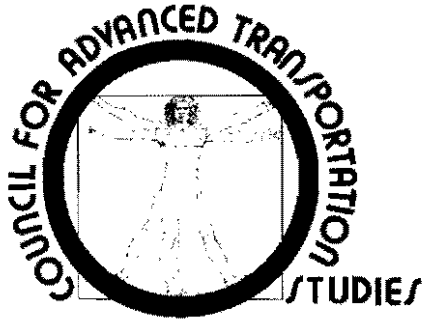
Proceedings of
The University of Texas at Austin *and* Texas A&M University
Joint Conference *on*

LONG RANGE IMPLICATIONS OF SCARCE, EXPENSIVE ENERGY ON TRANSPORTATION



THE UNIVERSITY OF TEXAS AT AUSTIN

TEXAS TRANSPORTATION INSTITUTE

Texas A & M University

at Joe C. Thompson Conference Center-Austin, Texas
October 24-25, 1974

PROGRAM

THURSDAY MORNING: *GENERAL SESSION*

9:00 a.m. —Registration

10:00 a.m. —Moderator:
Dr. W.R. Hudson, Director, Division of Research in Transportation, The University of Texas

10:10 a.m. —Opening Remarks:
Dean Fred J. Benson, College of Engineering, Texas A & M University
Dean Earnest F. Gloyna, College of Engineering, The University of Texas

10:20 a.m. —Keynote Address:
Lt. Governor William Hobby
"Texas and Energy: Problems and Prospects"

11:00 a.m. —Mr. Luther DeBerry, Chief Engineer, Texas Highway Department
"Transportation and Energy Issues"

11:30 a.m. —Mr. Walter Wendlandt, Director, Transportation Division, Texas Railroad Commission,
"The Role of Railroad Commission in a Scarce Energy Economy"

12:00 noon —LUNCH

THURSDAY AFTERNOON: *LOCATIONAL AND LAND USE POLICY EFFECTS OF SCARCE ENERGY AND TRANSPORTATION*

1:30 p.m. —Moderator:
Dr. C. Michael Walton, Department of Civil Engineering, The University of Texas

1:35 p.m. —Mr. Bob Armstrong, Texas Land Commissioner,
"Land Management, the Other Piece of the Puzzle"

2:05 p.m. —Dr. Bassett Maguire, Jr., Department of Zoology, The University of Texas
"Neither Transportation nor Energy is the Problem"

2:30 p.m. —BREAK

2:45 p.m. —Dr. Peter House, Assistant Director Washington Environmental Research Center
—Mr. Edward R. Williams, Program Officer, Washington Environmental Research Center
"How to Prophesize an Apocalypse: The Use and Misuse of Long-Range Forecasting" or "Run Henny Penny, the Sky is Falling"

3:10 p.m. —Panel Presentation and Discussion
Moderator: Mr. Bob Armstrong, Texas Land Commissioner
Mr. John Roark, Director of Transportation Planning, North Central Texas Council of Governments
Mr. Scott Romney, President, Lakeway, Austin, Texas
Mr. Sam Dunnam, The Dunnam Company, Austin, Texas
Dr. Harry Hornby, NASA-Ames, Moffitt Field, California

THURSDAY AFTERNOON —Continued

4:45 p.m. —Summarization: Mr. Bob Armstrong, Texas Land Commissioner

7:00 p.m. —RECEPTION AND DINNER: J.C. Thompsom Conference Center

Toastperson: Dr. Stanley R. Ross, Vice President, The University of Texas
Remarks by: Congressman J.J. Pickle and Congressman Olin Teague

FRIDAY MORNING: *ECONOMIC AND POLICY CONSTRAINTS OF SCARCE ENERGY ON THE FUTURE OF TRANSPORTATION*

9:00 a.m. —Moderator:
Mr. G. Sadler Bridges, Head, Economics and Planning Division, Texas A & M University

9:10 a.m. —Dr. Phil Gramm, Department of Economics, Texas A & M University
"Energy in Perspective"

9:30 a.m. —Mr. Robert Lockwood, Research Associate, Bureau of Business Research, The University of Texas
"Policy and Plausibility in Transportation Futures"

9:50 a.m. —Mr. Robert Floyd, Director for Agency Liaison, Texas Motor Transportation Association
"Long-Term Impact of Energy Shortage on Trucking Industry"

10:10 a.m. —BREAK

10:25 a.m. —Dr. Lee Case, Economist, American Association of Railroads
"Long-Term Impact of Energy Shortage on Railroads"

10:45 a.m. —Mr. Charles P. Zlatkovich, Research Associate, Bureau of Business Research, The University of Texas
"The Future Role of Rail Transportation"

11:05 a.m. —Panel Discussion
Moderator: Mr. G. Sadler Bridges, Texas Transportation Institute, Texas A & M University
Mr. Jim Seamon, Rail Transportation Specialist, Transportation Research Board
Dr. Phil Gramm, Department of Economics, Texas A & M University
Dr. Lee Case, Economist, American Association of Railroads

ACKNOWLEDGMENTS

The organization and planning of this Conference required the assistance and effort of several individuals at Texas A & M University and at The University of Texas. While it is impossible to acknowledge all the people involved in making this Conference a success, the major contributors are listed below.

