

## NASA PRESENTATION

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Good afternoon, ladies and gentlemen. I will briefly go through a program plan here that we've worked up. We've been taking a hard look at this area for the past year, and also other solar energy areas; and we have put together a preliminary program plan in wind energy which we have discussed with the NSF.

Obviously, as a result of our workshop, there are going to be a lot more inputs into this plan than you're going to see now. This plan, I want to stress, is tentative. But it will give you an idea of this five-year program. First I will briefly review the objectives, the approach and the planned accomplishments for this program.

The objective is to develop a wind energy system that supplies reliable energy at a cost that is competitive with other energy systems. This is a government-directed industry program with strong university support. We plan to set up a review board which would consist of utilities, manufacturers, consumers, and the appropriate municipal, state, and federal agencies. This board would be like an advisory board. It would meet and review the program from time to time, and offer valuable inputs as to the way we are proceeding and so forth, which areas should go forth faster, which slower, that type of thing.

We feel very strongly that there would be an effort, within our national laboratories, to provide the basis for program direction.

We would study, build, and test wind energy conversion systems and components without storage. We would also study, build, and test energy storage systems. And I will go into the reason here: We feel that we should get on quickly with the job of the wind energy conversion system, and not necessarily tie it directly in with the storage right at the beginning.

A very important facet is that we will conduct meteorological studies in cooperation with other agencies, particularly with NOAA, to estimate the wind energy potential and determine favorable regions and sites for wind power. Another important part of this overall program is to study and identify the suitable applications for a demonstration test -- just what is the overall potential and what are these applications? At the end of 5 years we hope to have identified cost-effective wind energy

conversion systems, not necessarily with storage tied to them. And we would have these systems in operation and have some data to back this up. Not only will we have some of these prototype subsystems in operation, but we will have had bench tests and subsystem tests of the key components going on within industry and within universities or the laboratories.

Demonstration systems for selected applications and some of these, hopefully, with storage would be at the point where we would be ready to begin tests at the end of 5 years. It is unlikely that in 5 years, we would actually have systems complete with storage and for actual applications ready to go.

At the end of five years we hope to have determined the potential for wind energy in this country. We would also plan to have under development analytical techniques for selecting sites for wind conversion plants.

Next, I will discuss several action diagrams to point out the key phases of the overall program. The key phases are the wind energy conversion system, the meteorological studies, the energy storage system, and environmental impact studies.

In the overall program (fig. 1) you can see we would be carrying on a number of steps in parallel, starting in the first year. This would be the study, design, build and test of wind energy conversion systems, without storage. We gather and assess wind data to come up with the favorable site selections and what is the potential of wind energy. We would study, design and build and test energy storage systems. We would identify and study the suitable applications for wind energy, concentrating on the most favorable ones in the beginning and coming up with what are the practical applications for wind energy.

Then, we need to determine what the requirements are for major facilities. We are encouraged by what came out of the workshop here. It looks like a lot of the components and sub-systems can be adequately designed with simulations and modeling.

All the above phases are parallel and will focus on the design and demonstration for those favorably selected applications. We would then construct and test those demonstration systems. That completes the overall program.

Now in figure 2, looking at the wind energy conversion systems which are primarily the towers, the rotors and the electrical generation. Where should we begin, and how can we put a wind generator together that meets our requirements. First we started with systems design studies of wind conversion systems. We would concentrate on those without storage at this point, and these would be to identify the size of machines that makes sense, hopefully focusing these into applications.

We then select the ones with the most promise to actually have prototypes running within the 5 years. We may pick out one or more combinations for detail design of these prototypes. Once we have a detail design

of these prototypes, we would then select the most promising one and proceed with construction of that prototype. We would also at that time begin bench testing and in-house testing of the components and subsystems.

Also in the systems designs we would come up with some advanced concepts. These would be split out and paralleled to start studying these advanced concepts, deciding which of these should be built and tested, primarily at the component level.

What we have is a program going down three paths leading toward the construction of prototypes as quickly as possible, probably building very heavily on the technology that was discussed by Dr. Hutter, and breaking off in parallel component tests and modeling of rotors and the key electrical conversion and also with advanced concepts.

We would test these prototypes within the 5 years, and all of this would be input, then, into the design of the demonstrations for selected applications.

