

TECHNOLOGY ASSESSMENT ACTIVITIES IN THE INDUSTRIAL, ACADEMIC, AND GOVERNMENTAL COMMUNITIES

WEDNESDAY, JUNE 9, 1976

CONGRESS OF THE UNITED STATES,
TECHNOLOGY ASSESSMENT BOARD,
OFFICE OF TECHNOLOGY ASSESSMENT,
Washington, D.C.

The Board convened at 10:08 a.m., in room 2318, Rayburn House office Building, Hon. George E. Brown, Jr. (member, Technology Assessment Board) presiding.

Present: Emilio Q. Daddario, member ex officio and Director, OTA; and Dennis Miller of the staff.

Mr. BROWN. The subcommittee will come to order. The Technology Assessment Board is entering the 2nd day of a 4-day series of hearings on technology assessment (TA) with the purpose of analyzing and exploring the ways in which TA are conducted in governmental, academic, and private industry operations; how TA fits into the general program of policy formulation and decisionmaking within Government and private enterprise; and how it is conceived of or defined to the extent that this is possible to do here. Our expectations are that as a result of these hearings, we will be able to more effectively plan and carry out the program for the Technology Assessment Board and the Office of Technology Assessment (OTA), which is a relatively recent creation of the Congress for the purpose of assisting it to make better policy judgments than it has been able to in the past.

We are grateful for all the witnesses who have participated and cooperated in helping us to achieve this purpose. This morning we have four witnesses. Due to the exigencies of executive branch policy with respect to giving testimony, we are going to proceed in the following fashion. Our first witness will be Mr. J. W. Davison, vice president, research and development, Phillips Petroleum Co., who will give us some insight into how his company perceives problems in this area. Then we have three witnesses representing various offices within the executive branch. I am going to ask all three of them to come forward at the same time to make their statements and then be questioned as a panel, if that is satisfactory to them. I think this approach may slightly speed up our activities.

The House is in session as of 10 a.m. It is my intention to carry through until we have finished with all the witnesses, even though it may be necessary to go slightly beyond 12 noon. With that brief introduction, I would like to ask Mr. Davison to come forward.

Mr. DAVISON. Mr. Chairman, with our permission, I would like to have Mr. Emil Malick, who is President of Provesta, a Phillips Petroleum Co. subsidiary, join me at the witness stand.

Mr. BROWN. We are happy to have him and certainly welcome him here. We are happy to have you also, Mr. Davison. You may proceed with your statement in whatever fashion suits your convenience.

[The biographical sketch of Mr. J. W. Davison is as follows:]

J. W. DAVISON, Vice President, PHILLIPS PETROLEUM COMPANY

Mr. J. W. Davison, Vice President, Research and Development, Phillips Petroleum Company.

B.S. chemical engineering, University of Kansas, 1943.

Military service, U.S. Navy, 1944-1946.

Professional experience at Phillips Petroleum Company: refining department "1943; research and development department, 1946; in that department: manager, process evaluation branch, 1956; director, process evaluation and optimization, 1934; director process development, 1965; director, chemical and polymer process, 1988; director, rubber, carbon black, and polyolefins, 1969; vice-chairman of the operating committee, 1971; chairman, 1973; manager of research and development, 1975.

Numerous articles published in technical journals; author of 21 U.S. patents.

Advisory activities include memberships in: the board of directors of the Coordinating Research Council; the U.S. national committee of the World Petroleum Congresses; the executive committee of the Frontiers of Science Foundation of Oklahoma; and the business advisory committee of the National Association of Conservation Districts; also Phillips representative to the Industrial Research Institute.

Professional memberships include: registered professional engineer in Oklahoma, member and fellow of the American Institute of Engineers, and American Men of Science.

STATEMENT OF J. W. DAVISON, VICE PRESIDENT, RESEARCH AND DEVELOPMENT, PHILLIPS PETROLEUM CO., ACCOMPANIED BY EMIL MALICK, PRESIDENT, PROVESTA, A PHILLIPS PETROLEUM CO. SUBSIDIARY

Mr. DAVISON. Thank you, Mr. Chairman, members of the Board and staff of the Office. My name is Joe Davison. I am vice president of research and development of the Phillips Petroleum Co, I want to tell you today the philosophy and approach of my company in planning, assessing, and implementing technologies. My remarks will apply to almost any company working with private capital that depends for its existence on extensive research; on upgrading technologies; on finite sources of energy and other natural resources; on the need to make them compatible with social, environmental, and economic factors; and on the need to choose from among technologies those that can make the best input to the public.

The interrelation of these and other determinant factors is complex as is shown on this chart. (See fig. 1.) Referring to the chart, going around clockwise, it involves technology present and future, U.S. Government and public policies, the economy, social needs and trends, and so on.

FACTORS IN CORPORATE PLANNING

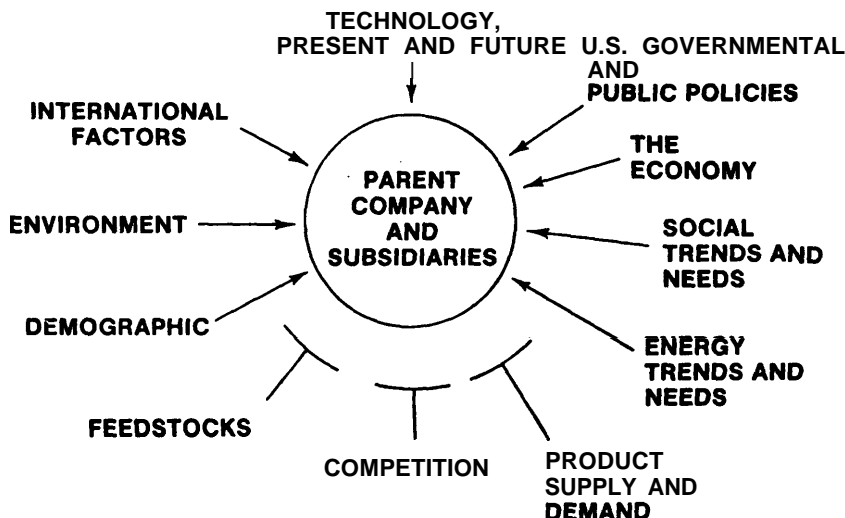


FIGURE 1

The assessments are never one-shot decisions but involve many reassessments from the cradle of the idea to the grave of a technology, in the light of changing conditions. In our company overseeing all such planning and implementation worldwide is a full-time organization reporting directly to our chief executive officer. Branching out of it are satellites or divisions in our operating groups in R. & D. These divisions make long-range alternative strategy studies or what man of us call scenarios. Cofunctioning in environmental assessments we have a full-time staff to assure that all phases of operations safeguard and preferably improve the environment and conserve natural resources. The total effort in our company applied to environment is the equivalent of approximately 600 full-time employees.

The final key to whether a given technology is of value is simply how well the public receives it and benefits from it. The measure of this is whether the input can be made to the public in a manner that is economically and competitively self-sustaining and rewarding. In competitive enterprises this of course is the bottom line, the make or break.

We have studied your 1975 report to Congress and agree that everything we in industry do affects society and Government in one way or another. The other side of the coin is of course that everything Government does in the regulatory actions that it takes vitally affects society and industry. In this sense our relationship to each other is clearly bilateral, an equation containing two mutually dependent variables,

Government and industry, in which each is affected by and must be responsive to the other. Our philosophy is that what is good must be good for both parties, Government and competitive enterprise, to maintain the well-being of those that both are intended to serve-the public.

The Office of Technology Assessment (OTA) could help to stimulate in Government a better understanding of this bilateral relationship. We compliment you on an impressive job in setting up your objectives and in putting control over your expenditures and we say this as a major company with many international technological firsts and a highly inventive team that has ranked first for each of the last 8 years in the number of U.S. patents assigned to U.S. oil companies. However, while we look upon the OTA with hope, it is at the moment also with bated breath. The question in our minds is in just what manner you will actually implement your mandate. We are anxious that you do well, and we stand ready to help.

Now let me take you through my company's version of project planning or TA. (See fig. 2.)

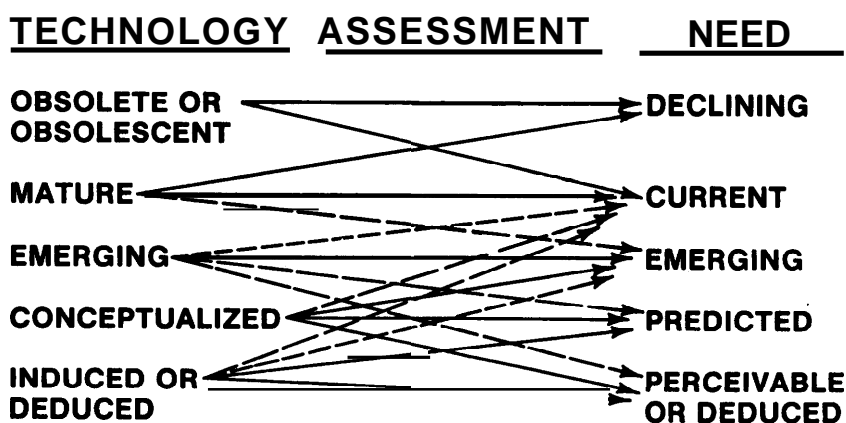


FIGURE 2

Technology assessments pose a chicken-and-egg situation. One must either first have something to assess, some conceptual, embryonic, or mature technology, as on the left side of the chart, or one must be able to perceive an existing or future need for a new technology or one adapted from an existing technology, as on the right side, the need side.

This sensing and measurement of public need involves many factors such as the anticipated growth or decline in public demand for products that would employ the technology, opportunity to improve the products needed or thought to be needed by the public, opportunity to better adapt to societal needs, obsolescence of a current technology or emergence of better ones, changes in corporate organization and facilities, trends in sources of raw materials and feedstock, ability to better complement other lines of business, and discernment of long-range societal trends and needs.

The TA then proceeds as shown here (see fig. 3), through searches of literature, conceiving a process, review of applicable past now-how, resources study, and so on clockwise around the chart, with, of course, close attention to societal compatibility.

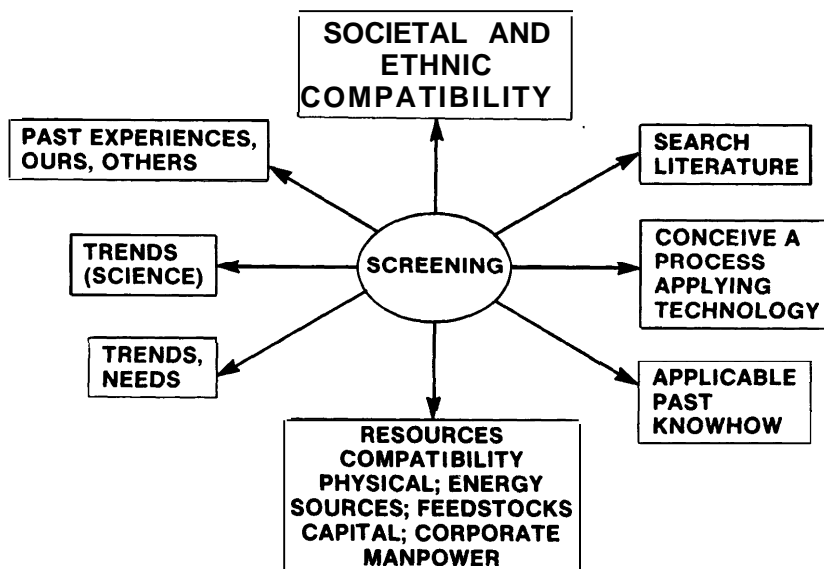


FIGURE 3

"Guesstimates" are then made as to the degree to which the technology can satisfy or improve response to present or future public need in terms of performance life, economics, chances of success, time to develop, safety, health, and environment. (See fig. 4.) As can be seen, there are many complex factors and the public is involved in most of them. Throughout there is progressively greater effort in consumer

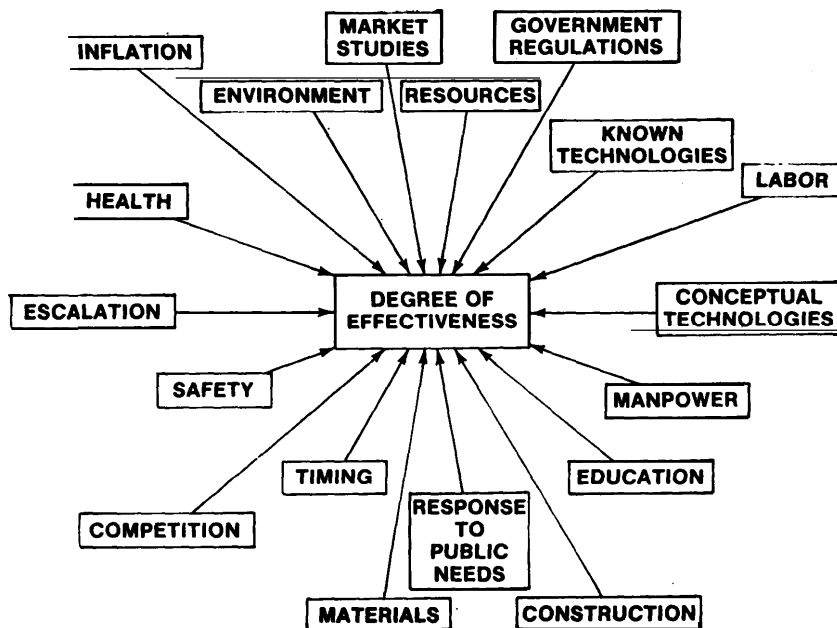


FIGURE 4

research, compatibility with existing or possible future regulations, appraisal of competitive technologies, estimates of costs of plants, materials, labor, escalation, inflation., and so on.

Assuming the assessments indicate a favorable balance (see fig. 5), we would then enter a more advanced phase in which previous assumptions would be checked in greater depth using more laboratory, literature, market, and small-scale plant studies as shown here.

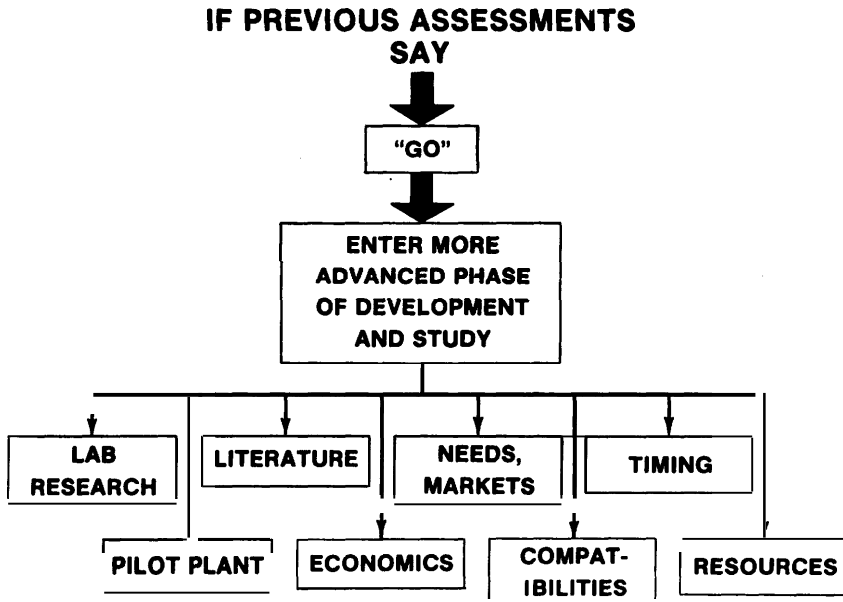


FIGURE 5

If the assessments still say go (see fig. 6), we would then pin down hypothetical processes that would employ the technology and make still more refined assessments of the probability of success and the costs in translating technology into a production, using past inputs, economics similitude comparisons, and prototype product performance.

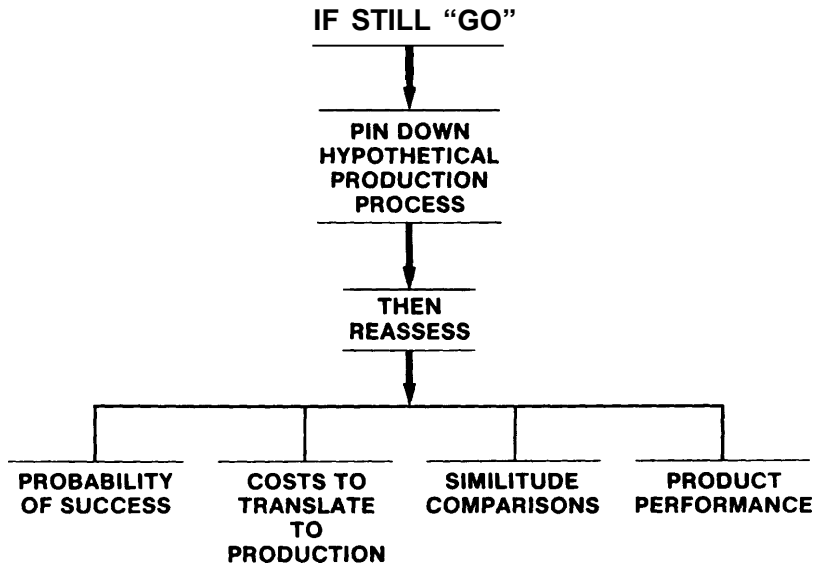


FIGURE 6

Next we would decide whether the present technology is OK, a new technology is needed, or a combination of old plus new would do the job. (See fig. 7.) Also whether the new undertaking can survive; be self-sustaining, and yield returns that would justify the capital put into it. At this stage optimistic thinking is essential because undue conservatism would prematurely destroy the prospects of ever creating anything new.

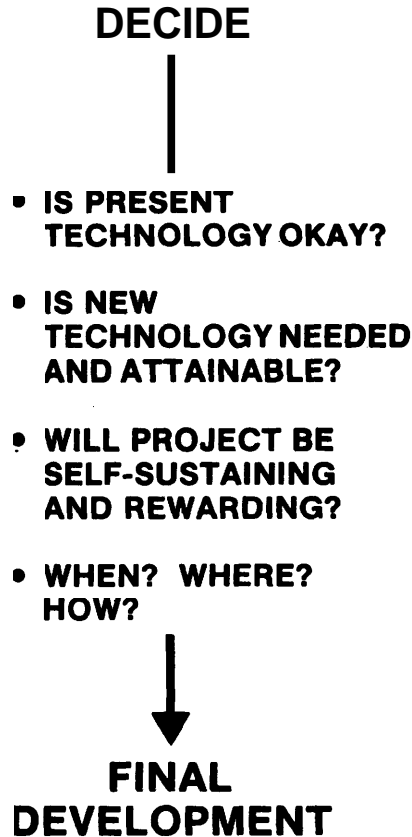


FIGURE 7

If it appears that the candidate technology would satisfy all criteria, the program would then enter final development. (See g. 8.) At this stage the costs normally far exceed earlier phases. Thus the reassessments become very hardheaded. During this phase there is often the need to design and build the pilot or prototype plant that might obtain process data, or verify product quality and get product samples for lab and field testing. If problems appear, they are again assessed in terms of the need to modify the technology, to develop a new one, or to cancel the entire effort.