The University of Texas/Texas A&M Coordinating Committee

Dean F. J. Benson, Texas A & M University
Dr. C. J. Keese, Texas A & M University
Dr. C. V. Wootan, Texas A & M University
Dr. L. C. Reese, The University of Texas
Dr. H. E. Sutton, The University of Texas
Dr. W. R. Hudson, The University of Texas

Program Working Committees

Dr. J. F. Betak, The University of Texas
Dr. C. M. Walton, The University of Texas
Dr. R. Holder, Texas A & M University
Dr. W. Hazard, The University of Texas
Mr. T. Hill, The University of Texas
Mr. C. Zlatkovich, The University of Texas
Mr. G. S. Bridges, Texas A & M University
Mr. R. Lockwood, The University of Texas

Administrative Arrangements at The University of Texas, Austin, Texas

Mr. Frank Bergman
Ms. Patti Rein
Ms. Pat Williams
Mr. Tom Caffrey
Ms. Linda Pethia
Ms. Sharon Soechting
Ms. Nancy Kramer

Other Cooperating Agencies within the University

COLLEGE OF ENGINEERING—E. F. Gloyna, Dean
CENTER FOR ENERGY STUDIES—Herbert Woodson, Director

The University of Texas at Austin and
Texas A&M University
Joint Conference on

LONG RANGE IMPLICATIONS OF SCARCE EXPENSIVE ENERGY ON TRANSPORTATION

BE IT REMEMBERED that the above entitled conference was conducted on the 24th and 25th days of October, 1974, at 1—110 Joe C. Thompson Conference Center, The University of Texas at Austin, 26th at Red River, Austin, Travis County, Texas, and the following proceedings were reported by George H. Hickman, Certified Verbatim Reporter, 11601 Eubank Drive, Austin, Travis County, Texas, a Notary Public in and for Travis County, Texas.

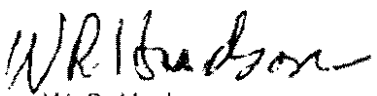
Table of Contents

Preface

It is obvious that energy and transportation are essential components of the Nation's strength and prosperity, and that the two are inextricably intertwined. Yet, it is painfully clear that as a Nation and a State, we have not been able to treat the enormously complex problems which are associated with these major factors of our lives.

While these conference proceedings do not provide the solutions to the problems facing us, they do certainly offer some insights and hold forth promises of directions which might lead to solutions. It is most propitious that two universities, Texas A&M University and The University of Texas can come together to begin the difficult jobs of defining the problems and seeking solutions. This "coming together" is underscored by the fact that this is the second conference in a series of joint efforts on these topics. It is also suggestive of the scope of the problems and depth of the difficulties, that two such universities are jointly treating these issues.

We commend these proceedings to you in the hope that they may generate more cooperative efforts among universities, industry, and government in considering the Long Range Implications of Scarce, Expensive Energy on Transportation.



W. R. Hudson
Director of Research
Council for Advanced Transportation Studies
University of Texas at Austin

Dr. W.R. Hudson, Congressmen J. Jake Pickle and Olin Teague, and Dr. C.J. Keese at Conference opening.

Conference registration activities

Morning Session

LONG RANGE IMPLICATIONS OF SCARCE, EXPENSIVE ENERGY ON TRANSPORTATION

Phase I - The General Session

DR. HUDSON: Good morning. I am Ronald Hudson. Welcome to the Joint Texas A&M - University of Texas Conference on Long Range Implications of Scarce, Expensive Energy on Transportation.

This conference is the second in a series of joint efforts between our Universities and we are pleased to host it here in Austin. We feel this assembled group can make an outstanding contribution to the subject at hand this morning, this afternoon and tomorrow morning.

A few brief announcements in case the program is misleading to you. There is no organized luncheon. Restaurant facilities are available here in the Center dining hall, downstairs. They have a buffet line with a small menu.

Snack facilities are here on this floor and, of course, the Villa Capri Restaurant is right across the street. Right down the street there is a small snack restaurant and for those of you that have cars, there are many restaurants in the area that you probably already know about.

I would like to make a few brief introductions at this time of some of the people whose cooperation has been involved in planning the conference. Professor Jack Keese, Director of the Texas Transportation Institute; Dr. Charles Wootan, Assistant Director of TTI; Dr. John Betak, Assistant Director of the Council for Advanced Transportation Studies, who is in charge of the arrangements; Mr. Frank Bergman of CATS who is in charge of most of the physical arrangements. If you have any problems on arrangements, please check with him.

There are many others who worked on portions of the program and many other people on the program that you will meet this afternoon, tonight, and tomorrow.

Now, to get our program under way, I would like to introduce Fred Benson, Dean of Engineering at Texas A&M University. From personal experience, as a student in his classes, I can verify that Dean Benson is an outstanding teacher.

He helped found the Texas Transportation Institute, he served as its first director, he has long been active in transportation affairs in Texas and was a strong motivator of this cooperation. It is my pleasure to present Dean Benson, Dean of the College of Engineering, Texas A&M University.