In the area of the meteorological studies (fig. 3) we have mainly started out to assess what the existing wind data are. Obviously, we will need very close cooperation and coordination with an agency like NOAA. The purpose is to identify sites for these first prototypes and pick out the favorable sites. We must get the wind data we need to do the detailed designs of the prototypes.

Also we want to determine the wind energy potential in the U. S. Using the existing data we would try to determine that potential. We would determine the favorable wind sites in the U. S. Also we would develop analytical techniques for wind prospecting so you don't have to smother the landscape with anemometers.

We would make additional measurements, wind measurements that are required in areas where there isn't sufficient data and feed this back to up-date the wind energy potential estimates.

In the area of energy storage (fig. 4) we would again look at the various types of energy storage systems that are available. We would do some design studies and select the systems that look the most promising for fabrication and evaluation. In parallel, there are going to be some advanced storage systems identified. We will do design studies on these systems also and build and test those advanced components. All of this, again, leads into the demonstration systems occurring after 5 years.

For the conversion systems in Fiscal 1974 we would immediately start with several systems design studies, followed by a detailed design of the prototypes that appear to be the most promising. Remember that we have a key point here where we bring in the advisory groups to help in the selection of this. We begin construction of that prototype at the beginning of Fiscal 1976, and should be able to have a prototype and start testing at the beginning of Fiscal 1977. We also build and test the prototype components and sub-systems as soon as we've identified the system that we have selected.

The meteorological studies are an on-going program. We envision these studies would assess and make use of existing wind data, set up instruments for making additional wind measurements as required, and develop analytical techniques for wind prospecting.

The key points are that by the middle of Fiscal 1975 we would have those prototype sites, and have made an up-dated determination of just what the wind potential is in the United States in these selected areas. By here we would identify these suitable sites for selected applications.

I haven't gone through all of the program here but very briefly have tried to give you what we see as the approach at this point to getting on with the job. The key thing is to do these things in parallel, carrying them out, and to constantly be evaluating the direction we are going in.

#### DISCUSSION

Q: When do you expect to be able to make announcements on this or a similar program being started?

Dr. Morse: I would say within the next several months.

Q: You announced the NSF funding program. How about the NASA?

Dr. Morse: The funding is for wind energy conversion. The projects or part of the program that NASA would conduct for NSF and the grants or contracts that it would issue and manage would be from those funds.

Mr. Thomas: And as I'm sure you are all aware, NSF is the lead agency. They have the solar energy program. What NASA is willing to contribute at this point is manpower and facilities. We have laboratories, experimental capability, and analysis and project management. That would be NASA's contribution.

Q: Out of this million dollars from NSF?

Mr. Thomas: Yes.

Q: What is left over?

Dr. Morse: It's all left over. They are not going to pay their salaries out of that. NASA Lewis is contributing the manpower, the facilities, and the experience to the program. The money that I mentioned that NSF has will be spent partially through NSF and partially through NASA Lewis. Again, this is a program with strong university and industry involvement. We expect the bulk of that money to be spent externally.

Q: Are there any sorting criteria that you can give us for which type of proposals go to which, or do all of the proposals go to NSF for this time period?

Dr. Morse: All RFP's and program announcements will state clearly on whether that should be directed to Lewis or to NSF. At the moment, unsolicited proposals should go to NSF. They will be reviewed in the usual way except that now Lewis will be included as a reviewer on all proposals. I might also mention that proprietary proposals will be handled accordingly.

Q: There seems to be an incompatibility -- maybe it's only by inference -- between system design and your technology in the position phase. You have a systems design that goes right on into the concept. You have a technology phase which says there are some technology gaps which have to be identified. Are you fellows getting together on this?

Dr. Morse: Yes, we are.

Q: That's one question. The second question is: Is your objective merely to demonstrate a large rotor that can effectively turn out so much power in some kind of wind, regardless of what you use it for? Or is it to integrate an objective as to how you will use this energy in a system?

Mr. Thomas: The objective is to discover how you use the energy and whether or not it can be practical and competitive.

I think the other point is, too -- I mean, you can sit back and show all these little magic blocks up there on the Vu-graph. The way those were arrived at is: What is a reasonable objective and goal to get accomplished by the end of 5 years?