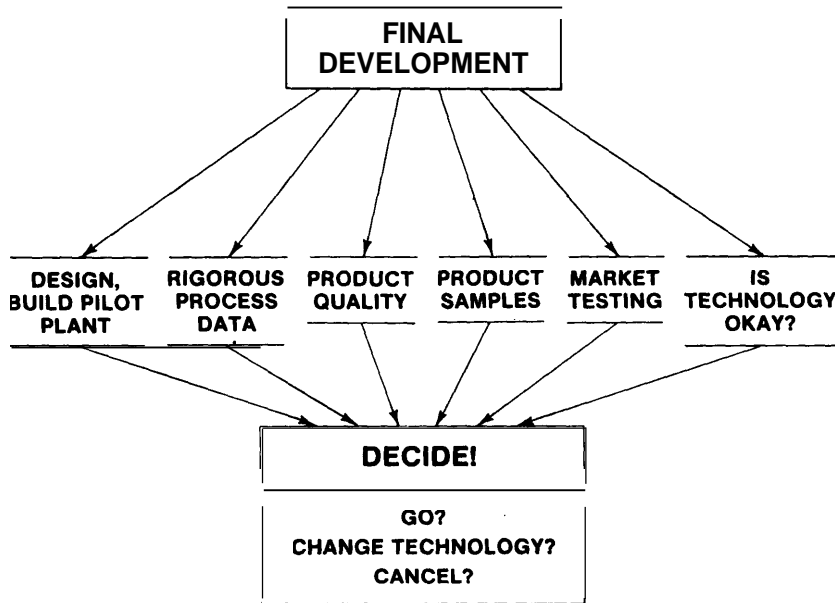


FIGURE 8

If the signals are still go, we then freeze and the effort expands into full, detailed plant design, process flow sheets, drawings, specifications, staffing, and other considerations that attend commercialization. (See fig. 9. Then we make a final check with still tougher reassessments to check the probability and degree of confidence of suc-

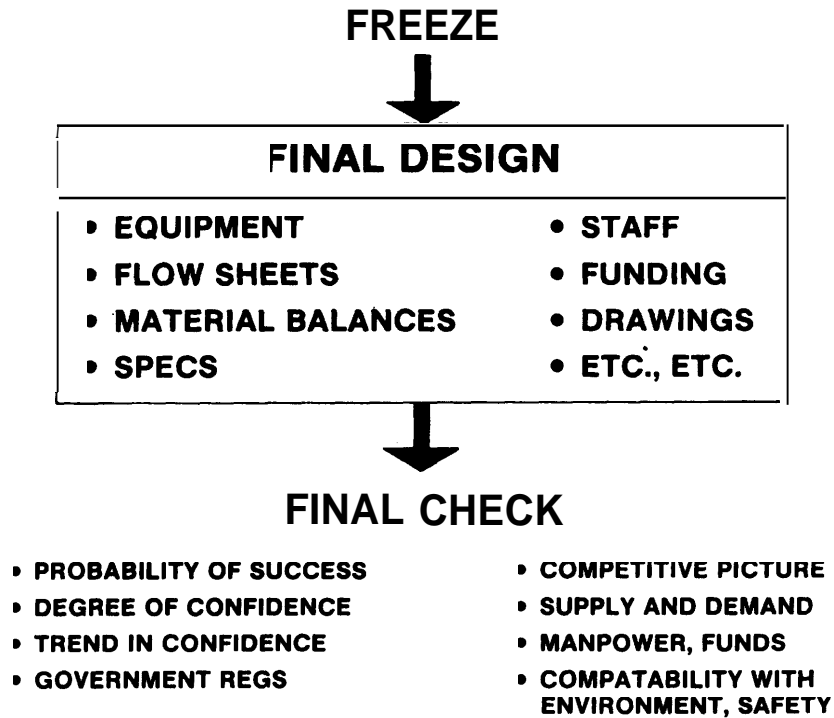


FIGURE 9

cess, the trend in confidence, competitive developments, supply and demand, manpower, operating funds, scheduling of funds, capitalization needs and sources, and a host of other considerations. The "go" decision is now made, or the total effort is again remodeled or

rescheduled, or in the most hopeless cases it is canceled with the least expenditure of further funds. (See fig. 10.)

FINAL DECISION

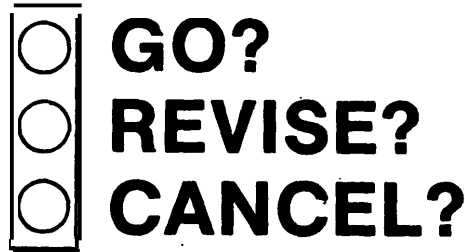


FIGURE 10

Gentlemen, please do not conclude that through such rigorous evaluation we somehow achieve that happy state where we hit a winner every time. We still have losers just as you do at times in your decisionmaking. As a rule however, when we do it is not because of faulty technology but rather because of the influence of unexpected changes in societal, regulatory, or other factors. We must of course come up with more winners than losers, so that on balance we are self-sustaining and rewarding to those who have invested money in us with the expectation of good returns. Otherwise our sources of capital will withdraw and dry up.

On the other hand, we do not expect every technology to be a winner from inception every time. Before some can generate a self-sustaining capability, a great deal of money has to be poured into them speculatively and without, offsetting current income. From a fiscal standpoint, such money is in a very real sense a loss. Often in such technologies much of the life of new patents is eaten up before manufacturing even begins. Sometimes the technology may continue a loser during its first years of commercial operations because we guessed wrong about how well the public would receive it, or about the cost

effects of unexpected changes in regulations, or other factors influencing manufacture.

However, in some cases we deliberately accept in advance that on balance the commercial implementation of the technology will be a loser in its early stages, especially if it is highly innovative in concept, form, or marketplace. In such cases we turn our backs to short-term economics and speculate through faith that the technology will in time help fill some important societal needs. In such cases we attach greatest weight to those technologies that would simultaneously allow us to conserve energy, or to make wiser use of it, or to upgrade it to a greater degree into forms that would fill more critical societal needs.

Let me tell you now of an example that has all of these attributes, plus many major secondary and tertiary societal implications. It is one into which we have put much research, development, and funding over a period of years with no offsetting income as yet, and it has now passed through all of the developmental phases that I have described. (See fig. 11.) It is known as single cell protein or SCP for short, and its assessment is now underway by governments and



FIGURE 11

private concerns here and abroad.

It is potentially a giant stride, forward in simplifying, improving, and speeding up the protein production chain for getting massive

new sources of protein to relieve the world's critical and ever-growing food shortages. (See fig. 12.) As shown on the left in this chart, SCP shortens the chain from the conventional agricultural cycle—as compared to the soybean cycle as shown in the middle—to the vastly shortened cycle, as shown on the right for SCP. Besides shortening

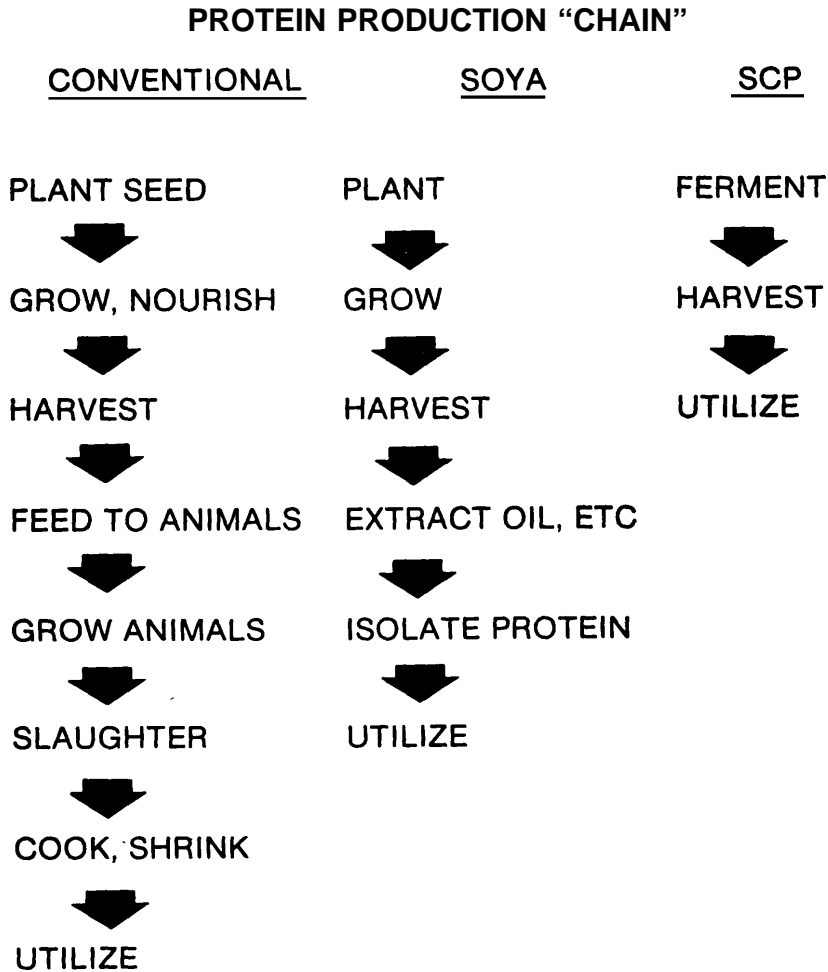


FIGURE 12

the chain, at the same time it greatly increases the efficiency of energy utilization. As part of my presentation, I am providing for your record a recent paper on SCP by Provesta Corp. along with related statements in the Journal of Commerce and the Congressional Record.

Mr. BROWN. Without objection, that will be made part of the record.

[The material referred to above is found in appendix B, exhibits 1, 2, and 3 of this volume.]

Mr. DAVISON. Thank you. Some have asked us what a petroleum company is doing getting into the food business. Actually what we

and others have been getting into here is much broader in scope. In this instance, we started our learning tree by assessing the basic scientific truth that some species of organisms can use the energy contained in petroleum derivatives to perform a host of functions; some are useful like SCP and some are not. SCP, of course, is only one of these functions. Some organisms break down petroleum derivatives into their elements, hydrogen, oxygen, and carbon and then use the elements along with growth minerals and nutrients as building blocks to proliferate greatly, as shown by the checkmark on this chart, to create useful protein and other products. (See fig. 13.)

MICROBES UTILIZE ENERGY FROM HYDROCARBONS, GASES, ALCOHOLS AND OTHER SOURCES

FAVORABLY

- ECOLOGICALLY AND ENVIRONMENTALLY, BY BREAKING DOWN AND ELIMINATING UNDESIRABLE PRODUCTS
- ✓ — BY PROLIFERATING GREATLY IN A USEFUL MANNER WHILE BREAKING DOWN THE ENERGY SOURCES
- BY FORMING NEW SECONDARY PRODUCTS WHILE BREAKING DOWN THE ENERGY SOURCES
- BY "RESTRUCTURING" THE ORIGINAL ENERGY SOURCES INTO NEW USEFUL PRODUCTS

UNFAVORABLY

- BY CREATING MANY UNDESIRABLE SIDE EFFECTS AND PRODUCTS

FIGURE 13

In this same way other organisms perform still other functions. (See fig. 14.) Some are unfavorable, as shown on this chart. Here

MICROBES UTILIZE ENERGY

UNFAVORABLY

- | | |
|---|--|
| — POLLUTION (AIR, WATER, ETC.) | ✓ — CORROSION |
| — CONTAMINATION | — DESTRUCTION (ASPHALT
ROADS, CONCRETE, ETC.) |
| — DESTABILIZATION OF
OTHER PRODUCTS | — "SOURING" OF OIL |
| — GUM FORMATIONS | — COOLING TOWER DAMAGE |
| ✓ — PLUGGING (FILTERS,
LINES, MEMBRANES, ETC.) | — INDUSTRIAL DERMATITIS
(CUTTING OILS, ETC.) |
| — DAMAGED PROTECTIVE LININGS | — RUBBER DETERIORATION |
| DAMAGED PIPELINES | — DRILLING MUD BREAKDOWN |

(— AND MANY MORE)

FIGURE 14

technology tries to find corrective products and measures. The checkmark shows an example where a bacteria plugs filter lines in jet aircraft. Coincidentally Phillips worked on a technology for a solution that is now used in all U.S. military aircraft and NATO aircraft to solve this particular problem of detrimental organisms. It should go without saying that these organisms are not, of course, the ones for making SCP.

In other cases, the reactions of the organisms are of value ecologically and environmentally in breaking down and eliminating undesirable products or situations. (See fig. 15.) This chart shows

MICROBES UTILIZE ENERGY

FAVORABLY

— — — **ECOLOGICALLY AND ENVIRONMENTALLY,
BY BREAKING DOWN AND ELIMINATING
UNDESIRABLE PRODUCTS: — — —**

OIL SPILLS	— REMOVAL OF PLASTICS, SOLVENTS, ETC., IN OTHER CARRIERS
WASTES IN WATER	
SLUDGE	— PHENOLS
CHEMICAL WASTES	— DETERGENTS
REMOVAL OF HYDROCARBONS FROM ATMOSPHERE	— OTHERS

FIGURE 15

examples of how microbes can dispose of wastes in water, sludge, or the atmosphere. In still other reactions certain micro-organisms form desirable secondary products such as vitamins and enzymes while breaking down and consuming the elements of the original petroleum derivatives. (See fig. 16.) And in still others, certain species can

MICROBES UTILIZE ENERGY

FAVORABLY

**— — — BY FORMING NEW SECONDARY PRODUCTS WHILE
BREAKING DOWN THE ORIGINAL PRODUCTS — — —**

- VITAMINS**
- ENZYMES**
- AMINO ACIDS**
- ANTIBIOTICS**
- CERTAIN ACIDS
(CITRIC, GLUTAMIC, ETC.)**
- MANY OTHERS**

FIGURE 16

chemically restructure petroleum derivatives into new useful products such as those shown here. (See fig. 17.) There are many of these. We've only shown a few on the chart.

MICROBFS UTILIZE ENERGY

FAVORABLY

— — BY “RESTRUCTURING” ORIGINAL PRODUCTS INTO NEW USEFUL ONES

- LONG CHAIN FATTY ACIDS
- MANY OTHER ACIDS
- KETONES
- ALCOHOLS
- AROMATICS
- SIDE CHAINS

FIGURE 17

Finally, and here is where SCP comes in, certain select organisms can be made to proliferate> in a useful manner, while breaking down the original energy sources, thereby producing new sources of biomass or protein, as shown by the checkmark on this chart. (See fig. 18.)

MICROBES UTILIZE ENERGY

FAVORABLY

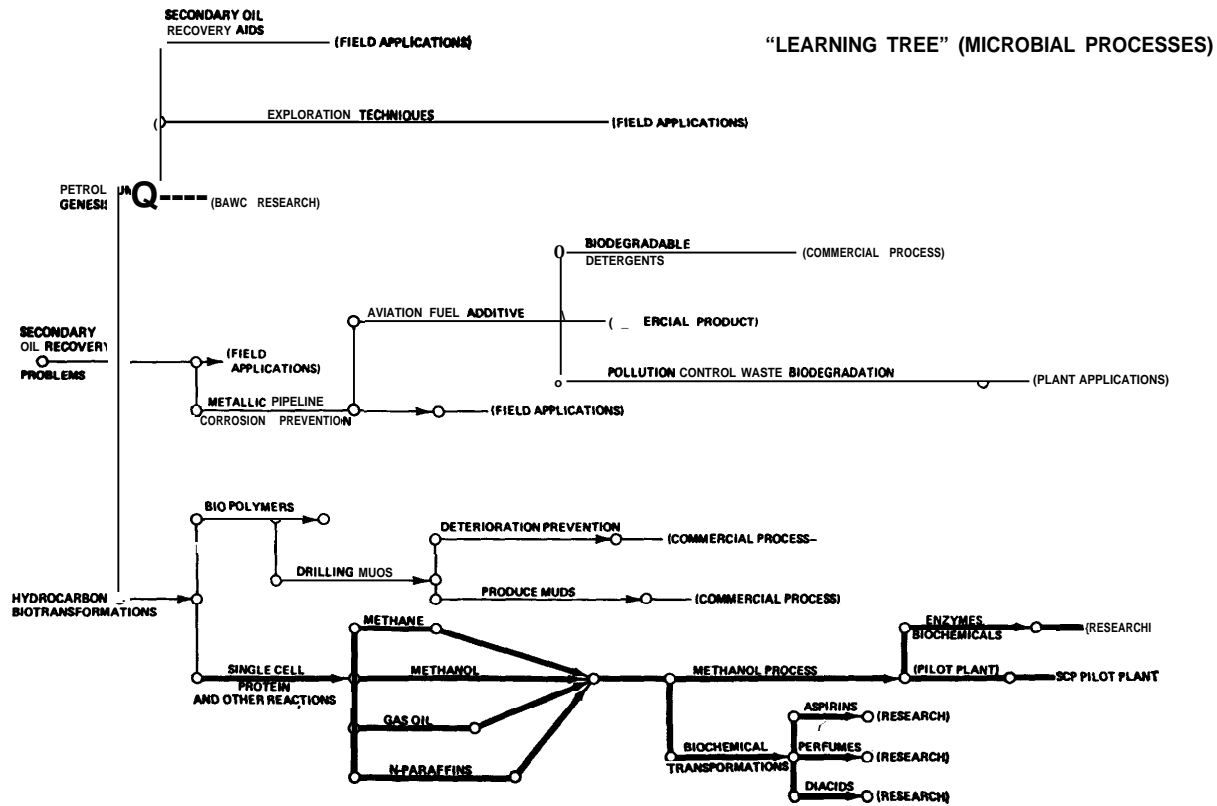
**— — BY PROLIFERATING GREATLY IN AN USEFUL MANNER WHILE
BREAKING DOWN THE ENERGY SOURCES — — —**

