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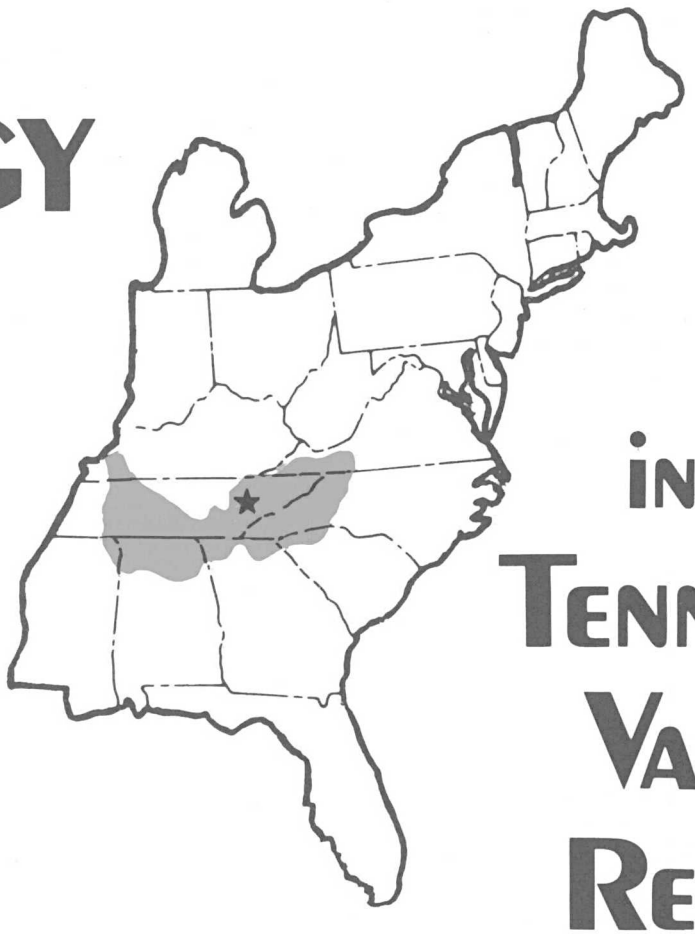
WATec

5TH ANNUAL ENERGY CONFERENCE AND EXHIBITION

FEBRUARY 23-25, 1978 KNOXVILLE, TENNESSEE

ENERGY



IN THE TENNESSEE VALLEY REGION

PLENARY SESSION

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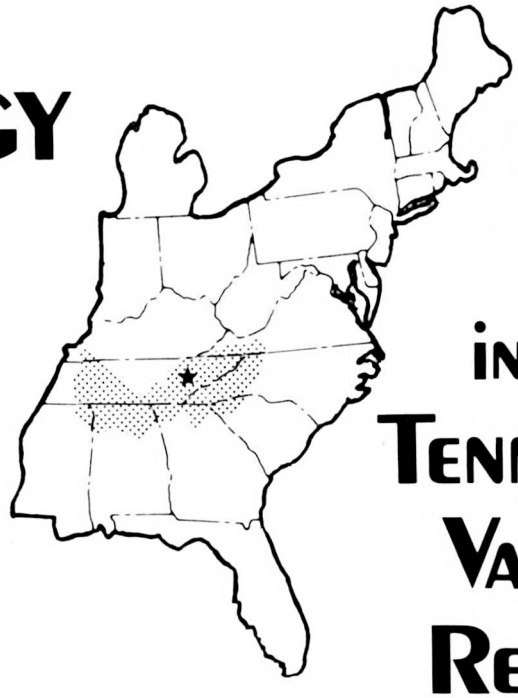

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Plenary Session

Public Awareness Symposium

The contents of the presentations at this symposium, and the opinions expressed in the discussions, reflect the views of the participants and do not necessarily reflect those of the individual sponsoring societies.

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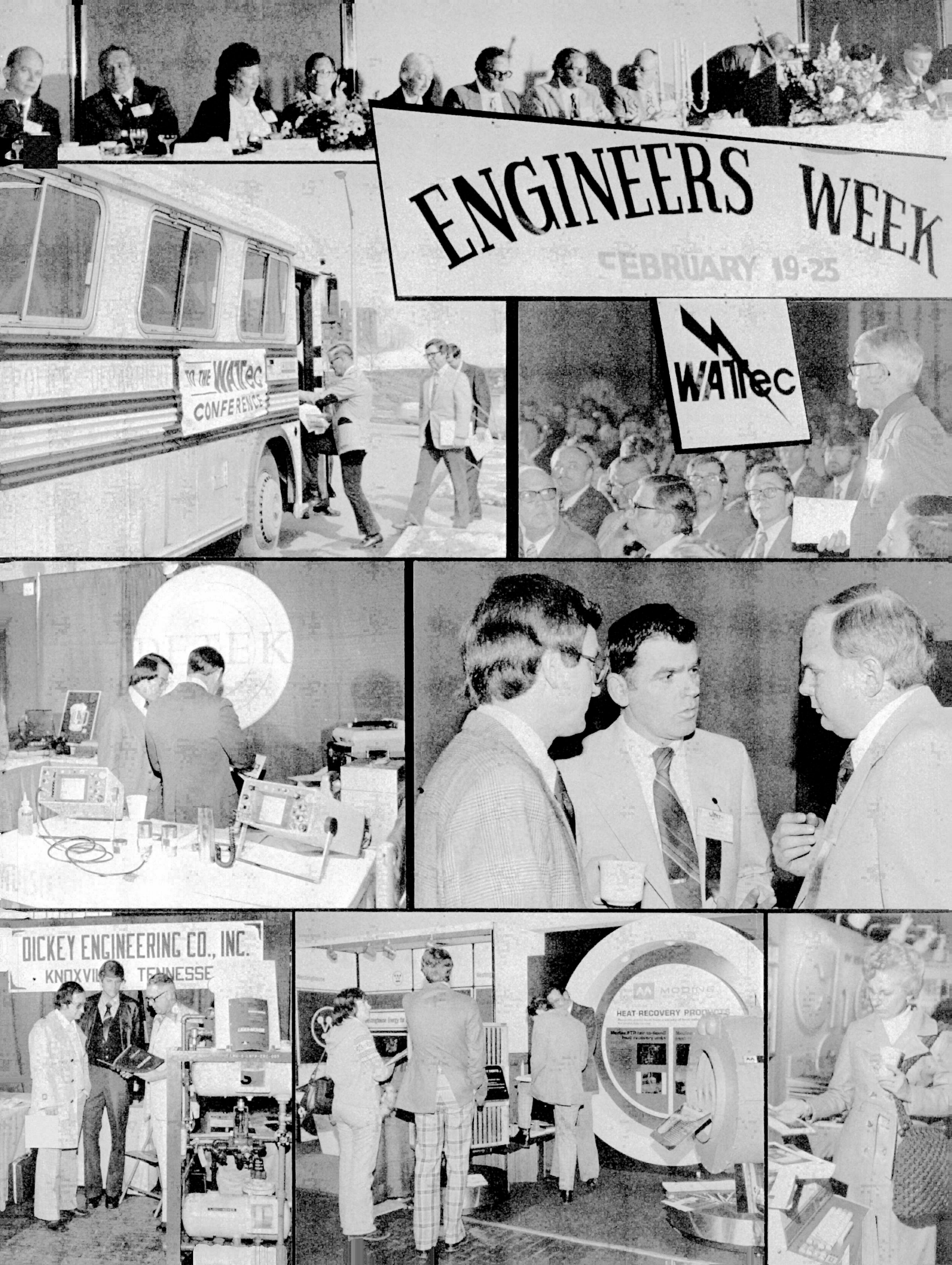
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Contents

George R. Jasny
General Chairman,
WATTec '78

Foreword

To those directly involved in various aspects of the energy business, there is little doubt that our nation (and much of the world) may face serious shortages of oil and natural gas as soon as the early 1980s. The implications of these shortages for both industrial and developing nations will be profound. Steps must be taken, starting now, to conserve energy wherever possible without creating serious impacts on employment, to pursue greater use of electricity generated from coal and nuclear power, and to develop alternative sources of energy such as solar power, fusion, and nuclear breeders.

Since 1973, the WATTec Conference has attempted to serve as an interdisciplinary vehicle for sharpening the skills and broadening the perspective of the technical community of the Knoxville-Oak Ridge area in energy-related areas. This has been done through specialized technical sessions sponsored by individual technical societies, industrial exhibits, and plenary conference sessions, at which nationally recognized energy and policy experts have spoken. The interest of the technical community has grown to the point where upward of 500 people attended this year's technical programs and over 400 heard the plenary session speakers.

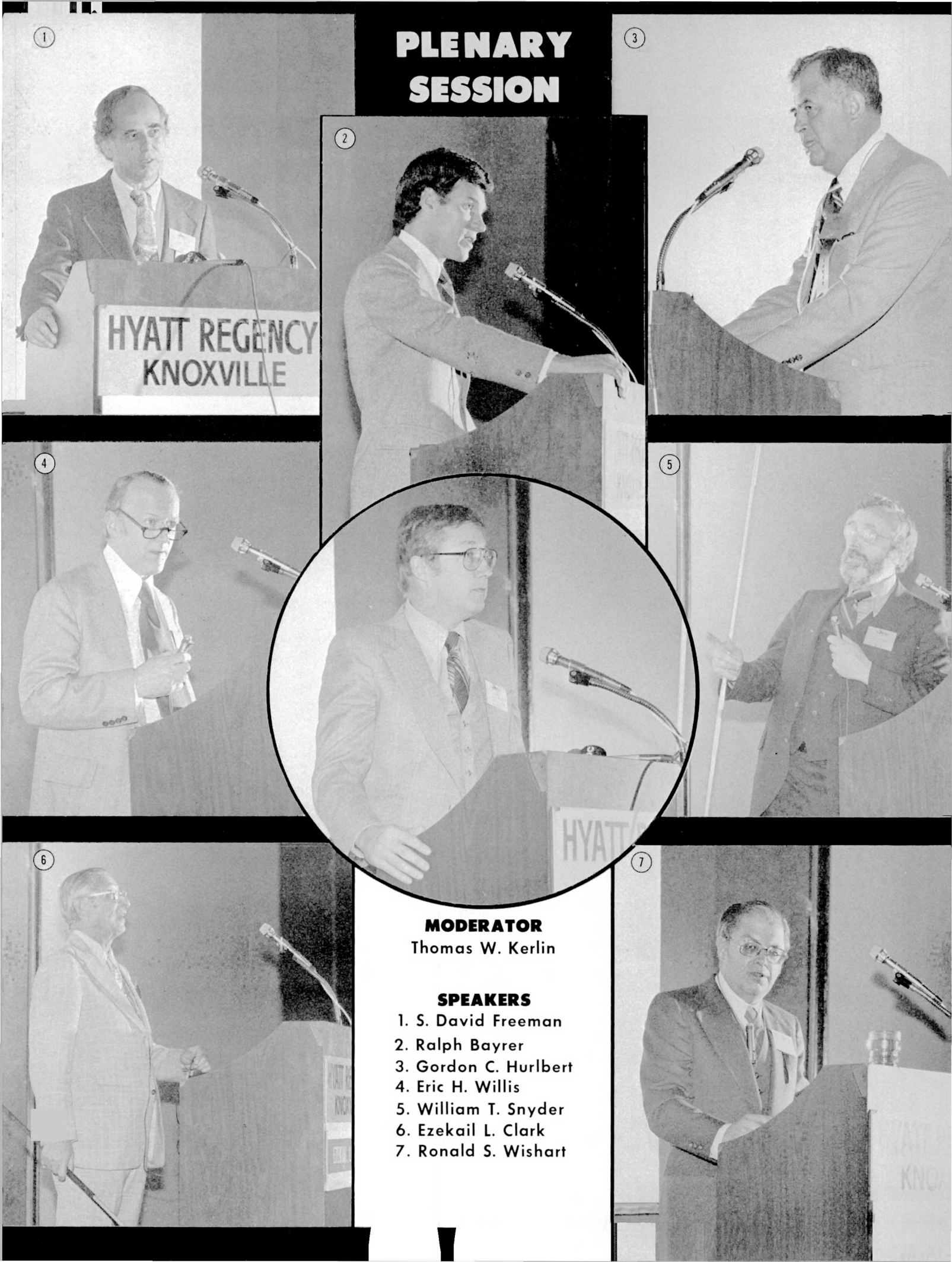
Although much has been said and written by various specialists in attempts to analyze the energy problem and propose courses of action, much of the public remains uninformed or unconvinced. As late as a year ago, a major national poll indicated that a large percentage of our citizens were not aware that the United States imports about half of the oil which we consume. Yet no effective national

energy program is likely to emerge until a majority of our citizens understand the problem, the options, and the consequences of these options. It is to this task of informing the non-technical public that the WATTec Public Awareness Symposium, now in its third year, has been directed. In general, the invited audience has consisted of leaders from labor, management, business, churches, women's clubs, and the black community. In previous years a national audience was selected. This year, in keeping with the theme of the overall WATTec Conference, an audience of over 300 people composed largely of representatives of organizations from the Tennessee Valley were in attendance.

These printed proceedings record the material that was presented at both the Plenary Session and the Public Awareness Symposium, which took place on February 24 and 25, 1978, respectively. This publication of the conference proceedings was prepared from a verbatim record taken by the conference reporting firm of Childers and Shelnutt of Atlanta. All speakers and participants knew and agreed that the record was being kept and that the proceedings would be published. The Symposium Committee appreciates the assistance of the Information Division of the Oak Ridge National Laboratory in obtaining the services of Childers and Shelnutt and in editing, composing, and printing the content of the proceedings. We also appreciate the services and assistance provided by the Oak Ridge Operations office of the Department of Energy.

George R. Jasny
General Chairman, WATTec '78

PLENARY SESSION



MODERATOR
Thomas W. Kerlin

SPEAKERS
1. S. David Freeman
2. Ralph Bayrer
3. Gordon C. Hurlbert
4. Eric H. Willis
5. William T. Snyder
6. Ezekail L. Clark
7. Ronald S. Wishart

PLENARY SESSION

Introductory Remarks

Thomas W. Kerlin: Good morning, ladies and gentlemen. Welcome to the Plenary Session for WATTec '78. I am Tom Kerlin. I will be serving as your program chairman for today. I'd like to begin this morning with a few remarks by George Jasny, who is General Chairman for WATTec '78. George.

George R. Jasny: Thank you, Tom. It's indeed a pleasure, ladies and gentlemen, to welcome you to this, the fifth WATTec Conference. What I'd like to do is start today's proceedings by telling you a little something about this conference. I suppose a good way of starting that is to try to clear up what must be a mystery to many of you: namely, what does that strange acronym WATTec stand for.

The answer goes back to five years ago when we were facing another energy crisis—perhaps the first in a long series of energy crises—the Arab oil embargo. At that time three local engineers, two of them, as I recall, welding engineers and one a testing engineer, came up with a rather outrageous notion. They observed, first of all, that we were having an energy crisis. Secondly, they reflected on the fact that the Knoxville-Oak Ridge area modestly thinks of itself as "The Energy Center of the World." And, thirdly, they also observed that welding and testing are involved in all aspects of the energy business. They concluded that they should organize an interdisciplinary energy conference to talk about the problems of energy; and they thought it would be a good idea to do this in conjunction with Engineers' Week, which normally takes place at this time of the year. These engineers also contributed, free of charge, a name for their proposed conference. The name came from their crafts: "W" for welding, and "T" for testing. Throw in a connective vowel, add "Tec" for technology, and you have WATTec.

I didn't tell you this story just so you would remember what made up an acronym which most of you will probably end up forgetting. What I did want to do was to reflect on the power of their idea. I said it was outrageous. After all, it took a lot of gall on the part of those fellows to preempt the organizing rights of such august bodies as the power engineers, nuclear engineers, mechanical engineers, chemical engineers—I happen to be a chemical engineer—who certainly have more to do with the production of energy than welding and testing engineers. (Of course, those bodies were not taking the initiative.) Yet today WATTec has the solid sponsorship of 25 technical and scientific organizations in our area, including those of the power engineers, the nuclear engineers, and the chemical engineers.

WATTec provides a focus and sense of common purpose for some 4,000 technical people, whereas prior to this there was none. In the process, WATTec is forging a spirit of cooperation, mutual respect, and friendship among members of the organizations such as

TVA, Union Carbide, the local people from the Department of Energy, and other private concerns, who in the past were essentially strangers to each other. So it may have been an outrageous idea these fellows had, but I suppose our times call for more of these outrageous ideas.

WATTec is also providing some very solid interdisciplinary energy conferences. Currently it makes its impact through three major thrusts. To begin with, the sponsoring technical societies are encouraged to put on their own relatively specialized technical programs. Yesterday we had 13 of those sessions with about 45 presentations. There were over 500 people registered for these technical sessions. I was interested to note, by the way, that over one-third of all those presentations dealt with either conservation or solar energy. I think it's a hopeful sign that the engineering profession, which tends to be conservative by and large, is taking the challenge of energy conservation seriously and intends to make its rightful contribution.

Engineers need to improve their specialized skills continuously, but also periodically they need to have their perspective challenged and their outlook broadened. That's the purpose of this very fine plenary session which Dr. Kerlin has arranged for today. As you can tell from your program, the quality of our speakers is outstanding. On behalf of the organizing committee and all of our sponsoring organizations I'd like to thank our speakers, who are all very busy people, for investing their time and effort to enlighten us.

Speaking of enlightenment, the third day of our conference may well prove to be the most important. Its purpose is to enlighten the generally nontechnical public, which is after all an indispensable element in any solution to our energy problems. The speakers tomorrow will be of the same caliber as those today—outstanding. And in keeping with the theme of this conference, which is "Energy in the Tennessee Valley Region," we have arranged a new item: a round table involving several governors from TVA area states and the chairman of the Tennessee Valley Authority. They'll participate at the end of the presented papers tomorrow. [Editor's note: Due to the pressing concerns of the national coal miners' strike, then in its third month, the governors were not able to attend, and the round table was cancelled. Governor Ray Blanton of Tennessee made a brief appearance and issued a short statement, included in this Proceedings as chapter 13.]

Another innovation which I think bodes well for the future is that we have had extensive participation in the planning and organizing of tomorrow's public awareness conference by a number of nontechnical community leaders in the Knoxville-Oak Ridge area. These leaders are under the chairmanship of Jake Butcher, who is the chairman of the Board of the United American Bank.

Those of you who have full conference registrations, of course, are automatically included in tomorrow's public awareness conference, and I would urge you to take advantage of that opportunity. For those of you who were planning to be here only today, if you think you can spare the time, after seeing what the program is, if you would check with our registration desk we'll try to squeeze you in. Let me also urge you to make sure that you visit the exhibits in the lobby of the hotel. There are a lot of fine products. You need to find out what's new, and these products deserve your interest and support. It's obvious from what I have said that WATTec is the work of well over a hundred devoted amateurs. I'd like to publicly, if anonymously, thank them for their work. I hope you will feel the same way at the end of this conference.

I'd like to say one final thing. In putting together the program for WATTec '78 we recognized that such issues as energy conservation, energy production, and protection of the environment can be viewed from several legitimate perspectives. I hope that as you leave here you will feel that these issues have been treated fairly, objectively, and in a balanced manner. In that connection, I'd like to echo an observation that Dave Freeman, of TVA, made not too long ago. He said, "It's time for us to end the civil war between energy and the environment." To which I would like to add, "And I hope we don't wait 'til Appomattox." Thank you for coming. Have a good conference.

Mr. Kerlin: Thank you, George.

I'd like to call your attention to some small changes in the schedule. Because of an illness in the family, Dr. Carroll Chambliss will not be with us. The schedule has been changed so that Bill Snyder, who was originally scheduled for 3:45 PM, will speak at 2:05 PM and Ronald Wishart, originally scheduled for tomorrow, will speak at 3:45 PM today.

In putting together the program for the plenary session this year, we decided that we'd like to address both policy matters and technical matters. You will notice that both of these are covered in the talks that are to be presented today. We scheduled three talks for this morning, with the idea that we would look at energy policy matters starting at the local level, which for us really means TVA, then we would broaden our picture to the national level, and finally we would consider what impact international energy positions have on us in our local area. This afternoon we have a continuation, in which we also bring in some papers on particular aspects of energy technology that we thought were especially pertinent and interesting.

1. A New Energy Era

S. David Freeman, *Director, Tennessee Valley Authority*

Mr. Kerlin: In talking to George Jasny about the introductions for our speakers, George gave me some advice that I thought was quite good. He said the more prominent the speaker the shorter the introduction can be. My first reaction then was to introduce our first speaker as "Here's Dave." That didn't seem quite dignified enough, so let me say that our first speaker today is an engineer, a lawyer, an author, an adviser to presidents, and more recently a member of the Board of TVA. Mr. David Freeman.

S. David Freeman: Thank you very much.

We are at a crossroads in this struggle to overcome the crises in environment and energy. We have accomplished so much and there is so much yet to be done. It might be useful at this point to take a quick look ten years back, because sometimes looking backwards gives us the courage and the insight to look ahead when things look fairly dismal at the moment.

Ten years ago this nation—and Western civilization, I think—was headed straight for an environmental disaster. When the environmentalists with their strident voices first started complaining about the air in Los Angeles and New York and other cities, and we passed the air quality laws and the water quality laws in the early sixties, the most affected industries reacted with tremendous resistance. As a matter of fact, many said, "Never." It was reminiscent to some of the reactions to the civil rights battles.

In ten years' time we have passed our basic environmental protection laws. There is still a lot of fussing and fuming about where to draw the line, but there isn't anyone that I know who would come right out and say we ought to repeal the air quality laws, we ought to repeal the water quality laws. I don't think very many people believe that. We have built into our system the basic environmental protections, and thank God we did. It's time we give credit to that small band of people who stuck their necks out and blew the whistle so that this high-energy civilization of ours didn't continue on the road to disaster. There is still a difference of opinion about how these standards should be implemented and about where the line should be precisely drawn. But let's look back and see what has been accomplished. And let's give credit where credit is due.

The ecologists sounded the alarm, but the ball was in the hands of the builders and engineers to build the technology, the cost effective and reliable way to implement these environmental laws. And I think it's useful for us to remember that an engineer is not a doctor or a biologist. We are way beyond our expertise when we get up and say sulphur dioxide is not harmful and when we make statements about the health effects of these pollutants. And whether we are beyond our expertise or not, this country has enacted laws

through a democratic process, through the Congress of the United States, which have made the Environmental Protection Agency the doctor. It's not a bad idea to lean on the side of caution in controls that affect human health.

I dare say to every engineer in this audience who designs buildings that the design standards for reinforced concrete and steel that we use as civil engineers have safety factors in them that are far greater than the safety factors in our air pollution standards. Think about that for a moment. We would not be able to sleep very well if we were designing structures with the thin margin of safety that exists in our air quality standards today. I think it's time we started accepting the environmental standards just as we accept the wiring codes and the design standards for steel and concrete. Then we can get on with the job. This running battle is not doing anyone any good.

I don't mean to say that we don't have a role to play in explaining to the government and the public how much it costs to build environmental protection standards into facilities and to argue about timetables and implementation plans. We have a responsibility to point those things out. But the basic standards, the health effects, are naturally not to be decided by people who don't have the expertise. This is a job for the people who have been assigned the task by the Congress.

What about the other side of the coin, the energy side? If we look back over the last ten years, I think there is a tendency to say that very little has been accomplished. However, I don't think that's true. About five or six years ago in a fairly flippant way I said the only thing wrong with coal was that you can't mine it and you can't burn it. Since then we have made considerable progress. We have on the books now reclamation laws and safety laws for the mining of coal. Looking forward to the months and years ahead, I think the rules are laid out for mining coal in a way that is satisfactory to society. The question marks are being removed, and I think that the market for coal is increasing.

On the air quality side, we have clarified the laws with the recent amendments, and we have made advances in the technology. The Tennessee Valley Authority is going to be washing and scrubbing its coal in the future. Several years ago the technology was really not perfected, in the opinion of the people there at the time. A scrubber is a large chemical plant that is very difficult to deal with. We built a scrubbing facility at Widow's Creek using limestone and created a lot of gunk down there. But we are now in a position to use magnesium oxide to scrub the coal, and we end up with sulfuric acid as a by-product. We have been working on scrubbers for twenty years and progress has been slow and painful. But there has been progress, and I think this country is now in a position to burn coal as coal, in conformity with environmental standards.

The standards are not the whole story. Probably the most terrible pollutants in terms of human health are the small particles, or submicron particles, for which we don't even have standards. We at TVA are going to be installing some of the world's largest baghouses to try to contain those particles. The scrubbers help on the submicron particles, too. We have to look at the bottom line in protecting human health, and we are developing the technology to do so.

Look at nuclear power. No one, I think, is going to accuse me of being an ardent nuclear advocate; I'm not. I'm not an ardent coal advocate either. I think that it's important to recognize things for what they are. Nuclear power is inherently a very dangerous source of energy. But we are formulating the safety standards and complying with them. We are doing the engineering to use nuclear power and light-water reactors with a risk that society

is accepting. A decade ago we didn't have these safeguards. Despite all the gloom about nuclear power, the number of plants that are being built now is at least up to the highest projections that we made in the national power survey back in the early sixties. The last decade has seen nuclear power move out of the laboratory to become a commercial source of power. Nuclear power has come of age.

Certainly the national coal miners' strike now going on underscores the importance of having a diversity of energy systems and sources of supply. TVA would be in very bad shape if it had all of its eggs in the coal basket. And we may have a problem next year or the year after that will make us very happy we don't have all our eggs in the nuclear basket or in any other single basket. I'm a great believer in flexibility and diversity of energy sources, because there are problems with each of them. In the last three or four years we have had an oil crisis and a gas shortage; this year we have had a coal strike. Fortunately, we now have both nuclear power and coal as economically viable and available sources of electricity.

We are making progress across the board in the energy field except in one crucial area. The energy crisis is a crisis of oil and transportation, and there the movement has been backwards. The conservation effort in the transportation field—the move to smaller cars, which is absolutely essential—is just to bide time. We are a civilization with a time bomb embedded in it. It's going to explode. The oil supply of this world is bound to be fraught with peril as we become more and more dependent on people halfway around the world. It will be even worse as the Middle Eastern barrel begins to peak out and production is constrained by the self-interests of some of the Arab nations.

The concentration of effort must be not only on conservation in the transportation field, but also in getting off oil. I hope that one of the primary goals and programs and leadership efforts in the Tennessee Valley Authority in the next decade will be to move the transportation system in this region off oil and onto domestic sources of energy. I believe this would be in the form of electricity. The electric car and electrifying the railroads seem to me to be the most sensible way for this region and this nation to keep their mobility and independence. We are going to lose our mobility or our independence or both if we keep on assuming that we can ride around in Cadillacs and big cars supplied with oil from halfway around the world, where one person can just shut a valve and shut us off, and where the oil is going to peak out and run out one of these days.

The question arises, what is TVA's role in helping to resolve the energy crisis? I think that we are sitting in a very advantageous position. We have a power system that can be a living laboratory; TVA can continue its traditional role as a leader.

TVA is the organization that demonstrated the integrated multipurpose development of a river valley. It made hydroelectric power an attractive source of low-cost energy that was emulated throughout the rest of the country and, indeed, the world. After World War II, TVA took its power plants from hundred-megawatt units up to thousand-megawatt units. Invariably it was TVA that was buying the biggest and most efficient units as we went up the ladder. Those economies of scale back in those days are very real and very important to the growth of the economy and the system.

When nuclear power came of age, TVA took a leadership role, and we now have the largest construction program in the nation and perhaps the largest one in any single entity in the world. We are building six very large nuclear power plants, and we will have 23,000 megawatts of nuclear capacity by 1986 if we can get the plants finished on that timetable.

(We are a whole lot better at starting plants than we are at finishing them, but we are going to be making a mighty effort. It's going to be awfully hard to justify the rate payers' bills of dollar adjustment when nothing is generated but jobs.) The nuclear initiative of TVA is only the latest of our leadership roles.

I think the time has come when TVA can demonstrate the technologies that allow us to burn coal cleanly and mine it more safely. We can also take the leadership role in the remaining serious problem in the area of nuclear power: finding a safe means of disposal for this highly radioactive waste. We must be able to go to the public and say with honesty that we are building plants and generating waste that we are going to dispose of with a minimum risk. I hope this is a subject on which TVA and Oak Ridge National Laboratory and others with expertise in this region can form a partnership. If we wait for the federal government as a whole to solve this problem, I'm afraid we are going to have radioactive waste piled up all over this valley in relatively unsafe situations, compared to what it could be. Having been in Washington for 16 years, my own view is that it's a great mistake to wait on Washington to solve the problem. We have a wonderful opportunity to exercise the leadership role that the President wants TVA to perform across the board in the nuclear field by showing how to solve the problem of waste disposal.

I don't think we are going to have one waste disposal area for the whole nation. I am appalled, personally, at the idea that we would be transporting highly radioactive waste across the country, taking it all to one point such as Hanford, Washington, or some other place in one corner of this nation. The transportation of the radioactive material is where the risks are the greatest. I would hope that we could have a permanent disposal system in the Tennessee Valley or nearby that would minimize transportation.

We have new frontiers and new opportunities for TVA to pioneer in. One is conservation. If the figures show that we can save more kilowatt hours per dollar with conservation than with building new plants, then I believe under our act TVA is duty bound to put its capital into conservation. Our job is not to build up a rate base or to sell electricity. Our job is to provide energy for the consumers of this valley at the lowest possible cost. If conservation is the cheapest and fastest way to get a kilowatt, then as far as I am concerned that is going to be a principal source of energy for TVA in the future. If we can squeeze out more energy we will be able to attract more industry into this region. Perhaps the limiting factor on our ability to grow economically will be the available energy supply. You can't build another nuclear plant and get it on the line until 1987. But I know you can build heat pumps and heat exchangers and you can insulate buildings in a much shorter time frame than that. In combination, that can add up to the equivalent of a nuclear plant.

It's not a question of solving this energy problem with elephants or ants. We need elephants, but we also need the ants. In combination, thousands and thousands of ants can add up to the strength of an elephant. I think that solar energy is by far our most neglected option. My personal view is that solar is an alternative to nuclear fission and nuclear fusion for the long term as a workhorse in the energy field. I don't exclude the others; I think we need all three horses in the race. But solar energy should not be thought of as a distant dream. It is a present opportunity and reality.

In my view, solar energy in many parts of the Tennessee Valley is economical today for heating water and perhaps for providing space heating. And certainly in new buildings it is a mistake, I believe, to pass up solar. A house or building is going to be here for the next fifty years. If we put a solar collector in it when we build it, those solar collectors are going to

have the energy efficiency and the energy cost equivalent of the Norris Dams of today. The fuel cost will not go up and the economics will be better each year. We do need demonstrations to firm up the numbers and prove this out. But in my view, if we can generate a kilowatt hour cheaper with a solar collector in someone's building than we can with a large central station power plant, then our money ought to go into solar collectors. We need more central station power plants too, but the solar collectors are options that can produce energy next year and the year after and increase our opportunities for economic growth.

A lot of trash around this valley is being dumped in landfills. This society can't continue much longer as a throw-away society. Somewhere somebody has got to begin to close the circle, and begin to move us to a society that reuses these energy sources for energy instead of throwing them away. I would hope that TVA would come up with a comprehensive program to assist the cities and the counties and the metropolitan governments in building facilities that will use this trash to produce steam or other forms of energy. It's just a 1 or 2% solution, but we need to get all those ants to work instead of just concentrating on the elephants.

There is a lot of wood that goes to waste in this valley. My staff tells me that the surplus wood that would not hurt the natural renewal of the forest is the energy equivalent of 10 to 15 million tons of coal a year in the Tennessee Valley. We need to be energizing private enterprise and others to bring that wood to market. TVA has already authorized some demonstrations. We are going to take Maryville College off oil and gas and put it on wood as an energy source by next summer with technology that is currently available. This doesn't require research. It's a question of getting out and building the systems and doing it now.

So there are a whole variety of new worlds for the TVA organization to conquer in the energy field. In the process of doing so we are going to add to the employment and add to the opportunities for economic growth in this valley. I want to conclude by saying a word or two about economic growth and the environmental question in conservation.

There has been the most profound confusion about the relationship between conservation of energy and economic growth. I submit that conservation of energy and environmental protection are essential to and will add to the economic growth of this valley. It's not only a question of the lack of a conflict. These two issues are supplemental to one another. If we make investments to conserve energy, we will have more energy available to power the new homes and the new factories that could come here. And if we do not continue to protect the environment of this valley, people will not wish to come here. If you haven't been away from here for 16 years as I have, if you haven't lived in other parts of the country and spent some time in New Jersey and New York and places like that, perhaps you don't appreciate the beauty of this part of the country. One of the main reasons people are attracted to settle here, one of the reasons we are enjoying a very low unemployment and very high rate of economic growth—50% higher than the nation—is that this is a nice place to live.

TVA was successful. The trees were planted. The land was restored. This is a green valley and there are great recreation facilities. And the air is relatively clean (except around the TVA power plants). And it is attractive to lure people. But more importantly, unless TVA cleans up its act and we have stringent environmental standards on air pollution, there will not be space in that garbage can in the sky for other people to come. There is only so much room in the air. If we use it up by permitting industries to be lax on air quality,

under the law there just isn't room for any other industries to come in. As a matter of fact, around any TVA power plant today you cannot locate another industry, because we are not in compliance and there isn't any space left in that garbage can in the sky.

If we are interested in economic growth in this valley, we have to be interested in strict appliance of the best available technology toward new plants. We must also really go after existing facilities and do the cleanup job that is necessary. It's important that we understand the supplemental and self-reinforcing nature of environmental protection and conservation and economic growth, because they all go together to add up to additional growth.

Another thing to think about is this: if the limiting factor is energy, if we have only so many kilowatts of capacity to make available, then perhaps we ought to start looking for industries that will give us the most jobs per kilowatt rather than the most kilowatts per job. I'm not certain that it is in the best interest of the Tennessee Valley to be going after the most energy-intensive industries. I'm not opposed to their coming here if we have the energy, but I think we should be as shrewd as we can about creating job opportunities and creating the maximum amount of quality employment for people in this valley. We have the water, we have the energy, we have a good climate, and we have the labor. I think our problem in this area in the future is to accommodate the growth that's coming without losing what we do have.

In other words, are we going to be the Tennessee Valley 20 years from now or are we going to be New Jersey? That, I think, is the issue. We are now at a crossroads. Instead of thinking in a depression psychology and waiting with bated breath for everyone who wants to come down here and dirty up the air and gobble up our available resources, we might think about being a bit more selective. And I think we *are* being more selective. This is not for TVA to dictate and it is not for any individual to say. It's something for us as a people of the valley to think about and talk about and reason together on.

I believe that we can look forward to attracting the footloose industries that are not coming here because our power rates are cheaper. Cheap power rates will not be the major magnet in the future. Our attractiveness goes across the board, and the availability of energy is going to be much more important than its price. It is important to recognize that more labor-intensive service-oriented industries are probably going to create more prosperity for us than the industries that use hundreds of megawatts of power and employ only a few hundred people. Although if we have the energy they, too, will be welcome.

I hope that I have painted for you my own vision of the future role of TVA, which is no different from its history: innovative leaders who are using their power system and their responsibilities across the board to provide a yardstick for reasonably priced energy. This includes a continuation of our traditional role of opposing monopolization in the fuel field, of trying to buy our fuel supply at the lowest possible price, of encouraging competition by having as many different sources of energy as we can, of opposing the oil people coming in trying to gobble up the coal industry and the uranium industry. We will try to preserve free enterprise in the fuels industry, while also leading in the advance of technology to provide energy at the lowest price to our customers.

But more than just being an energy company, we will continue to recognize that the bottom line is jobs and the prosperity of the people in the Tennessee Valley. TVA began life as an environmental protection agency and conservation agency. We took the water that was being wasted and lost to the sea and transformed it into useful kilowatt hours that

helped energize this valley. We restored a green cover to the valley and probably accomplished more in environmental protection than any agency that I know of.

There is still a big job to be done on both fronts. I hope that TVA will be a leader in performing a happy marriage between environmental and energy needs, and in the process help develop this region as a durable society so we can leave something for future generations that will last. Thank you.

Mr. Kerlin: I think we have time for a few questions if you'd like to have a shot at Mr. Freeman.

From the floor: Mr. Freeman, yesterday I had the privilege of listening to the Nuclear Regulatory Commission (NRC) describe its approach to regulating waste management practices. Previously I heard the Department of Energy (DOE) describe some, and TVA also has an approach. How would you conceive of TVA providing an interface for the three agencies?

Mr. Freeman: My approach would be that TVA would put together a project for doing it. Washington has been talking about it. We have the waste. They have the paperwork, but we have to come up with a way of disposing of the waste. My approach would be to say nothing to them until we got our program put together. There are too many people involved in this issue, who all have different ideas. My feeling is that if an agency has the waste and puts together a program using the best expertise available, then it should go to Washington and tell them, "This is what we are going to do." And I dare say if we can get the public support in this valley for a site and a project, Jim Schlesinger will be forever grateful. And so will Doug Costa.

From the floor: What efforts is TVA making towards giving some kind of credit to people who want to use solar collectors in their homes, like TVA has been doing with insulation programs in the Tennessee Valley? What efforts are you making to permit the use of solar power as an alternate source of energy in the Tennessee Valley?

Mr. Freeman: Perhaps I was a bit too subtle in what I said on that subject. I tried to make clear that my own personal view is that we should have a program for solar energy similar to our program for insulation. But we do have to have enough of a demonstration to persuade ourselves that putting our money into solar energy is cost-effective for TVA. My own view is that it is. We are paying 4¢ a kilowatt hour for running gas turbines now. I know good and well that we can generate heat for hot water in homes with solar collectors at a lower cost than that.

So my own view is that once we have some data in hand, once we have proof positive, we would support a program in which TVA provided the front-end money to help people solarize their homes and in which TVA did some screening so that we would have reliable contractors. But that's going to require a few more months. We hope to have a demonstration program on a scale involving 500 or a thousand homes in the coming months.

I can only speak for myself, however. I'm just one person on a three-person board.

From the floor: I appreciated your comments about the disposal of nuclear waste, Dave. There is an image that you may have created when you referred to the piling up of high-level wastes all over the valley.

Mr. Freeman: I know they are small in quantity, but they are very deadly.

From the floor: The image, however, was that it would be piling up all over the valley. As you know, and maybe not many of the public know, the high-level waste when solidified and gasified from a thousand-megawatt reactor will only occupy the volume of a 4-ft cube.

Mr. Freeman: I am well aware of that. I am also well aware that the Bureau of the Budget has not provided the money for the vitrification of the waste from our military program which has been piled around for a long, long time. Certainly once you vitrify it, it becomes small in volume. But most of the waste to my knowledge has not yet been vitrified.

The solution to the highly radioactive waste is technically there. What we lack thus far is a decision-making process that will take these technical solutions and make a reality of them.

From the floor: This is a principal public issue. The image is that it's like the slag heaps around the Pittsburgh area or in the Ruhr Valley. I just thought I would try to erase that image.

Mr. Freeman: You are entirely correct. The problem is not the volume of this waste. The volume is tiny. But the fear is there because the wastes are very deadly. We have them controlled at the TVA plants, but not in a way that is a permanent solution. Until we have a permanent solution I find it difficult myself to say that the nuclear option is acceptable.

It can be made acceptable and we ought to do it. But until we have worked this problem out, I think the critics have a legitimate point when they say it's morally questionable to start more and more nuclear plants without having at least a program that is being implemented to provide a trash can to contain these wastes.

I am very impatient about the lack of progress in the federal government in this area. The problem has been studied to death. I think someone somewhere has got to try to do something. I don't know if we (TVA) will be able to do it. My style is to speak out loud; I figure if I say something dumb enough people will straighten me out, and they are doing that. This is a serious issue. I think it needs to be discussed in blunt language. The problem is one for which I think the technology can make the risks acceptable, but we are not doing it yet.

From the floor: Mr. Freeman, President Carter's energy program rightly or wrongly has been termed a conservation emphasis program. My question to you is how does TVA hope to sell conservation to a nation that's not used to conservation, without also emphasizing the fact that if we conserve for a while then down the stream the supply will be greater?

Mr. Freeman: There is no conflict. My idea is that we are producing. You know, it used to be that when you paid $13 or $14 a barrel for oil and these prices we are paying for natural gas and prices that are available for coal, that you had a right to assume that there was a free market situation where producers had a marked incentive to produce.

The debate on energy really amuses me. When I first got into it and talked about a need for a national energy policy, the first thing that happened was that Mike Wright and all the oil people came into my office and said, "This sounds a little socialistic to me. It sounds to me like the government is going to try to interfere in my business. Now, I can tell you we provide this country with all the oil it needs. We don't need any research on coal liquefaction and all of those things." The energy industry is traditionally opposed to any governmental intervention.

To criticize the President's program because it emphasizes conservation is to suggest that the only answer to our energy problem is to subsidize Exxon and all the big companies. I don't think that's the answer. There is no dearth of offers being made to us for nuclear power supply systems when we build nuclear power plants, and we can get bids on coal-fired plants. There is no need to subsidize the production of coal or oil or gas or nuclear energy.

These are commercial. But what's not happening is conservation, and the reason it's not happening is that the consumer doesn't have the front-end capital.

You asked me how I think we can make it happen? By making available the front-end capital for investments that have a payout of six or seven or eight years. A company that's making some product here in the valley is not in the energy business. They're not going to go out and borrow money for a heat recuperator that will pay out in eight years. But TVA is building a power plant that takes 20 years to pay out; we can do twice as well by putting the money in the heat recuperator.

It's not going to happen by preaching at people. We have gone as far as we can, or at least some distance, in that one- or two- or three-year payout investments have been made. Industry has done a lot of conserving. But there's a world of conservation that can be obtained through machines that have a payout of five, six, or seven years or through readjustment of commercial buildings. That's the area where TVA puts up the front-end money.

I think we can have a great spurt of conservation. I realize it's just buying time, but we are working to the tune of hundreds of millions of dollars on breeder technology, on fusion technology. What we are not working on equally as hard is solar technology, and we need to get that horse in the race.

The survival of our civilization, of course, depends on some long-term source of supply. But the government at the time the President sent his energy program to Congress was already putting billions of dollars into that R&D. Perhaps it was poor public relations not to brag about that. What had not been done up to then, however, was to have a conservation program, and I am proud to be associated with it.

From the floor: You created another image that bothers me a little in saying that industry could not locate next to power plants because of the deteriorating quality of the air. I wonder if you have any instances in which industries have been refused permission to locate near a nuclear power plant, or whether, in fact, there are any industries that are not allowed to be located near a coal-burning power plant in the TVA area.

Mr. Freeman: I'm just stating a fact. Today under the air quality laws, since most of our coal-fired plants themselves are not in compliance, you cannot add to the pollution in an air space where the air is already too dirty to meet standards. I'm not arguing one way or the other. I'm just stating a fact. Around a nuclear plant we have a zone of land for a safety zone. That is a well-known situation. There is plenty of land in the Tennessee Valley for industry to locate. But I'm stating a fact that to the extent we are exceeding the air quality standards in our coal-fired plants we are inhibiting the growth of industry.

There have been some discussions about siting, for example. We are looking for places to put additional units for coal-fired plants. When the staff briefed me, I was intrigued to learn that we couldn't consider any of our existing plant sites because the air quality was too bad. Even when we do what's needed to meet the standards we will probably just barely be meeting the standards; there won't be any room at that trash can for anyone else. There are some good potential sites in the vicinity of some of our steam plants that are out-of-bounds because we have already used up the available space in the air for pollution.

I think there is no use in hiding the dirty facts that exist. We have a real stake in being hard-nosed about air pollution control in order to leave room in the air spaces for additional industry. That is the theory behind the best available technology thrust of the new clean air act. I think it's in the public interest, and I think we ought to stop fighting it and recognize that it's to our benefit.

2. Features and Objectives of the National Energy Plan

Ralph Bayrer, ***Director, Division of Policy Planning and Analysis, Department of Energy***

Mr. Kerlin: We have heard a very stimulating talk about the situation primarily in the Tennessee Valley. Now we want to broaden our circle and look at an area of great interest to all of us: the National Energy Plan.

We are fortunate this morning to have Mr. Ralph Bayrer to speak to us on "Features and Objectives of the National Energy Plan." Mr. Bayrer is director of the Division of Policy Planning and Analysis for the Department of Energy (DOE). He joined DOE when it was the Energy Research and Development Administration (ERDA) in 1975. Previously, he had been with McKenzie and Company, an international management consulting firm, and prior to that he spent six years working with Admiral Rickover. Mr. Bayrer.

Ralph Bayrer: Thank you, Tom. Good morning. I am delighted to be here with you today.

I'd like to think that in the presentation of the National Energy Plan I would be hitting one of the less controversial subjects being presented here. However, given its reception in the Congress I'm not altogether sure of that. It's a very complex subject. I don't think I really appreciated how complex it was when I joined ERDA three years ago when it was first formed. The National Energy Plan has some very simple fundamentals in terms of the nature of the problem that we are facing. But it's complex in terms of the kinds of solutions that we should be working on. Some of the reasons for this complexity, I think, were signaled in the earlier talk this morning presented by Dave Freeman. I should thank him for sounding some of the very important aspects of the National Energy Plan.

Among those aspects was the fact that it's very much a liquid fuel or oil problem we are dealing with. Secondly, that conservation has to play a strong and central role in what we do. Thirdly, that the terms of working out the problem of diversity of supply seems to be the key answer. And, finally, in whatever we do we've got to act in a way that's environmentally responsible and that also meets the economic needs of the country. In fact, our approach must reconcile the whole host of political and other important social objectives that we hold important to us and that have been embodied in the legislation.

I am going to be presenting to you the details, or at least some of the details, of the National Energy Plan. However, if you don't carry away the specifics, I hope you do carry away a sense of urgency, a sense of purpose, an awareness of the issues involved (some of them highly political), and a sense of direction as to where we want to be headed. To achieve that, I will give you a quick summary of the problem (I think it's one that virtually everyone here is familiar with), some of the possible alternative approaches of dealing with it, then

the rationale for the approach that's been selected by this administration in the National Energy Plan, and finally, some of the specific elements of that plan.

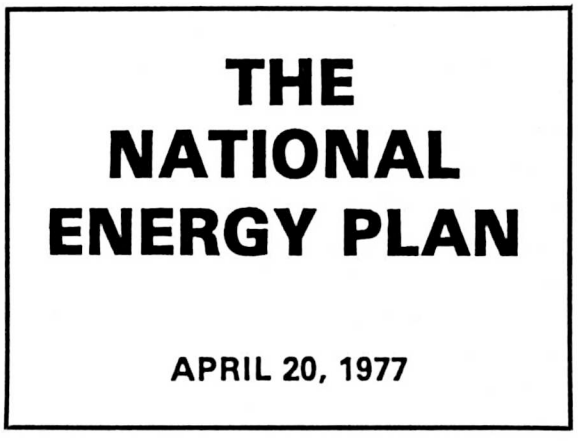
Before I proceed along those lines, I'd like you to understand that part of the controversy that you have been hearing about and which you see in the Congress is probably perfectly normal and to be expected. As far as the economics go, if you are talking about investments of hundreds of billions of dollars in the energy area just in the next decade or so, the question is how the costs of our energy infrastructure are going to be borne in the country and how we are going to reconcile many of these important objectives that we have to deal with.

Right now should be a time of debate. It's a time for many of these political forces to come together to hammer out a rational process that we can live with for the years to come. Because it's something we are going to have to move ahead with forcefully and with a great deal of political support. To that extent I think the debate we have been seeing is a healthy sign.

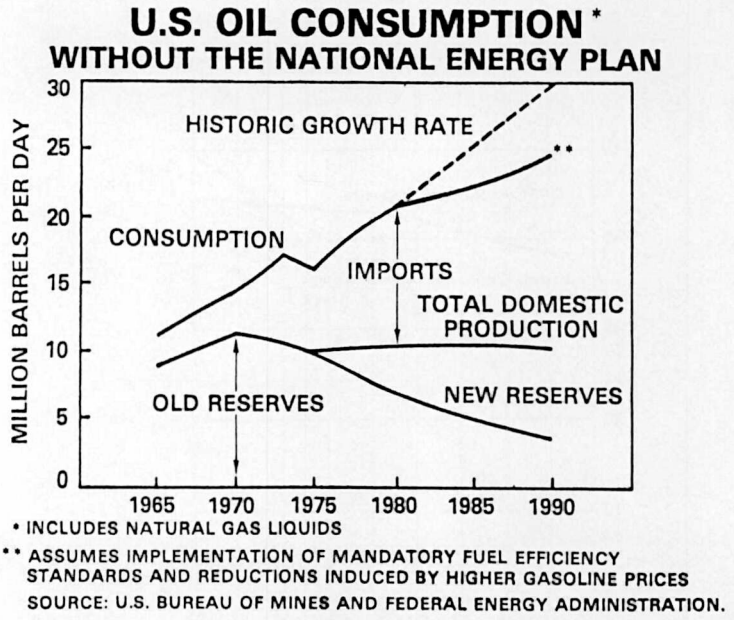
Now, I have found myself that it's difficult to talk about the specifics of the plan or many of the important facts that underlie its formulation without really taking a look at figures and other details. For that reason I brought with me today a set of slides. I hope we can focus our attention on them as we move along through the presentation.

The presentation itself, as you can see, deals with the features and objectives of the National Energy Plan (Slide 2.1). April 20th was the date on which the plan was submitted to the Congress for last year.

I think this slide (Slide 2.2) has to be the starting point of any discussion of the nature of the problem that we are dealing with. You can see on it U.S. oil consumption without the National Energy Plan. The vertical axis is millions of barrels a day, and time is the horizontal axis. At the bottom of the chart you see the old reserves. That's the projected production that's in place today in the United States. Building on that are the new reserves. Between the new reserves and the upper line (consumption) is the difference between what we are likely to be producing domestically and what consumption would be like without the National Energy Plan. The difference has to be made up, of course, by imports. I don't think I have to discuss at any length the problem that those imports present—not only our



Slide 2.1



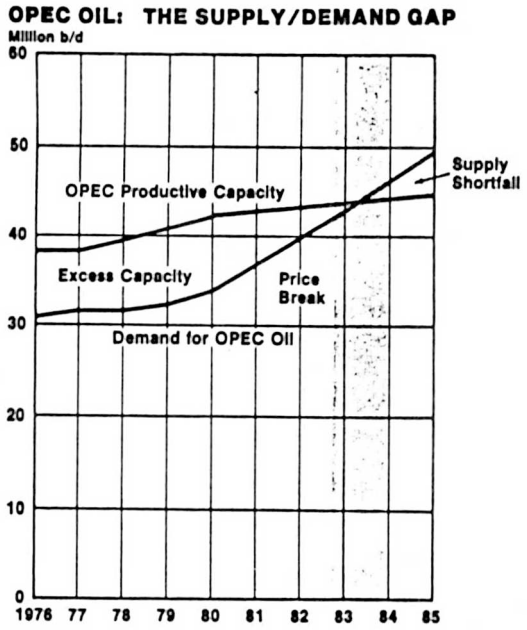
Slide 2.2

reliance on foreign sources of energy, but also the balance of payments problem that is introduced. And then, as I will be showing you shortly, imports are not a solution that we can rely on practically, because of the finite resources available in the world.

You might question the reliability of the data that constitute this particular slide. That from time to time becomes a matter of debate. I would say they are probably very reliable. If you take a look at, say, what drilling activity has been done in the United States in recent years, it's very close to historic highs right now. You see that the new finds of any magnitude in this country have not been increasing as a result of the increasing drilling activity but, in fact, you find new finds following a perfectly expected normal curve, in which we have already passed the peak. The new reserves that are shown here and new reserves that are yet to be brought into production are by no means assured in the country today. For one thing, a great deal of them have yet to be found. Secondly, a lot of them are in areas that are not yet released for private drilling activity, such as the offshore lands. There are also other parts of that production which are bound up for other causes within the country today.

If we turn to the next slide (Slide 2.3), we can try to summarize in fairly simplistic fashion what the oil supply-demand gap is likely to be worldwide in the future. This slide has been taken from a CIA report that was released sometime in the last year. The bottom curve shows what the demand for OPEC oil is likely to be: it climbs fairly sharply through the 1980s. The top curve, on the left side, shows what the OPEC productive capacity is likely to be in the future. (I have read some studies saying that might be a little bit optimistic as well.) If you look at the two curves, you see a crossing, about in the shaded area, in 1983 to 1984.

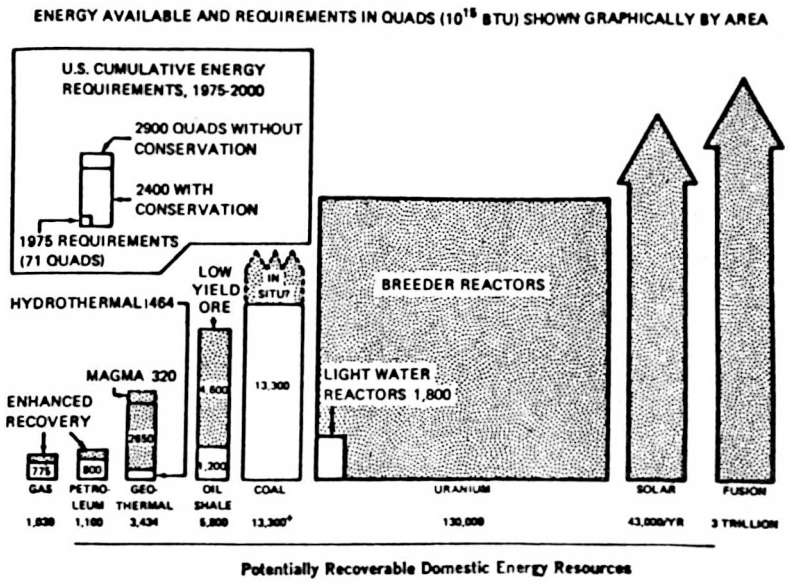
Of course, those curves won't cross one another and demand isn't going to be higher than supply. Normal economic forces will take care of that. What the figure shows is that about that time you can expect to stop hearing stories about oil gluts and the impact of the



Slide 2.3

North Sea oil or the Alaskan oil. At that time there will be a very close approximation between supply and demand, and there will be a very real possibility of a sharp break in price upwards. That sharp break in price, or its possibility, provides a great deal of motivation behind the urgency of the National Energy Plan, because just the sharp break that occurred at the time of the embargo back in 1973 caused significant economic dislocation in the country. Part of our planning right now is to be sure we are in a position to ameliorate any such break in the future and to provide alternatives to the foreign oil should that occur.

If we look at the next slide (Slide 2.4), we can see what some of those alternatives might be. This chart shows, first of all, that the United States is indeed blessed with a great deal of



Slide 2.4

potential energy supplies in the country. I think there are very few other countries in the world that have anything remotely approaching us in terms of diversity and amount of energy. Everything shown on the chart is shown pretty much in proportion to the size of the energy resource represented. The basic unit is 10^{15} Btus. As a point of comparison, in the upper left-hand corner in the enclosed box you can see what energy consumption is likely to be in the United States for the next quarter century. In the very small box up there 75 quads represents approximately one year's energy consumption today.