We set down our plan, what we thought we could do. Then those blocks are really backed up by the actual tasks that have to be required in each one of those areas, in terms of manpower and dollar expenditures and what the hopeful output will be for each one of those blocks. It would be a number.

Now, I won't go into detail on those, because, if I put up the definition of those tasks, give you the outline of a work statement and told you what the manpower was and what the dollars were, there wouldn't be much sense in putting out a competitive RFP because all proposals would come with the same costs and the same amount of manpower.

Now, obviously, what's come out of this meeting, we are going to get criticisms, good and bad; depending on how much money NSF is going to divert to this NASA effort depends on how fast we go down this path. But we look on this as a joint venture with NASA and NSF, and to go down those parallel paths together in the best and the optimum way overall.

Q: Dr. Morse, does this mean that the proposals which have been submitted this year already on the subject are -- to use a word of Mr. Zeigler's -- inoperative?

Dr. Morse: No, that isn't so. We have ten unsolicited proposals, two of which have been reviewed. The other eight are in various stages of discussion and formalization. Some of these proposals may very well be supported, based on their own merits. It may be that some of these proposals fall very close to what we have in mind for an RFP, in which case we would not go ahead with that, and indicate to the principal investigator that, at the moment, we are going to hold off on that.

- Q: Will the storage facilities or the mechanism for the program selected for storage involve a concept of shipping?
- Mr. Thomas: Can you elaborate on that? I'm not sure I know what you mean.
- Q: Does the use of wind energy involve shipping in any way?
- Dr. Morse: You mean like producing hydrogen and shipping it in some form?
- Q: No. For sail, the idea being if the storage mechanisms were practical enough -- is that ruled out?
- Mr. Thomas: We haven't really considered that, although the FCST panel on transportation did recommend that the old sailing ships may hold a lot of application today and that work be done in that area.
- Q: I noticed in your 5-year plan you didn't have any kind of estimates or projections on what kind of money would be allotted for wind research. Will you comment on that?
- Dr. Morse: I really don't think it is appropriate to comment on that, since one never knows how those will turn out. We do have a 5-year program. We have worked out a budget for all those areas, and the only figure that is really a pretty real one is \$12.2 million for next year.
- Q: It appears that you really intend mostly study programs the first years, instead of hardware. Is that true?
- Mr. Thomas: That's true, but those study programs are the first step in really defining and identifying which way to go on the hardware.
- Dr. Morse: Although I might indicate the program at Oklahoma State is looking at two key components of the system, and that is a hardware type of a program, the bulk of it is systems studies.
- Q: You mentioned earlier you have provisions or are you making plans for industry-university participation? Where in that program is the flexibility to do that sort of thing?
- Mr. Thomas: It seems very clear to me, since I drew all the diagrams, but at the end of the first systems studies which will be in the first fiscal year, we plan to do several parallel studies in the same area. Each of these studies would probably have several different concepts. The point then is to pick out the system or systems that have the potential for practical completion within the 5 years. Those systems would be reviewed by the advisory board. The advisory board would be composed of representatives from the industries and universities that are working in this area and representatives from the utilities or other potential users.
- Dr. Morse: I might also add that the problem of universities responding to RFP's, if they have a 2-week response time or a very short response time, is one that we have discussed and considered. We intend to maintain a strong university involvement as far along the program as it is appropriate to. So we're concerned with maintaining the involvement of the universities and industry. We would like to see a growing industrial involvement. We would like very much to have them pick

up the ball and make something of it and the sooner the better.

Q: Is the planning information that you included here going to be included in the proceedings of the workshop?

Dr. Morse: I would think a summary of what we said will be.

COMMENT: May I point out that we received recently from NSF two RFP's, both two months after the deadline for response.

Dr. Morse: Right, that's the gentleman from Alaska.

COMMENT: Airmail takes one day.

Q: What do you see, if anything, as the place in this program for small-scale developments? In other words, on demonstrations and perhaps the type of thing I was talking about the other day--a demonstration of the home heating plant based on wind power.

Dr. Morse: I think it's in there, and I think that shows the power of these workshops. We have been focused pretty heavily on a way to make major impact using wind supplied energy in a major way. It's become apparent from this meeting and other discussions that perhaps one way to attack the problem is through the small size user located type of a system. We are going to give small users serious consideration in our planning, but you're right, it was not a major part of our thinking.

