

INTRODUCTION: THE ENERGY CRISIS REQUIRES
AN ACCELERATED APPLICATION OF TECHNOLOGY

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I was asked to provide opening remarks for the 23rd conference directed to current problems in Energy and Resource Development, an area where, hopefully, X-ray technology can subscribe even more contributions to problem-solving. Yesterday I attended the opening day of the Federal Energy Administration hearings--held a few blocks away. Among over 20 speakers there were several whose thesis was "keep off my turf--and maybe there's no energy problem anyway." Believe me there is--for all.

In noting our technological interest in energy and other resource development, it crossed my mind that our most important resources are our human resources. X-ray technology has made vast contributions to those human resources. As a recipient of the X-ray art rather than a practitioner in your field, I can only tell you of problems and suggest objectives. But our society badly needs more, and accelerated, focus of technology on the field of inanimate resources--which we have too long taken for granted as being both plentiful and cheap. Henceforth they will be neither.

Energy is the central pillar of a modern society's ability to do the things it wants to do--to attain the goals of standard of living, improved quality of life, and security of those goals--national security broadly defined.

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While energy is the central theme of my brief remarks, we have to maintain surveillance and press our technological efforts towards the vast range of primary resources on which our society depends. The strategic and critical materials program of our country--for which I was responsible for four years of federal office--extended formally from aluminum and antimony through over 70 items to vegetable tannins and zinc. Technology was continually changing that listing and the criticality of the items--for example, making our mica stockpile non-important. Oddly enough, energy fuels were never included as strategic or critical, perhaps because we have always assumed a lavish, uninterrupted supply.

There is a definite correlation between resources and our gross production. In a world of expanding consumption, these one-time resources inevitably dwindle. There are consequent increasing costs and an increasing political and strategic significance unless our technological and political wisdom finds another way. While the world's bauxite producers, for instance, are unlikely soon to have the political competence and economic muscle to ape the Arab oil embargo, they might some day. Meanwhile the rising costs may bring extraction for such resources back to our own country--if technology is wise enough.

There are to my mind, three main avenues for probing and advance for all resources including energy. All three avenues must be pressed. This is not an "either-or" business. A maximum effort may still not avoid disaster.

First, increase our supply capability by such measures as getting more of what exists from the ground, the ocean bed and, yes, the sun. We, for instance, were recently getting out only 31 percent of oil in known reservoirs. Perhaps the tripling in price of crude oil causes a better record today.

Second, we must check the increase in demand while maintaining our way of life. The current term for this effort is "conservation" which logically includes recycling, extending to our limited water resources. Conservation is really a form of efficiency and is a program all can support. Conservation generally reduces both costs and environmental impacts. It practically always reduces the threat to both our national security and the freedom of our foreign policy.

Third, there is substitution--use the more abundant and/or more secure resources rather than the less abundant and/or less secure. The obvious energy examples are emphasis on coal and nuclear power.

I repeat. All three avenues--supply, conservation, substitution--are essential, not "either/or"

As to expansion of supply, there is a pressing requirement for a team effort among technology, capital and government. Energy, by its nature, requires vast capital inputs--favorite estimates are \$200 billion by 1980 and as much as a half trillion dollars by 1985. This capital will only be forthcoming if the price of energy attracts that capital--unless there is a choice of a vast government subsidy, which I think unlikely. The need for wise government input stems from the seemingly inevitable heavy component of government supervision of energy matters as well as the fact that much of future prospective supplies are on government land unless we import those supplies. With a 10 billion R&D budget in five years, as proposed, our financing of that area of effort should be adequate--providing industry subscribes its share.

As to conservation, the shock of the Arab embargo, coupled with the shock of increased costs has triggered our basic economic reactions--at least temporarily. Maybe the embargo should have lasted longer. In 1972 and 1973 our energy consumption rose about 5 percent annually. According to the Chase Bank our energy consumption in the first half of 1974 fell 2.6 percent below that consumption a year earlier. So far so good, although we should beware of the pitfalls of statistical inference; part, or even all, of the situation may be due to slowdown of our economy.