You can see as you look at the lower left-hand corner of the chart that the oil and the gas represent probably the smallest of the energy resources available to us in the country today, and that all the others appear in greater magnitude. But it has not been accidental that we have relied as heavily as we have on the oil and gas, and that they have been the cheapest, most convenient form of energy and probably environmentally the most tractable. That can't really be said for any of the other energy resources shown on the chart. In fact, the problem that we are faced with today, a good part of the energy-supply strategy that the Department of Energy is following, is how to exploit these other energy resources in a way that makes sense economically and that we can reconcile with the environmental standards we have been setting for the country as a whole.

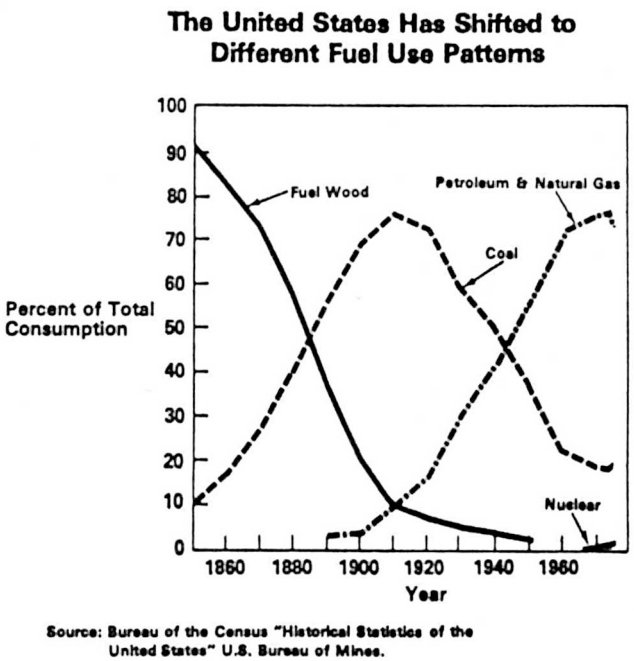
We can break the other energy resources into two pieces. The first piece (the last three resources shown on the right-hand side of the chart) are what we have been calling the essentially inexhaustible energy resources: uranium, fusion, and solar power. The solar and the fusion are so large that they are not shown on the chart in proportion to the other energy resources but are just shown as arrows pointing upwards. All three of those at the right-hand side require technologies that are just not available today, at least not in an economic sense. They will require the kinds of development for large-scale deployment that make them appear on the horizon for the end of the century in terms of meeting a large part of our needs. So they are not an immediate answer to the energy problem.

Coal and oil shale, the next largest energy resources, are much closer to being developed. But there are some very real environmental and technical problems for coal and oil shale that need to be resolved. Nevertheless, we can move ahead on those energy resources fairly rapidly, given the right sort of program. And we think we've got those kinds of programs in hand.

There are many real choices still to be made that we don't have the answers for: for example, the extent to which we want to move to synthetic fuels; the question of whether we want to go to fuels from coal or whether we want to use fuels from oil shale; the extent to which we want to exploit the coal resources. Do we want to burn coal directly using scrubbers? Do we want to depend on some of the new technologies coming along like atmospheric fluidized-bed or fuel cell? Do we want to gasify the coal, which is perhaps environmentally the easiest way to exploit the coal. There are a lot of tradeoffs still to be made and a lot of analyses to be done.

There is one problem associated with turning to these alternative sources of energy. That problem is one of time. I sometimes feel uncomfortable using this chart (Slide 2.5) because it borders on being too simplistic. The curve on the top left, namely wood, represents the percentage of energy met by wood at the middle part of the last century, in 1850 or so. You can see it met 90% of all our needs and fell off sharply as coal began to replace the wood. Coal peaked about 1910, and then finally petroleum and natural gas climbed rapidly so that they meet about 75% of our energy needs today in the country.

The significant point here is that there is just about 60 years between the tops of each one of those peaks, and 60 years is not a luxury that we have in front of us in terms of



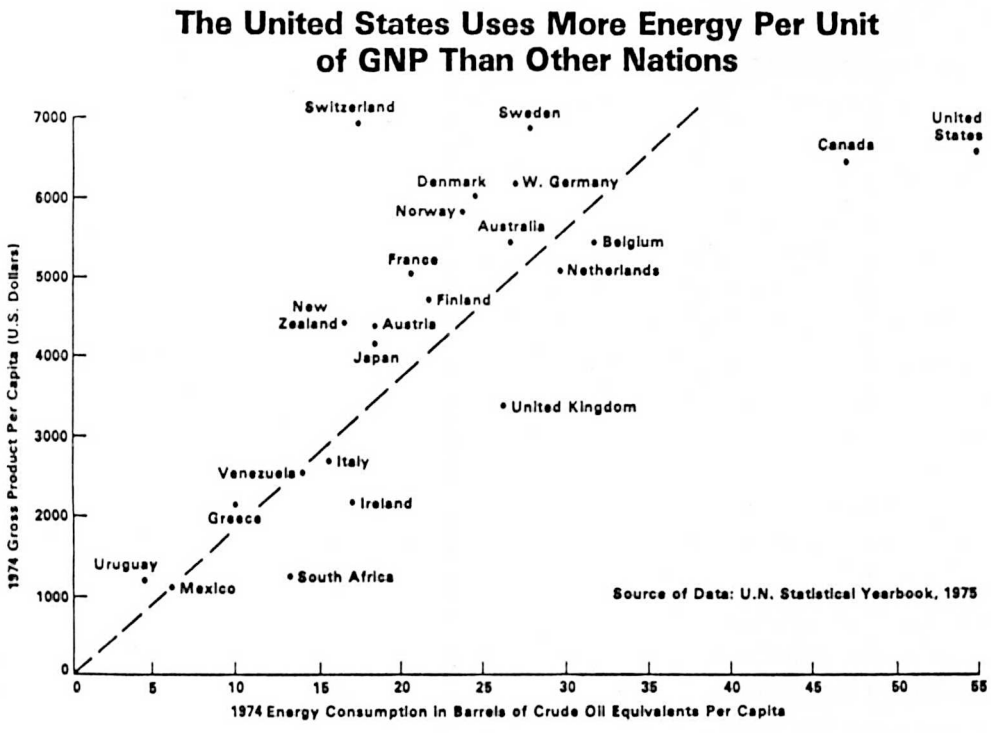
Slide 2.5

converting to alternative fuels of energy in the country today. Even in existing technology like the light-water reactor, it takes something like 10 to 12 years to plan and build a plant. So you can get an appreciation for why a lengthy period of time is required to build the infrastructure in the country, to build the technologies, and to convert the end uses so that, in fact, you can move to alternative sources of energy.

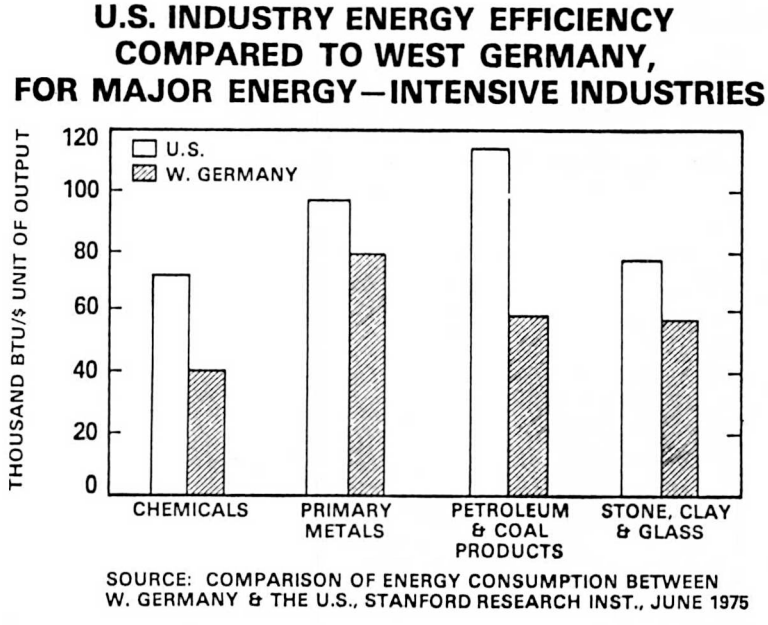
That leads us to the subject of conservation. The next slide (Slide 2.6) shows the United States' use of energy as compared to that of other nations in the world. We have found that the most useful way of presenting this information is to plot the gross national product per capita of each of these countries (vertical axis) against the (1974) energy consumption in barrels of oil equivalent per capita (horizontal axis). You can see that the United States is all the way out on the right-hand side of the chart. For a given level of per capita income we use by far the most energy per capita anywhere in the world. Many other nations such as Sweden, West Germany, and Switzerland have comparable standards of living but use far less energy per capita.

This chart tends to be somewhat controversial. We've had a number of studies that have shown, for example, that there are a lot of differences in geography and lifestyle between the United States and other countries with high standards of living. People in Europe don't have to travel the same distances, don't require the same mobility, and tend to live more in apartment buildings. Nevertheless, there is a lot of potential in terms of our ability to conserve in the future.

The next chart gives an example from industry (Slide 2.7). Here we show the foremost energy-intensive industries in the United States: namely, chemicals, primary metals, petroleum and coal products, and stone, clay, and glass. The energy consumption is given in thousands of Btus per dollar unit of output, with a comparison between this country and West Germany.



Slide 2.6



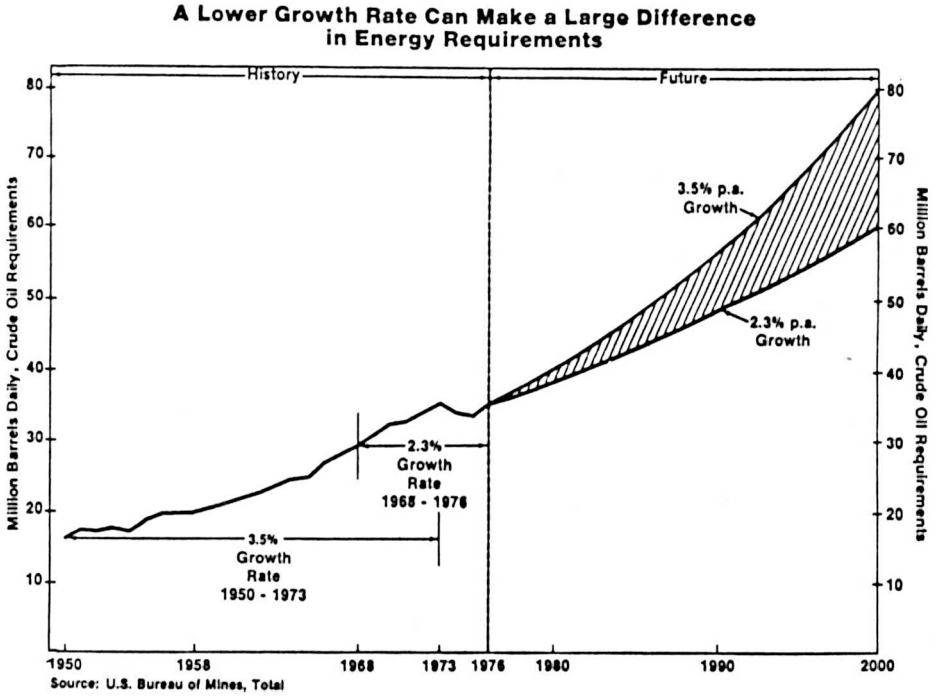
Slide 2.7

You can see in most of these cases that West Germany only uses about two-thirds of the energy input we do for the same level of output. Now, that's not accidental. In Europe energy has always been much more expensive relative to other commodities than in the United States. They have had much more incentive to conserve energy than we have had. We can already see the process moving in this country; many of these industries have already made substantial strides forward since 1974. But this chart gives an indication of the magnitude of potential that we have.

On the next chart (Slide 2.8) we can give an indication of how we'd like to exploit that potential in the future. The left-hand side of the chart shows what our historical growth rate has been in energy consumption in the United States until the year 1976. For most of that period we have been having about a 3.5% compound growth rate. In the last few years the growth rate has been diminished somewhat to 2.3% as a result of the oil embargo, the recession, and other factors.

What we'd like to do, and what's embodied in the National Energy Plan, is to find a way of keeping energy growth to that 2.3% growth rate for the rest of the century, rather than reverting back to a 3.5% growth rate. The difference between the two by the year 2000 (shown by the shaded area at the right) is substantial indeed. If we keep to a 2.3% growth rate, we'll be using something like 60 million barrels a day equivalent of oil, rather than 80 million—a reduction of about 25% in what our energy needs would otherwise be.

For this reason conservation plays a central role in the plan. It can make a big impact. It's also something we can do right away, because we have the technology (if for no other reason than that Europe has led the way). It's cost effective to go that route. Virtually any type of conservation, in terms of investment required and the equivalent cost of energy, is better than those alternatives that we would otherwise have to move to.



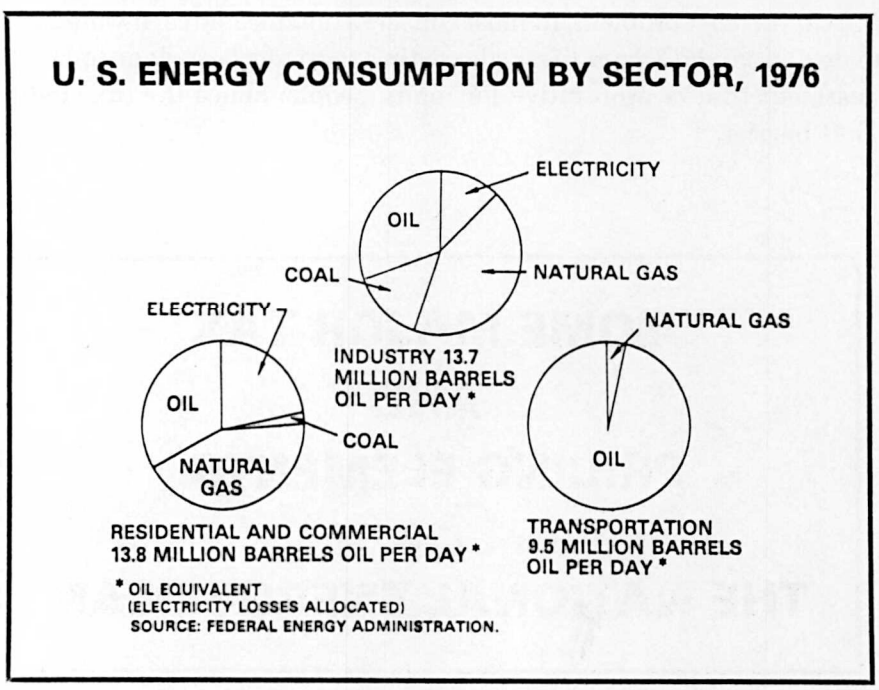
Slide 2.8

In the next chart (Slide 2.9), we begin to point out some of the obvious targets of energy conservation that we look to as we put together the National Energy Plan. The three main consuming sectors here are: transportation, industry, and residential and commercial. The transportation sector, which uses virtually only oil, is one of the primary targets, as Dave Freeman said earlier this morning. Right now we have relatively few alternatives to turn to. The vast consumption of liquid fuels here is where we have shorter supply and the most difficulty in terms of developing new supplies in the future. Industry is much more diversified, with oil, coal, electricity, and natural gas. Finally, the residential and commercial sector is divided pretty much three ways between electricity, oil, and natural gas.

In the National Energy Plan, in terms of limiting that energy growth rate and implementing conservation in the future, we would like to devote most of the growth in energy consumption in the United States to fueling the needs of industry and increasing our economic output. The plan calls for something like a 4% growth rate of energy consumption in industry. Our attempts then are to hold the transportation sector and the residential and commercial sector pretty much flat, if we can, through conservation.

In the National Energy Plan there were a series of proposals to limit the consumption of fuel in transportation through taxes, and to provide economic incentives to use less. Congress is tending to move more directly in the area of putting requirements out for fuel economies in the fleet, as I'm sure you are all aware.

Before I turn to specific details in the industrial and the residential and commercial sectors, I'd like to summarize some of the basic principles that are fundamental to the proposed energy plan. At first the growth of energy demand has got to be restrained through conservation. This makes sense economically and environmentally, in terms of



Slide 2.9

timing. Secondly, energy prices must reflect true replacement costs. The alternative fuels and energy resources are all going to be more expensive than the fuels we have been enjoying today, particularly the coal, direct burning natural gas, and petroleum. They are not going to be a great deal more expensive if we understand the technologies and the problems involved. But my guess is that we are talking about at least a 50% higher cost of energy. In pricing the energy in the United States, then, it makes sense that the consumer realize what the marginal cost of turning to those alternatives is going to be. Consumers should not see a price level that encourages them to overconsume today to the detriment of the future.

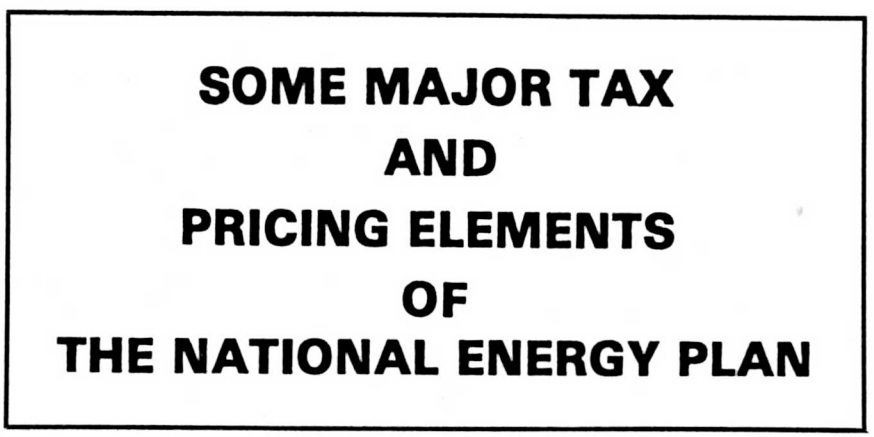
Producers and consumers are also entitled to more certainty of government policy than they have had in the past, so that they might be in a position to make some of the very large investments that are going to be required as we shift fuel bases. Finally, the more plentiful resources like coal should be used more widely. And alternative sources of energy should expand, particularly solar energy, within the United States.

I summarize those particular points right now because I think those are points in which there is a large measure of agreement in the United States. I haven't seen a great deal of debate in the Congress along those lines. The debate is centered more on the specific means of going ahead and approaching each of those objectives in the country.

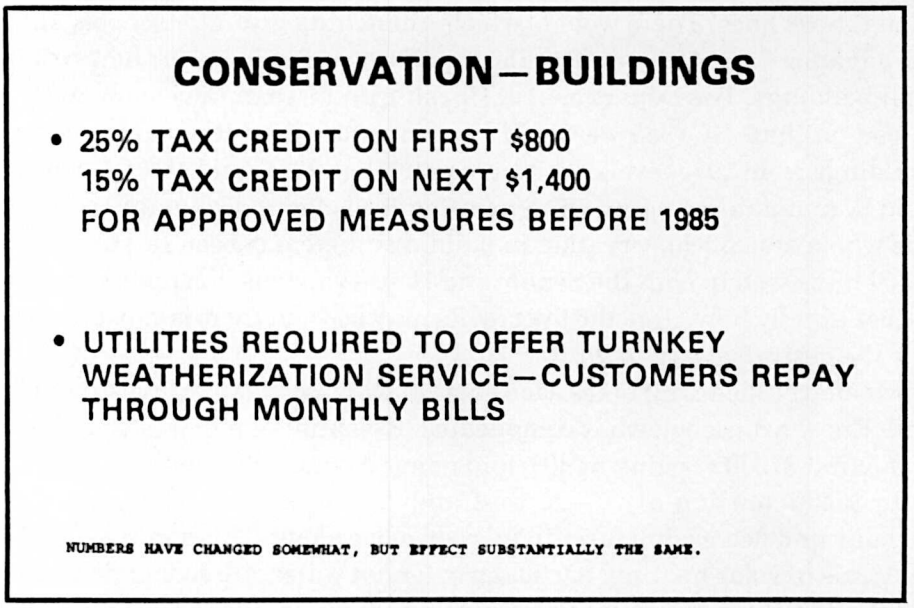
In the remaining part of the presentation I'd like to take you through some of the major tax and pricing elements of the National Energy Plan as this administration has proposed them (Slide 2.10).

We first take a look at conservation, and conservation in buildings in particular (Slide 2.11). The administration has proposed here a 25% tax credit on the first $800, and 50% tax credit on the next $1400 for measures that are approved before 1985. That's part of the incentive to get movement under way along these lines before 1985.

The reason the tax credit approach has been adopted, as Dave Freeman mentioned earlier, is the capital cost problem. In most conservation measures, it would make sense for everyone to do a great deal more life cycle costing than has been done today. It's that first capital investment that is prohibitive for many people; hence the tax credit is a way to overcome that barrier.



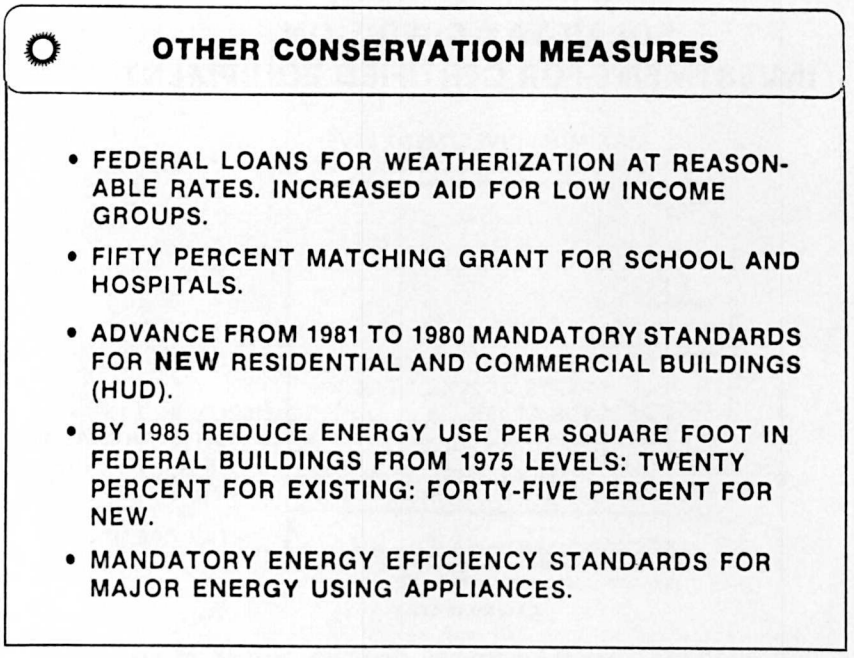
Slide 2.10



Slide 2.11

The second element of the policy to overcome the capital cost barrier would be for utilities to offer turnkey weatherization service. The utilities would provide the capital cost initially and customers could then repay over time through their monthly bills.

In the next chart we look at some other conservation measures (Slide 2.12). There would be federal loans for weatherization at reasonable rates and increased aid for low-income



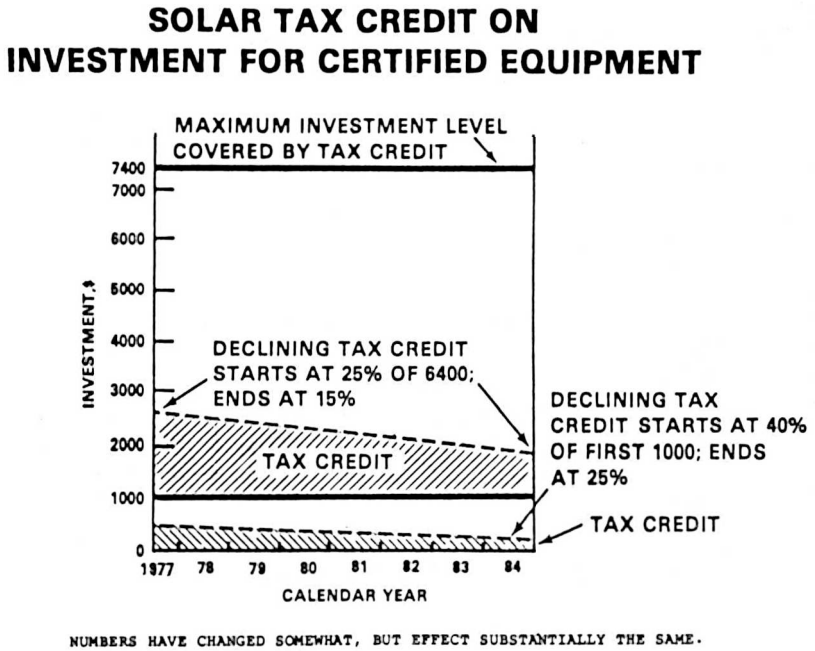
Slide 2.12

groups along those lines. There would be a 50% matching grant for schools and hospitals. We would advance from 1981 to 1980 the mandatory standards for new residential and commercial buildings. The Department of Housing and Urban Development (HUD) would have the lead on that. By 1985 we would hope to reduce the energy use per square foot in federal buildings from 1975 levels: 20% for existing buildings and 45% for new. In addition there would be mandatory energy efficiency standards for major energy-using appliances.

In this whole area of conservation in buildings there has been relatively little debate. From what I have seen in both the Senate and House versions, the numbers may change a little bit—just exactly how large the tax credits may be—but there is substantial consensus that that's the desirable way to go.

The next chart (Slide 2.13) takes a look at the solar tax credit on investment for certified equipment. The chart is somewhat complicated. Essentially, the plan would provide a tax credit on the first $1000 starting at 40% and going down to 25%, with an additional credit going up to $6400 starting at 25% of that and ending at 15%. Thus, there is a greater incentive today and decreasing incentive as you move along. This again recognizes the fact that some forms of solar heating, particularly for hot water, are economical in the country today and it's the capital cost that restrains us. We have hopes that with the National Energy Plan we could have something in excess of 2 million homes enjoying some form of solar heating by the middle of the 1980s.

If we move on to the next question of pricing (Slide 2.14), we get into more controversial waters. The basic principle here is that energy should be priced at replacement cost and there should not be any apparent subsidy to the end consumer. Oil pricing would be such that previously discovered oil would be priced at the current levels that are controlled at $5.25 and $11.28 per barrel. Newly discovered oil, however, would be priced at the current



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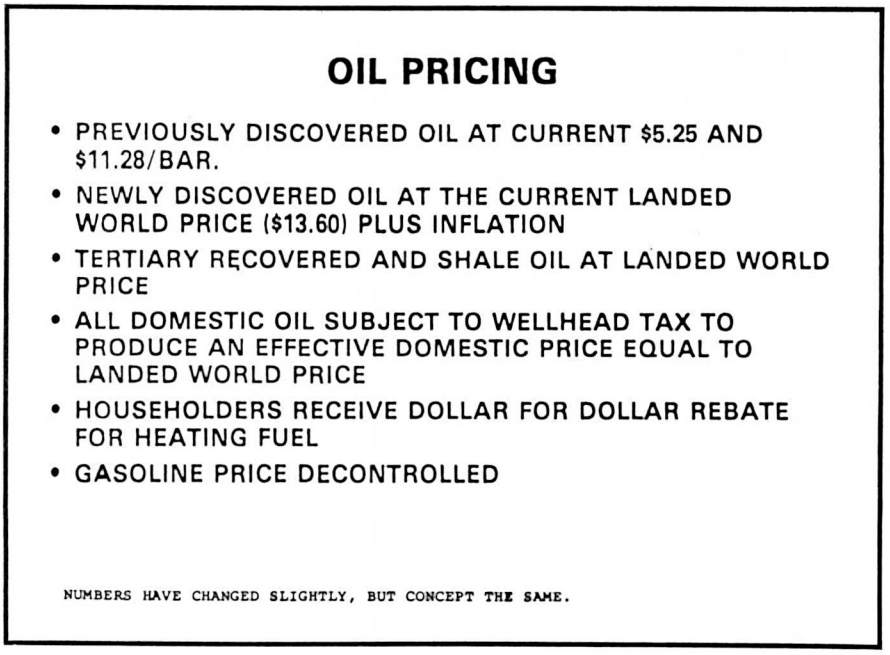


Slide 2.14

landed world price of about $13.60, and there would be an inflation factor thrown in so that price would grow with inflation into the future.

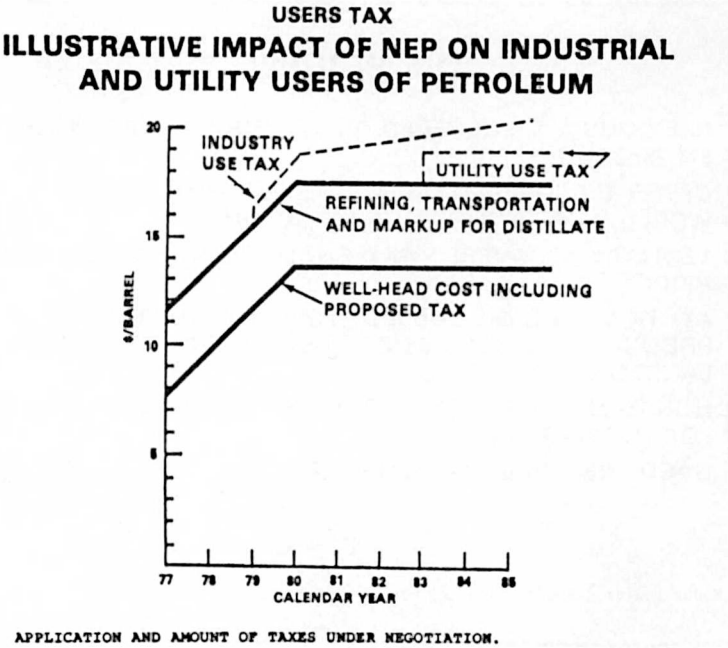
Tertiary recovered and shale oil would also be priced at the landed world price. In addition, all domestic oil, particularly the previously discovered oil in the first point, would be subject to a wellhead tax to produce an effective domestic price equal to the landed world price.

So the end consumer would basically see the landed world price in his purchases. Householders would receive a dollar-for-dollar rebate on that for heating fuel to shelter the building sector. And gasoline prices would be decontrolled.

In the next chart (Slide 2.15) I try to show what all those features look like graphically. The bottom curve shows what the wellhead cost would be, including the proposed tax; the shape of the curve is an upward ramp. In addition, you'd have existing refining, transportation, and markups for distillates (the second curve). Then on top of that there would be an industry use tax and a utility use tax to further discourage the use of oil by industries and utilities in the United States.

Virtually the same rationale is being used in terms of pricing natural gas in the United States (Slide 2.16). There would be a user's tax and a wellhead tax to bring the price of natural gas up to the Btu equivalent of the cost of distillate oil. Today the controlled price of gas, which in many areas is a preferred fuel anyway, is lower than that of oil. There's an artificial incentive built into the economy to use natural gas, which is also going to be in short supply in the country.

The next chart (Slide 2.17) illustrates why some of these taxes are important in terms of shaping the use of energy in the United States in coming years. The chart shows a number of alternative conservation techniques for energy sources. The vertical axis gives industrial user prices in dollars per million Btu. The shaded areas on the bars represent the areas of



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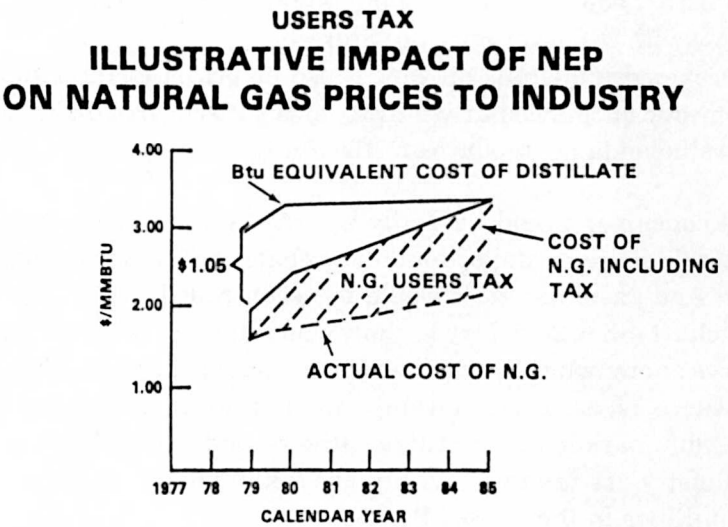
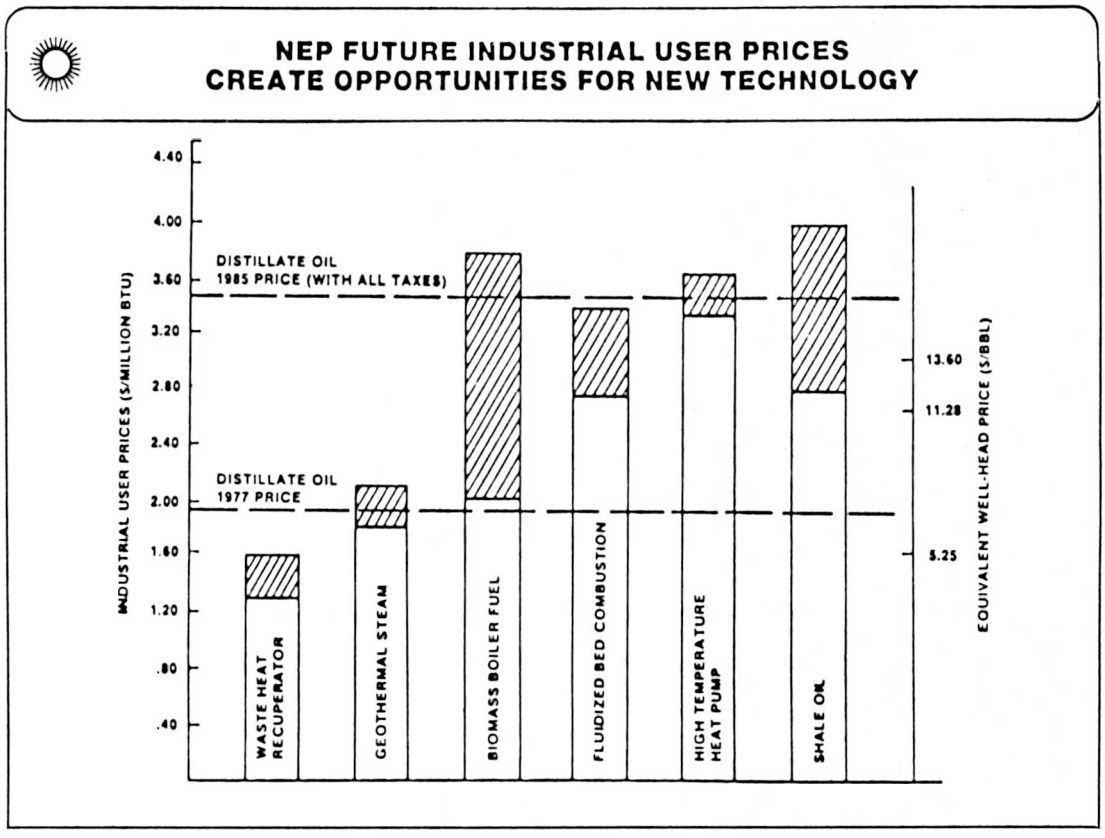


Slide 2.16

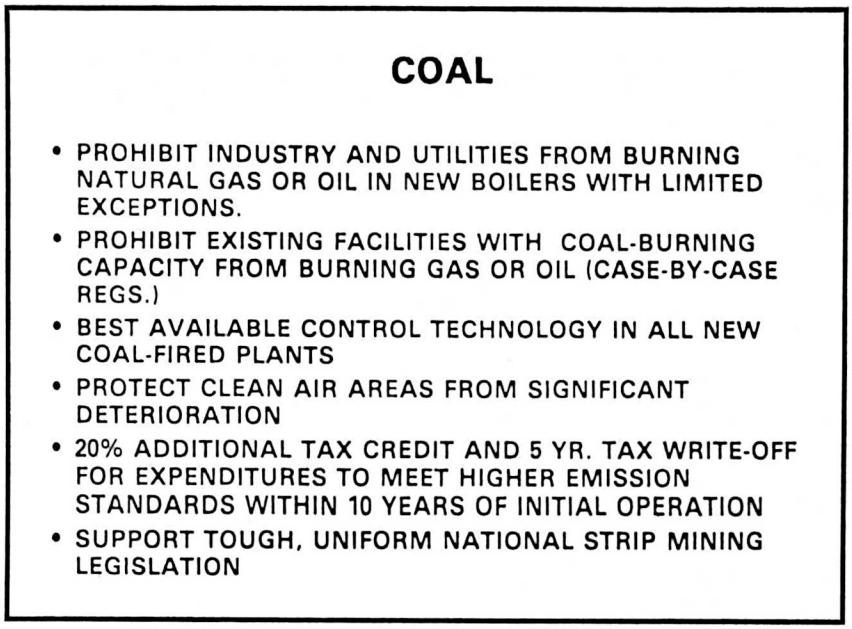
uncertainty today: until these alternative technologies are actually functioning we won't know exactly what the price is going to be in the future. The two dotted horizontal lines represent the price of distillate oil. The lower line shows the current (1977) price of distillate oil; the higher dotted line shows what the price of distillate oil would be with all the taxes that are proposed. You can see that with the imposition of those taxes virtually every one of the technologies shown on the chart is likely to become economical in the future and to provide a strong incentive for its introduction and wide-scale use.



Slide 2.17

A great deal of incentive through the National Energy Plan is for industry to convert from oil and natural gas to the use of coal (Slide 2.18). In addition to the pricing incentives that I have described, the proposed legislation would prohibit industry and utilities from burning natural gas or oil in new boilers—namely for process steam—with a few limited exceptions. It would prohibit existing facilities with coal-burning capacity from burning gas or oil on case-by-case regulations. We would require the best available control technology in all new coal-fired plants to protect the clean air areas from significant deterioration. We would provide a 20% additional tax credit and a five-year tax write-off for expenditures needed to meet those higher emission standards within ten years of initial operation. And then we've already supported uniform national strip mining legislation.

To complete the discussion of policy and technologies, I'd like to turn to the light-water reactors (Slide 2.19). There are five elements to this policy (the first two are on this chart). First, in the area of uranium enrichment we need to restore worldwide confidence in the United States' ability and willingness to support separative work units (SWUs), which I think most of you recognize is representative of the effort required to enrich uranium. To do that we would first reopen the order books. We have not taken any new orders for enriched uranium since 1974. We would guarantee the sale of SWUs to those countries that accept our nonproliferation objectives. We intend to build 9 million additional SWU capacity in the gas centrifuge technology at Portsmouth, Ohio. Then we will tie this to our international responsibilities in terms of controlling proliferation.



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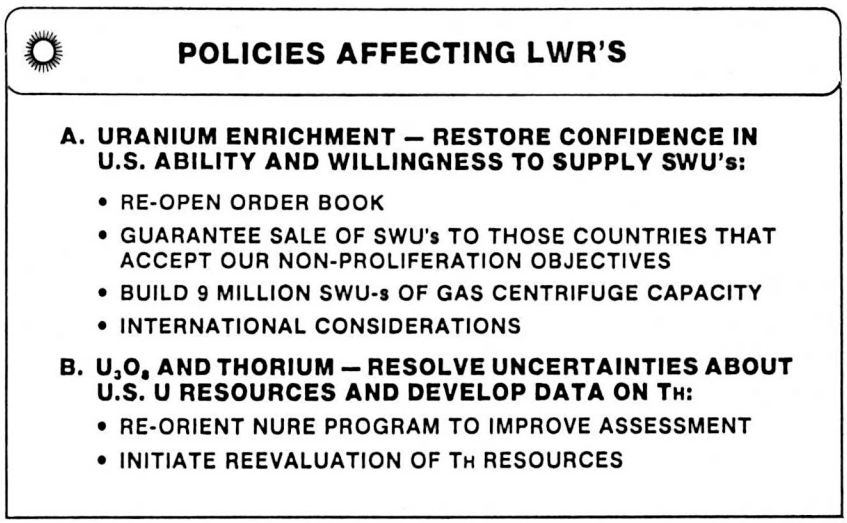
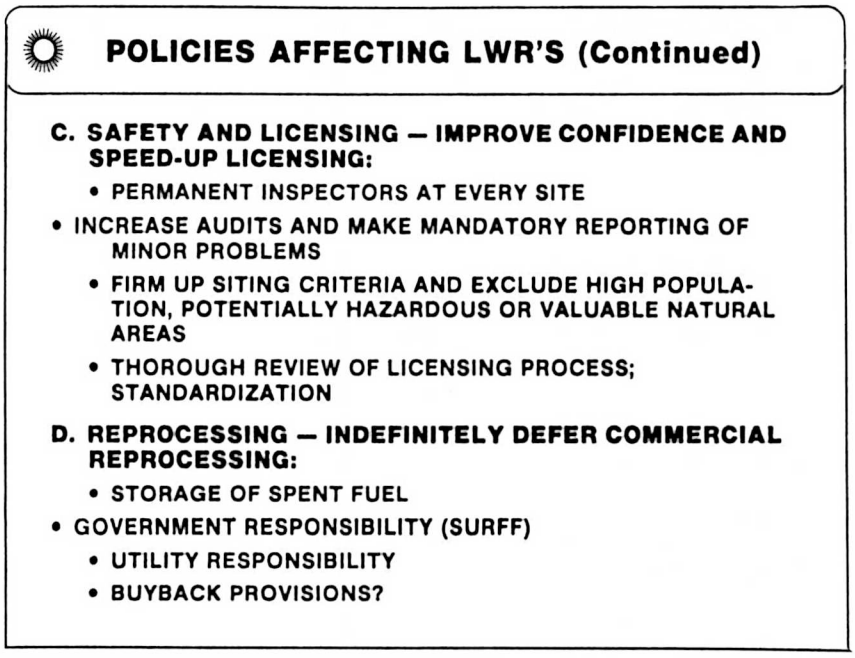


Slide 2.19

Secondly, in the area of uranium and thorium, we've got a full-scale program right now, the so-called NURE program, that will resolve uncertainties about the size of our resource space. This will allow us then to reevaluate the size of the thorium resources in the country.

On the next chart (Slide 2.20) we look at two more elements of the nuclear policy. In the area of safety and licensing we intend to improve confidence and to speed up the licensing process itself. Again, many of you realize that it takes significantly longer in this country to plan and build a nuclear plant than it does abroad: it takes 10 to 12 years in this country, whereas in some countries abroad it is more like 6 to 8 years. We have some legislation being

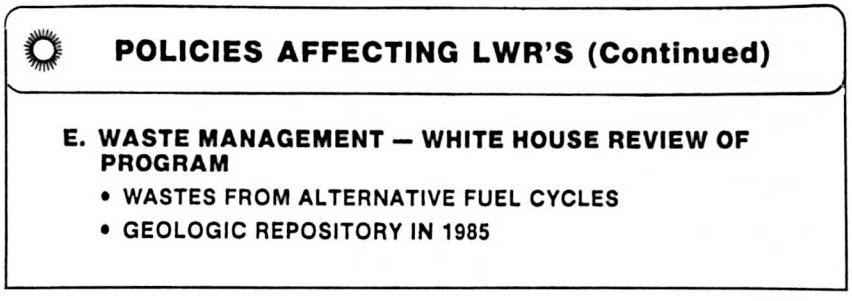


Slide 2.20

developed right now for the purpose of speeding up the licensing process. We would also provide for permanent inspectors at every site; increase audits; make mandatory the reporting of problems; firm up siting criteria; and carry out a thorough review of the licensing process with a view toward greater standardization.

In the area of reprocessing, we would indefinitely defer commercial reprocessing and turn again more to the storage of spent fuel, because of the proliferation problems involved in the spent fuel and in pulling out of plutonium. It would be the government's responsibility to take care of those waste products, with a utility buy-back provision.

Finally, our responsibility in the area of waste management (Slide 2.21). This is an area that Dave talked about at some length this morning. The United States government has got to take the lead to solve that problem so we can demonstrate that we can handle safely waste from alternate fuel cycles. We must show it in concrete, realistic fashion in a geologic repository by 1985.



Slide 2.21

To summarize the points that I'd like you to take away from this presentation today, there are three main elements to the President's strategy:

1. an implementation of an effective conservation program for all sectors of energy use so as to reduce the rate of demand growth to less than 2% per year in the future;
2. the conversion of industry and utilities that use oil and natural gas to coal and other more abundant fuels in order to reduce imports and to make natural gas more widely available for household use; and
3. a vigorous research and development program to provide renewable and essentially inexhaustible resources to meet the United States' energy needs in the next century.

I hope you can take some of those fundamental points in which there is general agreement with you, as the country then resolves the specifics, hopefully fairly quickly.

I would be glad to answer questions on any of these proposals.

From the floor: I don't think it's working yet. The economics that we are using now for looking at coal and oil and nuclear fuel are based on not paying for the oil, the manufacture of the oil, or for the coal and natural gas. All we are paying for is the transportation charge: take it out of the ground and get it to the users. Why doesn't the administration take a positive approach and say, "Okay, for future generations let's put a tax right now on all oil, gas, and coal and use that money to go ahead for capital expenditures the same way we use gasoline taxes to build thousands of miles of superhighways so we can travel much further?" To me this would make a simpler approach that most people could understand.

Mr. Bayrer: I think there's a great deal of merit in that suggestion, and I suggest that the first part of the administration's proposals is, in fact, to do that, to put taxes on natural gas and petroleum to discourage their use.

The next question, I think, centers on who should make those investments in the United States as a whole. I think Senator Long has suggested something along the lines you mentioned—to use a good deal of that tax revenue and invest it in the alternative energy resources. At the moment the plan is to return most of those tax revenues to the economy as a whole. We will use government-financed R&D to bring those technologies to a reality, but then we will depend on the private sector as being the most efficient vehicle for making the actual investments in the alternative capital infrastructure in the country for those alternative sources. But in any event, you really have to consider both elements—the tax itself and the use of the tax revenues—as the question suggested.

From the floor: Considering the fact that one of your charts showed that the breeder reactor is one of our future renewable resources and that it's going to account for large portions of energy, why is the administration discouraging the development of the breeder reactor?

Mr. Bayrer: I think the answer to that very clearly hinges on the proliferation problem. The breeder reactor, at least as it was conceived in the Clinch River breeder, in the liquid metal fast breeder, would produce substantial amounts of plutonium which would have to be separated through reprocessing. This would essentially create in the midst of our society, and perhaps in the world, a greater amount of material that could be used for weapons. That is a central, dangerous point as far as the administration can see.

The proposal right now is to continue with research on the breeder. In addition, we have a very large-scale study under way looking at other fuel cycles. We will try to identify those

fuel cycles that have a lot less potential for weapons proliferation, and we will perhaps turn to one of those in order to exploit the uranium and thorium resources.

The feeling is that, with the slowdown in orders for nuclear plants and the like, we now have some breathing space to do that sort of fundamental study. The study should be completed in another year or so, and then we will take another look in the future. But the hope is that we will have a much more proliferation-resistant form of technology than the breeder reactor. At the same time we can proceed quickly ahead in the areas of both fusion and solar, either of which would also be sufficient, if proven economically and technically, to meet our needs in the future. So we are trying to keep our options open and use the breathing space that we have right now.

From the floor: Has there been any attempt to check on the adequacy of our transportation system to meet the new demands of coal? As we expand our coal capability, or are requested to, has there been any actual assessment of what this will do to our transportation system?

Mr. Bayrer: One factor that I left out of the presentation is that if we follow the National Energy Plan, we anticipate that by 1985 we will have virtually doubled coal production in this country. That is a remarkable feat if you consider that it has been pretty much at the same plateau for the last two or three decades in the country. So this becomes a very pertinent question.

Is our infrastructure at all prepared to deal with that magnitude of growth in coal? I am not able right now to cite any specific studies, but we have looked at the question and my impression is that the railroads are obviously not today ready to carry that sort of increased load. But investments can be made so that it would be profitable. It doesn't require any specific government program to assist that sort of development. Nevertheless, it's something we have to keep our eye on very closely if we hope to implement the National Energy Plan in the future.

From the floor: Would you care to expand a little further on the reluctance to make a decision between shale oil and coal that you mentioned earlier?

Mr. Bayrer: To a certain extent I should start an answer to that question by saying that it's going to be the economy as a whole that will make the inevitable decision as to how quickly we move into either one of those resources. The real decision facing the administration right now is to what extent it should support the beginnings of one or the other of those industries. If you take a look at the economics, there is a significant amount of uncertainty in both. If you look at, say, surface reporting of oil shale, you can see believable estimates that run from about $17.00 to $28.00 per barrel of fuel from oil shale. Similarly, from coal you will see estimates running from about $18.00 to $30.00 per barrel. You're not really going to settle this question until you have built some of the plants and see what it really takes to deal with the environmental problems and to perfect the technology.

So to a certain extent it looks something like a wash. There are other formidable factors that enter in, such as how easily one is going to deal with the environmental problems of either or both of these resources. Our guess right now is that in the in situ process of oil shale we can deal with the environmental problems most easily; and, in fact, that might be the most economic. To a certain extent I think the Congress has been reluctant to push in situ oil shale simply because the resource has been projected by some to be economic today. The question is then, why should the government be pushing it if it's likely to be economic.

My own personal feeling is that the institutional obstacles and the uncertainties and the risks are sufficient that even if oil shale were to be economic in the future or even if it could be produced economically by the time you got those first plants built, it would still require some additional incentives from the government. But by and large we have programs in the Department of Energy supporting the development of both of those technologies. We have three or four synthetic technologies under way to use the coal, and we have several going in the area of oil shale as well. I don't think we are really in a position to say which is going to be the real winner in the economy in the future.

From the floor: On your chart you showed natural gas with a very, very small peak. There are projections, though, that there are tremendous amounts of natural gas available from pressurized water along the Gulf Coast. Are there any government plans to investigate particularly whether natural gas is really there or not?

Mr. Bayrer: Very much so. In fact, one of the points I mentioned in the introduction was resource applications within the Department of Energy. One of our assignments is to look at new technologies and new resources that can be commercialized fairly rapidly in the country. These geopressured resources are some of them. I don't know how many of you followed the debate that ERDA had with the *Wall Street Journal* last year on the editorial page, but they put a great deal of focus, in fact, on these kinds of gases.

In addition, there is gas in the Devonian shales here on the East Coast. There is gas (methane) in coal mines. There is gas in tight sands out in the West. All of these promise to be substantial in quantity.

The big uncertainty is what would be the cost of exploiting those gases. Our guess right now is that probably a relatively small fraction of those large amounts are exploitable in the near future in economic terms. The geopressure looks good enough that ERDA started drilling last year, and we already have one producing well along the Gulf Coast validating the resource. But there is a great deal more work to be done. My own personal guess—this is not Department policy—is that we'll be doing a more substantial amount of work in each of those areas just validating economics and the size of the resource base in the next few years or so.

Mr. Kerlin: Thank you, Mr. Bayrer.

3. Impact of International Energy Trends on U.S. Energy Policy

Gordon C. Hurlbert, *President, Power Systems Company, Westinghouse Electric Corporation*

Mr. Kerlin: Well, we want to broaden the circle once more and look at the international picture, keeping in mind that we are interested in how it impacts on our area.

We are fortunate to have Mr. Gordon Hurlbert, who is President of Power Systems Company, Westinghouse Electric Corporation, to speak to us this morning on the "Impact of International Energy Trends on U.S. Energy Policy." Mr. Hurlbert.

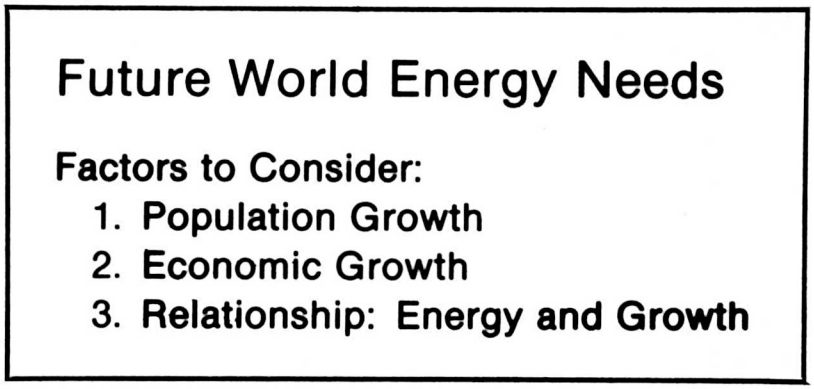
Gordon C. Hurlbert: Good morning, ladies and gentlemen. I welcome the opportunity to attend this meeting and to discuss with you my thoughts on the international energy situation.

Before getting to my assigned topic, however, I'd like to say a few words about the growing energy crisis here in the United States. While the electricity supply situation is not yet as severe as it was in January 1977, we are already seeing disruptions in my state of Pennsylvania and adjacent states to the west of us. I just want to make one point. This marks the second consecutive winter in which this country would be in serious trouble if it were not for the steady performance of our 68 operating nuclear power plants. I don't have the numbers yet for all of those plants. But I do know that in January the 23 Westinghouse reactors operated at an availability level of 90.8% and produced more than 10 billion kilowatt hours of electricity, saving 42,000 carloads of coal, much of which was transported to coal-short utilities. I hope our energy policy makers in Washington take cognizance of this development.

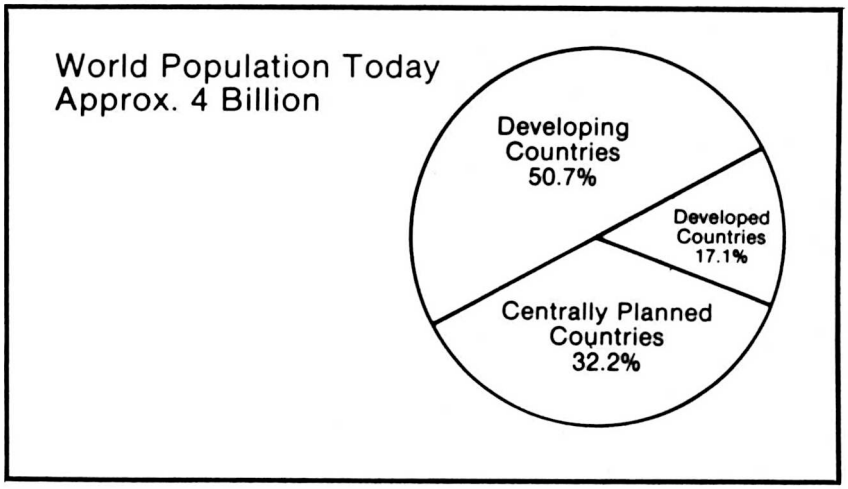
Most observers of the international energy market will agree that short-range trends are substantially influenced by the price and the availability of OPEC crude oil. The area that I would like to discuss this morning concerns the long-range trends in international energy—the shape of the trends for the balance of this century.

Identification of the long-range future world energy needs involves consideration of three separate factors (Slide 3.1). First, population growth of the world by the three major segments: the developed nations, the developing nations, and the centrally planned nations. The second factor is the expected economic growth of these three sectors, and the third is the relationship between energy and growth.

The world population today (Slide 3.2) has approximately 4 billion people, divided as follows: the developed countries—representing only 17% of the world population; the centrally planned countries—about one-third; and the developing countries—about half of the population.



