, urban wind energy production systems as worthwhile—despite the fact that these systems are at work today in some of America's major metropolitan centers. Interestingly, DOE contracted Rockwell International the mammoth electronics and communications corporation, to administer the small wind systems program.

"Wind energy is treated as a stepchild of the solar program; worse, small wind energy systems are treated as the offspring of the stepchild," charged then Senator Thomas J. McIntyre (D-N.H.) in 1977. Between July 1, 1975 and December 1, 1975, roughly 2/3's of the wind program's grant money went to such firms as Lockheed-California, Boeing Vertol, Grumman Aerospace, MacDonnell Douglas, and Rockwell International. During this period, only \$2 million out of the more than \$20 million available was earmarked for "Farm and Rural Use (read: small) Systems", and Rockwell International received more than half of this—\$1.3 million.

The DOE's wind program has sponsored huge studies to carefully define the parameters of wind power use. For example, the Battelle Memorial Institute received \$1.4 million for "developing information on wind descriptors for designers and manufacturers" in several task areas. The major thrust of the program was outlined in the "Mission Analyses" by General Electric and Lockheed. Their purposes included to "define functional, cost and performance requirements of these systems; access the benefits to be derived from and the barriers to large scale implementation; and examine the impact of possible future use of wind energy conversion systems on a large scale . . ." The findings of the "Mission Analyses" may have been influenced by the size of the companies performing the studies. Although Lockheed found that small windmills could produce 209 billion kw in 1990, this is only 1/6 the total wind power potential that Lockheed foresaw for that year.

The DOE, with NASA's help, has gone ahead with its effort to develop major, centralized wind systems. In 1975, an experimental 100 kw wind turbine test facility began operating near Sandusky, Ohio. More recently, the DOE installed 200 kw capacity wind machines in four sites around the country; those sites are Clayton, N.M.; Block Island, R.I.; Culebra Island, Puerto Rico; and Oahu, Hawaii. The current phase of DOE wind system development involves the installation of Mod-1 type 2000 kw wind power plants. The first of such plants was built in Boone, North Carolina in the fall of 1979. DOE anticipates creating 2500 to 3000 kw wind generators during its next research phase. Such a plant would have a capacity of app. 25 times greater than the Sandusky unit.

Another concept in generating large amounts of electricity from the wind in a centralized fashion has been proposed by several utilities. Utilities, including the Hawaiian Electric Co., New England Electric Co., and the New England Gas and Electric Association are investigating the feasibility of establishing clusters of large windmills (of the 2.5 to 3 megawatt variety) in western

and New England sites. Boeing, Bechtel, General Electric, United Technologies, Bendix, Westinghouse, and Coa are all in various stages of determining the degree of commitment each will make to this venture. Most of these corporations have already been engaged, in some manner, in large-scale wind systems R & D.

Big Business, as detailed above in this and other sections, continues to move into the renewable energy resource market. The emphasis, time and again, of these mega-conglomerates is to develop massive, centralized energy systems that can only be controlled and managed by a utility or another energy conglomerate. Studies, like the one done on the wind energy generating potential of Pacheco Pass in California, indicate the viability of small wind systems. These small systems could serve to infuse the small wind businesses with new revenues and more jobs. However, the government and the energy conglomerates appear to be following their traditional patterns of operation. That can only bode ill for the small renewable energy businesses.

Developing Solar's Potential

In spite of these and other previously described roadblocks to a solar/renewable energy transition, the future is not entirely bleak. President Carter has set a national goal of 20 percent dependency on solar energy sources by the year 2000. The Administration, however, has yet to demonstrate a workable plan to attain that goal. Others, including the Council on Environmental Quality and Denis Hayes, the director of the Solar Energy Research Institute, urge a higher goal--up to 33 percent. "Solar is so viable now that, if the government didn't have a 'bloomin' thing," insists Thomas E. Stelson, U.S. Assistant Secretary for Conservation and Solar, "we'd have the 20 percent. If we do it right, we'll do better than that."

The Massachusetts Energy Policy Office reported in 1978 that a \$480 million solar investment to retrofit half the buildings in the state would create 32,000 jobs and save an equivalent of 9.5 million megawatts of electricity per year. The study notes equivalent nuclear development would generate less than half those jobs at five times the cost per unit of energy. A Senate Commerce Subcommittee staff proposal sent to the president shows that a \$1.65 billion commitment to conservation programs would create more than 100,000 new jobs and save 2 billion gallons of oil per year.

The transition to solar energy independence won't be easy or cheap. But these and other studies clearly illustrate that our problems do not lie with solar technology. Rather, our most pressing and challenging problem is unencumbering the solar movement from the talons of the energy conglomerates and their advocates in government.

Several solutions have been tendered by elected officials and solar activists. On the national level, Senator Edward M. Kennedy (D-Mass.) twice has introduced legislation to prohibit large corporations from investing in a competing resource, but his colleagues voted the measures down. The divestiture issue has received some tangential support from an unlikely source. Senate Minority Leader Howard H. Baker, Jr. (R-Tenn.) on ABC's *Issues and Answers* warned: "The oil industry in the United States may be headed for something worse than controls. It might be headed for a break-up or even nationalization. I told one person associated with the oil industry in a responsible position that 'If you don't get

those profits plowed back into production and less of it into different kinds (of energy sources), this country will turn on you and devour you.' "

At the state level, California State Senators Sieroty and Petris introduced a bill that would limit each company to control of no more than 10 percent of the solar market. Governor Jerry Brown, with the help of activists like Tom Hayden and Fred Branfman, of the Campaign for Economic Democracy, has established a public corporation, SolarCal, to encourage solar development.

SolarCal and other efforts apparently are effective --California accounts for almost half of the nation's sales of solar items. Statewide voter initiatives slated for the November ballots, could, if passed, pump as much as \$700 million into financing the installation of solar devices. These votes will mark one of the first times that citizens have had the opportunity to direct their government to allocate funds for solar development. Similar legislation and initiatives are being considered in other states.

Many solar proponents, however, have been content to watch from the sidelines or even encourage the unrelenting encroachment of the energy conglomerates into the solar arena, on the theory that bigger firms have the capital and marketing capabilities to expedite solar commercialization. Ray Reece, author of *The Sun Betrayed*, rejects that rationale, contending it ignores the fact that big businesses continue to hinder rapid solar development. Second, he says, these are "precisely the corporations and companion institutions that have essentially fabricated or at least compounded the nation's 'energy crisis' in the first place. Entrusting the major corporations with solar development is just another variant of the fox-guarding-the-hen-house theme."