Lt. Governor William Hobby giving keynote address.

General Session - Opening Remarks

DEAN BENSON: Thank you, Dr. Hudson. Ladies and gentlemen, it is a pleasure for me to be here this morning to participate, at least briefly, in this conference.

I notice that Dean Gloyna and I have been allowed ten minutes—five minutes each, I assume—for our remarks and that's probably appropriate for deans. I will try to finish mine within the five minutes allocated.

This conference has been scheduled to consider the long range implications of scarce, expensive energy on transportation. Certainly, this is an important subject.

Energy problems are in the forefront of the nation's thinking as of this time, and oil and natural gas, as energy sources are extremely important to the state of Texas which furnishes a substantial part of our nation's domestic supply; I think, something on the order of 40 per cent.

I noted a report, in the Houston Post this morning, of a study by a University of Houston, faculty member indicating that Texas will be a net importer of oil and gas by 1985. I am extremely interested in getting my hands on that study because I don't really believe it. In the energy equation, transportation is certainly a major factor. Transportation is a very large user of energy and the efficiency is relatively low. In any severe curtailment of energy usage, it seems evident that transportation will be expected to provide a substantial part of the decrease.

This nation is said to have a highly mobile population and transportation is largely responsible for this mobility. Most of our people transportation and much of our goods transportation is provided by motor vehicles operating on the streets and highways of the nation. Much has been written about the love affair between the American people and the automobile. I am sure that this is all pretty factual. In many areas of the country, the automobile is the only means of transportation except for walking, which is not really very popular. I was impressed most with that about a month ago when I was in Amarillo and having car trouble. I took my car to the garage to be fixed and it's the usual thing, you know. They tell you it will be two hours and you know it will be four or five: What do you do? I can assure you that if you don't have your own personal car in Amarillo, you don't move except on foot.

As a people, we are also reputed to be wasters of energy and undoubtedly, this criticism has some validity. It certainly has validity in our energy usage in transportation. The TV programs, newspapers, the governmental agencies and legislative bodies have been very active in advising motorists of this fact over the past five years and up until the present time, these admonitions have generally fallen on deaf ears. Car pooling schemes have failed miserably and the use of public mass transit has not materially increased. The average American family still prefers the automobile for transportation and uses its car in the manner which provides maximum convenience for the individual. Substantial increases in fuel costs have had little effect on automotive use and largely empty mass transit vehicles, I will remind you, are also wasters of energy.

Frankly, I don't see any immediate change in this situation. I have said facetiously a number of times that I can solve Houston's traffic problems tomorrow if the people of Houston will do what I tell them to do, but I know that there is little likelihood that that is going to happen. New transit systems have been disappointing in most American cities. A wide variety of experimental systems have been tried with government financing and with very limited success in attracting riders. The People Mover System at the Univeristy of West Virginia is in the process of being abandoned. As a matter of fact, it looks like they are going to have a big argument because the Federal government doesn't want to finish it and the University of West Virginia contract says if they don't finish it, they have to tear it down. The San Francisco Bay Area Rapid Transit System, better-known as BART, has been delayed for several years in achieving complete operation and has had many problems. Ridership on the System has not been spectacular.

So the solution to the nation's energy problems, I think, will require a variety of approaches. These will include, first, new finds of oil and gas. I have talked to a good many of my friends who are independent oil operators and these people are optimistic and I believe them. Secondly, increased use of coal, increased use of nuclear energy, development of alternate liquid fuels and completely new sources of energy are currently feasible. Thirdly, there is much to be gained by energy conservation.

It is, of course, in this last area, the area of energy conservation, that substantial contributions can be made by transportation. Hopefully, this conference can shed some light on possible approaches to conservation which can be sold to the people. I want to emphasize that last because unless we can develop an approach

that the people will buy, we really have accomplished nothing. Thank you.

DR. HUDSON: Thank you, Dean Benson. I would like to introduce a gentleman that just came in. He was just a little late. Herbert Woodson is Director of our Center for Energy Studies, one of our cooperating agencies. Thank you.

Our next speaker is my boss. He is an outstanding environmental engineer and a member of the National Academy of Engineering. Since becoming Dean of Engineering in 1970, he has continually supported the increased development of multidisciplinary activities in transportation here at the University. I am proud to present Earnest Gloyna, Dean of Engineering here at the University of Texas.

DEAN GLOYNA: Thank you, Ron. On behalf of the president of our University, Dr. Lorene Rogers, I would like to welcome all visitors to our campus.

We are very happy to have everyone here, and we are certainly glad to see a spirit of cooperation between two fine institutions. Not only is it a real challenge to develop a spirit of cooperation between the various disciplines on each campus, but in this day and time it is absolutely vital to cooperate between our two Universities.

Dean Benson, we are happy to welcome you and your group to Austin. I can truthfully say that Fred and I have never had any difficulty in working out our mutual problems.