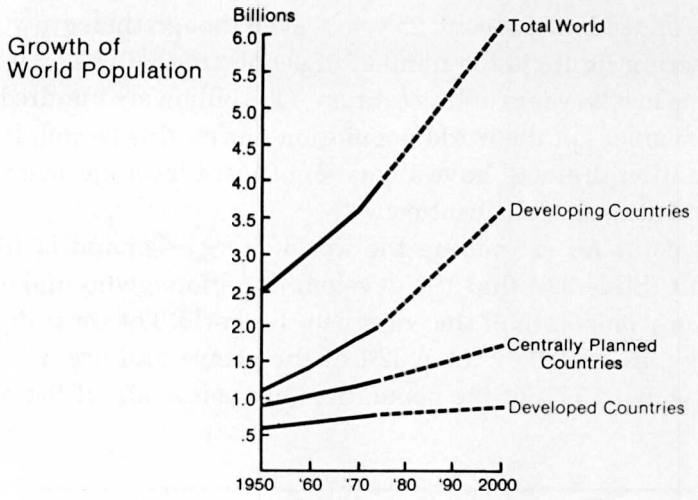
Slide 3.1



Slide 3.2

The difference in the growth rates of these three population sectors is of paramount importance (Slide 3.3). The developed countries have become more mature in their population. Their growth rate is now less than 1% per year. And their social organization and age profile both tend toward a more stable population. The growth of the centrally planned countries has now started to taper off, due primarily to their internal economic pressures, coupled with the fact that most women work in these societies and there is still a lack of adequate housing. These factors have a tendency to limit family size and that reduces their population growth rate. The developing countries are the ones that still have a very high population growth rate. It is expected that this group will increase from 51% of the world population today to 60% by the year 2000 (Slide 3.4). A significant fact is that the total world population is expected to grow from 4 billion today to over 6 billion by the end of this century.

To better understand the significance of these growth rates, the actual increase in millions of people for the two 25-year periods, 1950 to 1975 and 1975 to 2000, should be compared (Slide 3.5). The developed countries actually have a smaller net gain in population during the second 25-year period. The centrally planned countries have a larger



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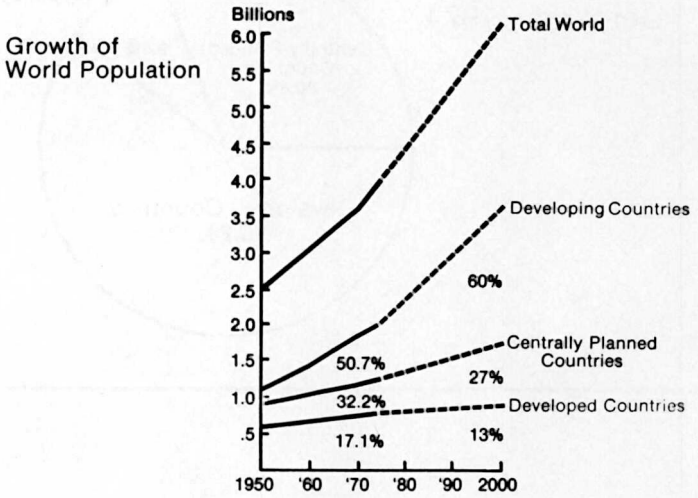

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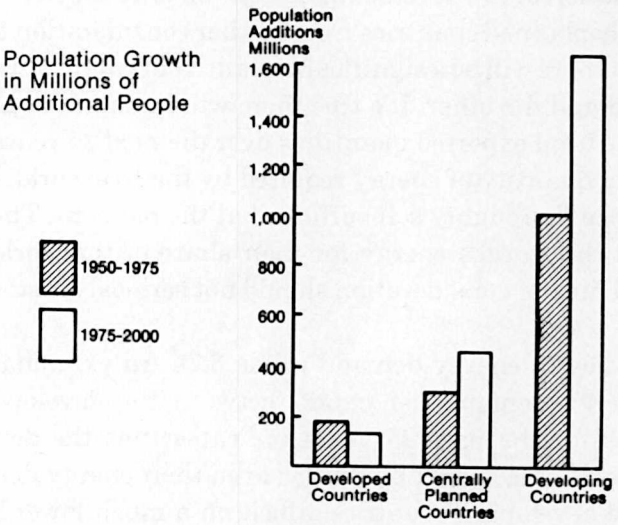
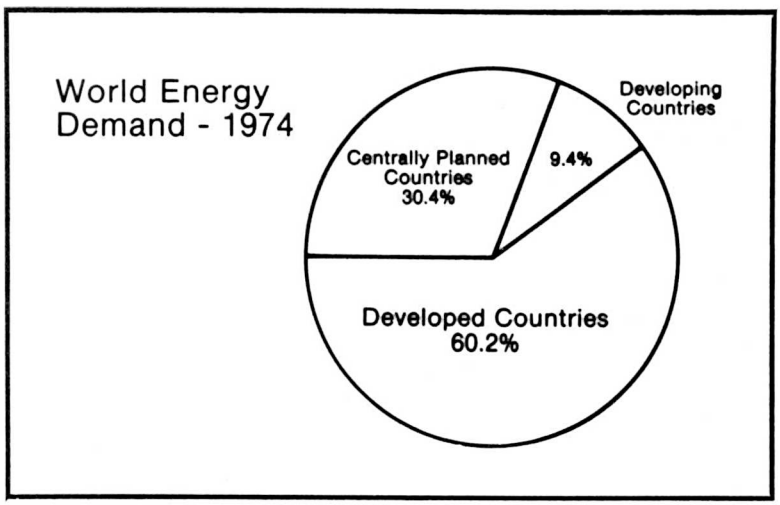


Slide 3.5

number of people added in the second 25 years, even though their growth rate has declined. The really staggering figure is the number of people that will be added in the developing nations during the last 25 years of this century. One billion six hundred million people will be added to this segment of the world population during this period. It is this tremendous increase in population that will have a very significant leverage on energy demand in the world during the balance of the century.

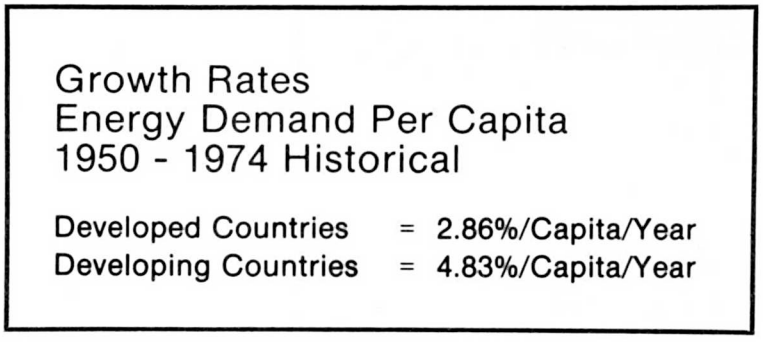
My starting point for examining the world energy demand is 1974. It immediately becomes apparent (Slide 3.6) that the developing nations, who make up one-half of the population, use only one-tenth of the energy in the world. The centrally planned countries are about average, in that they have 32% of the people and use 30% of the energy. The developed nations, with 17% of the population, are using 60% of the world's energy.



Slide 3.6

From this base point I will relate the effect of the leverage brought about by the large increase in the population of the developing nations on only the free world energy picture. I will drop the centrally planned countries from further consideration for two reasons. First, it is not expected that there will be a significant quantity of energy interchange between one segment of the world and the other. It's true there will be some oil, gas, and coal imported and exported, but the total exported quantities over the next 25 years will be insignificant compared to the total quantity of energy required by the free world. Second, the centrally planned economies are thoroughly self-sufficient at the moment. They are on the average using their share of the world's energy for their share of the world's population. Thus, removing them from further consideration should not seriously distort the trends that I see ahead.

Population is a key to energy demand (Slide 3.7). An examination of the historical growth rates of energy demand per capita between the developed countries and the developing countries for the past 25 years indicates that the developed nations have expanded at the rate of 2.86% per capita per year in their energy demand, compared with 4.83% growth for the developing countries, albeit on a much lower base.

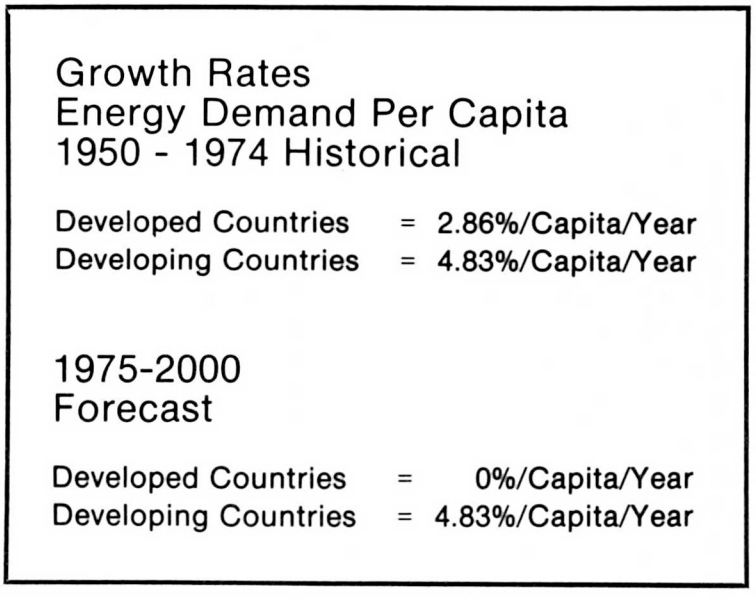


Slide 3.7

A forecast of the potential energy demand for the next 25 years can be based upon these historical rates with some modification (Slide 3.8). In the case of the developed countries, energy conservation will be of major importance to their economies. Conservation can be accomplished through improved energy utilization efficiencies, but it can also be accomplished through deprivation and a lower standard of living. Prudent projections of conservation through improved efficiencies indicate that the developed nations could reduce their total energy demand by 20 to 25% per year by the year 2000. This would reduce the energy growth rate per capita to approximately 1.9% per year.

On the other hand, some observers have suggested that our energy growth should be reduced to a point of zero growth to avoid further dislocation of resources and irreversible environmental impact. Although I am personally convinced that this latter goal cannot be accomplished without serious economic and social chaos, a forecast based on no increased energy use per capita provides the basis for the *minimum* projection.

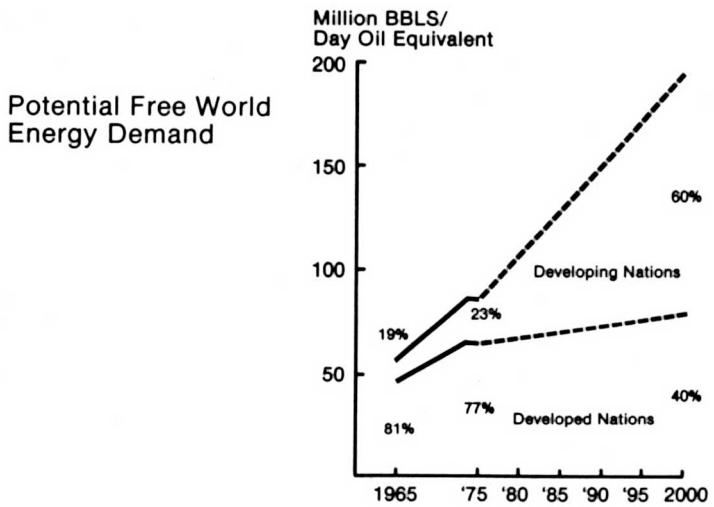
The developing countries will be undergoing some significant changes in their societies as well as economic growth. One factor of major importance is the urbanization of the



Slide 3.8

populations in the developing countries. In 1975 approximately 23% of their population lived in cities, compared to 65% in the developed nations. It is estimated that by the year 2000 over 40% of the population of the developing nations will be living in cities. This equates to a high demand for energy to provide the services for urban living as compared to rural living, even if it's only a single drop lamp. The negative growth effects of conservation will be offset by the increasing effects of urbanization. Thus, I will use the same rate of 4.83% per capita per year for the balance of the century for the developing nations.

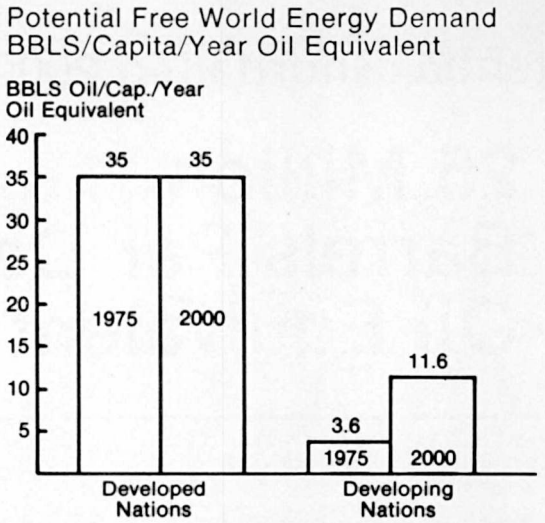
With the energy growth rate per capita determined and the population growth rate determined, it's a simple calculation to estimate the potential—I emphasize the word "potential"—free world energy demand for the balance of this century (Slide 3.9). Both the developed countries and developing countries will require more energy. But note that the developed countries' share of the total energy drops from 81% in 1965 to 40% in the year 2000. On the other hand, the developing countries increase rapidly to a share that is three times as large in the year 2000 as it was in 1965. All you have to do is go to Korea or Brazil or Taiwan or Mexico to be convinced that this is going to happen.



Slide 3.9

In 1975 the developing countries had a per capita use of about 3½ barrels of oil equivalent per year, which increases to 11 barrels per year in the year 2000. (Slide 3.10). Due to my arbitrary assumption of zero energy growth, the developed countries remain at 35 barrels per capita per year in the year 2000. Even though the per capita energy use in the developing nations in the year 2000 is less than one-third that of the developed nations' rate, their total use will be 50% greater. This highlights the tremendous leverage of the high population growth rate on further potential energy demands in the free world.

A review of several international oil companies' estimates of fuel production from various energy sources (Slide 3.11) gives us a picture of the potential free world energy production plotted against the potential demand that we have just discussed. These projections assume that the countries which have fuel resources available will produce them and offer them for sale at reasonable conditions. The projections also assume that no interruption in this relationship will arise through the political processes.



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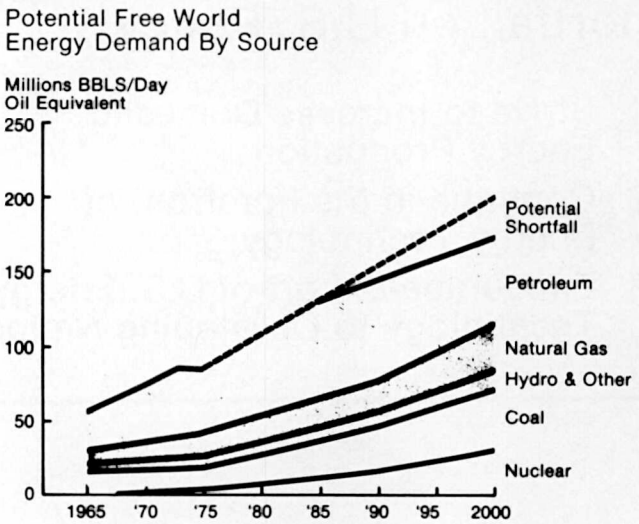


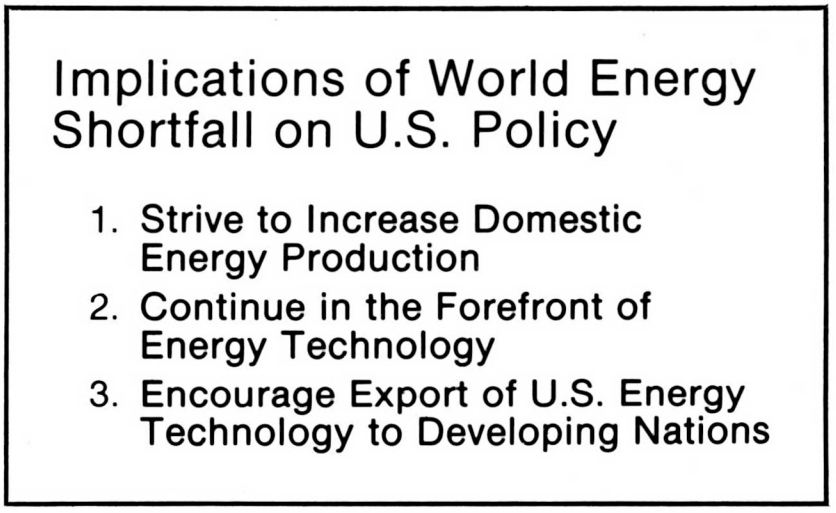
Slide 3.11

The significant fact to come from this analysis is that the potential shortfall in the year 2000 is about 25 million barrels per day oil equivalent for the free world (Slide 3.12). The magnitude of this figure is better understood when it is compared to the 1977 United States energy use of 35 million barrels per day oil equivalent. The expected shortfall in 2000 is equal to 70% of the United States' current demand, if you buy the assumptions listed.

At this point we can reach several conclusions. First, that there will be an energy shortage in the free world prior to the year 2000. Second, this energy shortage is especially aggravated by the rapid growth in population of the developing nations. And third, the magnitude of the potential energy shortage is 70% of the current energy demand in this country.

I see three separate areas where the international energy market would impact U.S. energy policy (Slide 3.13). First, the United States should strive to increase domestic energy

Slide 3.12

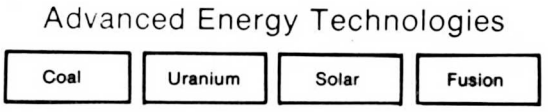


Slide 3.13

production without further delay. Second, we should make every effort to continue to stay in the forefront of the new energy technologies. And third, we must encourage export of U.S. energy technologies to the developing countries so that they can feed their people, clothe their people, and house their people.

Today we have only four known sources of energy which have the potential of supplying major quantities of energy (Slide 3.14). These are coal, uranium, solar, and fusion power. And each one requires substantial technological development in order to realize its full potential. Let me give you a few examples of the type of technological advancement that I feel should be pursued rapidly and diligently in the United States.

First is the improved use of coal (Slide 3.15). The greatest obstacle to the increase of the use of coal today is our inability to burn it without unacceptable insults to the environment. One promising answer to environmental problems lies in the gasification of coal prior to combustion. For example, our company has been developing, since 1970, the fluidized-bed low-Btu gasifier. We have a process development unit in service at our Walt's Mill site in Pennsylvania (Slide 3.16). This unit will allow us to produce a clean fuel gas with a



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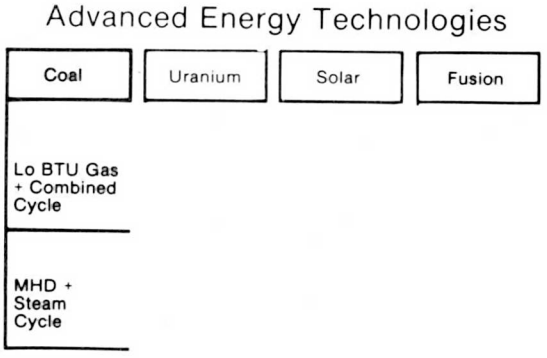


Slide 3.15

Slide 3.16

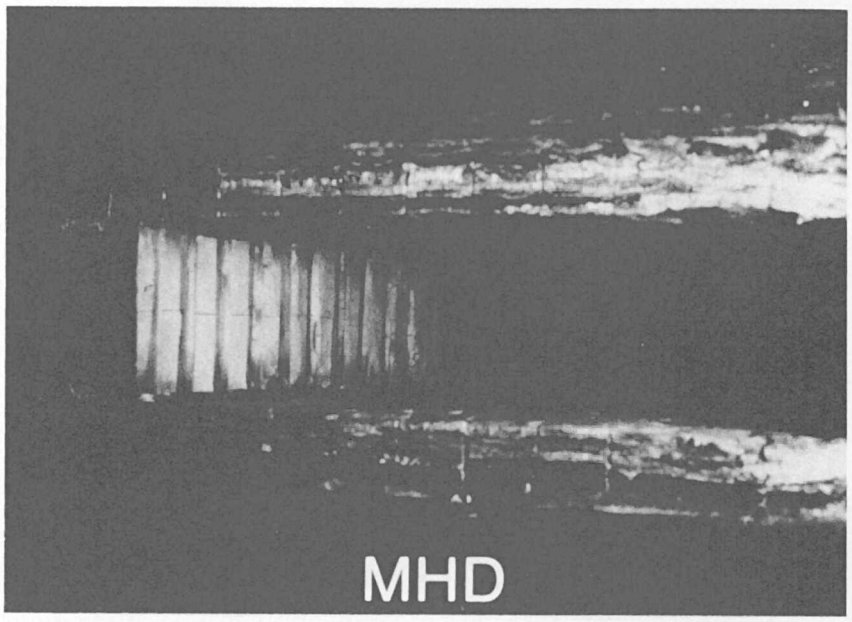
minimum of sulfur and no particulates. This gas can be used in combustion turbines, in conventional steam boilers, or in the manufacturing processes. It is expected that we can attain better than 90% thermal efficiency on the gasifying unit.

If the fuel gas is used in combined cycle plants (Slide 3.17), with combustion turbines in association with steam turbines, higher conversion efficiency can be obtained. We have not yet reached the upper inlet temperature limit of combustion turbines. Current models are in excess of 2000°F. With additional development work in our new blading materials and turbine design, it is not unreasonable to expect that inlet temperatures as high as 2600°F

Slide 3.17

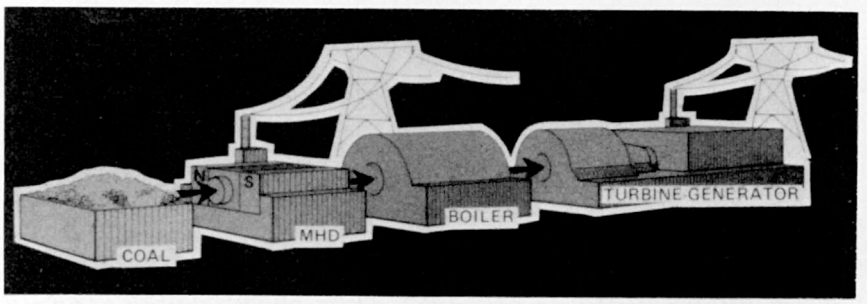
can be attained. This would give a combined cycle plant with a heat rate of around 7000 Btu per kilowatt hour. With a 10% loss in the gasifier, that would give an overall heat rate of less than 8000 Btu per hour. This is a substantial improvement over existing conventionally fired coal plants before we had the scrubbers.

A second path toward better utilization of coal is the development of the magnetohydrodynamic (MHD) plant (Slide 3.18). Substantial effort is under way, both here and in Russia, on the development of a workable MHD channel. However, the magnitude of



Slide 3.18

the present engineering problems requires a concentrated development effort. An MHD plant with a steam bottoming cycle will still have severe environmental impacts to overcome if coal is the prime fuel (Slide 3.19). It also requires at least two decades of engineering development to bring it to the demonstration plant stage. But its high thermal efficiency potential probably justifies continued development spending in the United States. The main thing to consider is that the United States, because of our present position in this technology plus our vast resources of coal, should not relinquish our position of leadership. Successful development will increase the efficiency of our use of our own resources and will provide a good competitive technology base for the export of plants to the developing world.



Slide 3.19

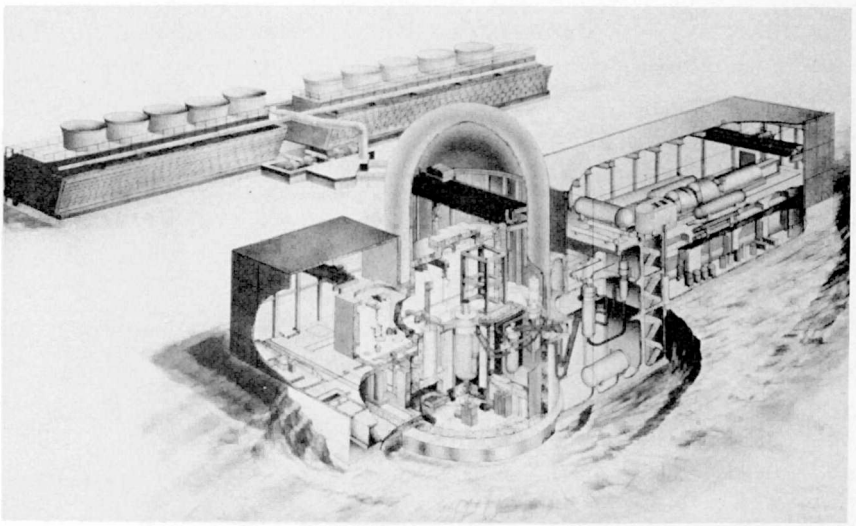
The second major energy source in the world is uranium (Slide 3.20). If it is utilized in a nuclear breeder, uranium is the largest single source of energy now available to mankind. In the United States alone, it is estimated that the energy resource available for using our uranium reserves in a breeder reactor will be at least a hundred thousand quads of energy. But this technology is not yet quite ready for the commercial market.

Most reactor development, both here and abroad, has been centered on the liquid metal fast breeder reactor (LMFBR) (Slide 3.21). The United States still has a commanding position in the fundamental technology of the LMFBR, but we have been inexcusably slow in translating the technology from the laboratory to a demonstration plant. Other

Advanced Energy Technologies

Coal	Uranium	Solar	Fusion
Lo BTU Gas + Combined Cycle	Liquid Metal Breeder		
MHD + Steam Cycle	Light Water Breeder		

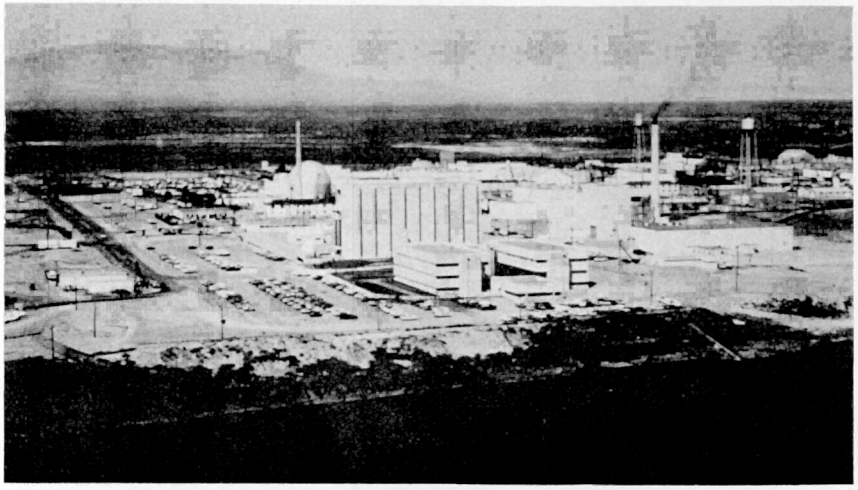
Slide 3.20



Slide 3.21

countries, such as England, France, and Russia, have large demonstration liquid metal breeders in operation (Slide 3.22). Their engineers are thus now in a position to identify and correct the real-world kind of problems with equipment design and operation that cannot be identified in the laboratory and the test facilities. In my view it will be a tragedy of the first magnitude if our country doesn't soon develop a policy that will permit the engineers to design, build, and operate demonstration-size breeder plants such as the Clinch River plant. It is true that the fast-flux facility at Hanford, Washington (Slide 3.23), which my company is building for the Department of Energy, will provide very valuable information on component performance, materials accountability, and fuel design compatibility. But we have learned from experience that the real gremlins don't show up until the hardware is built and operated on a system. If we continue to mark time in this country on the LMFBR, it won't be too long before the nations which are operating their breeders will replace us as technological leaders.

Slide 3.22

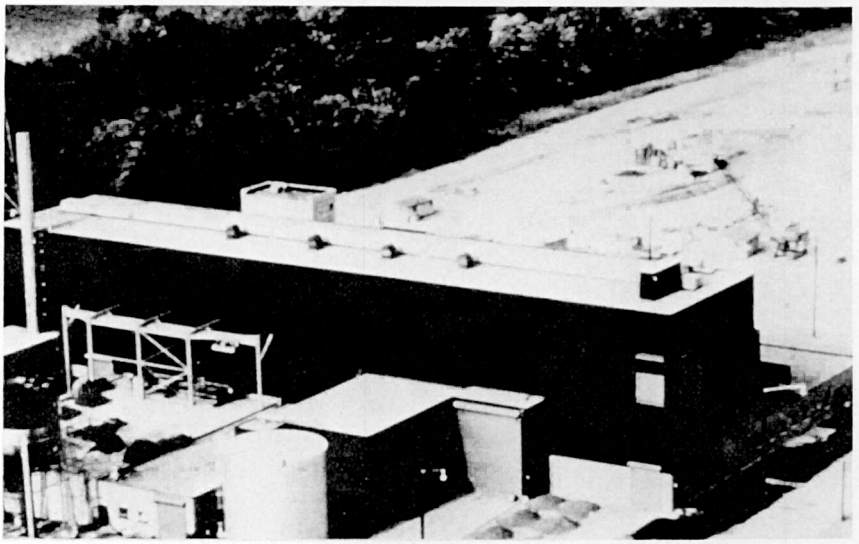


Slide 3.23

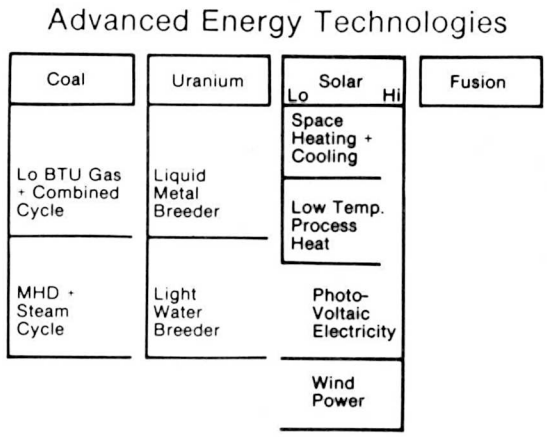
A second path open to us in breeder reactors is the light-water breeder now operating in Shippingport, Pennsylvania (Slide 3.24). This is a different type of breeder which uses thorium as the primary fuel. Experience currently being gained in the operation of this reactor should be beneficial to our country in its evaluation of thorium as a future energy resource.

The third energy alternative is solar energy (Slide 3.25), about which much has been written in the public press and technological journals. Solar is really a generic name, which covers several different energy forms. In my mind I divide solar into two categories. First, a diffuse, low-grade energy that can be used primarily in biological applications such as space heating. And second, electrical energy application for the low-grade solar energy, where it is upgraded to high-quality electrical energy.

Many of the developing nations in the sun belt of the world have solar energy as their only indigenous energy resource (Slide 3.26). Development of the applications of solar to



Slide 3.24



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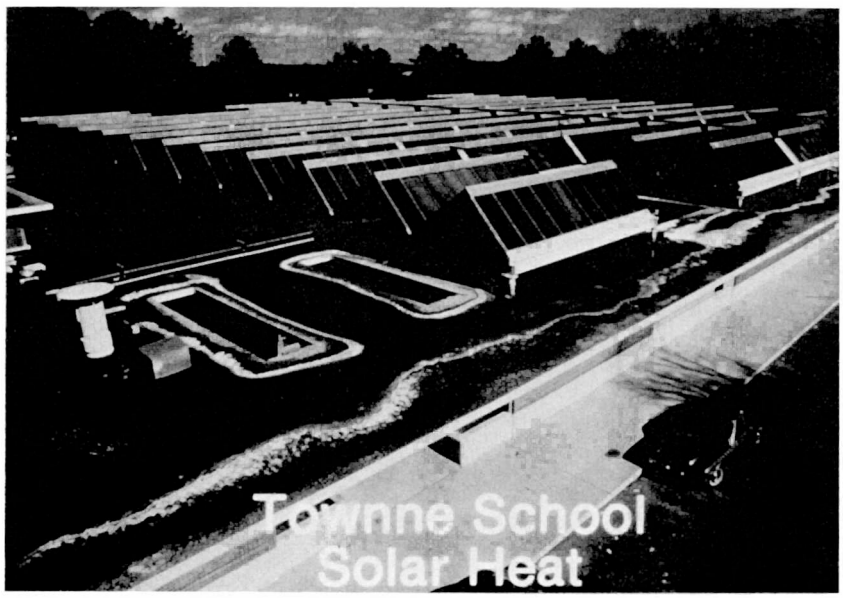
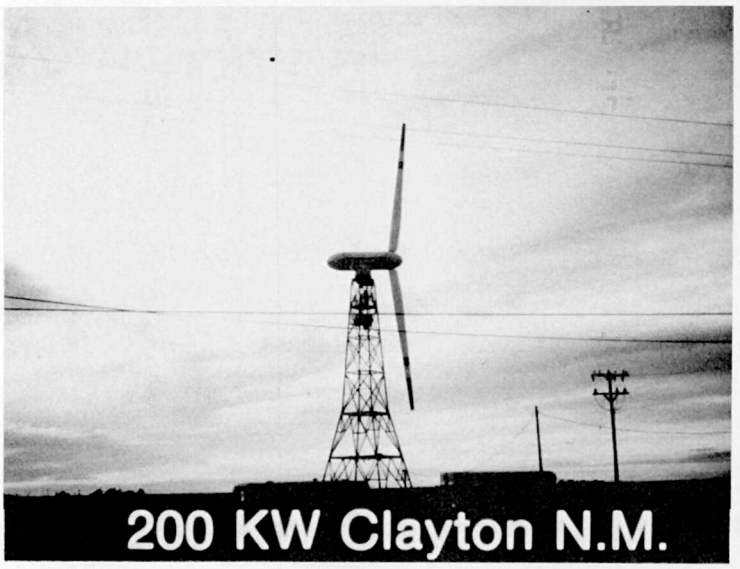


Slide 3.26

space heating, irrigation, water desalting, and other low-temperature applications will have a beneficial impact on their economies. But today the collector systems are too capital-intensive to be attractive. Significant cost reductions must be accomplished before this technology can be applied worldwide.

The economic advantages of upgrading solar energy to electricity are less obvious in the industrialized nations. Systems using windmills (Slide 3.27), photovoltaic conversions (Slide 3.28), or solar thermal electric are presently all much, much too capital-intensive to be attractive for power generation. But it is too early yet to render the final decision on solar energy. There may be an Edison or a Westinghouse out there who will produce the flash of genius and the invention to bring it to true commercial practicability for delivering electricity. Therefore, it is advisable for our nation to continue its strong thrust forward in developing solar energy.



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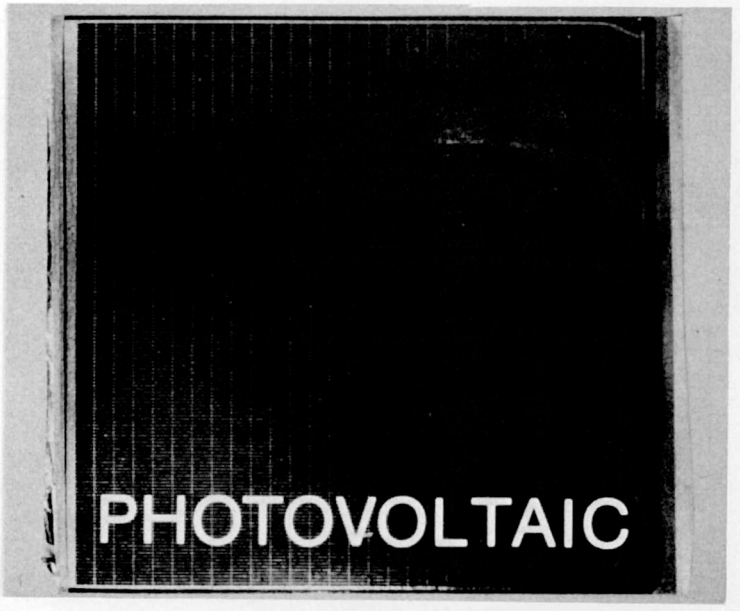
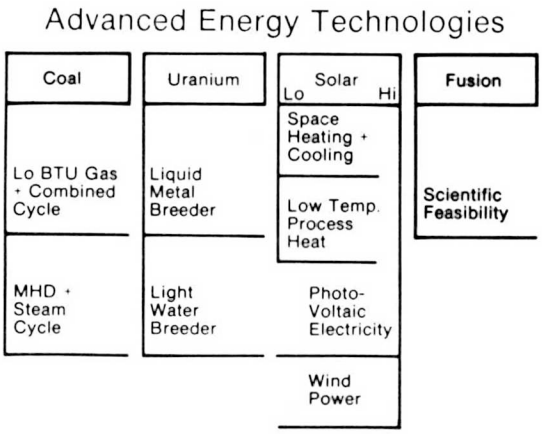


Slide 3.28

A fourth alternative energy source that should receive our attention is the development of the technology of fusion power (Slide 3.29). At the present time, fusion technology is still in the basic research stage both here and abroad. Several avenues are being explored, but the work is expensive and the results are agonizingly slow in materializing. Even though the time frame for the ultimate development of the fusion power is beyond the end of this century, the work has to be done so that the future generations of Americans will have the benefits of the fusion power available to them.

That ends my summary review of the areas that I think need attention for the United States to maintain its lead in energy technology.

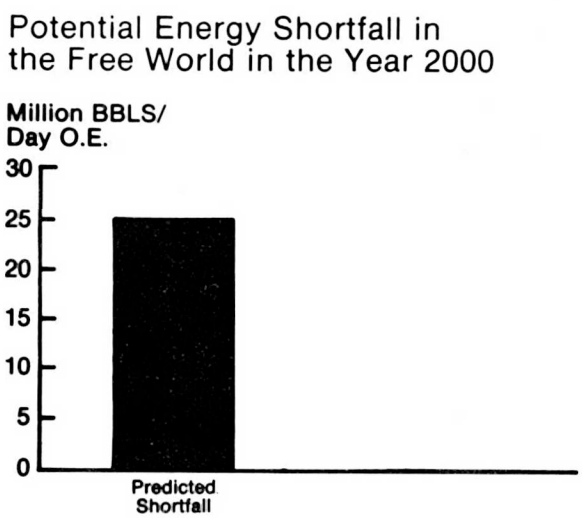


Slide 3.29

If we continue to spend substantial funds in energy development, what impact will these developments have on that potential free world energy shortfall of 25 million barrels per day oil equivalent? (Slide 3.30) This, of course, calls for a very subjective type of forecast. But based on the assumption that technological developments would be competitive among nations and that they would proceed unhampered by social unrest, one can reach some basic conclusions.

Improving coal burning techniques (Slide 3.31) would increase the efficiency of coal utilization by 12 to 15%. Maximum theoretical savings that could be attained if this technology was applied to all coal burned in the year 2000 would be 6 million barrels a day oil equivalent.

If the breeder reactor development is pursued vigorously (Slide 3.32), commercial breeder reactors could be on the line by 1990 and make some contribution by the year 2000.



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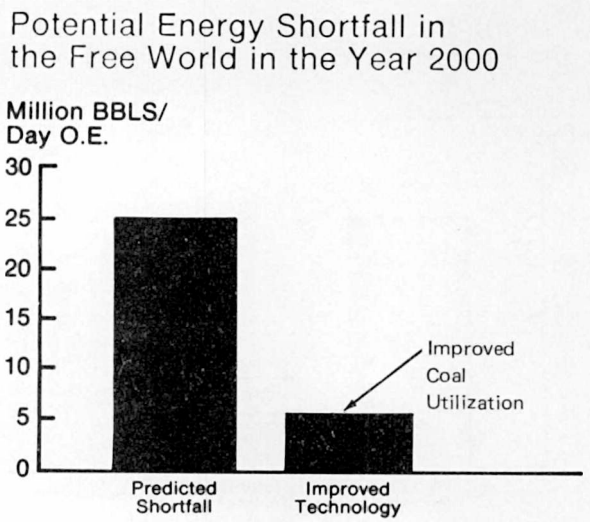

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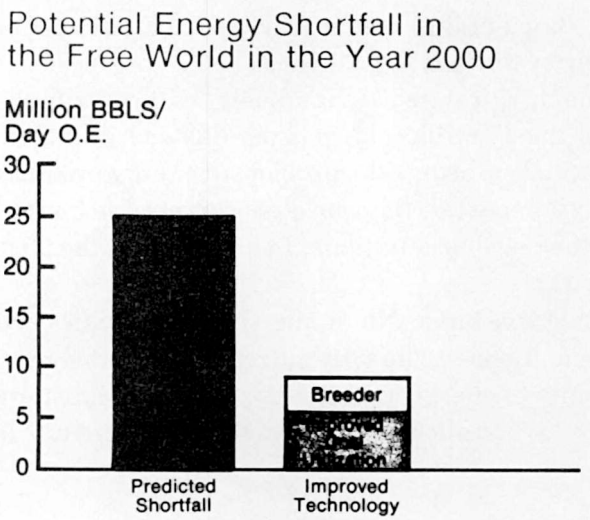
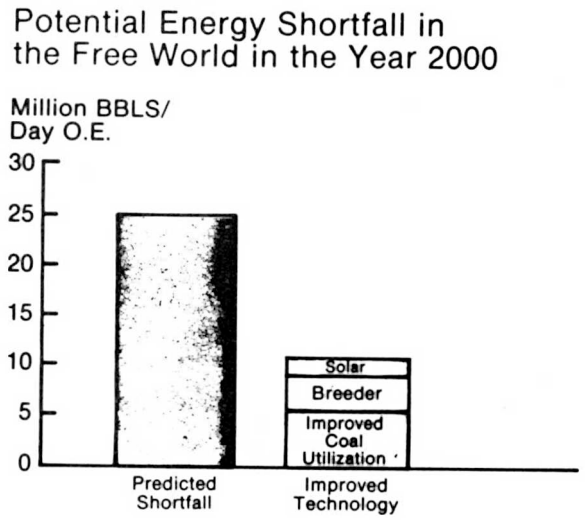


Slide 3.32

It is possible for the United States to meet this date. And since England, France, and Russia have operating prototypes, it is not unreasonable to assume that they will have commercial breeders on the line in this approximate time scale. An optimistic growth of the breeders starting in 1990 would add a hundred plants of one million kilowatts each by the year 2000 in the free world. This would be equal to 3 million barrels per day of oil equivalent.

Solar is much harder to predict (Slide 3.33) because of the probable diverse applications of solar energy throughout the world. The solar contribution may not be as large as popularly predicted. For example, over 40 million homes would have to be converted to solar heating to equal one million barrels per day oil equivalent. It would take over 300,000 windmills rated at 200 kilowatts each in order to equal one million barrels per day oil equivalent. In view of the present capital cost of equipment to utilize solar energy, I think it would be most optimistic to assign 2 million barrels per day equivalent to solar power by the turn of the century.

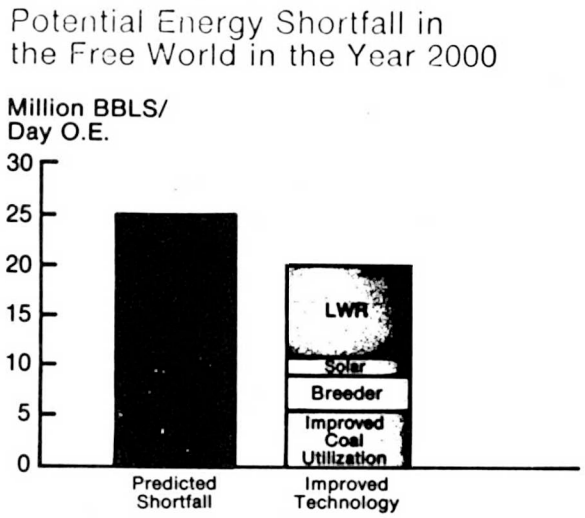


Slide 3.33

As I have already stated in the case for fusion power, no contribution of energy supply is expected from fusion in this century.

New energy technology, if pursued vigorously, will contribute 11 million barrels per day equivalent toward the 25 million barrels per day energy shortfall. This is a sobering conclusion in itself, because it brings the problem of energy production into sharper focus. You will recall that my forecast of the world energy need is based in part on zero energy growth per capital in the developed nations. In view of this the 25 million barrels per day shortfall is understated.

What other options do we have? Numerous scientific studies of energy supply have all produced the same basic themes. The only currently available raw energy sources which can supply large amounts of energy are uranium and coal. Substantially more light-water nuclear capacity could be installed and fueled than is currently forecast (Slide 3.34). If



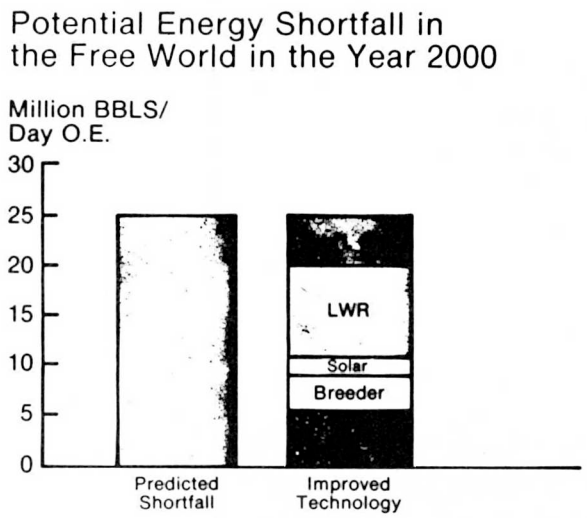
Slide 3.34

national policy in the free world were encouraging to nuclear power, it is not unreasonable to predict that an additional 300 gigawatts of capacity over and above the present predictions could be installed by the year 2000. This would amount to 9 million barrels per day equivalent.

The last option we have is to further increase the combustion of coal (Slide 3.35). It will require about 440 million tons of bituminous coal to close the gap of 5 million barrels per day oil equivalent. This is 12% more than the original prediction and will be difficult to attain. National policies will be required which encourage the mining and combustion of coal, and further efforts in improving the associated technologies are needed so it can be burned in an environmentally acceptable manner.

The lesson that this brief analysis can teach us is that conservation plus energy production are major problems confronting the world. Even to meet my very low energy demand forecast requires assumptions of conservation, technology, and social acceptance that may not be possible. What we do here in the United States about our own energy demands is far overshadowed by the energy demand created by that great population explosion in the developing nations and their thirst for the good life.

What is the impact of the international energy trends on the United States energy policy? (Slide 3.36) As I see it, it is desirable and imperative that our domestic energy policy



Slide 3.35

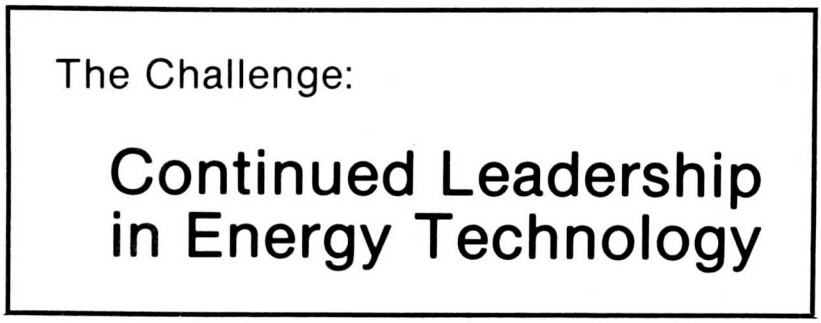
New Energy Technologies are Needed By:

1. **The Free World to Reduce Energy Shortage**
2. **The United States to Reduce Need for Imported Oil**
3. **The U.S. Economy to Provide an Export Market**

Slide 3.36

encourage, in addition to conservation, rapid progress in energy supply development and then the development of new energy technologies. The new energy technologies are needed by the free world to cope with the expected energy shortfall. They are needed by the United States to reduce our dependence on imported energy, and they provide jobs in the export market exporting our technology.

Leadership in energy technology is the challenge (Slide 3.37). I urge national policy implementations which will assure that this leadership remains in the United States. Thank you very much.



Slide 3.37

Mr. Kerlin: Any questions?

From the floor: What has happened to the potential for gas-cooled reactors for fast breeding?

Mr. Hurlbert: The leaders in the gas-cooled fast breeding reactors were the British. They have now opted to go with liquid metal. We have some minor work being done, primarily out on the West Coast, but around the world everybody is going to liquid metal at the present time. The Germans are now moving towards the liquid metal breeder, too.

From the floor: Can the U-233 from a thorium breeder be made less of a proliferation problem than the plutonium?

Mr. Hurlbert: Our judgment is that both can be handled. Both are dangerous, but with suitable safeguards both can be handled well. Both are dangerous materials, admittedly. I'd rather burn them up, though, than do anything else with them in a breeder, or in a burner reactor.

From the floor: You speculated on the per capita increase in energy consumption in the developing countries and it was a straight line projection. Is there any likelihood that it will taper off over the next 10 to 20 years? Has that been considered?

Mr. Hurlbert: Yes, the last six months' indication has shown the population rate tapering off in the developing countries. There is an unbelievable desire in most countries of the world—I don't know how much you travel, we get a third of our business outside the United States—to improve their standard of living, to feed their people better, to house them better, to clothe them better. If this were to continue as I have projected it, they'd still only be at a quarter of our level. I think that that part of it may be a little overstated. I think that the use in the United States and the Western world, though, may be even understated.

From the floor: What about the high-temperature gas-cooled reactor converter? Do you see any future for this?

Mr. Hurlbert: As you know, there is one operating at Fort St. Vrain in Colorado. There is only limited development work being done at the present time. The British are seriously considering leaving any type of a gas-cooled reactor and going, hopefully, with the Westinghouse boiling-water reactor (BWR). But development of any reliable reactor would cost billions of dollars. We are on a learning curve and we have built some. We have got experience. We have got cost reduction. And it's hard for me to see how any reactor could be developed and be competitive with one that's got a headstart on it like the light-water reactor. But the answer is, I really don't know.

From the floor: Would you care to give your personal speculation concerning the effect on the carbon dioxide problem of meeting future energy demands by expanding coal utilization?

Mr. Hurlbert: The answer to that is I just don't know. I don't think that there is enough data to indicate whether it is a problem or whether it's not a problem. I have asked our scientists to look at that. There seems to be so much diverse opinion that I don't think anybody knows whether there's going to be a carbon dioxide effect, a greenhouse effect, in this country.

Thank you very much. You were an excellent audience.

4. Energy Research and Development Prospects

Eric H. Willis, *Acting Deputy Assistant Secretary for Energy Technology, Department of Energy*

Mr. Kerlin: Good afternoon. I'd like to continue now with the discussion by Dr. Eric Willis. Dr. Willis is Acting Deputy Assistant Secretary for Energy Technology with DOE. He is from England, educated in England. He has served, before coming to DOE, at the University of Cambridge, in the British Navy, and in the U.S. Department of Defense. Dr. Willis will speak to us today on "Energy Research and Development Prospects." Dr. Willis.

Eric H. Willis: Good afternoon, ladies and gentlemen.

I'd like to spend a few minutes this afternoon just going over the current status of the R&D effort of DOE, how we feel we are placed. I have had an opportunity to have a look at this because I have had to do quite a lot of testifying before Congress in support of the fiscal 1979 budget. We are currently going through the authorization in both the House and the Senate and then we turn our attention to the appropriations. In case anybody here doesn't know the difference between authorization and appropriations, authorization is like having your checks printed and appropriations is like having the money put in the bank so you can write those checks. So when you see lots of money going into authorizations, just remember there's the other side of the coin. Somebody has got to put the money in the bank and that's the appropriations people.

Before Christmas, I had the opportunity of visiting the Soviet Union and, in the company of Deputy Secretary O'Leary, I met with the ministers of oil, power, gas, and coal. They were as conscious of their energy problems as we are of ours. They perceive the need to conserve. At the same time, they project an overall energy demand rise of between 4 and 6% per year, with a concomitant attention to planning on the supply side. By contrast, our objective, as stated in the National Energy Plan, is to reduce our annual rate of growth of energy consumption to 2%, approximately, by the year 1985.

There are striking similarities between the situations confronting the two countries. They both have large reserves of coal in areas remote from the population centers where the need lies. Both have dwindling supplies of oil and gas in the more accessible regions and are having to resort to the inhospitable and the remote areas for additional supplies. Which means, of course, that it costs more.

The Russians seem to be prepared to take extraordinary measures to solve their problems. These measures include the wheeling of power, electric power, 2400 kilometers from power station complexes called energy centers—co-located with the vast open-mine coal deposits that they have, such as that at Ekibastuz—to the industrial centers of European Russia. And they study our mistakes very carefully. Nowhere are the causes of the New York blackout more thoroughly analyzed than in Russia. So much for advanced

technology. The overall impression was not only that they had the capacity to solve their problems, but that they had the will to get going with the job. And here we see the stark contrasts as well as the similarities between the two social systems.

The will to get going—this is the key ingredient noticeably absent from some of our current debates. In a monolithic system, such as the Soviets have, decisions can be made without regard to the democratic process of checks and balances which we feel are the strength of our republic. There is debate, to be sure, amongst the Soviet leadership, and we came up against that. But the public does not get involved. The Soviets are thus able to achieve great successes, and equally monumental failures. (And we should not forget the latter possibility in a monolithic system.)

Our problem then is to focus the will of the American people on a problem that some maintain is a total fiction—they believe there is no problem. Others maintain it can be solved by concentrating on large numbers of dispersed systems fueled by solar, wind, and other renewables. Others maintain that free market forces alone will do the job—that is, everything will be all right if the price is right. Others are wanting more regulation and even rationing. Still others are looking for the technological fix which will somehow provide salvation. We must hope that these sometimes (and indeed often) divergent viewpoints can be woven into a consensus which will prove more enduring than the decisions made by a monolithic society. Indeed, it isn't just our hope—it's our duty to work for it.

Clearly, the National Energy Plan of last April attempted to inhibit consumption by conservation and regulatory measures. That is probably history by now to most of you. However, Secretary Schlesinger has indicated, in testimony before the House Science and Technology Committee on January 25, that a Phase II of the National Energy Plan, this time focusing on supply, will be forthcoming in about 90 days. And they are very busy working on that at the moment.

The Secretary also noted that our most critical short-term need is to lessen our dependence on increasingly costly and unreliable foreign sources of oil. The "costly" and the "unreliable" are key words. It is becoming increasingly clear that the current supply/demand relationship for petroleum will change in the near future, with a significant cost increase possible when the current world demand starts exceeding the present excess supply. This could conceivably happen in the 1982-85 time frame. This, in turn, would further aggravate our international position, particularly as it relates to the balance of payments. And even a $2 trillion gross national product is not immune to Mr. Macawber's dictum that even the slightest amount of expenditure over income leads, as he put it, to "abject misery." (And those familiar with Charles Dickens will recognize Mr. Macawber.)

In view of these and other factors, the President has committed this nation to reducing oil imports below 6 million barrels a day by 1985. This compares with an estimated 16 million barrels per day if current trends were to persist.

Now, somebody in the audience—probably with an advanced-technology digital hand calculator—will have already figured out that somehow or other we have to come up with the equivalent of 10 million barrels of oil per day in that time frame. We can get it either through conservation, through increased domestic oil production, through substitution of coal for oil and natural gas, or through such use of the so-called renewable fuels as we can get. And clearly, those of us who are research managers have an obligation to accelerate

and inject into the market whatever technologies can be brought to fruition in this time period.

We can't have our gaze completely on the wild blue yonder when there is a yawning chasm at our feet. Make no mistake, it's there. At the same time, it must be recognized, I think, that the principal mechanisms which must be implemented to counter the incipient 1985 situation are not technological in nature. This fact is reflected by much of the content of the National Energy Acts legislation currently before Congress.