There has been some progress, at least, in easing conglomerate control of government solar contracts. After several years of hearings, debates, and frustration, the Senate Small Business Committee finally succeeded, on April 30th, in pushing the Energy Department to develop a plan giving small businesses a bigger slice of the solar contracts pie. The Solar Energy Research Institute recently reserved 25 percent of its budget for small firms.

Such progress has been slight, however, and plainly inadequate. "Significantly more creative and comprehensive measures must be taken to re-introduce competition into the solar market and stimulate solar's growth," says Don Green of ACTION. Green and a growing number of solar advocates feel that divestiture of the energy conglomerates in concert with a total re-direction of government R & D funds to support small-scale, locally based, cost-effective solar energy resources is necessary. "We should either equalize or eliminate government subsidies of the various energy sources," Green postulates, "giving solar an equal chance through government support or by standing on its own." Another measure intended to help small business (which, incidentally, provided employment for 98.7 percent of U.S. citizens hired between 1969 and 1976) would reduce the number employees that qualify a business to receive 'small business' status from 500 to 100 and match the amount of federal R & D dollars received by small business to the percentage of annual contribution that small business make to the gross national product (approximately 48 percent).

Recommendations

In an effort to promote and implement positive, new, constructive policy steps that will help to insure the rational, just, and economically sound development of solar energy, Citizens' Energy Project proposes the following policy changes:

- Increase the staff and budgets of the FTC's Bureau of Competition and the Department of Justice's Anti-Trust Division to enable them to more aggressively and accurately monitor big business involvement in solar energy and pursue litigation where necessary.
- Prohibit firms from investing in more than one area of energy development through horizontal divestiture.
- Mandate that at least 46 percent to 48 percent (the annual percent contribution of small businesses to the nation's GNP) of all government solar procurements be made from small solar business's where "small" is defined as 100 employees or less rather than the Small Business Administration's 500 employee definition.
- Discontinue efforts to mandate private electric utilities into any specific or general role in solar commercialization.
- Amend current U.S. patent laws to permit independent researchers who develop a marketable solar concept with the aid of government money to retain the exclusive patent rights. The only condition should be that the inventor demonstrate a sound plan for producing and marketing the patented idea.
- Mandate that at least 46 percent to 48 percent (again using the GNP contribution guideline) of all government solar energy R & D grants and contracts (primary contracts as opposed to secondary contracts) be awarded to small businesses (again using the 100 employee guideline).
- Suspend current government regulations that mandate conformance with federal solar standards as a precondition for receiving federal solar grants.
- Streamline federal paperwork requirements for receiving federal grant monies; the guidelines developed by the DOE's Appropriate Technology Small Grants Program might be a good model here.
- Local and national solar/citizen groups must begin to address the issue of big business involvement in solar commercialization and what role, if any, would be considered appropriate for them.
- The federal solar budget should be amended to put the bulk of funding into the development and commercialization of small-scale, locally-based, inexpensive solar technologies--notably passive and active solar hot water/space heating, small wind systems, alcohol fuel, wood stoves, and other biomass, and retrofit of out-of-use low-head hydro sites. Funding for such programs as SPS, OTEC, and Power Tower should be reduced or eliminated altogether.
- An independent task force or standing advisory committee should be created within DOE to address the needs of the solar small businesses and to investigate the problems inherent with big business involvement in solar commercialization.
- The DOE should assume the leadership position in countering the anti-solar propaganda of the major energy companies. The effort should be highlighted with wide distribution of explicit repudiations by DOE. Simultaneously, the DOE should present the real story about the economic viability of solar devices to the American consumer.
- End the practice of the "revolving door syndrome" by establishing strict guidelines to prohibit domination of DOE's solar programs by former employees of energy conglomerates--especially those firms already receiving nuclear, conventional fuels, or centralized energy systems R & D money.
- These recommendations apply to all of the various forms of solar energy, including: direct and indirect solar, windpower, low-head hydro, alcohol fuels, etc.

Some solar activists have proposed the creation of an independent solar development agency or a locally controlled 'solar congress' to prevent the potential of solar from being thwarted by other interests. Such designs, however, must be politically cogent and supported by a wider audience than now participates in the generation of alternative energy policy. Given the current favorable socio-political climate for decentralization of power, such a movement might succeed if well-coordinated and persistent.

Regardless of the path taken, only a strong, concerted effort will re-establish competition--vital to the development of solar energy. It must be made clear to the oil industry and others that the promise of a solar society will be neither diminished nor deferred by selfish interests. Oligarchical control of the nation's energy supply has no place in the future of our democratic society. The ominous trends to the contrary can be reversed. However, we must act now if we are to ever witness the dawn of the solar age.

References & Resources

The Sun Betrayed, by Ray Reece, Pub. by South End Press, Boston, Mass., copyright: 1979

The Solar Conspiracy, by John Keyes, Pub. by Morgan & Morgan, Dobbs Ferry, New York, copyright: 1975

Serving Two Masters, by Common Cause, October, 1976, c/o 2030 "M" St., NW, Wash., D.C.

"Big Industry Vs. Small Business" in *Alternative Energy Magazine*, c/o P.O. Box 3026, Wichita, Kansas, July, 1977, Vol. 1, #5

"The Future of Solar Power" by Ray Reece, in *The Texas Observer*, Dec. 15, 1978 and January 19, 1979, Austin, Texas 78701

"The Solar Monopoly: Big Business Reaches For The Sun" by Scott Denman, in *The NATION*, Sept. 13, 1980, Vol. 231, No. 7, pp. 210-214

"Who'll Control Sun Power?" by Peter Barnes, in *The Republic*, February 2, 1975

"Exxon Vs. The Sun" by Ray Reece, in *Mother Jones*, Sept., 1980, Vol. V, No. VIII

"Corporations and Their Monopoly on the Sun" by Tom Braden, in The Washington Post, March 3, 1976

"Ripping Off the Sun" by Richard Munson, in the Progressive, September, 1979

"Power Politics: Big Business--the Fight for Solar Energy Heats Up" by Scott Denman and Ken Bossong, in Seven Days, June 29, 1979, Vol. 3, No. 8

"Windpower" by Preston Gralla, in NEW AGE, August, 1979, p. 49

"Windpower: The Big Companies Blow It" by Ken Bossong in People & Energy (the article is now available through Citizens' Energy Project, 1110 Sixth St., NW, Wash., D.C. 20001)

"Here Come The Sun Kings" by David Kaplan in New West, August 11, 1980, Vol. 5, No. 16, pp. NC-17

Copper & Big Oil Companies, a study by SUNRAE, 5679 Hollister Ave. Rm 5B, Goleta, CA 93017

American Petroleum Institute study, issued in March, 1980, on Solar and the Oil Companies' involvement. A.P.I. is located in Wash., D.C.