Our Council for Advanced Transportation Studies (CATS) has its roots deep in our campus. Starting with our Civil Engineering Program, our Highway Research Center under the guidance of Dr. Lee has been a major contribution to CATS. Today, under our multi-disciplinary program the Council for Advanced Transportation Studies is a college wide effort consisting of about 65 faculty members, 25 disciplines and at least 10 colleges, and our able research director Dr. Ronald Hudson has been an effective leader.

We find that not only is this program developing on its own, but has considerable interaction with other important groups such as the Energy Research Center, the Environmental Engineering Group, the Center for Water Resources and various planning programs.

We find that through these activities, we have been able to develop a spirit of cooperation between colleges like Engineering, the LBJ School of Public Affairs, Business, Natural Sciences, Social Sciences and others. We probably would not have been able to accomplish this cooperation if we tried to do so on a routine academic basis.

However, we have a lot more to do. You people who are here to talk about transportation and energy represent a segment of today's leadership. People talk a lot about energy, and we even joke about Texas becoming an importer of coal. It is a fact that the cities of Amarillo, Austin, and others are going to import coal.

It's also interesting to note that people, including the academic community, have not yet endorsed all forms of energy nor have they endorsed all forms of transportation. As a member of a National Academy of Sciences Committee, I must tell you that we still lack the ability of selling the public on the nuclear programs.

Probably one of our greatest efforts and inputs to society must be that of learning how to work the problem. Our technical problems in transportation and energy utilization, water, use, land development must be translated into solutions. Institutional arrangements must be found which will accommodate the technical answers. Finally, after we at the universities have learned to cope with the problem, we must carry our answers to the public intelligently, and learn to resolve our issues. Then and only then can we really tell the man on the street with confidence, that, "Yes, indeed, society does understand the various problems of transportation and energy."

If we can't do this, we are in real trouble, but I think we can do it. The fact is that we have people on our campus and on A&M's campus, working together. Technical people are working with people who are interested in economics and finance, in human resources, etc. I thank you.

DR. HUDSON: Thank you very much, Dean Gloyna. Our keynote speaker really needs no introduction. He is intensely interested and knowledgeable in affairs of Texas and of energy. He is chairman of the Energy and National Resources Committee of the National Conference of Lt. Governors.

He is also chairman of the Governor's Energy Advisory Council. We are pleased to have with us today the Honorable William Hobby, Lt. Governor of Texas, to discuss "Texas and Energy; Problems and Prospects."

"Texas and Energy: Problems and Prospects"

LT. GOVERNOR HOBBY: Energy has certainly gotten to be a very fashionable subject these days. I did hear an awfully good story the other day that I hope isn't too sacreligious, but very pertinent to our problem.

As you remember, when Moses was leading the Children of Israel out of Egypt and they got to the Red Sea, things looked pretty bad. The Bible says that the Children of Israel were murmuring against Moses and the fact was that Moses was pretty sick of the Children of Israel.

The manna hadn't fallen too good for the last few weeks and the Pillar of Cloud by day wasn't too bright and the Pillar of Fire by night was burning kind of low.

They got to the Red Sea and were pretty discouraged. He stood there on the shore, looked up and said, "Lord, you and I need to have a little talk. I'm going to step right over here behind the burning bush and I need to get some guidance from you."

He said, "Lord, you remember about four years ago, you appeared to me in a dream one night and told me to go out and get some folks organized and when the time came you would tell me when to lead them out of Egypt and into the Promised Land."

The Lord says, "Yes, Moses, I remember. He said, "Lord, I've done all I can and I guess it hasn't been enough because here we are at the doors of the Red Sea.

"You see that big dust cloud over there on the horizon? That is the Egyptian cavalry. They are going to come in here with their swords and their chariots and they are going to kill us all. Lord, what do you want me to do?"

The Lord said, "Moses, I have got good news and I've got bad news. Which do you want first?" Moses said, "Lord, it's been a long time since I have had any good news. Lay the good news on me first."

The Good Lord said, "Moses, when you get through talking, I want you to go over there and stand on the shore of the Red Sea and raise your right arm and wave it from left to right and I am going to roll back the waves of the Red Sea and you can lead the Children of Israel across on dry ground.

"When they are all across and when the Egyptian cavalry is right in the middle of the seabed there, I want you to stand on the far shore of the Red Sea there and raise your right arm and wave it from left to right and I will roll those waves back and drown every Egyptian soldier."

Moses said,"Lord, that's the best news I have heard in a long time. Now, what is the rest of it; what is the bad news?"

"The bad news is, Moses, before I can do that, of course, you are going to have to file an Environmental Impact Statement."

We had a little education last fall on the meaning of energy shortages. We, as a nation—not so much in Texas, we were very fortunate, but even in Texas we had gasoline lines, we had some lay-offs in plants, we had and are continuing to have natural gas curtailments.

We have seen our utility rates double and triple. Again, bear in mind that we got by last year pretty light in Texas compared to the rest of the nation.

The long range shortages are going to threaten the whole economic viability of the nation until we eliminate the long run supply and demand gap.

Our present dependence on the high cost imported oil creates a balance of payments drain that strains the national economy and endangers the very existence of the international monetary system.