Obviously, conservation must be pressed very hard indeed, and all forms of near-term alternative energy sources must be employed to their every limit. We have to make every Btu count. It would, however, be dangerous, in my view, to count upon any extraordinary technological breakthroughs to solve our 1985 situation. Now, what happens beyond that time is quite another question; and we have to ensure that our long-term commitment to research and development is not sidetracked by the exigencies of the moment. Our principal job is not just to research technologies in the sandbox, but to make things happen. Now, you have every right at this point to ask me how the Department of Energy stands on the R&D issues. And I will do my best in a few minutes to be equal to that task.

Let me deal with a few specifics, starting with the fossil energy program. (Zeke Clark will be speaking more about that later on.) Number one priority in this area is clearly the development of technologies aimed at overcoming the constraints on increasing the production and use of coal. This includes the solvent refining of coal; the fluidized-bed combustion; and low, medium, and high Btu gasification. These are all elements of a program aimed primarily at improving the environmental acceptability of coal utilization. About $177 million is projected in the fiscal 1979 budget on near-term projects emphasizing the direct use of coal, and nearly all of this is driven by environmental considerations. I find it somewhat ironic, however, that even if we remove every noxious molecule by these processes, the carbon dioxide problem may prove the most intractable of all. And of that we know relatively little.

The liquids problem, basic to our transportation, must also be addressed. An answer could come either from coal or from other sources such as shale and enhanced recovery. One of the really basic R&D problems, I think, lies in alternatives in the transportation sector. What have we got? Electric cars are essentially limited to the charge density of batteries, the charge and discharge rate, and the life cycle. Until one can pull up at a service station and obtain a recharge in the same time frame as for filling a gas tank, the electric car can only have a marginal impact on our land-based transportation liquid fuel consumption. I consider improved battery storage as a major item to be tackled; I don't think we know nearly enough about basic electrochemistry.

The Department's overall policy on nuclear energy, simply stated, is that the increased deployment of civilian nuclear power is absolutely essential. I state that because often it's stated to the contrary. The National Energy Plan endorses the present generation of nuclear technology, that is, the light-water reactor operating on a once-through cycle. In addition, advanced nuclear options must be made available so that these developing systems can be utilized if and when it is determined that their deployment is consistent with our national objectives. In this area, waste disposal, reactor safety, and proliferation are serious factors to be reckoned with. We have to face an unpalatable truth—maybe not in this room but in other parts of our country —that society is tending to back away from the unrestrained use of nuclear power. And the nagging uncertainties of radioactive waste for posterity are difficult to assuage.

One of the recent realizations of our age is that the latent time for negative effects of technology—on biological systems, that is—is long compared with the normal time scale of traditional experimental and observational science. This has been particularly true of seemingly innocuous food additives that later turn out to be carcinogens. I mean who'd have thought, for instance, that people using saccharin in the fifties for their diets, keeping in good health, might be laying themselves open to cancer in the seventies? Hence a technology is no longer held to be innocuous by the absence of immediate deleterious effects. And society appears to have shifted the burden of proof to the introducer of the technology to show that no harm will ensue.

Since most of us in this room know that it's difficult or impossible to produce such proof, we are living in a world which presumes guilt rather than innocence. Thus nuclear waste, reactor safety, and the question of proliferation will continue to inhibit the social acceptance of nuclear energy. I believe the controversy surrounding the proposed California Sundesert nuclear power plant to some degree reflects this view. There is no question, then, but that the timely resolution of the radioactive waste issue bears a clear and unambiguous relationship to the future development of civilian nuclear power within the United States. By like token it must receive, and is receiving, our first priority.

The second area of emphasis is in light-water reactor (LWR) technology development aimed at fostering improvements in both productivity and uranium utilization. For example, the program contemplates achieving a 3% net improvement in LWR availability by the year 1985. This program is within the framework of DOE's intent to improve the productivity and reliability of both nuclear- and fossil-fueled generating facilities. In advanced technology, the liquid metal fast breeder reactor program is, and will remain, viable. In this respect it's sometimes confusing when one thinks about the Clinch River Breeder Reactor and equates it with the whole program. In actual fact, between $300 million and $400 million is going out this year on the breeder program. The current budget requests now before Congress, however, are predicated upon the cancellation of the Clinch River project, and we will just have to wait to see what present legislation brings us. Work on the fast-flux test facility will continue, as will the related efforts on fuels components and safety research and its development.

I would like to dwell for a moment upon the so-called renewable resources, particularly solar. The popular conception of solar energy tends somewhat to be euphoric. However, we must recognize that the problems of introducing solar energy as a way of life are again not merely technological ones, but ones that involve socioeconomic, lifestyle, societal, and institutional phenomena, many of which we ought to acknowledge are not fully understood. There is a distinct danger that we may be translating "Great Expectations" into "Much Ado About Nothing," and that would do our nation a great disservice if it were to happen.

The principal barrier in the way of stimulating a demand pull for solar dispersed systems is cost reduction, although we are getting increasingly optimistic about photovoltaics. At the moment there is barely an "exotic market," when what we need is a "popular market" if the quad impact we are seeking is to be realized. But mere cost reduction does not of itself assure a market. It's not good enough for the price to be right. There are other critical factors in market penetration that must be tackled, and one of the virtues of the Department of Energy should be that its wide perspective can address these issues.

By way of illustration, I recently helped to dedicate a windmill at Clayton, New Mexico. We have, in truth, not faced up to the implications of the widespread use of such systems as

the windmill. The windmill in Clayton, at 200 kilowatts, is supplying 35 to 60 homes. We don't know how their management will operate, what their relationship to utilities will be, their capitalization, and the major social adjustments needed when consumers (consumers used to pointing at the big *they*) suddenly become owner/operators of a multitude of small cooperatives. It's a big change when you have been used to blaming somebody else and you have to fix your own windmill in the middle of the night.

On the solar central power sources, the 10-megawatt power tower at Barstow, California, is now getting under way. A little further away perhaps is the ocean thermal concept (OTEC). And potential obstacles such as heat exchangers and biofueling seem now to be much more tractable than we thought. That wouldn't affect places like Tennessee, but it could be of great value to island economies such as Hawaii and Puerto Rico, where fuels are extremely expensive.

The aerospace community, almost to a man, embraces the scintillating idea (quite literally) of the space power station. For the few unfortunates present who have not been tantalized by this tempting morsel, let me explain that this concept envisions solar collectors, 7 kilometers on a square, in synchronous orbit, beaming the power back to earth by microwave radiation to inject it into the nation's energy grid via a ground antenna. You can imagine this poses some problems of its own. We are presently studying the various ramifications of this concept with NASA, and we hope to reach an assessment point to determine the pace for further action by the middle of 1980.

Here indeed is some room for imaginative risk taking and foresight, particularly on the part of the aerospace community. But here again, as distinct from the traditional space program, there are new elements to consider. The traditional space program only relates to the general public as a spectacular entertainment, the benefits of Telstar notwithstanding. One factor with the space power station will be that it will have to prove competitive in the open market. Secondly, it will have to be environmentally, institutionally, and internationally acceptable. We have all heard those words before. That means we have to look very carefully for potential problems and solve them before they arise. I feel that the strictures which apply to nuclear today may well be applied to the space power station tomorrow.

As for the future (though it is very much alive today), there is the fusion energy program. We are progressing on two fronts on that: magnetic and inertial confinements. There are other, possibly nearer-term, uses of fusion, including the production of fissile material to extend the lifetime of our thermal fission reactors and the production of hydrogen to provide liquid and gaseous fuels from coal. We have been successful thus far in obtaining funding and support for these programs. But don't take this support for granted. To sustain this level of support and enthusiasm for 20 years before commercial payoff will prove a challenge to management creativity and advocacy of the highest order.

Bob Seamans used to impress upon me that one of the greatest achievements of Jim Webb (who ran NASA) was his ability to demonstrate to the American people a convincing series of achievements on the road to success. He did this by a succession of Mercury capsules and Gemini and the Apollo program, until he finally got on the moon. People assumed it was nice smooth sailing from one end to the other. On the contrary, he had quite a bit of trouble sustaining that support and enthusiasm, because people started to get a little bored with it and the expense was getting high by the end of the Apollo program. Somehow we have to find a similar analog in energy for our rather expensive long-term research.

All this comes back to the national will—the will to tackle the near-term problems, which as I have said are largely nontechnical, at the same time that we continue to support the long-term research so vital for the future, which is usually extremely technical. It's this balance that we are striving for at the Department of Energy in energy technologies. And we count on this community to be a major force in assisting in the resolution of our national problems. But the most important ingredient of all is a focused national will.

There's a quotation I used to remember from Omar Khayyam, which says:

> The Moving Finger writes; and, having writ,
> Moves on: nor all your Piety nor Wit
> Shall lure it back to cancel half a Line,
> Nor all your Tears wash out a Word of it.

So, time is marching on. And let not history write our epithet as the generation who gave up on it. Thank you very much.

Mr. Kerlin: Questions?

From the floor: I realize that your reference to electric cars, for instance, is a very small part of the transportation picture, which again is not a great part of the national energy problem. However, do you really feel that electric cars, to be feasible, have to have a recharging time in minutes rather than hours? It would seem to me that since most cars in use today spend anywhere from 8 to 18 hours doing nothing, sitting around, that at least the problem of fast recharge isn't a problem for electric cars.

Dr. Willis: I think that's quite a good point. However, if you are on the open road and you are going any distance at all, you will soon run out of your endurance and you would be in a very bad situation if every 250 miles or so you are constrained to stop for 18 hours to get the car back on the road again. And I think for hauling and things like that we have really got to get a system (and it could be done) where you can get a very fast recharge and the concomitant part, a very fast discharge. That is a difficult trick to accomplish.

From the floor: I'm wondering what is the Department of Energy doing for railroads? In other words, are we going to see the steam locomotive come back or are we going to electrify all the railroads to replace the diesel engines?

Dr. Willis: I'm not going to duck that question. I'll give it to the Department of Transportation. I don't know. It's a good question. Certainly if coal has got to be moved by quantities and distances, some form of rejuvenation for the railroads will be called for. In New England, for instance, the bulk of the railroad network has been torn up. In fact, I'm not certain it's possible to go above Boston in a railroad today. New Englanders will correct me, but it's not possible to go far, anyway.

From the floor: Has the Department of Energy considered sponsoring prime-time TV dramatic programs of the "Towering Inferno" variety which would demonstrate what will happen in 1985-1990 if we do not acquire the national will?

Dr. Willis: It has considered quite a lot of public communication of that sort, not necessarily "Towering Inferno." I think we're in an awful danger if we do that sort of thing, though, because when you cry wolf and nothing happens the next day and life goes on just as it was, you tend to devalue your credibility. I heard that sort of criticism after the National Energy Plan came out.

I think our problem is a very subtle one. Somebody said it had been done, the 1973 embargo had been overcome without any pain to the nation. I don't think that's true. I think there was considerable pain to the nation. The trouble was we are all anesthetized, and we

are anesthetized by a slow, progressive disease. The problem is how to tell people that this is not a sudden, acute illness, but a chronic one. Either curtailments or a severe dose of a two by four to the pocketbook will probably be the only way of really getting people's attention. Maybe like the story of the donkey.

From the floor: I don't know whether it is true or not, but I read in the paper a Harris poll result that said 48% of the polled Americans did not know we even import oil and 38% of the college-educated people did not know that we import oil. Also, to make conservation measures work, I think we need to let automotive fuels rise to the price of a dollar gallon. When people ask why, tell them it's because we're running out.

Dr. Willis: Well, that has been suggested in some quarters. That's why I was saying some people want regulatory measures and rationing. We do live in a free economy, a free-enterprise economy, and there's a very delicate balance in our society between government regulation and private enterprise. I think if the government comes down with too heavy a stick it can be counterproductive. On the other hand, what is good for the private individual is not necessarily good for the country as a whole. For instance, if I were running an oil company, I would feel it incumbent upon me to get the best return on my stockholders' equity that I possibly could. Which means I would buy oil from whence I could and sell it to who I could, even if it meant buying it overseas.

Now, that may not be commensurate with the national well-being. We are now finding a situation where we're looking at what is happening with the free-market economy and then trying to equate that with what is good or not good for the nation. It's a very difficult one to put over. And I agree with you, people are totally ignorant despite the fact that it comes on the news nearly every night that there is a problem.

Indeed, to exacerbate the problem, we have at present a world surplus of oil. Now, the OPEC countries are not just being nice to us, as they were a few months ago, by not raising the price of oil. It isn't because they like us and want to be nice. It's because there's a world surplus at the moment and they can't jack up the price right now. But the minute we go beyond a world surplus to an excessive demand that price will go up. That's when the crunch will come. Whether we should artificially jack up the price before that is a very difficult question. You can see the the reaction to the National Energy Plan where there was a proposal to do something like that; it was thumbs down all the way along. Very difficult.

From the floor: Did I understand you to say that there was another part of the energy package being prepared?

Dr. Willis: Yes, sir.

From the floor: Dealing with the supply?

Dr. Willis: Correct. It should be out about 90 days from January. I suppose that would be round about the end of April.

From the floor: Will this be a part of the present discussion that's going on now?

Dr. Willis: Yes, it will be a continuation of that, but in the supply area.

From the floor: This country is so diversified and there are so many different lifestyles. Don't you think it's wrong to impose one major energy package on the whole country as opposed to an individualized section, so to speak?

Dr. Willis: No, not really. We have a national problem which has to be addressed as a package. We are a nation which imports and just like any family the nation has its balance of accounts. And, therefore, the corrective measures have to be applied to the whole family; you cannot selectively pick out some people for more astringent measures than others.

Indeed, there are different lifestyles, and we have to tailor the remedies to those particular lifestyles. The sun belt people will probably use more solar energy, for instance, than those who live in Maine. But, otherwise, we have in our democracy to be extremely even-handed in the way we deal with different regions of the country.

Mr. Kerlin: Thank you very much.

5. The Role of Energy Management in Meeting Energy Needs in the Tennessee Valley Region

William T. Snyder, ***Professor and Head, Department of Engineering Science and Mechanics, University of Tennessee at Knoxville***

Mr. Kerlin: Our next paper is our first departure from the printed schedule. Dr. Bill Snyder, from the University of Tennessee, where he is head of the Department of Engineering Science and Mechanics, will speak to us now. In addition to his duties in the administrative and educational areas, Dr. Snyder has found time to get involved in research projects and demonstration projects in the energy management area. So, his topic for our talk this afternoon is "The Role of Energy Management in Meeting the Energy Needs of the Tennessee Valley Region." Bill.

William T. Snyder: During the past few years, the term energy management has received widespread use. It is important to relate the term energy management to the general concept of management without a descriptive modifier. The term management is used in a dual manner to refer to a group of individuals within an organization with power and the responsibility for making day-to-day as well as long-range decisions, and to refer to a process which may be broadly defined as follows: Management is the art and science of directing human effort.[1]

The traditional definition of resources to be managed in performing an economically desirable industrial function includes land, labor, capital, and raw materials. To this classical list of resources to be managed must now be added energy as a resource coequal with the four classical resources.

Although energy conservation is a concept which plays a central role in energy management, the concept of energy management has broader implications than energy conservation. Schipper[2] has defined energy conservation as follows:

> Energy conservation is the strategy of adjusting and optimizing energy-using systems and procedures so as to reduce energy requirements per unit of output (or "well-being") while holding constant or reducing total costs of providing the output from these systems.

1. Philip E. Hicks, *Introduction to Industrial Engineering and Management Science*, McGraw Hill, New York, 1978.
2. Lee Schipper, "Raising the Productivity of Energy Utilization," *Annual Review of Energy*, vol. 1, 1976.

Aspects of energy management not included in the definition of energy conservation are availability and cost of energy forms, substitution of energy forms, energy demand, developing procedures and methodologies for analyzing and monitoring energy consumption, and developing a contingency plan to cope with energy curtailment.

Historical Energy Management Disincentives

Although it is widely perceived that energy management is an idea whose time has come, it should be noted that in many energy-intensive industries the concept of energy management is not new. For example, the Du Pont Corporation formally recognized the need for energy management in 1903 by establishing the heat, light, and power group within their corporate engineering department.

The energy-intensive nature of the U.S. economy has its roots in historically cheap and abundant fuel supplies. The total energy consumption of the U.S. has increased from 30 quads in 1946 (1 quad = 10^{15} Btu) to over 75 quads in 1976, a rate of increase much greater than the rate of increase of population. Through much of this 30-year period, energy prices relative to the prices of other goods actually declined. There was therefore little incentive to take account of energy consumption and cost. Joseph C. Delibert of Babcock and Wilcox was quoted recently in the *Wall Street Journal*[3] as saying:

> Before supplies started to get expensive, it frankly didn't pay to save gas ... At the bottom line it has been a matter of dollars and cents.

Coupled with the historical low costs of energy was the perception that our energy resources were virtually limitless. Insufficient attention was devoted to the problem of energy shortages prior to the 1973 oil embargo. There has also been until recently an absence of information and understanding of the potential benefits to be derived from energy management, with a tendency to equate energy conservation with deprivation and reduced standard of living. A typical viewpoint, expressed as recently as 1972, is contained in a publication of the Chase Manhattan Bank[4] which states:

> Analysis of the uses of energy reveals little scope for major reduction without harm to the nation's economy and its standard of living. The great bulk of the energy is utilized for essential purposes—as much as two-thirds is for business related reasons. And most of the remaining third serves essential private needs. Conceivably, the use of energy for such recreational purposes as vacation travel and the viewing of television might be reduced—but not without widespread economic and political repercussions. There are some minor uses of energy that could be regarded as strictly non-essential—but their elimination would not permit any significant savings.

3. "Pragmatic Planners: Firms Put Off Energy Steps Pending U.S. Action," *Wall Street Journal*, May 26, 1977.

4. Chase Manhattan Bank, "Energy Outlook in the United States to 1985," Chase Manhattan Bank, New York, 1972.

During the past four or five years, however, a broad base of opinion and supporting documentation[5-14] has emerged to indicate that a large potential for energy conservation exists through effective energy management.

Elements of Energy Management

Recognizing energy as a coequal resource to be managed along with land, labor, capital, and raw materials suggests that the key elements of energy management will be the same as the elements involved in the management of other resources. Several elements that must be present in a successful energy management program may be listed as follows:

1. Commitment of Management. The most important element in a successful energy management program is to have the commitment of management personnel within the firm. This commitment must flow from the highest level of management and must include a commitment of the necessary personnel, time, and funding to carry out a successful program.

2. Assignment of Program Responsibility. The planning and implementation of an energy management program must be the clearly defined responsibility of one individual who has access to and responsibility to top management within the firm. This individual should be given an appropriate title such as Energy Management Coordinator and should be located on an organization chart in a manner which shows unambiguously his or her direct access to the top management person within the firm. The role of the Energy Management Coordinator is to develop and implement an energy management program to achieve prescribed energy use goals. Depending on the size of the firm, it may be desirable to establish an Energy Management Committee to assist the Energy Management Coordinator. It is essential, however, that accountability and responsibility for the program be vested in one individual and not in a committee. It may also be desirable and necessary to acquire the services of an outside professionally trained energy management consultant to assist the Energy Management Coordinator.

3. Establishment of a Reliable Information Data Base. Making correct energy management decisions requires the availability of a reliable energy information data base.

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5. Office of Emergency Preparedness, "Potential for Energy Conservation," U.S. Government Printing Office, Washington, D.C., 1972.

6. Shell Oil Company, "Energy Conservation Potentials," Shell Oil, Houston, Texas, 1973.

7. E. Kovach, Ed., "Technology of Efficient Energy Utilization," Scientific Affairs Division, NATO, Brussels, Belgium, 1974.

8. D. Large, "Hidden Waste," Conservation Foundation, Washington, D.C., 1973.

9. U.S. House of Representatives, Subcommittee on Science and Astronautics, "Conservation and Efficient Use of Energy," Pts. 1-4, U.S. Government Printing Office, Washington, D.C., May 1974.

10. U.S. Senate, Committee on Interior and Insular Affairs, "Energy Conservation and S 2176," U.S. Government Printing Office, Washington, D.C., August 1973.

11. U.S. Senate, Committee on Commerce, "Energy Waste and Energy Efficiency in Industrial and Commercial Activities," U.S. Goverment Printing Office, Washington, D.C., May-June 1974; also U.S. Senate, Committee on Commerce, "Industry Efforts in Energy Conservation," U.S. Government Printing Office, Washington, D.C., October 1974.

12. Ford Foundation, Energy Policy Project, "A Time to Choose: America's Energy Future," Ballinger Publishing Co., Cambridge, Mass., 1974.

13. L. Schipper, "Energy Conservation: Its Nature, Hidden Benefits, Hidden Barriers," Report No. LBL 3295, Lawrence Berkeley Laboratory, Berkeley, Calif., 1975. Also "Energy Communications," in press.

14. L. Schipper, "Efficient Energy Use," Report No. ERG-75-08, Energy and Resources Group, Univ. of Calif., Berkeley, 1975.

This data base must be internal as well as external to the fullest extent possible. The internal data base involves knowledge about the use of energy within the firm, whereas the external data base involves knowledge about energy use in general, current and future availability, costs of various forms of energy, and knowledge about available energy conservation technology.

The importance of information in effective energy management cannot be overstressed. This idea is expressed in Harvard sociologist Daniel Bell's "post-industrial society":[15]

> A post-industrial society is basically an information society . . . The basic resource of the post-industrial society becomes theoretical knowledge, just as the strategic resource of the industrial society is money capital, and the strategic resource of a pre-industrial society is raw material. Thus, just as capital and labor frame the problems of an industrial society, so information and knowledge frame the problems of a post-industrial society.

4. Conducting an Energy Audit. One of the most important processes involved in establishing a reliable information data base is the energy audit. The energy audit consists of two phases: the billing audit and the field audit. The billing audit involves an analysis of historical energy consumption patterns and the determination of energy use by function within a facility. An appropriate energy use performance factor must be defined, such as energy consumption per unit of production, per unit of gross sales, per dollar value added in manufacturing for an industrial facility, or annual energy consumption per square foot of usable floor area in a commercial or institutional facility. The field audit involves a walk-through inspection of a facility making observations and measurements to identify promising energy conservation opportunities (ECOs) and cost savings opportunities (CSOs).

5. Identification and Analysis of Potential Energy Conservation Opportunities. The walk-through part of the audit process is essential to observe energy consuming processes and facilities first-hand and identify potential ECOs. Each potential ECO should be analyzed with respect to projected annual energy savings, annual energy cost savings at current and projected future energy costs, and an appropriate financial analysis giving return on investment and/or discounted payback period for the capital expenditure required to implement the action. Several types of financial analyses are available for analyzing capital investments. The particular type to be used will depend on traditional financial practices of the firm. In any event, a financial analysis procedure should be used which takes into account the time value of money, that is, interest.

ECOs can be conveniently divided into three categories as follows:

1. ECOs involving primarily procedural changes with little or no capital investment required;
2. ECOs involving modification of existing equipment or the installation of new equipment using currently available "off-the-shelf" hardware and know-how; and
3. ECOs involving longer-range research and development resulting in fundamental changes in process development.

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15. Daniel Bell, *Physics Today*, p. 46, February 1976.

Professional engineering consulting firms can be a valuable resource to those firms with a limited in-house engineering capability in carrying out detailed design, economic analysis, and installation of equipment changes which will result in a reduction of energy consumption per unit of productivity occurring within the firm.

6. Establishing Goals, Implementing Programs to Achieve the Goals, and Monitoring Results. After identifying potential ECOs, realistic energy conservation goals should be established, programs necessary to achieve the goals should be defined and implemented, and procedures should be established for monitoring the results on a systematic basis. At this stage, specific responsibilities may be delegated by the Energy Management Coordinator to other individuals who will have the daily responsibility of implementing the energy conservation actions and monitoring results. It may be desirable to install submetering on large energy-consuming devices or groups of devices to aid in the monitoring process.

7. Developing a Contingency Plan for Energy Curtailment. An important final item is the development of a set of alternatives that can be used in the event of a request for voluntary curtailment of energy use (for example, 20% curtailment) or a mandatory curtailment of energy use.

It should be emphasized that energy management as defined by the seven elements described above is not a single-shot process but is a sustained, ongoing process that must be integrated into the day-to-day operation of the firm, whether it be industrial, commercial, or institutional.

An ECO Case Study Analysis

As an illustration of a format which may be followed in analyzing a potential ECO, the following case study is based on an industrial plant energy audit conducted by the author and faculty and student colleagues from the University of Tennessee. This format has been found useful in presenting the results of an ECO analysis in a form which is concise and contains the essential quantified data necessary for a manager to decide whether to proceed further with implementation of the ECO. The format of the write-up consists of the following five elements:

1. description of current practice;
2. observations made during the plant walk-through;
3. recommended action;
4. energy and cost savings analysis;
5. economic payback period analysis.

Current Practice

Three tanks in the electroplating area are heated with hot water which is generated by the gas-fired boiler. Each of the tanks is 15 ft in diameter and 15 ft deep, and unenclosed on the top surface. The exposed surface area of heated electrolyte solution is 177 ft^2 per tank. The temperatures maintained in the three tanks were 130 ± 10°F, 160 ± 5°F, and 185 ± 5°F, respectively. Considerable heat loss occurs from the heated open surfaces.

Efforts have been made to reduce heat loss from the open surface by using ⅝-in. polypropylene balls and by using canvas covers rolled over the tanks during the electroplating process.

Observations

The use of the polypropylene balls was abandoned because of the inconvenience of having to pick up some of the balls which were scattered around the floor when work pieces were removed from the tank. However, the effectiveness of polypropylene balls in reducing heat loss from a heated surface has been demonstrated in the literature.

Recommended Action

It is recommended that 1-in.-diameter polypropylene balls be used on the surface of the three tanks that are heated. Balls are commercially available which are chemically inert in the plating solutions and will not be damaged by the temperatures encountered.

Anticipated Savings

Assume a surface heat transfer coefficient of 25 Btu/hr-ft^2-°F. The heat loss from the three tanks, assuming ambient temperature of 60°F, is:

$$Q = (25 \text{ Btu/hr-ft}^2\text{-°F})(177 \text{ ft}^2)[(130 - 60)°\text{F} + (160 - 60)°\text{F} + (185 - 60)°\text{F}] = 131 \times 10^6 \text{ Btu/hr} .$$

Assuming three-shift operation, seven days per week, with 5% downtime for maintenance gives an annual heat loss from the plating tanks of 1.09×10^{10} Btu/yr.

Trade literature of polypropylene ball suppliers indicates that heat loss can be reduced by 60 to 90%. Assuming a 75% reduction in heat loss gives an annual savings of:

$$(0.75)(1.09 \times 10^{10} \text{ Btu/yr}) = 0.82 \times 10^{10} \text{ Btu/yr} = 0.82 \times 10^5 \text{ therms/yr} .$$

The heat for the plating tanks is supplied by a gas-fired boiler. Assuming an overall efficiency of 75% means that input energy from the natural gas must be:

$$(1/0.75)(0.85 \times 10^5 \text{ therms/yr}) = 1.09 \times 10^5 \text{ therms/yr} .$$

Assuming the gas to cost $0.20 per therm gives an annual cost savings of:

$$(\$0.20/\text{therm})(1.09 \times 10^5 \text{ therms/yr}) = \$21{,}800/\text{yr} .$$

Economic Analysis

Trade literature from one of the suppliers of 1-in.-diameter polypropylene balls indicates that 144 balls/ft^2 of surface should be used. The total number of balls required plus 10% for loss would be:

$$(1.1)(144)(4)(177) = 112{,}147 \text{ balls} .$$

The quoted price for this quantity is $27 per thousand, giving a total cost of $3,028. Assuming additional labor of 1 hr per shift at $5.00/hr to pick up balls from the floor gives a

total annual labor cost of $5,475 for maintaining the balls. Thus, the net annual savings will be the difference between fuel costs savings and increased labor costs, or:

$$\$21,800 - \$5,475 = \$16,325/\text{yr} .$$

The following formula may be used to calculate payback period:

$$n = 12 \frac{\log[(S/rC)/(S/rC - 1)]}{\log[1 + r]} ,$$

where

C = capital cost,
S = annual savings,
r = interest rate,
n = number of months to achieve payback.

With S = $16,325, C = $3,028, and r = 0.1, the payback period for implementing this ECO will be less than three months.

Potential Industrial Energy Conservation in the Tennessee Valley Region

Industry is the largest single user of energy in the United States. Major energy savings are possible through the implementation of good energy management practices.

The diversity of industry in the Tennessee Valley region spans a wide range of technologies and energy uses. A complete breakdown of potential energy savings for specific industries on a state-by-state basis in the Tennessee Valley region would be a monumental task. However, a methodology is presented which is felt to be a conservative estimate for the potential industrial energy savings by 1980 in the seven states of the Tennessee Valley region. The methodology is based on the results of Federal Energy Administration- (FEA-) sponsored detailed studies[16] of the ten major industrial users to determine the maximum energy savings possible by 1980. The FEA studies considered the technical and economic feasibility of installing various modifications in equipment and operating practices. An analysis was made of specific ECOs which showed promise of an adequate return on investment and would be available for installation by 1980. For each of the ten industries, an estimate of 1980 energy consumption was made based on projected industrial growth to 1980 and continued use of technology prevalent in the industry in the year 1972.

Although the original FEA studies of the ten major industries were not state-specific, the methodology was further refined to a state-specific basis in making projections of 1980 maximum savings as part of the EPCA/ECPA program.

Two modifications of the FEA methodology were made in predicting 1980 industrial savings for each of the seven states in the Tennessee Valley region. First, an estimate of the

16. FEA studies: "Energy Efficiency Improvement Targets." Ten summary volumes and appendices. Available from regional FEA offices.

compliance factor was made for each of the ten major industries. The compliance factor is an estimate of the number of firms which are likely to implement energy conservation measures. This is a very difficult parameter to estimate, but it is felt that the values used are conservative.The second extension of the FEA methodology is to assume that the total industrial energy savings will be 1/0.76 times the estimated savings for the ten major industries. The figure is based on the fact that the ten major industries consume approximately 76% of all industrial energy. There may be a distortion built into this method of projecting total industrial energy savings on a state-specific basis in those states that have large industries which are not included in the ten major national industrial users.

Table 5.1 lists the ten major energy-consuming industries by standard industrial classification (SIC) number in decreasing rank order of energy consumption. Table 5.2 gives the FEA maximum savings by SIC number for each of the seven states of the Tennessee Valley region. The estimated savings for each SIC category are obtained by multiplying the data in Table 5.2 by the compliance factors shown in Table 5.1. These results are shown in Table 5.3. The estimated total 1980 annual savings for each state is obtained by dividing the total for all ten SIC numbers from Table 5.3 by the factor 0.76. These values are shown in Table 5.4 with the FEA projections of maximum savings assuming 100% compliance by each industry.

Table 5.1. Ten major energy-consuming industries and estimated compliance factor for each industry

Ranking	Industry	Standard industrial classification (SIC) number	Audit factor (F_A)[1]	Implementation factor (F_I)[2]	Compliance factor (CF)[3]
1	Chemical and allied products	28	0.75	0.75	0.563
2	Primary metal industries	33	0.75	0.75	0.563
3	Petroleum and coal products	29	0.75	0.75	0.563
4	Stone, clay, and glass products	32	0.75	0.75	0.563
5	Paper and allied products	26	0.75	0.75	0.563
6	Food and kindred products	20	0.50	0.75	0.375
7	Fabricated metal products	34	0.50	0.75	0.375
8	Transportation equipment	37	0.50	0.75	0.375
9	Machinery, except electrical	35	0.50	0.75	0.375
10	Textile mill products	22	0.30	0.50	0.150

[1] F_A = fraction of firms in the Tennessee Valley region estimated to conduct energy audits.
[2] F_I = fraction of firms conducting audits estimated to implement energy conservation opportunities (ECOs).
[3] $CF = F_A \times F_I$ = compliance factor.

Table 5.2. FEA projections of 1980 maximum annual energy savings by state (in 10^{12} Btu/year)

State	Standard industrial classification (SIC) number									
	20	22	26	28	29	32	33	34	35	37
Alabama	0.76	5.23	9.43	10.62	0.83	4.00	13.39	1.57	0.28	0.79
Georgia	1.7	13.28	8.56	4.90	0	3.33	1.13	0.89	0.39	1.63
Kentucky	1.35	0.41	1.18	21.94	0	1.55	6.98	6.48	1.69	0.76
Mississippi	0.68	0.51	3.37	4.49	0	1.67	0.27	0.45	0.31	0.32
North Carolina	1.51	26.51	6.66	6.85	0	2.99	2.12	1.05	0.98	0
Tennessee	1.62	2.96	3.81	28.09	0.50	4.53	8.01	2.27	1.38	0.73
Virginia	1.11	4.26	5.09	11.77	0	3.01	1.06	0.77	0.39	0.89

Table 5.3. Estimated 1980 annual energy savings including compliance factors by state (in 10^{12} Btu/year)

State	Standard industrial classification (SIC) number									
	20	22	26	28	29	32	33	34	35	37
Alabama	0.29	0.78	5.31	5.98	0.47	2.25	7.54	0.59	0.11	0.30
Georgia	0.64	1.99	4.82	2.76	0	1.87	0.64	0.50	0.22	0.92
Kentucky	0.51	0.06	0.66	12.35	0	0.87	3.93	2.43	0.63	0.29
Mississippi	0.26	0.08	1.90	2.53	0	0.94	0.15	0.17	0.12	0.12
North Carolina	0.57	3.98	3.75	2.17	0	1.68	1.19	0.39	0.37	0
Tennessee	0.61	0.44	2.15	15.81	0.28	2.55	4.51	1.28	0.78	0.41
Virginia	0.42	0.64	2.87	6.63	0	1.69	0.60	0.29	0.15	0.33

Table 5.4. Total estimated and maximum 1980 annual energy savings by state (in Btu/year)

State	Estimated savings	Maximum savings
Tennessee	37.92×10^{12}	70.92×10^{12}
Alabama	31.08×10^{12}	61.71×10^{12}
Kentucky	28.59×10^{12}	55.71×10^{12}
Georgia	18.89×10^{12}	47.12×10^{12}
North Carolina	18.55×10^{12}	64.04×10^{12}
Virginia	17.92×10^{12}	37.30×10^{12}
Mississippi	8.25×10^{12}	15.88×10^{12}
Total	161.20×10^{12}	352.68×10^{12}

The total energy savings potential for the Tennessee Valley region is shown in equivalent energy units in Table 5.5. The value of Tennessee Valley Authority's total energy production in FY 1976 was 347×10^{12} Btu.[17]

Table 5.5. Total estimated and maximum 1980 annual energy savings for the Tennessee Valley region

Energy unit	Estimated savings	Maximum savings
Btu	161.2×10^{12}	352.68×10^{12}
Tons of coal	5.76×10^{6}	12.6×10^{6}
Barrels of No. 2 fuel oil	27.41×10^{6}	59.98×10^{6}
Percent of TVA FY 1976 output	46%	101%

17. *Tennessee Valley Authority Handbook*, 1977 ed.

Conclusion

The potential for industrial energy conservation in the Tennessee Valley region using available energy management techniques and equipment is great. A conservative estimate based on estimated compliance factors indicates that the reduction in annual industrial energy consumption achievable by the year 1980 is equivalent to 46% of the total energy produced by the Tennessee Valley Authority in FY 1976. Because of the strong interdependence of the seven states in the region with respect to energy supplies, the task of industrial energy conservation should be approached on a regional basis by strong cooperation and interaction among the seven states of the region. The first principle of energy management—the commitment of management—requires the strong support of each of the governors of the seven states to a regional effort of industrial energy conservation in the Tennessee Valley region.

From the floor: In view of what you said, don't you think that more incentives and/or regulations to save energy need to be written in the National Energy Policy as far as industry is concerned?

Dr. Snyder: I would certainly endorse the incentives. The question is how best to build in those incentives. I guess I'm either cynical enough or realistic enough to feel that the economic factor is the major factor. Unless the incentives can be fundamentally economic in nature, I'm not very optimistic at getting us to change our behavior. We're talking about behavior modification. You can get people to change their behavior by either rewarding them or punishing them or a combination of the two. And I think this combination has to be fundamentally economic and not an appeal to patriotism primarily.

From the floor: What factors do you take into consideration for your number there that Tennessee has the highest percentage for the ability to conserve energy in relationship to other states? Is it due to the industrial cooperation you mentioned?

Dr. Snyder: No, it isn't. The number came out that way because that's the way the distribution of industry or energy consumption in industry exists in the southeastern region. Remember, I started with the FEA numbers. I'm not here to defend or attack them, but I started with those on a state-by-state basis and applied the compliance factors. It just turns out that there is a greater potential for saving energy in the state of Tennessee than in any others. It doesn't have anything to do with cooperation or institutional arrangements. It's just the way the industrial energy distribution exists in the southeastern region. Mississippi was at the bottom because there's less industrial activity in Mississippi than in Tennessee, I presume.

From the floor: I was wondering, are your savings based on known technology?

Dr. Snyder: Yes, they are. Again I used the original FEA data in which the claim is made that the projected savings for the ten major industries are based on known technology with acceptable financial return.

Mr. Kerlin: Thank you, Bill.

6. Environmentally Acceptable Energy from Coal

Ezekail L. Clark, ***Assistant Director of Gasification Development, Division of Coal Conversion, Department of Energy***

Mr. Kerlin: Our next paper has to do with the use of coal. We are fortunate to have quite an expert in this area, Mr. Zeke Clark, whose position is Assistant Director of Gasification Development, Division of Coal Conversion with DOE. He will give us a paper on "Environmentally Acceptable Energy from Coal." Mr. Clark is an old hand in the coal business, having begun with the Bureau of Mines in 1945. So we look forward to hearing an interesting talk from Mr. Clark.

Ezekail L. Clark: Thank you very much.

Ladies and gentlemen, it's a real pleasure for me to come to this area. I have a long history of association with TVA, which outdates many of you here. As a young engineer I worked on the TVA ammonia plant, which was a coal-based ammonia plant at Muscle Shoals. It was the second attempt to build an ammonia plant at Muscle Shoals. The first one didn't do so well, but this one worked and helped greatly in the war effort for the Second World War. It's with great pleasure that after converting this ammonia plant to natural gas, I'm talking to them again down there with a view to retrofitting it to the use of coal again.

I think if we are going to talk about environmentally acceptable energy from coal, we've got a problem. Because what is really environmentally acceptable? I think the first slide (Slide 6.1) gives at least a status picture. It's a momentary glimpse at what is environmentally acceptable. As you can see we have a moving target. (The figures here are in pounds per million Btu.) By 1985 we expect the present numbers for sulfur oxides to be cut in half. We expect the nitrogen oxide allowables to be reduced by a very large factor. Then I think Dave Freeman mentioned that there were such things as very fine particulates, which are not even on this chart because the discussion about them came after this chart was made. And again not on this chart is the present feeling that even though you may meet these standards, you must use best available control technology to reduce the sulfur emission, at least, by 90% of the sulfur in the fuel. In other words, you must somehow prevent 90% of the sulfur in the fuel from escaping from your facility. These are just temporary targets, but it gives you some idea of the stringency under which any coal-based energy supply must function.

We have a few options to try and meet these environmental standards (Slide 6.2). Of course, the first option, the use of low-sulfur coal, is actually being implemented now. I just heard the other day that even TVA had shipped in some 200,000 tons of low-sulfur coal. (Not because it was low-sulfur but because it was non-union, to supplement their supply in the area.)

New Source Performance Standards

Emission Limits Lbs/10^6 BTU	Year 1975[1]	1980[2]	1985[2]	1995[2]
SOx	1.2	1.2	0.6	0.3
NOx	0.7*	0.4	0.15	—
Particulates	0.1	0.02	0.02	—

* Solid Fossil Fuel
Liquid Fuel — 0.3
Gaseous Fuel — 0.2

[1]Statutory
[2]Contemplated

Slide 6.1

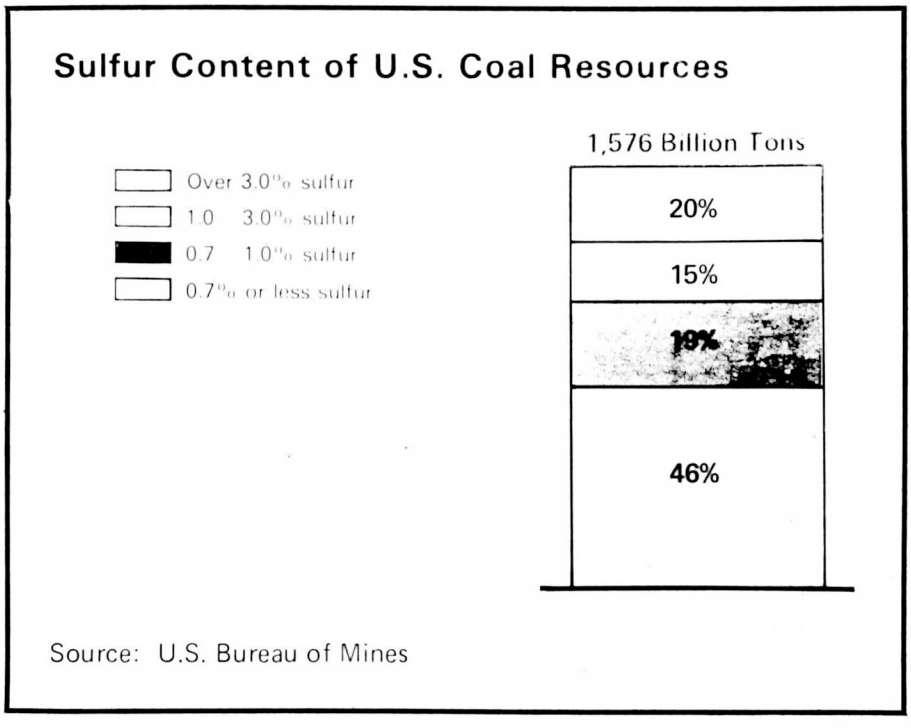
Options

- Low—S Coal
- Flue Gas Desulfurization
- Combustion
  - Coal-Oil Mixture
  - Fluidized Bed
  - Direct Substitution
- Liquefaction
  - H-Coal
  - EDS
  - SRC
- Gasification
  - High BTU
  - Low BTU

Slide 6.2

These options are to some extent listed in the order of their capability for implementation. We have to act very carefully. The use of low-sulfur coal has many constraints. But it involves a rather negligible capital investment. One can use low-sulfur coal very often in existing equipment without any additional investment. (And we have heard about the problems of getting people to invest money in conserving and improving the environment.) Similarly with flue-gas desulfurization. While it involves some investment, this process is considerably less expensive than, for instance, liquefaction or gasification, which are major structural and molecular conversions of the entire coal particle or molecule.

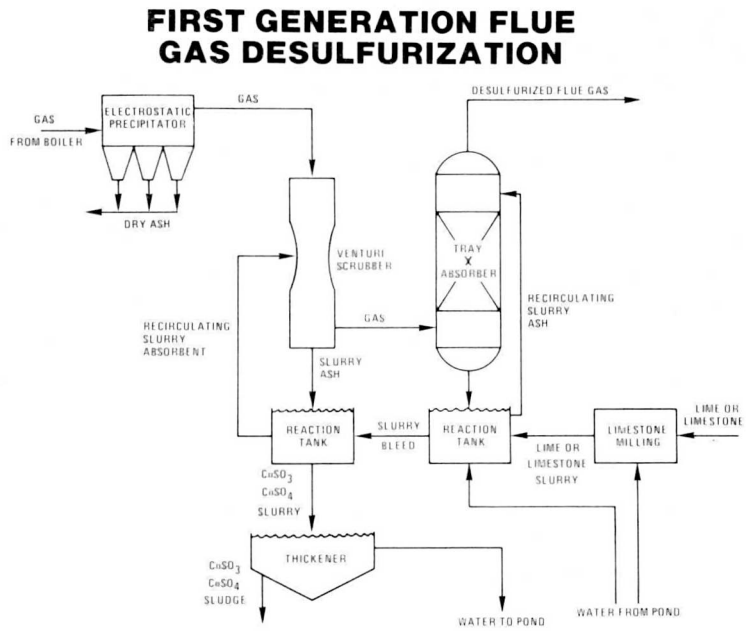
Let's look at the first option (low-sulfur coal) in more detail (Slide 6.3). Almost 46% of the coal available in the United States has less than about 0.7% sulfur and should meet the requirement of 1.2 lb of sulfur dioxide per million Btu. Unfortunately, almost all of this coal is in the West. There are problems of transport. The states in the West are putting on extraction taxes. There are problems of logistics. There are some technical problems in that the particulates from western coal and the deposits formed on combustion are somewhat at variance with those we are accustomed to. Because many of these coals are lignitic coals, they have different ash constituents, and they do involve some problems. But now with that proposed requirement that you must remove 90% of the sulfur in the coal, even if you use this low-sulfur coal in a new source, you would still have to involve yourself in a flue-gas scrubber. And while a flue-gas scrubber is not the terrible curse that everybody claims it is, it certainly isn't going to help us.



Slide 6.3

The next slide depicts a flue-gas scrubber (Slide 6.4). Essentially what we are doing is taking a power plant and putting at the end of it a chemical plant. With our desire to have good availability, we certainly know that we are not improving the availability. We are also taking a penalty in heat rate of approximately 7 to 10%, depending on the system. If we use a simple system such as this one here, which is a limestone slurry, we have to set up a very large area for holding the waste that we take out of our scrubbers.

I know development work is going on on improved systems, but I want to warn you that a regenerating system, which produces sulfuric acid, for instance, is even more complex as far as the back-end chemical plant that one has to put on the end of a power plant. And I think most power plant engineers shudder at the thought of adding this complexity and are



Slide 6.4

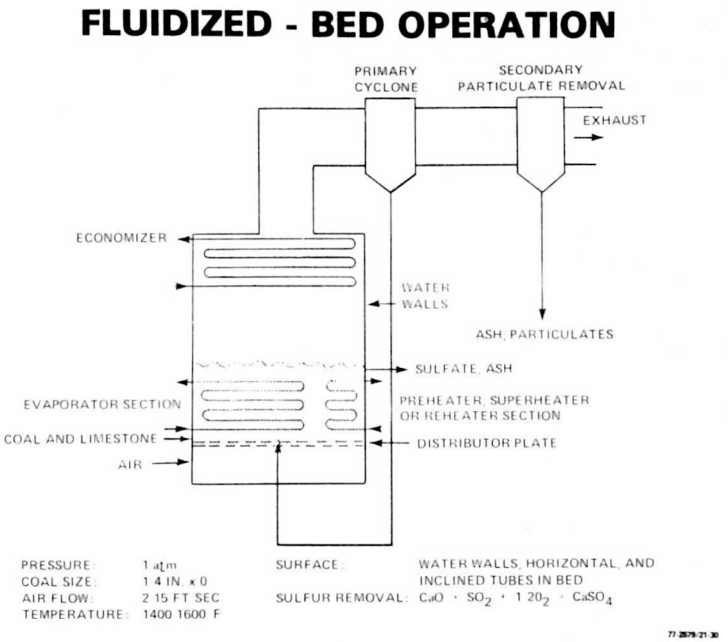
concerned as to what it does to the power plant's ability to be on-line for the production of electric power. I must also mention that the cost may be $50 to $80 a kilowatt, depending on whose numbers you take. Again it's small compared to the more drastic treatments of coal, but it's an appreciable item.

Then we have a problem as to what this will do for us in the future. Will this system take care of additional requirements for more rigorous environmental standards? Here we are quite concerned. Flue-gas desulfurization will not take care of the nitrogen oxide materials. It will not take care entirely of the fine particulates, although the scrubbing system does, indeed, help the particulate removal system. So we do have a problem as far as using this relatively low-cost option as the final word in how to handle coal.

There is one other problem. This option is only available to the combustion of coal for the generation of electricity. (We have many other requirements for energy other than the combustion of coal to produce electricity.) Therefore, this option has to be implemented on existing power plants. Considerable progress is being made. I would say almost 20% of existing utility stations have either installed, are designing, are ordering, or are in the process of negotiating for the purchase of some sort of a flue-gas scrubber. Such a scrubber is necessary for many of these stations because of the regions where the environmental standards are not attained. (I think Dave Freeman put it in proper perspective.) This means that in order to expand your operations you must reduce pollution to avoid overloading the aerial garbage can. We always want to protect that air space because this is the atmosphere in which we would like to live and which we would like to keep as clean as possible.

So, one has some difficulty in accepting flue-gas desulfurization as the last word. But it is something that is being implemented. You should know about it; it is a viable, meaningful option.

We could also improve combustion (Slide 6.5). Essentially this is a flue-gas scrubber. It's a fluidized-bed combustion system, or fluidized-bed boiler. Actually what we have done



Slide 6.5

is put the scrubbing system within the boiler in the form of a fluidized bed. I think it's less expensive in capital cost than a flue-gas scrubber. Another advantage here is that one can retrofit an existing boiler and convert it to fluidized operation and to the use of coal. Some fuel oil and coal-fired boilers are, indeed, being retrofitted using a dolomite or limestone fluidized bed.

The fluidized bed captures the sulfur. At the present time, all we know how to do is take the ash and the particulates and the sulfate (the calcium or magnesium sulfate in the ash) and dispose of them by means of some sort of a landfill. We must see to it that we don't create a water disposal problem in the process, by allowing this material to contaminate an aquifer. We must be careful that these materials that are being disposed of do not contaminate our water supply.

I think this system is also a viable option. Again, the system is only useful for boiler operations. Some effort is being made to adapt it to heating air. Another potential application is being looked at actively: we are building an oil refinery pipe still which will heat crude oil on the way to the fractionating column, using coal and this type of fluidized-bed system. Thus, it has some industial application, which should be implemented.

We are implementing the fluidized-bed combustion system on a commercial scale. There are at least six or seven systems actually being built for commercial demonstration under our current DOE program. We will thus get a reasonable understanding of their use in a commercial milieu rather than having to rely on cost studies done on paper and all sorts of assumptions as to their operating capabilities.

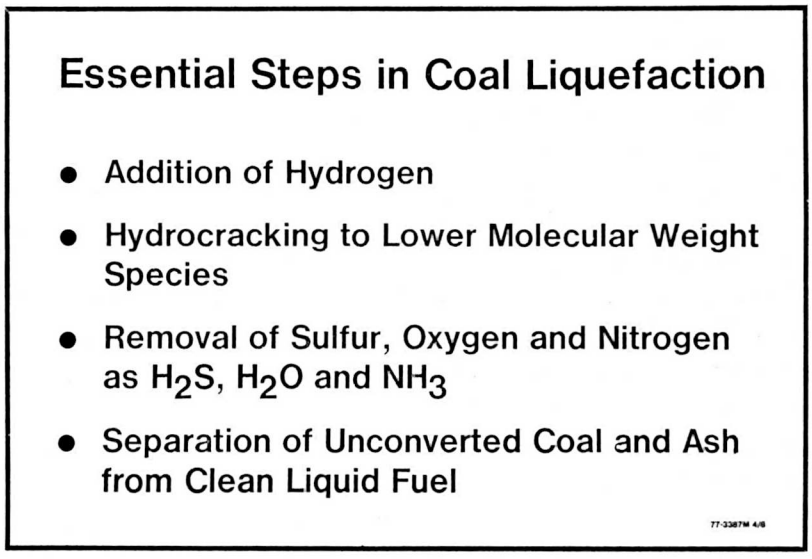
This is an environmentally acceptable way of burning coal. It does not, however, take care of the nitrogen oxide problem. It creates a slight problem in that the particulates from this type of combustion are somewhat different from the ones we are accustomed to handling from normal coal boilers. Some additional experimental work has to be done to be sure that our existing precipitators, our existing scrubbing systems, or whatever we are using for solids removal, will work on this different sort of solids.

For both the fluidized-bed combustion and the flue-gas scrubber, we have a back-pocket tool that we can use to allow them to meet a more rigorous sulfur effluent standard. And that is to clean the coal more thoroughly before it is fed to the combustion process. Indeed, we do have a rather sizable program on coal cleaning for combustion in an attempt to extend the usefulness of these two systems.

I might also mention that if you do this combustion under pressure and if you are able to remove the particulates, one could take the hot flue gases and feed them to an expansion turbine, which essentially ends up in a combined cycle system which may give you an improved efficiency for power generation. I think TVA is looking at this possibility very carefully. They are doing some cost analyses and some preliminary work aimed at implementing such a facility in this valley. So I want to again point out that these systems are being energetically activated, not only by us, but by people outside DOE. We are also making every effort to increase their longevity in spite of increasing rigor on sulfur standards.

With this sort of minor introduction, I am going to come to processes which are more drastic, where we change the coal into a material similar to materials that we are using now. We try to package things in the way the consumer wants, even though that way may not be ideal from the conservation point of view. But I don't think many of us are going to put a coal boiler (if you could buy one) into our homes and start lugging ashes out every other day to deposit them on the sidewalk for the man to pick up, if such a man exists. Let's look and see what we can do to convert coal to a fuel which we are accustomed to using and which we are accustomed to burning. This means converting coal to liquids or gases. While this looks like a needless extravagance, again it is an opportunity to use coal to fulfill a variety of end fuel uses that we cannot fulfill by nuclear energy, by solar energy, or by geothermal energy.

The next slide (Slide 6.6) starts to look a little bit at the liquefaction process. Coal contains about 5% hydrogen and about 80% carbon, with some heteroatoms in there.



Slide 6.6

Petroleum normally contains about 12% hydrogen and 88% carbon. If we would like to convert coal to a petroleum-like liquid, the steps shown on this slide are quite obvious. We've got to add some hydrogen. We've got to reduce the molecular waste so it will be a liquid instead of a solid. We have to remove all these substances that are not normally in petroleum; otherwise, we couldn't put the material into a normal refinery. And, finally, after we do this conversion we've got to separate our products from the unconverted coal and ash. Obviously, if we make all these conversions and just don't get the ash out of there, the material will be so foreign to a petroleum refiner that he won't be able to handle it.

The next slide (Slide 6.7) goes into a little more detail. It gives you an idea of the relative amounts of hydrogen used in these processes. The reason these calculations are done is that the hydrogen used in the process is the most expensive ingredient, and you would like to know where this expensive ingredient is being used up. Hydrogen can only be made by the gasification of coal. So, in order to have a successful liquefaction process, we must have an efficient gasification process. And I might add to that, if you wanted to make methanol or any of the other unusual fuels that people are talking about, again you must start by gasifying the coal to produce the raw materials for methanol production. One has to conclude that gasification is basic.

The next slide (Slide 6.8) shows various liquefaction processes. The first is a liquefaction process that results in a solid (solvent-refined coal); in other words, it's a purification process. You notice the sulfur is reduced appreciably. These processes are in order of increasing severity. The two-stage process is a second treatment of the first line. We hydrogenate again over a catalyst to increase the hydrogen content. Notice what a nice job

Coal Liquefaction
Chemical Hydrogen Requirements

	Hydrogen Consumption Wt % on Coal
● Hydrocracking of Coal Polymer	1 0
CH_2 MW 200 CH_2 H_2 CH_3 CH_3	
● Oxygen Removal as H_20	
9% $R_{OH} \cdot H_2$ RH H_20	0.5
18%	1.0
● Sulfur Removal (2.5%) as H_2S	0.32
● Nitrogen Removal (1.0%) as NH_3	0.22
● Production of Light Hydrocarbons (6% on Coal)	1.0
H/C 1.0 + $2H_2$ H/C 3.0	
	3.0 3.5

Slide 6.7

Analysis of Liquids from Various Liquefaction Processes

	H	N	O	S
SRC I — Solid	5.66	2.09	4.39	0.80
SRC II*	8.60	1.03	2.91	0.22
EDS*	8.00	0.70	2.20	0.50
H-Coal*	9.36	0.39	0.55	0.10
Two Stage**	9.20	0.20	0.25	<0.06

*Gas Oil Fraction 400° F

**LCFining of SRC I in Foreign Solvent

Slide 6.8

we've done on removing nitrogen, oxygen, and sulfur. This material, while it's somewhat aromatic in character, can go directly and efficiently into a petroleum refinery as a substitute for crude oil.