Energy Research Development and Small Business: Hearings before the Select Committee on Small Business, U.S. Senate, 94th Congress, Part 2 and Part 2A, October 8, 22, and November 18, 1975

The Solar Market: Proceedings of the Symposium on Competition in the Solar Energy Industry, Bureau of Competition of the Federal Trade Commission, Pub. by the U.S. Government Printing Office, Wash., D.C. 20402

"Government Contracting: Perpetuating the Energy Crisis" by Phillip Sperber in the American Bar Association Journal, Vol. 62, pp. 1301-1304, October, 1976

"Barriers and Incentives to Solar Energy Development: An Analysis of Legal and Institutional Issues in the Northeast" by Arnold R. Wallenstein; available from the Northeast Solar Energy Center, 70 Memorial Drive, Cambridge, MA 02142 (December, 1978)

"Locating and Obtaining Patents for Solar Energy Inventions" by the National Solar Heating and Cooling Information Center, P.O. Box 1607, Rockville, MD 20850

"Domestic Policy Review on Solar Energy" by the U.S. Department of Energy (July 19, 1978 draft); see in particular "Option: Maintaining Competition" and "Paperwork Reduction Option"; available from the DOE's Office of Conservation & Solar Applications, Wash., D.C. 20585

1979 Semi-Annual Report to Congress from the Department of Energy, information available on this report through the Office of Publications, DOE, Wash., D.C. 20585

'Key' Contacts:

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Dr. Corey Rosen-Staff Representative, Senate Small Business Committee, U.S. Senate, Washington, D.C. 20510

Ken Hughes - Staff Representative, Joint Economic Committee, U.S. Senate, Washington, D.C. 20510

Ben Wolf-President, American Wind Energy Association, 1609 Conn. Ave., Washington, D.C. 20009

ADDENDA

DOE Contracts Favor Big Business: According to the findings of the Senate Small Business Committee, the 'real' amount of Federal contracts let to solar small businesses have not exceeded 13% in the last five years and, not surprisingly, in the years prior to 1975. The Committee staff reports that for 1976 and the years prior, small businesses received app. 17.9% of the government solar contracts. This figure, the Committee argues, does not include research contracts. Therefore, the actual figure for all solar contracts is closer to half that amount. In 1977, the figures supplied by the DOE indicate that 18% of the solar contracts given to industry went to small businesses. However, the staff points out that the figure is derived from only those contracts given to industry. Therefore, if the research and government-owned and controlled organizations' contracts were included, the figure would probably be cut in half for those two years. In 1978, the figure for prime solar contracts let to small business by the DOE was 9.7%. That figure was 12.5% for 1979 and included not only prime contractors but the first level of sub-contractors who received government solar R & D dollars. It should be noted that the actual amount of money received by small businesses was less if only the prime contracts are factored in. The point here is that the big businesses control the contract when it is let to them.

The Revolving Door Syndrome: As mentioned earlier in the report, the DOE is staffed with a large contingent of former employees of various big businesses. Preliminary results from a new survey conducted by Citizens' Energy Project indicate that this trend is continuing. Of the top 165 DOE Administrators, 97 have responded to the CEP survey. CEP found that while 32% were formerly employed by big businesses (app. 1/3 energy-related), less than 5% were at some point in their careers employed by a small business. Also, the survey shows that of those responding to date, 32% have been employed by one or another branch of the armed forces, usually in a high-technology field (i.e. communications, weapons systems, computers, etc.). CEP found that the instance of 'lateral transference' was high. For example, 23% of those responding to date served both in the Atomic Energy Commission and the Energy Research and Development Administration before assuming their positions with the DOE. 46% served in the ERDA before moving laterally over to their new position with the DOE.

CEP Intern, Leslie Larson, conducted this survey.

SUNPOWER INC.,
Athens, Ohio, November 6, 1980.

Mr. SCOTT DENMAN,
Citizens Energy Project,
Washington, D.C.

DEAR MR. DENMAN: William Beale asked that I relate to you the conclusions of our experience attempting to secure funding from DOE for innovative energy technology.

You may or may not be aware that Stirling cycle engines have been identified as a very promising solar technology by the DOE. The free piston Stirling engine, invented and patented by William Beale, has been singled out as having the virtues of simplicity, economy and quiet operation. The Office of Congressional Technology Assessment is aware of Sunpower's work, the Institute for Scientific & Technological Cooperation has identified the free piston Stirling as economically promising and Mr. Peter Hunt, Research Analyst for House Subcommittee on Power is personally familiar with our work.

Sunpower has for the past several years been diligent in submitting our ideas to the government in an effort to commercialize products with an enormous potential for conserving fossil fuel, effecting the balance of payments, and contributing to rural food production and social welfare in Third World Countries.

What we have succeeded in achieving is at least two completely filled file drawers of rejected proposals.

The reason for the difficulty small business has in securing funding can be largely attributed to the relationship which has been established between government and big business, which I believe to be both understandable and detrimental to the best interest of our economy.

This then is how, from a small business view, the system works.

Big business is constrained by contemporary management and decision making strategy to maximize short term profits. There is little or no apparent incentive to undertake research which will not product a profit for 3-5 years. Capital can more fruitfully be used in improving existing products, drilling deeper oil wells etc. The results of this strategy have been fairly well documented as resulting in the U.S. losing its technological edge to more imaginative and farsighted corporations abroad. For example, the largest corporation in the world told us that they could not invest \$100,000 in a specific application of our technology because profits would not be realized in 6 months time, a rule of thumb management considers part of its responsibility to the Stockholders. However, this corporation indicated that it would seek funding from the government to develop the technology. In effect then big business competes with small business for the same funds, and in many cases with ideas from small business. Sunpower can document several cases where companies have utilized ideas, hardware, and computer codes originated here to secure substantial research programs from the government. The prime contractor for the 89.5 million dollar automotive Stirling engine program as well as the corporation receiving 15 million dollars per year for a Stirling-Rankine heat pump program are examples of this.

Not only can large corporations reduce risks and satisfy their stockholders, they can retain a highly paid engineering staff and make profit on government R & D. To this end they utilize their considerable organizational, influential and financial muscle to lobby legislation through Congress which will provide for funding programs they have or can acquire the unique expertise to be awarded. An example of this is the "2nd team" Automobile Stirling component test program.

There are similar themes which make it more difficult for the Government Agencies to fund small companies. From a managerial point of view it is much easier to administer several large programs than numerous small ones. After all the same paperwork and attention are required for both large and small programs. Generally speaking, small companies require less funding for their idea development which makes it more difficult for project managers to spend an allocated budget. A Sunpower proposal was one rejected by DOE because we didn't ask for enough money. Also working with big business is managerially less risky because if a large company fails, who could have succeeded.