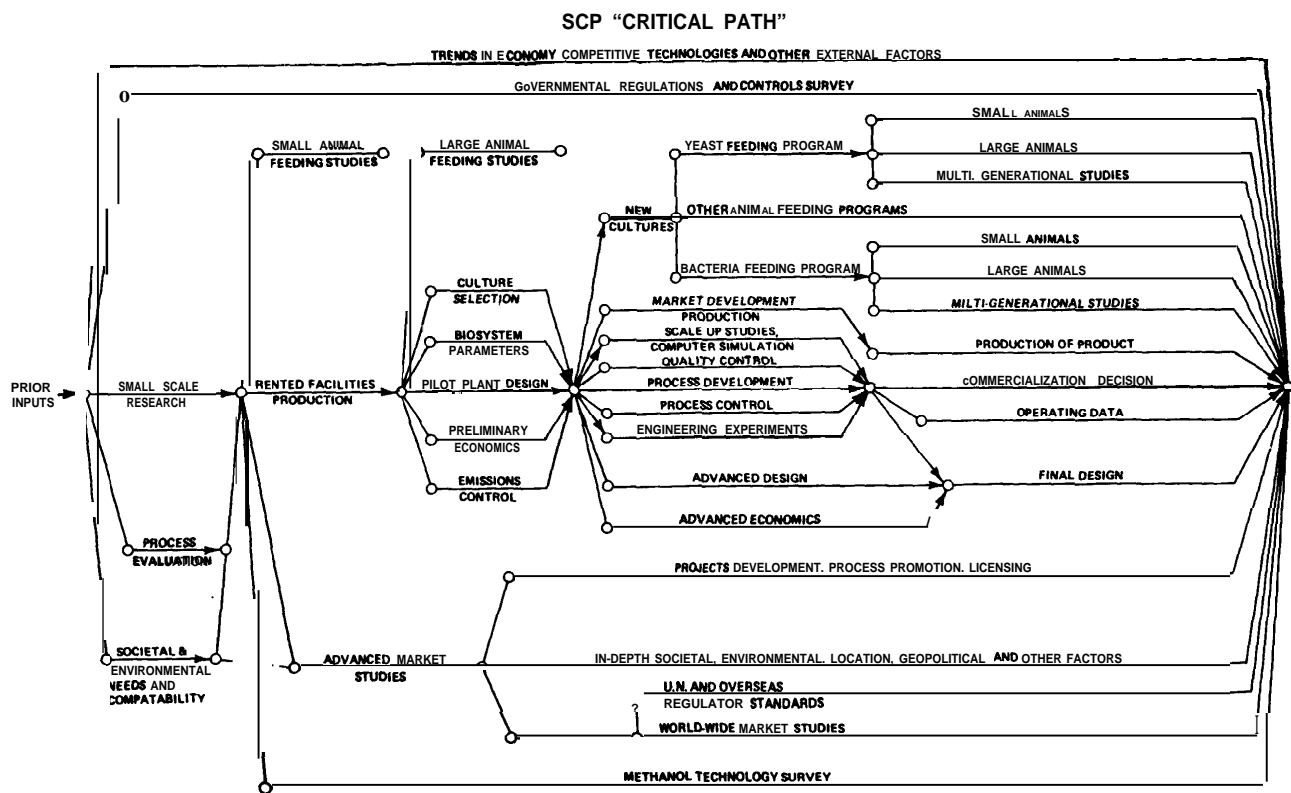
- ✓ — FORMING 'BIOMASS' (PROTEIN, ETC.)**
- HELPING TO RECOVER OIL**
- LOCATING OIL**
- CAUSING NEW OIL 'GENESIS'**
- LEACHING OF ORES, ETC.**
- EXTRACTING AND 'REFINING' USEFUL COMPONENTS
FROM THE ENERGY SOURCE**

FIGURE 18

The variety of such reactions and their applications is so great that a conventional learning tree visualization of them in chart form would be a maze of complexity. So we have chosen to show instead only that part of the learning tree in dark lines on this chart. (See fig. 19.) I do not expect you, Mr. Chairman, to read all that. But it

FIGURE 10





portrays some of the aspects that apply more immediately to some of our assessments. This branch of the tree of course includes SCP, some of the feedstocks that can be used, etc. From this one branch we can now make a project plan of SCP's critical path. (See fig. 20.) As seen, it is complex with numerous intermediate decisionmaking points. If you were able to read this chart from where you are sitting, you would see the large diversity of factors such as animal feeding tasks and emissions control—including if possible the recycling of water.

Actually SCP is nothing new. It has been around for billions of years in a variety of life forms. It consists of highly select micro-organisms whose body mass is made up mainly of rotein. In the case of SCP the final products can be the whole dried organisms or extracted parts. Mankind has eaten some micro-organisms for many, many years in the form of cheeses, yogurt, and other products.

Here is a startling figure that reveals SCP's potential impact. A cow weighing 1,000 pounds can add about 1 pound of effective protein to its body mass per day. In contrast, 1,000 pounds of SCP could within 1 day begin producing as much as 1 million pounds. This is a theoretical rate, of course. The potential productivity of SCP staggers the imagination. Just one large SCP plant could produce about as much protein as might be isolated from 300,000 acres of so beans or from beef grown on about 5 million acres of good grazing land.

The first reaction of some to whom these figures have been cited has been, "Good Lord, is SCP going to knock the chicken ranchers, the cattle growers, and soybean farmers out of business?" Actually the exact opposite, we think, should take place. The secondary and tertiary societal effect would be many but positive. Extensive animal feeding tests have shown that SCP helps animals gain weight and makes more efficient use of the total feed given them.

In addition, the use of SCP as a protein supplement in animal feeds could displace soymeal now used in such feeds. This would create a positive domino effect because the protein in soymeal could then be extracted and used much more efficiently "energywise" as high-value textured vegetable protein for direct human consumption. Millions of pounds of such protein are today being sold as meat extenders for mixing into hamburger and other products, and billions more could be produced and exported by the United States through this SCP domino.

SCP is not a panacea that will displace agricultural and animal sources of protein. Conventional sources will continue to be needed to an increasing extent despite their much lower energy use efficiencies. They employ far more people and thus have greater infrastructural societal value than SCP. The old ways and the new would thus work hand in hand complementing each other, thereby serving mankind in its urgent quest for more protein.

The reason we chose SCP as a case history, in our remarks to you, is that from a TA or a project-planning standpoint, it is one of the most complex that we have ever seen, not only in its conventional parameters and their influence but also in its exceptional array of secondary and tertiary factors—societal, ethnic, psychological, novelty, regulatory, evaluatory, food policy restraints, political, geopolitical, educational and others. The leverage these factors exert on implementing decisionmaking is great. What makes it even tougher is

that many of them are subjective and abstruse, thus difficult to quantify in their TA.

The many factors influencing SCP commercial timing and viability could in their aggregate be overshadowed by one alone, and that is the nature of (government regulations here and abroad that will control SCP manufacture, sale, and usage. Aware of this danger, the Protein Advisory Group of the United Nations evolved and issued a series of advisory guidelines for use by regulatory bodies here and abroad. These were prepared under the capable direction of Dr. Max Milner, who we are pleased to learn is now a staff member of OTA. The guidelines appear workable and seek to create commonality among regulations of all countries to allow unimpeded export-import trade and to give planners of commercial SCP enterprises a firm, consistent handle on regulatory aspects in assessing the viability of new projects.

How does one make reliable TAs under circumstances such as this when the make or break depends so greatly on regulatory decisions that have yet to be made? The answer may be to have a vehicle in our Government, namely OTA, which working with other Government agencies and private enterprise, will make informed, thorough, and unbiased assessments that will later serve as guidelines to cognate U.S. agencies as well as to Congress.

As I have said before Mr. Chairman, ladies, and gentlemen, we are anxious that you do well and stand ready to help. Thank you.

Mr. BROWN. Thank you very much, Mr. Davison. I find your testimony to be not only valuable but extremely interesting. It appears to me that you have a broad concept of technology assessment (TA) in your company, one that is interwoven with the entire formulation process, and serves as a major adjunct to your policy decisions. I am not entirely clear as to the degree to which you isolate this function as a separate organization. I might say that this is not necessarily good or bad. We have a tendency in the Government I think, to overbureaucratize functions. Sometimes this becomes counterproductive. Could you describe again briefly how you handle this function?

Mr. DAVISON. Yes, I would be happy to, Mr. Chairman. At the beginning of my remarks when I mentioned the overseeing body that is titled "Corporate Planning Group," I certainly did not mean to imply that we compartmentalize this function. Quite the contrary, this full-time staff that reports directly to the chief executive officer of Phillips then branches down through satellite groups, which are divisions in every operating group of the corporation and in R. & D. These groups have many other functions, but the gist of it is that they function throughout the whole fiber of the operating groups and R. & D. in assessing technology. It is very much of an ongoing activity along with the functions that I have described in total.

Mr. BROWN. You say it is integrated with your overall corporate planning activities.

Mr. DAVISON. Very much so. As a matter of fact, in preparing our remarks we thought that in some aspects perhaps these remarks and the sequence of slides that I showed you might be considered trite. someone might say, "Well you know, that's just project evaluation." In a broad sense it is, it is true. but I think the important thing is to try to read back into that project evaluation from the very inception the environmental, the ecological, the societal impacts so that you are

considering them hopefully. And I must say we are not always successful but we are learning.

Mr. BROWN. Of course, you have a slightly different need in private enterprise, which does not occur quite so much in public entities, and that is the market viability aspect of it. In fact, you can have a very successful technology resulting in the development of a product, service, or what have you with which as a result of market competition, you might fail. You not only have to make sure that the technology is viable but that you can produce the end result of that technology in a competitive fashion with all other enterprises that might be involved in the same endeavor. I cannot quite see a comparable situation in Government. We have a little bit of difficulty of course in the concept of planning in Government, making long-range policy determinations. The general assumption is that it is something Government ought not to be involved in. Although as a practical matter it is absolutely necessary, and it is being done in many different areas.

I might say that in other areas of Congress we are looking rather fully at the overall problem of long-range planning. This hearing and its results I think complement and fit into that. Your testimony indicates how closely they are identified in your own organization. I am very much interested in the example you gave of the single cell protein (SCP). Could you give me an indication of how close the development of this product is getting to the point at which there would be large-scale marketing—before it becomes an important aspect of our economy

Mr. MALICK. Mr. Chairman, before I answer that question, with your permission I would like to go back and make a brief comment on the rather important remark you made a moment ago. This distinction, this philosophical conceptual distinction that you mentioned, between the motivator in industry, that is that the measurement of viability is in terms often of economic parameters, whereas from a societal standpoint you in Government have to be mindful and conscious of the broader implications exclusive of how it might affect, one particular company or another. We really don't turn our backs on those technologies that do appear to be viable from a functional standpoint societally. If they do not fit our operations, quite often what we do if they are functionally useful, societally useful, but for some reason or other we do not have the feedstocks or we do not have such plant operations, or if it would cost too much to build a plant, then what we do, sir, is to license those technologies.

Let me give you a prime example. Air Force aircraft were crashing in the United States and other countries because micro-organisms were growing in the fuel tanks and clogging the filters. As part of the schemata Mr. Davison just described, one of the objectives in our studies is not just to proliferate micro-organisms for such products as SCP but to get rid of the unpleasant ones that cause undesirable effects in other situations. We discovered a technology to do the latter, that is to kill undesirable organisms. However, the chemical components of the product monomethyl ether of ethylene glycol, for one, were chemicals that we were not lined up to produce. So, what we did was to license companies all over the world, in the United States, Japan, and elsewhere, to let that technology be applied and move forward.

And again in still another case, the short-term viability of this matter that you asked us to address at this point, SCP, has not been a

pivotal consideration at this stage of development. We have been working over 7 years, as the dates of the articles that we have submitted to you indicate, without 1 cent of return, on the assumption that in time the societal value of protein is going to be literally staggering the way the demand is growing now.

Now if I may, I will answer the question you addressed to me, namely, how close the development of SCP is getting to large-scale marketing. It is in some cases in its inception stage and past this stage in others. The awareness that organisms could proliferate and produce large masses of protein has existed for many years. Just to give you a point of reference, milk contains about 4 percent protein, meat anywhere from 20- to 30-percent perhaps, whereas these organisms contain 50- to 80-percent crude protein. And the knowledge that their body structure is made up that way has existed a long time, Mr. chairman. The question was one of developing efficient processes that would yield SCP products that nutritionally and toxicologically would be useful in one or another application. One of the applications is as animal feed, as Mr. Davison mentioned, the other ultimately is possibly for direct human consumption.

With respect to the former use, as soon as an awareness developed that certain hydrocarbons would grow protein-rich SCP, some companies abroad assumed, as we all sometimes do in science, that they had discovered a really major breakthrough, and they immediately proceeded to build plants with what we call first generation technologies. Two have just been completed in Italy, each of 100,000 tons, by two competitors of ours. We elected to pass up first generation technologies because of this concern that you are attentive to, the societal implications. There was a possibility that with certain feedstocks some problems might arise from the standpoint of consumer interests. We opted instead to go on to a more advanced technology that would eliminate such problems. Our judgment was correct. For as we understand it from the press and reports, at this moment those brand new plants are shut down because the Government of Italy has prohibited putting the products on the market until such time as certain additional quality criteria or measurements are satisfied.

So you could say that SCP in general is on the verge of being commercial if some resolution of the problems is arrived at momentarily. We ourselves are now addressing a number of locations around the world, examining the parameters of each of these prospective projects to see where, when, and how suitable projects applying our technology could move forward. With respect to animal feeds in the United States, the economics and the need are both rather uncertain. Soy meal as you know, has been rather low in price. It does provide a good protein supplement for animals, and we have plenty of it in the United States. For that reason, I do not see the entry of SCP in the animal-feed market very quickly.

Let me digress and say we are not the only company working on SCP. There are a number of companies all over the world each with its own particular technology and proprietary processes. One company in the United States is now marketing a form of SCP that is in fact a yeast, *Torula* yeast. It has been eaten by people for generations. The difference is that now the yeast is made using alcohol produced from gas. It is being marketed as a supplement to be added to different foods as a protein reinforcement.

As to progress beyond this point, we have this rather strange anomalistic situation. There is a tremendous need for protein in certain parts of the world. We know that extreme protein deficiencies affect brain functions, gestation in mothers, and health. But those areas that have the greatest intrinsic demand have the least capability to buy any products. In contrast, here in the United States we have a large production of other protein products for human consumption, as we have mentioned in our paper. When the advent of SCP overseas will be will de end a great deal on how Government and industry work together, and what priorities they set on its commercial progress. That was a rather long-winded way of answering you, but I thought it might be helpful.

Mr. BROWN. It is quite obvious to me that this serves as an almost classic example of the importance of TA and its integration with market assessment, cost-benefit analysis, and the whole range of policy tools that you would have to apply. For example, you face a problem of declining availability of petroleum resources and higher prices. How is this going to affect the desirability of using petroleum resources for the manufacture of protein?

Mr. MALICK. There are several ways of doing this, Mr. Chairman. With one, you start with a liquid hydrocarbon fraction; with the other you start with—

Mr. BROWN. Is this a fraction that would not have minimum economic value otherwise?

Mr. MALICK. In certain a placations it would have a negative value. For example, normal paraffins have a very low octane number, and they have a high waxing point at which they cause the pour point of materials to be raised to a point where they might clog up something at low temperatures. In other situations, those components as chemicals are useful in making certain other products. So it really varies. Now, the other way of doing it, the way we have gone to what we call our second or third generation technologies, is to take gas—just gas—and make an alcohol out of the gas, that is oxidize the gas into an alcohol. If you take methane and oxidize it, you get methanol, which is methyl alcohol. There is a lot of methane around. This methanol is used as the energy source for growing the SCP. As for the extent to which you dip into the hydrocarbon resources, the best perspective I can give -you is this. There is a world protein gap that has been measured by the World Health Organization. I have a chart if you would like to see it, that shows what the deficiency is below the U.S. recommended level of daily protein intake for good nutrition, health, and mental development. The amount of this gap in the world daily diet is such that with less than 1 percent of the total current proven reserves of petroleum in the world, that gap could be completely filled on a projected future basis as well as a current basis.

With less than about 6 percent of the total world petroleum and gas reserves—this is theoretical of course because it will never happen—100 percent of the world's protein requirement for direct human ingestion could be satisfied. So it really does not hit the world petroleum resources that hard. Yet it has a tremendous impact.

Mr. BROWN. That is a very important point. If the SCPs can be developed from alcohols such as methanol, then the methanol could

be produced from a wide range of wastes. Even in India it could be produced from agricultural waste, all those cows that are not being eaten and leaving a lot of manure around that could be converted into protein. Your assessment has taken into account all of these factors, I presume.

Mr. MALICK. Yes, sir, it has. "

Mr. BROWN. What about adverse side-effects, the possibility that there would be carcinogenic effects or other effects on human health? Has this been subjected to analysis also?

Mr. MALICK. First of all, just like people, all SCPS are not alike. Some are potentially questionable in character and repute, and others are rather spotless and virginal in these aspects. You have to discriminate and not generalize. One does have to discriminate.

As far as toxicology is concerned, some toxicologists feel that with certain substrates, that is with certain forms of hydrocarbons, there is a possibility that a residual chunk of the hydrocarbon might be left trapped in an organism. This in turn might theoretically cause a carcinogenic response in whatever the host is of that particular material. The fact is that to the best of my knowledge, there has been no evidence that this has happened. But the theory does exist. Other substrates such as alcohols do not pose this question at all. The alcohol approach is not the same as the hydrocarbon approach. An alcohol is an alcohol and not a hydrocarbon even though it may be made from a hydrocarbon. Thus you cannot leave a trace of a hydrocarbon in there. We have run animal feeding tests for over 4 years. Others have for that length of time and even longer, and the responses of the animals have been excellent. There is no evidence of any difficulty.

Mr. BROWN. One of the big problems with carcinogenic effects is the long time delay.

Mr. MALICK. For that purpose you have to run multigeneration tests with these substances, Mr. Chairman, that is right.

Mr. Davison. And those are in progress, as a matter of fact.

Mr. MALICK. Yes.

Mr. BROWN. I think this is fascinating. Mr. Davison, in your testimony there comes through this concept of the difference between public and private enterprise and the need for cooperation between them. You do stress however, the degree to which your company, and presumably the forward-looking portions of private enterprise, takes as a sort of trusteeship responsibility with regard to what they are doing. Your testimony emphasizes this to a great extent. Government on the other hand, which is supposed to exercise a trusteeship role, sometimes neglects the importance of what you might call the enterprise role, the necessity to operate in a profitmaking mode in order to survive. I am interested in the role of OTA, which you point out, as possibly making a bridge between these two by improving the understanding on the part of Government of the economic impacts of what might be proposed, and possibly helping private enterprise through the widespread dissemination of its results and techniques and so on to understand the importance of the trusteeship role. They need to consider second- and third-order effects on human beings, which is a trusteeship function. Would you care to comment a little further on how you see OTA meeting this role or the process of TA meeting this role?

Mr. DAVISON. yes, Mr. Chairman, I would. I thought our remarks some minutes ago were certainly perceptive of the differences that exist between industry and Government. My testimony as you have noted, refers to specific products and specific processes. It is true that industry does deal with these and it is a very important difference in that we are trying to get such commodities, such products and processes, viably to the marketplace. Whereas Government—and I must confess I sympathize with you in this role—is attempting to look very broadly at bodies of technology. It is a most difficult problem to bring these two concepts together satisfactorily and carry on a dialog about them in a way that will be meaningful in serving the public interest.