Mr. Thomas: In all fairness, it really wasn't left out completely. The original systems design studies have been encompassed in the range of 50 kilowatts on up. And maybe we have to go down a little further than 50 kilowatts, but that was the size that we were looking at.

There would be application studies in there. The whole point is to identify those applications that can do the job. If it turns out to be 50-kilowatt machines and you have to put up thousands and thousands of them to do the job, that would very much influence the program.

But at the same time you wouldn't go just that way. You'd be looking at the large ones, too.

Q: Do you expect there will be anything in your RFP's on this, or will this be handled on the basis of unsolicited proposal type of thing?

Mr. Thomas: My own feeling is that that would be part of the RFP route.

Dr. Morse: I would agree with that.

Q: Would you clarify one point on your charts -- the difference between energy systems, energy resources, and solar energy?

Dr. Morse: Solar energy is a resource, and you need systems to use it. NSF had a program while solar was in its infancy, in which we were looking at energy systems of the United States -- for example, a report by Dr. Szego's company, several volumes on energy systems.

We were looking at geothermal, at coal gasification, at a variety of

other problems: Solar energy grew to the point where it has now been singled out as a separate program area. This doesn't mean that it's distinctly different from the resources systems.

Q: Is the \$300,000 being granted to Montana State and Oklahoma State a total figure for the both?

Dr. Morse: No, for the three -- for NASA Lewis for this workshop, for Montana, and for Oklahoma State. I'm sorry, that comes to \$200,000 not \$300,000.

Q: Are these FY 1973 funds?

Dr. Morse: Yes.

Q: Is it illegal for a privately financed corporation to earn a profit on proposals that are submitted in response to RFP from NASA or NSF for this wind generator?

Dr. Morse: I'm not a lawyer. It's my understanding that that is legal.

COMMENT: In response to solicited proposals, I believe all the things that normally have been going on, such as the fee, are perfectly legal. It's only in response to an unsolicited proposal submitted that we must have some kind of a cost-sharing as there is no fee allowed.

Mr. Thomas: We are going down that route right now with some of our RFP's, and these are either going to be cost plus fixed fee or just a fixed price contract with a fee in there. That's the way NASA does business. Now, on the unsolicited proposals, I'm not quite that sure, but even there there are some ramifications. I know that some contracts let for unsolicited proposals have included a fee.

Q: Will NASA or NSF be handling the RFP's?

Dr. Morse: We haven't decided, but, since NASA is going to implement this program, it seems reasonable that they will issue RFP's, evaluate them, award the contract, monitor it, and follow it up. That doesn't mean that NSF will not do the same. There is still a difference between the total NSF program and the total NASA program.