There have been numerous attempts to involve the small business community in government R&D. One of the very obvious difficulties is in the definition

of "small". There is clearly a difference between the ability of a company of 15 people to procure a contract and that of a company of 500. It should be emphasized that it is in the ability to get the contract and not in the ability to do the work where the small company is at a disadvantage.

Should additional examples of our company experience appear helpful, do not hesitate to call upon us. We are more than willing to cooperate with your efforts to encourage the Government to support research and development with small firms.

Sincerely,

CRAIG KINZELMAN.

PARTIAL LIST OF PROPOSALS SUBMITTED TO U.S. GOVERNMENT AGENCIES SINCE OCTOBER 1977

Product	Agency	Result and observation
600-W Stirling engine generator run on a wood stove.	DOE—Midwest AT grant program.	Rejected for not promising to conserve enough energy. Yet, 100-W Stirling engine program funded.
Artificial heart.....	HEW.....	Rejected because we only proposed one part of job. RFP targeted to Aerojet.
Stationary Stirling.....	DOE/Fossil.....	Small business set aside; awarded to 2 U.S. companies without Stirling engine expertise teamed with European multinational corporations.
Solar powered water pump.....	DOE/Solar Thermal.....	Didn't request enough money. Wasn't enough money to fund all good ideas. Took 2½ mo for debriefing.
Solar water pump, Stirling refrigerator, Stirling engine generator.	US/SID—Office of Energy...	Unsolicited proposal submitted 1 yr ago without decision.
Rice husk-fired all purpose Stirling engine for Third World application.	AID/Dacca.....	Presently under consideration.
Regenerator test rig.....	DOE/Fossil Fuels: Prime contractor MTI.	Prime contractor decided to do work in-house.
1 kW duplex Stirling NG liquifier.....	DOE/Office Advanced Technology.	Under active consideration.
600-W Stirling engine generator.....	DOE—2d round AT grant program.	Awarded contract—work in progress.
Stirling engine sizing study.....	Argonne.....	Report delivered.
Purchase of SD-100 research engine.....	Argonne.....	Engine delivered.
Purchase of RE-1000 research engine.....	NASA—Lewis.....	Engine delivered 3 mo early.
Cryogenic cooler component development...	NASA—Goddard.....	Work completed, follow on work proposed.

SOLAR DPR INSTITUTIONAL INCENTIVES AND BARRIERS PANEL

OPTION: PAPERWORK REDUCTION OPTION

1. *Statement of need/opportunity*

An opportunity exists for the federal government's internal administrative processes to be simplified in order to assist small businesses that wish to be involved in federal research, demonstration, procurement or grant programs. At present many federal programs of this nature have lengthy applications requirements, demand extensive submittals for progress reports and evaluations, and have a lengthy processing schedule.

The effect of these requirements is:

- (1) increased costs for those companies attempting to obtain federal monies;
- (2) increased costs to the federal government for processing applications;
- (3) unneeded frustration for both the federal and private parties; and
- (4) a possible stifling of new ideas by those who become disenfranchised with federal support. (In essence, the advantages of federal assistance to a small firm are frequently negated by the entanglements imposed upon the funds).

2. *Background discussion*

Throughout the public meeting process of the Solar DPR, representatives of numerous firms cited the "hassles" of trying to work with federal agencies and their paperwork. Although federal guidelines affect large and small firms alike, it is typically the smaller firms which are least able to understand federal processes and cope with delays in scheduling or late payment.

The need to improve paper processing is one item which the federal government can solve, given a sufficient commitment to the problem. Although the Federal Commission on Paperwork Reduction expired in October 1977, the task of reducing paperwork can be achieved in each agency or through congressional action.

The federal government has a number of arrangements through which small companies or individuals can obtain federal monies. Through the RFP process, agencies can solicit bids from individuals or companies to work on a project. This process typically includes a 30-90 day response period following the publishing of the RFP in Commerce Business Daily. A subsequent 2-6 months of processing through the federal procurement process is then needed before funds are obtained. Documentation required for the *procurement process* is also cumbersome and includes forms to specify how various agency requirements are being met (such as OSHA, EPA, etc.).

These agency requirements have typically been imposed through congressional legislation aimed at achieving various social-equity goals. While these objectives are certainly not being disputed, the cumulative effect of these requirements may be to thwart small business involvement in government programs.

3. Description of proposed option

The problems of procurement procedures and paperwork are neither peculiar to solar program or DOE. The basic problem is common to all large and small businesses who deal with the federal government. The choices for correcting this problem or to devise means through which DOE's solar efforts can be expedited within the framework of existing processes. Given the relatively specific charge of the Solar DPR it seems inappropriate to suggest an agencywide federal reform. Therefore, the option needs to suggest specific steps which can achieve the goal of reducing the barriers to small businesses in the solar field.

Options include:

Grants:

(i) Utilize the less complicated grant process rather than contractual agreements as a means of expediting projects which are less than \$100,000 in size.

(ii) Keep initial proposals as brief as possible until grants are awarded

(iii) Enact legislation developing simplified procedures for small grants in the energy area.

(iv) For new programs and existing program develop a comprehensible and brief application process, (similar to that now in use by the Appropriate Technology Section of DOE's Conservation and Solar Section).

Procurement:

(i) For some types of procurement, group application approvals such that several awards can be approved as a group rather than individually. This should expedite the process.

Administrative Actions:

(i) Eliminate or reduce the material required for progress reports, final reports and accounting documentation

(ii) Increase the speed of payment for work and the percentage of payment granted at the onset of a project

(iii) Utilize one-time certification such that a small firm dealing with various federal agencies does not have to repeat certification of having met various requirements

(iv) Use referencing as a means of reducing submittal requirements when the materials were previously submitted to another agency

(v) Institute a small business ombudsman with a toll free phone number to assist small solar businesses.

4. Consistency with Federal programs

There is an unfortunate conflict between measures which are meant to encourage small business participation in the solar field, and those procedural requirements which try to ensure attainment of certain equity and social goals but simultaneously frustrate small business participation. This option attempts to strike a balance between the two but is relatively consistent with both.

5. Legislative and budgetary requirements

(1) Legislative—In order to be effective, this option will probably require some legislative action.

(2) Budget—This option might result in cost savings due to the reduced quantity of paperwork being shuffled.

6. *Implementation requirements and roles of Federal/non-Federal players*

- (a) Legislation needs to be developed and enacted.
- (b) An executive order or administrative policy needs to be developed.
- (c) Federal players include Congress, OMB, GSA, DOE, HUD, and others.
- (d) Non-Federal players may include groups such as the Citizens Committee on Paperwork Reduction, Small Business groups, labor unions, and others.