I'm sure many of you realize that if we wanted to go all the way—and I'm sure you've read many times about how the Germans made aviation gasoline in World War II—we could go, in the liquefaction plant, directly to motor gasoline or any other material that requires some aromaticity as a criterion of its performance. So we have a very potent tool.

The next slide gives you a picture of what the problem is (Slide 6.9). These processes have been around for quite a long time. For comparison, the flue-gas scrubbing systems

Capital Investment

- In 1976 Dollars about a Billion Dollar Investment is Required for a 50,000 BBL/Day Plant
- Under Normal Capitalization the Investment Accounts for 40% to 50% of the Product Fuel Cost

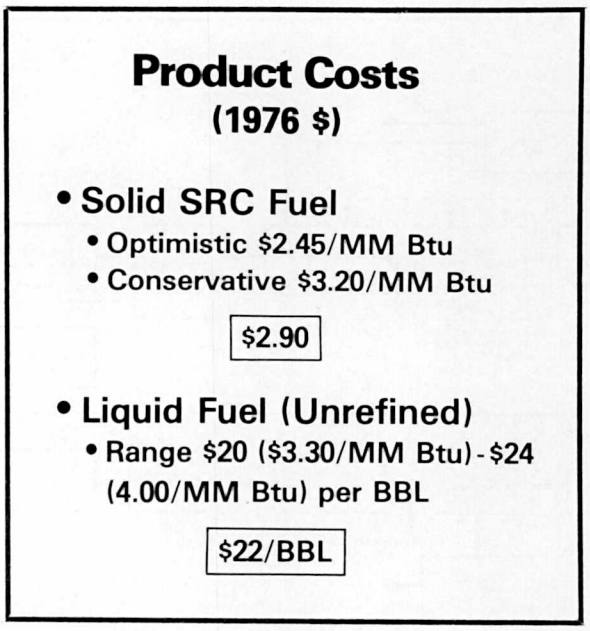
Slide 6.9

have been around maybe 10 or 15 years, and they are beginning to be implemented. The liquefaction of coal was first done on a commercial scale in about 1945, but originally it was developed or implemented—I think discovered is a better word—in the 1913 or 1914 era. So, here's a process that's something like 60 years old. There is a lot of background, a lot of literature. There's a lot of technology. And still for our converted system, we are talking about a billion dollar investment for a 50,000 barrel a day plant, with normal capital return. About half the product cost is involved in the capital investment.

Again I want to warn you that these are paper numbers based on no available industrial plant. It would be preferable to build some sort of an industrial plant based on this type of a system, to at least get a baseline case on an industrial, commercial effort at our present level of knowledge. Then we could build on that level with reasonable numbers and reasonable criteria of cost.

The next slide (Slide 6.10) gives you an idea of the product costs. These don't look too good. Again you notice if we talk about solid fuel we are up about $2.90/MM Btu. If we talk about liquid fuel we are up to around $3.30, $3.50, $4.00. But I want to remind you of Gordon Hurlbert's comments and Ralph Bayrer's comments. Both of them pointed out that there is going to be an increasing price of oil and possibly a very sharp increase in the 1983 to 1986 period. If we don't start building some of these plants now, we won't have any available by that time.

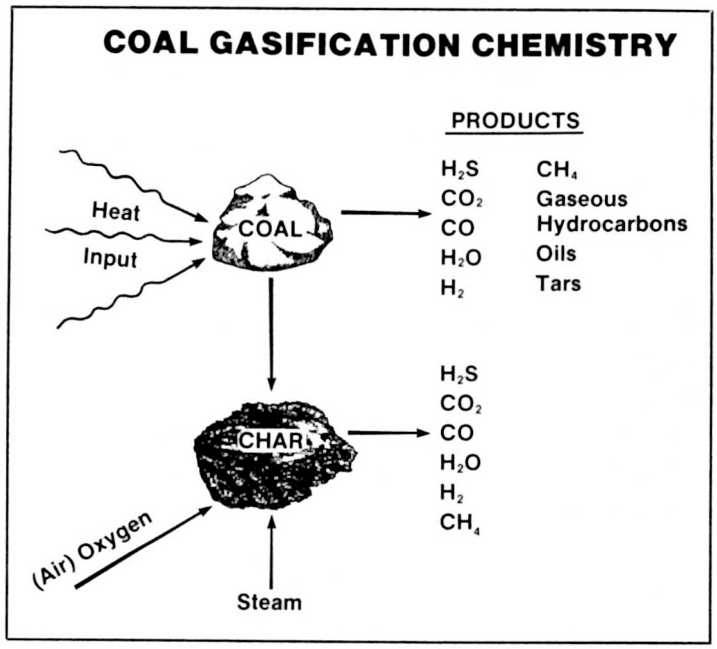
However, these numbers are going to be competitive numbers. If the plant is started now and our assumptions are correct, they will be competitive numbers within the next seven or eight years. And we know how long it takes to build a billion dollar plant. We are talking about a minimum of four years of construction, design, planning, and implementation and shakedown. If you do it in four years, you do very well, even though some of the unit operations here are well known.



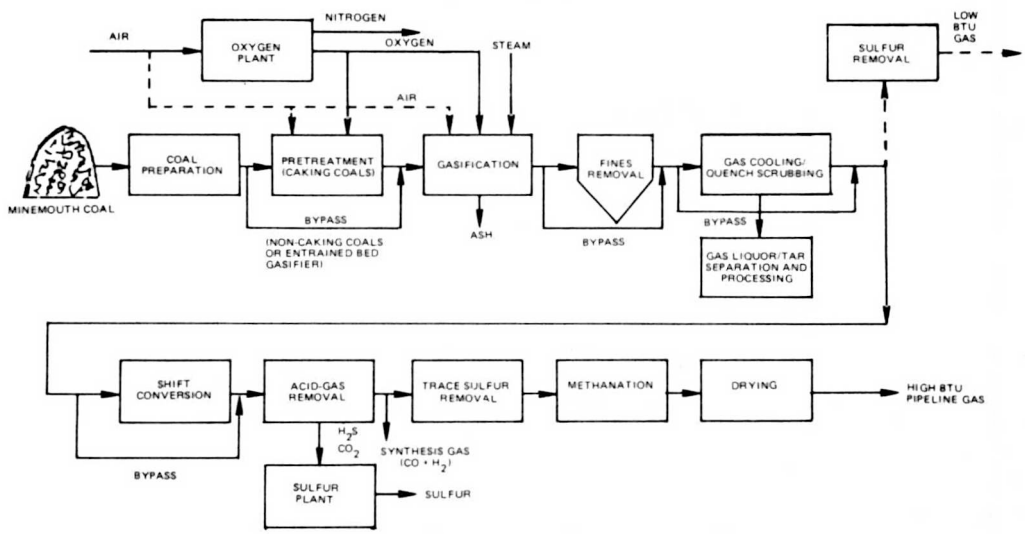
Slide 6.10

Now I want to come back and say a few words about gasification. This is a simple diagram (Slide 6.11) which tells you that if you react coal (a solid particle) with oxygen (either oxygen alone or oxygen in air steam), you can produce a variety of products. This is an attempt to show a little bit of the mechanistic nature of the process. When the particle of coal falls into the gas fire, it's probably immediately carbonized to a char, which reacts with the oxygen and steam. This is an oversimplification, but it gives you an idea of all the products that can be made. By controlling the parameters of the process we can adjust it so that the products we make are the ones we want.

The next slide (Slide 6.12) gives you some idea of the complexity of these systems. This is a schematic flow diagram of the coal gasification plant, to produce synthetic natural gas.



Slide 6.11



SCHEMATIC FLOW DIAGRAM OF A COAL GASIFICATION PLANT

Slide 6.12

It's a complex system. A plant of this type costs somewhere between $1 billion and $1½ billion to produce 250 million cubic feet a day of essentially natural gas or methane.

There are at least five gas transmission companies interested in building coal gasification plants. One of them already has the certification to build such a plant from the Federal Energy Regulatory Commission, which used to be the FPC. The second company is going through the procedure of getting certification. Neither of these companies has a ghost of a chance of borrowing the capital required to build this plant. The only way it will happen is if the government will help them.

We had a discussion this morning; Dave Freeman and I argued about something and we agreed. And I can quote him, and I can quote myself, that there is a tendency for the government to develop a system to go to a point which is probably within 5 or 10% of where you have to be to be commercial. In other words, as we get down to the ten yard line, a paranoia develops. The government is afraid that if they go any further and help a commercial enterprise, they will be accused of subsidizing some large, evil, industrial complex like an oil company or a gas company. And everybody knows these people are evil. Everybody knows it's good politics to rant and rave against them.

I would like to see us make this subsidy and build at least one or two of these gasification plants, because that's the only way we are going to get a number of these plants built. Just to give you a picture of the cost problems, previous speakers have pointed out that energy costs now for new energy supply, such as from gasification or liquefaction, should be priced at the replacement cost. And the price of gas from this system is going to be close to the replacement cost. We are now importing liquified natural gas at a cost to the consumer of over $5.00. It has been estimated that if inflation takes place, as we know it will, the Alaskan pipeline gas might cost us $5.00.

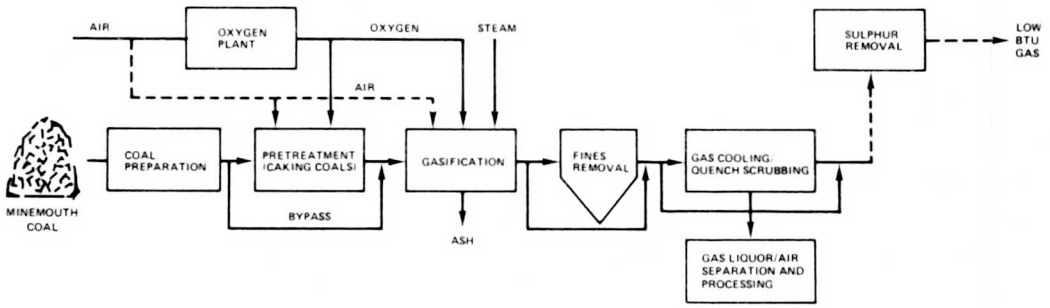
I can't think of a better way to increase the work for our construction industry and to lower our balance of payments than to use processes that are available and have been around for many years. Many portions of this facility have been operated and I think there is a reasonable expectation of trouble-free operation, or at least no further trouble than arises in building a plant composed of known ingredients. The biggest problem will be the integration. And yet we have another opportunity to use gasification to improve our position.

The next slide (Slide 6.13) shows a plant for making medium- or low-Btu gas. You can see that it is considerably less complex, considerably less involved, and it will be of considerably lower capital cost. We estimate that this gas, of approximately 250 to 300 Btu, can be made for something under $3.00 per million Btu. We feel that's a competitive value. These plants should be implemented and industry should be assisted in building them.

Again, I would like to see our Department of Energy go further than the department normally goes. I would like to see us take the risk of being abused politically and actually implement one or more of these existing facilities. This would provide an opportunity to break down some of the institutional barriers that confront industry now in their desire to go forward with new supplies and a new supply base for improving the availability of necessary fuels, such as gas and liquids. Thank you.

Mr. Kerlin: Questions?

From the floor: I was a bit concerned about these moving target particulates and sulfur oxide and nitrogen oxide guidelines that I'm sure the Environmental Protection Agency (EPA) proposed. It's a fact that to get the last 2% of the pollutants out is the same as getting out the first 98%. It looks like you are trying to get all of it out.



Slide 6.13

What concerns me is, do we have to continue to retrofit existing power plants and industrial power plants to meet these new standards? In other words, we throw away our precipitators and we put in high-energy Venturi scrubbers and desulfurization and keep retrofitting the old plants. And now all the new plants have to meet the new standards, where is all the money coming from? Where is the balance between the pollutants and the economy?

You say we are going to create all these construction jobs, but we are going to put all our chemical firms out of business because all their products are going to have to rise in price. In the end the people are going to pay. Where's the balance?

Mr. Clark: I think a good picture of the balance was given by Dave Freeman this morning. I don't know if you heard his talk. He said that it is better to err on the side of safety in thinking of biological or medical effects on the population. I certainly feel, as you do, that there is a balance. I don't know how to achieve the balance; it's not within our expertise.

But I do want to assuage your concern to some extent. First of all, you will notice that those were new source performance standards. The way the older plants will be retrofitted is by the establishment of nonattainment areas. In other words, in order to increase the pollution in that area you have to reduce it in an existing plant. So this will be done as part of the capital cost of the new facility. I agree with you it will be an expense, but I don't think you want the Tennessee Valley to become like New Jersey, and this is what Dave Freeman said. There's got to be a balance, and I think we have to achieve this in a reasonable manner at reasonable costs to the consumer.

From the floor: In your example on the low-Btu gasification plant, you mentioned a product cost of about $3.00 per million Btu. Are there any numbers for typical capital investment for that sort of a plant?

Mr. Clark: First of all, you must realize that there is a bottom size from the point of view of an economically acceptable plant. It looks like somewhere between $100 million and $150 million is economical for a reasonable-size plant. But I want to warn you that this plant is fairly large. To give you an idea of its size, there are probably only a hundred plants, single plants, that could afford to use the total output of such a gasification plant.

I want also to amplify this by pointing out to you that we are very interdependent in our fuel usage. For example, putting a medium-Btu gas plant of this sort in front of a refinery would supply essentially all the thermal energy needed to refine the crude passed through that refinery. That would mean a net savings in liquids of 8 to 10% of the crude put in that refinery. We don't have to say that in order to get liquids we must build a liquefaction plant. We can get liquids by building gasification plants and thus decreasing the use of liquid fuels.

As a result of last winter's problems with gas curtailment, the fuel oil usage went up 14%. Total petroleum usage went up 3 to 4%. But fuel oil usage was primarily to replace natural gas that people could not get. So we see the interdependence here because we could not supply the natural gas and we didn't want to start coal gasification. We essentially increased our imports of liquid fuels.

From the floor: What about the refinement of coal? You know, last year at this conference we heard a lot of papers that were presenting coal as a refined substance that had many of these contaminants refined out of it. I haven't heard anyone say anything about using coal that had been run through a coal refinery as such.

Mr. Clark: I think you must be referring to SRC, or solvent-refined coal, which was the first line of products on that product sheet I had. A plant to construct this material on a reasonable scale is being seriously considered by DOE as one of the first facilities they would build in an attempt to provide, as you point out, refined coal. And as I pointed out in the last line of that product chart, the result of the two-stage process is a raw material for providing crude to a refinery. So this has not been lost. We are going forward with it. There is a very large pilot plant in Tacoma, Washington, working on it. There's a smaller one in Wilsonville, Alabama, which some of you may know about. This is not a lost cause in any sense of the word. It's in the forefront of the do-it-now approach of the Department of Energy.

Mr. Kerlin Thank you very much.

7. Utility Rate Reform: Good Intentions on the Way to Enactment

Ronald S. Wishart, Jr., *Director of Energy Policy, Union Carbide Corporation*

Mr. Kerlin: Our last speaker this afternoon is Mr. Ron Wishart, who has demonstrated considerable flexibility by changing both days and titles for his talk. Mr. Wishart is with Union Carbide Corporation, where he serves as Director of Energy and Transportation Policy. I went over his biographical sketch and he has all of the credentials you would expect for a person with that type of position, but there was another entry on his biographical sketch that caught my eye and I thought I would just pass it on to you. He was a volunteer in the Indian Army in World War II, where he served as an ambulance driver for the Bengal Lancers. And that struck me as probably saying more about the man than which organizations he belongs to. His paper today is a question. It's titled "Utility Rate Reform: Good Intentions on the Way to Enactment?" And so, Ron, if you would tell us about your thoughts on this subject.

Ronald S. Wishart: Thank you, Tom. I looked over your program and I must say I am delighted and flattered to be a speaker among such a distinguished group. I know many of the people and, of course, I recognize the names of many others. There are many with whom I find myself in excellent philosophical agreement and others—whom I have followed or preceded or been on panels with before the Congress of the United States and other places—with whom I would have to say that I find myself in very deep dissent. So I would certainly say you are getting a very balanced program with proponents of widely divergent attitudes before you.

When I started off my life in Union Carbide, I was so fresh out of school that I hadn't had a chance to be technically obsolescent. So I was in a research department. One thing I learned very early in that research department was that the hardest art in research was to ask the right questions. There were many, many people working to try to get the answers. And so it seemed appropriate to me today to ask a question, and that is the title of the paper, "Utility Rate Reform: Good Intentions on the Way to Enactment?" The paper is really a series of questions, because I think we have today very few answers.

I chose this particular topic to talk about because I think that in terms of energy, after the great debate of last year, the most politicized issue that affects us in all of the states—and one that will be an increasingly active subject as a result of whatever may be passed in terms of a National Energy Plan legislation—will be the question of retail ratemaking for electricity.

Last year, President Carter declared the "Moral Equivalent of War" on the energy crisis facing the nation. This year, *The New York Times* summarized expert opinion on world oil supplies and concluded that there is no foreseeable shortage and little chance that the price of oil will rise more rapidly than the general rate of inflation through the early 1980s.

Faced with a choice between these conflicting signals, the public is understandably not sure of the answer. A recent *New York Times*/CBS News public opinion survey found that more than half of the general public believes that "the shortage of energy we hear about" is not real but rather fabricated in order to permit oil and gas companies to charge higher prices.

Well, the prices *are* undeniably higher—as we can all testify—and the oil companies *have* improved their return on investment. But that higher return still looks pretty bad when you compare it to that enjoyed by governments which produce—and even governments who use—oil and gas. As a matter of fact, it compares unfavorably to that of CBS and *The New York Times,* which "produce" only opinions on oil and gas. Interestingly, in this time of increased concern with energy, producing opinions may be more profitable than producing oil.

From the many surveys that I've seen, the public perception seems to be one of an energy price problem rather than an energy supply crisis. And the public may not be far wrong. For we are dealing with a problem induced by supply and demand—after all, there is only so much recoverable oil in the world—and the most visible reminder of the problem is the energy bill that we receive each month. Even here in TVA land, which was established as a yardstick for the nation's electric rates, you are experiencing the same kind of price increase as consumers in other parts of the nation.

The situation that we're all experiencing is certainly not a novel one. In Economics 101, it might have been described: "The scarcer a commodity becomes relative to demands for it, the higher its price. And the higher its price, the greater the efforts to make more efficient use of it, the greater the incentive to find and develop more of it, and the greater the need for technology to find something else to take its place."

Recent events, however, have made me decide to add one more provision to that economic testament: "The higher the price of a commodity, the more interest there is in finding ways to make it less costly, ways to make it *seem* less costly—or ways to have someone else shoulder part of the cost."

A case in point is the large number of proposals for utility rate reform that have surfaced as the result of rising utility bills for homes, office, and industries. The big question is, "Do these proposals actually lower the cost, do they just make it seem lower—or do they unfairly push the burden off onto someone else?"

Because, as someone wisely observed, "utility ratemaking is not an art; it is a science—a *political* science," these proposals for changes in the way electricity and gas are priced are getting a lot of attention. Consumer activists propose them as a way of getting *lower* prices; environmentalists see them as a means of getting *higher* prices; and holders and seekers of public office may well see them as a way of getting both consumer and environmental votes.

Just what are these rate reform proposals supposed to accomplish? Some claim to make it easier for the poor and the elderly to pay their energy bills. Some are aimed at cutting costs by spreading the use of power plants over more hours of the day. Others hope to reduce the

number of power plants needed in the future. Some are designed to make users of electricity and gas pay *all* the costs of supplying them, even speculative estimates of social and environmental costs included, in an effort to send up the kind of price signals that will make you think twice before using additional amounts. And still others propose to reduce energy bills for some segments of the population by shifting part of the cost to someone else.

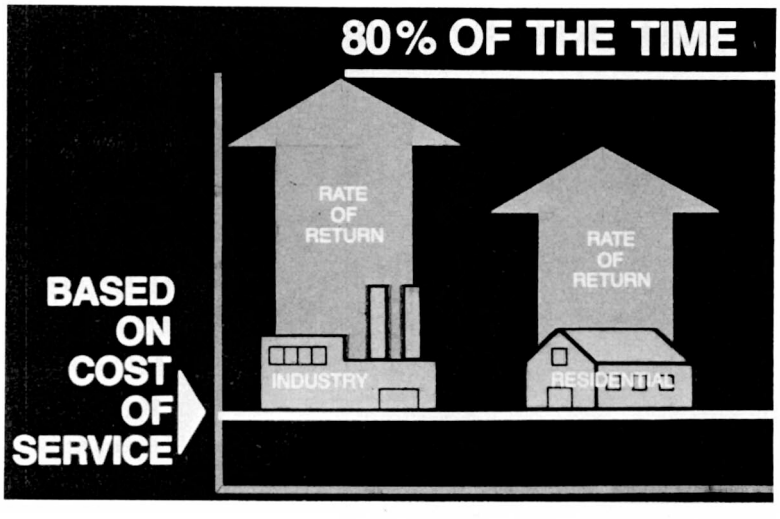
The question surrounding most of the proposals is not whether or not the announced goals are desirable. For most of them seem to be. The real question is, "Will these proposals actually accomplish the desirable goals or are they ideas whose good intentions are lost on the way to enactment?"

In most cases, the answer is that we don't really know, that we are just beginning to study, test, and experiment with the various proposals, and that we don't really have a good idea of the benefits we can expect from them. We therefore need the opportunity to explore them, to separate fact from fantasy and truth from recycled misinformation.

I use the term "recycled misinformation" to describe myths that are repeated so often they take on the aura of truth. The most prominent piece of recycled misinformation in the utility rate field—and the underpinning of many current rate proposals—is that the residential customer subsidizes the industrial customer and that home electric bills would go down if all customers paid their fair share.

This supposed fact has been stated so often by the press and by proponents of rate reform that it has taken on an Old Testament aura of its own. And yet a recent study commissioned by the Electricity Consumers Resource Council (Slide 7.1) shows that *80% of the time* the subsidy actually goes in the other direction. In 40 out of 48 cases reviewed, electric utilities had a higher rate of return on investments to serve industry than on their investments to serve residential customers. In other words, relative to the cost of service, industrial rates for electricity are usually higher than residential rates.[1]

1. ELCON, "Profiles in Electricity Issues," February 1977; and Joseph M. Cleary, Airco, Inc., "For Electricity, 1984 Is Here," October 20, 1977.



Slide 7.1

Interestingly, the study indicates that if rate reform really did place all customers on rates that reflect the costs to serve them, industrial rates would probably go down, not up.[1] That may explain why the utility rate reform section of the administration's energy proposals started out by embracing cost-of-service rates, but ended by exempting residential customers from cost-of-service considerations. It might also explain why an amendment to the administration bill which would have banned subsidy of one customer class by another was resoundingly defeated.

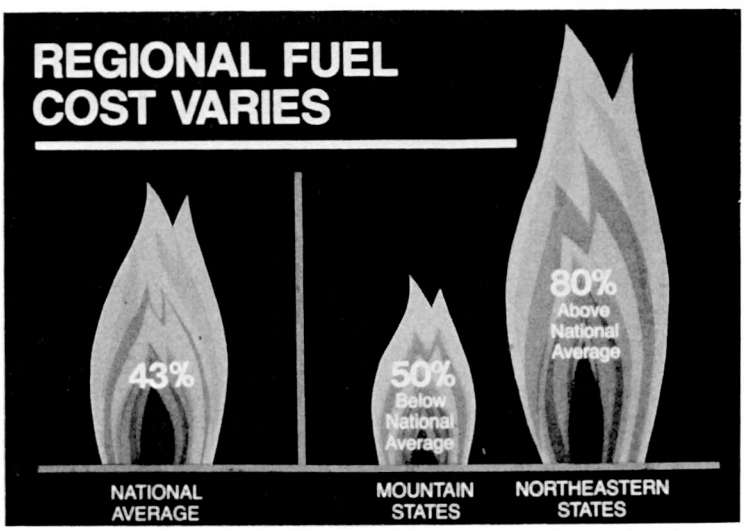
What I'm suggesting, then, is not that we oppose changes in the way we price the energy we use but that we experiment, ask questions, and get answers so that we know what we're buying *before* we buy it.

Fortunately, all of us will have that opportunity as a result of the recent Senate-House conference bill on utility rate reform. Instead of forcing states to adopt some of the rate reform proposals, as proposed by the administration and House bills, the conference bill requires state public utility commissions to hold hearings on various proposals for changing the way electric rates are charged.

This approach not only allows all of us to look before we leap into the various proposals, but it also recognizes that there may be legitimate reasons for different rates in different states that would not be changed by nationally-imposed electric rates. Fuel costs, alone, are a good example (Slide 7.2). On a national average, fuel represents 43% of the cost of generating electricity. But that percentage varies from 50% *below* the national average in the mountain states to 80% *above* it in the northeastern states.[2]

Since we are all users of electricity and as such will feel the impact for better or for worse of any rate reforms that are adopted, it seems important that we understand what is being proposed and that we make a constructive contribution to our state's consideration of these proposals. The fact that rate reform proposals are complex and often hard to understand makes it tempting to leave the decision to someone else. But since you, and not someone else,

2. Frank Seidman, Director of Technical Affairs, ELCON, "National Electric Rate Reform, Keeping the Old Myths Alive," October 10, 1977.



Slide 7.2

will be paying the resulting bills, it's obviously worthwhile to be a knowledgeable participant in the upcoming dialogue on the kinds of rate reforms that would be most beneficial in the TVA area.

To stimulate your interest in knowing more about rate reform, I would like to review, hopefully in nontechnical terms, some of the current rate proposals: what they are, what they hope to accomplish, and what we actually know about their impact. I do this in an admitted self-interest since Union Carbide, as a major user of energy, has more than a passing concern with anything that promises to raise or lower the price of energy or to make more or less of it available. But, for that matter, so does everyone else in this room.

Perhaps the most widely publicized of these rate proposals is the so-called lifeline rate, proposed as a way to help the poor and the elderly who can't afford to pay their energy bills.

What is a lifeline rate? It is simply a uniform, below-cost charge for the first several kilowatt hours of electricity consumed by each residential customer. The most common amount proposed is 300 kilowatt hours, but some proposals have ranged as high as 700.[3] Under these lifeline plans, the revenues lost by selling at less than cost are usually recovered by increasing the rates for business and industry and for those residential customers who use more than the set amount of electricity.

Lifeline proposals, although well-intentioned, seem to be based on another bit of recycled misinformation: the premise that benefiting the low-use residential consumer of electricity is the same thing as benefiting the poor and the elderly. The fallacy of this premise is indicated in a major study of lifeline rates by a nationally-known firm of economists, which found that on a lifeline plan restricted to those who use less than 500 kilowatt hours per month, more than half of the poor would be left out in 14 states and more than one-fourth would be by-passed in 25 additional states (Slide 7.3).[3] Not only wouldn't these large numbers of the poor be helped by lifeline rates, they would actually be harmed, since they would end up paying the higher prices assigned to those who use more than a lifeline level.

Just who are the poor who would be by-passed? According to the study, they include those whose electric bills are included in their rent, those who have electric water heaters, and those who are farmers. "By any reasonable definition," the study concluded, "lifeline should be judged a failure as an instrument to help the poor in these states."[3]

In your own area, TVA came to the same conclusion (Slide 7.4). It reports that "the consumers who face real hardship in paying electric bills are those with low incomes and high levels of electricity use."[4]

One TVA study applied a hypothetical lifeline rate to actual consumption of electricity in high-income and low-income neighborhoods. It was found that lifeline produced *higher* electric bills for 26% of the low-income families and *lower* electric bills for 49% of the high-income families. Under this lifeline plan, one-fourth of the low-income families would help to subsidize the electric bills of almost half of the high-income families.[4] As a way to help the poor and the elderly, lifeline rates may indeed lose their good intentions on the way to enactment.

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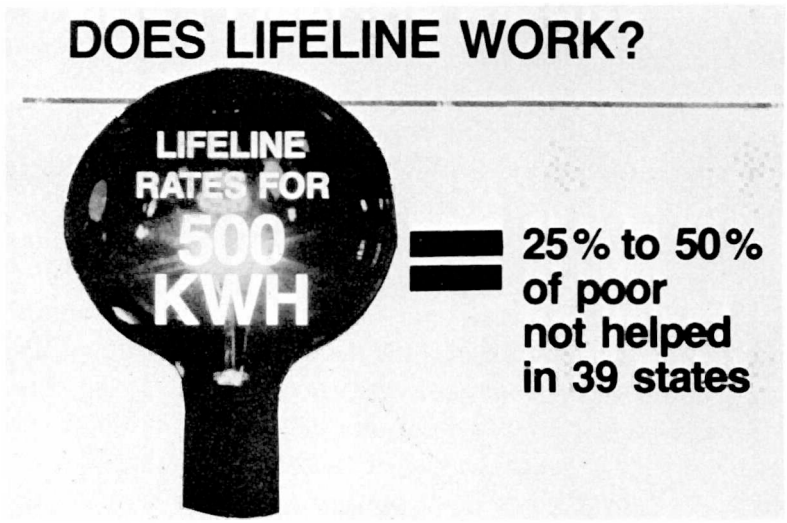
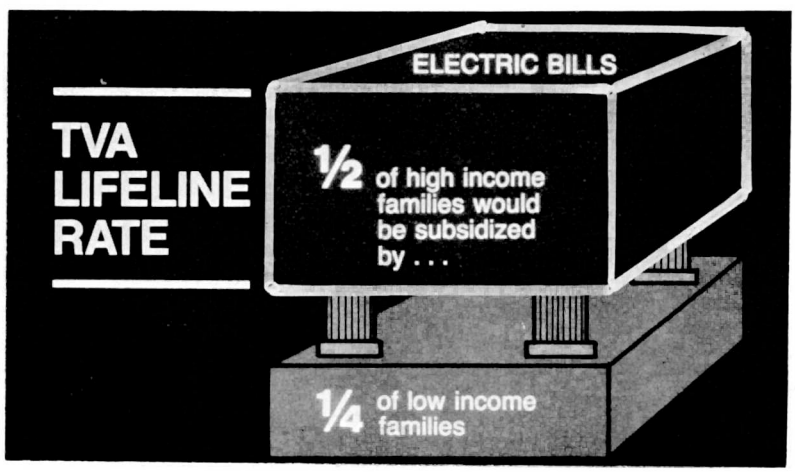
3. Joe D. Pace, National Economic Research Associates, "Lifeline Rates & Energy Stamps," June 17, 1975.
4. Tennessee Valley Authority, "Lifeline Electric Rates, Their Effect in the Tennessee Valley," May 1977.



Slide 7.3



Slide 7.4

Another current rate proposal, ~~uniform or flat rates~~, is based on the idea that all consumers, regardless of what it costs to serve them, should pay the same price for each kilowatt hour of electricity. It, too, seems to be based on some recycled misinformation that all groups, often translated to mean industry, are not paying their fair share.

Although the idea sounds appealing on the surface, let's see what flat rates would actually do. A study conducted for the Electricity Consumers Resource Council by nationally-known economic consultants forecasts the following results if everyone paid a uniform price for electricity:

- From 75 to 120% of the reduced electricity prices in the average household would be offset by increased prices of other goods as industries pass on their higher electricity charges; and
- General economic growth, jobs, and income would be so adversely affected by electricity pricing in which industry subsidizes residential consumers that the loss in gross national

product (GNP) income per household would more than offset all the savings in the average household cost of electricity.[5]

Another study (Slide 7.5) found that if uniform electric rates were applied during the three-year period from 1977 to 1979, the GNP would be down $9.9 billion; employment would drop 430,000 man-years; consumption would drop $7.5 billion; disposable income would be down $2.9 billion; and the federal deficit would be $3.4 billion higher.[5] Since uniform rates seem to affect far more than just electric bills, it seems wise to make sure that they, too, wouldn't lose their good intentions on the way to enactment.

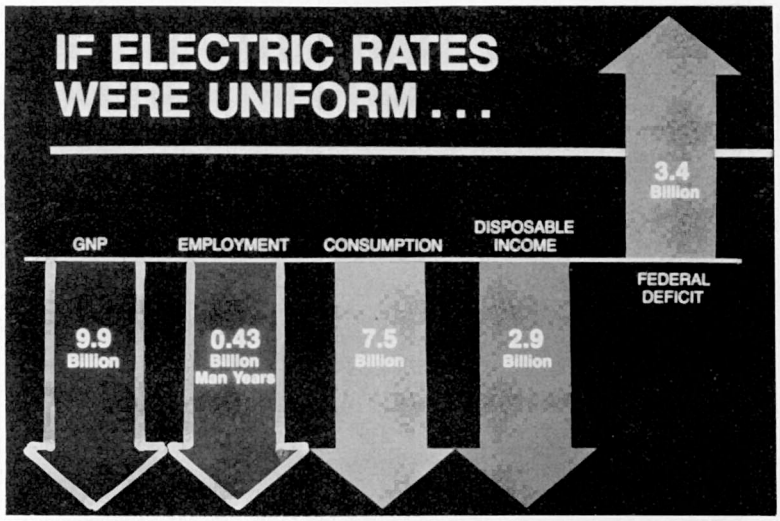
One rate proposal that would have become law under the administration's energy bill is time-of-day or time-of-use rates. These would charge consumers the highest rate for the electricity they use at times of greatest demand on the utility system, in the hope of eliminating the need to build additional power plants to handle that peak load.

Actually, the concept is not new. Some utilities have employed a limited version of it in the past in an effort to even out electric usage between seasons. It is interesting to note that groups who attacked these rates in the past as "promotional rates" are now advocating them as "cost-justified" rates. It seems that utility rates, like beauty, are all in the eye of the beholder.

To a process industry like Union Carbide Corporation, with its chemical and gas separation plants operating 24 hours a day, equitably set time-of-use rates are a standoff. Such rates may offer opportunities for cost savings by maximizing production in off-peak times. So the process industries, in general, might favor time-of-day rates, or even time-of-year (season) rates.

True time-of-use pricing is just in the experimental stage in the U.S. today. Several utilities offer consumers who participate lower rates if they cook, wash, do dishes, or heat water during certain hours when the local demand for electricity is lower. These experiments are designed to find out just how much people will change lifestyles in order to save money on their electric bills, and just how much energy and money can be saved by

5. ELCON, "Profiles in Electric Issues," June 1977.



Slide 7.5

both the utility and the consumer. To date, most of this research and demonstration has been done with residential customers. But in January 1977, time-of-day rates were offered to large industrial customers by one Wisconsin utility. The Kohler Company was one of the first to try the special rate. A recent *Wall Street Journal*[6] story about that experience indicates that the change may have impact on marriages, social life, efficiency, and productivity—as well as on electric bills.

Time-of-use rates may more accurately reflect the cost of providing electricity and therefore provide truer price signals to the consumer than the average rates now employed. But the truth of the matter is that we really know little about them and their impact on energy conservation, cost reduction, and the way we live. As *The Washington Post* concluded in a recent editorial, "Nobody has had much experience with this kind of power rate, and it is difficult to predict how effective it will be." Noting that a number of experiments are now getting under way, the *Post* concludes, "...it is not yet clear what will work best."[7]

Perhaps the most far-reaching—and most complex—rate reform proposal of all is marginal cost, which has been defined as "the cost of society's scarce resources which must be used to produce an additional unit of some commodity." Marginal costs are supposed to give consumers price signals that indicate simultaneously the cost of commodities to individual consumers and the cost to society as a whole of producing such commodities.

The hope-for-result, according to proponents, is a rate structure that doesn't foster misallocation of scarce resources, such as natural gas, oil, clean air, clean water, and land. Another obvious hope is that by making people pay *all* the costs of producing additional electricity, it will make them think twice before using those additional amounts—no matter how worthwhile the purpose for which they use the energy.

In fact, the economist's definition of marginal costs has been described as including "all sacrifices, present or future, and external as well as internal," "not only fuel costs but also environmental costs and the costs of not having enough."[8] Those charged with figuring these rates are put in the unenviable position not of figuring total costs but of identifying the *additional* cost of something—and doing so for ten or more years into the future.

One of the problems with marginal cost pricing of electricity is that there seem to be as many methods of arriving at marginal costs as there are people advocating it, with little or no agreement among economists as to which method is best. In a recent electric rate case, one expert estimated the marginal cost of generation, transmission, and distribution at $297 per kilowatt; another estimated it as $450 per kilowatt—a difference of 52%.[9] This suggests the present confusion over setting electric rates on the basis of marginal costs.

If you're even slightly confused by marginal cost proposals, you're not alone. As one economist who supports marginal costs said, "I'm afraid that when economists start discussing marginal costs pricing, there is a certain theological aura to the discussion—it

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6. "'Graveyard' Shift Cuts Kohler Co. Power Bills But Irks Some Workers," *The Wall Street Journal*, October 18, 1977.

7. "Your Next Electricity Bill," *The Washington Post*, November 22, 1977.

8. Irwin M. Stelzer, National Economic Research Associates, "Marginal Costs and Electric Utility Rate Design Alternatives," March 4, 1975.

9. Response to Maryland Public Service Commission opinion by Baltimore Gas & Electric Company.

somehow seems as if the economist, after some mysterious communion with his intellect, has come out with an answer, which, if it has meaning, has no real world counterpart."[10]

Perhaps the ultimate statement on marginal costs comes from a noted economist and federal regulator: "When God conferred on living creatures the benefit of abundant air and water, so abundant that marginal costs were zero, did fairness require that the beneficiaries somehow pay for it? ...I would suggest that whether or not you should be required to pay for something from which you benefit ought to depend on whether your consumption imposes sacrifices—i.e., costs—on others; if it imposes no such costs on society, only a sadist, a monopolist or a government would think of extorting from you some portion of that costless benefit or value of service."[11] .

So again, marginal cost pricing may be a complex idea whose time has come—or it might be an idea whose good intentions would be lost on the way to enactment. We obviously need to study and understand it before we make marginal cost pricing a controlling part of our lives.

As you can see, there are great areas of uncertainty in all of these rate reform proposals. But the basic question behind all these uncertainties is reflected in a statement that I read recently: "You can command, cajole, or shame people into changing their consumption patterns to buy at a time when they would rather not. But why do it if it reduces people's quality of life more than it reduces cost of consumption?"[12]

There is obviously no reason why we shouldn't review utility rate structures to see that they reflect current costs, that they fairly apportion these costs among various users, and that they contribute to important national objectives, such as reducing our dependence on imported oil. But there is also no reason to change rate structures just to be changing them.

We may find that some changes need to be made in the way electricity is priced and we may find that existing rates are economically fair and appropriate. But if this review is conducted through reasoned discussion—not through a counterproductive exchange of charges—with consumers, business, industry, environmentalists, utilities, public officials, and other interested parties, we have the best chance of making the right decisions. I sincerely hope that you will be a part of that determination in the TVA area.

If the current energy situation is indeed a price problem, as the public perceives, then it is more important than ever that the price signals we receive be based on reality, not on wishful thinking. If the price signals are wrong because they fail to track true costs or are unrealistic because the costs have merely been shifted to someone else, they're not going to encourage us to do the things we should do to solve our energy problems.

It therefore occurs to me that the Old Testament of resource economics that I have cited today may not be a bad guideline for those in Washington who are determining our energy future. For it avoids the nonproductive approaches of blaming others for the energy situation that we have all helped to create and of trying to "solve" the price problem by shifting part of the burden to someone else. Instead, it rightly suggests that more efficient use of scarce resources, the finding of new supplies of these resources, and the development

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10. Sally Hunt Streiter, National Economic Research Associates, "Marginal Costs and Electricity Prices," January 27, 1975.

11. Alfred E. Kahn, "Efficient Rate Design: The Transition from Theory to Practice," February 24, 1975.

12. Leo T. Mahoney, Jr., National Economic Research Associates, "Let's Put Marginal Cost Pricing Into Perspective," February 13, 1977.

of other resources to take their place are productive reactions to higher energy prices. Admittedly, doing these things won't make us *like* higher prices, but it will make certain that the energy we need is there when we need it—that we have something to buy with our energy money in the years ahead.

Mr. Kerlin: Questions?

From the floor: Could industry combat rate discrimination through cogeneration?

Mr. Wishart: I don't think so. I'm taking your question quite literally. Could it avoid the impact of rate discrimination by doing more electricity generation and cogeneration? Yes, it could. The recent study commissioned by DOE—I don't think it's been published yet—suggests that maybe one-tenth of the steam that is raised represents an opportunity for additional cogeneration.

There's a great deal of cogeneration going on, as I think you know. In our own plants more than half of our electricity is cogenerated and has been for 50 years. It's a common industrial practice where there is a combination of a large steam load and electrical appetite.

From the floor: I'd like to ask you a question about marginal pricing in relationship to natural gas. If we go to deregulation (at the wellhead) as well as marginal pricing, since the northeastern states are so heavily oriented towards the Arab oil, I would be afraid that they would buy more gas than they are buying now and would defeat the purpose of conservation and marginal pricing.

Mr. Wishart: Well, we may have an opportunity, in fact, to see what happens there. I don't know how this compromise is going to turn out in Congress, but in any case it wouldn't deregulate natural gas for interstate pipelines before 1986, I would guess.

I would think that the supply-demand situation would eventually equilibrate out so that the price of gas would be at least equal to that of oil (imported oil), and it should, of course, be higher. It's a premium fuel. I think that would be a long time in the future, because I think the actual, average price into the interstate pipelines is still only around 70¢. The new gas is something over $1.42. In the interstate market we have been up to $2.35 and come back down again. And to tell you the truth, because of a promise of deregulation, because of the higher costs being allotted or allowed by the FERC at the present time, and because of the lessons of last year, which led the gas companies not to dump as much gas last summer but rather store it, I really don't think there is a natural gas problem except maybe in one or two pipelines. And that's a local situation.

I happen to be aware of some gas wells that have been shut in, not because anybody is trying to get the price up. The contract's signed, it's a takeover contract with the pipeline; the pipeline can't find customers for the gas. I think that's a beneficial effect of even the promise of deregulation.

I happen to be a believer that we will find at least a maintenance of supplies at around 19 trillion for the next 10 or 20 years, maybe involving, of course, importation of Mexican gas, which is guite a bit.

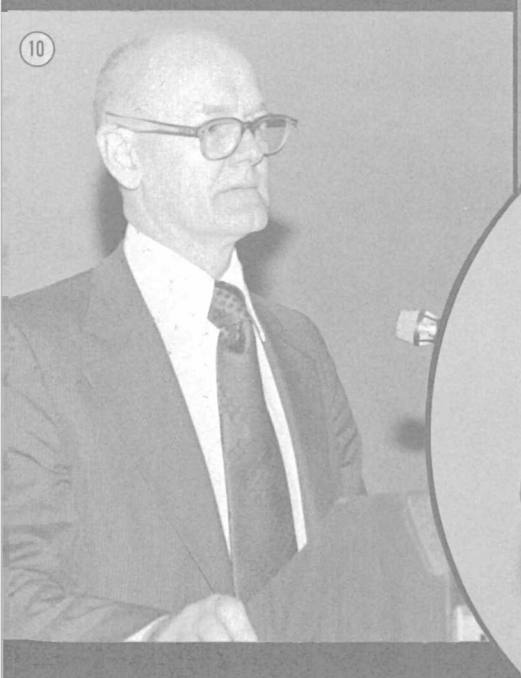
Now, what is actually happening with industrial users of gas? There are companies like mine that have been for five or six years anticipating that since they are "low-priority users in the boilers" they will not have gas available to them. So we've made very extensive investments in substitute fuels, principally petroleum because we can do that quickly. We are going the next step to coal, and that will take us six or seven years.

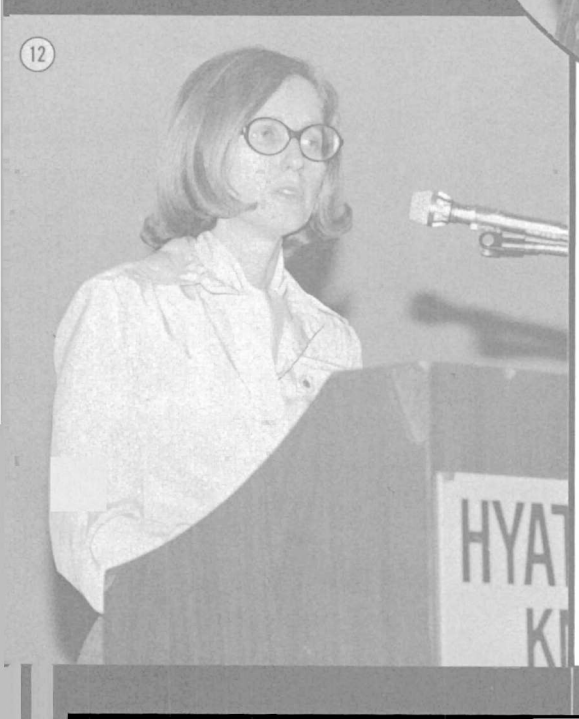
Now, that is not uniform. There are some major industrial firms, even some represented in this room, who now perceive that in the areas where they use gas they will not, in fact, be short, and they have stopped further investments in the oil step. They will go directly to the coal step.

I think the principal problem you see in the northeast is that pipelines with low average costs for a large volume of gas would raid the market in a completely deregulated situation. They would drive the price of the incremental quantities of gas out of sight because they can average it into the large base volume they have. That is the one hazard I see in total deregulation. Of course, one of the big hangups is that the intrastate market wants to protect itself. But it is true that in a deregulated market for that material the prices have gone up and since the supplies are adequate they are coming back down.

Mr. Kerlin: Thank you.

PUBLIC AWARENESS SYMPOSIUM





MODERATOR
Jake F. Butcher

SPEAKERS

8. Aubrey J. Wagner
9. Herbert Foster
10. Robert C. Thomas
11. Leon Lynch
12. Maxine Savitz
13. Gov. Ray Blanton
14. Margaret Maxey

PUBLIC AWARENESS SYMPOSIUM

Introductory Remarks

General Chairman George R. Jasny: Good morning, ladies and gentlemen. I'm George Jasny. I am the general chairman of the WATTec Conference and it's my very great pleasure to welcome you to this third day of the fifth annual WATTec Conference. We have had two splendid days heretofore and it looks like the third one is going to be in the same vein.

I really am here not only for the purpose of briefly welcoming you, but also to make a few business remarks. First of all, I know that a large number here don't know what WATTec is all about. I will tell you that it's an interdisciplinary energy conference now in its fifth year. The acronym stands for welding, testing, and technology. The conference came about because five years ago a very small group of welding and testing engineers had the gall to think that they could do something about educating the technical community about the energy crisis, which at that time was created by the Arab oil embargo. Since then WATTec has come to stand for a great deal more than that. It has come to stand for cooperation among about 4,000 technical people in the Knoxville-Oak Ridge area, people who heretofore were practically strangers to each other.

With this year it has come to stand for another major leap into community involvement. Thanks to the leadership of Jake Butcher, we have this year a great deal of nontechnical involvement in thinking and worrying about how to get the public to understand and do something about the energy situation that this country faces—an energy situation which we face now and will continue to face in years to come. Mr. Butcher will be the chairman of today's session.

As with all ambitious conferences there are always some last minute problems. Without going into any great detail about it, I'm sure you can appreciate that the coal crisis (which fortunately appears to be on the way towards settlement) has been a major concern to the President and to every governor of this country, particularly the governors of the coal states. Until about 5:00 last night we were all set to have a very fine, innovative Governors' Round Table to support the very fine program that we will have today. Unfortunately, Governor Carroll, who appears to have become the President's major governor-helper in connection with the coal problem—partly because Kentucky is the largest coal-producing state in the nation—was called away. Therefore, we have had to eliminate the Governors' Round Table from the program.

However, Governor Blanton is here. He arrived here late last night. We have been in touch with his staff, and it has been our recommendation—I believe it will come to pass—that sometime this morning Governor Blanton join us for some remarks. We know he has

been in touch with the White House throughout the day yesterday. Hopefully, he will not only have something to say to us in a general sense, but he may bring us some of the more detailed, up-to-date tidbits about the coal settlement.

I am pleased to say that all of our other speakers are here with one substitution. Mr. Herbert Foster will speak for Mr. Bagge of the National Coal Association. Mr. Foster is a vice president of the National Coal Association. Again, I'm sure you can appreciate with the coal crisis being in the situation that it was in yesterday, it was almost predictable that Mr. Bagge was going to have to stay close to the telephone in Washington.

One advantage that the elimination of the Governors' Round Table will have for this group is that we will be able to proceed at a more leisurely pace. There will be time for questions after each speaker, and with this fine audience I'm sure that there will be as many questions today as there were in days past.

Again let me thank you for being here on this beautiful Saturday morning. I know for some of you it took a certain amount of willpower to come here instead of staying in bed or playing golf. I'm sure you will find this a stimulating and worthwhile conference. Mr. Butcher, with our thanks, the program is yours.

Jake F. Butcher: Thank you, George. Good morning. Maybe some of you wonder why I, as chairman of a bank in this Southern Appalachian region, the largest bank in the region, would become so interested in this WATTec Conference and with the Public Awareness Symposium which we have today. I do recognize, as all of you recognize, that energy has to be the key issue in the continuing industrial development and economic growth of our region. Indirectly, it's going to affect all of us. I think you'll also agree that we live here in East Tennessee in this valley in the energy capital of the world, and we also hope this will be the site of the international energy exposition in 1982. We have completed just about all of the very critical phases for the energy exposition through local, state, national, and international levels. Sometime this summer, hopefully, we'll have the bonds sold and we'll be able to host this international energy exposition.

The theme for this year's symposium is "Energy in the Tennessee Valley Region," that is, the area served by the Tennessee Valley Authority. It's an area of some 80,000 square miles, where 8 million people live. As you know, TVA is our country's largest utility. In fact, only two states—California and Texas—produce more electricity. Tennessee gets 98% of all its electricity from TVA. About one-third of all electricity in Kentucky comes from TVA; and Mississippi and Alabama get about one-fourth of all their electricity from this source. Georgia, North Carolina, and Virginia get small amounts.

Coal and nuclear power are vital to TVA. We all have a big stake in TVA's continued growth and capability to supply the electricity needs for our homes, businesses, and public institutions. We all know that abundant jobs and a healthy economy require an economical and reliable energy supply. Recent events have heightened our awareness of this intricate relationship: namely, the 1973 oil and gasoline prices, the natural gas shortage of 1977, and the deepening crisis of our coal supply which we are now facing and agonizing through. (Hopefully, we now have a negotiated settlement, as we all heard last night and this morning.)

We in the Tennessee Valley region have unique characteristics that distinguish our energy picture from that of other regions of our country. Coal and nuclear power will be vital to our energy growth. Furthermore, conservation offers additional leverage in meeting our energy requirements. Another factor of importance is the Tennessee-Tombigbee waterway,

which is about one-fourth complete and is scheduled to be in operation in 1984. I personally take a lot of pride in thinking that I have had some little bit to do with the continuation of this waterway. I have helped, as many of you have helped, convince the President that we need to continue funding the completion of this project. It will greatly facilitate the movement of the Appalachian coal in the Southeast when it's completed. It will also mean over 40,000 jobs in Tennessee alone, and many more jobs in neighboring states. It will greatly increase the Tennessee Valley's access to world trade.

Recently, the Bureau of Labor Statistics estimated that employment in the Southeast will grow 30% faster than in the nation as a whole through 1985. Let me assure you that for such employment opportunities to come to reality we must plan our energy supplies and avoid energy wastage. All of us want a strong America, but not everything can be done by the federal government. If you strengthen the energy security of your community, you strengthen the energy security of your state; and if you strengthen the energy security of your state certainly you strengthen the energy security of all America.

This regional forum recognizes that the energy issues have outgrown simple technical concerns. Broader elements in our society, including business, labor, and political groups must all be involved.

Our speakers today will give you their views on energy from the perspective of their own particular sectors. All have eminence. Some are well known to you, and most certainly all will speak with authority. Their views are not the same, and there has not been an effort among us to coordinate them. But the thing they share in common, which they share with me, is the conviction that it is essential to provide the public with the facts about our energy issues.

8. Electric Energy: The Future is Now

Aubrey J. Wagner, *Chairman, Tennessee Valley Authority*

Mr. Butcher: Our first speaker today is Aubrey J. Wagner, Chairman of the Tennessee Valley Authority Board of Directors. TVA is the nation's largest energy utility, and they have been challenged to provide a new yardstick for energy-efficient and environmentally-acceptable power production utilization. Mr. Wagner will speak to us this morning on "Electric Energy: The Future is Now." I give you Mr. Aubrey Wagner, Chairman of the Tennessee Valley Authority Board of Directors.

Aubrey J. Wagner: Thank you very much, Jake.

The longest coal strike in the nation's history has reminded us again of how delicate and vulnerable the nation's energy pipeline is; and how crucially vital energy is to the world and the nation. Whether it is oil from the Middle East, coal from Appalachia, or uranium from the West, we depend on a constant flow of nature's resources for energy and, in a very real sense, for our survival.

The quintessence of our energy problem is this: we must find an inexhaustible basic energy source that can be harnessed at acceptable cost without causing unacceptable environmental side effects. Unless we find the answer to this problem (and I'm confident that we can), life as we have known it will soon be over. There are, of course, countless steps and details that must be worked out along the way—pricing policies, allocation questions, stretching existing fuels, and so forth. But we must not let them distract us from our fundamental task, or we will have done no more than briefly postpone the day of complete national disaster.

Unless the coal strike is finally settled very soon, we will begin to see a very small sample of what a permanent energy collapse would do. As things stand today, this is the way the power supply looks in the weeks ahead in our region: As of today we have 1.8 million tons of coal in our stockpile. That's in 10 of the 12 plants, 10 of the 12 largest ones, and this is a supply for 24 days at normal burning. A few weeks ago we were losing about half a million tons a week from our stockpile. Last week we lost 112,000 tons only. This is due to the fact that the weather warmed up a little bit, we're getting a little more coal, and people are really conserving energy and helping us. So, it looks to me now as though, if the tentative agreement that's been reached is ratified by the locals, we should be able to get by without any industrial curtailment and resultant loss of jobs. That's certainly a goal we're working towards and I believe we are going to make it. But even after that, it will be from two to four weeks before coal starts flowing; so, it's important to keep up the conservation efforts in the weeks ahead.

I think, as Jake Butcher indicated, we are fortunate in this area in having a varied system of power supply. We are dependent on coal, of course, heavily. But we also have a good slug of hydro and a good slug of nuclear power; and while we don't like to run them, we have some wild card gas turbines that are a little expensive but that help us out in a pinch like this. So, we're in better shape than many sections of the country are from the standpoint of our basic supply and the variety we have in it.

Even after the coal supply gets back to normal, we still face some very formidable challenges through the rest of this decade and into the 1980s. The challenges arise from the fact that the demand for electric power is growing daily. The need for electricity in the 1980s and beyond will increase substantially over today's demand. It is imperative to our national well-being— economically, socially, and from a national security standpoint— that those needs be met. And candidly, unless something changes there is a strong possibility that they may not be met.

Continued population growth, along with an inevitable shift from oil and gas to electricity, will ensure that the demand will increase. While it is true that programs to encourage energy conservation along with the rising cost of energy will help to slow the growth rate, the rise in demand will still be substantial, and is certainly coming.