I believe though in taking consideration of the trust aspect and how we can come together and be helpful. I think the start you are making right here and will in Los Angeles with further testimony and discussions is most useful. You brought—and I think this is to the good—you brought certain industry people into your advisory boards. They are giving input. And to that extent I can only again compliment you, and I hope that this trend will continue. We want to help. Any time we can be of help on a given project or technology, we will.

Mr. BROWN. I think this process of involving through various panels a cross-section of competent people from private enterprise and from other sectors of the economy may be one of the most significant contributions that OTA and the Technology Assessment Board can make. But I am interested in getting reactions to that.

The problem that results in a lot of Government regulation, which is the bane of your existence in private enterprise, is the apparent desire of private industry, in some cases, to market a product almost regardless of its effect upon society as long as it makes a profit. This can extend all the way from something relatively harmless like making hoola-hoops—and who am I to say that hoola-hoops are not valuable—but they do use scarce resources—to something far more serious such as a failure to anticipate the carcinogenic effect of some product that has a great deal of use in a special application but far more importantly has adverse effects in the long range. That results in, as I say, a great deal of effort on the part of Government to do what it thinks is necessary to protect the public, but which the company probably could have done and done more efficiently in going through some processes you have so ably described both in your testimony and with your charts. I do not like to suggest this, but maybe a wider attention to TA on the part of private enterprise might succeed in reducing the regulatory role of Government. a highly desirable result if it. should come about.

Mr. DAVISON. I think those again are good remarks, and I am not going to sit here and say that there is not some form of regulation or some sort of overview in which Government will play a part. I just cannot be critical in that respect. But I certainly agree with you, and I would like to think that we are learning. We are all learning. We are learning more about TA. I think that perhaps a number of years ago there was more of a tendency for private enterprise to produce something, to put it, into the public sector with more exclusive attention to the profit motive. But I honestly believe, as I remarked before, that the fact that out of 30,000 Phillips employees we have the equivalent

of 600-and I do not mean 600 full-time but on call for a percentage of their time-the equivalent of 600 people involved in environmental work, that, I think, is outspoken testimony to the emphasis that we are giving it. We are not alone in that respect. There are many other competent companies that are doing the same thing. Monte Throdahl I know, spoke to you yesterday about Monsanto's efforts in these regards.

Mr. BROWN. Gentlemen, I again want to thank you for the contribution that you have made to our hearings. We would like to keep in touch with you. If there are any additional questions to help clarify The thrust of your testimony, I hope that we can communicate them to you and have you respond at an appropriate time. Thank you very much for your testimony.

[The following questions were submitted by Congressman Brown to Mr. Davison and his answers thereto:]

Question 1. Compare the process of TA in The Phillips Petroleum Company with the concept and utilization of TA in OTA. Contrast the strengths and weaknesses.

Answer 1. In concept and utilization we both seek the same end result: the capability of reaching sound decisions on future actions. In formulations we differ. Ours comprise a series of TAs, each of which affects the course of effort and substance of the final TA, and those made during the gestative process (often years) may NOT characterize the final one. Yours appear to be one-shot, and if made at interim stages in the gestations would in effect be speculating presciently and perhaps erroneously on the final stage. This means that OTA will be unable, in some instances at least, to provide valid TAs to Congress et al. until the technology is a fait accompli. This poses a dilemma since Congress seeks sound inputs before the active interface between society, environment, and technology.

The strength of our approach to TAs is that they are at all times current and thereby representative of the true state of existing knowledge. Its weakness, inherent in evolutionary processes, is that the final stage often cannot be accurately measured in form, timing, and impact until it is actually evolved.¹ In theory the strength of TAs made by a body such as OTA stems from their implied potential for greater societal and environmental objectivity because of their greater emphasis on these aspects (as Chairman Brown observed) than on industry's "bottom-line," economic viability. However, emphasis or bias in either direction could lead to distorted decisionmaking, possibly damaging from the standpoint of one or the other party. Recognition of this by both parties will offer an excellent opportunity for creating a system of constructive checks and balances in TA "points of view," government vs. industry. All that is needed is open-minded and frequent coordination between the parties. Among other things, this would safeguard against making premature "package" TAs of *emerging* lines of technology in all of their potential forms that might severely penalise individual technologies falling within the package. Similarly, it would guard against specious TAs, representative of only one or another embodiment of a broad line of technology, that would lack true relevance to other embodiments.

If in policy and practice government and industry coordinate closely throughout the period that OTA is evolving each TA it will insure that as evolution takes place it will always accurately reflect the current characteristics of the topic under study. It would still be impossible to give Congress a final-status TA until the final attributes of the technology are evolved. But OTA would at least be able to do the next best thing, to give Congress sound current advice and interim guidelines on what may be emerging—in effect, interim progress reports in fields in which Congress has expressed interest. One must hope of course, that Congress would make prudent use of such interim inputs and not jump the gun.

¹ Exceptions include government-sponsored technology-oriented contracts whose end objectives and characteristics (specifications) are often presumptively predefine by the buyer.

² This approach, frequently used by government, is known as the "least common denominator" principle in specification or regulation writing, intended ostensibly to protect restrictively against the worst embodiment that might be offered by anyone within the scope of the regulation, often at the expense of the best.

Properly sed, both parties would benefit from them. This is, in effect, what we recommended in our testimony and it reflects the concurrence expressed by Chairman Brown in his response to us.³

Question 2. Does information about your TA activities appear in any Phillips Petroleum Co. reports?

Answer 2. Yes. During formative stages our reports sometimes contain highly proprietary data and are given internal distribution only. Frequently however, TAs or their counterparts are published prior to commercialization of the technology. An example of the latter is the paper on single cell protein submitted to OTA as part of our testimony. In other instances we issue informative releases on impending actions and in still others special descriptive reports are sent widely to public, government, environmental, private, and academic sectors. An example of the latter is the booklet "The Casebook, Examples in Environmental Protection" given to OTA as part of our testimony. (See appendix B, exhibit 4, on how to obtain copies of the report.) Such "Casebooks" are updated and reissued periodically. Additionally, special brochures explaining our individual TA efforts and their implementations (prospective and actual) are at times issued. We also prepare and make wide release of information movies.

Question 3. Do you see any value in having close relations and better communications between your organization and Federal and State governments?

Answer 3. Emphatically yes.

Question 4. How do you decide how much time, effort, and money should be allocated for a particular TA or EIS?

Answer 4. As explained, allocations change during evolution of the technology. Those initially made to highly innovative technologies having little precedent simply reflect a priori judgment. The allocations are then readjusted periodically as data are acquired, based on parameters described in our testimony. In contrast to TAs, the scope of EIS processes is usually well-defined at the outset through prior knowledge of the criteria by which the EIS will be measured by EPA.

Question 5. Do you see any relationship between the TA and EIS processes?

Answer 5. EISs employ TA methodology but measure some, not all, of the parameters of TAs. TAs include EIS factors but not in precisely the same format as EIS-related assessments prepared specifically for submittal to EPA and other agencies.

Question 6. How has TA affected your way of doing business? How do you involve the public in your TA processes?

Answer 6. To one degree or another TA has always been intrinsic to everything we do in conceiving, planning, developing, and implementing technologies or changes therein that affect the public and the primary, secondary and tertiary attributes of whatever we bring to the public. The weighting of the many factors involved in TAs varies depending upon the nature of the technology, its novelty, methods of production, choice of feedstocks, markets, timing, societal, environmental, and other factors. Common to all, is consideration of the impact of the technology on the public and the environment. As explained elsewhere above and in our testimony the measurement of this impact employs methodology modelled to fit each case and including market research, studies by independent consumer testing laboratories, sample consumer group evaluations, test marketing in selected areas, study of the experiences of others in similar lines of effort, external and internal compatibility, and many other factors.

Question 7. How do you handle impact statements and how do you inform the public of the requirements and your efforts? How do you discuss the impacts and educate the public ahead of time?

Answer 7. Industry does not itself prepare EISs. What it generally does is to apply for permits to discharge effluents of one type or another. Normally public hearings are held before such permits are granted. Frequently we inform the public in advance of what we are thinking of doing and then allow and measure public response. In the case of new installations, we prepare environmental assessments, then submit these to EPA. It in turn assesses our data and then itself prepares the EIS. For major new projects we often hire competent third parties and firms to prepare the environmental assessment, to give it greater utility and neutrality. Generally, where we seek EISs from EPA we release no publicity until EPA gives us its EIS. However, we do at times in the interim publicly announce our projected plans, if this appears to be in the best interests

³Mr. BROWN. "... I think this process of involving through various panels a cross-section of competent people from private enterprise and from other sectors of the economy may be one of the most significant contributions that OTA and the Technology Assessment Board can make ..."

of all concerned, then hold discussions as needed with interested or affected outside groups. Additionally, we prepare special reports, brochures, and other communications for dissemination to many outside groups.

We now have three governmental witnesses and if I might, I would like to ask all three of them to come forward. I would like to conduct their part of the hearing in a way that would be most convenient to them. Dr. Sidney R. Galler, who is Deputy Assistant Secretary for Environmental Affairs, Department of Commerce (DOC); Mr. Bruce Pasternack, Deputy Administrator for Policy, Federal Energy Administration (FEA); and Mr. John S. Barron, Assistant to the General Manager of the Tennessee Valley Authority (TVA).

Gentlemen, do any of you have time pressures that require you to leave in the next hour? If not, then I would like to ask each of you to present your testimony one after the other, and then we will have some discussion with all three of you after that is over. If there are no objections, we will take them in the order that I listed. First, Dr. Sidney R. Galler, who is from the Department of Commerce. We are very pleased to have you here.

[The biographical sketch of Dr. Sidney R. Galler is as follows:]

DR. SIDNEY R. GALLER, DEPUTY ASSISTANT SECRETARY, U.S. DEPARTMENT OF COMMERCE

Dr. Sidney R. Galler, Deputy Assistant Secretary for Environmental Affairs in the Office of the Assistant Secretary for Science and Technology, U.S. Department of Commerce, with responsibility for developing, coordinating, and evaluating the Department's environmental affairs.

Born November 9, 1922, Baltimore, Maryland; married; four children.

B.S. 1945; M.S. 1947; Ph. D. hydrobiology, University of Maryland, 1948.

Military service U.S. Army, World War II; head of the Biology Branch of the Office of Naval Research, 1950-1965; Assistant Secretary (Science) of the Smithsonian Institution, 1985-1971; appointed to present position by Secretary of Commerce, 1971.

Professional activities include: establishment of the U.S. Navy Hydrobiological Research Program, which served as a foundation for the later development of U.S. national research programs in biological oceanography; and development of the first U.S. program of animal orientation research which has contributed to improved high altitude aircraft operations and manned space flight; also pioneering work in bio-instrumentation which led to the development of the first U.S. satellite biological experiment launched from Cape Kennedy on February 4, 1958.

At the Smithsonian, initiated the Smithsonian Center for Short-Lived Phenomena—the first international early warning system for scientists to facilitate early investigation of major natural catastrophes, e.g. earthquakes, volcanic eruptions, pest infestations, etc. Also, helped develop the Smithsonian Center for Environmental Studies, a research facility for discovering scientific solutions to environmental problems such as the protection of watersheds in areas of rapid industrial and residential development.

Author of numerous scientific and technical publications. A member of: the American Society of Limnology and Oceanography; Society of Sigma Xi; The Research Society of America; and the American Institute of Biological Sciences; and a Fellow of the American Association for the Advancement of Science, a Founder member of the Marine Technical Society, and a Fellow of the Washington Academy of Sciences; also a member of the Cosmos Club, and listed in *American Men of Science* and *Who's Who in America*.

Awards received include: the Navy Civilian Service Award, several Outstanding Performance Awards, and the Navy Distinguished Civilian Service Award. (This award is the highest civilian award of the U.S. Navy.) Special Achievement Award received from NASA in 1971; and for advancing international scientific collaboration. Letters of commendation awarded from secretaries of the navies of Mexico, Argentina, Chile, Peru, and Brazil.

Honors received include the Smithsonian Exceptional Service Award, the highest staff citation awarded by the Smithsonian; and in March 1975, a Special Achievement Award by the Secretary of Commerce.

STATEMENT OF SIDNEY R. GALLER, DEPUTY ASSISTANT SECRETARY FOR ENVIRONMENTAL AFFAIRS, U.S. DEPARTMENT OF COMMERCE

Dr. GALLER. Thank you. Mr. Chairman, it is a privilege to be invited to appear before the Technology Assessment Board and provide you with information about one aspect of the U.S. Department of Commerce's (DOC) activities in the area of technology assessment (TA). I would like to focus my presentation on the National Environmental Policy Act (NEPA) and specifically on section 102 (2) (c), which, in my view, provides an important mechanism for assessing the impact of technology on the environment.

Up to a point, the subject of TA like beauty, is in the eyes of the beholder. I would like therefore, to provide you with the context for my perspectives on TA that follow. Let me quote from section 101(a) of the Declaration of National Environmental Policy:

The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment . . . and new and expanding technological advances . . . declares that it is the continuing policy of the Federal Government . . . to create and maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans.

Next let me quote briefly from section 102 of NEPA:

The Congress authorizes and directs that to the fullest extent possible: . . . (2) all agencies of the Federal Government shall include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the human environment, a detailed statement by the responsible official on the environmental impact of the proposed action. . . .

It is my considered opinion, Mr. Chairman, that NEPA, including the requirement to prepare environmental impact statements (EISs), whenever appropriate, provides for assessments of the impacts of proposed technology based actions on the environment. It is especially interesting to note that section 101(a) addresses the need for man and nature to exist in productive harmony and fulfill the social, economic, and other requirements of Americans. It is also noteworthy that section 102(2) (c) addresses the need to prepare EISs on proposals for major Federal actions significantly affecting the quality of the human environment. Obviously then, NEPA encourages the development of an information base to facilitate assessments of the impacts of technology on the life-support capacity of the natural ecosystem—that is, the environment as we know it—as well as on the supply of materials and energy for the delivery of food, shelter, clothing, and the amenities that determine in the aggregate the quality of the human environment. In summary then, I am suggesting that NEPA, and specifically the requirement to prepare the EIS under NEPA, for the first time in our Nation's history institutionalized a process for projecting and assessing the effects of technology-oriented decisions on the quality of the total environment. so much for the context of my perceptions on TA.

On December 8, 1970, the Secretary of Commerce established the post of Deputy Assistant Secretary for Environmental Affairs to assist the Department in complying with the spirit as well as with the letter of the NEPA. I assumed my post on January 11, 1971, just in time to take part in the preparation and review of what is now

known as the Trans-Alaska Pipeline (TAP) Environmental Impact Statement, which was at that time being prepared by the Department of the Interior (DOI), with collaboration from other Federal departments, including our own. Since that time, our department has gained considerable experience and insight, both in the preparation of, and in the review and comment on, the EIS.

Because of the nature of our missions and programs in the DOC, the number of EISs that we have prepared has been relatively small, averaging about 12 or more a year. However, we have reviewed many thousands of EISs over the last 5 years, and have commented on about half of the number that have come in for our review.

The question is frequently asked, "Is the environmental impact statement an effective technology assessment tool?" Let me respond as follows; that since the advent of NEPA local, State, and Federal Governments, as well as business, industry, and the public at large, have become increasingly conscious of the need to predict and assess the technological impact of proposed major actions on the total environment, prior to reaching a decision, rather than making the ex post facto assessments that typified our pre-NEPA activities. Indeed, in my opinion, the EIS requirement provides an extraordinarily interesting and important challenge and opportunity to improve the TA process. At the same time, our experience with the EIS as a TA tool points to the need to reappraise that process toward insuring that it indeed meets the intended requirements to identify and assess the impacts on the human environment of a proposed major Federal action before and not after the primary decision—that is, the go-no-go decision—is made. Also that regard, I think it is necessary to examine closely the connotations of the term, "major Federal actions," because in my view, the most serious and chronic defect in the whole EIS assessment process continues to be its largely ex post facto nature, notwithstanding the earnest and sincere efforts on the part of all Federal agencies, including our own, to inject the EIS *process* into the earliest stages of project planning.

One major obstacle that militates against optimum utilization in the decisionmaking process of the information document we call the EIS, is that the implementing guidelines fail to take into full account the fact that many of the so-called major Federal actions are basically actions that are derived from earlier decisions made in the non-Federal sectors of the community before the formal EIS process was actually initiated. I have estimated that over the last 4 years approximately 80 percent of all the projects for which Federal EISs have been prepared, originated outside of the Federal sector. I estimate further, that during that same period more than 50 percent of those projects requiring EISs could be identified as originating in the private and local sectors. For example, if the XYZ electrical generating utility conducts a market survey that projects a market demand for electrical energy well beyond its current capacities, it must by law take whatever action is deemed appropriate to increase its capacity in order to meet that demand. In point of fact, the local XYZ utility is under societal-generated statutory pressures to initiate projects to increase capacity for societal good.

Ironically, and notwithstanding well-intentioned efforts on the part of the utility to factor environment into its early project planning, it

rarely possesses an adequate in-house capability for doing so. Most frequently, it depends on outside consultants or contractors to gather and package the available environmental information in the form that corporate management can use in arriving at the primary decision—that is, whether to go nuclear, fossil fuel, et cetera. That first or primary decision is made by corporate management largely based on its perceptions of its legal and social responsibilities to the community that it serves, as well as to its stockholders and to the lending institutions. Once the utility decides on the basic energy source, it has, in effect, made the first and most important decision. From that time on, environmental factors, while still very important in developing actual project implementation plans, come to be looked upon as hurdles to be overcome before the utility can meet responsibilities to serve the community.

From the moment of the first decision, the project begins to unfold. It takes on a life of its own, as it were, as it travels through the successive levels of local, county, and State governments, meeting the various legal, social, and financial requirements imposed by the communities and their governmental agencies. As it proceeds, the project may develop a tremendous socioeconomic and political momentum. So when it finally enters the Federal sector, seeking the necessary Federal subventions, it has become, for all intents and purposes, an irresistible force.

Thus, some 2 or 3 years after the first decision was arrived at, and with thousands of miles frequently separating both the impact site and the local community's exceptions of the project, from Washington, D.C., and the lead Federal agency's perceptions of the project, the lead Federal agency is required to undertake the development of an EIS. It is small wonder then that the current process often generates more purple prose than dialog, and exacerbates rather than ameliorates the differences in perspective between the local, State, and Federal communities; since neither the private sector nor local and State governments, can be expected to view the TAs inherent in the EIS in the same way as the Federal sector.

In our view, another equally distressing weakness in the current EIS recess is the lack of clear requirements for the inclusion of what I call an economic dimension in the EIS. Most EISs are largely devoted to discussions of possible impacts of technology on the physical, biological, and ecological elements of the environment; for example, the impact on the life-support capacities of the biosphere. With few exceptions, the presentation of information about economic factors is nonexistent, or at most cursory, under current guidelines for the preparation of EISs. This is the case despite the fact that the decision-making process in the United States almost invariably depends on the availability of an adequate body of information both on the economic and on the environmental dimensions of a proposed action.