7. *Probable impacts/timetable*

- (a) Energy—not quantifiable, (unknown).
- (b) Competition—hopefully these efforts will help small businesses and increase competition.
- (c) Economic and Employment—more efficient solar development—should not affect employment.
- (d) Social Impacts—unknown.
- (e) Environment, Health, and Safety—none.
- (f) Regulatory—unknown.
- (g) Other—unknown.

Recommendation

Implementation of these options in their entirety is highly recommended: Their impact will be diffused but crucial to the effectiveness of all other programs.

PANEL	I	TITLE	DATE
Institutional Incentives and Barriers		Federal Paperwork Reduction	17/21/78
<p>DESCRIPTION</p> <p>This option addresses the need to reduce paperwork and expedite processing of funds going to small businesses involved in various aspects of the solar program.</p> <p>Current procurement procedures and grant programs can require extensive documentation and entails considerable costs for application submittals, progress reports, and subsequent evaluations. During the DPR Public Hearings, numerous company representatives testified as to the need to reduce federal requirements, particularly for smaller scale endeavors.</p> <p>It is hoped that the streamlined administrative procedures will help small businesses be more competitive and contribute to the development of solar energy.</p> <p>Most components of the option's recommendations can be implemented with little cost and through administrative actions, although new legislation may also be needed.</p>			
IMPACT		COST	
<ol style="list-style-type: none"> 1) Should reduce small business costs of dealing with federal requirements 2) Should increase small business involvement in solar programs, and increase competition for grant monies. 3) Should expedite processing of solar programs and buys 		<p>Unknown- possible savings</p>	

OPTION: PATENT POLICY

1. *Statement of Need.*—Current federal patent policies may be divided into two areas: (1) policies relating to privately developed inventions and (2) policies relating to inventions resulting from work performed under government contracts. The first area constitutes the existing patent system, under which the U.S. Patent Office awards patents to new and useful products, machines or processes that are not known to others and are not obvious or trivial advancements in the state of the art. Patentees have a legal right to exclude other from making, using or selling the subject of the patent for 17 years, and patent rights (including the right to sue for infringement) can be sold or transferred like other property interests. Solar patents are treated in the same manner as all other patents under this system.

The fact that a patent confers a legal monopoly does not necessarily create a monopoly situation in violation of the antitrust laws. The current patent system may be used in an anticompetitive manner, however, if a company uses an important patent in an exclusionary manner, or acquires (through research or purchase) an impregnable network of patents, or uses patent licensing as a means of imposing territorial restraints or restraints on price or use.¹

There is also no distinct or special treatment afforded to solar patents in the second area. DOE generally follows ERDA's policy of taking "title" to patents on any inventions developed in the course of federally-funded research, development and demonstration, but giving the contractor or grantee a revocable, non-exclusive, royalty-free license to use the patent. Since the government takes title to the patent, it also receives the right to sue for infringement, and this right is exclusive.

DOE has the ability to grant greater rights in exceptional circumstances, but reserves the right to "march in" and terminate these expanded rights under certain conditions (including a decrease in competition or an increase in concentration). Current DOE regulations also allow DOE to take "background" patent rights; that is, rights to patents or inventions underlying or serving as a basis for later inventions. Thus a government contractor's patents on inventions that are not the subject of the government contract may be used by the government or by other government contractors, and in addition the government may license third parties to use the patents.

DOE's patent policies thus tend to disadvantage those companies participating in federal R&D vis-a-vis their competitors. For example, DOE generally does not award exclusive licenses to its contractors, although firms engaging in private R&D receive their own patents, and DOE does not regularly enforce against infringement. As a result, anyone who so desires can practice government patents, but firms who do so under a nonexclusive license do not receive any protection from immediate appropriation or copying of their ideas. Investments in the necessary commercialization and development work may be discouraged if firms do not have adequate opportunities to recoup their investments. The fact that government contractors' patent licenses are revocable at any time may also reduce the incentive to make large investments in commercializing inventions subject to government patents.

DOE's ability to appropriate background patent rights may have the effect of discouraging those companies who would be most valuable to DOE from performing government R&D work, since the "best" companies are likely to be those that have conducted extensive research in the area and have patented their own discoveries. On the other hand, granting exclusive, nonrevocable licenses to government contractors could allow firms to "sit on" patents and delay commercialization of the inventions. In general, DOE's patent policies (and red tape) tend to hurt small businesses more than large.² And uncertainty about the meaning and application of DOE's patent policies discourages participation by all firms.

2. *Background.*—Existing programs and policies are as described above. The antitrust laws may be used to attack a network of patents erected by a company to restrict competition, and compulsory licensing has been ordered in at least

¹ See L. Sullivan, "Antitrust," ch. 6 (1977).

² See Environmental Law Institute, "Legal Barriers to Solar Heating and Cooling of Buildings," ch. 26 (1976).

100 antitrust suits in the United States.³ In other countries, mandatory licensing statutes are common.⁴

3. *Options.*—

(a) Encourage the antitrust agencies to monitor anticompetitive practices involving the use or acquisition of solar patents and to take enforcement actions as appropriate, including requesting compulsory licensing;

(b) Direct DOE and other appropriate agencies to develop expanded criteria for the issuance of exclusive licenses to government contractors to use solar patents for fixed periods of time, and to consider instituting a two-tiered system that gives a preference to small businesses either in obtaining exclusive licenses or in the length of such licenses;

(c) Direct DOE and other appropriate agencies to review and revise as necessary, in light of option (b), the criteria for exercising march in rights and terminating exclusive licenses to use government solar patents;

(d) Direct DOE and other appropriate agencies to develop a system and criteria for determining in advance of making an award whether or not a government contractor will receive an exclusive license for a fixed period of time on the inventions developed in the course of the government-sponsored R&D work;

(e) Direct DOE and other appropriate agencies to review and specifically define the limited circumstances in which a government contractor's background patent rights will be appropriated, and to define and circumscribe the uses to which such patents will be put as well as the potential recipients of licenses for such patents.

4. *Consistency.*—Opinion (a) is consistent with antitrust statutes and principles; options (b), (c), (d) and (e) require procedural and substantive modifications of DOE's current patent regulations, but are consistent with the principles underlying government R&D work and patent policy. DOE may be the only agency that asserts a right to take background patent rights (for example HUD does not); thus option (e) would bring DOE's policies more into line with those of other agencies. DOE's basic patent policy is "consistent with the general patent policy of the federal government, which is to take the principal or exclusive rights to inventions developed under federal contracts where a principal purpose of the contract is to develop or improve products intended for commercial use by the general public."⁵

5. *Legislative and Budgetary Requirements.*—No new legislation is required for any of these options. Option (a) could be implemented by statute or by appropriating increased staffing and resources for these purposes, however. Options (b), (c), (d) and (e) would require changes in existing DOE regulations, and perhaps in regulations of other energy R&D program agencies. Options (b), (c), (d) and (e) may also increase the need for review and enforcement efforts at DOE, so that additional staffing may be required.