The goal of self-sufficiency even by 1985 requires that we develop about as much additional energy as we are now producing while cutting back on our consumption growth rate massively. Technology produces best when it is in step with obvious economic incentives. Jawboning for energy conservation--which I engaged in as a government official--is a weak instrument compared to an energy cost situation which makes conservation financially remunerative to individuals and business who will then support and adopt the needed measures. As to substitution of abundant and/or secure fuels, we here meet the confrontation between our rapid adoption of a belated environmental program and our energy crunch. Those of you interested in environmental technology will on self-examination--find that you are likely to be pressing for or against solutions to our energy crunch. We should press for reconciliation and compromise of that confrontation. True, there are other major problems such as need for capital and the long lead times of development and construction also existent for expansion of supply. Coal, which we have in abundance and which has long been a stepchild of policy, is the central example of our environmental/energy dilemma. We know our coal problems. But thus far the technology to solve them has not been brought on line.

Hence, while recognizing the unwisdom of our coal situation we are really probably continuing today politically on a course which continues our dependence on scarce and imported oil and gas for 75 percent or more of our energy.

I have mentioned costs, capital and environmental factors and hope that you will understand my time problem in failure to mention other matters such as solar power, shortages of water and manpower and our incomplete governmental energy system. That system has to be reversed from assumption of plenty and low cost to the opposite. This is hard to do in an election year. But coal, oil, gas and some nuclear power--and energy conservation--are our principal energy resources until circa 1990 at least. Nuclear power today is about the same as wood. We badly need quick pay-off technology to help bridge the long time gaps between what we may know purely scientifically (which is a lot) and actual mass energy delivery to the consumer. The nuclear breeder program is an example. If successful in carrying through to the end of the next decade with today's technologies, you have only postponed a grim future of energy scarcity unless research and development has by then found new ways.

For, looking further down the road, there is no doubt that the world's Petroleum Age will wane in the lifetimes of many here. One reputable study of a great oil company suggests that world export oil will peak as early as 1980. Other estimates look to around the year 2000 for a waning of petroleum supply--not far away when we are dealing with the current central pillar of the world economy. Technology has little time to find a way.

Currently, the United States and the world are going through economic and political, as well as technological, transitions due to energy which are revolutionary. It is a quiet revolution but not thereby less frightening. Our suddenly realized dependence on foreign oil--especially on the Middle East--cannot help but limit the freedom of action of our foreign policy and gravely impair our national security. An embargo imposed once can more easily be imposed again. In fact, the embargo of last October was made effective by positive action of only three Arab states--Kuwait, Abu Dhabi, and Saudi Arabia.

Oil power is now power indeed. Soon Middle Eastern oil money power alone may be a serious power in world affairs--both threatening balance of payments crises and overshadowing the foreign investments of even the United States. A very significant proportion of our exports will go this year to pay for foreign fuel. We will be safer from every standpoint if we pay that same price but for our own indigenous production and conservation.

The estimates of oil exporting countries earnings above their absorptive capacity are staggering. Reportedly a World Bank study sees them as accumulating over a trillion by 1985 or 10 times the book value of today's U.S. foreign investments. Such financial power could dominate the economic world to an extent not seen since U.S. financial power had that dominance post World War II.

There may be an uneasy solace in noting that practically all energy forecasts have proven to be materially in error--as this one may be.

Our country is in an energy hurry with applied science-technology--as a critical need. Harvey Brooks, Dean of Harvard's Physics and Engineering, is reported to have remarked that our energy crisis is political and economic, not technological.

After a life of 43 years in government, four as head of a federal energy agency and over 20 of them as a professor dealing with economics and politics, I regretfully conclude that I have more faith in your and other's technology than in our economic and political wisdom getting there on time and without crack-ups. So it is doubly heartening to meet you all this morning.

Returning to my role as welcomer; all of our sponsors have faith that when you leave you will be glad you came. We sincerely hope that you will take away a feeling of both personal and intellectual hospitality from our University and Rocky Mountain State.