These high prices feed the fires of double digit inflation. Our whole country is vulnerable to international blackmail by the OPEC countries. I think our greatest mistake so far in Texas is that we haven't joined OPEC.

Everybody in this room is familiar with the likelihood or probability that energy is going to remain scarce and expensive and become increasingly so in the foreseeable future.

We have been properly scolded for being wasteful and failing to recognize the signs which indicated that a crisis was coming and we have been necessarily prodded into taking energy conservation measures seriously, but the development of a definite program to end the crisis today and prevent crises in the future continues to elude us.

When the embargo hit last fall, the government had to institute emergency measures. We were forced to deal with the crisis on a day to day basis only.

Now, the present supply picture has improved, but the situation could deteriorate very rapidly in the event of another embargo, a coal strike, or of resumed growth of demand or if other unpredictable events come to pass.

Just yesterday evening about four o'clock or five

o'clock, Abe Duckler, whom most of you know, the Executive Director of the Energy Council, and I were talking with a group from Washington called the Futures Group, who were preparing four different scenarios for use in some policy-planning workshops that the Council will be putting on later this fall.

They described, in this telephone conversation, the four scenarios, and the man who is doing this work for the Futures Group said,"Now, we have some other possible events that we haven't included in these scenarios because we think that they have a very low range of predictability."

I asked him what were some of these other events that affect the whole picture that have such a low range of probability. One of them named as having a low range of probability was the possibility of another Middle Eastern war.

I said, "Well, of course we are going to have another Middle East war. I don't know whether it will be two months from now or two years from now or five years from now, but there hasn't been a time in history when we weren't going to have another Middle Eastern war, and I really see no reason why the 1970's and 1980's should be any different from the 1950's or 1960's or the 1850's or 1860's or whatever."

So, of course, that source is going to be cut off in the future. We all know that. Our domestic production of oil and gas is declining. According to the Federal Energy Administration, our crude production in 1974 is 150,000 barrels a day less than it was in 1973, and 400,000 barrels a day less than in 1972.

Even with accelerated development programs of more exploration, secondary and tertiary recovery, and so forth, it's hard to see how we can reach current levels of production again before 1980.

The rate of exploration and discovery of natural gas, as you all know, has been declining ever since the 1950's. Coal production can't be increased significantly without fast capital investment and environmental costs.

Nuclear energy isn't making up the deficit because of incredible regulatory lags and insufficient capital.

We can no longer rely on emergency measures. The time has come, I think, to investigate the basic causes. The State of Texas, through the Governor's Energy Advisory Council, is now in the final stages of an 18 month policy study costing about a million and a quarter dollars.

By January, we will have recommendations about the proper direction for State energy policy to take. We can't do the job alone; the State can't do the job alone. We need a coherent national effort.

The Federal government must initiate a single coordinated national policy dedicated to the goal of reducing dependence on foreign sources to an acceptable level.

What are the basic elements of a policy like this? First of all, we have to change our patterns of energy consumption to improve the efficiency of our use of energy.

Second, we have to accelerate the development of domestic sources while maintaining and improving our environment.

Third, we must prepare standby procedures to govern the period prior to achieving essential self-sufficiency to make us less vulnerable to political and economical pressure.

The most neglected issue and, yet, the most important to achieving self-sufficiency is conservation. We need more efficient modes of transportation. Industry, the consumer, all of us, must economize. The financial structure of our utilities must be improved while encouraging industry and efficiency.

Judge Langdon, the Chairman of the Railroad Commission, advances the thought—and I think a very good one—that it may be necessary for us to go to a reconstruction finance corporation type of economic organization to insure the captial needs of energy production. I have seen some projections that show it may reach one trillion dollars by 1990 or 1995.

We have to allocate our energy supply to the areas where we get the greatest benefit, according to the particular qualities of each type of fuel. Texas is willing to insure adequate supplies of natural gas for its highest BTU use or for other necessities, but we can only make this contribution if we are given sufficient time and assistance to make the conversions.

The growth and demand in this decade will require a corresponding growth in reliance on imports, but conservation still draws only a small share of the manpower of financial resources of the government's energy program. Conservation programs must be given equal billing to increasing domestic supply.

We need to remove all artificial impediments to production and the number one item to go should be price controls. Secondary and tertiary methods can yield significant increases in the production of oil from existing fields, but these methods are costly. A one per cent increase in the ultimate recovery from known

Texas fields alone would provide one and a half billion more barrels of oil or more than this state's entire production in 1973.

Now, without action to stimulate production, we may not again produce as much as we are now producing until late in the next decade.

We need to produce more oil and gas, at least for the next decade or two, until coal, nuclear and other sources can develop better technology. This production will require enormous amounts of capital to compete for the manpower and equipment that will be needed.

Our industries and utilities in Texas are very dependent on natural gas after 20 years of prices being artificially depressed by the Federal Power Commission. To allow interstate purchasers to mix cheap-flowing gas with new unregulated gas gives interstate purchasers an unfair advantage. Our State's economy must be given time to adjust to the higher costs of gas and to amortize the cost of conversion to substitute fuels. We are willing to compete for fuels, but we can't accept a position that does not let us compete on an equal footing with other consumers.