6. *Implementation and Players.*—Option (a) may be implemented through an executive order or through new legislation and appropriations for Justice and the FTC, and will conceivably affect all holders of privately-developed solar patents. Options (b), (c), (d) and (e) require DOE, HUD, and any other appropriate agencies (perhaps NSF, CSA, Agriculture) to review and modify all existing regulations relating to patent and licensing of solar inventions and then to implement the modified procedures and policies. These options will have an impact on all actual or potential government contractors and government patent licensees.

7. *Impacts.*—

(a) *Energy.*—Indirect impact on energy supply and demand for conventional fuels. By facilitating the use of government solar patents and providing incentives for the investment of capital in efforts to commercialize solar patents more solar equipment will be developed and sold and thus more solar energy will be used. Protecting background patent portfolios and increasing the number of exclusive licenses awarded to contractors for the inventions they develop in the course of government R&D should encourage the "best" firms to participate in government programs. This should improve the quality of the work performed and the results obtained and accelerate technological improvements in solar.

³ See F. M. Scherer, "Industrial Market Structure and Economic Performance" 391 (1970).

⁴ See *id.* at 396.

⁵ See *op. cit.* note 2, *supra*.

(b) *Competition*.—Option (a) will help to maintain competition in this technology-oriented industry. Although seemingly restrictive of competition at first blush, options (b) and (d) in fact will stimulate investment in private research, development and commercialization of solar patents and will thus increase competition between solar and conventional energy sources. And in any event options (b) and (d) are subject to the safeguard of termination of the exclusive license as provided by option (c). Option (e) will attract more competitors into government solar programs.

(c) *Economic and Employment*.—Minimal impact on employment. Long run impact on the economy will stem from increased levels of private risk capital devoted to solar development and commercialization efforts and from downward pressure on prices of conventional fuels as costs of solar technologies are reduced and performance is improved. There is a potential of monopoly pricing for the periods of any exclusive licenses.

(d) *Social*.—Option (a) will maintain competition and decrease the likelihood that the solar industry can be controlled by one or more large companies through patent ownership or enforcement; options (b) to (e) will help bring about the social benefits stemming from an industry comprised of a great number and variety of firms.

(e) *Environmental/Health*.—Minimal impact.

(f) *Regional*.—Minimal impact.

8. *Recommendations*.—Implementation of the above options is recommended to increase the quality and quantity of private and governmental research, development and commercialization efforts and to attract a greater number and variety of firms to the solar industry and government solar programs.

SOLAR DOMESTIC POLICY REVIEW

INSTITUTIONAL INCENTIVES AND BARRIER PANEL OPTION: MAINTAINING COMPETITION

1. *Statement of Need*.—Two components of the solar industry must be examined when focusing on competition: one operates in the competitive market and the other relies on governmental activity. In the competitive market, solar equipment and individual solar technologies compete with other solar equipment and technologies, as well as with conventional energy equipment, such as gas and oil heaters and electric air conditioners, and with conventional energy sources, including gas, oil and electricity. Solar's ability to replace electricity puts it in at least indirect competition with coal and uranium as well. This sector of the industry includes private research and development work, and operates with marketing and other decisions based on traditional economic criteria.

The antitrust statutes were passed in large part to attack monopolies and other restraints of trade in the competitive market and to promote certain economic goals, such as competition and allocative efficiency. These statutes also address certain noneconomic goals, such as "a preference for decentralization of economic power, reduction of the range within which private discretion may be exercised in matters materially affecting the welfare of others, enhancement of the opportunity for more people to exercise independently entrepreneurial impulses, and, most blatantly, a social preference for the small rather than the large."¹ With respect to solar, traditional antitrust principles relating to horizontal integration and market extensions suggest that in order to "maximize competition, it would be preferable if the manufacturers, distributors and installers of solar equipment be independent of, rather than affiliated with" their conventional fuel competitors.² All of these principles are applicable to the "free market" component of the solar industry.

The second component of the industry, which operates under government regulation and subsidization, is probably the larger of the two. Federal and state governments spend large sums of money annually on research, development, demonstration, technology transfer, information dissemination, and other programs. Studies have found that, in the solar R&D area, the dollar amounts of the awards are distributed 20 percent to large firms, 40 percent to university research labs, and 40 percent to small firms. There is greater small business participation in

¹ L. Sullivan, "Antitrust," ch. 1 at 11 (1977).

² Environmental Law Institute, "Legal Barriers to Solar Heating and Cooling of Buildings," ch. 7 (1977).

solar heating and cooling, and the participants in the HUD residential demonstration program are almost all small businesses.³ Under the Solar Heating and Cooling Demonstration Act, federal agencies must take steps to assure realistic and adequate opportunities for small business participation,⁴ but strictly speaking competitive considerations are not a part of the DOE award process.

In the "governmental" component of the industry, the antitrust statutes of course do not apply. But the simple fact of government funding and regulation can interfere with the functioning of the market and can have the purpose or effect of decreasing competition and injuring individual competitors. On the other hand, government programs can be implemented in a manner that will increase or maintain competition, and can be used to carry out particular social goals, such as facilitating small business participation in the industry, since small firms may be more innovative and creative than large firms.⁵

In the long run, it is likely that the more expensive, centralized, large-scale solar technologies, such as OTEC and solar power satellites, will continue to be owned and operated by a few large entities, either private or governmental. These large-scale solar systems could lead to the creation of natural monopolies due to scale economies, high capital costs relative to sales, and geographic or natural resource limitations.⁶ The decentralized solar technologies, including solar heating and cooling, photovoltaics and wind, could become highly concentrated over the next few decades, and some firms could attain dominant or even monopolistic positions. The potential thus exists for suppression of solar technologies, restriction of the development of solar technologies, and monopolistic pricing.

2. *Background.*—The antitrust statutes are enforced by the Justice Department, the FTC, and state attorneys general offices. Justice and the FTC both undertake studies and evaluations of industry structure and performance, and the FTC is currently conducting a study of the energy industries, including the solar industry. There are a number of federal programs to aid small businesses, but only recently have programs been directed specifically at solar small businesses. DOE, HUD and the other solar program agencies do not include competition and antitrust principles in the awards process. There is currently no regulation of prices or service in the private solar market, although participation in the various government programs is of course subject to explicit requirements and conditions.

