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Mr. Chairman, I am pleased to appear before this Subcommittee to discuss the role of solar energy in the future energy programs of the United States. In my remarks, I will address several major issues:

- o The benefits and costs of solar energy.
- o The current barriers to commercialization of known solar technologies.
- o The federal role in solar energy commercialization.
- o The effectiveness of a Solar Energy Development Bank in stimulating solar commercialization.

Benefits and Costs of Solar Energy

Assuming oil price decontrol and a continuation of current energy policies, U.S. oil imports would be approximately 12 million barrels per day by 1990. Two major economic risks are associated with that level of oil import dependence: first, the economy would be more vulnerable to oil shortages and interruptions; and second, there would be considerable upward pressure on world oil prices which would add to inflation. In addition, such a high level of imports could even affect national security. Thus, as with any other oil import reduction program, a major benefit of accelerated solar energy commercialization would be a lessening of economic and national security risks. Another major, and unique, benefit of accelerated

commercialization is that solar energy is environmentally clean and inexhaustible. In addition, the commercialization of solar energy would provide information about the feasibility and costs of alternative technologies which would be helpful in designing our long-term transition to alternative energy resources. But even with new, higher oil prices, many solar technologies are more expensive than conventional fuels, so that rapid and large-scale solar commercialization would require government subsidies or higher direct consumer costs, at least in the short run.

Current Barriers to Commercialization of New Solar Technologies

At present, only a negligible share of domestic primary energy is provided by solar technologies based upon direct conversion and storage of the sun's energy.

The principal barrier to rapid comercialization of solar technologies is that most are currently more costly than alternative sources, such as natural gas, oil, and electricity. Because that barrier is much higher for some systems than for others, these technologies fall naturally into two cost categories: those that are substantially more costly than alternatives and those that are close to being cost competitive. In the higher cost category, only additional R&D can determine whether significant technological

improvements can make these solar technologies cost competitive with alternative energy sources. This category includes solar energy systems for agricultural and industrial process heat, photovoltaic cells, electricity, ocean thermal energy conversion, and central station solar thermal electricity generation. Even with considerably higher oil prices, the intermediate outlook for commercialization of these technologies is not promising.

The second, and most cost-competitive, category includes solar hot water heating, passive solar space heating, and active solar space heating and cooling. Technologies in this category have achieved only negligible market penetration for three reasons: (1) alternative fuels have been held below their replacement value by subsidies and regulatory controls; (2) new technologies take time to be accepted; and (3) initial capital costs for solar equipment are high relative to alternative fuels.

Until recently, solar hot water heating was slightly more expensive than electric hot water heating and substantially more expensive than natural gas. Similarly, active solar space heating was considerably more expensive than natural gas or oil-fired space heating and even slightly more expensive than electric base-board heating. But solar energy has been unfairly penalized in competition with these alternatives, because all the alternative fuels--oil, gas, and electricity--have been priced below their

replacement costs. Interstate natural gas prices were regulated until 1978, and the gradual decontrol of domestic oil prices has only recently started to raise these prices to world levels. Similarly, because electricity prices are based upon historical costs of capital, and because replacement costs of utility capital have inflated much more rapidly than the general price level, electricity remains seriously underpriced. All these distortions tend to bias consumer choice against solar technologies.

A second major barrier to rapid solar commercialization is the lack of consumer information, which impedes the spread of even cost-effective technologies. Because it is expensive and inconvenient to learn about new technologies and difficult to adapt a new energy technology to the requirements of a particular building and site, acceptance of the newer solar technologies can spread only slowly.

The third and final barrier to solar commercialization is the high initial capital cost of the newer solar technologies relative to alternative fuels, a problem even when life-cycle costs favor the solar technology over alternatives. For example, the initial cost of a solar space heating system for an average single-family house can be as high as $10,000, while a new electrical heating system costs only $1,500. Consumers may be reluctant to purchase the solar systems when the payback is spread over eight to ten years, particularly since many houses are resold before the cost savings can

be realized. Many homebuyers may also hesitate to purchase unknown solar technologies.