The Federal government needs to expand the leasing of off-shore tracts as soon as possible. The Atlantic and Pacific coasts must share the burden of producing energy because they share the benefits. These are our best remaining reserves. The East Coast should be forced to allow refinery production or it should not be allocated by government fiat domestic oil and gas. Those non-producing areas that are potential producers presently enjoy the exploitation of Texas' natural resources.

Tax policy should not be manipulated so as to hamper the industry's ability to generate capital for investment. If the depletion allowance is to be removed, we have to remove price controls so that exploration costs can be recouped.

I whole heartedly endorse proposals to remove allocation controls as soon as feasible so that we can distribute supplies more efficiently and more quickly.

The Federal government needs to realign its priorities for research and development spending. Secondary and tertiary recovery can significantly increase our known domestic supplies. Coal gasification and liquefaction are essential to the utilization of our most abundant fuel within our environmental restrictions.

Research in these areas should be funded at least on parity with research into nuclear, solar and other exotic sources. Undoubtedly, as we begin to implement whatever program is finally adopted, we will encounter programs peculiar to the interim period.

We will continue to need substantial amounts of imported crude through 1980. This doesn't mean that we have to be vulnerable to blackmail. Storage capacity could be expanded rapidly to provide a buffer against the effects of another embargo.

Even if we remove allocation controls, we should prepare contingency plans that can insure distribution of supplies across the nation during such shortages.

Such planning, however, should include the provision that we are making a total national effort to provide domestic supplies.

Forty-four states cannot expect to drain a mere handful of states of their resources while making no effort to develop their own potential, to build refineries and pipelines, to drill in their coastal waters, and to mine their coal.

Texas, Louisiana and Alaska can't supply the whole country. This effort requires the dedication of the entire nation, the Federal government, all 50 state governments, business, labor and all individuals.

Project Independence must be a national commitment by all sectors of this great country to be more energy conscious, more energy productive, more energy efficient.

We have to do it together. The State of Texas is working very hard to do what it can. Even with controlled prices, we are producing at 100 per cent capacity and drilling for oil and gas at record rates.

We have been leasing thousands of acres of State-owned land. The work of the Governor's Energy Advisory Council is the best policy planning going on anywhere in the United States.

I don't know what the Council will finally decide, but I would like to mention some of the options that Texas certainly is going to have to consider.

First, we have to strive to save every possible BTU that we can; slower speeds, lower thermostats are just the start. The State needs to improve building codes, to require more insulation, revamp zoning laws to encourage more efficient building.

Utility rate structures should be flattened so that industries and businesses pay their fair share of the cost of the energy and are encouraged to conserve.

We have to insure that our resources are reserved for their most beneficial uses. We are going to have to, in my opinion, prohibit or, at least, severely restrict the

use of natural gas as a boiler fuel, but we have to give industries and utilities adequate time and assistance to convert so that the cost can be properly amortized and absorbed.

More efficient modes of transportation need to be developed by addressing the total regional needs of our metropolitan areas and this State must update its own energy planning.

We need accurate, accessible and up-to-date information about supply and demand. We need to initiate power plant siting procedures so that we can locate sites in advance of when they are needed for construction and in time to allow active citizen participation in the decision.

We need to regulate strip mining and superports so that our environment is adequately protected while we utilize these resources.

Third, we must try to convince the Federal government that the need for realistic energy policy is a very pressing one. We are straining to produce oil and gas to control prices while our consumers pay higher prices to subsidize the consumers in New York and Maryland.

Maybe we should consider giving the Railroad Commission the authority to lower the prorationing allowables so as to restrict production until producers can get a fair price.

This protects our local diminishing economic resources and pressures the Federal government to formulate the kind of national Federal policy that we need.

Our policies of leasing State-owned land should be re-evaluated. Price controls on State royalties are costing our available university and school funds over $28 million this year.

This equals the State's share of the costs of educating 48,000 school children. Maybe we ought to stop leasing until we get a firm return. Producing at depressed prices is wasting this asset which is constitutionally dedicated to the school systems of Texas.

We must also explore possible mechanisms for using State-owned oil and gas for our local needs in times of emergency. Some of these are pretty extreme measures, but we are facing pretty extreme problems.

Texas is willing to bear its fair share of the burden. We are willing to economize, but only if it is part of a total national effort. We cannot afford to sacrifice our own interests while the Northeast tries to get the energy at controlled prices and without the environmental costs.

I am not going to sit idly by while the consumers and producers and taxpayers of this state are abused. I think the duty of State government requires strong action to protect the interests of the people of this state. Thank you very much.

DR, HUDSON: Thank you very much. Governor Hobby, will you receive a few questions if there are any?

LT. GOVERNOR HOBBY: Certainly.

DR. HUDSON: If you have a question, please rise, give your name and affiliation in order that our reporter can get them down properly.

DEAN GLOYNA: I want to comment that I certainly agree with everything you said. The question is, how can the State of Texas effectively start getting the East Coast to react and do something in time?