3. *Options.*—(a) Direct the antitrust agencies to develop guidelines for certain activities (*e.g.* mergers, marketing arrangements), and for the level and type of participation by certain types of firms (*e.g.* large energy companies or firms with the potential for market dominance) in the solar industry; the guidelines will serve as a mechanism to trigger antitrust scrutiny of potentially anticompetitive activity, which could lead to enforcement action in appropriate cases;

(b) Examine and revise as necessary the policies and award procedures of DOE, HUD, and other solar program agencies in order to: (1) eliminate anticompetitive tendencies or effects in the implementation of solar RD&D programs, or (2) foster the development of a competitive solar market in the long run, or (3) achieve certain "social" goals, such as increasing participation of small businesses in research and development;

(c) Develop long range plans for regulating the operation and ownership of centralized solar energy facilities at the federal or state level, through a public utility commission approach or through more direct federal involvement similar to COMSAT.

4. *Consistency.*—Options (a) and (b) are consistent with the antitrust statutes and competitive principles; option (b) reflects the concerns for small business manifested in SBA and other programs; option (c) recognizes the rationale underlying public regulation of natural monopolies and of industries where capital costs are very high in relation to sales.

5. *Legislative and Budgetary Requirements.*—No new legislation is required for any of these options, although the long range implementation of option (c) could require legislation depending on the approach selected. Options (a) and (b) would require small staffing increases at Justice, the FTC, DOE, and other affected agencies, with accompanying budgetary increases. Depending on the ap-

³ See *id.* at 145.

⁴ 42 U.S.C. § 5512 (Supp. IV 1974).

⁵ See F. M. Scherer, "Industrial Market Structure and Economic Performance" 353-54 (1970).

⁶ See *id.* at 519-20.

proach selected to carry out option (c), establishment of a new agency or funding for a variety of new regulatory undertakings will be necessary.

6. *Implementation and Players.*—Options (a) and (b) anticipate amendments to the existing regulatory structure and to solar program award procedures, as well as the development of new policies toward competition at Justice, the FTC, DOE, HUD and other affected agencies. Justice and the FTC must take the lead in developing and applying the antitrust guidelines suggested in (a), while under option (b) revised procedures must be developed by all affected agencies but carried out by the program agencies (DOE and HUD). Option (c) requires review by these same agencies, and may result in either the imposition of additional duties on DOE or the creation of a new agency to undertake the necessary regulatory activities. There is also the potential for state involvement under option (c).

7. *Impacts:*

(a) *Energy.*—No direct impact on energy supply or demand, but by ensuring a competitive industry structure in the long run (options (a) and (b)) and by providing a framework to ensure fair prices and service and equitable access to solar energy generated from centralized sources (option (c)), these options allow for the maximum utilization of solar energy. Without the protections envisioned by these options, supply restrictions, monopolistic pricing, and lack of innovation, product improvement or differentiation might occur, thus reducing the demand for solar energy equipment and decreasing the potential for use of solar energy.

(b) *Competition.*—Options (a) and (b) should stimulate or at the least maintain competition within the solar industry in the long run, resulting in lower costs, better and more varied products, better service, etc.; option (c) anticipates the need for regulation of prices, service, and other concerns, where reliance on the competitive market may not serve the public interest. All should increase competition between solar and competing conventional energy sources.

(c) *Economic and Employment.*—To the extent that these options assure a stable, competitive solar market, prices will be reduced and competition in the areas of quality and performance should increase, thus stimulating employment. Lower costs for solar energy will eventually create downward pressure on the costs of substitutable energy sources.

(d) *Social.*—Option (a) may reduce the likelihood that the U.S. consume will be totally dependent on a handful of powerful corporations for a need as basic as energy; option (b) may encourage and facilitate small business participation in the solar industry, thus stimulating decentralization and a variety of independent entrepreneurial undertakings; option (c) lays the groundwork for the establishment of a fair method to allocate the costs and benefits of centralized solar energy generation.

(e) *Environmental/Health.*—Increased use of solar energy reduces dependence on fossil fuels with attendant reduction in environmental degradation; regulation of centralized solar facilities should include regulation of siting and safety features.

(f) *Regional.*—Minimal impact.

8. *Recommendations.*—Implementation of the above options is recommended to encourage the development of a more competitive solar market in the long run, where possible, and to rely on governmental regulation as a second best in areas of potential natural monopoly.

<p>titutational Incentives Barriers</p>	<p>TITLE Maintaining Competition</p>	<p>DATE 7/21/78</p>
<p>SCRIPTION</p> <p>In the absence of antitrust enforcement and other regulatory activity by the appropriate solar energy program agencies, the potential exists in the solar industry for monopolistic pricing, restrictions of supply, delays or reductions in technological innovation and product improvement, and a government-induced decline in competition in the industry. Three options are recommended: (1) direct the antitrust agencies to develop guidelines for and to proceed against, if necessary, particular types of activities and particular types of firms that have the potential to decrease competition in the solar energy industry; (2) direct solar program agencies to examine and revise solar award procedures in order to foster competition or participating the operation goals; (3) develop long-range plans for regulating the operation and ownership of centralized solar energy facilities.</p>		
<p>IMPACT</p>	<p>This option will have minimal direct impact on U.S. energy supply or demand, but will allow for maximum development of a solar energy market and a competitive solar industry, which should be able to meet all demands. This option should also increase competition between solar energy and conventional energy sources. An anticompetitive solar market that results in higher prices, lower quality products, restricted supply, etc., will reduce the demand for solar energy devices, thus decreasing the use of solar energy.</p>	<p>COST</p>

Additional Submissions of Milton Stewart

REPORTS: DOE SOLAR DEVELOPMENT AND SMALL BUSINESS

Title: Survey and Analysis of Small Business and Minority Business Enterprise Participation in Solar Energy Procurement Activity

Author: Techmatics Corp. (DOE contract)
Date: February 1977

Major Conclusion/Recommendation:

Small Business received 7.1 % of the solar energy prime contract dollars in FY76 + TQ

Title: Analysis of Small Business Participation in the Photovoltaic Area of Solar Technology

Author: Techmatics Corp. (DOE contract)
Date: April 1978

Major Conclusion/Recommendation:

The climate within the photovoltaics industry has encouraged the small entrepreneur to present and develop concepts which will come to fruition. A desired end result of DOE policy would be an increase in the number of qualified small business sources available to Photovoltaics.

DOE should institute a functional technology transfer program, parallel prime contracts for small business, and increased use of small business set-asides.

Title: Survey and Analysis of Small Business and Minority Business Enterprise Participation in Solar Energy Procurement Activity

Author: (DOE contract)
Date: July 1978

Major Conclusion/Recommendation:

Small Business received 10.5% of the solar energy prime contract dollars in FY 77.

Title: Enhancing Small and Minority Business Participation in Solar R&D: Recommendations for Programmatic Initiatives.