An additional area where progress can be made is to increase the amount of assessment that occurs in the EIS. Too often, an EIS consists of a partly digested compendium on everything that is known or can be predicted about a particular development, with little assessment of the significance of the impacts and the trade-off relationships between values, public and private. In my opinion, EISs like TAs must be evaluative, not just predictive or encyclopedic. Furthermore,

the EIS, in my view, was intended to be an objective assessment report, not the advocacy document that it unfortunately has become in too many cases.

Fortunately, we believe that the likelihood for improving the EIS process in the problem areas just mentioned is very good. We have developed a preliminary plan in our Department for an experimental project to establish a standardized methodology for developing, evaluating, and displaying information in the EISs; as well as developing a procedure for restructuring the final EIS into a more useful informational document for decisionmaking.

We would like to apply the results of this effort to actual projects as a test on a retrospective or current time-frame basis. Since this effort could have significant benefits for other agencies, we would be delighted to collaborate with the OTA, the National Science Foundation (NSF), and other agencies concerned with TA or its close kin, EIS. I am certainly aware of the leadership role that NSF has played in both the development of TA techniques and their application. The insights that NSF has gained from its experience could be invaluable. By introducing these innovative approaches decisionmakers would be provided with more useful information in the EISs.

Deciding what a TA should consist of is in some respects like peering into a prism. What is encompassed within the scope of vision and its arrangement is dependent, in large measure, on which facet it is viewed through. We, in the DOC, are keenly interested in the effects governmental regulations have on the development and application of technology and the innovative technological process. For example, when Congress or a Federal agency specifies directly or indirectly the application of a certain technology or class of technology, such as the best available technology under the Federal Water Pollution Control Act requirements, we in Commerce, wish to assess the impact of those regulations on the development and application of new treatment technologies. Further, we wish to evaluate the economic as well as the environmental effects that may follow from the application of those technologies. The Office of Environmental Affairs is conducting several industry TAs that are identifying and evaluating the energy, economic, and environmental consequences of mandated pollution-control levels and associated waste-treatment technologies. I might add, Mr. Chairman, we are doing this in very close consultation with our brother agencies, the Federal Energy Administration (FEA), The Energy Research and Development Administration (ERDA), as well as the Environmental Protection Agency (EPA).

In summary, I believe that the techniques for TA are sufficiently developed to find useful application in the preparation of EISs, and the development and review of governmental regulations. We should move ahead in applying these techniques toward projecting the broad implications of technology in environmental rotation programs, and so provide the policymakers in the Federal Government with the best possible information on major national issues and programs. Thank you.

Mr. BROWN. Thank you very much, Dr. Galler. Your testimony raises the important question of the relationship between EISs and

TAs. I want to explore that more fully with you after the other witnesses have also presented their statements.

The next witness is Mr. Bruce Pasternack, Associate Administrator of the Federal Energy Administration, Mr. Pasternack.

[The biographical sketch of Mr. Bruce Pasternack is as follows:]

**BRUCE A. PASTERNAK, ASSOCIATE ADMINISTRATOR, FEDERAL ENERGY
ADMINISTRATION**

Mr. Bruce A. Pasternack, Associate Administrator for Policy and Program Evaluation, the Federal Energy Administration (FEA).

B.S. engineering, the Cooper Union, New York; M.S. systems engineering and operations research, University of Pennsylvania; Ph.D. course work completed, environmental management and public administration, Drexel University.

Systems designer and project manager for environmental analyses and information systems, General Electric Company; staff member for energy programs, Council on Environmental Quality, where coordinated a Presidential study of the environmental impact of potential oil and gas production on the Atlantic Outer Continental Shelf and the Gulf of Alaska, and also worked on the Council's strip mining study conducted for the Senate Committee on Interior and Insular Affairs, drafted environmental legislation, and was responsible for environmental monitoring and solid waste activities at the Council; Deputy Assistant Administrator for Policy and Director of the Office of Policy Evaluation, FEA where was responsible for policy development and analysis for the President's Energy Program, and also served as Deputy Project Manager for the *Project Independence Report*, for which coordinated all policy, technical review, and administrative matters, and developed legislative initiatives for data, analysis, and conservation.

Additional activities at FEA include: directing the preparation of the *National Energy Outlook*, the analytical framework for development of a national energy policy; chairman of a Federal planning effort to relieve the Nation's natural gas shortage; directing an interagency review of liquefied natural gas policy; and as a member of the Agency's Project Review Board for new contract proposals, and the Senior Review Committee for exceptions and appeals cases. Currently responsible for development and analysis of energy policy proposals and legislation and evaluation of FEA programs and budget.

STATEMENT OF BRUCE A. PASTERNAK, ASSOCIATE ADMINISTRATOR FOR POLICY AND PROGRAM EVALUATION, OFFICE OF POLICY ANALYSIS, FEDERAL ENERGY ADMINISTRATION

Mr. Pasternack. Thank you. Mr. Chairman, members of the Technology Assessment Board, and staff: I am very pleased that these hearings are being held at this time, and particularly that the Federal Energy Administration (FEA) has been asked to appear. With your permission, Mr. Chairman, I would like to submit my written statement for the record and offer some remarks in summary.

Mr. BROWN. Without objection, that will be the order.

[The complete statement of Mr. Bruce Pasternack is as follows:]

FULL STATEMENT OF BRUCE A. PASTERNAK, ASSOCIATE ADMINISTRATOR FOR POLICY AND PROGRAM EVALUATION, FEDERAL ENERGY ADMINISTRATION

Mr. Chairman, members of the Board, I am pleased to be here today to discuss with you the role of technology assessment (TA) in the operations of the Federal Energy Administration (FEA). As such, I will confine my remarks to those efforts within the agency whose purposes are the anticipation of impacts, both now and in the future, of the various policy, regulatory, and program alternatives developed in response to the energy situation now confronting the Nation.

As this Board is well aware, the ongoing debate over various energy issues clearly illustrates the difficulties involved in making policy decisions in the

face of countless conflicting values and interests. In this type of environment, the concept and approach of TA is a valuable tool.

Technology assessment is often used to refer to a policy study that examines the fullest range of the impacts resulting from the introduction of a new technology, or the expansion of a present technology in a new or different way. For the purpose of this presentation, I shall use the term technology to refer not only to new physical inventions or processes but also to new regulatory patterns, distribution patterns, or patterns of consumption-in short, to new "soft" as well as "hard" technologies. Furthermore, I shall use the term TA to refer not only to analysis of the impacts of a single technological change, but also to the analysis of the impacts of multiple technological changes taking place concurrently-that is, changes in broad scenarios as well as changes of a more limited nature.

Although the term TA cannot be found in any of FEA's functional statements, the methodology has been an integral part of this agency's workings since its inception shortly after the Arab oil embargo began in the fall of 1973. In the period immediately following the embargo, our energy management programs were primarily regulatory in nature as we sought to distribute equitably a reduced volume of energy supplies throughout the country. Our objective was to lessen, to the greatest extent possible, the adverse social and economic disruptions caused by the embargo.

Since the embargo, both the Congress and the Administration have recognized the crucial need to develop an in-depth understanding of the domestic and international energy situation in order to develop an effective national program to limit future vulnerability to embargoes. Our own authorizing legislation (the Federal Energy Administration Act of 1974) directed as, among other things, to develop and implement a comprehensive national energy data system, to develop an analytical capability to forecast and estimate short- and long-term energy problems, and to implement policies to meet energy needs. Thus, the Agency was given a broad mandate to perform TAs as previously defined, and to act on the basis of those assessments. It should be noted here that another agency, the Energy Research and Development Administration, is primarily responsible for decisions regarding energy research, development, and demonstration activities related to new scientific and engineering technologies. Complementing this effort, the focus of FEA is on the economic and operational aspects of the various components of the energy system.

To achieve an understanding of the energy situation, FEA first established a comprehensive information data base composed of supply, demand, production, and import statistics that would form the foundation for techniques to forecast our energy future. Then using various econometric models and judgment, FEA developed both the Project Independence Report of November 1974 and the National Energy Outlook of this year that report to the American people on our energy outlook and the factors that will affect our future energy situation. With the help of the Project Independence Evaluation System (PIES) developed for the Project Independence Report and refined since then, a set of national energy objectives and policies was formulated. The PIES model evaluates technologies, lead times, costs, and geographical locations that affect energy commodities from the point of discovery, through production, transportation, conversion to more useful forms, and ultimately consumption by all sectors of the economy. While its advantages in projecting the broad impact of alternative policies are obvious, we recognize its limitations in evaluating specific projects. The Federal Energy Administration has built upon the PIES model and reinforced it with other economic, environmental, and consumer impact evaluation tools.

Much of the work that might be classified as TA is performed within the FEA's Office of Policy and Analysis. This Office is primarily responsible for the evaluation, analysis, and coordination of energy-related policies and programs that will culminate in a national plan to meet the future energy needs of the Nation. This includes managing the decisionmaking process for all policy, program, and regulatory options; providing statistical and analytical studies of the economic and social impact of the options; and developing short- and long-term energy supply and demand forecasts.

Environmental concerns are centered in the Office of Environmental Programs under the Assistant Administrator for Energy Conservation and Environment. This Office ensures that FEA is in compliance with the National Environmental Policy Act, reviews environmental impact statements prepared for specific energy-related projects, examines the environmental issues surrounding the

development of our energy resources, and analyzes existing and proposed environmental regulations with the aim of achieving a more perfect balance between energy and environmental concerns.

In another area within FEA, the Office of Energy Resource Development, a Project Operations System has been developed to provide assistance in expediting site-specific energy projects throughout the Nation. This system attempts to identify energy facilities that are encountering serious roadblocks to their development, determines the nature of the problems involved, and makes an assessment as to whether the Federal government can have a positive impact by helping reduce causes of project delays and offering assistance as needed. Projects here include coal mines, gas, oil, and coal slurry pipelines, railroads, synthetic fuel plants, and utility facilities.

The formulation of a national energy policy is a complex task that requires the close cooperation of Federal, State, and local government bodies, and the public-at-large. Our Intergovernmental, Regional, and Special Programs Office provides a daily liaison with State and local government officials, national associations of elected officials, and business, consumer and other interest groups on a wide range of energy issues of particular concern to the States and the public. As an example, this Office directs the Intergovernmental Coordinating Committee of the President's Energy Resources Council (ERC).

Prior to the development of FEA energy policy initiatives, the views of consumers and special interest groups are made through a variety of mechanisms. A total of 14 advisory committees representing such groups as Consumer Affairs/Special Impact, Food Industry, Environmental Interests, Energy Financing, and so forth, meet regularly to air their specific concerns to the Administrator. In addition to these meetings, public hearings are held as a matter of course in the issuance of regulations and when such major policy issues as the importing of liquefied natural gas, industrial conservation, electric utility rate reform, etc. are being considered. The Office of Intergovernmental, Regional, and Special Programs is thus closely involved in reviewing and analyzing the actual and potential impact of the FEA policies, programs and energy-related problems on the public sector. It advises the Administrator of the results of these reviews and analyses as well as about the concerns of the public, so that he can consider those factors in the development of FEA policies and programs.

Finally, the Office of Policy, under the Assistant Administrator for Policy and Analysis, provides the focal point for the refinement of energy policy initiatives and has a close working relationship with the Offices mentioned previously. This Office utilizes the various analyses, forecasts, and data provided by the other Offices, in the development and evaluation of energy policy options. Various policy alternatives can be evaluated, in part, through the use of the quantitative, economic, and social impact analyses performed by these Offices.

All of these activities have, for example, been necessary during the past year in the coordination and development of policy proposals concerning fuels allocation, oil decontrol, and natural gas curtailments planning, and are being utilized now in planning for the Strategic Petroleum Reserve, outer continental shelf development, liquefied natural gas imports, and Western energy supply development.

I would now like to review briefly some examples of the kinds of TAs that are undertaken by FEA. It is the responsibility of the FEA's Office of Energy Conservation and Environment to identify and encourage the widespread adoption of existing commercially available technologies to conserve energy. To fulfill this responsibility, the Office has funded numerous studies to determine the energy savings potential and economic attractiveness of energy-conserving practices and techniques, as well as the environmental impacts of energy programs. Several examples of such TA studies funded by this Office include:

The projected impact of anticipated changes in energy supply technologies on various industries identified as key energy consumers. These include steel, copper, aluminum, selected chemicals, paper, glass, and cement. The studies concentrate on changes in energy supply mix, in production processes, in pricing of inputs and outputs, and other factors directly relevant to these industries.

The potential impacts, beneficial and otherwise, of substituting telecommunications for travel. Two means of energy-saving are being explored: (1) decentralization of work forces, which would reduce commuter travel; and (2) the increased use of telecommunications by existing work forces, in their current organizational structures.

A socioeconomic impact study of coal and oil shale boom towns. This would identify socio-economic and fiscal problems associated with the development of oil and coal reserves between 1975 and 2000 in Colorado, Montana, Wyoming, and Utah. In each community, in the four states under analysis, the capital needs for public and private services are being identified. The implications for Federal and State policy would be evaluated with a detailed examination of financing options for both the energy development projects themselves and for the related socio-economic infrastructure changes they are likely to require. I am presently assisting the Environmental Protection Agency's Technology Assessment of Western Energy Development by serving on its advisory committee for this study.

The Office of Policy and analysis, in another example, is currently leading the ERG interagency task force evaluating liquefied natural gas (LNG) import policies, as directed by the President in his February Energy Message to the Congress. The Task Force is presently assisting in the development of criteria for a national security economic review of LNG import ventures beyond those already unconditionally approved by the Federal Power Commission. Recognizing that this issue has important implications beyond national security, public hearings have been held to consult with consumer, environmental, regional labor, industrial and other groups in order to assess the potential impacts of various alternative policies. Of particular interest are considerations related to pricing, government financial assistance, domestic regional supply dependence, international sources of supply, and possible reassessment of import target levels if natural gas deregulation is not achieved.

As can be readily seen therefore, Mr. Chairman, the concept of TA is an integral part of the FEA's operations. I do not mean to imply that its application is simple or universally acceptable. There are many important problems for which either the scope or time for addressing the issue is too limited to apply TA techniques. Nevertheless, it is an important tool to be used in achieving viable solutions to the energy problems that confront the United States.

Mr. PASTERNAK. The ongoing energy debate that we have seen over the last couple of years clearly illustrates the importance of considering the innumerable values and conflicting interests that occur in making policy decisions. Technology assessment (TA) by that or any other name, and I think the name itself is less important than the concept, is a valuable tool. Its value is equally great or what I would consider the soft technologies such as regulatory decisions, patterns in consumption, and broad changes in policy, as well as the hard technologies discussed earlier in these hearings.

The term, technology assessment, does not appear anywhere in FEA's official organization chart. That might be a good thing as opposed to a bad thing, for its methodology has been a vital part of our agency since its inception. I would like to spend a few minutes talking about what was probably the first major TA activity in our agency. That was the Project Independence report which we produced in November of 1974. That report was done in a rather short period of about 6 to 8 months. It was a first attempt to look at the overall energy outlook for the 10 years following the embargo. And while we were particularly concerned about assessing our future supply of and demand for energy, we also recognized the need to do more than just look at supply and demand.

Thus, while we produced an encyclopedic set of volumes of resource-supply reports that look at the supply potential of each energy source from coal and oil to solar energy and geothermal at different prices and under different regulatory environments and that describe the technologies that would be used in developing these resources, we also for the first time looked at a whole series of what we called cross-cut studies. We called them that because they basically went across

all the disciplines. These included studies such as assessments of the availability of water to supply our energy needs in the West, in parts of the Midwest, and in the East; the transportation requirements that will be placed on an industry to move coal, oil, natural gas, and other sources of energy across the country, very often in areas that were untapped before; possible labor shortages and the requirements for labor when you develop areas such as the northern Great Plains, which were previously rural and basically undeveloped, and the migration patterns that would result; the possible shortages and bottlenecks in supplying material, equipment, and the construction facilities that will be needed to develop the large amount of energy we will need over the next 10 years and beyond; the environmental impacts of this development on both air and water quality as well as land use and solid waste; the financing and capital problems that would be faced not only by the energy industry but by the investment community; and a whole range of conservation options to look at whether or not in fact, the energy was needed over the next 10 years and beyond.

We developed a very sophisticated forecasting and impact assessment tool to evaluate these alternatives. But, in the context of doing that we were very careful and continue to be careful to recognize the limitations of any model or any computer simulation in looking at as tough an issue as energy. We held a series of regional hearings during that study at over a dozen sites around the country, focusing on the impacts of alternative policies in that particular region. So, for example, in Denver we held hearings relating to the impact of oil shale and Western coal development in that region. In San Francisco we held hearings on energy conservation and its possible impacts.

The final report of over 20 volumes makes no policy recommendations. It was deliberately done that way. However, it evaluates alternative policy directions and tries to assess the impacts of going one route versus another. The Project Independence report was updated last winter, and we also released a report on the national energy outlook this year. This is a further look at the energy problem, and considers new issues such as regional concerns that we did not get into as much the previous year.

The Office of Policy Analysis in FEA directs many TA-related activities. It prepares the policy papers and analyzes and directs the FEA issue process. This attempts to insure that the views of all senior FEA officials, whether in resource development, in conservation, in the Office of Consumer Affairs, or in intergovernmental programs, that all the views of these officials reach the administrator before he makes any decision. This is not the only office in FEA that practices TA. My written statement goes into some of the other areas. I will just highlight a couple of them.

In our resource development area we have made a very strong effort in the last several months in building an activity to evaluate the roadblocks to energy development and to understand what it is in local areas that is causing energy development to slip.

We have also looked at the question of solar energy and have a basic memorandum of understanding with the Energy Research and Development Administration that we signed recently. This divides

some responsibilities in the solar area. Our Solar Office is responsible for working with other agencies in the Federal Government to commercialize solar energy to set an example, and to understand the impacts of solar energy. This Office is also working with other agencies in a cooperative venture to see how we can improve the use of solar electric generation in the Southwest.

Our Conservation and Environment Office basically has a major responsibility in looking at changing consumption patterns in industry, households, transportation, and utilities. It funds and has funded several special studies to deal with the attractiveness and the impacts of energy-conserving practices. Among these are included a series of studies, many of which were done with the Department of Commerce, on the projected impacts of changes in the energy supply technologies on the major consuming industries. So we have looked at the steel industry, the petroleum refining, chemical and other industries from the standpoint of what will be the impacts of introducing new technology to conserve energy.

We have also looked at the potential impacts of substituting telecommunications for travel on the decentralization of work forces. This is a joint project with the National Science Foundation, which I think Dr. Stever mentioned in his testimony yesterday. We are carrying out right now, a major socioeconomic impact study of coal and oil shale boomtowns. This is something that certainly the people in the West are very concerned about.

Our utility demonstration projects across the country are designed to evaluate the effects of new rate structures such as peakload pricing or lifeline rates on not only the consumers but also on utilities, on industry, and on the whole regulatory environment under which utilities have to operate; and also to assess the impact of new load-management devices, some which have very wild-sounding names like ripple-control systems.