Federal Policy Guidelines for Solar Energy Commercialization

In developing federal goals and policies to stimulate the commercialization of solar energy, several points should be considered. First, the phased deregulation of natural gas, oil price decontrol, and the movement toward full-cost pricing of electricity will increase the prices of alternative fuels substantially over the next several years, and will make solar energy cost competitive for hot water and space heating in many parts of the nation. Because electricity rates differ considerably across the nation--a kilowatt hour currently costs approximately 10-12 cents in New York, but only 3-4 cents in the Pacific Northwest--the competitive position of solar energy also differs from state to state. Since solar technology will become significantly more cost competitive over the next several years, large federal subsidies are most likely not required to enhance the deployment of solar technologies.

A second major point is that the goal of any federal program for solar commercialization should be modest market penetration over the next five years to develop the capacity of this industry to produce and install cost-

effective and reliable systems. To date, there have been many cases of poor installation and malfunction, because in many regions the industry lacks the necessary skilled work force. Overly ambitious goals could actually hurt the long-run development of solar energy since not only could many poorly functioning systems be installed, but even properly functioning units could become obsolete as solar technology improves.

The appropriateness of a modest solar energy goal is further reinforced by the fact that solar energy could not provide significant oil savings or oil import reductions over the next five to ten years. A large number of solar technologies are still in the research and development stage and are not ready for commercialization. The two major solar technologies that could be commercialized are hot water and space heating. These two technologies could probably not reduce oil imports significantly in the next ten years, however. First, a significant percentage of solar energy would be substituted for electricity which would, in turn, reduce the need for coal and nuclear power more than for oil or gas. Second, even when natural gas and oil are used in the residential and commercial sectors, solar energy replacements would still require backup systems to provide nearly one-half the energy. Furthermore, in some regions of the country, such as the Pacific Northwest which has very inexpensive electricity from hydropower, solar technologies would not come close to being cost competitive.

Oil imports can be more effectively reduced during the next ten years through a number of alternative policies, such as an aggressive residential and commercial insulation program, accelerated retirement of oil and gas boilers in both utilities and industrial sectors, production of unconventional gas and heavy oils, and some limited mass transportation incentives. As a strategy for oil import reduction, solar energy should be considered as a longer-run measure which would become effective after 1990.

The Effectiveness of a Solar Development Bank

H.R. 605 creates a Solar Energy Development Bank to subsidize long-term, low-interest loans made by local financial institutions to builders, homeowners, and businesses. At least 60 percent of Solar Bank's loans must finance residential solar installations. The authorization proposed for the Bank is $100 million in fiscal year 1980, and $150 million and $200 million, respectively, in 1981 and 1982. Even if all loans were subsidized at the six percent maximum rate, and even if the Solar Bank received no further authorizations after fiscal year 1982, this amount would subsidize about 50,000 solar systems over the three-year period.

In general, this bill would encourage the commercialization of solar hot water and space heating in the United States. But since a large part of

the subsidy would go to individuals who would have purchased solar systems anyway, the bill will not provide any significant stimulus to this industry. More stimulus could be provided either by increasing the authorization level or by reducing the maximum interest subsidy so that the authorization level could support a higher outstanding loan level and thus a larger number of solar installations. Several other points regarding the various provisions of the bill are important:

- The interest rate subsidy addresses the major barriers to rapid expansion of solar energy: the ability to finance large upfront capital requirements and to make solar energy more than marginally less expensive than alternative fuels in many regions of the nation.

- The interest rate subsidy mechanism gives all parties to the transaction—the Solar Bank, the local lender, and the ultimate consumer—incentives for careful selection of solar energy systems that are technically proven and cost-effective. The HUD Solar Heating and Cooling Demonstration program gave full-coverage capital grants for solar equipment, thereby eliminating incentives for prudent selection and operation of solar energy systems. But under the provisions of the Solar Bank, both the local lender and the consumer stand to lose if anyone chooses a technically inadequate, or overly expensive, solar energy system.

- The interest subsidy of 6 percent is substantial and, therefore, the provision barring individuals from qualifying for both the interest subsidy and energy tax credit is appropriate.

- The bill's definition of what qualifies as solar is relatively broad and perhaps should emphasize hot water and space heating, which are the most cost-effective technologies.

- The implicit goal of the bill—to provide modest stimulus to an infant industry rather than to reduce oil imports--is appropriate, since the potential oil import saving are probably less than 2,000 barrels per day.

Mr. Chairman, I would be pleased to answer any questions.