

locally remote from, major population centers, such a chimney could be used to store natural gas near the consumer-end of gas transmission lines. In this way it could help gas companies provide better service to consumers during periods of peak demand.

It has been estimated that if nuclear stimulation of natural gas reservoirs is successful, the economically recoverable gas reserves of the United States could be more than doubled from less than 300 trillion cubic feet to about 600 trillion cubic feet. If in-place retorting of domestic oil shale in nuclear chimneys proves feasible, as much as 160 million barrels of oil might be recovered. Similarly, nuclear chimneys might lead to the recovery of millions of tons of copper that are not economically within reach at present and such chimneys also could provide space needed for storing billions of cubic feet of natural gas.

The costs of determining the feasibility of these, and perhaps other, applications for nuclear explosives can, of course, only be estimated, but it is believed that the government's share could range from \$10 million to \$20 million a year for several years.

#### BRIEF DESCRIPTIONS OF ADDITIONAL PROGRAMS IN MINERALS

##### TECHNOLOGICAL AND RESEARCH CORE

For fulfilling its obligations as the focal point of the United States Government effort to assure an adequate supply and dependable flow of minerals, the Department of the Interior deems it essential to maintain a technical and scientific competency in all major phases of mineral supply, resource base appraisal, extraction, processing, and utilization. Such competency allows the Department to furnish accurate and timely advice as the basis for policy decisions and to discharge its advisory function for management of the mineral resources on public lands. In addition, the core activities, involving basic and exploratory research, provide the capability to identify and meet needs and opportunities in the minerals field. A cadre of competent and knowledgeable earth scientists and minerals technologists identifies emerging needs and problems and formulates effective measures to meet them.

These responsibilities necessitate intimate knowledge of diverse sciences and complex technologies. Interdisciplinary staffing is essential. As an example, the core research personnel of the Department represent about 50 different disciplines and possess an intimate working knowledge of the practices employed for the discovery, production, preparation, and use of at least 60 different mineral commodities.

The foundations of the core programs are (1) basic studies of scientific concepts and principles and (2) fundamental measurements and phenomena to produce accurate data of a lasting nature upon which applied research and technology can build.

Special development programs directed toward specific, measurable goals and exploratory research aimed at adaptation and application of scientific knowledge require the stimulation and support of a concurrent program of imaginative basic research in promising scientific areas. Continuous aggressive pursuit of knowledge in the physical sciences and allied disciplines is mandatory for advances in technology for recovery, reclamation, and effective use of mineral materials. Equally important, basic scientific investigation is necessary to assure that Department personnel maintain broad technical competency in their component disciplines; such competency will provide a monitoring window to the rapid advances taking place in basic science throughout the world.

##### MINERALS EXTRACTION RESEARCH

Projections show that unless we find more domestic deposits that can be worked economically with present technology, or develop the technology that will enable us to process new marginal or deeper lying deposits our dependence on imports will increase or the price of mineral products will rise substantially.

The most acceptable solution to our mineral resources problems is continuous and accelerated technological advance. This requires a better understanding of the mechanics involved in each of the elements of mining (ground control, rock breaking, materials handling, and environmental control and management). Such an understanding of fundamentals is essential to the development, engineering, and design of improved mining systems.