Figure 1  
 FIVE-YEAR WIND ENERGY PROGRAM  
 Overall Program

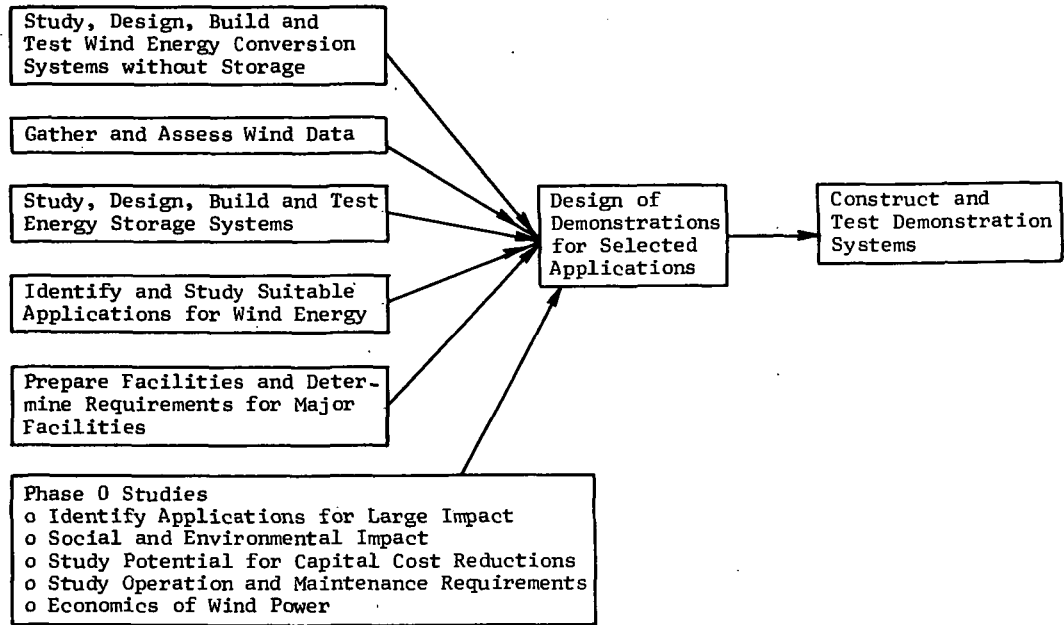


Figure 2  
 WIND ENERGY CONVERSION SYSTEMS  
 Action Diagram

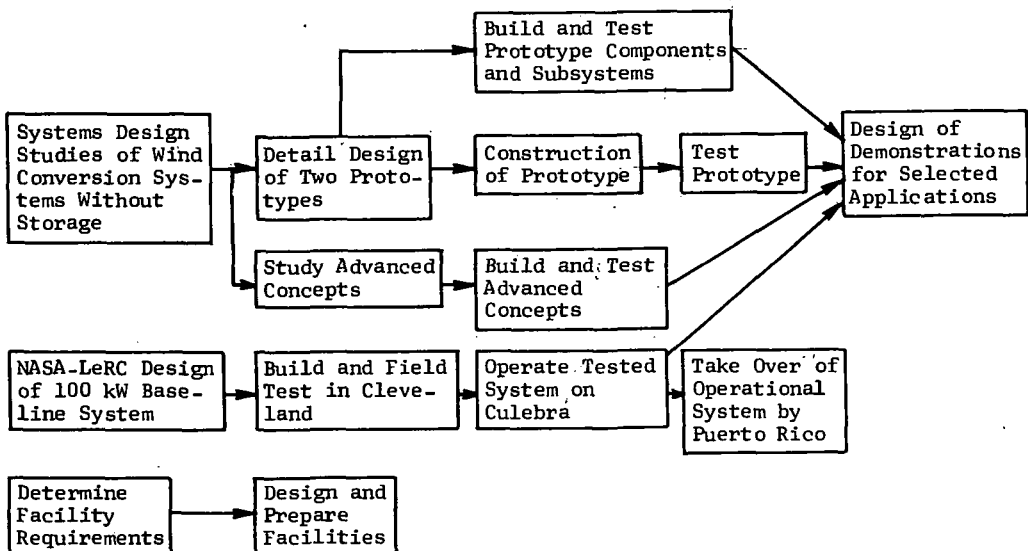


Figure 3  
METEOROLOGICAL STUDIES

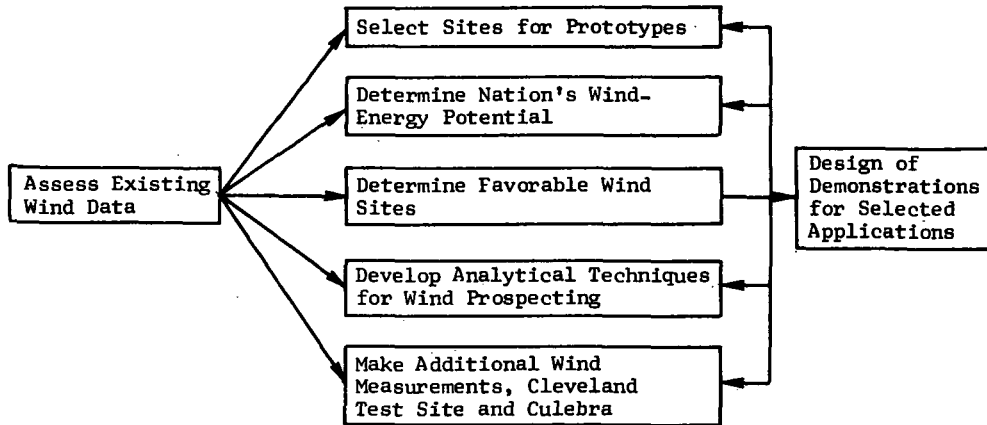


Figure 4  
FIVE-YEAR WIND ENERGY PROGRAM  
Energy Storage Systems