Finally, I would like to offer a personal note, if I might. I have been involved in what is very similar to TA techniques for several years now. My training before coming to Washington was, I think, in many ways a predecessor to TA. That was the systems or systems analysis approach. I have been fortunate to work in both environmental and energy agencies in government, and at the Council on Environmental Quality (CEQ) to participate in one of the first major TAs. This was the one done by the University of Oklahoma on offshore technology and Outer Continental Shelf development. I also worked on a major strip mining study done for the Congress, on the impacts of strip mining regulations on the economy and social structure of Appalachia. And of course, in CEQ I had a very close involvement with the National Environmental Policy Act and environmental impact statements (EISs).

At FEA I have been fortunate to direct the preparation of the "Project Independence" report and the "National Energy Outlook," as well as to oversee some major policy formulation activities. These include some current work on Alaskan development and the possible impacts on the State of Alaska as well as on the lower 48 States. I am sure you have heard about some work we have been doing recently on Alaskan oil distribution from the west coast. We just recently held

a set of hearings in Los Angeles to look at liquefied natural gas policy and its impacts not just on supplying natural gas but also on environmental problems, and problems of alternate fuels. We are looking at the role both of natural gas and of electricity in the future, again not from just the energy standpoint but also from the environmental and economic standpoints.

I have recently been asked and am now serving on an advisory committee to the Environmental Protection Agency and the University of Oklahoma. This has a major 3-year TA of Western energy development going on. I believe in these approaches, whether discussing energy or other subjects such as food, health, and some of the others that are the concern of your Office. I think that energy is a fertile area for TA. As we see the massive structural and societal changes resulting from what has happened since the oil embargo a couple of years ago, I think that TA will be even more important in the future.

I would caution however, that the application of TA is neither simple nor universally acceptable. There are many important problems—and it seems to me as if we see them every day—for which either the scope or the time allotted for analysis is not enough to permit a very good TA to be done. Nevertheless, I think the energy problem lends itself very well to TA, and if we ever hope to solve this problem we are going to have to work with these techniques. Thank you.

Mr. BROWN. Thank you very much, Mr. Pasternack. I think your paper illustrates another aspect of the TA process; that is, its relationship to the policy analysis needs of the government, which is an extremely important aspect, of course.

Our last witness this morning is Mr. John S. Barron, who brings us a perspective from his role as Assistant to the General Manager of the Tennessee Valley Authority (TVA). Mr. Barron.

[The biographic sketch of Mr. John S. Barron is as follows:]

MR. JOHN S. BARRON, ASSISTANT TO THE GENERAL MANAGER, TENNESSEE VALLEY AUTHORITY

Mr. John S. Barron, Assistant to the General Manager (Planning, Budget, and Systems), Tennessee Valley Authority.

Born July 10, 1932, Montgomery, Alabama; married, two children.

B.S. forest management, Alabama Polytechnic Institute (now Auburn University), 1954.

Commissioned Ensign in the U.S. Naval Reserve, 1964; forest technician for pulpwood procurement, International Paper Company; partner, Dixie Timber Company, Grove Hill, Ala.; assistant forester, Fulton Land Management Company, managing 170,000 acres forestland Alabama State Parks, first forester on staff, 1959, (third professional forester in State parks field in United States); subsequently Acting Chief and Assistant Chief of State parks; planner on Recreation staff, Tennessee Valley Authority (TVA), 1962; Chief of Recreation Section, TVA, 1964; represented TVA on the interagency task force to draft the Executive Order implementing the Land and Water Conservation Fund Act, 1965; Acting director of TVA's Office of Tributary Area Development, which is concerned with the unified resource development of subareas of the Tennessee Valley, 1966; Director, 1967; Assistant to the General Manager (Planning and Budget), 1973, aiding the General Manager in the development and administration of TVA's budget program and in guiding the development of related planning activities by offices and divisions.

Course participation at the Civil Service Commission's Executive Centers in Berkeley, California, and King's Point, N. Y.; and lectures given at the Center in Oak Ridge, Tenn., as well as at the University of Tennessee.

A member of Xi Sigma Pi forestry honor fraternity.

STATEMENT OF JOHN S. BARRON, ASSISTANT TO THE GENERAL
MANAGER, TENNESSEE VALLEY AUTHORITY

Mr. BARRON. Thank you, Mr. Chairman. I would like first to introduce my associate, Mr. William E. Dickenson. Mr. Dickenson is the Coordinator of Research and Development Activities in the Tennessee Valley Authority (TVA). We are pleased to have the opportunity to appear before this Technology Assessment Board, and we hope that TVA's experience in assessing the benefits and the impacts of some of our programs will be of interest to you; and that we will be of some assistance in the future.

As you know, Congress created the TVA in 1933, directing it to aid in—"the proper use, conservation, and development of the natural resources of the Tennessee River drainage basin and adjoining territory." This work has resulted in a diverse organization. The agency has staff members involved in many areas—developing fish and wildlife, protecting air and water quality, working with farmers to improve production, developing new fertilizers, reclaiming eroded and surface-mined coal lands, working with citizens organizations, State and local agencies to help make economic progress, and of course as we are best known, in producing an ample supply of electric power to serve the needs of about 7 million people in areas of 7 States.

I might digress here for a moment and point out that our power program in particular makes us an exceptional Federal agency in that a 1959 amendment to the Tennessee Valley Authority Act charged us with the responsibility for operating a power system that is self-financing and self-supporting. We do not rely on appropriations to operate the power system. It is totally independent in that it is required to be financed strictly from revenues and borrowings against future revenue.

Our work is not completed, nor has it been easy. The process of trying to balance economic opportunity with an improved environment has given us numerous occasions perhaps without using the exact term, to use TA in examining the many ways, expected and unexpected, in which our technology affects people's lives. This has been a part of TVA's method of operation since the beginning.

Since Congress, the Nation, and the Office of Technology Assessment (OTA) are vitally interested in the benefits and impacts of energy, I would like to focus on TVA's electric power program and some of our efforts to reduce the impacts of producing electricity for the home, farm, schools, businesses, and industries of our region. But before I do, let me take just a moment and give you a brief example of how TA entered into some of our early decisions. When we were first building the water-control system in the valley, it became evident as we practiced our form of TA that a product of the reservoir construction program would be a vast breeding ground for mosquitoes. This was not only significant from the point of view of the nuisance of the mosquito, but malaria was a rather prevalent disease in the Tennessee Valley region at that time. Consequently, we entered into a program to modify first the shoreline, the anticipated shoreline of the reservoir, and then, second, a program that would manipulate the reservoir levels in a way that has essentially precluded the breeding of mos-

quitoes and, as a consequence, our reservoirs are essentially mosquito-free.

In the 1950's, TVA began building large coal-fired generating plants as the region's use of electricity outgrew the hydroelectric output from our dams. As a result, TVA became a large user of coal, and a considerable amount of this coal was surface-mined. Recognizing the impacts of unregulated strip mining, TVA supported the effort for State regulation of strip mining. It worked on cooperative studies to show the extent of strip mining and to publicize the effects on land and water. I might add that our 1963 report, "An Appraisal of Coal Strip Mining in the Tennessee Valley," has been used nationally as a reference source. The Tennessee Valley Authority surveyed mining and reclamation methods throughout Appalachian and Midwestern coal fields, and carried out a series of demonstration projects to show that reclamation could be workable and effective in valley strip mining.

As early as the 1940's TVA began to encourage reclamation in strip-mined lands, and in 1965 we began including reclamation requirements in our term-coal contracts whenever the coal was to be produced by stripping. This was recognized as only a limited approach since TVA buys only about 15 percent of the coal stripped in the major States where we purchase coal, but it was a start. Our provisions have been strengthened as experience has indicated that changes and improvements are needed. Over 35,000 acres have received reclamation treatment under these provisions. Meanwhile, the States involved have adopted reclamation laws of their own, and we have also supported sound reclamation efforts on the national level.

As early as the 1950's, TVA incorporated design features in our coal-fired plants to minimize their impact on air quality. In the mid-1960's, extensive improvements such as the use of tall stacks and improved electrostatic precipitators were begun. These efforts continue today.

For example, in fiscal year 1975, TVA invested about \$180 million in construction of facilities to protect the quality of air and water as part of our long-range program for environmental protection at powerplants. Even larger expenditures are expected in the current fiscal year.

Again in 1975, TVA continued its program to install high-efficiency precipitators at all of its coal-fired plants. Additional precipitators, and improvements on those already installed, were under construction at seven steam plants. The cost of this current program in precipitator installation and updating is expected to be about \$300 million.

A full-scale sulfur dioxide scrubber is under construction on a 550,000 kW coal-fired unit at Widows Creek steamplant in northern Alabama. The estimated cost is \$54 million. The limestone scrubber is one method to remove sulfur dioxide from stack gases, but the process has not been commercially proved on units as large as the Widows Creek unit, and it possesses many technical and economic problems. The Widows Creek installation is a demonstration project undertaken by TVA to gain firsthand experience and to contribute to this important technology.

To comply with the Environmental Protection Agency (EPA) and State water quality requirements, and to protect aquatic life from the effects of warm water discharges at our steamplants, TVA is installing

cooling towers at all of our nuclear plants. The estimated cost of cooling towers for the seven nuclear plants now under construction is \$640 million. Extensive changes are also being made at existing coal-fired plants at a cost of about \$75 million, to comply with recently announced EPA limitations on nonthermal discharges. TVA continues to assess new energy technologies with the goal of providing clean, economical, and reliable electric power supplies.

In fiscal year 1975, energy research and development activities paid for by TVA totaled \$21 million and included contributions to both the Clinch River breeder reactor project and to the Electric Power Research Institute (EPRI). An additional \$4 million was spent on cooperative programs financed by outside organizations.

During the year, TVA's board approved future projects expected to total nearly \$40 million over 5 years for environmental research carried out by TVA and financed by EPA. Twenty-two of the projects are new areas of cooperative research between EPA and TVA, while three are continuations of existing agreements. Among the projects are studies to measure the effects of powerplant emissions of air and water quality and the continuation of studies to develop and evaluate technology for removing sulfur oxides from stack gases.

Examples of in-house research include pilot and bench-scale studies on stack gas cleaning, use of powerplant waste heat for raising fish and agricultural products, investigating improved methods of particulate collection, improving the appearance of transmission lines, feasibility studies of methods for producing synthetic powerplant fuels from coal, and analysis of new energy conservation schemes. About 50 projects were included in the in-house program.

Activities carried out cooperatively with other organizations included participation with ERDA in gasification of coal and studies of fluid-bed combustion. Conceptual design and cost studies of low-Btu gasification systems for producing fuel with low heat content were completed for EPRI during the year. Pilot-scale studies on sulfur dioxide removal from stack gases, conceptual design and cost studies for comparison of several alternate sulfur-dioxide removal systems, and combustion modifications for controlling nitrogen oxide emissions were conducted for EPA.

In the late 1950's and early 1960's when nuclear powerplants for the generation of electricity became feasible, TVA began its assessment of this new source of energy production. Some of the areas we examined in a 1966 study included cost alternatives of coal versus nuclear, nuclear safety and the ability to obtain licenses, operating assurance, and funding requirements, to name but a few. Compared to today's environmental review and the licensing process, the study was relatively elementary; but we did consider alternatives and impacts.

I would like to give you now, one localized example of how we assessed these impacts. TVA has begun preliminary construction work on a four-unit nuclear plant in a predominantly rural area of middle Tennessee. At peak construction, the project will require about 5,000 workers. In the final environmental impact statement for the project, TVA assessed the impacts of the influx of workers into the five-county area and, in cooperation with city, county, and State officials, has developed a mitigation program to provide necessary facilities and services in a timely and cost-effective manner. Some of the areas of concern

include housing, education, recruitment? and training of local workers, water and sewer facilities, local governmental budgets, health and medical services, planning and coordination, and employee transportation.

TVA, as a resource development and conservation agency, has long been involved in the multidisciplinary review and assessment of its programs and projects. Mom recently, we have incorporated these existing assessment approaches into our procedures for complying with the National Environmental Policy Act in which social, economic, and environmental aspects of proposed actions are all carefully reviewed prior to decisionmaking.

We would be happy to respond to any questions which you might wish to ask.

Mr. BROWN. Thank you very much. Mr. Barren. We would like to pose a few questions to all of you gentlemen now. and we will try not to keep you too long. We would like to ask you, if it is desirable to do so, if we could submit additional questions in writing and have you respond to them and help us to complete the record in that fashion.

Dr. Galler. you put a great deal of stress in your statement on the relationship between the technology assessment (TA) process, and the preparation of environmental impact statements (EIS). I found your comments about EISs to be extremely useful and helpful. I wonder if you could just comment for a moment about how you perceive the differences between the two. Obviously there are areas of considerable overlap. In many cases they almost parallel each other. They are very similar. But do you see both similarities and differences and if so, what are they? How can we help to make a distinction between these two processes, if possible?

Dr. GALLER. There are of course, Mr. Chairman, both similarities and differences, as you point out. The EIS is a limited type of TA in the sense that it does not come into play until after a decision is arrived at that a proposed Federal action has a potential for significantly impacting on the environment. Only after that preassessment is carried out and a determination is made that it does fall within the meaning of section 102(2) (c) is the TA process that we call the EIS formally initiated.

Obviously there are many other categories of TAs—we heard of one in particular this morning from our colleagues (Messrs. Davison and Malick of Phillips Petroleum Co.) in the private sector—that would not ordinarily fall under the rubric of NEPA or an EIS. Such technologies however, embody much the same kind of criteria and principles that we try to follow in the EIS.

I would say that one way of making a distinction is that the EIS, to the extent that it does include or does really involve TA, is limited by the Federal Government today and applied only in those instances where there is a major Federal action that preassessment has determined could have an impact on the environment, a significant impact.

Mr. Brown. You suggested that one of the defects of the EIS is that it is made too late in the process to be as useful as it might be in the policy development phases. Do you perceive any possibility that this can be corrected? To the extent that it can be, then an even greater parallel with the technology assessment process is I think created.

Dr. Galler. I think it can be improved, vastly improved, Mr. Chairman. I think one of the most useful devices, institutionalized devices,

that has evolved in the Federal Government over the years, a TA assist, if you please, can be seen at the institution of the county agent, the Agricultural Extension Service. Here you have an informational extension from the Federal Government going right out into the localities and working with that private enterprise, we call the farmer, and with local communities; providing both an informational assist that helps the local community come to some first determination and at the same time providing the kind of quality assurance that we desperately need in the EIS process, which it presently lacks. So that today, with the best of intentions, a locality or private organization can attempt to receive adequate information on, the social, the economic, the environmental costs and benefits of a proposed action, come to a first decision, a decision that becomes reinforced by discussions and interplay with the local community. And then 2 or 3 years later it is suddenly discovered that someone else's perceptions have supplanted the perceptions at the point of impact, vastly different—a different language, if you please, a different set of criteria, a different mode of T.A. I think that it is very important that we in the Federal sector recognize that there is nothing in the law that I have been able to determine—and let me hasten to add I am not a lawyer, but I have asked our lawyers to examine this—there is nothing in the law that prevents the Federal establishment from considering providing the EIS process at the front end rather than at the hind end of decisionmaking.

Mr. BROWN. Do you see anything in the law that precludes the application of the environmental impact process to regulatory activities? Your Agency is possibly more engaged in regulatory activities than it is in the development of new technologies. I have in mind a specific problem not involving the Department of Commerce but involving the Environmental Protection Agency (EPA) when they proposed rules having to do with parking limitations and other activities of that sort in an effort to control atmospheric pollution. What they ran up against, of course, was a widespread perception that those regulations would have a very serious impact on economic and other activities, which had not been as thoroughly studied as they might have.

So my question is, is there anything that would preclude EISs being used for regulatory or policy-type decisions at an early stage in order to assist in the more coherent formulation of these regulations and policies?

Dr. GALLER. Mr. Chairman, let me be very careful and circumspect in my answer here. First of all, I want to make very clear that what I am about to say is not intended to be a criticism of a sibling agency—the EPA in this particular instance. I would like to point out—

Mr. BROWN. I should point out at this point, if I may interrupt you, that the agency claimed that they were only doing what Congress compelled them to do.

Dr. GALLER. Sir, I was about to say that. They are under some very specific statutory constraints both with regard to the Federal Water Pollution Control Act, especially the 1972 amendments to the act, as well as the Clean Air Act. And in the case of the Federal Water Pollution Control Act, the only two areas in that Act that are exempted from a statutory ban on the preparation of EISs for regulations deal

with construction plants and the National Pollutant Discharge Elimination System (NPDES) new source permits.

May I give you a generalized response, Mr. Chairman. I think regulations today-I am trying to be very neutral and very objective-regulations by the very nature of the goal of a regulation have a tremendous impact on technology development, technology innovation, technology transfer, and technology application. For example, let us take a look at what has happened in the automobile industry as a result of a regulation, what has emerged as a technology, the end-of-pipe technology that we call a catalytic converter-I am not going to say whether it is good, bad, or indifferent-but it has in effect foreclosed on options to develop through some other means, perhaps a stratified charge engine or another mode of pollution control. This derived from the regulation that was implementing something in the Clean Air Act. Unfortunately-well, let me put it in the positive; I honestly believe, that had we gone through the kind of ES recess that we went through, let us say, with the Trans-Alaska pipeline, it might have revealed options and opportunities for technologies that were not revealed until ex post facto.

Mr. BROWN. Mr. Pasternack, you commented in your statement on the applicability of TA to soft as well as to hard technologies, and its relationship to your role in identifying policy options. Do you feel that this is a proper and legitimate application of the TA? You have indicated that you do. I guess I would ask you to comment on whether or not there are any boundaries or limits that we need to think about in these terms. If we take it far enough, we could almost say anything Congress does or anything any agency does, whether it relates to technology or not, because it almost always results in some social or political impact on human beings, is a proper subject for TAs. Do you perceive it as being that broad?

Mr. PASTERNAK. No, I do not. And if I might, I would just like to add one thing to what Dr. Galler said about regulations in EISs. In contrast to anything in the National Environmental Policy Act (NEPA) precluding an EIS for a regulation, we in fact do prepare EISs on our regulations when they satisfy the section 102(2) (c) criteria of a major Federal action impacting human environment.

But to answer your question about the scope or the breadth of a TM; probably an advantage of not having been in the Government for a very long period of time is that I tend not to believe in overly structured bureaucratic or organizational theories in Government. I believe in allowing some flexibility. And I think that if we establish criteria that in effect require detailed TAs or EISs or whatever for every kind of action or every policy decision made in either the executive or legislative branch, I think it would make the system so rigid it would never be able to operate.

I think there is a need for looking at the broad decisions that have long-range impact, the ones for which you have the ability and the time to do a proper analysis, and for which you ought to be carrying out TAs or related kinds of studies; and then separating these from the short-term, crisis-kind of decisions that you have to make in running an agency or making laws.