There have been many forecasts made for the 1980s and the years beyond. For the nation as a whole, a half dozen organizations who are close to the business have estimated that electric power demands will grow over the next ten years at annual rates that vary from 5.7 to 6.4%, depending on whose estimates you take. Considerable variation is estimated among different regions of the nation, ranging from 4.8% in the Northeast to 7.4% in the midcontinent area. In the TVA region, we estimate that during the next ten years our loads will grow at an average annual rate of 5.7%. These figures may be compared with a national growth rate of 7% (or perhaps a little more) in the period preceding the Arab oil embargo.

In absolute terms (rather than percentages), the nation's electric utilities are currently generating about 2 trillion kilowatt hours per year. Within ten years it is estimated that this will run to about 3½ trillion kilowatt hours nationally. In terms of peak loads, the annual peaks are currently running about 400 million kilowatts, and within ten years they will probably be in the neighborhood of about 650 to 700 million kilowatts.

On TVA's system, we supplied 118 million kilowatt hours in 1976, and we estimate this will go to about 210 million kilowatt hours by 1986. Our highest peak load in 1977 was 21.8 million kilowatts, and it has since passed that mark, reaching almost 22 million kilowatts in January of this year. We estimate that by 1986 we will have to carry a peak of about 36 million kilowatts.

All of these figures—whether you are taking regional or national peak loads or energy—average about 70 to 75% total growth over a ten-year period. That's a little slower than our doubling every ten years, which has been a standard formula for a long time.

These forecasts take into account factors that will tend to increase the loads as well as factors that tend to decrease them. For example, the national estimates include a projected population growth of about 50 million more people in the nation by the end of the century. This is going to account for about a 15 million increase in the number of households to be served in the next ten years. Electric energy is going to be required to heat those households and operate water heaters, appliances, and other conveniences that the American people now demand.

Over the next ten years, total employment is forecast to increase by 12 or 13 million jobs. It is going to take more energy to run the offices, the factories, and the shops where these people will work. As gas and oil become less available, in many instances electric energy will substitute for them. Thus, while growth in our total use of energy may slacken or even tend to level off, our use of electricity will continue to rise. And that's important to recognize when we face such questions as whether or not we're going to build nuclear plants and what we are going to do about our coal-burning plants (whether we're going to stand in the way, hold them up, or let them go ahead).

Increasing amounts of energy will also be required for cleaning the environment. For example, air-cleaning equipment is being backfitted on existing coal-burning stations (as well as on new stations) and will consume as much as 10 to 15% of the output of those power stations. This not only requires the addition of more capacity to meet growth loads in the future, but it reduces the capacity that's already available to serve present needs.

For instance, we have a 17,000 megawatt capacity in coal-burning facilities in our system. If you figure that 10 or 15% of that would go to handle air-cleaning equipment, a pretty good slug of capacity is gone from what we now have available.

The automobile, as we all know, is a major user of energy in this country. Now, it's granted that we are going to have to have more efficient automobiles in the years ahead. I am persuaded that the American people are going to continue to drive automobiles; and I think they should be able to. To what extent will this load be placed on the electric utility industry as our oil supplies begin to dwindle? The answer to that question can profoundly affect the amount of electricity we are going to need in the years ahead. For example, we estimate that a small, lead-acid battery-powered electric automobile would add about 5,000 kilowatt hours a year to the average homeowner's consumption. About a third of the present average in the Tennessee Valley would be added by a single, small, lead-acid battery-powered automobile. Nationwide that's about 50% of the average consumption at the present time in the average American home. More sophisticated electric cars that are capable of the kind of range and speeds that we expect of them would add even more.

So far I have been talking about factors that increase our power loads. There are, of course, also factors that will tend to reduce the consumption of electricity in the years ahead:

1. The inevitable increase in price will undoubtedly be a factor. As prices increase, the incentive for conservation will become greater.
2. More homes are being insulated and new homes are being built with energy conservation as a major objective.
3. Heat pump sales are booming.
4. The efficiency of appliances is improving, and more will be done in this area as the years go on, I'm sure.

In addition to price as an incentive for conservation, a growing public awareness of the importance of conservation has a very substantial impact on our energy use. In the TVA area, our load projections have been made, first, without taking into account either the effects of conservation or the substitution of electric energy for other energy sources. Then we have separately estimated the impact of conservation and the impact of substitution. The net effect of these two factors will be to reduce our total load ten years hence by 6.9%. That is the combined effect of conservation and substitution of fuels, the result of an estimated 10.3% reduction from conservation and an increase of 3.4% from substitution. Those are not goals; they're our best realistic estimates of what we expect will happen.

Among residential consumers, the net effect is nearly twice as great: resulting in residential loads of 12.2% less than they would be without either conservation or substitution. We think residentially that conservation will reduce our load about 14.1%, while substitution will increase it by only 1.9%. Now that's an estimate from our people. I'm sure they're right. I'm surprised that substitution doesn't increase more than that, and I think they may find that we are in for a surprise here.

Now that we've established that the demand is going to grow, how will we meet it? Those who are responsible for planning the nation's power supplies, as contrasted with those who tell us how we should do it, will agree unanimously that the only available technologies for new large-scale baseload generating stations are fossil-burning steam plants or light-water nuclear reactors. We can talk about other things, but when it comes right down to what do you order to put power on the line, you have your choice of either fossil-burning plants or light-water nuclear reactors at the present time. This will certainly be true for the 1980s and probably for the balance of this century. Since oil and gas should no longer be burned under boilers, the choice boils down to coal-fired or nuclear-powered steam plants. And this is where the fireworks start.

Those who are opposed to nuclear power say, "burn coal." Those who are concerned about air quality say, "go nuclear—or solar—or solve the problem with conservation." The fact is that we must use coal, nuclear, and conservation—all three—at the same time we research fusion, solar energy, and other forms which have promise but are not yet technologically or economically available to us.

True, we will get help from some of these in bits and pieces, and we need all the help we can get. There is, for example, a cooperative program between TVA and Maryville College to demonstrate conversion of sawdust and wood waste to gas and fuel oil using the same process that turns wood into charcoal. Programs like this may help us buy some time in meeting energy demands, but not much time. Maybe five minutes in 24 hours, something like that. There is energy potential in wood wastes and cull timber. But I believe raising wood to burn could be a mistake. Land is too valuable. And wood is too valuable for other uses. It might be like breaking the doors off of your house and burning them to keep the fire going.

Baseload electric generating capacity from large coal or nuclear plants is what's important, and we must get new capacity on-line to keep up with the growing demand for electricity. This is imperative. We've got to start thinking about supply as well as conservation, although I don't mean to downplay conservation's importance one bit.

A year ago, the Federal Power Commission (FPC) warned that regional electricity shortages are a distinct possibility in the first five years of the 1980s, unless planned power plants are allowed to begin operating and several other conditions are met. The FPC said, for example, that higher demands for electricity, coupled with delays in the operation of nuclear plants, will ensure shortages of energy capacity. I didn't say they might create them, I said they would *ensure* shortages. And I'm sure that's right. The situation this winter for the TVA power system in the face of bitter cold weather is a case in point which illustrates the accuracy of this forecast. Our immediate problem, of course, is one of energy rather than capacity, but I want to talk about capacity for a moment.

As you know, we have been in a continual power emergency during the extremely cold weather this winter. The reason is very simple: we have not had adequate capacity to supply power on the very cold mornings when heating demands were extremely high. One reason

for this continuing problem is the licensing and regulatory delays in our Sequoyah nuclear plant. These delays have prevented it from being on-line yet, even though it was planned to be on-line five years ago. This, coupled with manufacturer's problems for our Raccoon Mountain pumped-storage project which have delayed it for two years, left us about 4 million kilowatts short of our planned capacity to meet our loads this winter. It goes without saying that if we had had that 4 million kilowatts available it would have been like manna from heaven.

As a consequence of these delays and this scheduling problem, we have seen times this winter when we were able to carry our load with only a very razor-thin margin. I think one time we were riding the tie lines entirely; there was no reserve at all. An emergency outage at any one of our medium to large generating plants would have required our dropping firm load to avoid losing our system. We have never had to drop firm load yet in TVA and we are very proud of that. That's a record we'd like to maintain, but it's getting more difficult with each passing year.

As the months and years go by, unless schedules for planned power plants can be regained, the certainty of continued load growth will, as FPC warns, ensure shortages. In other words, while "deferral," "postponement," and "delays" sound harmless enough years before a plant is scheduled for initial operation, they are, in reality, insidious and they plant the seeds of disaster of major proportions. It's one thing to sit in an office far removed from the scene of battle on a nice warm day and say, "Well, what if we do delay this plant six months, it won't hurt." But when that six months gets here, if it's the bitter cold winter we just had it looks quite different. We have to remember that as we plan these things in the future. Unless we eliminate the causes for that delay we are in trouble from now on, I think.

In the case of nuclear plants, particularly, something must be done—and now—to create a climate in which a utility can get a reasonable schedule for construction and then stick to it. As an example of the growing regulatory load, a licensing review panel of the Atomic Industrial Forum reported this month that nuclear plants being designed in 1972—five or six years ago—were subject to 32 Nuclear Regulatory Commission (NRC) guides. That number doubled in 1973 alone, and today there are some 250 regulatory guides or NRC technical positions either in existence or under development. Two hundred fifty instead of 32 in five or six years.

A nuclear reactor designed in the 1960s required about 500,000 engineering manhours to design; a contemporary reactor project consumes 3.5 million manhours, an increase of 700%. A typical plant's Preliminary Safety Analysis Report (PSAR) used to fit into two volumes; today it requires thirteen. Environmental reports in the 1960s took a single volume per plant; now ten volumes of data are required at the construction permit stage and twelve for the operating license review. The engineering drawings for a nuclear plant once covered 2,200 pages; now they fill 45,000 pages. Some of this, gentlemen and ladies, is to be expected in a developing technology. And we absolutely must make nuclear plants as safe as humanly possible. But we also need to place greater emphasis on standardized designs and somehow freeze the design so that it isn't changed again and again after construction has started. This business of design changes and having to rip things out after the plant has been built is crazy and it's got to stop. We need to speed the licensing process. We need to eliminate frivolous intervention by those who oppose the plants.

I'm not talking about serious, legitimate involvement by the public. I think that's needed. I'm talking about delay for delay's sake which costs time and money, and,

ultimately, may cost the entire nation a great deal more than that if electric utilities are not able to meet power demands. The cost goes far beyond the dollars that are added to the cost of the plant. We need early review and approval of potential power plant sites to help speed the process.

And I'd like to reiterate my very strong belief that we need to move ahead with a vigorous research and development program to bring the breeder reactor to the point of commercial use. To most of you my views on the breeder are very well known by now. It will give us the inexhaustible energy source I defined at the outset—or at least it will buy the time that we need to develop something better. I believe it will be needed by the end of this century. I'm firmly convinced of that and I hope I live to see my prediction come true. I hope we have it, too. We should be working now through projects like the Clinch River project to have it available as a commercial option by that time—available as a commercial option, I say. Construction of the Clinch River project does not commit us to widespread use of breeders or to the plutonium age. It simply moves us a necessary step closer to making the breeder a commercial reality, to be there if we need it.

In closing, let me say that few among those who in the 1960s forecast today's energy needs visualized the oil and gas shortages we face today. No one could foresee all the changes that would occur. There was a time when coal cost $4.00 a ton and when the environmental impacts of burning fossil fuels were almost unrecognized. Undoubtedly, as we look ahead to the 1980s and beyond there are factors that will affect demands and our ability to meet them that are not now apparent. But one thing is clear. The capacity must be there to meet the loads when they arise.

The coal strike settlement and the prospect of a balmy spring around the corner may make the crisis invisible again. It will stop hurting for a while. But the fact remains that the problem has not gone away and it will not go away. And not until all of us—legislator, utility official, regulator, researcher, design engineer, producer, and consumer alike—apply our best efforts will we solve it.

Our goal in this energy business, it seems to me, simply has to be to provide all of the energy that the people of this country honestly need at prices they can afford without unacceptably altering the environment. If we keep our eyes on that goal, I think we'll come out of this fine. If we don't, we're in trouble. Thank you very much.

Mr. Butcher: We have approximately ten minutes in which we can field questions directly to the speaker.

Mr. Wagner: Anything at all. Yes.

From the floor: Yesterday, Mr. Wagner, I asked your colleague on the TVA Board about how he would go about handling the waste management problem at nuclear power plants. Do you have any comments on the approach?

Mr. Wagner: Well, it seems to me that the problem in handling waste management from nuclear power plants is largely one of persuading the public what will work. I'm satisfied that the long-life wastes (I think that's what you're talking about) can be converted to ceramic material or confined in ceramic material very far in the ground and the radioactivity that escapes to the surface will be no more than we get from the uranium that's in the ground now.

I think the technology is understood. It's too bad that we didn't go ahead and manufacture some wastes and store them years ago. My understanding is that the matter was not considered urgent because there were no wastes to be stored, really, from the

nuclear power business. There were some military wastes that could be stored, of course, and so with a typical scientific approach we figured we'd keep looking for something even better. As a consequence, the public now feels that there is no established safe way to dispose of them.

If you're speaking about Mr. Freeman, I wasn't here. But I know he feels that perhaps TVA should be in a position to participate with the Department of Energy or someone in a test arrangement. I would be glad to see that done if it's feasible. I'm not sure whether it is at this point.

From the floor: Mr. Wagner, yesterday a speaker discussed the pressure to redistribute the rates, giving poor people the benefits of a lower rate and passing higher rates on to someone else. What is your feeling relative to that direction?

Mr. Wagner: Well, my feeling is that every rate should be based on the cost of providing that kilowatt hour. That if there are problems that poor people have in paying the electric bills or any of their bills, the problems ought to be approached as social problems (which they are); they ought not to be left to the utilities to handle. The reason is I think this is a very imperfect solution. For instance, the most common and appealing method (and many state legislators have gone for it and some regulatory commissions have gone for it) is a proposal that we use the so-called lifeline rate. You sell the first 500 kilowatt hours (or something like that, 500, 700 kilowatt hours) at a reduced rate and after that you'd pay higher rates.

Well, in an area like this, particularly, where there is a great deal of electric heat (41% of our homes are electrically heated), you will find many of the high heat bills come from the very poor people. The poor folks who have bills of 500 kilowatt hours, that's $15 a month, say, don't come in and complain. The people who complain are the poor folks who have bills of $100 and $150 a month. They get socked right in the nose.

The fact is that many of our poor live in homes that are poorly insulated, and they have electric heat because it was easy to put in. We made a study in Chattanooga on this subject a year or two ago. We investigated consumption in three areas: one medium income, one high income, and one low income area. To summarize that study in a sentence for you, if we had put in a lifeline rate there we would end up with 25% of the low-income people helping to subsidize the electric bills of 50% of the high-income people. The reason is that many of the high-income people heated their homes with gas and oil, or they had second homes or something like that. I think tinkering with rates to try to accomplish social objectives is not the way to get at it.

There are some things that can be done with rates that are based on cost. We are experimenting with some peak load pricing, as you know, in Knoxville, where if it costs us more to supply electricity on peak the consumer would pay more for it if he used it on peak. There's a question there. The reason we are experimenting is to find out whether the cost of billing and metering and so forth is enough to offset the savings. You may remember that a special meter for peak load pricing costs $100 a household. An ordinary meter costs $15, I think. The savings has to be great enough to overcome that higher meter cost. I think it may be. That's the area in which there's an opportunity to do something with the rate, I think, to help the power supply situation and help everybody's cost of power.

But to try to solve low-income problems with electric rates is wrong in my mind. If we are going to tackle the question of helping low-income families with their electric or utility bills, I believe we ought to, first of all, be sure that their houses are insulated so that they're

using their energy efficiently. Then we should let the social welfare agency decide who needs help and handle it with energy stamps or something like that. I think that's the way the problem should be approached—as a social problem, which it is, not as an electric rate problem. I don't think the electric utilities are in a good position to know who needs help anyway.

From the floor: Mr. Wagner, you mentioned the increased costs of peak power units. Do you have cost figures of the differences between your hydroelectric generation versus fossil or coal versus nuclear versus your peak unit?

Mr. Wagner: Yes, we do, and I can give you some from my head. Our hydro power costs about 1 mill per kilowatt hour. This is at the bus bar, at the generating station. Our nuclear power costs about 5 or 6 mills, our fossil-fired power about 11 or 12 mills, and our oil-fired gas turbines about 35 to 40 mills. That's roughly it. Now, people say, "well, but that nuclear power sounds low." Actually, it was lower than that one year; generally it may be lower now in relation to coal-fired than it would be in the long run because of the very favorable fuel price we got for our Brown's Ferry plant. But I'm satisfied that nuclear will continue to enjoy a cost benefit of about 30% below coal-fired plants. And depending on what we ultimately decide we need to do on air quality it could be even more than that. We have to burn more coal and we've got to learn how to burn it, but we have problems with air quality that certainly have to be reckoned with as we add new plants.

From the floor: Mr. Wagner, based on those figures, how do you justify giving lower rates to large industrial users on the basis that it costs less, if it really does cost more if you use these high-energy sources when you have to produce a lot of electricity?

Mr. Wagner: If you are talking about marginal pricing, I'm not very good on that; but I don't believe in it. The industrial sources cost less generally to supply power to than residential customers. This is because they take a big slug of power through one meter and many of them operate around the clock. That's just the way the costs figure out. I know a lot of people can't believe that, but it's true, partly because of the cost to distribute. The power companies have to go around and read a meter for each customer, and it takes about as long to read a residential meter as it does an industrial one, perhaps longer. There are other factors that go into it, but in general if you're interested in that and want to pursue it, I'd be glad for some of our rate people to talk with you. I'm convinced that our rates are fairly set as between residential and industrial consumers, because the industries that we serve have had cost studies and rate studies made which prove that we are slugging them and that they are carrying the residential customers. And, of course, residential customers feel they are carrying the industrial customers. I think we've got a pretty good balance, really.

From the floor: Mr. Wagner, we are hopefully going to be through the coal crisis, but I think it's appropriate for us to look back. From your perspective are you satisfied with the planning situation that we had in our attempt to get ready to handle the emergency preparedness if the coal strike had continued or if it does continue?

Mr. Wagner: Well, you're never satisfied with something like that, but I think the planning that was developed is about as good as anyone could do, yes. Do you have any particular point that worries you about it?

From the floor: Well, I guess from the first standpoint, the request to have a voluntary 20% cutback in electrical utilization in the Tennessee Valley region. Do you feel that you got the sort of response that you had expected? And do you feel that when the next time comes we have to look to a curtailment of electrical energy usage? Will we follow the same paths

next time or do you believe we need to implement better measures to allow us to get a better response from the public on a voluntary 20% cutback? From your perspective were we going to have the proper organizational structure setup to handle the 30% forced power cutback if it had come?

Mr. Wagner: Well, the 30% power cutback on industries, I think, would have been handled satisfactorily, yes. Either our directly served industries or industries served by distributors. That can be fairly well accomplished. As to the impact on residential consumers, I'm sure you realize there's no way you can go around and read everybody's meter and see how much they use. We have to make that voluntary.

Our response, we think, has been very good. The thing that concerns me about it, though, is that we had a request for voluntary conservation in effect before this occurred, and many people were saying, "well, I've already got my thermostat down to 60° at night and 65° in the daytime and I can't cut another 20%." And I know that that's true. But there are things that we could suggest, I think, maybe cutting off water heaters and that sort of thing. I just don't believe, though, that we are ever going to have to face that in the Tennessee Valley. I think we've got enough diversity—the hydro that we have and the nuclear power that we have and if something goes wrong with one of those we've got the coal power—so we can handle our residential load if we get genuine voluntary conservation. I think we've been getting it.

One thing about the second conservation step. If it had been necessary to go through a 30% cut on industry and people started losing their jobs as a consequence, I think there might have been some people who hadn't been conserving fully in their homes who would have seen the need for it. And I believe we would have gotten some more in the second cut.

From the floor: Your comment about the fact that many people are already conserving and find themselves when they are faced with another request for 20% not having a margin to work with is one of the points that I was addressing or questioning. Are you going to factor that? I'm sure that you'll be factoring that into the planning—I don't know whether it's called the second stage or third stage in the TVA plan. Do you really feel that we have an appropriate 20% voluntary cutback available to us that TVA can use in their planning for possible problems in the future when we have problems with peak load?

Mr. Wagner: Don't probe into our family secrets too deeply! We naturally have to make allowances for what we think we will get. As things would tighten down, if it had developed or if it does still develop, I think people will see a necessity for doing it. Or else you are going to face rotating blackouts, and by the time we get something like that the need for conservation takes hold pretty quickly.

From the floor: I just want to discourage TVA from using the peak power rate. I'm not one of them, but I know that there are many women who work because they are poor and when they go home at night that's the peak time and that's when they have to do their work.

Mr. Wagner: Well, thank you for that observation. The peak rate at night goes off at about 10:00, I think, so some things could be done after that perhaps. But I know what you mean and I agree. Let me say just briefly that's one reason our peak rate and our off-peak rate are at about a ratio of 3 to 1 instead of 12 to 1 as some people have urged. We have set it up that way to reflect the actual difference in cost as nearly as we could instead of making the on-peak rate a penalty. I don't think people ought to be penalized for doing things. I don't believe in trying to shape their lives for them beyond the extent to which the cost alone will do it. I'm glad to have that observation. Thank you.

9. Coal Prospects in the Tennessee Valley

Herbert Foster, *Vice President-Public Relations, National Coal Association*

Mr. Butcher: Our next speaker is Herbert Foster, Vice President-Public Relations of the National Coal Association. Coal is this country's most abundant and accessible energy resource. It is destined to play a major role in achieving the goals of the President's National Energy Plan. Mr. Foster will speak this morning on "Coal Prospects in the Tennessee Valley." Mr. Herbert Foster.

Herbert Foster: You are very kind to accept a substitute. When my boss, Carl Bagge, found that he had an unavoidable summons to go with some of the members of our Executive Committee to see the Secretary of the Interior today—and it was today or never—I was called upon to speak in his place. Last October, when he accepted an invitation to speak on "Coal Energy Prospects in the Tennessee Valley," he didn't foresee he would have to make it clear that his remarks were based on prospects for the next seven years and not the next seven days. If you want to talk about coal in the 1980s, I'm your man. If you want to talk about coal for next week, I'm afraid I can't help you.

The National Coal Association represents the coal industry in Washington, D.C. in every field but two. We stay away from prices, because it makes the Antitrust Division of the Justice Department very nervous, and we stay away from labor matters, because they're the bailiwick of the Bituminous Coal Operators Association. Our bylaws tell us to stay away from labor relations. Our Board of Directors very pointedly tells us to stay away from labor relations, and our instinct for survival tells us the same thing. Therefore, I can't say anything directly or indirectly about the strike, the settlement, the prospects for rank and file ratification, and the timetable for the mines resuming full production.

But when production does resume, as it will, the coal industry will have some shining prospects for growth in the Southeast, and some very considerable obstacles. As a matter of fact, coal has long been the mainstay of this lower right-hand portion of the United States, and coal will continue to be its strength and its salvation. Coal from the Appalachian ridges here along the spine of the East is among the finest in the world. I predict that Appalachian coal—not imported oil to any important degree anymore and no longer natural gas even along the Gulf Coast, but rather the rich deposits of southeastern coal—will be the propelling force in the southeastern economy for years to come.

There will obviously be continued and increasing use of atomic energy in the region. I think—and I haven't heard Mr. Wagner say anything I disagree with—that it will by and large play second fiddle to coal. The TVA is even now in the process of selecting a site for yet another nuclear plant; but TVA is still the largest consumer of coal in the United States.

Let me digress here a moment to say that we coalmen are quite comfortable now with the competition of atomic power. We're awfully glad that it exists, because the nation is going to need it. There was a time a few years ago when the first TVA plant at Brown's Ferry nearly did us in. That was back in the middle sixties when the proponents and promoters of nuclear plants were talking of 4 mill power. If that didn't quite meet the dream of David Lilienthal, who once prophesied nuclear power too cheap to meter, it was still a lot cheaper than coal-fired electricity even then. And in the face of that kind of talk in the heart of coal country, it was pretty tough to get investments in coal mines. It was also pretty tough to get long-term contracts for coal.

Of course, time went by. Four mills turned out to be a lot cheaper than nuclear power, too, then or now. So the idea of fantastically cheap power has gone glimmering, and now the nation's leaders talk about doubling coal consumption by 1985. We realize that the nation is going to need all the power it can get from both coal and nuclear reactors (and every other economically feasible domestic source, if there are any) to meet the demands of the future.

Our chief concern is not finding customers, but finding ways to satisfy them. And that involves in a great many cases either getting government out of our way or getting answers to a lot of unsolved problems that involve government. That, in some measure, is what I want to talk about today.

Unfortunately, in the five or six weeks since the current session convened, the Congress has not made very remarkable progress toward enacting the bill which embodies President Carter's energy plan (or as much of it as has survived the trip through the Senate and the House with their varying ideas of what it should look like). When President Carter proposed his energy plan almost ten months ago, he said in his address to Congress that we need to increase the production and use of coal by 400 million tons a year by 1985. At that time, we mentioned one of the President's products: we said, "Peanuts." Later, when the elaborations of his energy plan were published, it appeared that the 400 million tons was a rhetorical minimum and he was talking about essentially doubling the 1976 production of coal. So that instead of 670 million tons, he was talking on the order of 1¼ billion tons. The 670 million was the 1976 production, and he was talking about 1¼ billion tons in 1985. Most coalmen would agree that this is a desirable destination, but a few of them quarrel with how the government plans to get there.

Essentially, the government plan is what I regard as tinkering with the system. They propose mandatory switching to coal burning in existing plants, although under the late-lamented Federal Energy Administration the government tried for three years and got nowhere with that idea. The plan also entails requiring new utility and heavy industrial plants to be built with a capacity to burn coal. It entails imposing heavy taxes on utility use of oil and gas and tax incentives for conversion of plants to coal.

In short, with the government pushing and hauling every inch of the way, the nation is intended to have twice the reliance on coal that it had in 1976. Big deal. The fact is that while government is still struggling in Washington to write the program into law, out in the real world it's already beginning to happen. And the propulsion comes from the forces of the marketplace.

In fact, the influence and intervention of government has been largely counterproductive. Fifteen months ago, back in November 1976, when the Federal Power Commission made a study of where the electric utility industry was headed (some five months before the national energy message), the Federal Power Commission staff reported

that the utility industry had notified it of firm plans to build about 250 coal-fired generating plants by 1985. These units would use about 400 million tons of coal a year. In other words, the utility industry had already looked ahead to its 1985 needs and made the basic decisions to cut out oil and gas as future fuel for its new plants and make the commitment to coal. This was a major change, of course. Five years earlier the utilities had planned to increase the use of oil and gas as fuel. The 1973 Arab oil crisis changed their minds dramatically and so did the accompanying increase in the price of oil.

But this was a marketplace factor, not a government action. I must say in candor that since the delivery of the energy message the chief product of government, and I mean the Congress as well as the Executive Branch, has not been help for the coal industry but hobbles. This only continues a trend that began a few years ago, but a great many of the hobbles have been locked in place in the last few months.

We have seen the passage of an exceedingly restrictive and, in my view, needlessly rigid surface-mining bill. We fought that battle and lost, and there is no point in reopening it now. However, we are appalled by the regulations issued by the Department of the Interior to implement that bill. In some crucial respects, they go far beyond the rigid requirements of the law. We are trying to get these excesses removed through the rule-making process, the regular procedures of government. However, the law also contained a deadline. If we are ever going to have recourse to the courts, we had to do it within 60 days of the time of the issuance of the rules.

Therefore, the National Coal Association has asked the federal courts to review these surface-mining regulations. We are joined in this suit by more than 80 coal companies and the American Mining Congress. Independent suits were filed by a number of other large coal companies, some coal-producing states, and other interests. During the Congressional debate on the surface-mining bill, someone said that it would cause the coal industry to have more lawyers than miners—and so far it looks as if he may be right.

There is another concern of the coal industry here in the Tennessee Valley. That's the Clean Air Act, which has ruled out the use of high-sulfur coal in new plants unless they are equipped with scrubbers. This act has also imposed severe restrictions on the use of much of the local coal in existing plants. Mr. Wagner can tell you a good deal more than I can (and probably with a good deal more heat) about TVA's long negotiations with the Environmental Protection Agency over scrubbers. Unfortunately, he didn't win all the way. This is no small matter. It's going to involve multiple billions of dollars, which are going to have to show up in power rates.

I don't want to be overly stubborn about this. The Clean Air Act, at least most of its major provisions, is here to stay and there is no use fooling ourselves about that. On the other hand, some of its provisions, and particularly some of the regulations issued or proposed under its authority, are a needless hardship to the nation. I don't know what the regulations implementing the 1977 amendments will say in detail, but so far we don't have great reason to be optimistic.

It's because of regulations and restrictions like this that Carl Bagge wrote a long letter to the President on January 12th. It was not simply a letter of complaint, but it laid out what we think is a compelling case. We said, in effect, "Mr. President, here is a list of 241 coal-fired generating units which the electric utilities say they plan to build in 1985." (We went back and surveyed the utilities and updated that November 1976 list. These are no dream world forecasts. These are firm plans and commitments.) "And here's another list. It's a list of 332

coal mines which the coal industry says it plans to open or expand by 1985. You say you want to double coal production and use by 1985? This shows we can do it."

We went on to tell the President that the new power plants will be burning about 400 million tons of additional coal in 1985. Industrial use of coal is expected to expand, the steel industry will come out of its current slump and increase its demand for coal, and there will be more coal exports.

The new mines we listed could produce about 600 million tons of coal in 1985. And those are by no means all the new mines on the drawing board; we only surveyed the 100 largest companies, who produced about two-thirds of the coal mined in the United States last year. There are hundreds and, indeed, thousands of smaller producers who mined about 250 million tons last year; and they also have expansion plans. In short, private industry has already made its plans and bet its dollars on projects that will meet and perhaps exceed the President's goal.

And then we came to the purpose of the letter. We told Mr. Carter we need his direct involvement to reduce or remove any unnecessary government obstacles. We asked him to direct federal officials to review how present and future laws and regulations would affect each of these planned facilities. If they find that government constraints will prevent or delay any of the projects or significantly increase their cost, then top federal officials should decide whether we need energy more than we need the objective of the regulations. As we told Mr. Carter, we hope the study shows no conflict between an ample supply of coal-based energy, as represented by his detailed plans, and any government requirements for environmental or other objectives. But we need to find out. We need to make some reasoned judgments now.

If increased and, in fact, double mining and use of coal is an important national objective (as Mr. Carter says and as we profoundly believe), then we, as a nation, should give some serious thought to whether we can reach that objective. We must analyze the real worth of any obstacles that stand in the way. If we can burn 1¼ billion tons of coal in 1985, that's equivalent to 5 billion barrels of oil, most likely oil we would have to import. It's about $70 billion worth of oil in today's prices. I have no idea what the total would be in 1985 oil prices, but it's a hemorrhage that our economy can't very well stand.

"And so," we said in tones a good deal more polite, "it's your move, Mr. President. It's your move, Secretary Andrus. It's your move, Secretary Schlesinger. It's your move, Doug Costa, of the EPA. Industry is ready to go. Here are our plans. Please find out if they are going to happen; and if they aren't, please determine why and whether the reasons are worth it."

Let me stop a minute and run down the list of what those plans look like in the Southeast. In Alabama, the electric utilities plan to build nine more coal-fired generating units, and the coal companies plan to install or expand 20 mines with a production of almost 24 million tons in 1985. There are ten power plants planned in Florida and six in Georgia. In Kentucky, utilities have 15 generating units under construction or on the drawing boards scheduled to go on line by 1985. There are plans for 29 new or enlarged coal mines in East Kentucky alone with production of more than 26 million tons. In West Kentucky, add 14 more mines with annual production of 19½ million tons. There are plans for six more generating units in Mississippi, three in North Carolina, and four in South Carolina. Tennessee has no coal-fired generating plants reported; they are going nuclear. Tennessee will be adding two mines producing 2 million tons. Virginia will add seven mines with an

output of nearly 6 million tons, and West Virginia plans 55 mines averaging nearly a million tons a year each and six new generating units.

Then what are the constraints we are talking about? I have already mentioned the issue of air quality. The EPA is rewriting many of its new source performance standards which may govern many of those 241 power plants we spoke of, as well as industrial plants that may be built in the future. The sulfur dioxide standards, which have been the big issue in the Tennessee Valley, will probably be made more stringent still. But you have yet to deal with nitrogen oxide standards for power plants and dust limits for surface mines. The EPA will also be reviewing its so-called tradeoff policies on new facilities in areas which do not yet meet air quality standards. In areas which do meet air quality standards, EPA has regulations to prevent significant deterioration. That means there are severe limits on whether you can put a power plant there. As a matter of fact, there are also limits on whether you can put a coal-cleaning plant there, even if the plant is intended to remove some of the sulfur from coal and hence make it more acceptable. We are involved in one of those cases right now.

Sometimes the environmentalists meet themselves coming back. In surface mining, the Interior Department has issued its interim program regulations with tight deadlines for compliance. In many cases, the zeal of the regulation writers outran the law. As I said earlier, we sought with judicial review of the interim regulations to protect our access to the courts, if we need it, if the rule-making process proves impervious to evidence and logic. But these interim regulations are only the beginning.

The more comprehensive program regulations are due soon and then the states will be developing their own programs, for the law provides a substantial basis for the states to write their own regulations and, if they like, go beyond the federal law. This could prevent mining in many areas. The EPA is also developing a number of new water regulations which will affect its existing mines and new facilities.

If the environmental rules (and I have listed only a few of the sticking points) aren't enough, we have other government restraints. For example, the government has had a moratorium on leasing Western coal lands for about seven years now. A group of professional environmentalists and the Natural Resources Defense Fund recently won a court decision which will mean a delay of an additional several years in the government's very slow pace of resuming leasing. The court ruled that the government had not filed what the court considered an adequate environmental impact statement on the resumption of leasing.

It seems to us that we may have too many environmental impact statements already. Instead of requiring more, we ought to have some *people* impact statements about the impact of our government actions. The impact on people is going to be goose pimples; it's going to be chills and dark rooms and closed factories in some cases.

As Otis Bennett, Chairman of the Board of National Coal, said in a recent speech, "What we need to do is get the government on our side and off our back." I'm sorry to say that we have not had a substantive reply from the President to our letter. We asked him not only to study the consequences of the restraints we talked about, but to make the results public; because we think the people need to be told the people impact. And that's a good place to start.

Speaking of environmental matters brings me to another Presidential action, and this one had a gratifying result. In his energy message, the President called for a study of the

environmental effects of increased coal-burning use in 1985. The National Institutes of Health assembled a panel under Dr. David Rawl, which issued a report at the end of the year. The report stated that with strict environmental controls (whatever that means) we do not need to fear the impact of coal use by 1985. We can go ahead and make our plans without fear that the greenhouse effect is going to bring the oceans to a boil or any of the other dire happenings that the proclaimers of doom have been prophesying.

The Rawl Committee pointed out some areas of concern where more research is needed. We agreed. The National Coal Association testified last year (before the Rawl Committee was formed) that we need serious research to fill the gaps in our knowledge about certain health and environmental effects of coal, so that we can head off potential problems before they occur.

One of the hypothetical problems that has captured the imagination of feature writers, and certainly gotten some free space for compulsive declarers of doom, is the greenhouse effect. This is the theory that carbon dioxide from the combustion of fossil fuels will accumulate in the atmosphere, retain an increasing amount of the sun's heat, and raise the temperature of the earth. All I can say to the theoreticians is that if they can't deliver on that promise they'd better not show their faces in the Midwest after this winter. But, seriously, let's deal with the real problems and deal with them realistically.

We need to have some environmental laws, obviously. And they have been enacted. Probably there is some overkill in these laws, and we happen to think there's a lot of overkill in the regulations that implement the laws. We think the regulations can be made workable, and we think they need to be made workable for the national interest. Let me give you an illustration.

Carl Bagge is a member of the advisory committee to the Fossil Fuel section of the Department of Energy. In a meeting last month, the committee discussed the problem of fluidized-bed combustion. This is where you burn coal in a bed of crushed limestone, keep the mixture suspended in a blast of air, the limestone particles absorb the sulfur, the spent sulfur and limestone are removed, crushed coal is introduced continuously, and everybody is happy. The method holds great promise both as an efficient combustion system and as a way of dealing with sulfur emissions without installing scrubbers. But under the regulations being considered by the Environmental Protection Agency, fluidized-bed combustion would be ruled out. The government spent millions of dollars on it. It's a commercial technology in Britain. There's a demonstration unit operating in a power plant in West Virginia. And the EPA is preparing to knock it in the head.

In summary, I guess I bring you a mixed message. Coal can be the nation's salvation, but it can only play that role with government's help or at worst with a little benign neglect. We can't make it in spite of government. We don't need to be thrown a life preserver to stay afloat, but we certainly don't need to be thrown an anvil. And you here in this audience can help, you from the Tennessee Valley, where the increased use of coal has carried forward the inspiration that Franklin Roosevelt got from the dreams of George Norris 45 years ago.

All of you here who depend on coal for fuel and for electric power have a common cause with us. I hope you'll raise your voices and send word to Washington that coal needs a reasonable chance to do its work. We need regulations that are workable, environmental goals which are attainable without shutting the country down. Give us these things and the National Energy Plan—by whatever name you want to call it—will become a reality. Thank you all.

From the floor: I'd like to make a comment about your carbon dioxide remarks. As a scientist myself, I must tell you that the carbon dioxide problem is not a wild-eyed theorist's dream made up because they're looking for work. It is a problem that could potentially be of very devastating effect. The truth of the matter is the scientists don't know enough about it, and really what they are saying is that they need time to study it and to really consider the matter to see what the effect is. I guess my point is that when you make the sort of statement you did you lose credibility. We in the nuclear energy field have seen this happen to us several times. The coal industry, or the fossil fuel industry, really ought to soft-pedal this thing so that the scientists can have time to really study the problem.

Mr. Foster: I agree with you, sir. I think I said that we have called for research on this question as one of the problems (and a leading problem) we had asked for research on. I was trying to put it a little bit in perspective. If you read *Scientific American,* as I'm sure you do, and *Science,* both have said in recent issues that the cause is quite likely to be the change in the amount of earth that's under forestation instead of the amount of fossil fuel you burn. It's a large, complex question. But I'm trying to deflate a little bit of the idea that fossil fuels are the sole cause and the advent of doom is next Tuesday.

From the floor: What is your association's position on the technical fixes to the problems that doubling the coal utilization would have on the environment? Would you suggest vastly increasing coal-washing plants and production, tall stacks or gas scrubbers on the back end of these burners?

Mr. Foster: We don't know the best possible world. We think that we need to do what needs to be done to achieve an improved environment without shutting down the use of coal. That, of course, sounds like a selfish solution and perhaps it is, but we do think that some of the environmental measures are so counterproductive, they screw down the limits so far, that they are not worth what the requirements cost in terms of lost energy.

That 10 to 15% loss of electric power to run scrubbers that Mr. Wagner mentioned is getting into that area. We, for example, thought that the idea of interruptible controls, which TVA advocated, made a lot of sense. We don't see the use of scrubbers on everything to reduce 90% of the sulfur in coal that is very clean to begin with—cleaner than you could render it with available technology anyhow, cleaner than you could render other comparable coal with available technology. That is excess even in our view.

From the floor: Your association doesn't suggest that there is no need for protective measures?

Mr. Foster: No, obviously not. There is need for protective measures, but you can't swim if you're surrounded by life preservers.

From the floor: But you have done a very good job in looking at what's required to increase production and selling coal in terms of additional mines.

Mr. Foster: I'd like to think we have. I don't think we have done as good a job in that area as we need to.

Mr. Butcher: Thank you very much.

10. Natural Gas Prospects for the Tennessee Valley Region

Robert C. Thomas, *Senior Vice President, Energy Resources, Tennessee Gas Transmission Company*

Mr. Butcher: Our next speaker will be Mr. R. C. Thomas, who is the Senior Vice President, Energy Resources, Tennessee Gas Transmission Company. Today's fuel of choice for many industrial and residential uses will continue to be a vital part of the new energy mix required to meet expanding future demands. Mr. Bob Thomas will speak to us today on "Natural Gas Prospects for the Tennessee Valley Region." Bob Thomas.

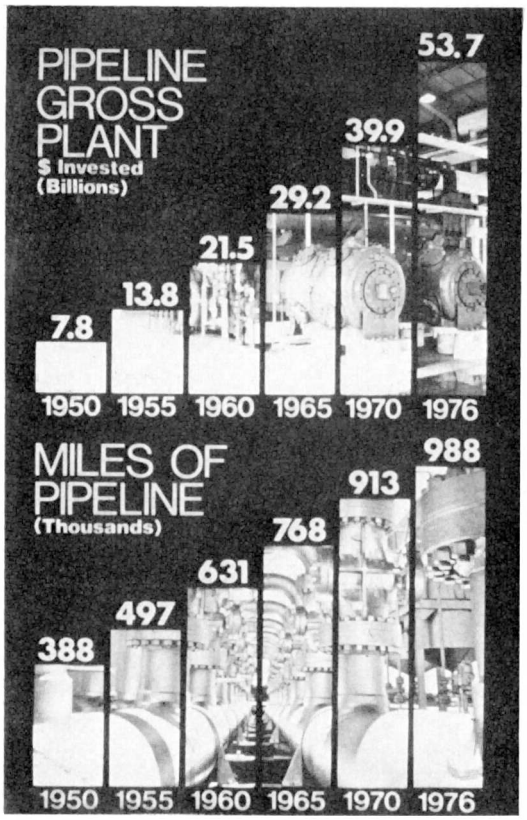
Robert C. Thomas: Thank you, Jake. It's a privilege for me to be here to talk to you. I'm overjoyed to see all of you here, because that indicates your interest in what is a very vital theme for all of us.

What I'd like to do today is to talk about four different areas. The first is the future of natural gas energy in the United States. The second is the past and future supply of natural gas energy in the Tennessee Valley area. The third area is the work that the pipelines that service this area are doing to ensure that we have increasing gas supply in the future. And, fourth, I'd like to finish on some national policy considerations that will affect our total energy supply.

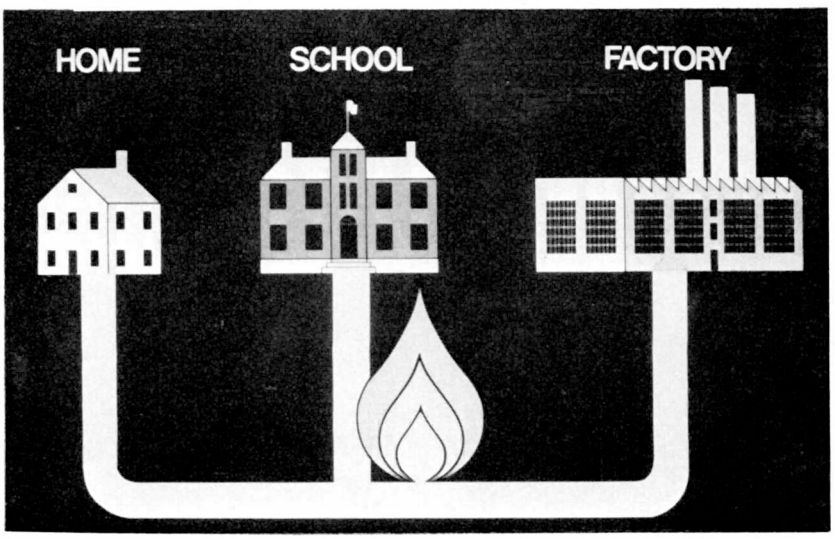
The natural gas industry is a very large but relatively young business (Slide 10.1). Although a low-Btu-content gas was being manufactured from coal in the 1800s, it is only the last 35 to 40 years that have seen the tremendous growth in the high-Btu gas industry. It is now our nation's sixth largest industry, with almost $54 billion in gross plants.

Gas provides about one-third of the primary energy consumed in the United States and is the largest domestic source of today's energy requirement (Slide 10.2). Over half of the residences and commercial establishments in the United States (and this totals some 44 million customers) utilize natural gas. Gas also accounts for over 40% of all energy consumed by the nation's industrial sector.

The annual natural gas percentage of total U.S. energy consumption over the past 27 years is shown on this chart (Slide 10.3). There are really two significant factors that you can observe on the chart. First, the growth in the energy market share of gas was almost exclusively at the expense of coal. Even though gas burns cleaner and has fewer storage and handling problems than coal, in reality it took over the coal markets due to its cheaper price. The second factor is really the one that concerns us today, and that's the decline of gas from a percentage of 33% in 1970 to 27% in 1976. This clearly shows, in our opinion, the effect of short supply as a constraint on gas consumption. Also of note, oil claimed the majority of the market share lost by gas. And I might add, this was and will continue to be *imported* oil.



Slide 10.1



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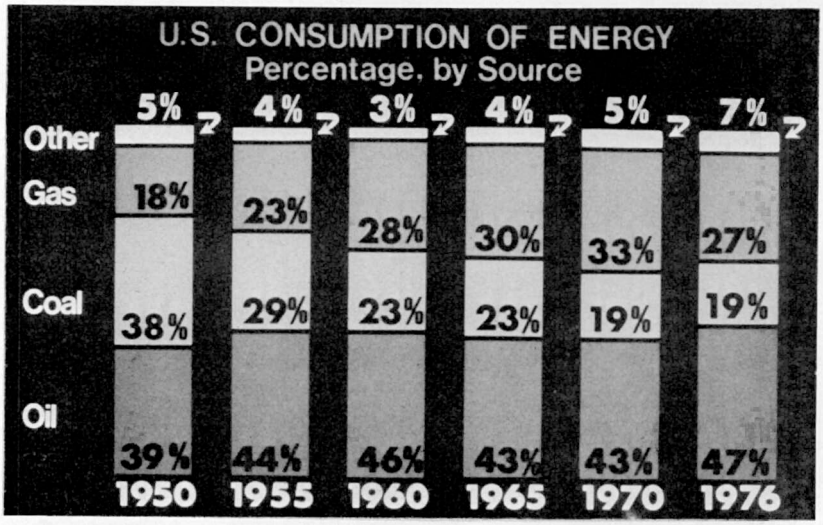
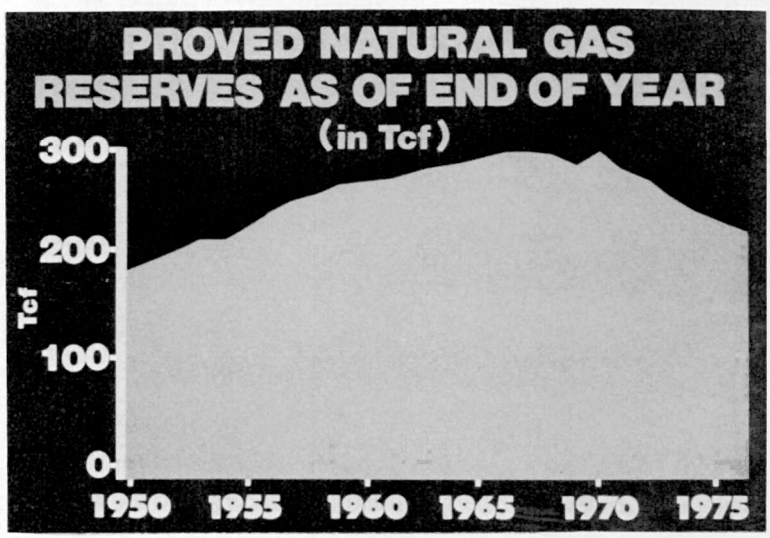


Slide 10.3

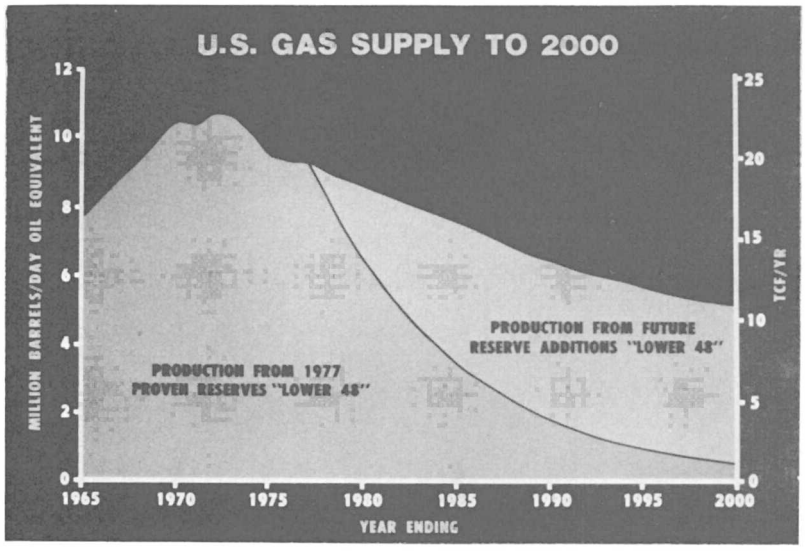
The next slide illustrates the decline of proven gas reserves (Slide 10.4). Total gas reserves peaked out in 1967. Except for the addition of the Alaskan North Slope gas in 1970, the annual reserve additions have been substantially less than 50% of annual deliveries.

Reserves are important, but perhaps even more important is production or deliverability from these reserves (Slide 10.5). The obvious starting point in calculating gas available for use is production from existing natural gas reserves in the lower 48 states. This is shown on the left of the slide. The hard fact is that consumption of these reserves is rapidly decreasing the deliverability from this source. I'm sure you can see from the slide that we can't sit back and rely on only what we have now.

The most obvious source of additional supply will be from reserves yet to be discovered in the historical areas of the lower 48 states. These potential new reserves will be more



Slide 10.4

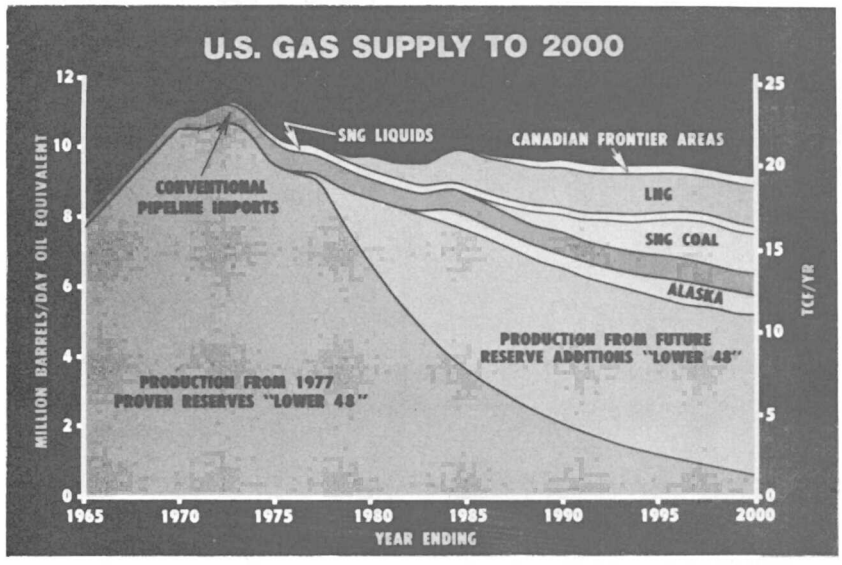


Slide 10.5

difficult to find and more expensive to find and produce than the reserves now on stream. After we add the deliverability from these future reserve additions (shown on the right of the chart) to the proven reserve deliveries, we can see that we are still going to be short of the gas that we require. Obviously, the only way to augment this dwindling deliverability is by the addition of supplemental gas supplies from nonhistorical areas.

This slide (Slide 10.6) sets forth the U.S. gas supply when projected supplemental supplies are added to the base provided by conventional reserves. The supplemental supply mix shown in the layered buildup consists of the following segments:

1. At the bottom is 2.5 billion cubic feet per day from the Prudhoe Bay field of Alaska beginning production in 1985. This will increase to over 3.3 billion cubic feet per day as other North Slope gas comes on stream.



Slide 10.6

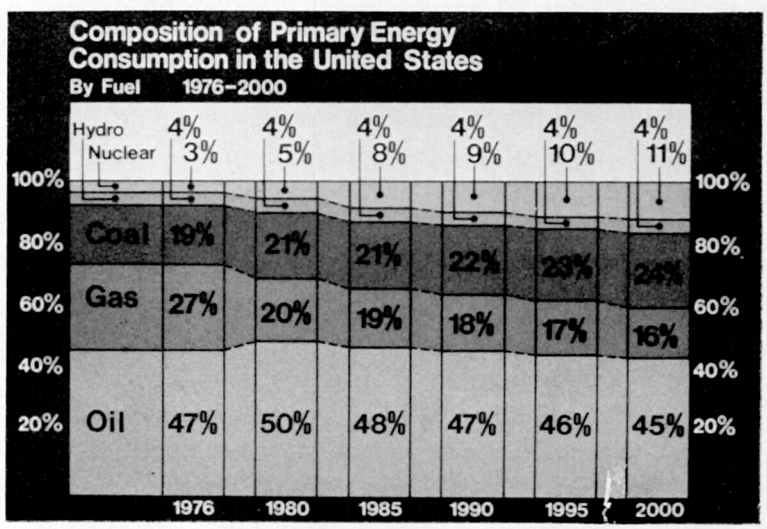
2. Next we have pipeline imports from:
   a. Western Canada, which will decline from 2.5 billion cubic feet per day to only 500 million cubic feet per day by the early 1990s. (However, this decline in pipeline imports will be offset by initial purchase from pipeline imports from Mexico.)
   b. Mexico, starting at 1 billion cubic feet per day in 1980, increasing to 2.5 billion cubic feet by the early 1990s. (So, essentially the U.S. will remain constant on pipeline imports.)
3. Next is synthetic natural gas (SNG) from ten coal gasification plants, which would produce 2.7 billion cubic feet per day by 1990.
4. We see that SNG from liquids will remain almost constant at 365 million cubic feet per day.
5. The big section is liquified natural gas (LNG), which we project will add 8.2 billion cubic feet per day to the U.S. supply by 1990 from various international sources.
6. And finally, on the top layer, gas from the Arctic Islands of Canada, which we project should provide about 1 billion cubic feet per day beginning in the late 1980s.

As can be seen from this slide, total gas supply is expected to decline slightly from today's 21 trillion cubic feet per year to about 20 trillion cubic feet per year in 1983. Beyond that point, the total supply should remain approximately stable from 1983 to the turn of the century, at about the 20 trillion cubic feet per year level.

We are clearly *not* running out of gas. A lot of people believe that. That's not the case. However, we must note that almost 42% of the supply at the end of this projected period will come from supplemental sources, from nonhistorical areas of supply. And each of these new areas of supply will have its own set of economic and political problems.

