KEYNOTE ADDRESS

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Good afternoon. It's a pleasure to be here. I appreciate this opportunity to discuss the status and major accomplishments of DOE's geothermal program; to share with you our evaluation of priority needs in the geothermal field; and to suggest the future role of the Department of Energy in helping meet those needs.

Before going into some detail concerning the geothermal program, perhaps I should place it into the overall context of the Administration's energy policy and, more specifically, our view of conservation and renewables.

First: Our national energy policy. We very definitely have a policy, and it consists of goals, strategies, and programs.

Our goal is an adequate supply of energy at a reasonable price. In this case "adequate" means on both a short- and long-range basis. It means adequate supply for emergencies. It requires reserves to be in place. In a sense, "adequate" is a supply of energy sufficient to assure us energy non-dependence -- that is, the ability of this nation to withstand an interruption of its imported supplies of energy without tremendous adverse impacts on our economy or national capabilities.

"Reasonable" is a term which varies from user to user. For instance, residential consumers should be enabled to acquire energy supplies adequate to their needs, without forcing a change in lifestyle because of the price. Industrial concerns must remain competitive in domestic and international markets, and not be forced from the markets by the cost of energy.

Our strategies are: (1) to minimize Federal control and involvement in energy markets while maintaining public health and safety and environmental quality; and (2) to promote a balanced and mixed energy resource system.

These strategies will provide economic efficiency. They offer the best possible assurance that individuals and businesses throughout the nation will have abundant and affordable energy available when, where, and in the forms needed.

We consider conservation as a resource, and therefore very much a part of any "balanced and mixed energy resource". By the same token, geothermal, as well as other alternate and renewable energy forms, has a legitimate place in our overall energy strategy.

Over the past decade, Federal support for geothermal development has totalled approximately $1 billion, and private industry has spent a similar

amount. Of this industry investment, about 20 percent has been spent for exploration, and a like amount for field development; 50 percent has gone for geothermal power plants; and 10 percent for technology development. Nearly all of the Federal monies have been devoted to research and development activities.

Considerable progress has been made in geothermal technology development as a result of this investment in time and money, but a great deal remains to be done. Those working in the field are now in a position to identify particular problems that must be overcome if we are to bring the benefits of this renewable form of energy to large numbers of consumers.

From the viewpoint of the geothermal industry, remaining problems or barriers are both technical and financial:

- Great uncertainties still exist with respect to determining the size and expected life of geothermal reservoirs.
- More effort must be made to reduce high drilling costs and to develop well stimulation techniques.
- Technology must be developed that will allow economic disposal of spent brines.
- Major corrosion and materials problems must be addressed.
- Environmental problems must be solved, including those related to waste disposal and subsidence.
- More efficient engineering components must be developed, including pumps, heat exchangers, and instruments.

On the financial side, the high cost of capital and the perception of high risk associated with geothermal investment stand as major impediments to industry growth. The perception of high risk is related both to the fact that the geothermal industry is still in its formative stages and therefore lacks a "track record", and to major uncertainties in the future cost for competing fuels.

With today's technology, only a few of the highest-grade geothermal reservoirs can be economically exploited. Geothermal drilling costs can be up to four times the costs for oil and gas wells. At the same time, profits in the geothermal industry are small, severely limiting the amount of industry investment for the necessary R&D.

At this point I should emphasize that the demonstrable need for major geothermal R&D funding, which the industry is unable to meet through its own resources, does not in itself make the case for Federal support. Other considerations are also present: it is clearly in the national interest to foster development of alternative and renewable energy sources, especially if they offer large energy potential. And we believe this surely to be the case with geothermal.

We presently generate a relatively modest 1237 megawatts of electricity from geothermal reservoirs using dry steam. The potential for dry steam appears limited to perhaps another 1500 + megawatts, and indeed facilities are now planned to achieve 500 megawatts of this potential. But we have hardly begun to tap the potential from very-hot-water (greater than 200°C) and hot-water (150° to 200°C) reservoirs. For example, we have on-line a mere 23 megawatts generating capacity from very hot water, out of a potential of more than 10,000 megawatts; we now have a generating capacity of only 11 megawatts from hot water, although the additional potential from this source may be well over 20,000 megawatts. Certainly, a resource of such magnitude is one that we cannot afford simply to ignore.

DOE has been working closely with industry to establish R&D needs and priorities. I alluded to the research needs and barriers to further geothermal development, as perceived by industry, a moment ago. And I will return to discussion of the direction of future cooperative industry/government efforts to overcome these barriers in a moment. But first, let me recapitulate what we regard as some of the major DOE geothermal program accomplishments.