LT. GOVERNOR HOBBY: I don't know that we can, but I think that we ought to press our case before the National Congress and before the Federal administrative agencies a good deal more forcefully and effectively than we have.

That would certainly be one of the recommendations that the Energy Council will make to the Governor next December or in January. The consuming states, particularly the Northeastern states and the upper tier of Midwestern states have done an infinitely more effective job of lobbying, particularly first the Treasury and then the Federal Energy Office and now the Federal Energy Administration, than the producing states, particularly Texas.

Just to cite one example of the kind of lobbying that I am talking about, Bill Johnson, for a couple of years, was Simon's principal assistant—first when he was Assistant Secretary and then when he moved over as Assistant Administrator to the Federal Energy Administration.

He told me that at the strong insistence for example, of senators from the New England states, Simon met once a week with the New England Caucus, an organization of House members and senators from the New England states.

Johnson said the only time he had ever laid eyes on either of our two senators was when he went up to the Hill for a hearing on something or other.

We have been, far too much, nice guys in this area. Now, Louisiana has—beginning the first of this year—

begun to mount a very effective effort in the area of Washington representation, an area where the interest of State governments are represented.

We need to do a good deal more in that area. We need to give a lot of thought to tax policy. We, in effect, now are taxing it at the pump. There has been consideration, as you know, given to taxing it at the refinery which would be an improvement.

Why not go farther back up stream, though, and levy more of our taxing effort where it comes out of the ground. We produce about 38 per cent of all of the oil and gas produced in the continental United States.

We only refine about a quarter of it. Of course, we can refine a considerable amount of that which is imported, as well. As you know, Dean Gloyna, the Legislature in the last 30 years has made, I think it is, three different efforts to tax interstate oil and gas as opposed to intrastate.

Each of those efforts has been struck down as violating Interstate Commerce laws and the Constitution. Maybe it's time to stop worrying about a difference that we apparently cannot constitutionally make anyway and get more of our resources from this, what is after all a dwindling State asset, a wasted asset that will probably last until about the end of this century and then we will have to go on to other things.

DR. HUDSON: Governor, I see in the morning paper—and I didn't have long to look at it—that the University of Houston Energy Report is out and says we are going to be— What does it say, Fred?

DEAN BENSON: A net importer of energy by 1985.

DR. HUDSON: Do you have any comments on that?

LT. GOVERNOR HOBBY: Yes. As you know, that is a very standard kind of forecast, that most people who make those forecasts show curves crossing some time in the 1980's, but they never say where we are going to import it from.

That is the aspect of the question that worries me; where are we going to get it?

GENERAL ROSE: I have one question I would like to get Governor Hobby's view on and that is, how effective he thinks ERDA will be. I think one of the most pressing problems in this country is to get the resources going, financial resources, for the research and development that has to be done to bring on new sources of fuel.

I think speeding that up is very critical to all of us, and very essential. Of course, ERDA is just getting started and I would like to hear a little discussion about what Bill thinks about that and the shift of a lot of the power to the Interior.

LT. GOVERNOR HOBBY: Jim, I certainly agree that the emphasis on research and development that President Nixon started talking about about a year and a half ago—which Congress is being very slow to move on—is very much needed.

I hope that ERDA will administer those funds in a very careful fashion. I think the job of administration of those funds that the National Science Foundation has done has been excellent.

As it happens, just before I left my office to come over here this morning, Dr. Hackerman was in to talk about another matter. Of course, he has just recently been elected Chairman of the Board of the National Science Foundation and he was extremely complimentary about the Council's work.

It was the cooperative aspect of it. Just as this conference celebrates a cooperation in this area between two great State universities, so this council includes not only the principal universities of the state, the private sector, State agencies, the Governor's Office, Air Control Board, Water Quality Board, the Railroad Commission, the Attorney General's Office, the General Land Office.

It's a harmonization of all of these different resources. I think if we continue along these lines, we are going to get a good share of our ERDA money right here in this state.

GENERAL ROSE: Well, as a comment, I returned last night from a three-day national meeting of energy advisors for all of the state and we had representation there, of course, from the Federal agencies.

I think it is important to this group to pass on—I think you would like to know—that the work your council is doing received very high marks at that three-day technical discussion across the country about what's going on, what should be done and what can be done.

Of course, a great deal of concern was expressed about getting those resources on out and about using the expertise of the universities and of industry and government, State and local, and the interchange of

talent and personnel on more or less an inter-governmental concept of shifting expertise on loan or an exchange basis up and down the scheme of things to get the talent employed.

I think it might be interesting to this group, or I would like to hear our reaction—since we are on the University of Texas campus and talking to experts—about their idea about exchanging people from the University with people from the Federal and State government up and down the line as well as with industry to coordinate and move information.

That seems to be the technical problem we have been dealing with during the last three days: how to communicate and get all the good ideas and developments into play. I would like to get a reaction on that interchange of people.

DR. HUDSON: Thank you. Earnest, would you care to respond to General Rose on this exchange of people?

DR. GLOYNA: I think that's absolutely necessary; just as we are trying to establish inter-disciplinary programs throughout the University and inter-University, it's just as important to have that type of relationship with government and industry both.