Mr. BROWN. I would like to ask Mr. Daddario, also a member of the Board, as well as its Executive Director, if he cares to present any questions at this point.

Mr. DADDARIO. I would like to follow up the question to Mr. Pasternack, Mr. Chairman. You are involved, as you have said, Mr. Pasternack, with the Oklahoma University group. You have had experience with the outer Continental Shelf and with strip mining. That group has worked very closely with us in a whole series of our activities. In fact, it was one of the three university groups that assisted us in an examination of the Energy Research and Development Administration (ERDA) plan and program over the course of the last 2 years.

By their own admission as that group has worked over the years, they have become more comfortable and more competent in dealing with this. As Dr. Stever said yesterday, the mere fact that the Government, in one way or another *in* various places, is supporting this activity, it is developing capabilities that we did not have.

So I wonder from your point of view, what you have learned in that process, how you see it within your own agency? Do you find that there are policy constraints within the agency because you have to get things done that prevent you from using that experience and from being able to develop TA concepts that you would like to apply?

Mr. PASTERNAK. I would be happy to answer that. It also leads me to think about an earlier question to Dr. Galler concerning how you would improve the EIS process. In my mind one of the ways you improve the whole EIS process as well as the TA process is by budding the capability and the experience for doing these kinds of studies. I can see, for example, in a specific case, namely the difference between the way the proposed gas pipeline and gas transportation systems from Alaska to the lower 48 states are now being considered versus the way they were considered with respect to the oil pipeline 5 or 6 years ago, that the experience that was gained by the Department of the Interior, EPA, the Council on Environmental Quality (CEQ), and other agencies has been invaluable in taking a much more contemporary approach. In fact, what we have seen over the last few years in our agency as well, is both growth and greater sophistication in the development and evaluation of policy. The kinds of activities like the work that was done in preparing the national energy outlook and the Project Independence reports are very much leading us toward the point where we have got the tools and are able to use them much more quickly in making policy decisions. And so as a matter of course, even what might seem as a very quick assessment, in a 1- or 2-week study, in order to get some policy decision or recommendation, often follows the same approach that you would have used but that might have taken you 2 years to do, a few years ago.

I do think there are limits. I also think that very often the decisions are such that the conclusions are very obvious, or your time limitation is such that you cannot make this kind of formal analysis, but you can do it informally. In my opinion, if you have people trained in thinking to consider secondary and other effects rather than just direct environmental impacts or direct economic impacts, you have advanced the state-of-the-art considerably.

Mr. DADDARIO. In what way are you able to determine how the public perceives this improvement? Do you get that across or is that a problem? And would it be helpful if the public could realize that there has been an improvement in the capability both to understand the impacts and to deal with them more quickly?

Mr. PASTERNAK. I think the public-at-large does not perceive an improvement in the Federal decisionmaking process. I think in localized areas where there has been direct contact on major or even minor issues that the advancement is well-perceived. I will give you an example of that. We are working very closely right now with the town of Gillette, Wyo., which has experienced traumatic growth in the last few years, and is going to experience even greater growth as coal is further developed. We are working with them on planning for this development—financial planning systems, infrastructure development, et cetera. I think they are aware of the approach that is being followed. In fact, the mayor of Gillette is also a member of this advisory committee on Western energy development that I sit on.

But if you ask the average citizen in the State of Wyoming whether the Federal Government is any more sophisticated in its decisionmaking, I think the answer would probably be no. I think the credibility problem that is faced not only by our agency but by the Congress and by the private sector is one of the most difficult obstacles we have to overcome.

Mr. DADDARIO. Have you been able to use those regional meetings that you held as an opportunity to get the point across to those people who are emotionally concerned because of all the energy activities that are being proposed that you are dealing with very difficult problems but have developed a capability over the course of time? Have you been able to make that clear to them?

Mr. PASTERNAK. The regional meetings, whether hearings or advisory committee meetings, are invaluable both to communicate to the people in the region what we are doing and to get information from the affected areas. An example of the latter was in the recent hearings we held in Los Angeles on liquefied natural gas imports. We had held hearings in Washington where we had a whole range of witnesses come in and talk to us about the impacts and essential policies. But the first time that one particular subject came up was in Los Angeles where we had five or six State energy officials plus environmental officials and local government people talk to us about their concerns. They didn't discuss the safety problems of importing liquefied natural gas (LNG), but the problems of what they were going to do if they did not have the gas and had to burn more oil in the Los Angeles air basin; the impacts of that on air quality. At least two or three of the environmental officials expressed the judgment that this was a more significant adverse effect than the potential for an LNG tanker collision or any other kind of failure. This concern never came up either during our Washington hearings or in any of the analyses done by consultants or any of the inner agency group. Yet it was a very important fact and it is very important to us in doing the analysis.

Mr. BROWN. Dr. Galler, you started to interject a moment ago.

Dr. GALLER. I was just going to add one comment, Mr. Chairman. I do not disagree with what Mr. Pasternack has just discussed at all, but I think it is important to point out that the public perception of the decisionmaking process in Government has become more sophisticated. This is certainly true in the environmental arena as a result of the passage of NEPA and the institutionalized collaboration of the public in the EIS process. As you know, a key step in that process

is to distribute the draft environmental impact statement for public review and comment. So the public, at least as I see it, has definitely become more sophisticated in examining environmental assessments.

One of the problems however, is that the flow of information to the public to help it participate in the decisionmaking process, is an attenuated and disjointed flow. The EIS today is, as I mentioned, a largely ecologically based presentation. The economic components are almost completely lacking in many cases. So that the public reading a document is really looking at two dimensions of a three-dimensional problem, while the decisions are made on three dimensions. The public, which gets only two of those dimensions, wonders what is the real basis for the decision. So, on the one hand, I think public perceptions have become more sophisticated. On the other hand, I think the information that the public needs to help it understand is still insufficient and has not caught up with the public's perception.

Mr. DADDARIO. Sid, would it be helpful if the whole question of EISs were reviewed by the Congress? Particularly in light of what you have said today that you have preliminary plans to look into certain standardization and review criteria? Is part of the problem that when the Congress originally passed legislation that included environmental impact statements, it was then wrestling with all types of early warning procedures to determine what the impacts of the application of technology would be? The Congress was sensitive to it, the public was demanding it, and the TA concept was floating around in the Congress, but it had not developed enough support. In fact, there were all kinds of difficulties with looking into the social, political, and economic impacts. Despite these difficulties the Congress was able to include EISs which were in a sense a part of the TA concept, in clean air and other legislation. Congress knew something had to be done but had not had the experience—no one had—to think this concept out so it would work perfectly. We now have had some experience and questions have been raised. Perhaps it would be helpful if the original organic legislation could be reviewed, taking into consideration the experience that we have all had.

Dr. GALLER. My personal opinion is that it would be timely, useful, and constructive. I think we need to internalize the experiences that we have gained in the last 6 years and fine-tune the process. So I would say, yes. I think it would be both germane and very useful for Congress to reexamine.

Mr. BROWN. If I may interject here. You mentioned the lack of an economic component to the EIS. Yet we have had in some parts of the Government—and I am thinking of the Corps of Engineers—a practice for many years of doing rather sophisticated cost-benefit analyses at a very early stage of development. It seems to me that what you are saying is that there should be a marriage between the EIS and the cost-benefit analysis—

Dr. GALLER. Precisely, Mr. Chairman.

Mr. BROWN [continuing]. as an improvement on our policy formulation procedures.

Dr. GALLER. Yes, sir, that is exactly what I am saying. I do want to emphasize that as one who has considered himself an environmental professional for more than 30 years. I look upon the EIS as a very important useful step in the direction of assessing the impact of

technology on the total human ecosystem. We have got to have the ecological information that prior to NEPA was never really being marshaled, but which is only one of the three dimensions. I think we must find some way of incorporating either as an integral part of the EIS process or as a concomitant document the cost-benefit analysis, the economic dimension.

Mr. BARRON. Mr. Chairman, could I interject? I feel as though I have to make some thoughts known here. I must disagree with my colleague from Commerce to some degree I do agree that the EIS is an excellent tool that has contributed much toward TA. I agree also with his statement that the passage of NEPA has been responsible for requiring that various facets of TAs and environment assessments be made. But it seems to me, that from the point of view of TVA, an agency that has been involved since its inception with resource and development and considers itself environmentally oriented, the requirements of NEPA have always been with us. They are just more formalized by the enactment of legislation. They are now required by law. But there is nothing that prohibits our taking the requirements of NEPA and implementing them very early in the decisionmaking process which we do. Moreover, I should point out that the economic considerations are a vital part of our EIS preparation. What I am trying to say is it depends on your point of view, where you sit.

Mr. DADDARIO. How do you determine whether EPA's requirements are really the best ones? Why should you accept them without a research analysis of your own? In several places in your statement you talk of expenditure of hundreds of millions of dollars apparently because EPA has imposed these obligations on you. How do you know they are the right thing to do?

Mr. BARRON. If I left that impression with you, then our testimony has failed to produce the communication that we desired. I think if you would go back and look at some of the key dates, you would see that many of the investments that were mentioned in our statement predated NEPA rather substantially. The requirements, for example, for reclamation provisions in our coal purchase awards were considerably earlier than NEPA. This decision was made after consideration of the cost versus the environmental effects. Similarly, our precipitator installation program and tall stack program predated NEPA very substantially. Actually at the time of the passage of NEPA, we were into the second generation of precipitator installation since precipitator technology had improved in the interim. The TVA is probably unique among Federal agencies in that we have a very broad mandate that requires the generation of electric power sufficient to meet the needs of the power-service area while at the same time imposing a responsibility for the development and protection of the environment of the seven-State area that comprises the Tennessee Valley.

Mr. DADDARIO. I recognize that. I did not intend by any means to say that you were just reacting in a knee-jerk way to anything that EPA had put out. Obviously TVA has a good record in this particular area. But you are dealing with tremendously difficult problems. You use both coal and nuclear energy; and are working with the private sector in a consortium on breeder-reactor development. There are all

kinds of management problems. Also certain of the safety and safeguard questions are far from being thoroughly researched.

The OTA is just completing an examination of the EPA R. & D. plan. We are finding some difficulty frankly between their regulatory capabilities and the basic research that goes into the development of the regulations. There is a need to understand what technology is available on which to base regulations and then to improve both the technology and the regulations by an R. & D. program. That is really what I am getting at.

Mr. BARRON. Sir, we could not agree with you more. I think perhaps a classic example is our position with respect to sulfur dioxide removal and the use of scrubbers. TVA has taken the position since the very beginning that scrubber technology has indeed advanced to the point where it has application in certain selected systems, generally those that are small, and in situations where the reliability is not a key factor. We have also pointed out that in effect the use of the scrubber simply exchanged an air problem for a solid problem, and that the sludge that results from the use of the limestone scrubber is going to constitute a very substantial problem in terms of disposal in future years.

It is ironic to us that at the same time that we are forced to retrofit scrubbers in some existing plants and to install them in any future coal-fired plants, we are being funded by the EPA to do applied research in scrubber technology and in the stabilization of the sludge resulting from the use of the scrubber. So we agree with you very definitely. But there comes a point in time, in this particular instance where we entered into litigation, in effect exhausted our remedies, and had no choice. There have been other instances when we have taken a strong contrary position. I think in many cases it has been successful.

I would like to point out that I think TVA has an unusual opportunity in that we are a member of the Federal family, but a unique member. Basically we are a federally owned corporation with a diverse charge by the Congress. Also, we operate in a small region of the United States relative to the Nation generally. Throughout the discussion following the formal statements, it has come across more and more that one of the problems is how to apply TA in the microsphere as opposed to the macrosphere. As a result of our being regional, we are a testing ground.

For example, we talked about regulation. We in TVA feel as though our experience in the electric generating field, while at the same time we are a member of the Federal family, puts us in a special position to offer suggestions, comments, and criticism to proposed regulations affecting the electric generating industry. We feel that having the diversity of technical expertise that exists in an agency with such a broad charge, we are well-equipped to contend with problems that involve or mandate a multidisciplinary approach. In effect, we can give the private enterprise point of view but in our capacity as a member of the Federal family. I think that is a unique position we have to offer, for whatever it is worth.

Mr. Daddario. You are doing pretty well. Someone is always around every election trying to sell you off to the public.

Mr. BARRON. No one has come up with a buyer.

Mr. BROWN. Gentlemen, I want to get back to the broader effort to understand the role of TA and its relationship to other policy tools. I have lived long enough to have seen the development of a number of processes that purported to solve the problems of making policy decisions. During and after World War II, we had operations analysis for example. You referred to your background in systems analysis, a favorite catchword of the next generation. Today we have EISs and TAs.

How do we perceive all of these tools? Is there a magic solution to the needs of human institutions to make sound decisions? Are we groping for them, or are we achieving a more mature viewpoint, based on a "kit of tools" that can be applied in particular situations to assist both public and private institutions in improving the social quality of their decisions. React to this a little bit for me. I have not phrased it exactly as a question, but what does it generate in your minds!

Dr. Galler. May I make one comment on tha Mr. Chairman. I really cannot squarely address the question that you raised, But as a bureaucrat for some years now, it seems to me that the TA process, whether you call it TA, EIS, or systems analysis, is going on all the time. One of the problems is a lack of coordination, what I call the lack of hysteresis in the system. I wish we had a little bit more of a time lag between the first findings on an issue and the regulatory "hip-shooting" that takes place. I think it is terribly important that we institutionalize the process to the point where the private sector, the public sector, and the public-at-large, have confidence that when a regulatory decision is reached, it is arrived at only after a full, careful, and in-depth examination of the social, economic, and environmental dimensions of an issue. I fear this has not been the practice. I fault no one. There have been converging and contradictory pressures. The fact remains however, that once a regulation is in effect, it is awfully difficult, to undo it. So, I think we have to be much more careful to rely on TA, and also to have some kind of system to prevent regulations from being made until the TA has been completed.

Mr. BARRON. Mr. Chairman, as you were asking your question, I was thinking of the analogy of a medical doctor. I think it is still apropos in the light of my colleague's comments. The physician may utilize any number of tools in the diagnostic process, depending on two things, the extent of the malady and the patient's circumstance. In some instances he might have to rely strictly on "hip-shooting" if the patient is blue, is not breathing, and there are signs of cardiac arrest. On the other hand, if the malady is such that there is no apparent immediate need, then the full spectrum of diagnostic techniques can be brought into play. I think this analogy is perhaps the most appropriate answer to your question. Technology assessment is a vital member of a group of tools that are available to Federal agencies. I certainly do not believe that it is the final solution, nor do I believe that you would suggest so. But we consider it to be an essential major component of any decisionmaking process in our organization, whenever the circumstances permit.

Mr. BROWN. What bothers me is that as human beings we have an unfortunate tendency to grab onto a useful tool and think that it will

solve all our problems. I was very interested in the testimony yesterday of the gentleman from the Department of the Interior. He referred to their use of TA as a part of what he called the Program Decision Option Document in which the basic concern is to examine program options and select the best one, by using TA and any other available tools. The tendency to look at a useful tool without seeing what it is to be used for is a failing we all share. I do not know how to correct it, but I am trying to create a record here from which to gain the insight that will help us to achieve this kind of perspective. Do you have any further questions, Mr. Daddario?

Mr. DADDARIO. I think, Mr. Chairman, that Dr. Galler's earlier remarks would be helpful on the point you just made. As I understand it, what he said was that it is not so much how you use a tool but how you fit it into the overall planning process in the first place. The tool is something you are trying to force into the planning process. If you could look at the constraints that are bound to arise earlier rather than later in the process, you would save yourself a lot of trouble.

Dr. GALLER. Yes, precisely.

Mr. BROWN. What bothers me, Mr. Barron, about your medical example is the difficulty that is being perceived in looking at the overall problem of human health today. Doctors may be causing as much disease as they cure. The fact seems to be that human health is being adversely affected by such environmental considerations as stress and pollutants of various kinds in the environment. But doctors are still trying to look at an individual human being without considering all of these environmental factors. In other words, they are looking with their rather limited tools for examining and diagnosing, and not seeing the broader aspects that need to be looked at.

Mr. BARRON. Yes, sir, I would agree. I think, as I pointed out earlier, it depends on where you sit. In the final analysis, whether by a physician or by a head of a Federal agency, the decisions must be made by human beings, and I for one hope that we never reach the stage where this is not the case. I think it is incumbent on that human being as a responsible person to use all the tools that are available to him in making the decision. But in the final analysis, the buck must stop somewhere, and he has to weigh the pros and the cons from the environmental and every other aspect to make a decision and be responsible for it. I really do not see a substitute for that.

Mr. BROWN. Your agency is unique in another way, in that it was created at a time when this country was temporarily concerned with broad problems of river basin planning, and the welfare of the human beings in the total environment within that river basin planning area. Thus your mandate as an agency is much broader than that of any other agency in its concern for the environment, for the development of the industries, for economics of the region, and for various other issues necessary to get a total perspective. Therefore, your experience and example can be useful in examining some of the problems of more narrowly defined agency roles.

I do not know how we can infuse that broader concern and mandate that you have into other agencies including the Congress, because the Congress needs an infusion of long-range planning and policy planning, a broad approach to problems that it does not take today. It looks

narrowly and within a relatively short time frame at most of the problems that it faces.

Dr. Galler, in your testimony you made reference to a list of industries identified by your Department that were involved in TA. Would you be able to provide this information for the record?

Dr. Galler. Yes, sir.

[The information referred to above is as follows:]

COMPANIES CONDUCTING SOME FORM OF TECHNOLOGY ASSESSMENT STUDIES

Chemagro Co.	Gulf
U.S. Steel Corp.	EXXON
Kennecott Copper Corp.	Atlantic Richfield Co.
Lockheed Missiles and Space Co.	Alyeska
Deepsea Ventures, Inc.	Shell Chemical
DuPont	Hercules, Inc.
Reynolds Aluminum	Chevron Chemical
Alcoa	Ciba-Geigy
Ford Motor Co.	Dow Chemical

Mr. BROWN. As I said before, we have not exhausted all the questions that probably would be useful in making a complete record on this point. We would like to submit some of those questions in *writing* to you gentlemen. But in view of the time, I think it is best that we adjourn at this point So the hearing will be adjourned.

[The following questions were submitted by Congressman Brown to Dr. Galler and his answers thereto:]

Question 1. You mentioned lessons learned as a result of the Department's efforts to prepare the Trans-Alaskan Pipeline (TAP) Environmental Impact Statement (EIS). Would you expand on this comment, especially with regard to the organization and conduct of the TAP EIS. Do you recall anything in particular that would be helpful to the Office of Technology Assessment (OTA) in the conduct of technology assessment (TA) ? Also, how you you involve the public in the TAP EIS? Was the public informed ahead of time about TAP impacts on the environment?