Work is continuing on the 50-megawatt electric binary-cycle plant at Heber, California, which is being cost-shared by DOE and a consortium of utilities, including the Electric Power Research Institute (EPRI). Agreement has been reached with the California Public Utilities Commission for sale of heat to customers in proximity to the plant. From the Heber facility, and from the pilot-scale hydrothermal plants at East Mesa and the Salton Sea area of California, solid data are now available that define future research needs. Future binary plants will depend for their design information on the experience gained at Heber; therefore, we are making every effort to ensure that the lessons learned from this project are freely available.

The technology for economically exploiting dry-steam and high-temperature hydrothermal resources is fairly well developed and commercially available.

The DOE research program is now focused on closing the remaining technology gaps and in reducing the cost of exploiting the more abundant moderate-temperature hydrothermal resources. The technology base resulting from this work should also have application to geopressured, hot dry rock, and even magma resources.

Technology development programs have demonstrated progress in several areas, including: field tests of a diamond drill bit using cavitating water jets to penetrate hard rock; operation of a borehole location system, derived from missile inertial navigation technology, which will enable operators to determine the true position of well bores and thus drill more precisely; developmental work on techniques using specially formulated explosives and acid treatment to stimulate reservoir production. And, an 11-month endurance record has been set by an electric downhole brine pump, with further equipment tests planned.

In the area of geochemical engineering, new instrumentation has been developed and tested to assist in determining seismic and electro-magnetic characteristics of geothermal reservoirs. This work has paid off in immediate application to design of the Heber facility. In the area of materials sciences, a carbonate scale inhibitor has been tested and is now in use at the Salton Sea plant. Materials used in drill bits and well cementing have also been developed and tested successfully.

Major problems in emissions from geothermal powerplants have been largely solved, and technical concepts for hydrogen sulfide removal are nearly ready for full-scale development. And in fact, field testing has already begun on scrubbing processes for geothermal gas emissions.

Buried beneath the Gulf Coast are huge reservoirs of hot brine with dissolved natural gas. These geopressured geothermal resources flow vigorously through wells without pumping, thanks to natural high pressure. We have experimented with a dozen such wells, and are testing three others to measure long-term performance. This research will determine the potential for commercial recovery of the thermal energy and the natural gas.

Work continues on development of hot dry rock technology beyond the experimental 5-megawatt facility at Fenton Hill, New Mexico, which has produced the world's first elecricity from hot dry rock resources. DOE, with financial and technical support from West Germany and Japan, is now constructing a larger (35-50 megawatts) facility at Fenton Hill. This facility will complete

development of the hot dry rock technology base and demonstrate feasibility on a commercial scale.

Technology is, as was indicated, not the only barrier to wider use of geothermal energy. Through the DOE-sponsored Geothermal Resources Development Fund we are seeking to overcome the financial/institutional barriers. Loan guaranties approved under the Fund are designed to minimize the lender's risk, develop normal borrow-lender relationships, promote competition, and encourage new entrants into the geothermal market. To date, nine loan guaranties have either been finally approved or approved for negotiation, for a total Federal guarantee commitment of $290 million.

The task of monitoring and servicing the loan guaranties continues to ensure that technical and other contractual commitments are met. The disbursement of loan funds at contractually specified milestones is subject to DOE review and approval as each project proceeds. We have approved loan guarantee projects with the greatest care and, barring the unforeseen, continued success of these projects will result in essentially no real cost or outlay to the government.

Conclusion

As I indicated earlier, the potential for geothermal is large but it cannot be realized without continuing efforts, now underway, to overcome existing technical and financial/institutional barriers. The Department of Energy intends to continue its partnership with industry to help develop what could be a significant domestic energy source.

We believe that the systems, components, and techniques for exploiting hydrothermal resources will reach maturity by the early 1990's. Work undertaken over the next few years should give us a good indication whether geopressured, hot dry rock, or magma resources will be economically attractive, and thus candidates for continued development.

In addition to the long-range, high-risk research that DOE has emphasized over the past two years, we are looking closely at nearer-term research needs that industry alone is not in a position to fund. More specifically, we are evaluating areas of research that may be cost-shared with industry and that are aimed directly at reducing costs and improving equipment performance.

It may be of particular interest to some of you that the Department of Energy favors extension of the tax credits currently available for certain kinds of geothermal investments, but that under present law are due to expire. I should point out, however, that no Administration policy has yet been determined on this tax issue, and there is some opposition to the extension.

We are optimistic about the future of geothermal. We firmly believe that the next ten years will mark as much progress in geothermal development as we have seen in the decade just passed. If our assumptions are correct in this regard, geothermal will achieve a significant niche in America's energy budget for the twenty-first century.