Author: American University and Systematics General Corp. (DOE contract)
Date: December 1978

Major Conclusion/Recommendation:

Develop procurement plan for competitive solar R&D and distribute; abbreviate RFP's and response requirements; provide set-asides for prime and subcontracting.

Title: (GAO review of DOE efforts to encourage small business contracting in solar energy research and development.)

Date: June 26, 1979

Author: GAO

Major Recommendation/Conclusion:

DOE goals for small business awards based on incomplete information; DOE office responsible for maximizing small business participation lacks the needed independence that Congress mandated.

DOE should improve procedures for setting goals for contract awards and make them more realistic; provide better guidance to procurement officers on small businesses available.

Title: Improving the DOE-Small Business Relationship

Author: Development Sciences, Inc. (DOE contract)

Date: October 3, 1979

Major Conclusion/Recommendation:

Four offices within DOE have small business responsibilities, but none now has the breadth of policy and programmatic authority necessary to carry out a DOE-wide small business strategy.

A new office is needed with: 1) access to senior officials; 2) authority to be involved in program and budget policy; and 3) authority to implement a unifying innovation policy.

Title: The Department of Energy's Practices for Awarding and Administering Contracts need to be Improved.

Author: GAO

Date: November 2, 1979

Major Conclusion/Recommendation:

DOE's contracting practices: 1) avoid or limit competition; 2) use contractor involvement in basic management functions; and 3) reveal a need for more control over contract administration.

DOE should ensure that competition for contracts is maximized, establish specific guidelines on management tasks not subject to contracting, and establish a training program to re-educate procurement officers.

Title: Proposals for a Comprehensive Program of Financial Assistance to Small Energy Conservation and Renewable Resource Companies.

Author: Derek Hanson and Associates, Inc.
Date: March 1980

Major Conclusion/Recommendation:

DOE's present "shotgun" Approach to financial assistance to small energy companies does not encourage strong private lender participation.

DOE should expand to \$50 million its ATSG program, organize a second with emphasis on commercialization, and establish 10 SBIC's and 10 MESBIC's with a total leverage of \$100 million to provide a much-needed source of private capital.

Title: Conservation and Solar Energy Programs of the Department of Energy: A Critique.

Author: Office of Technology Assessment
Date: June 1980

Major Conclusion/Recommendation:

DOE/CS lacks a clear vision of where it is going and how it will get there; it needs to develop the capability to make sound policy and achieve objectives in the face of pressures to the contrary; and it needs better program evaluation.

Title: Small Business Participation in the Department of Energy's Solar Energy Programs.

Author: GAO
Date: September 29, 1980

Major Conclusion/Recommendation:

Small Business received about 4.7% in FY79 and 14.5% in FY80 of DOE's direct solar budget, but DOE has no way of knowing whether this is appropriate and has not related it to DOE's overall goal of 20.1% small business funding.

Goals should be established for small business utilization; better monitoring of contracts needed; and solar program officials need training to become more sensitive to small business problems.

Title: "Role of Government Funding and its Impact on Small Business in the Solar Energy Industry."

Author: House Small Business Committee Report

Date: October 3, 1980

Major Conclusion/Recommendation:

Major oil company marketing strategies and big business policies in general, along with DOE regulations, are creating an anti-competitive situation in the solar market.

DOE should review its entire solar energy development policy and its effect on small business.

FACT SHEET ON DOE'S IMPLEMENTATION OF THE FEDERAL
RESIDENTIAL CONSERVATION SERVICE (RCS) PROGRAM
WHICH FAILS TO PROTECT CONSUMER AND SMALL BUSINESS INTERESTS

Background

The National Energy Conservation Policy Act (NECPA) of 1978 established a program of residential energy audits to be performed by utilities in accordance with state Residential Conservation Service (RCS) Program plans. Section 216 of NECPA contains one of the strongest legislative provisions ever adopted to prevent anticompetitive and anticonsumer practices. Utilities were barred from financing, installing, or supplying of energy conservation measures, unless the program antedated the Act or a waiver was obtained from the Secretary of Energy.

However, in the Energy Security Act (ESA) Amendments of 1980, Congress recognized that utility programs could provide substantial benefits, and that prior program approval by DOE was unnecessarily restrictive. While reaffirming the basic concern that utilities might abuse their monopoly position, Congress indicated that such programs would be permitted under certain restricted conditions.

Congress required that DOE approve state RCS plan amendments that will incorporate adequate procedures to insure that utility programs do not involve unfair methods of competition or have a substantial adverse effect on competition. DOE was also required to issue rules by October 28, 1980 (within 120 days of enactment of ESA) to guide the states in developing plans that incorporate the proper procedures.

DOE's Failure to Comply with Federal Law

- DOE has proceeded to approve state plans which do not address even the basic essentials of protection of small business and consumer needs.
- The DOE policy on these issues, to the extent one has even been formulated, was developed without any significant outside comment. Even the Federal Trade Commission, which shares oversight authority with the Department of Energy over the RCS program was not informed of the DOE "policy" until after it was announced in the Federal Register.
- This "policy" was adopted by the Department without proper notice and comment rulemaking as required by the Federal law. DOE was mandated by the ESA to adopt rules and then to approve plans permitting utility involvement in energy conservation work. Instead, DOE has raced ahead of the rulemaking schedule and has expressed no intention to provide substantive guidance to states as required by law.
- In the October 30, 1980 rulemaking hearing, not one commenter offered support for the DOE position in written testimony, although many others vociferously criticized the DOE approach. DOE's proposed rules provide no additional guidance to the states on these issues.

Adverse Impact on Consumers, Small Businesses and Energy Conservation

The lack of adequate guidance to states on appropriate RCS plans will impede the drive for energy conservation and adversely affect consumers and small business energy conservation firms. DOE's inaction subjects consumers to utility programs that are improperly devised and implemented. There is substantial experience with proposed and existing utility programs (New Jersey, Massachusetts, Virginia, California) that suffer from anticonsumer and anticompetitive problems. The Nation's progress toward energy conservation would be hindered by Federal regulations that do not protect consumers and small businesses from utility abuses of the Federal RCS program. Indeed, well-designed utility programs would be jeopardized by inadequate regulations.

What You Can Do About This Problem

The DOE is still receiving comments on the October 8, 1980 proposed rule dealing with utility programs until November 24, 1980. It is also possible that late comments, if not unreasonably late, will be accepted. Comments should be sent to Carol Snipes, Office of Conservation and Solar Energy, Department of Energy, Room 1F-085, 1000 Independence Avenue, S.W., Washington, D.C. 20585. Comments should be identified on the envelope and on the documents with the designation, "Residential Conservation Service Program, (Docket No. CAS-RM-79-101)."

