NSF PRESENTATION

Frederick H. Morse*

National Science Foundation
Washington, D. C.

The following is a brief summary of the National Science Foundation's energy conversion program, which is one part of the NSF solar energy program. Also included is a comment on NASA's involvement in the wind energy program.

Perhaps the best way to begin is to look at NSF, then the RANN (Research Applied to National Needs) program, the solar energy program, and, finally, within the solar energy program, the wind energy conversion program. For the purposes of managing research programs addressed to national needs, the National Science Foundation has organized components of its coordinated and problem-focused research into the Directorate of Research Applications. A major activity in this Directorate are the RANN programs. The Director of the RANN programs is Dr. Eggers. The authority of the NSF to become involved in research that is directly related to the problems of society and the environment was enhanced by the provisions of ammendments to the NSF Act in 1968. The NSF is therefore directly engaged in research programs that are related to social and environmental problems as well as the potential impact of future technological development. Solar energy is just one example of the new technology in which NSF, through RANN, is deeply involved.

While the emphasis of the RANN programs is on problem orientation, NSF supports fundamental and applied research through the divisions of the NSF Research Directorate. In many cases, programs within the Research Directorate are related and complimentary to certain RANN programs. For example, within the Research Directorate there is a program of global atmospheric research; also, there is a wind engineering program which is concerned with the interaction of wind with structures.

Within RANN there are four divisions: Environmental Systems and Resources, Social Systems and Human Resources, Exploratory Research and Problem Assessment, and Advanced Technology Applications. The Advanced Technology Applications Division is concerned with new or improved technologies that can enhance economic productivity, exploit the potential contributions of advances in science and technology, or stimulate those applications that will contribute to the solution of

*Present Address: University of Maryland, College Park, Maryland

some major national problem, such as the energy problem. The solar energy program is centered within the ATA Division. The NSF solar energy program was initiated in fiscal 71. In July 1971, the President, in a special energy message to Congress, called for programs to provide the nation with adequate sources of clean energy. Shortly after that message, the Office of Science and Technology, through the Federal Council of Science and Technology formed eleven panels, in the various energy areas, to establish Research and Development goals for those energy technologies. The National Science Foundation and NASA were asked to jointly organize a solar energy panel. This panel was established in January of 1972.

The Solar Energy Panel consisted of 40 individuals from universities, industry, and government, with backgrounds in electrical engineering, mechanical engineering, solid-state physics, chemistry, biology, and architecture. Also included were a sociologist, an environmentalist, and an economist. The panel assessed the potential of solar energy as a national energy resource. The scope of the Panel included direct solar energy applications as well as the indirect applications - wind and ocean thermal energy and renewable organic fuels. In December 1972 the report of the Solar Energy Panel was released. This report is available from the Solar Energy Panel, Department of Mechanical Engineering, University of Maryland, College Park, Md. 20904.

The panel's key recommendations are that the Federal Government take the lead in developing research and development program for the practical application of solar energy as an alternative energy supply to meet the heat and power needs of the United States and that this program be a simultaneous effort in three areas - economical systems for heating and cooling buildings, economical systems for reducing and converting organic materials into solid, liquid and gaseous fuels, and economical systems for generating electricity. The Solar Energy Panel identified seven areas, as most promising from technical, economic, and energy standpoints. These are the following:

(1) Heating and cooling of buildings
(2) Photovoltaic energy conversion
(3) Solar thermal energy conversion
(4) Wind energy conversion
(5) Ocean thermal energy conversion
(6) Photosynthetic production of organic matter
(7) Conversion of organic matter into fuels

Sometime after the panel's release of the report, the National Science Foundation presented a 5-year program to the government, and it was given the responsibility for the terrestrial solar energy program. The objective of this program is to develop, at the earliest feasible time, the many applications of solar energy as alternative energy sources. An interagency panel was recently convened to inform and coordinate the activities of other agencies such as NASA, NBS, NOAA, DOD, AEC, and others in terrestrial solar energy applications. This interagency panel presently meets on a monthly basis.

A brief comment on the funding. In fiscal 71, $1.1 million was spent on terrestrial solar energy projects. In fiscal 72, that funding was $1.6 million; in fiscal 73, it was $3.8 million; and in fiscal 74, the estimated budget is $12.2 million.

There are many ways of collecting and converting solar energy into electrical energy. Solar energy is collected naturally in the Earth's atmosphere, which gives rise to the wind. It also warms the surface of the ocean, thereby establishing the temperature gradients therein. And it is collected on the surface of the Earth, a fraction of which is captured by the photosynthesis process.

In addition, man can construct collectors, such as solar cells, to convert solar radiation directly into electrical energy, or concentrators to convert solar radiation into electrical energy by means of heat engines such as those operating on the Rankine cycle.

Let us now turn our attention to the wind energy conversion program. The objective of this program is to develop reliable and cost competitive wind energy conversion systems that are capable of rapid commercial expansion to produce significant quantities of energy on a national scale.

There are many technical challenges to face in meeting this objective, such as performance predictions, configuration tradeoffs, failure mode analysis, development of low-cost structures, etc. There are also many environmental, social, and economic programs involved in the large-scale extraction of energy from the wind; for example, the environmental impact at these systems on the marine or plains ecology, or the institutional constraints on these systems, and so on. Time does not permit a full discussion of these types of problems.

In fiscal 73, the NSF wind energy conversion program initiated three projects. One project was a grant to the NASA-Lewis Research Center to organize and conduct this workshop. The second project, at Montana State University, will identify the major technical problems of the tracked airfoil system that were previously described at this meeting. A grant to Oklahoma State University was also awarded for the development of a variable input-constant output generator and an electrolysis units in the 10-kilowatt size, suitable for integration in a wind conversion system. In fiscal 73 these three projects totaled about $300,000. In fiscal 74, a funding level of the order of a million dollars is anticipated.

NSF will use the phase-project-planning approach. This approach consists of an orderly progression from Phase Zero, in which the conceptual design and performance requirements are specified, into Phase One, where the preliminary design is made and the critical subsystems are researched, designed, and tested, and finally into Phase Two, where the proof of concept experiments are conducted. In the NSF wind energy conversion program we expect to be through Phase Two within our 5-year program. The remaining phases, Phase Three (demonstration system design, construction, and testing) and Phase Four (commercial system design constructing and testing) are left to the user. In parallel with Phases One and Two, research on components and advanced concepts will be conducted on a continuing basis.

In carrying out its responsibility for the solar energy program, the National Science Foundation will involve universities, industries, and government agencies on the best-performer basis. As you know, NSF can and does award grants to universities. In addition, the NSF/RANN program can award contracts to profit-making industry. It is no longer necessary for industry to join with a university, as a subcontractor, in order to receive support; however, in many cases the resulting joint effort is stronger than either alone. In the wind energy program, as well as other areas of the solar energy program, NSF/RANN will continue to encourage and accept unsolicited proposals which represent the ideas generated by people in universities and industry. In addition, NSF/RANN forsees the release of program announcements and RFP's as the program develops. Unsolicited proposals should continue to be sent to NSF. NASA Lewis Research Center has reviewed all proposals in solar energy and will continue to do so.

In the area of wind energy conversion, the NASA Lewis Research Center has expressed a strong interest in the program and has been asked to prepare a plan indicating how they would support the wind energy conversion program. While the details haven't been finalized, it seems quite certain that the NASA Lewis Research Center will play a very major role in the implementation and execution of this national wind energy program. In the following presentation, NASA will describe some of the details of their proposed plan.