Answer 1. The Trans-Alaska Pipeline Systems Environmental Impact Statement (TAPS-EIS) is especially important as a historic benchmark in the implementation of the National Environmental Policy Act (NEPA). It was one of the first very large projects for which an EIS was required prior to its undertaking. The preparation of the TAPS-EIS was the responsibility of the Department of the Interior (DOI), although the Department of Commerce (DOC) provided substantial contributions during its preparation to DOI. This experience made us aware of several things: (1) the essential requirement for close cooperation and coordination among agencies to take full advantage of the specialization and expertise in each agency, (2) the great difficulty in projecting all potential impacts in the absence of a full understanding of the ecological social, and economic interrelationships of major projects with local, State, and national communities, and (3) the importance of a fully informed and involved public. The public was continuously kept informed by news articles, television news coverage, public hearings, and draft impact statements.

Question 2. In your opinion what Government action is necessary to insure that the EIS is not ex post facto in nature, but in fact is brought in and utilized early in the planning and decisionmaking process?

Answer 2. Under present arrangements, the preparation of an EIS is tied directly to a specific Federal decision. The information sought is that which is thought to be relevant to the making of that Federal decision. However, most projects involve a chain of decisions made by State and local bodies as well as private firms and individuals long before the project comes up for the "Federal decision." During this time the project may have gained considerable momentum and in effect lost alternative options without the benefit of the information and public participation involved in the Federal EIS process. The Federal EIS process often either reopens State, local, and private decisions creating confusion, frustration, and antagonism, or becomes a captive of the momentum that the project has already generated.

Furthermore, approximately half the States have adopted either comprehensive statutory or special EIS requirements. Unfortunately, most States lack the necessary technical expertise and resources to provide the type of impact assessment adequate for Federal purposes. With greater delegation of Federal revenues and decisionmaking to States and local communities, technical environmental assistance to industry, States, and communities should be investigated. Two specific forms of technical aid are categorical grants for personnel training and a federally sponsored State or regional environmental agent system.

Question 3. If an energy utility perceives it has a legal and societal responsibility to build a plant, would it be worthwhile for it to conduct a TA at that stage in order to determine if the perceived legal-societal need is real, and also to determine the best way to balance energy demand with environmental quality? Would public participation be important at this stage?

Answer 3. I believe most utilities now are under legal obligation to meet the market demand for electrical energy in their service areas. In recent years, most utilities with which I am familiar have conducted careful and conscientious environmental studies prior to committing their organizations to specific siting decisions. Because utilities are closely regulated, the public is involved in such decisions as, for example, the current discussions pertaining to the siting of a Pepco powerplant at Douglas Point, Md.

Question 4. How do you involve the public in the EIS and TA process at the Department of Commerce (DOC)?

Answer 4. The DOC has no formal process, but it does have a formal EIS process. We attempt to encourage public participation through public information releases, draft EISs for public comment, and public hearings where appropriate. For example, during the preparation of the EIS on the Department's supertanker subsidy program, public hearings were held to obtain comments and information from the public. These were used in the preparation of the final EIS.

Question 5. You mentioned conducting some TAs at the Department that will examine the impacts of regulations on the private sector and the public. Has a formal structure for conducting TA been established at the Department? How is TA information integrated into reports of the Department? Do you use private sector advisory panels for your EIS and TA activities?

Answer 5. In my remarks, I referred to several industrial environmental energy studies the Office of Environmental Affairs is conducting in an attempt to evaluate the impacts environmental regulations have had upon technological pollution control options. Moreover specifically, the studies measure what the energy impacts are of existing pollution control requirements and evaluate available technological options in terms of their environmental, economic, and energy consequences. We do not have a formal structure for conducting these studies. Typically, they are conducted by outside contractors. Other Federal agencies are consulted in the development and consolidation of the information and analysis. The that reports are made available to interested Federal agencies and to the public. We have not used private sector panels for either EISs or these studies.

Question 6. Do you see any value in having better communications between the public and private sectors? What about closer relationships with State and local governments? Do you utilize NSF TA reports and are they given to concerned offices in the Department?

Answer 6. Yes, I believe the lack of good communication among government and private sectors can significantly decrease our ability to work together efficiently for assessing the impacts of technological development. A failure to communicate leads to the lack of understanding on both sides, and we are committed to improving the interchange of ideas and information among the components of our society and government in general. In fulfilling our NEPA responsibilities we do not rely on any given set of reports such as the NSF TA reports, but rather deal with the special needs of each project as it comes along.

Question 7. How does TA fit into the general policy formulation and decision-making processes in the Department?

Answer 7. EISs and other types of TA studies are part of the information package that accompanies a project or decision memorandum for use by policy level departmental personnel. They also influence the drafting of recommendations and desire of projects.

Question 8. Has environmental impact analysis or TA affected the way business is done at the DOC? Do you have training at the Department on the subject of TA?

Answer 8. The requirements for the the preparation of environmental assessments and EISs have led to the establishment of a definite, but not formalized, procedure for identifying and evaluating the potential effects of a project before making final decisions. This has led to an increased number of relevant areas for defining agency and departmental positions.

We do not provide training on the subject of technology assessment.

[The following questions were submitted by Co man Brown to Mr. Bruce A. Pastirnack and his answers thereto:]

Question 1. Do you see any value in closer relationships between the public and private sectors? What value do you see in better communications on TA with local and State governments?

Answer 1. The liaison between the public and private sectors must be close enough to achieve the necessary interaction between these groups in formulating policy, especially on a national level. The formulation of national energy policy is a complex task that requires the close cooperation of Peale@ State and local government bodies, and the public-at-large. The FEA's Intergovernmental, Regional and Special Impact Office provides a continuous liaison with State and local government officials, national associations of elected officials, business, consumer, and other interest groups on a wide range of energy issues of particular concern to the states and the public. Better communication on all levels is, of course, a very desirable goal when considering energy policies that can impact virtually on every segment of society. Because many State and local governments do not yet have the capability to adequately analyze the effect of various energy policies on their own patricular locality, I see great value in better communications on TA with local and state governments.

Question 2. Has TA or environmental impact analysis affected the way business is done at the FEA?

Answer 2. Consideration of environmental concerns plays a major role in the development of an energy policy that properly balances resource development and environmental impacts. The FEA's Office of Environmental Programs acts to ensure the Agency's compliance with the National Environmental Policy Act by coordinating the preparation of Environmental impact Statements (EISs) for the FEA programs, and coordinating the review of other agencies' EISs. The major environmental issues associated with energy will focus on regional development questions. These include Outer Continental Shelf development, oil and gas production from Alaska, western coal development, commercialization of synthetic fuels, and nuclear power growth. The resolution of these issues will largely determine the future of energy production, and therefore, the future of resource development policy issues. In this way, environmental impact analysis does often affect, not necessarily the way business is done at the FEA, but certainly the outcome of policy issues.

Question 3. You mentioned that two ways to improve the TA and EIS processes at the agency level is both through experience and by building the capability of employees in these processes. Do you have such a program in effect at the FEA?

Answer 3. Although no formal TA or EIS training program is in effect at FEA, the experiences gained since the inception of the agency have resulted in a much improved, sophisticated system for policy evaluation. The FEA's forerunner, the Federal Energy Office, was instituted shortly after the start of the 1973-74 Arab embargo. Initial efforts concentrated on necessary regulatory programs to oversee the equitable distribution and pricing of limited energy supplies throughout the Nation.

Question 4. How do human value systems affect technological development? What role should the analysis of value systems have in assessing the impacts of technology on society and the environment?

Answer 4. Socio-economic impact studies should Perform a major role in assessing the results of proposed policy actions on society and the environment. The FEA's Office of Economic Impact Analysis develops and applies advanced economic models of the economy in the performance of macro- and micro-economic analyses of the potential impacts of energy shortages, and of alternative energy policies and programs of the economy and society. These include analyses of impacts on specific sectors of the economy and population groups. Because this Agency believes that there is a need for the analysis of value systems in assessing the impacts of technology on society and the environment, we have a special office of Consumer Impact that interacts on a continuous basis with consumer

groups and the general public so that outside value systems are considered as we make policy decisions.

[The following questions were submitted by Congressman Brown to Mr. John S. Barron and his answers thereto:

Question 1. At the end of your testimony, you mention that you are doing social, economic, and environmental impact analysis. How long have you been doing this kind of analysis in a formal process? How do the results enter into the decision and policy-making processes at the Tennessee Valley Authority? Are they taken into consideration at all in the planning process? For each of your major offices, what percentage of its time is spent on such analyses? Does a formal structure for conducting TA exist?

Answer 1. As the testimony suggests, the process of impact analyses became formalized with the enactment of the National Environmental Policy Act (NEPA). Prior to NEPA, the process was an informal, and often elementary approach to technology assessment (TA). Except in those situations where regulations require formalization, that informal process continues today.

Interdisciplinary coordination among the various programs is standard practice, both at the planning and the implementation level. Through this means, proposed actions are evaluated by interested disciplines to determine whether the action is acceptable, detrimental, or perhaps subject to a modification that enhances their particular interest with minimum adverse effect on the intended result.

Since the greater part of our TA is on an informal, day-to-day basis, it's difficult to estimate the time spent on this activity.

Question 2. How do you see the social, economic, and environmental impact analysis and TA differing or similar to the requirements for EIS?

Answer 2. TVA's integrated assessment research has been designed to facilitate and improve the overall impact assessment process for power-generating facilities. The work has been designed not only to meet the current EIS requirements but also to provide the basis for improved analyses both now and in the future. The primary thrust of this research has been to: (1) improve lines of communication among planning, engineering design, and impact assessment workers; (2) develop a unified information system containing data for use by a variety of planning and impact assessment activities; and (3) utilize improved techniques for data display, analysis, and management decisionmaking.

Question 3. How does your social, economic, and environmental impact analysis compare to the integrated TA program of EPA in which you are participating? What lessons have been learned to date?

Answer 3. EPA's Integrated Technology Assessment is a broad research program designed to consider the development of numerous energy sources, various control technologies, and their resultant impacts. TVA's Integrated Assessment research activities are limited to developing methodologies for better assessing the social, economic, and environmental impacts of nuclear and coal-based power-generating facilities. Research is under way to: (1) develop improved economic forecasting of the demographic and manufacturing sectors within the TVA power service area; (2) incorporate in an existing power system's integrated planning model, a model that will be capable of predicting the environmental residuals generated at each facility under various system operating conditions; and (3) demonstrate the use of computer graphics as a means of facilitating the impact assessment of power-generation facilities. We have found that most of the techniques developed are readily accepted as a means of improving day-to-day assessment activities, and that our expectations for this research have exceeded initial estimates.

Question 4. How do you get the public involved in your decision, planning, and policy-making processes?

Answer 4. TVA's dialog with members of the public includes open meetings of the TVA Board of Directors (normally twice a month), public hearings, the environmental review process, Congressional hearings, hearings before State air and water quality boards, communication with TVA officials, participation in conferences, and symposia on issues facing the region.

For example, TVA held public hearings at three locations (Chattanooga, Tenn., and Florence, Ala., and Paducah, Ky.) in June 1976 to receive views and comments from the public about alternative electric rate structures. Members of the public

testified at oversight hearings before the Senate Committee on Public Works in late April and early May 1975.

As a public agency charged by Congress with the responsibility for helping the people in the Tennessee Valley region carry out a unified resource development program, TVA has an obligation to respond fully and frankly to the public, and attempt to resolve conflicting viewpoints.

TVA hears from some segments of the public that electric rates are too high, and thereby detrimental to the economic and social progress of the region. Others maintain rates are too low, at least for some classes of customers, or in relation to other regions. Or they state by inference that rates are too low by advocating far stricter environmental controls on the production of power.

Others oppose the building of dams, while others support them to provide flood control, industrial, recreational, or other benefits.

TVA has responsibility in all of these areas as well as others, and the question the agency faces frequently is to whom shall it be responsive?

Question 5. How do you discuss impacts ahead of time and educate the public to the impacts?

Answer 5. TVA began consultations with State, local, and regional organizations in October 1972 about the possibility of building a generating plant at the Hartsville site in Tennessee, and its implications for the area. This consultation occurred almost four years before construction began on the site in April, 1976.

In mid-October 1973, TVA participated in a meeting with State and regional planning and assistance organizations to discuss assistance to the Hartsville area to offset construction impacts. In January, 1974, manpower needs were discussed with the Mid-Cumberland Development District Manpower Planning Board.

A TVA project coordinator was assigned to the area in February 1975 to work with local officials and organizations on resolving impacts resulting from the anticipated influx of construction workers. Since then the Hartsville Project Coordination Committee, composed of officials in a five-county area near the plant, has been formed to discuss and deal with project-related problems common to some or all of the committee participants.

Question 6. What value do you see in having closer relationships between the public and private sectors? What about the value of having closer State and local level relationships?

Answer 6. TVA believes that close relationships with both the private sector and State and local governments have the potential for producing products that are superior to the product that either could independently produce. Each has a point of view and an experience base that can and should be a factor in Federal decisionmaking and action. Particularly in our role as a utility, close relationships with the private sector are essential to the fulfillment of our mission. These relationships range from transmission line interconnections and the sale of electric energy to the exchange of information, techniques, and even personnel. Similarly, many actions are dependent upon local governments for adoption and implementation requiring close relationships with local governments, and the identification of mutual goods.

A key early decision by the TVA Board of Directors involved the question of how the agency would pursue its responsibilities under the TVA Act. The decision was reached to accomplish the Act's objectives through the strengthening of State and local governments rather than to establish some form of "system government." A close working relationship between local governments and TVA is essential to the fulfillment of our mission since change will largely be brought about through local actions.

Question 7. Have you done any research after the fact on the consequences of your project since TVA began operation? Are there any cases in your years of operation where your planning went awry? Please explain how it happened and what lessons were learned? Can you say that TA or EIS have affected your way of doing business?

Answer 7. In the mid-1930's TVA sent to Congress a general plan for the Tennessee Valley entitled *The Unified Development of the Tennessee River System*. This plan identified the needs and problems of the people of the Valley area and proposed programs to ameliorate these problems. Since the plan was formulated, TVA's numerous programs in multiple resource development have been aimed at solving those and other problems of the Valley.

These programs are constantly undergoing assessment, reevaluation, and modification. As the Tennessee River Valley changed from a rural to an urban character, natural modifications in the original plan and subsequent project plans

have taken place. For example, the early general plan was concerned with flood control but did not specifically address flood plain management. As urbanization took place many structures that were built in flood plains were destroyed or damaged by regional floods. The implication for TVA program and project plans was to purchase in some cases, more flood plain land, and in other situations to assist local and State governments in establishing flood plain use controls. Similarly, with respect to recreation, earlier water resources projects did not place recreational use as a high-priority water use. However, since World War II, residents of the Valley have enjoyed more and more leisure time. The result has been a greater demand for recreational areas, and has necessitated provision of more recreational facilities and retention of greater amounts of reservoir shoreline for public use than was once thought appropriate.

specifically, the lesson learned is that as needs and problems change over time, original plans for programs and projects must be modified and adapted to provide solutions.

TA and the NEPA have definitely changed TVA'S way of doing business. With the benefit of retrospect and early environmental impact investigation of projects, better decisions regarding TVA programs are realized.

Question 8. What new considerations have entered into your Policy planning in the last 5 years?

Answer 8. TVA's basic policies are set by the TVA Act and have not changed during the past 5 years. However, as noted elsewhere, the greater weight our society has given to the environment is reflected in a heightened concern for identifying the indirect impact of our activities on the physical, social, and economic environment in which we live. A correlate of this impact analysis is the policy of adapting project plans to avoid, or at least mitigate, any otherwise undesirable effects. In addition to the above, TVA' policy planning has been affected by the apparent secular trend of high inflation, the regional need for skilled construction labor, and the importance of a greater concern for energy conservation.

Question 9. Has TVA examined the impact of new technology on job structure in its region?

Answer 9. TVA has not examined the impact of new technology in the region on job structure in a general sense. It has assessed the impact of technology on future skill requirements for the agency and is working with educational institutions to assure that training opportunities are attuned to job requirements.

Question 10. Does TVA offer training on TA and the environmental impact process?

Answer 10. Since the enactment of NEPA and the emergence of numerous environmental regulations, TVA personnel have been fully occupied in meeting existing demands in support of the power program. consequently we have not offered training in TA to others. Conceivably, once the backlog of demand is satisfied, we could offer such training.

Question 11. In your discussion on approaches to the mining and combustion of coal, you repeatedly emphasized the magnitude of the capital outlays. Could you comment on the opportunities lost to invest those moneys in other technologies or institutions or for other goals, as a result of commitments to the combustion of coal? Did you convene public meetings where the community was given an opportunity to discuss TVA's plans for the allocation of funds, prior to the actual obligation of the money? Does hydro-electric power have any role in the future provision of electricity to the area? If not, what assessment strategies were followed to justify setting this basic option aside?

Answer 11. In meeting its utility responsibilities for sufficient electric energy capacity to meet the needs of the TVA region, the alternatives are reduced to the question of what form of generation will be selected.

When TVA began building coal-fired steamplants in the 1950's, two methods of generating large amounts of electricity at the time were hydro, and fossil-fueled steam electric generating plants. Since the hydroelectric potential of the river had been developed and could no longer meet the electric needs of the region, TVA chose coal-fired plants over oil-fired plants because of the availability of coal in the region and its lower cost.

TVA did not convene public meetings to discuss the allocation of funds to coal-fired plants. The decision was made in light of TVA's responsibility under the TVA Act to supply power to the region it serves at the lowest feasible rate to the consumer.

Hydroelectric power will have a limited role in the future provision of electricity to the region, primarily for meeting peak-hour loads, but it cannot meet

the total requirements due to the physical limitations of the river system. Thus the option has not been set aside, but is no longer available.

Question 12. With respect to your plans for nuclear power plants, did a disinterested third party conduct an appraisal or assessment to weigh the alternatives (fossil, hydro, and nuclear) and the diverse impacts on resources, economics, environmental elements, and rural institutions prior to a decision to proceed? If so, would you care to comment on the findings that persuaded TVA to select the nuclear option, and convinced the community to support the dislocation of many people?

Answer 12. Since its inception, TVA has relied chiefly on the advice of a diverse, well-qualified staff in making policy decisions. While consultants are sometimes utilized, their views together with other inputs such as the views of State or local governments or a part of the mix from which a staff recommendation is made.

This was the case when the decision was made to construct the first nuclear generating plant. Although the study could be considered primitive in comparison to today's environmental impact statements on generating facilities, it did consider such areas as comparison of costs, nuclear safety, and ability to obtain Atomic Energy Commission licenses and operating insurance, as well as the impact on the environment. Evaluations of a similar nature are made each time the decision must be made as to how Projected energy demands will be met.

There seeing to be some misunderstanding about dislocation of people as the result of construction of a power plant. The proposed four-unit Hartsville Nuclear Power Plant will require 1,940 acres for the plant site. Eleven households will be dislocated because of the plant. Furthermore, TVA steam plants are not located in heavily-populated areas

[The hearing was adjourned at 12:30 p.m.]