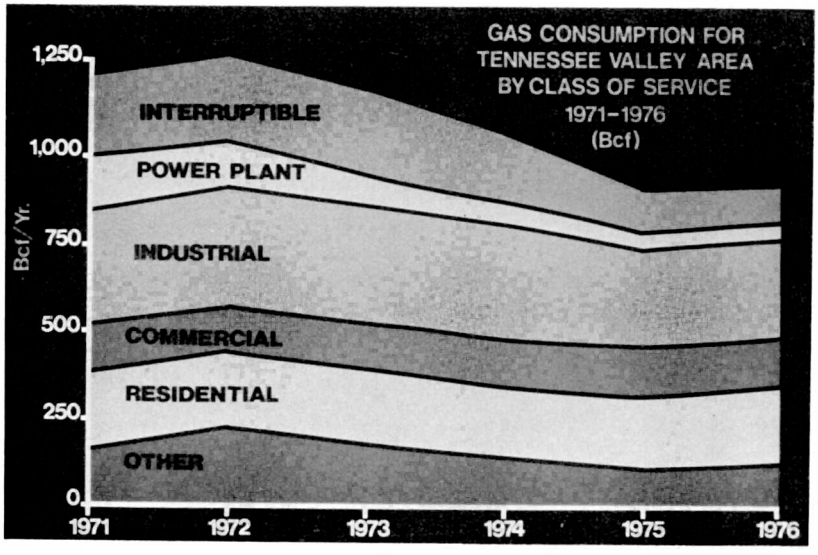
Even though there will be a significant and relatively constant supply of gas over the next 20 to 25 years (Slide 10.7), the absolute percentage of energy supplied by gas will decline, as other fuels (primarily coal and nuclear) absorb the growth in demand.

With this brief overview of the future of the natural gas situation over the total United States, let's come closer and look at what we might expect for the Tennessee Valley—or, as I will show it, basically the four states of Tennessee, Kentucky, Alabama, and Mississippi.



Slide 10.7

This slide (Slide 10.8) shows the actual consumption of gas in the Tennessee Valley Authority area by class of service for the period 1971 to 1976. Overall consumption has been reduced 25% since 1971. This decrease has been due to declining gas supplies and has affected primarily the lowest-priority classification, which is the interruptible industrial user. Consumption by the high-priority classifications, residential and commercial users, has actually increased. Gas consumed by the firm industrial user, which has a midrange priority, has declined only in Mississippi and Alabama.



Slide 10.8

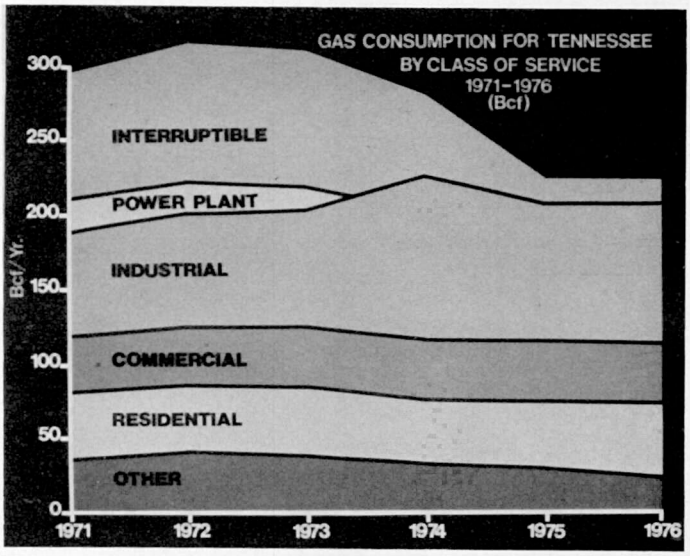
I should stop here and point out that classification of users into priority categories is not something that's been dreamed up by the pipeline companies; it has been done by the federal regulators in order to ensure that energy is delivered to the most vital needs first.

The next four slides will trace actual gas consumption for the four primary states in the Tennessee Valley area for the period 1971 to 1976. Tennessee's overall consumption has been reduced 25% since 1971 (Slide 10.9). And as you can see from the slide, this reduction reflects the phasing out of all natural gas used for electric power generation and decreased availability of gas for low-priority, interruptible industrial demand due to priority restrictions. I'd like to point out that gas consumption for the residential, commercial, and firm industrial users combined has actually increased 19% over 1971 levels.

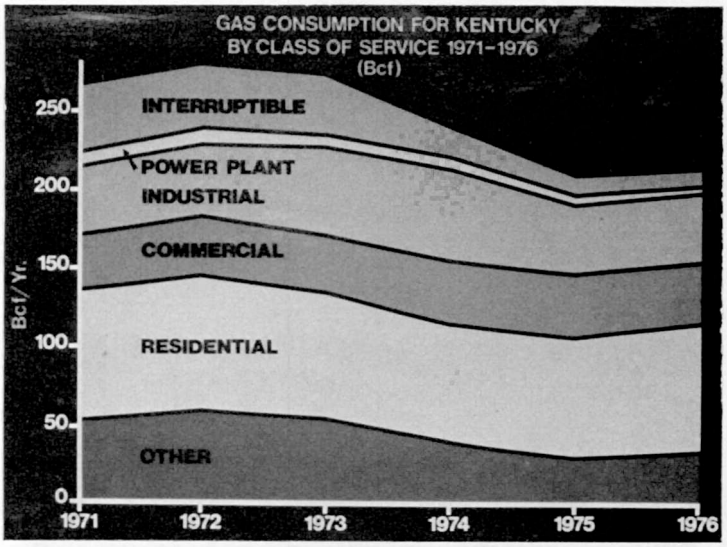
Kentucky's overall gas consumption has been reduced 19% since 1971 (Slide 10.10). This decline has also occurred in the interruptible and electric power generation classifications. However, the gas available for consumption for the residential, commercial, and industrial users combined has again increased slightly over 1971 levels.

Mississippi's overall gas consumption has been reduced 38% since 1971 (Slide 10.11). Again, the lack of supply and low-priority allocations have limited the supply available to the interruptible industrial and electrical power generation users.

Alabama's overall gas consumption has only declined 15% since 1971 (Slide 10.12). Residential usage has increased, while all other classifications have shown slight decreases.



Slide 10.9

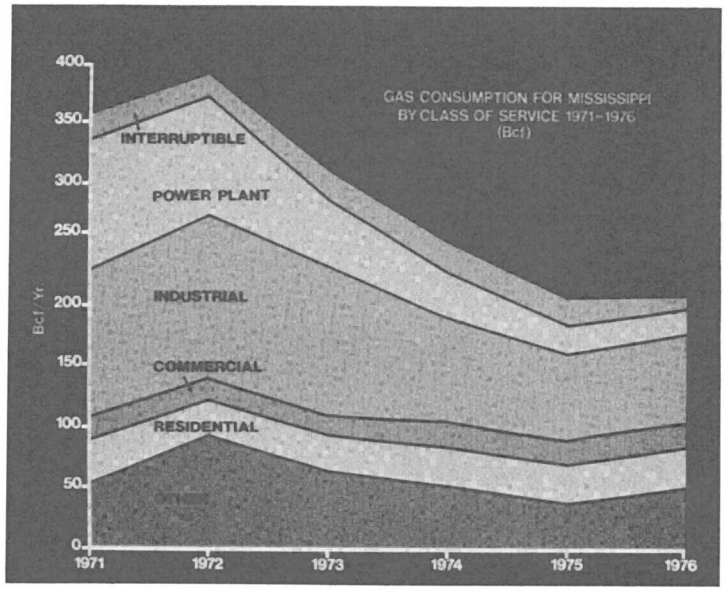


Slide 10.10

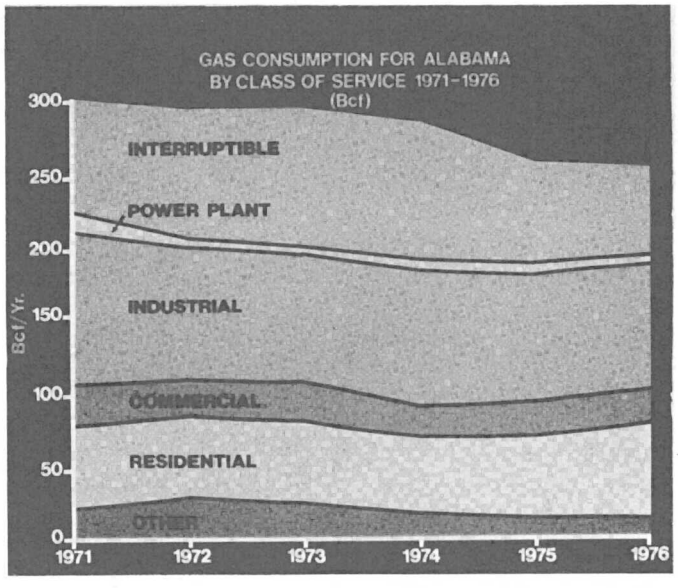
Now let's look at some five-year projections of gas consumption for these four states for the period 1977 to 1982. We selected this particular five-year period because we have better data available here and because this should reflect the lowest gas availability for any five-year period between now and the end of the century.

First, looking at Alabama (Slide 10.13), residential and commercial consumption will slightly increase. Firm industrial availability will decrease slightly, with the largest decline occurring in the interruptible industrial class.

In Mississippi (Slide 10.14), we expect consumption for all classes to stabilize, with a slight decline only in the firm industrial classification.



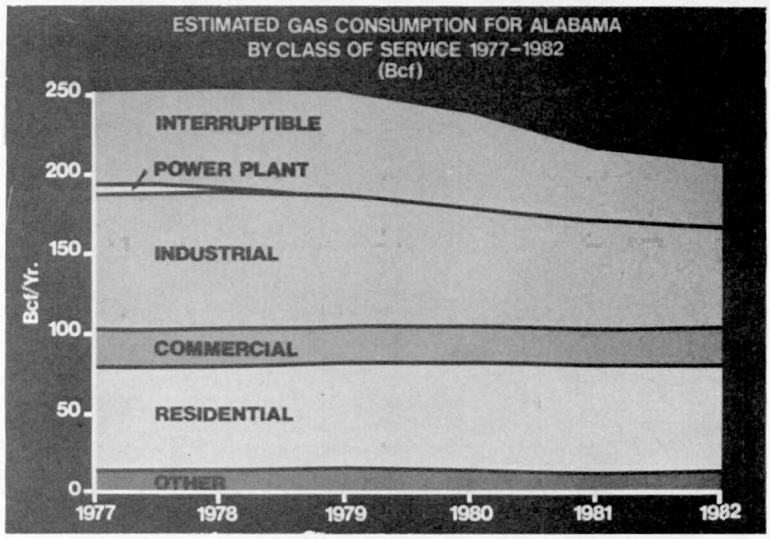
Slide 10.11



Slide 10.12

For Kentucky (Slide 10.15), we expect consumption to remain stable throughout the projected five-year period.

In Tennessee (Slide 10.16), we expect commercial and residential consumption to increase slightly, with firm industrial consumption having a slight decline through 1981. The increase in availability of gas for industrial purposes in 1982 is due primarily to the initial impact of the importing of Algerian liquified natural gas (LNG) by my company.



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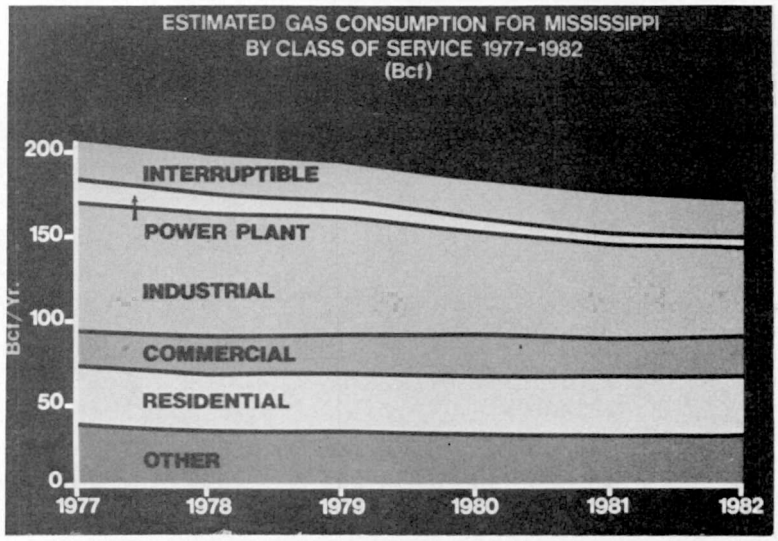
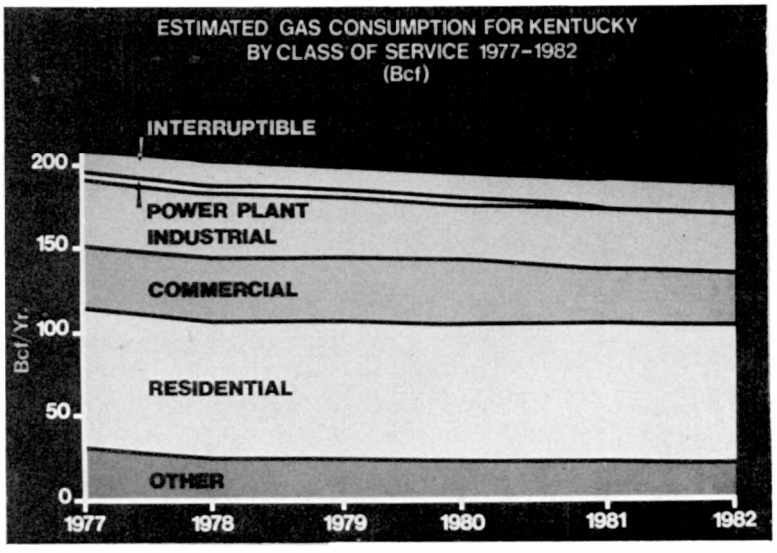


Slide 10.14

When we combine the various components of these four states (Slide 10.17), these projections show that total gas consumption in the Tennessee Valley area will have a slight decline from 1977 to 1982. Residential usage will show a gradual increase, while firm commercial and interruptible usage remain fairly constant. Firm industrial consumption stabilizes in 1981 because of the availability of additional gas supplies, primarily from the importation of LNG. Consumption is projected to remain fairly constant for the period 1982 to 1985, as we show on the bar chart (Slide 10.18). Let me emphasize at this point that these projections of future supply include only a very minimal amount of supplemental supplies, basically because only those filed for governmental approval before the first of 1977 can be



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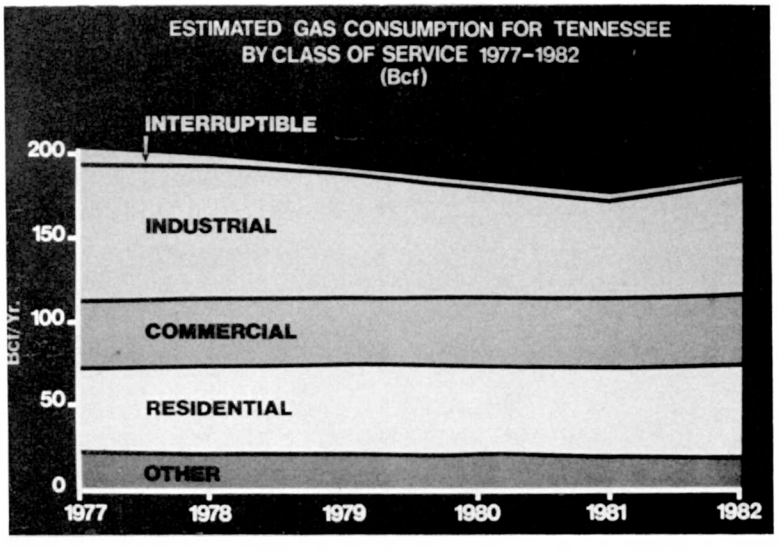
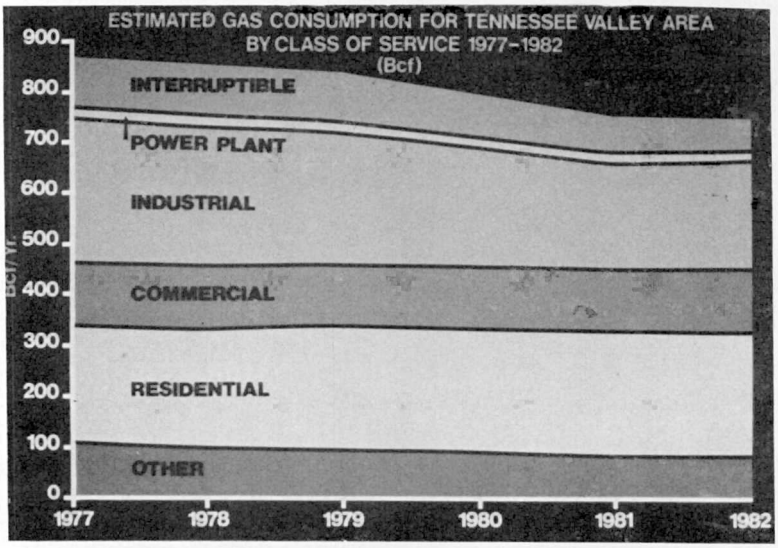


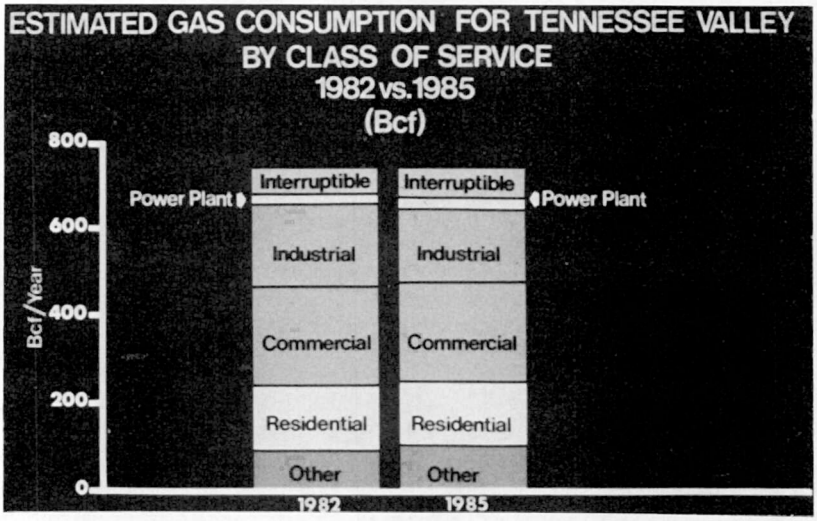
Slide 10.16

included. This is because very few supplemental projects have been approved by the regulatory authorities, and it takes many years to secure delivery once we have the approval. You can assume, for an LNG project, five years from the date of regulatory approval before you secure first supply. Additional supplemental supply projects are being pursued which, if approved, would benefit this area after the end of this period.

There are four major pipeline companies which supply the Tennessee Valley, and they are all very actively pursuing supplemental supply. I'd like to give you a closer look at the companies involved and some of their efforts. Here is a map showing the four major



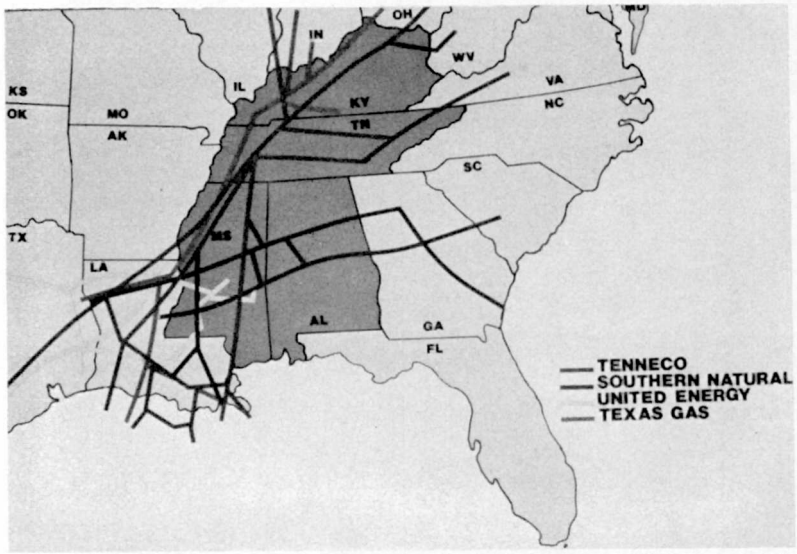
Slide 10.17



Slide 10.18

pipelines supplying the Tennessee Valley (Slide 10.19). Not all states are served by the same companies. So I'd like to examine each state as to its major suppliers of gas, and then briefly discuss these companies and their efforts to obtain additional supplemental sources of supply which would benefit the Tennessee Valley area.

Tennessee is supplied primarily by Tenneco, Southern Natural, and Texas Gas Transmission (Slide 10.20). Tenneco is represented by East Tennessee Natural Gas and to some extent by Tennessee Gas Pipeline Company. Kentucky is supplied primarily by Tenneco, Columbia Gas, and Texas Gas Transmission (Slide 10.21). Mississippi is supplied for the most part by United Energy, Chandeleur Pipe Line, Southern Natural, and Texas Gas Transmission (Slide 10.22). Alabama is supplied by Southern Natural, United Energy,



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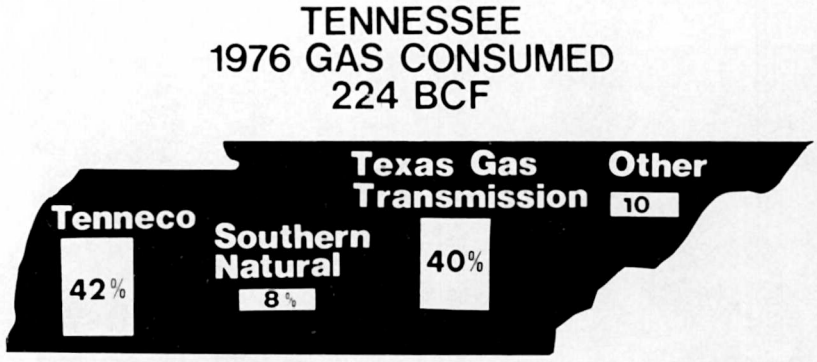

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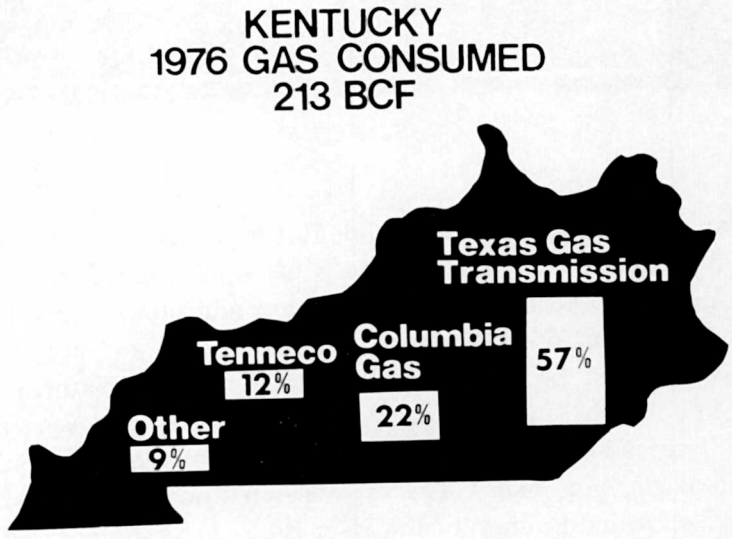

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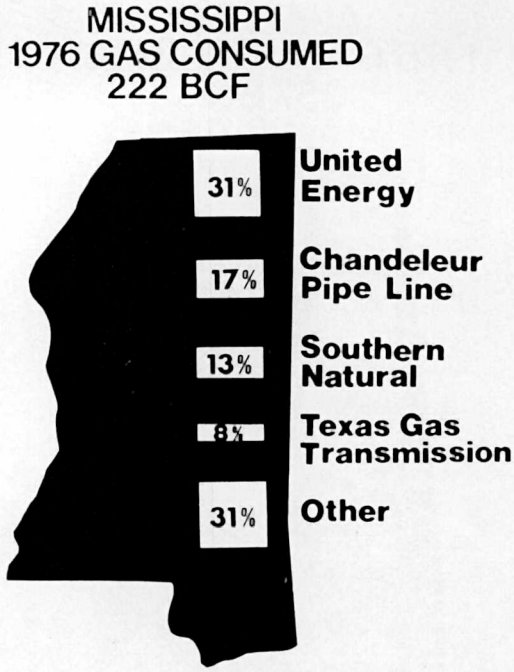


Slide 10.22

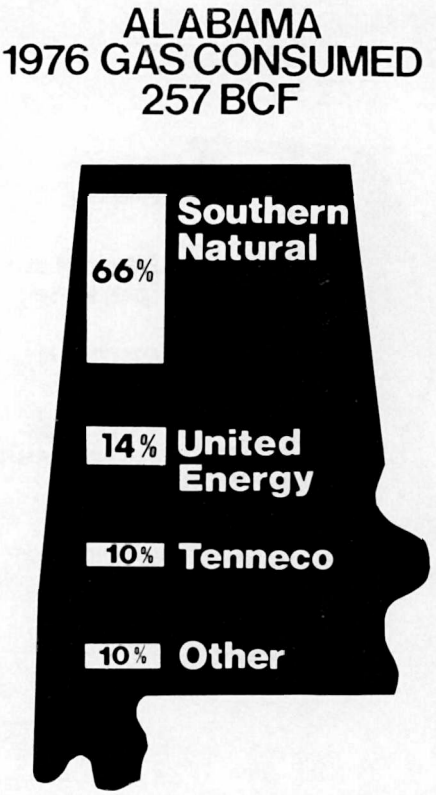
and Tenneco (Slide 10.23). When we combine these four states (Slide 10.24), we find that there are four major suppliers of gas for the Tennessee Valley area: Texas Gas Transmission, Southern Natural, Tenneco, and United Energy.

Let's look at what each of these companies is doing to bring in additional supplemental sources of gas to the area. This is gas over and above that which they are striving to achieve from historical areas of supply. I'll begin with my own company's efforts (Slide 10.25).

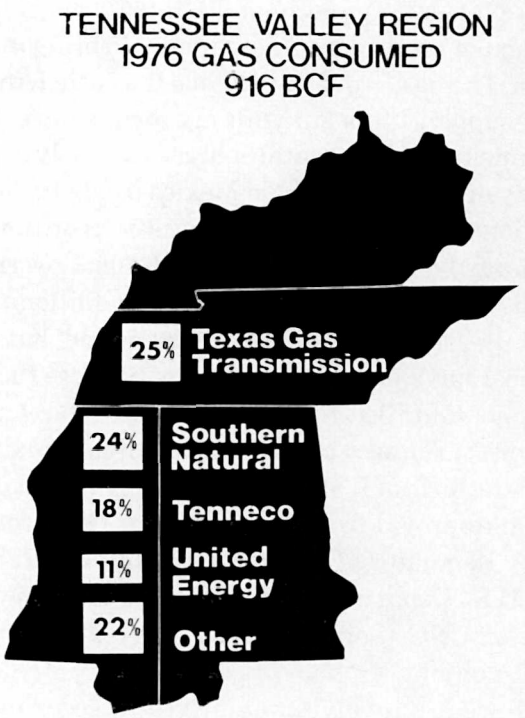
One of the most promising supplemental sources of supply involves the importation of 2 billion cubic feet per day of natural gas from Mexico (Slide 10.26). Tenneco's share of this supply would be 750 million cubic feet per day. Negotiations on the project have been broken off, hopefully only temporarily, because the United States Government has involved itself in the negotiations. This readily available source of additional gas could significantly benefit the Tennessee Valley during the 1977 to 1982 period, but it was *not* included in the supply projections which I have just shown. This is because the contracts have not been signed nor a formal application filed for approval with the regulatory bodies.

In another major project, Tenneco proposes to import approximately 1 billion cubic feet per day of natural gas in the form of LNG from Algeria by way of Canada (Slide 10.27). This project has received final approval from the Canadian Government and initial approval from the Federal Energy Regulatory Commission administrative law judge during 1977. Final approval by the U.S. Department of Energy is still pending. We're also actively pursuing other sources of LNG. Some of these sources are Trinidad and Tobago, the U.S.S.R., Nigeria, and Colombia.

In addition to LNG, we are involving ourselves in securing gas from Alaska (Slide 10.28) and gas from another cold climate, the Canadian Arctic Islands (Slide 10.29). (I think



Slide 10.23



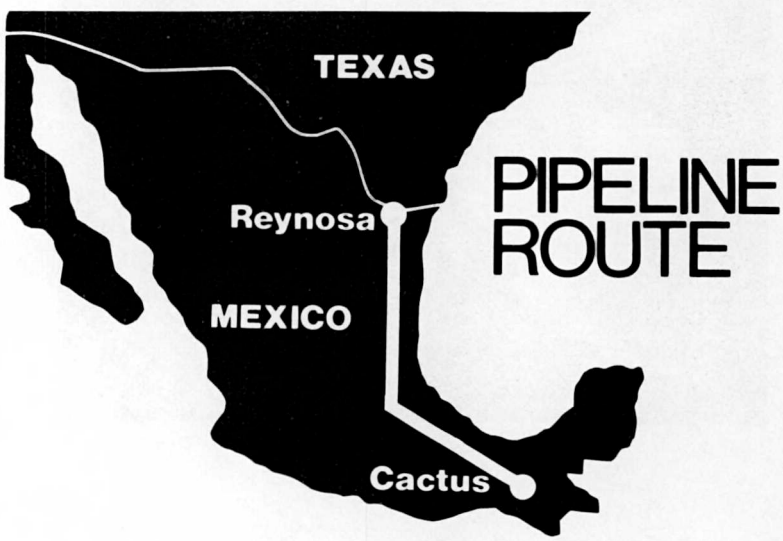
Slide 10.24

TENNECO

Supplemental Gas Supply Projects

1. **Mexican Gas**
2. **LNG**
3. **Alaskan Royalty Gas**
4. **Gas From The Canadian Arctic Islands**
5. **SNG From Coal**

Slide 10.25



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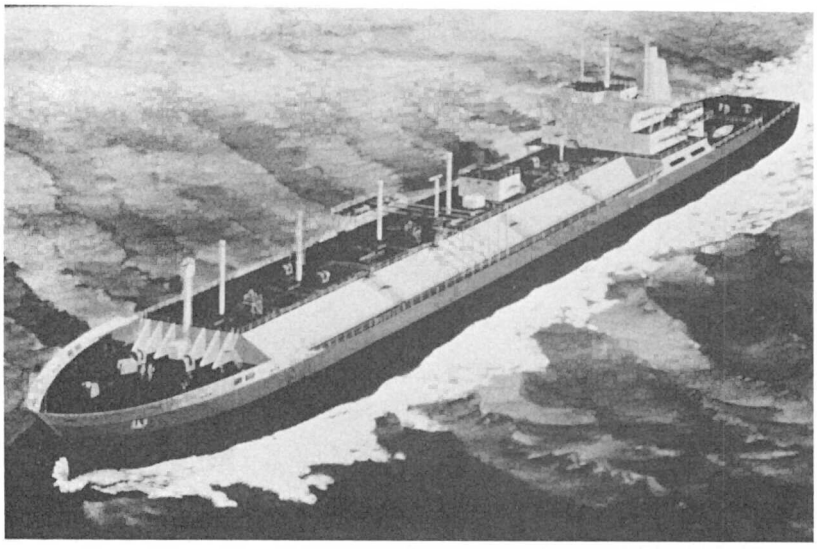

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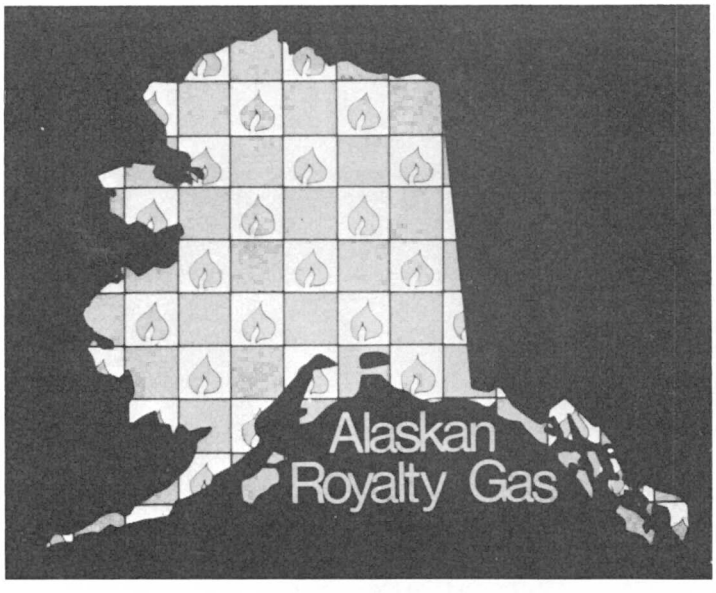

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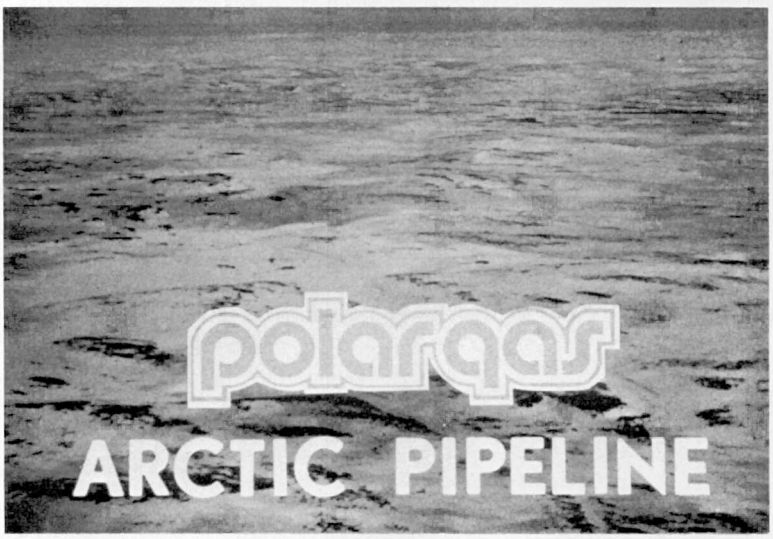
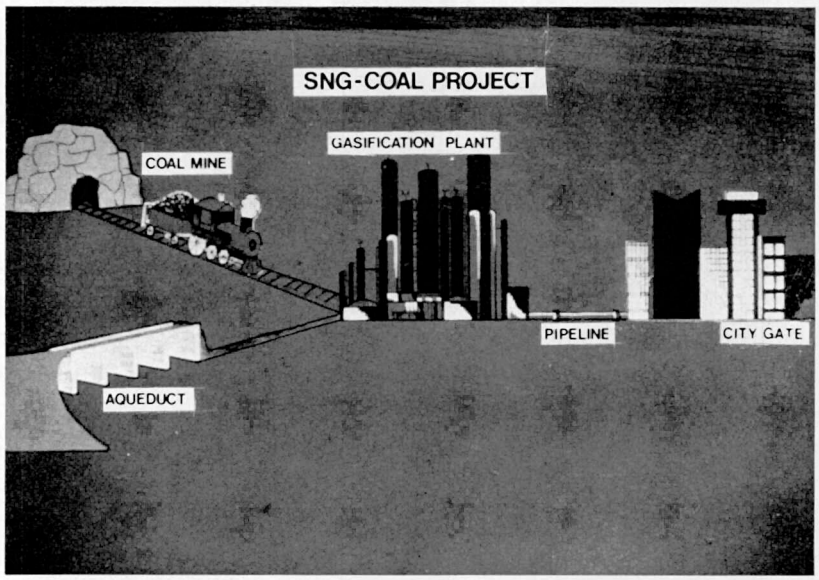


Slide 10.29

the temperature there was a rousing -35°.) We also consider synthetic natural gas (SNG) from coal to be a probable supplemental source of supply in the future (Slide 10.30).

We're continuing our efforts to secure additional lignite reserves and water rights in the northern Great Plains areas. We are suffering from what was mentioned earlier: the moratorium on the government's mineral rights in that area. We're also increasing our holdings of lignite deposits in Mississippi in preparation for potential future coal gasification.

Let's look at the other major suppliers of the Tennessee Valley and see what they're doing along the same line (Slide 10.31). Texas Gas Transmission is involved in two major



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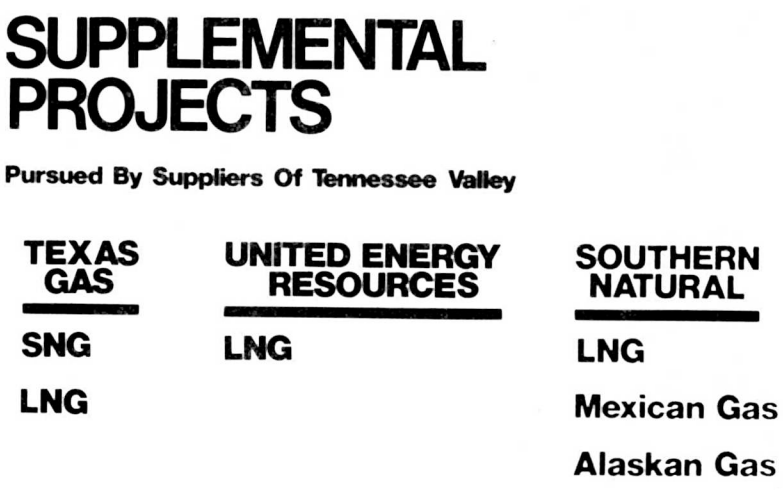


Slide 10.31

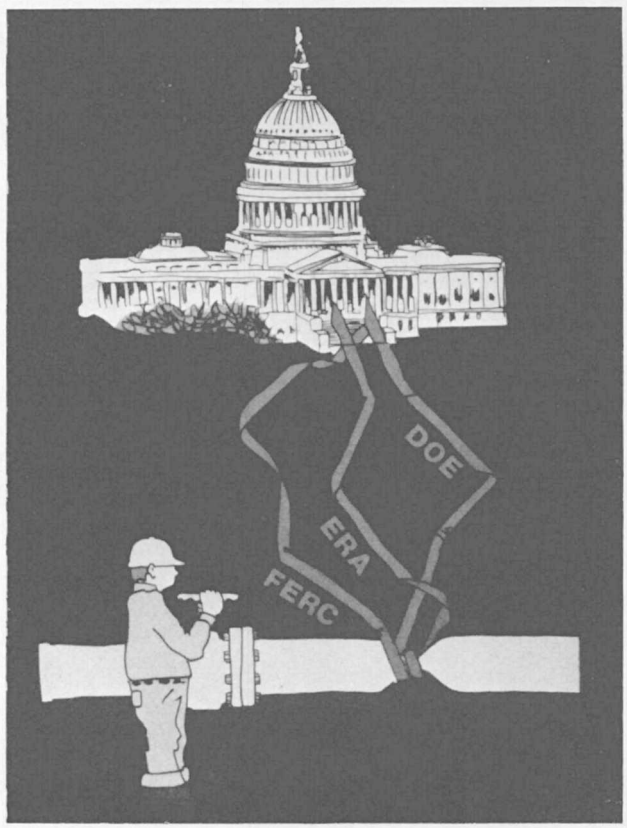
energy research and development projects: SNG from coal and methane/hydrogen research. Texas Gas is also continuing to explore the possibility of importing LNG from international sources and the manufacture of SNG from liquids in the United States.

United Energy Resources has been actively involved in contracting for the importation of foreign LNG. In fact, they contracted in October 1976 to purchase approximately 2.3 trillion cubic feet of natural gas imported from Algeria over the next 25 years, with the first shipment now expected in 1984. In addition, United has also participated in research efforts on some nonconventional sources of energy, including coal gasification, the recovery of methane from coal deposits, and geopressured geothermal energy.

Southern Natural is a participant in the Algerian LNG project and has contracted to purchase approximately 350 million cubic feet per day of supply from this source for 25 years. The deliveries on this will begin this summer. In fact, they were loading out the first ship that will go to Columbia Gas, I believe, yesterday in Algeria. Southern Natural is also one of the gas pipeline companies sharing in the proposed importation of Mexican gas that I mentioned earlier. Southern Natural, like Tenneco, is also involved as a prospective purchaser of Alaskan gas. In my opinion, the gas companies serving the Tennessee Valley area are working very aggressively to secure new supplies that will benefit all of us here.

Unfortunately, the efforts of all of our federal regulators seem to be canceling many of our own efforts (Slide 10.32). Government involvement has definitely high-centered the purchase of gas from Mexico. Delays in issuing decisions on pending LNG projects could jeopardize the acquisition of this substantial volume of energy supply. What we need to do, really, is to get our team together. The regulators, the administration, the Congress, and, yes, some of us in the industry need to stop fumbling the ball and do something positive about energy for a change (Slide 10.33).

Any energy package (Slide 10.34) or energy bill must recognize that this country cannot prosper and continue to provide employment for its citizens without an adequate and *increasing* supply of energy. Our industry would like to supply as much of this energy as possible in the form of natural gas.



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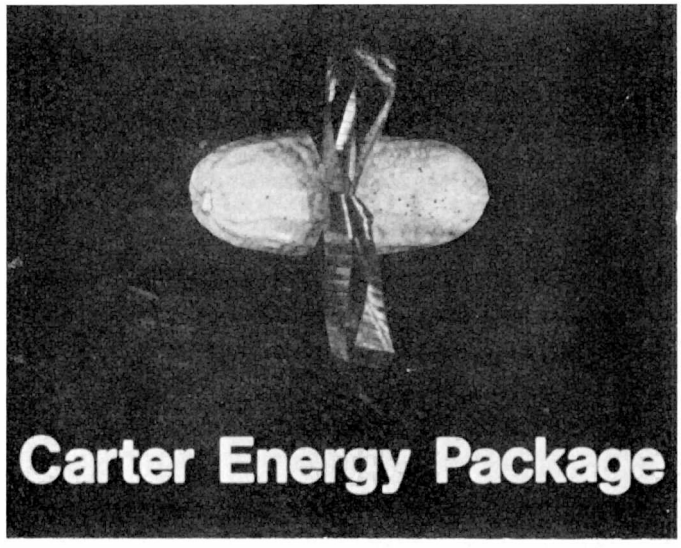
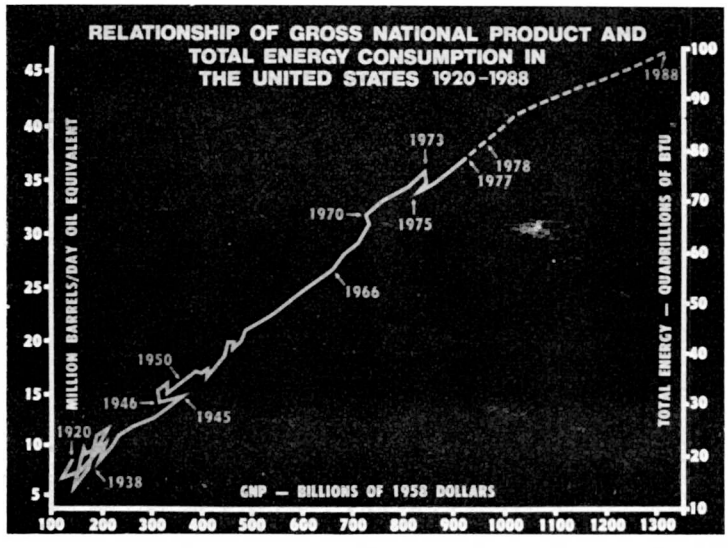
Slide 10.33



Slide 10.34

Let me close, however, by looking at a total energy picture and how it should affect our energy policy. This slide (Slide 10.35) shows the historical relationship of gross national product (GNP) versus energy consumption for the U.S. for the period beginning in 1920 and extending to 1977, with our projections on out to 1988. It's evident that there's a very definite relationship established there between gross national product and energy consumption. We think the message is very simple: if we as a nation are going to continue to grow and maintain our standard of living, we are going to require more energy. Increased conservation and efficiency will reduce the required growth of energy necessary to increase gross national product, but this required growth will not be reduced to zero.

Accepting this projected GNP growth rate of 3½% per year, we can now plot how much total energy is going to be required through this period (Slide 10.36). We have shown here



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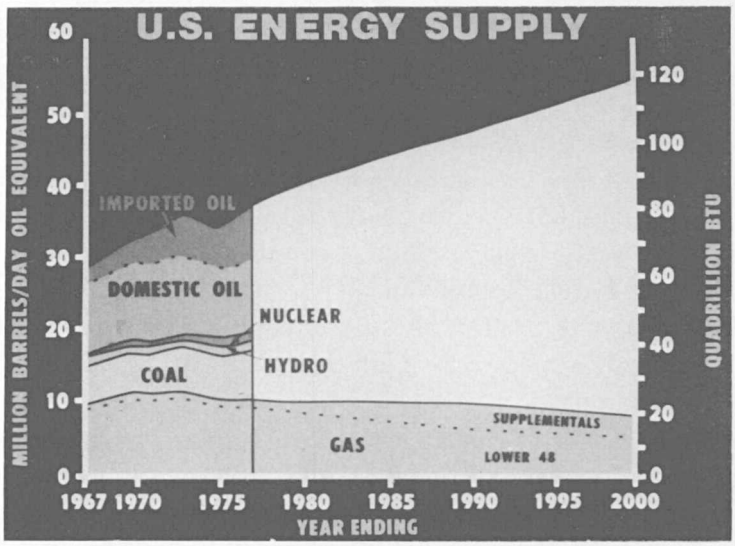
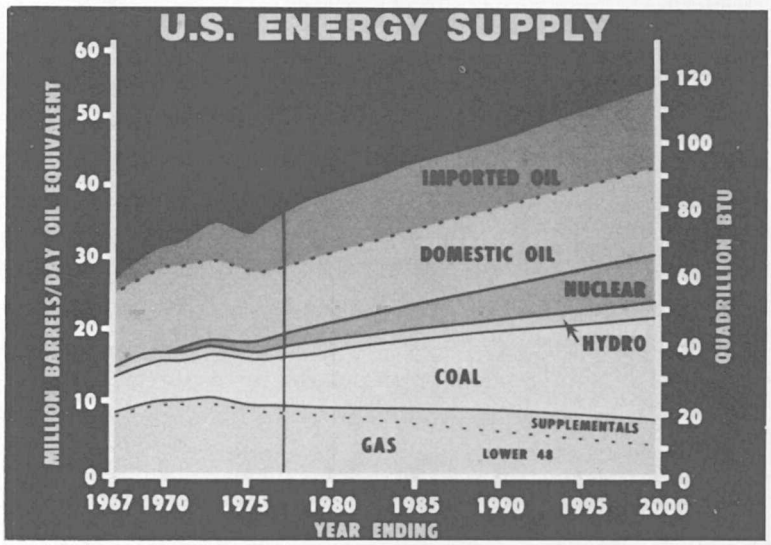


Slide 10.36

the mix of the primary energy sources used to fuel this total GNP growth from 1967 to 1977. Our concern, however, is what's going to be the source of primary energy beyond 1977. We have projected the part that natural gas will play, and let me assure you that we are going to be working very hard to increase the role that natural gas plays. Our concern is what's going to supply the remainder.

We feel that despite major increases in coal production, nuclear power, and even increases in domestic oil production, the volume of imported oil is going to continue to grow (Slide 10.37). This is going to have a tremendous effect on our balance of payments and on world economic conditions. Therefore, I feel that the U.S. should adopt a positive and aggressive energy policy that's designed to encourage domestic production of all sources of



Slide 10.37

primary energy and to secure all supplemental supplies of natural gas available from international sources at a competitive price. The remaining requirement for energy can be filled by imported oil on a short-term basis.

The real bottom line, we think, is this: To fuel a growing economy in the Tennessee Valley area and throughout the United States, we don't have the luxury of choosing among alternate sources. We need all of them. The National Energy Policy affects each one of us totally. Therefore, we must all involve ourselves in ensuring that the policy covers our needs. And where do you stand? Thank you.

From the floor: In your projections of gas supply, could you comment on what assumptions you made with respect to deregulation of gas prices and the impact of roll-in versus incremental pricing?

Mr. Thomas: My projections assume continued regulation under the conditions we have now with new gas prices being set under Order 778. As for the effects of incremental versus roll-in prices, at least the way that incremental pricing is now viewed and with the definition that's set up (and there's a lot of semantics involved in this)—a straight incremental pricing with the purchaser paying the higher price not being assured of ever receiving the supply would probably eliminate most, if not all, of the LNG and would likely eliminate the SNG from coal. So there would be a very dramatic effect if we go to incremental pricing. This assumes rolled-in prices.

From the Floor: Would you care to give us some information on whether or not your company is involved in the methane offshore gas and other areas there of utilization of methane?

Mr. Thomas: The geopressured zones of methane look to be a very attractive area. We feel that it's going to be quite a long-term project. Basically, this is the methane dissolved in the high-pressure, high-temperature saltwater zones at greater depths right along the Gulf Coast.

The problem here is when you produce these massive volumes of water per well (and we assume probably a minimum production rate of somewhere between 40,000 barrels of water a day to 100,000 barrels of water per day to get the gas that's dissolved in it), you've got to do something with the water. If you had to put it back in the ground under pressure, you would use about as much energy to get it back in the ground as you get by bringing it out. Nevertheless, there's a lot of gas dissolved in it and, yes, we're involved in research in this area, as are probably most other gas transmission companies and many oil companies.

The permit for the first well to be drilled in Texas solely to test the geopressured zone was issued just a few weeks ago, and the well is now started along the Gulf Coast. It's going to be most interesting to follow.

From the floor: The United States currently is in a position where we import about 42% of the daily requirements for oil in this country. This has given us a very great dependence upon foreign powers for our energy. Your proposal suggests that we should continue to become more dependent on foreign powers by importing natural gas from both Mexico and the OPEC nations. Perhaps you'd like to comment on how you see us becoming more independent as opposed to becoming more dependent.

Mr. Thomas: First of all, our initial proposal is to do everything we possibly can to stimulate increased production from domestic sources. Then, to the extent that we can't supply domestically, we feel the first choice is to diversify our sources by securing natural

gas from international sources, primarily because natural gas is more efficient. We have a more favorable balance of payments effect by importing gas than by importing oil, and to the extent that we do not secure the gas from international sources we are going to replace it with imported oil, anyway. So it's going to come from an international source whether it's gas or oil, if we can't supply it domestically. Our view is diversification through gas to different sources of supply, to take advantage of the increased efficiency and the better balance of payments problem.

From the floor: One topic of some local interest that I believe you didn't mention, at least explicitly, is production of gas from Devonian shales in Tennessee and neighboring states. Would you care to say anything about that?

Mr. Thomas: That's an area that we're not personally involved in, but we recognize that there are substantial volumes there. Again, this becomes a technical problem and an economic problem of how much we can get out at the price that's going to be allowed. Frankly, I think that this will be a supply that we see down the road. But in terms of the volume and the deliverability, I don't think we can put a line on the curve that would be big enough for you to see. Thank you very much.

Mr. Butcher: Thank you, Bob Thomas of Tennessee Gas Transmission Company. I think you were received with much interest and the questions could have lasted until lunch. Sorry that we don't have the time.

11. Project Pacesetter: The Pittsburgh Community Energy Program

Leon Lynch, ***International Vice President (Human Affairs), United Steelworkers of America***

Mr. Butcher: Our next speaker is an old Tennessean, an old friend of mine, who is now a resident of Pittsburgh. Leon Lynch is the International Vice President (Human Affairs), United Steelworkers of America. He works in the headquarters city for many energy-intensive industries that provide a model for community programs to protect jobs and economic vitality through vigorous efforts in conservation. Mr. Lynch's speech this morning is "Project Pacesetter: The Pittsburgh Community Energy Program." Leon Lynch.

Leon Lynch: Thank you very much, Jake. On behalf of the United Steelworkers of America, I would like to express my thanks to WATTec for the invitation to participate in this public awareness program on energy. It is an opportunity to bring to you the concerns and the goals of North America's largest industrial union, with more than 1,200,000 members engaged in the vital sectors that are very much a part of our national resource picture. It gives me the chance to report to you how we are involved in a community-based program to protect our jobs and our economic potential through planning and conservation of energy in the city that is symbolic of the workings of Industrial America.

Like so many organizations, our name may be somewhat of an anachronism which does not accurately reflect the times. For while a large concentration of our members do, indeed, work in the basic steel industry and the primary metalwork sectors associated with it, we have additional hundreds of thousands of workers involved in such diverse industries as chemical products, aluminum, nonferrous metals and mining, transportation, shipbuilding, electrical equipment, and many other fields. We have, for instance, more than 30,000 members who are covered by a Utilities Industry Conference.

In one very important common bond we do all come together, however: we are all workers, men and women, vitally concerned about the economic, political, and social health of the United States and Canada. We are ready to participate in forthright programs which will ensure that our two countries will remain as strong pillars of the Western economic system.

Not only are we consumers, but our work takes us into situations where we can see firsthand that the conservation of energy and the search for alternative power sources is a very real quest. Those of us who have experienced the wrath of the elements this past month in Pittsburgh or Columbus or New York or Boston—and in such unlikely places as Louisville, Washington, or other communities associated with the so-called sunbelt

states—may, indeed, wonder if forces over which we have little control may be pushing us to the threshold of a crisis atmosphere in energy resources, taking control away from the inevitable procrastinations of the human sector with the same fury of the blizzard winds that lashed residents of our inner cities in the Northeast.

We know that there has been a crisis literature since the watershed year of the oil embargo. And as Americans who have in the same period become somewhat cynical toward the political process and who have been manipulated by the techniques and the promotion of packaging, we tend to transfer some of that cynicism to the energy situation. The majority of the public opinion polls, for instance, suggest that Americans believe that the crisis has been "manufactured" and that the international oil cartel is reaping further billions of dollars in collusion with the petrodollar countries in the Middle East. There is ample reason to have caution toward the statements of the oil companies and the utilities, who have not always placed the public sector as a priority concern in their agendas. But we cannot afford simplistic rhetoric when so much is at stake. As with all complex situations, there are no simple solutions and there is not even an easy quick course allowing an understanding of the many aspects of the problem.

However, energy independence is one term which has come out of the crisis period. We believe it best characterizes the goal and objectives of most Americans—to ensure that as we enter the 1980s there will be no bad science fiction scenario of blackouts and brownouts, of the prospects of the largest cities in our nation at the mercy of massive power failures, of the world's greatest technology and most advanced society on its knees before an international oil cartel. How we achieve this goal in coming years may be the real critical phase. For if we are to conserve rapidly depleting oil and gas supplies, there must be a coalition of people not unlike the coalitions which have joined for the historic achievements of civil rights legislation in the sixties and consumer rights in the seventies. Labor, science and technology, education, business and industry, and consumers all have high stakes in this fight. Logic tells us that if our supply of energy is decreased, our standard of living will deteriorate. It is as simple as that.

In the industry sectors where our members work, there has been a history of using resources as if there was a bottomless barrel. Our members have over the years warned their company counterparts at the bargaining table that profit lines should not be the only criteria for planning and growth. We want to play a role in conservation of materials, but we want it to be a program of equality—that there be an equal distribution of energy as well as sacrifice, if need be. Special interests too often get the electricity, while the hapless consumers get what has been insultingly termed a "fuel adjustment charge" in many of our states.

As many of you know, our former president, I. W. Abel, and our current president, Lloyd McBride, have played a prominent role in Americans for Energy Independence. And my colleagues in the Steelworkers have lent more than just their names to a letterhead—urging our fellow members at the local union level to practice what we are all preaching in this effort to turn our nondirection in the area of national energy policy into a solid objective of securing independence from foreign oil by the eighties. In our basic steel contracts we've negotiated productivity committees. Part of their ongoing responsibility is to be sure that the operation of the plant is such that it saves energy.

In our headquarters city, still known as the Steel City of America, we are involved. Pittsburgh has been selected as a target city for energy conservation by Americans for

Energy Independence, and as most of you know for very symbolic as well as practical reasons. For Pittsburgh is the heartland of Industrial America, formed because the Allegheny and the Monongahela meet there to form the Ohio River. Where this happens is now called the Golden Triangle, and those of you who have visited our city know that the high-rise buildings that emerge there house the headquarters of the industries that made Pittsburgh great. These companies and corporations—U.S. Steel, Alcoa, Gulf Oil, Westinghouse, Koppers, H. J. Heinz, and many others—are all energy-intensive industries with a vital concern that their power sources are not shutdown because of intrigue in the Persian Gulf or international political decision-making tens of thousands of miles away.

Hence Project Pacesetter, a community oriented program, seeks to effect public awareness of the issues involving energy conservation. Together with leaders in education, local government, business and industry, the public interest sector, and voluntary organizations, Steelworkers president Lloyd McBride has taken a task force and overall leadership role in Project Pacesetter, serving as cochairman with Richard P. Simmons, the president of Allegheny Ludlum Steel Corporation. The community task forces are headed up by equally prominent spokespersons in their fields: the chancellor of the University of Pittsburgh, the chairman of our county commissioners, the chairman of the Board of United States Steel Corporation, the dean of one of our law schools, and the president of the League of Women Voters.

Each task force breaks down into subtask forces in an effort to create a network throughout the community of responsible organizations and individuals. These organizations and individuals will then carry an energy conservation and awareness program to those people involved in their clubs, unions, or organizations. Womens' groups, youth organizations, service clubs, veterans, professionals—virtually the whole solar system of community life—have been drawn into the task force concept. And through this we hope to achieve some meaningful impact in making energy a top concern.

We have a chart which shows this task force structure. As someone said to me the other day after the program had been unveiled, it looks as if the whole power structure of Pittsburgh is involved. Indeed, the groups which have in the past participated in the cleaning up of the grimy city that for decades was known as the "Two-Shirts-a-Day" town are involved in Project Pacesetter.

After World War II, there were those who were ready to accept the advice of Frank Lloyd Wright of an earlier decade, who suggested to the city fathers that they abandon Pittsburgh rather than try to renew it. But instead, the renaissance of the downtown proceeded. Where once only smoke stacks belched forth everything offensive in the Clean Air Act, a new skyline appeared. And a new spirit of renewal. It can happen again.

I'm suggesting to you that it is necessary to involve every local power structure if any real energy program is to be implemented at a community level. Here are some of the things which are in the process of being effected in Allegheny County and Pittsburgh as a result of some seven months of work by the task force of Project Pacesetter:

1. Through efforts with the Greater Pittsburgh Board of Realtors, the National Home Improvement Council, the Carpenters District Council, and other groups, a free home energy audit is being offered, with a printout offered to homeowners. Through this printout, owners will know how to tighten up their homes and save energy.

2. In our schools, we are in the process of adopting an energy curriculum to bring an awareness to thousands of public and private school students of the necessity of energy both in school and at home.
3. In several of the shopping plazas of the Greater Pittsburgh area, a model retrofitted home has been constructed to graphically show the need for insulation, weather stripping, and other home winterizing projects.
4. Residential energy contests and a renewal of recycling programs emphasizing newsprint are in the works.
5. And finally, the Business and Industry Task Force is now involved with the appointment of energy managers for most businesses in the county and the establishment of energy management workshops to assist them. Staggered working hours are being discussed by the Labor Task Force headed by one of my Steelworker colleagues, and at the local union level our members are involved in the workshop. On the Allegheny River, our union represents a local at the Brackenridge Works of the Allegheny Ludlum Steel Corporation, where more than 3,000 workers are involved in the flat rolled products division of this steel producer. For the past two months a committee of our local has been working with plant management in a Project Pacesetter undertaking which has as its slogan, "Save Energy—Save Jobs." Participating in this program has been one of our international officers, the director of the district involved, and most of the elected local union officials.

It is too early to assess the results of this local undertaking and the various task force projects which have been undertaken for Pacesetter. But we have made a beginning, and I can report to you that virtually every segment of life in the community has been alerted through the program to participate in the programs, the seminars, and the workshops scheduled for the overall task force. I have faith that the results will justify the choice of Pittsburgh as a pilot city for this undertaking. We are working closely with the University of Pittsburgh; they will monitor our program and evaluate the project at its close. We want to know if the project is a success. Americans for Energy Independence considers this a pilot project, with an eye to starting similar projects in other parts of the country.

Project Pacesetter is a privately funded program. We are, at present, engaged in fund-raising activities within Allegheny County, as well as being involved in the organization and the implementation of the project. We have approached major businesses and corporations, private foundations, and other unions for financial support.

Two weeks ago I had the difficult task of having to call many of our local union officers in the various plants and factories in the Greater Pittsburgh area, alerting them to the fact that one of our bigger utilities had asked Governor Shapp of Pennsylvania to set in motion the government machinery that would, in effect, make our area what one newspaper called "An Employment Wasteland." For this utility wanted the Governor to declare a state of emergency in Allegheny County and part of nearby Beaver County, which would have meant that over 1800 industrial concerns would be forced to begin massive layoffs. With more than 75,000 Steelworkers in this part of western Pennsylvania, the job and economic loss factors of our members, their families, and the community would be staggering.

According to the utility request, industrial firms would have to cut down their operations by February 23rd to reduce operations to the security level, which would mean that for each plant the use of electricity would be restricted to that amount required only for

maintenance. This would amount to a virtual cutoff of industrial customers. And, in addition, the Governor was asked to compel some 46,000 commercial customers of this utility to decrease operations to a maximum of 45 hours a week, reducing working shifts to either a six-hour day or a four-day week.

The utility claimed that a 25-day supply in its coal stockpile had brought the energy situation to this critical stage. It is not my role at this conference to weigh the validity of the utilities in their projections of critical energy levels and their requests for mandatory cutbacks which drastically cut into our employment picture. Every utility has different stockpiles and every state and region has different energy situations. And for every utility crying "crisis" there will be one or more public interest consumer groups offering counterdata which suggest that there is more involved in the situation than the public knows. In the past two weeks, we have seen emergency meetings by representatives of the governors of several eastern states to plan strategy for emergency contingencies. West Virginia, last year the nation's leading producer of coal, was among them. There can be little doubt that as we meet this issue is paramount in the mind of every concerned citizen and public official in the United States, especially in Pennsylvania, Indiana, Ohio, West Virginia, Virginia, and Maryland.

The policies of coal also include a very different ongoing situation which affects every one of us at this conference at the policy-making level. Most of us will have strong and even impassioned feelings about it, especially if we come from coal-producing states. As a union member and an officer of the international union whose origins were in the proud tradition of the United Mine Workers of America more than four decades ago, it goes without saying that I have strong feelings about the coal miners' strike and the tactics of those who many of us believe may have forestalled an equitable solution at their bargaining table. Thank God for the tentative settlement. I hope it will be ratified by the membership. This is, however, not the proper forum for that discussion. Let me say, though, that we cannot divorce this from the overall energy picture. In fact, it is a direct cause and effect relationship which has led to the alleged crisis stage for many of our utilities, whatever the merits of the strike or the position of the union.

This illustrates the complexities of the energy problem and the need to incorporate all of American life into a comprehensive effort to turn things around. And, specifically, I will suggest that it demonstrates the need for legitimate third-party agency or monitoring groups which can provide all of us with the facts about energy that are now confined to the books of the private utilities. The American Public Gas Association, the American Public Power Association, the Consumer Federation of America, and several other consumer-oriented groups have called for such public disclosure, and our union has supported this position. The position of all of us has been that we believe the monopoly aspect of the fuels industry and the energy resource sector is a powerful factor that has influenced government decisions time and time again. This has come down not for the consumer but for the producer, who is interested in a profit line and not the welfare of most of our citizens. Therefore, while we are active and enthusiastic participants in Project Pacesetter and are working toward the goals of energy independence in the 1980s, we are very much aware of the need for a responsible monitoring system which will instill public confidence when utilities make crisis requests to the authorities, setting off a chain of events which can bring the loss of thousands of jobs for our people and the curtailment of necessary services.

Speaking of the eighties, it can give us all pause to recall that the great political writer of the forties, George Orwell, chose the year 1984 to embody his dire prediction of an autocratic state that had consumed every aspect of the lives of its citizens, watching them through a system of life-size television monitors, and depriving them of even the most elementary thoughts and opinions. On somewhat of an ominous concluding note, therefore, let me recall something which he wrote about that same time:

> Our civilization . . . is founded on energy, more completely than one realizes until one stops to think about it. The machines that make the machines are all directly or indirectly dependent upon energy . . . Practically everything we do, from eating ice to crossing the Atlantic, and from baking a loaf of bread to writing a novel, involves the use of energy, directly or indirectly. For all the acts of peace energy is needed . . .

Forty years after Orwell related "all the acts of peace" to the consumption of energy, we realize how true it is. While some of us enjoy the luxury of debate in an open and democratic society, there are other societies which see energy resources as part of the arms chest of international political warfare. The Project Pacesetter efforts are an honest attempt to overcome some of the ignorance which abounds around the energy debate, and also to activate thousands of our citizens into a democratic role which will place energy among our topmost domestic priorities.

We believe that the good common sense which is inherent in most of the American people will surface above the ignorance and the greed that may reside within some centers which see fuel and energy as but a means toward profit and power. To this end we hope that Project Pacesetter succeeds and becomes a pilot for other cities and urban centers to emulate and expand and improve upon.

The longer the debate continues without solution—either the increasing of supply or the decreasing of demand, or some combination of the two—the deeper will the problem become. We must ask ourselves: How many more summers can we continue to use more oil and gasoline than ever before in our history (as was the case last year following the devastating winter of 1977)? How long can we continue to increase our oil imports while the Common Market nations and Japan are decreasing theirs?

How long before we recall the wisdom of the Walt Kelly "Pogo" comic strip, whose satire laid it out for all of us: "We have met the enemy and he is us!" Thank you.

From the floor: Two things that you mentioned I would like further comment on, please. You mentioned fuel industry monopoly and high profiteering of the fuel industry. I'd like some facts, if you have them, please, to back up those two statements.

Mr. Lynch: I think maybe you heard those comments a bit out of context. The thing that I was saying was that the cynicism that is certainly prevalent in our country today creates the opinion that the conditions that exist relative to the shortage of energy are not the facts. There are those who believe that this situation has been manufactured rather than being a statement of fact. I think if you will just read your paper from day to day you will see that there are many consumer representatives and organizations who make these allegations and who present such figures. I am personally not taking that kind of a position now, because I do not have such facts at hand.

From the floor: Mr. Lynch, we are aware of the fact that the steel industry has expressed some concern about its ability to be competitive because of its present circumstances and capital equipment. Could you comment on what your view is concerning the prospects for a competitive steel industry in the face of higher fuel costs and the possible need to convert to electrical furnaces for processing ore?

Mr. Lynch: Well, first of all, I want to make it clear that my position is with the United Steelworkers of America and not with U.S. Steel. A lot of people confuse the two. But I want to tell you there's a great difference. Our interest is in the area of protecting jobs. There are many times that we are parallel with the industry, whether U.S. Steel or any other of the companies in whose facilities we have members working. We feel that, obviously, if there is a shortage of energy in this country it's going to affect every industry, not only the steel industry but every other industry that is a high user of energy.

Because we have so many members working in the basic steel industry, we are concerned about conservation and trying to develop energy independence in this country by the eighties. That's our posture.

As lay people we don't have the technical know-how. We don't pretend to have it. But we do know that there has been some misrepresentation of facts by some segments of society—the utilities in some instances, or the consumer groups that are saying that the energy industries are not telling the truth about their conditions. So I don't have those finite figures for you.

From the floor: Mr. Lynch, I'd like to direct a question to Mr. Butcher, if I could, at this point. He's not one of the speakers, but I would like to ask him a question.

About a year or so ago I was talking with a banker in Maryland. He gave this little scenario. A utility came to him with a nuclear power plant and said, "We want to borrow money to build this plant." He said he turned to him and said, "Well, now, why should we give you money to build this plant when it's going to take three to five years longer to get that plant on line than a coal plant? Why don't you come to us with a proposal for a coal plant?"

I guess I wonder how prevalent that kind of thinking is and whether Mr. Butcher could address that problem either on a regional basis or with others in the investment community across the country.

Mr. Butcher: I don't know that that's a national attitude. Perhaps this banker might be like I am—if his bank is about the same size bank that we are and not the size of a Mellon bank in Pittsburgh, which would be sophisticated enough to lend to any type of industry. I cut my teeth in the coal business up at Lake City and know a lot more about financing it than anything else. But I'm sure that this won't carry on forever, because I think some of the larger banks that we have read about in the *Wall Street Journal* recently—the Citizens' Fidelity bank in Louisville, Kentucky, and some of the banks on the West Coast, along with the banks in Pittsburgh—are now exploring lending in areas other than just the coal industry.

Thank you very much, Leon.

12. The Energy Extension Service

Maxine Savitz, *Director, Division of Building and Community Systems, Department of Energy*

Donald Pitts, *Director, Tennessee Energy Authority Energy Extension Service Pilot Program*

Mr. Butcher: The last speaker we have before lunch is Dr. Maxine Savitz. Dr. Savitz is the Director of the Division of Buildings and Community Systems in the Department of Energy. Bringing energy solutions to the point of practical application at the grassroots level is the goal of the federal effort being piloted in ten states, including Tennessee and Alabama. "The Energy Extension Service" is Dr. Savitz's topic this morning. We welcome her and I'm sure you will be very interested in her talk. Welcome to Knoxville.

Maxine Savitz: Thank you, Jake.

Ladies and gentlemen, I'm pleased to have the opportunity to participate in the 1978 WATTec Public Awareness program. This meeting and the past ones have been very effective in discussing energy issues. It's also interesting to see that these sessions have moved from purely technical thrusts to much broader themes, to cover commercialization and public awareness. Partnerships of the technical community with business, industry, labor, financial institutions, and government are necessary if we are going to solve the energy problems. One of the reasons the energy situation is so complex is that it just doesn't reside in a technical solution but really needs input from all the sectors.

I am going to talk today about some of the Department of Energy outreach programs, including the Extension Service. Then Don Pitts, who is the Director of the Tennessee Pilot Extension Service, will give some details of the program that's going on in your state.

We recognize the complexity of the energy situation, and so the organization of the Department of Energy reflects this. Although it has been formed from existing energy agencies—the Federal Energy Administration, the Federal Power Commission, and the Energy Research and Development Administration—the department just hasn't collected them all under one roof. We tried to organize looking towards the market and looking towards commercialization. We don't have an Assistant Secretary just for fossil energy or just for nuclear. But we have a head of the Research Office and we have a head of Energy Technology. Then there are two assistant secretaries, one for Conservation and Solar Applications and one for Resource Applications, who are responsible for heading things into the marketplace, getting things commercialized. Unlike the Department of Defense and the Space Administration, the Department of Energy is not the major buyer or seller of the technologies that we develop; but we are sort of a stimulus to the market. We have to look at our projects to see if they will be practical, usable, and will reach economic return.

The federal government can facilitate the widespread adoption of conservation. And when I talk about conservation, I really have several definitions. It's not just curtailment, dialing down the thermostat, or driving at a slower speed, but it's also the more efficient use of energy. We have better constructed buildings, more efficient automobiles, better industrial processes (getting more product out for every Btu that we put in), and other things that we can do without changing lifestyles. There are programs through tax incentives; through energy performance standards for buildings, appliances, and automobiles; programs which help low-income citizens meet the rising costs of energy; research, development, and demonstration activities; and public information and education programs. There are ongoing or proposed programs in all these areas.

The Department of Energy has had an active research and development program in energy conservation; many of these projects have been done with local groups here, particularly Oak Ridge National Laboratory. Some of you in the last couple of days may have been hearing about the annual cycle energy system (ACES) that we have been doing with Oak Ridge. There have been other projects here with industry. The success of these projects in saving energy is critically dependent upon the market acceptance. We don't save any energy until people use these products. I'll give you some examples of how we are working with retailers, bankers, small business groups, trade associations, states, and organizations such as the League of Women Voters to push the market acceptance.

It's evident that motivating the consumer public, whether commercial or retail, is as important and difficult a challenge as developing a technological project. Many consumers don't consider the energy operating cost of ownership in purchasing energy-consuming projects. This is a major barrier to acceptance of new energy-efficient products.

The concept of energy cost of ownership simply defined means a common sense approach to buying. In the contemporary market, lowest buying doesn't necessarily mean lowest cost. The consumer must consider the cost of operating the product over the lifetime of the investment, as well as the initial cost. He must realize that products that save energy pay for themselves. The traditional marketing approach would condition consumers prior to introducing a new product. And if people fail to buy these products, we need to know why, and how we can change their opinion. We can then develop various strategies to expedite new product introduction and acceptance.

This past year we have embarked on a demonstration program in Denver, Colorado designed to accelerate the acceptance of energy-efficient products by increasing consumer awareness through the use of the concept of energy cost of ownership. The program involves major retailers, such as Sears, Montgomery Ward, J. C. Penney's, as well as local hardware stores, utility companies, civic groups, and local governments. What we have done is survey Denver to find out what their attitudes are about energy and energy-efficient products. We have also been running a television campaign generically selling insulation, night setback, and more efficient appliances. And now and then retailers have put points of sales in their stores so that all their energy-efficient products are in one place and are highly visible.

We are going to see whether people will buy more energy-efficient products in Denver than they do in a control city. We will determine this by getting sales data from the retailers. We are also going to go back and reassess the people's attitudes next month to see whether this marketing compaign increased people's awareness and will lead them to buy more efficient products.

One of the things that we did was run a local contest with the State of Colorado in which we selected 12 homeowners whose homes would be retrofitted, so that we would be able to get data on how much energy they have saved and their neighbors will be able to tell some of the things that are going on in the pacesetter program. To participate in the drawing, the homeowners had to bring in an application to a local store that was participating in the "Energy Cost of Ownership" program. Of those people who came in, we figured that about 25% actually made some purchase of an energy-efficient product. So once they did get into the store there was an effect.

We will evaluate this program in the next couple of months. If it looks promising, we will increase it into five or six cities and then go nationwide. We have gotten very good participation from the major retailers, and they're actually suggesting target cities where we could test the concept. I think getting them involved in promoting energy efficiency with all their marketing capability would be very useful.

Life cycle costing is a very good idea, but many of our citizens don't have the resources to use it or know when to use it. An opportune time to incorporate energy efficiency into a home can be at the time you purchase the home. That's the time when many people are decorating their house. They are also going to apply for a mortgage. If we could draw into the mortgage a package of retrofit options—insulation, storm windows, heat pumps (whatever is appropriate for the area) up to, say, about $2500—we could provide an easy mechanism for homeowners to finance these retrofit options. In nine cities we have a program where banks are voluntarily working with us to offer the customers mortgages with this package rolled in. The federal government is acting as a catalyst for this in providing information on what measures make sense in a given area in a sort of priority listing. We expect the first mortgage to be issued in the early spring.

Another problem is increasing people's awareness of what their energy costs are. They get a monthly bill, but is that enough? They read about energy costs in the paper. We are looking at a feedback mechanism much like a scale that people who are dieting may use to see what's happening to their weight. A meter in your house that continually showed how much energy you were using would give you constant feedback as you increased your thermostat or as you turned on that appliance for a longer time. We're checking out a meter that feeds back directly in dollars and cents per hour how much energy you are using at that time. We're working with PEPCO, which is the Washington electric utility. They have installed 70 meters into their service area. We are now going to collect energy usage data over the year in those 70 homes and compare it with energy usage in 70 homes that don't have the meter, to see if it does make a difference. Some preliminary studies done at Princeton University have shown that when people did get this information they consumed 10% less energy than when they didn't have the same kind of feedback.

Equally as important as dealing with the homeowner is dealing with small business persons. There are 9.4 million businesses that account for 55% of the nonagricultural work force and 45% of the gross national product. They spend over $6 million annually on energy. Increases in cost of energy and shortages of materials and fuels have impacted them much more than the larger companies. They don't have built-in technical know-how for what to do.

We have an Office of Small Business which has a dual mission: to ensure small business input into the national energy policy and programs, and to provide business information and assistance in coping with rising costs and shortages. We have provided

dollars and cents guidebooks to reduce the costs. We have looked at seven business sectors so far: laundry, dry cleaning, commercial printing, apartment building management, automobile dealers, gasoline service stations, and retail establishments.

Workshops have been attended by over 20,000 businessmen. Trade associations, small business associations, and SCORE volunteers have also participated in this program. We are now looking at the idea of an energy bus. Canada has had a successful bus that goes around to actually provide audits to small businesses and industrial companies. We are looking at the possibility of implementing something like that here.

The League of Women Voters has an active educational program. We are doing pilots in four communities with the League to see how we can help educate the public through their normal channels in using energy more efficiently. They will be holding public meetings and will be having how-to clinics to provide demonstrations on how to install insulation, weather stripping, and storm windows. They will also offer a clearing-house service which will provide a lot of technical information.

I think one of the most exciting programs we have is the Energy Extension Service. A couple of years ago we were looking at how people get information on energy and what kind of information is available. There were lots of brochures that the government put out, that utilities put out, that states put out; but that still didn't get people the necessary technical assistance and hands-on information that they needed. We looked at various models around, and it was very clear that something like the Department of Agriculture's Extension Service had been a very useful mechanism—county agents working closely with the universities and having a delivery system to the farmers to bring new technologies to them and new information on how to solve their problems.

We wondered if we should develop an energy extension service or investigate the possibility of creating one. We got a lot of support from the Congress. They put legislation into what was then ERDA's authorization bill to enable us to initiate an energy extension service which would provide technical assistance to the small businesses and to the homeowners. Again, it's not just distributing information but providing practical assistance.

The intent was not just to create a whole new so-called county agent system, but to build on existing systems where they existed. For example, could you use the Agricultural Extension Service to bring in energy information? Could you go to nutrition groups who are seeing homeowners about nutrition and talk to them about energy? So we wanted to embark upon a pilot program in order to see what would be the best way to set up a national program.

Different states have different unique abilities and different problems. So we embarked on an 18-month pilot program. Forty-nine states and the District of Columbia competed for what was going to be ten awards, and about $1.1 million is going to each of the ten states. The ten states selected include Tennessee, Alabama, Connecticut, Pennsylvania, New Mexico, Wyoming, and Wisconsin. Also, $30,000 is going to the other states in order for them to follow what's going on in the ten pilot states. A year from now they'll be ready to start the program and they will have learned from the other experiences.

We really see the Extension Service as a chance for state and local governments to implement the service for their own needs, not for needs that we in Washington think are necessary. Because we don't really know. Somebody described Washington as an island surrounded by four sides of reality. I think that's an accurate description of the city. The

Extension Service would also provide feedback to the department on some of the needs of the communities that could perhaps be addressed on a national level and are not being addressed.

What I'd like to do now is turn over the talk to Don Pitts, to let you know exactly what are some of the things that Tennessee is doing as one of the ten pilot states for this program. Don.

Don Pitts: Thank you, Dr. Savitz.

Ladies and gentlemen, on behalf of the Tennessee Energy Authority (TEA) I welcome this opportunity to present a very brief overview of our TEA Energy Extension Service Pilot Program. This program focuses on three specific geographic locations in our state, these representing the three grand divisions of our state and also representing three very different-size communities. These are Kingsport and Sullivan County, Nashville and Davidson County, and Paris and Henry County. The first of these, of course, is a moderate-sized East Tennessee area with a good mix of industry and the agriculture of that region. The second is a major metropolitan area of Middle Tennessee. And, of course, the third is a smaller-size West Tennessee city with typical West Tennessee agriculture and a good range of industrial activity in that area. In each county and city region there are five different target groups that we are directing our attention toward. These include the urban residential target; the rural residential and farmers; small businesses and industry; city and county governments; and what we group as the mortgage loan and realty area.

The program guidelines that we received to establish this program dictated the use of existing delivery organizations within the state. In Tennessee, the delivery organization that we chose for the urban residential is the Tennessee Environmental Council, a nonprofit organization which is based in Nashville and has very close ties with many of the urban organizations. In the rural residential and farming area, we have chosen the University of Tennessee's Agricultual Extension Service. To work with the small business and industrial community, we are using the University of Tennessee's Center for Industrial Services. To work with city and county governmental officials, we are working through the University of Tennessee's Municipal Technical Advisory Service and County Technical Assistance Service. And in the mortgage loan and realty area, we are working through the Continuing Education Center and the Business College of Memphis State University.

General technical support for our program, including preparation of many of the materials, evaluation activities, and things of that nature, are provided primarily through the University of Tennessee's Environment Center in Knoxville. The overall management of the TEA/EES program is vested in our staff located at 250 Capitol Hill Building, Nashville, Tennessee. This is a small staff consisting only of myself as project director, two assistant project directors (they are Miss Pat Hastings and Mr. Doug Bennett), and one secretary; and we are supported by two full-time telephone hot line operators.

I want to focus briefly on some of the delivery services that we are offering. In the urban residential area, we are primarily using workshops, which are at first aimed at very low- or no-cost improvements in homes, such as effective temperature control and weather stripping. We are also providing some of the how-to knowledge on adding insulation, as Dr. Savitz mentioned. One of the things that we are doing in the program of human interest is that we are taping talking-library conservation programs for the blind. We are also placing emphasis on the availability of additional backup information through the regularly manned hot line that we have in the office.

One of the things that we are doing that is of interest, I know, to some of you is we are going to provide, in the Nashville area only, infrared thermographic data on energy loss from individual homes and businesses. This is going to be offered in cooperation with the Nashville Public Library System.

In the rural residential and farming communities, we are conducting workshops for farmers in general conservation in agricultural uses, and we are providing individual studies and individual assistance to farmers on their farms. Assistance to the rural homeowners in ways to conserve energy in the home is somewhat parallel to what we provide people in the urban residential area. But there are some very distinct differences, as many of you would recognize; so that program is structured to work directly with rural homeowners.

In the small business and industry service area, our program began with a general conservation workshop in each of the three target counties. There is going to be a continuation of general seminars and workshops aimed at very specific regional needs for these people. The heart of this subprogram, however, is conducting approximately 250 in-house, individual audits of businesses and industries in these three counties. These services are offered primarily to firms with less than 250 employees. We are working with firms that do not have very large technical staffs with capabilities for doing this for themselves. Finally, there will be field follow-up by the University of Tennessee's Center for Industrial Services to see just how industrial management is implementing some of the recommendations that are made.

In the public governmental area, we are providing direct assistance to the local city and county governmental officials concerning energy conservation practices and procurement. We are providing energy audit services for all buildings in these counties, at least to the level of identifying those buildings that will provide the best energy conservation opportunities. This began with the study of energy conservation and cost profiles in all of these buildings, including public schools in the three counties. It is identifying the most suitable buildings for detailed audits. There would be some detailed audit services provided. In some cases where very extensive engineering services are required, we will simply provide referral services to appropriate engineering firms.

In the mortgage loan and realty area, our services include workshops and seminars for bankers, savings and loan officials, realtors, and home builders. The purpose of these is primarily to present good technical and economic data to assist these groups in evaluating the real worth of various energy conservation improvements or original installations, such as good energy-conserving heating and cooling systems and insulation in homes, as Maxine mentioned earlier. There we are involved in the preparation and presentation of educational materials suitable for several of the ongoing educational programs that these various organizations have, such as the in-house American Banking Association training programs and the community college realtor training programs that exist in our state. In summary, that program element focuses really on the provision of educational materials.

Now, just a word about the status of our TEA/EES program. All subprograms that we're talking about are well under way. There are slightly different starting dates on all of them because of the materials that needed to be prepared. We are of the opinion that Tennessee is at the very forefront in the delivery of energy extension services. This is due in part to the very cooperative attitude of existing delivery agencies that we were able to work with, primarily those of the University of Tennessee and the State Board of Regents and the

Tennessee Environmental Council. Secondly, we think this is due to the very widespread availability of technical expertise in the state of Tennessee, which has been made available to these delivery organizations.

In summary, we think we are away and running. We anticipate a very successful program, and we look forward to very early conversion of this pilot program to a full statewide program. Thank you.

From the floor: What is the timetable for carrying it to the full complement program throughout the United States?

Dr. Savitz: Our budget request is now before the Congress for fiscal year 1979, which begins in October of next year. That request includes funds for a full program. So it's hoped we will be able to begin sometime roughly a year from now—assuming we get the funds, which we think looks good. As I said, every state that isn't a pilot has been given some planning money so that they will be ready to move right into it.

From the floor: Are there major differences between how other states are approaching their energy extension service in the pilot program and how the State of Tennessee is approaching theirs?

Dr. Savitz: Well, some of them are targeting in different factions. Some of them are hitting just the agricultural groups, as opposed to the commercial. Some groups are looking very much at low-income groups and landlords, which is an area that hasn't been addressed in Tennessee. The State of Connecticut is using things like nutritional service people who have gone into the city areas. The Connecticut program is geared mainly to cities, as opposed to any rural areas. They are trying new techniques. I think the group got together recently—last month—to exchange their initial types of services. Things that are common to all of them are energy audits. They are all providing energy audits. They are all providing workshops. Training is common, but different types of training programs are under way to see which are the best types for the agents.

Mr. Pitts: One of the basic differences between our program and those of some of the other states is that some have chosen to try to cover the entire state as opposed to targeting very localized groups.

Mr. Butcher: Thank you both.

13. Remarks on Energy in Tennessee

The Honorable Ray Blanton, *Governor of Tennessee*

Mr. Butcher: While we are waiting on the Governor to get here, I would like to introduce one person. We had Keith Bissell as master of ceremonies for the banquet last night. We have with us now a state senator whom I have known for a long time, who is state senator for the area that covers Oak Ridge and Roane County and a good part of Knoxville. Senator Ray Baird.

Ladies and gentlemen, you know what a catastrophe we have had here in Tennessee down at Waverly [a propane gas explosion caused by the derailment of a rail tank car]; Governor Blanton has been tied up on it all morning and apologizes for being a little late. But, Governor, we're certainly proud that you could take time. I want to offer to you at this time the Governor of our great State of Tennessee, the Honorable Ray Blanton.

The Hon. Ray Blanton: Thank you very much. Mr. Chairman, Chairman Wagner, Director Spencer, distinguished ladies and gentlemen of this Energy Conference, distinguished members of the legislature, it's a pleasure to be here today.

I want to say to you very frankly, just because of the signing of the agreement between the coal operators and the mine workers doesn't mean today's meeting is moot. Because we need to stop operating on a crisis basis. Each winter we have either had a gasoline crisis with the OPEC moratorium on our foreign fuel or a natural gas crisis, and this year a coal crisis. And, of course, that old thermometer has been beating us over the head very badly, not just in the industrial uses and residential uses, but also for public service utilities.

We suffered $50 million worth of damage to our highways this year because of the freeze and thaw conditions. We had about $55 million worth of damage last year. So, the energy crisis is not the only burden that the taxpayers have to bear when we have severe weather conditions as we have here.

I want to challenge you and the members of the United States Congress (with you urging them) to support our great President in trying to come up with an energy policy that will sustain us in such times as we have had recently. There's not any need of a nation of this caliber going from one crisis to another when we have the resources that we have. It just doesn't make sense. If we can have a national energy policy that all of us can abide by and adhere to, with the sources that we have like our great utility TVA, there is no reason in the world that we should have to suffer what we have gone through.

But out of any bad always comes some good. And being a born optimist, I feel that through the measures we have taken in cooperation with the federal government, our utilities, and state and local governments, we have taught our citizenry that we can avoid waste in energy. The very fact that they cut back 10%, even though TVA asked us to cut back

20%, is an indication that we can keep the wheels of industry turning. We can keep our homes comfortable. We can keep our elderly from suffering. We can continue. So, if nothing else, our people learned that we can conserve energy.

I want to commend the members of the Board of TVA for their action. And I want to challenge them to look out in the future to make sure that they have long-range supplies of the necessary energy.

We as a citizenry of this country need to urge and support our national leaders, even though we may not be in total agreement with all the concepts they may come up with. But energy is the lifeblood of our country, and if we don't have an energy policy—one that will assure us a continuance of energy in a time of crisis—then we have failed as a nation to meet our responsibilities as governmental leaders.

I realize these solutions aren't simple, but from seminars of this type oftentimes can come very important conclusions as to what we can do to assure the needs of this country in the future. We need to think in the long range, not short range, because these short-range decisions and stopgap measures are the reason we are in the problems we're in today.

I want to apologize for not being able to join with you in all the meetings this week, because I'm sure that I would have benefited for it. I have had my representatives here and I'm sure they'll brief me on them. But we did have a tragedy in the town of Waverly yesterday afternoon. I was on the scene late yesterday afternoon and from aerial surveillance it looked like some of the photographs I have seen of bombed-out cities in World War II.

This is something that we are going to have to address ourselves to—the transportation of hazardous materials— because this is not the first time Tennessee has suffered. It was only last summer that we had a spill of bromine gas in Rockwood, Tennessee, and we had to evacuate the entire city. I started then to try to formulate a proposal for what we as state officials could do to try to regulate and protect the public from the movement of these hazardous materials. Our state, being located where it is, within 500 miles of 73% of the major markets in this country, is a crossroads for the transportation of a lot of these hazardous materials. And, hopefully, we'll wake up to the fact that some of these things can be prevented.

In this instance, it seems on first investigation that it was caused by derailment. In my years in Congress, being on the Commerce Committee, I urged that the federal government join in to try to reenervate our railway beds in this country. It's rather disheartening to go to Europe or to Japan and ride on a railway track at 120 miles an hour in comfort and realize that the railway beds that we have in this state are essentially the same as they were when the State of Tennessee floated bonds to build them back in the 1800s. Some of the tracks are limited to 35 miles an hour and they're hazardous even at that. So, I'm going to suggest that the nation take a look at what we can do to reenervate our antiquated railway system, because we have a derailment, it seems to me, an average of about once a month in our state, oftentimes endangering communities. Always endangering the people that work the railroads and the cargo.

I plan on going back to the scene of the tragedy in a few minutes. I leave you with this challenge, that this seminar today is very important. Please come up with solutions that we can live with for the betterment of the country, the future of our children, and the progress of America. Thank you very much.

Mr. Butcher: Governor, the Chairman of the WATTec Conference and I would like to present you with this gift in appreciation for your coming and also in appreciation of the support you have given our entire involvement.

General Chairman Jasny: Governor, we're well aware of the pressures you have been under and we are also extremely well aware of the importance that your visit to this conference symbolizes. We have a small token of appreciation for you. [The gift was an etching on glass.]

Governor Blanton: Thank you. That's beautiful. I can assure you I'll display it in a prominent place in the State Capitol or in the Governor's Residence. Thank you.

14. Ethics and Energy Policy

Margaret N. Maxey, *Associate Professor of Bio-Ethics, University of Detroit*

General Chairman George Jasny: Our next speaker is Dr. Margaret Maxey. She recently suffered a broken arm as the result of a fall in Detroit. Rather than take the easy way out—and I'm sure many people would have done just that—she put up with all of the inconveniences of traveling with a broken right arm so she could be with us. Dr. Maxey is a professor at the University of Detroit, where she teaches a most intriguing subject called Bio-Ethics. With gratitude and great pleasure, I give you Dr. Margaret Maxey.

Margaret N. Maxey: I am deeply gratified that you would have included someone from my professional perspective in your program. The remarks that I want to make have as their theme "Ethics and Energy Policy."

The Carter administration has put before the American people an energy policy stating very clearly that we are going to have a *nuclear,* not a nonnuclear future, however partial that may be. Nuclear energy politics for the last several years have been conducted as an attempt to eliminate nuclear electricity altogether. This is not going to happen. The real issue, therefore, is whether current nuclear policy meets the tests of wisdom, moral responsibility for those affected by it at home and abroad, and ethical imperatives for proper priorities in considering risks, costs, and benefits.

I think it's self-evident, and it's certainly a common-sense notion, that energy is that kind of power which generates and sustains a vital, dynamic industrial-social organism. Considered in itself, "energy" is not the kind of power we ordinarily talk about as "political." But in less than a decade, we have seen how rapidly and easily "energy" has been turned into an instrument for generating and sustaining a form of political power as pervasive and far-reaching as energy itself. Those who are in an official position now to devise and impose and enforce an "energy policy" for a nation or a globe have a magnitude of political power which is unparalleled in the history of humankind. For that reason alone, quite apart from any others, the citizens of this nation must have some kind of input and participation in the formation of energy policy.

As an educator, I find the level of public information about available resources, the exaggerated claims about alternatives like the sun and wind and tides—indeed, the entire level of public debate and media coverage—to be a matter of national embarrassment. Wherever I go, the recurrent, fundamental question that seems to be debated in this: "How much energy do we *really* need? What is the real problem about energy?"

I think that centuries ago Socrates articulated a truism which has withstood the ravages of time: namely, "The unexamined life is not worth living." I'd like to paraphrase that as a

preface to my comments: "An unexamined question is not worth answering." I think the most important reflection we do is not in trying to devise answers or solutions to our questions or problems. The most important thinking we ought to do is in formulating the problem or the question. Because the way we formulate it already predetermines what we are going to allow to count as a solution to that problem. So I'd like to offer for you three different versions of the problem of energy needs in this country.

First, the most obvious formulation has been devised as a result of the oil embargo. We have, obviously, a growing population with growing expectations and, therefore, we have the cry for "energy independence" in the United States. We've got to find resources, fuels, and forms and technologies for energy conversion within our own borders to make us independent of foreign potentates.

How much energy do we really need? Decisionmakers within industry, the utilities, and the labor movement answer, "Enough to become self-sufficient and self-sustaining in ways that will assure economic health and well-being within a system on which increasing numbers of men and women rely for their very livelihood." Zero-growth in our socioeconomic life is a myth as long as our population continues to grow. (Note that the doubling time is not now 100 years; it is 38 years for a current population of 214 million.) Demographers estimate that there are going to be an additional 15 to 20 million households by the end of this era, this century.

Those who accepted the professional commitment and bear a social responsibility to meet these increasing needs for energy and to satisfy subsistence and security needs say we've got to have technically available, feasible, economically affordable, and immediately available fuels and methods of conversion to meet that need. They see it as their duty to study the past patterns of supply and demand and then obey the laws of demand, of investors in a free-enterprise system. Accordingly, what are some of the facts, or components, in the empirical situation as they see it?

We cannot, they say, have social disruptions. It simply would be too costly. We think we run safety risks from certain forms of fuels and conversion. What about the greater social risks if we are deprived of adequate energy sources? Nonrenewable fossil fuels must be replaced smoothly with available alternatives. We think we have already-existing distributional deficits; they will be exacerbated if we do not have the kind of growth in energy production that keeps pace with growth in population and rising expectations.

It's beside the point to characterize this situation as a growth versus no-growth set of options. No knowledgeable person perceives, or argues for, alternative fuels as a condition for maintaining a so-called high-growth, high-consumption society. We are going to experience radical changes in life-style. But the point at issue is how we are going to preserve stabilizing continuities in an orderly and speedy replacement. We must have tested, proven, available, feasible alternatives. Without getting into exact percentages, it has been demonstrated that in all the industrialized countries at least half of our current consumption of oil and natural gas used for generating electricity, industrial heat, and residential space and water heating could functionally—I say functionally—be converted to other fuels via electricity. Reliance on oil could thus be limited to, say, the transportation sector, until alternatives or new technologies away from the internal combustion engine are developed. It's certainly not the time for developing countries to rely ever more heavily on hydrocarbons. They need reliable alternatives, too.

Because of the environmental objections and mortality rates in mining, transporting, and burning coal, converting it to synthetic gas by onsite gasification and liquefaction is

proving itself to be more and more economically attractive and environmentally preferable. Indeed, underground gasification and liquefaction could turn into a precious resource the coal which is too deep for man to mine and far more hazardous.

Instead of inefficiently burning coal for the generation of electricity, some people are saying we ought to be fissioning uranium. From an ethical perspective it is unconscionable to continue burning up natural gas, oil, and coal (which have other uses in agriculture, petrochemicals, and medicines for which there are no known or feasible substitutes) instead of fissioning uranium. Uranium has no other use except tinting glass yellow; surely we could find a substitute there.

Another component of the empirical situation is that existing deployment throughout the globe of operable nuclear plant capacity last year soared 33%, totaling 138 reactors, or 47,650 electrical megawatts. United States capacity is now 66 reactors and 47,001 electrical megawatts.

Up to 1976, Belgium led the world in percentage of power produced by uranium fission. It was then followed by Sweden, Switzerland, the United Kingdom, Spain, and then the United States. This year Sweden will lead the world at 14.6%. The Republic of South Korea, the People's Republic of China, and Switzerland will all exceed the United States' installed nuclear capacity. By the year 2000, First and Third World countries will have increased their nuclear capacity to these percentages:

France—90%,
Spain—67%,
Pakistan—60%,
Denmark—54%,
Iran—50%,
Egypt—43%,
Finland, Portugal, and the U.S.A.—40%.

The world is clearly not going to have a nonnuclear future, regardless of the "moral exemplarity" wishfully displayed by certain U.S. policymakers. What we need is an energy policy that will assure the wise governance of civilian nuclear electricity, and will assure an orderly replacement of existing fuels which should be put to uses for which we don't have substitutes.

It's on the basis of such hard figures and facts that these people, whom I have identified as professionals, utilities, industries, etc., are seeing the problem of energy need primarily as a matter of technical reliability in engineering and economics. They are understandably disconcerted when certain political activists, special interest groups, and career intervenors mount an attack upon their efforts. These activists deplore the entire energy establishment, which they condemn as existing in a destructive symbiotic relationship with big business, big government, and profit-seeking corporate industrialism intertwined with the military hydra.

This critique introduces a second version of the problem of energy. The real demon, say antiestablishment critics, is our capitalist growth-economy, which is neither natural nor accidental, but is rather an intentional deception. Aided and abetted by the Federal Power Commission, utilities have used ingenious tactics and methods to kick consumption ever upward, using every trick and strategy known to the science of mass marketing. In order to preserve and increase a monopoly on the development of alternative sources of energy, they are accused of having deliberately suppressed development of research on solar, wind, and

geothermal sources. Not because these sources are comparatively unreliable, or seasonal, or geographically limiting, but because they would make consumers independent of highly centralized sources of power. These costly and highly technical methods of energy conversion, including uranium fissioning, fusion, and huge solar collectors, are being developed, the critics insist, only as a pretext for garnering greater and greater concentrations of power, and geopolitical power. As a result of which the poor will be even more suppressed than they are now.

So, as the critics see it, the problem of energy need comes down to this: we've got to mobilize small people in this country—the vocal minority, or nonvocal minority, or silent majority—so that we will have an all-out effort against any large-scale centralized energy conversion. Consumer groups and political leaders are urging the government funding agencies and energy policymakers to renounce, once and for all, the hard path of unsafe, unreliable, uneconomic, unforgiving, alienating high technologies. If only we had small, local, autonomous, neighborhood units for energy conversion suited to end uses (such as residential solar collectors, local windmills, biomass units), then we could all live in harmonious, humanizing, face-to-face neighbor relationships which would eradicate the deleterious, alienating effects of hard technology.

Instead of a technical, engineering problem, these social reformers see the problem as a political and social-institutional one. In other words, we've got to change the entire socioeconomic structure to get away from centralization and move toward decentralization, local neighborhood communities. They do not see these neighborhood communities at all as bastions of privilege.

Closely related to this second version of the problem, yet somehow related to it, is a version that envisions a much more fundamental source of what the problem is. Our energy needs go directly counter to Judaeo-Christian values of simplicity, conservation, frugality, self-denial, sacrifice, and asceticism. An oft-quoted statistic is that we are only 6% of the world's population but we consume 35% of the world's energy. Our "energy problem" is a moral problem of decadent materialistic values in our society. Those adopting this interpretation say we've got to devise the most effective consciousness-raising techniques and strategies to cut back on materialistic demands in two ways:

1. Consciously and deliberately, we've got to make people feel shame and guilt for their waste of energy; and
2. We've got to instill fear about certain fuels and methods of conversion (uranium fissioning, reprocessing spent oxide fuel, and radioactive wastes).

As these people perceive the problem, it is one of bringing about a moral equivalent of war, thereby producing social reform. When others point out that U.S. energy-intensive technology allows 1% of the world's farmers to produce 15% of the world's food—or that the U.S. exports 50% of the world's fertilizer and farm machinery (which is very energy-intensive), particularly to developing nations—the fact is dismissed as self-serving, empty rhetoric.

From this brief overview of the different formulations of the problem, I hope I have indicated to you that there is something else going on. It simply will not do to continue arguing back and forth as to what the problem is as if it had no pedigree, no historical precedent, no cultural climate of opinion, without which the arguments pro and con about nuclear electricity, about coal, about conservation would have no plausibility whatsoever.

We are living and have been living for the last fifteen years in a climate of opinion which has been popularly called "our environmental crisis," "our crisis of finitude," "man's discovery of an ecological conscience." Without a doubt, we are the best-informed society in history. Consequently, we are the most forewarned, anxiety-prone, exhorted, and guilt-ridden of cultures.

This state of affairs is unprecedented for three reasons:

1. Dire predictions are being made, not simply by run-of-the-mill alarmists, but by several "experts" and "authorities" who appear credible;
2. Their projected catastrophies are not local or national, they're global; and
3. Their credibility is enhanced by the dramatic medium of mass communication, and the public's insatiable thirst for disaster movies and bad news.

At least since Earth Day 1970 (and we're getting ready now for Sun Day 1978) we have been inundated with allegedly hard evidence that the deterioration of the human species and our natural environment is accelerating at an exponential rate, and that our only habitable planet has been raped and polluted by technological man, recklessly driven on by rugged individualism and selfish greed. The damage inflicted seems gargantuan. Rivers and streams have been turned into sewers; Lake Erie is dead; Lake Michigan is dying. Species of birds and animals are becoming extinct at a rapidly increasing rate: the last dodo died in 1689; hundreds of other species have become endangered. Our insecticides and weed poisons may have supplied increasing food for a starving population, but these pesticides and chemicals have gotten into the food chain and have begun to poison us, ourselves. Plus the fact that soil depletion, erosion, and floods have been caused, and we have sustained a population that may be fed temporarily but that will only starve later. More people to feed, clothe, and shelter means a greater consumption of energy.

So, in short, growth of everything—population, high technology, and the energy that sustains it—must stop. Technological interventions, pretending to be "solutions," are not only inadequate, they are indicted for being somehow downright dangerous. It is advanced technology and the energy sustaining it in industry, agriculture, and medicine that has generated the environmental crisis in the first place. Our high-technology society is accused of having done more than any other to release toxic chemicals and radiation sources into our environment. Allegedly, radioactive carcinogens have made the preparation of food a lethal operation. Expert environmentalists are now testifying at Congressional hearings that even mother's milk is poisoned. The world is becoming dismally unsafe.

Permit me to suggest that this environmental crisis-mentality, the broad social movement, and the federal legislation of 1969 (NEPA) and all the regulatory machinery that has been generated by it, constitute the much more fundamental problem which we need to address: namely, how are we going to recover and maintain some kind of historical and scientific perspective that will give us a balanced interpretation of the actual state of affairs? There are many who insist that these biohazards have created a self-evident crisis. No crisis is self-evident. There are only certain problems in some people's minds that have assumed critical importance.

What about these scientific applications in agriculture, industry, and medicine? Are they causing the world to become dismally unsafe? What does the historical record show?

One famous saying in *The Second Report to the Club of Rome*[1] characterizes those who are expressing a profound aesthetic disgust for "technological pollution": "The world has cancer and the cancer is man." Those who are expressing a nostalgic wish to return to a simpler, purer life such as humans enjoyed a hundred years ago, free from technology-induced environmental degradation, might profit from a reading of Otto Bettmann's book *The Good Old Days—They Were Terrible!*[2]

As we condemn Detroit and the auto emissions for making our city air unbreathable, why do we not remember a New York or a Chicago in 1900 with 150,000 horses in the street and the emissions they produced. Why don't we recall the local waste management that was accepted as standard procedure: kitchen slops, coal soot, cinders, and other trash piled high on city sidewalks. When the younger generation tells us our air and rivers would be clean and potable if only they had not been befouled by profit-seeking corporate industrialism, some educators should invite them to re-read certain pages from history.

Past civilizations have handled human wastes with such primitive sewage management that water pollution was worse than it is today in many places. During an entire lifespan on earth, the quantity of air pollution produced by mankind does not begin to equal the quantities of toxic gases and particulates spewed forth into the atmosphere from just three volcanic eruptions: Krakatoa in Indonesia in 1883, Mt. Katmai in Alaska in 1912, and Hekla in Iceland in 1947. Mother Nature releases ten times more carbon monoxide into the atmosphere than all the activities of man.

When consumer advocates go through their litany of technology-induced hazards in the biosphere—citing in particular excessive radiation-therapy, pesticidal chemicals, and carcinogenic food additives—educators ought to restore some perspective to these mounting crescendos of fearful protest. Amongst others, William Lowrance, in a book that I think ought to be mandatory reading for every citizen of this nation, *Of Acceptable Risk: Science and the Determination of Safety,*[3] reminds us of what a life without advanced technology was really like, particularly electricity generation, spoiled food, impure water, boiling laundry kettles, and the backyard lye pot.

The major insecticide 75 years ago (sprayed on everything from apples to grapes to strawberries) was not DDT; it was lead arsenate, or "Paris green." Women canned food with such preservatives as boric acid and formaldehyde in high concentrations. Red food coloring was not Red Dye No. 2, but lead chromate—a horror to today's biochemist. Fatal diseases were not leukemia or Hodgkins disease or subtle forms of cancer. They were pneumonia, influenza, tuberculosis. Average life expectancy was 40 to 45 years just 70 years ago. More than 13% of all infants died before their first birthday. Today, as some people worry about hexachlorophene in soap, why do they so easily forget the harsh carbolic acid that it replaced, the surgical operations it has made safer, and the lives it has saved?

There's a new Quality of Life Index devised by the Overseas Development Council. It uses three criteria to measure how well nations are meeting basic necessities for food,

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1. Mihajlo Mesarovic and Eduard Pestel, *Mankind at the Turning Point, The Second Report to the Club of Rome,* E. P. Dutton and Co., Inc., Reader's Digest Press, New York, 1974. [Quotation is from A. Gregg, "A Medical Aspect of the Population Problem," *Science* 121: 681 (1955).]
2. Random House, New York, 1974.
3. Wm. Kaufmann, Inc., Los Altos, California, 1976.

sanitation, medical care, and education. These are: life expectancy, infant mortality, and literacy. Those nations which rank highest on this index—Sweden, 100; United States, 97; USSR, 94—are all technologically advanced. Among those measured, those nations which rank lowest are China, 59; Algeria, 42; and India, 39. In other words, those people who are now becoming paranoid and who say that they are victims of high technology think that they are suffering from a loss of confidence in experts. In fact, they are suffering from a severe case of historical amnesia and cross-cultural blindness. As Lowrance puts it:

> We now have the luxury to worry about subtle hazards which, even if they had been recognized, would have been given very low priority, if any attention at all, because of the much greater hazards of the day.

Now, do not hear me for a moment as saying that we should abandon attempts to control our environmental quality and to help industries or to teach them better habits of waste management and efficient use of resources. What I do think, and what I insist that as educators of citizens of this nation—today and tomorrow—and particularly as regulators we must do is meet ethical priorities for maximizing public health for the many—for the working classes, the elderly, the vulnerable persons in our society. George Will, in a syndicated column about a year ago, said this: "Few things are as subversive in public reasonableness as the misdescription of public issues."

Ostensibly, our society is democratic. Yet its social structure, as Mr. Will reminds us, is much more like the Titanic. When the Titanic rammed into an iceberg, the consequences of that disaster were far from democratic. Of the 143 first-class passengers on board, only four died. All of the rest who died in that tragedy were those who were not in first class. It is a fact of life that those whose lives are lived at or below the waterline in any society are going to be harmed first and worst when the necessities of life are denied them.

We know from the TVA experience and from the rural electrification movement just how extensively and how profoundly and pervasively electricity can raise the standard of living and improve the quality of life of more and more people. Thinking small, freezing growth, and going local is one of the surest ways to ensure a global catastrophe. If international inequalities continue, the end of hope and optimism about the future in poor nations will force them to demand immediate relief even at the price of a suicidal war.

If time permitted I would like to have gotten into what I see as three options for what I have called a very clear nuclear future. I have to capsulate it. One option is that we assume aggressive leadership in the development of reprocessing and breeder technology. Because if we do, the economic incentive exists now in many, many nations to develop regional reprocessing and breeder reactors so as to take care of the needs and raise the standard of living in underdeveloped countries. The only known device that will stabilize populations and domestic unrest is just a modicum of prosperity in underdeveloped or deprived nations. That's one option. And then we would have international monitoring and safeguarding and, hopefully, or at least optimistically, some control over proliferation.

The second option, if the first option doesn't happen, is that every nation will go it alone. Pakistan has ordered six light-water reactors and two breeders, and that nation can ill afford it. But they can't afford oil. They don't have coal. Nuclear is the only path they can follow. Unfortunately, if this second option is pursued will there be any allowance for international control and monitoring? I think not.

Then there's that third option, one in which we will follow the soft path. We will go local. We will pursue a nuclear isolationism or we will have a nonnuclear future altogether.

Somehow that seems very attractive to some people; they feel that obviously it must be tried, no matter what the consequences might be. People who say we should pursue that option somehow think that all the reactors already on line, all the spent fuel, all the tons and tons of plutonium in weapons, and certainly the millions of gallons of military wastes are somehow just going to disappear from the face of the earth. They will not. Therefore, if we would pursue Option 3, we would not be pursuing Option 1. And what will eventuate? Option 2.

I would leave you, then, with this kind of consideration. The Meinels, who are some of the most prominent researchers in solar energy, tell us this. Let's bury our polarized rhetoric, growth versus no-growth, solar energy versus nuclear energy, soft path versus hard path. We need all the options we can muster in the next 50 years, if we are going to avoid socially disruptive and harmful distributional deficits. (And those who are going to be hurt first and worst, as I said, are the poor, the vulnerable people.)

However, there are those who say plutonium is an intrinsically evil source, it can be made into weapons. There's almost a pathological fear about plutonium; it is immoral. There is nothing that predestines plutonium to be made into weaponry. We have lived for centuries with sulphur, charcoal, and saltpeter; there is nothing that predestines them to be made into weaponry.

More people died in World War I from conventional weaponry than in World War II. More people died from the fire bombing of Dresden than died in Hiroshima and Nagasaki combined. So, in other words, plutonium is a valuable resource more precious than gold. And may I add, you do not shoplift plutonium.

Abandoning this polarized rhetoric is not enough. We've got to recognize that the most paralyzing, debilitating, and manipulable human emotion is fear—fear begotten of ignorance. For that reason, amongst many others, the words of Madame Marie Curie (in light of her pioneering research in the properties of uranium and radiation) are especially poignant. It is to her that I want to yield the last word: "Nothing in life is to be feared; it is to be understood." Thank you.

General Chairman Jasny: Thank you very much, Dr. Maxey. I won't bother to say why. I think it would be anticlimactic to follow this inspiring presentation with questions. I believe Dr. Maxey would be available for some individual questions and I suggest that we follow this course of action.

From the floor: Just a minute. We're not finished. We've a little presentation to make to George Jasny in appreciation of the excellent job that he has done. We hope that you will enjoy this and remember all the critical times and the changes and so on and so forth.

General Chairman Jasny: Thank you very much, Tom.

This concludes our presentation. Thank you very much for coming.