We have a little problem. The problem is lead time and compensation. By compensation, I am talking about salaries. The biggest problem, I think, is trying to develop sufficient lead time so that we can take the few faculty that we have in the University who are very capable of making this transition.

We have to get the opportunity to work their plans into this type of interaction. I think we need to do a little planning in terms of budgeting for this type of activity.

At the present time, we do not have that flexibility in our budget-making operations.

DEAN BENSON: I agree with Dr. Gloyna. The problem that we have here is shaking the people loose quite often from jobs that they are pretty well committed to for these sorts of things.

Just to give you an example, the Governor called us in connection with the studies of the speed limit controls and asked us to give him some information on the energy savings at various levels of speed.

We agreed and took this job on and I think did a reasonable job for him. We estimate that this cost something like $50,000. That $50,000 came out of my budget. I had to find it because there was no money given to us for this and, really, a fair part of it we took out of our people's hides. We just said, "You guys have to work overtime until we get this done," and we doggone nearly had a revolution in one area after they had been on this for some time.

You can do these things this way a few times. if you continue on this pattern, you get to the point where your people are really not very happy, so we have to know what the needs are.

If we can get some feel for this ahead of time, I think there is no problem. Certainly, at our place and the University of Texas, we are willing to give the State government any help that we reasonably can.

If it is in the matter of an emergency, we are willing to do it on short notice and ask our people to work overtime to get this done, but we don't think we should be asked to do that on a continuing basis because we think we have to have some knowledge of what to expect.

I'd like to ask Governor Hobby a question. At the Project Independence hearings in Houston, the independent oil operators brought up the fact that they are having problems with tubular goods, with drill stems, with repairs for the drilling rigs, with crews and that nobody seemed to be much interested in helping them out; that they are not asking for grants or financial handouts, they were just asking for the opportunity, generally, to buy these things.

Is there anything the State government can do to help this group? Obviously, until we drill holes in the ground, we are not going to find oil and gas.

LT. GOVERNOR HOBBY: I believe I heard some of that same testimony, of course, and I've heard it many times before. I don't know honestly of anything the State per se can do to relieve the shortage of pipes and drilling rigs, that sort of things.

At that same hearing, Dean, you may have heard the testimony from Mike Halbouty who made what seems to me to be a very sound suggestion, that the Federal government change its off-shore leasing policy to allow competitive bidding on royalty percentages rather than on bonus payments to give the independents a better shot at this.

As all or most of you know, at the last lease sale that the Land Office held, they changed their leasing procedures in this direction. They raised the minimum bid on royalties to a fifth, but allowed competitive bidding

both on royalty percentage and on lease-bonus payments.

I believe there was one small piece of land in South Texas somewhere where the royalty bid was 95 per cent. There is no question that that is going to result in, I think, increased incentive to drill and probably increased earnings for the State, as well.

This is a move in a direction that would help the independents, because it reduces the front-end capital.

DR. HUDSON: Would anyone else like to respond on this matter of exchange between the universities and State and Federal agencies? We have people from several levels of university involvement.

DEAN GLOYNA: Just to follow up on the concept of budgeting, universities, of course, receive most of their budgets through their teaching programs, but this is not the way you can interact effectively in this area.

It is going to have to come through types of centers, the types of institutes and things like this that we are seeing working today.

These are going to have to be funded. In all probability, they are going to have to be funded on the basis of a line item and you are going to have to respond to this effectively in State government.

GENERAL ROSE: I was interested in getting that reaction from the standpoint also as to the feasibility of maybe this could be a Federal-State package to offset some of the financial costs, maybe through ERDA itself as a very necessary thing that must be done in the country to bring expertise into play.

These two universities, of course, earned high marks for the work they are doing. There was a great deal of discussion of not just the energy subject as it relates to sources of fuel, but to the relationships of transportation, of water, human resources, the whole bit.

I think that is something that is very critical for us to work on: how we can get the expertise into the right place at the Federal level as well as State government level and a cross section of industry and university expertise. I was interested in getting that discussed here.

DEAN BENSON: Well, of course, one thing I think we are going to have to take a look at is that we have a tendency to disjoint these problems from each other and say there is no relationship.

My personal opinion is that in the long range in Texas our biggest problem is going to be water. Water is tied to energy and vice versa.

I really think that we have to take a look, essentially, from the viewpoint of the State, at water, energy, land and food, in the long run, and we have to begin to try to tie these things together and see what the interactions are and see what our overall posture needs to be to do the best job we can for the future citizens of the state.

I just don't see any answer to the water problem in Texas right now; I frankly don't.

GENERAL ROSE: And capitalization for industry and business to do whatever they have to do to get it done.

DR HUDSON: The other aspect you mentioned, Jim, I would like to respond to just briefly, the business of exchange which you mentioned, of short term response.

Group response is one thing and a very important thing that Dean Gloyna and Dean Benson have responded to. The other business of exchange is where university people could spend a year with the Federal, State or local government and vice versa.

There is a great deal of interest. The mechanism by which this can be done is not clear in many cases. There are certain kinds of implementing mechanisms, but the red tape is restricting the matter.

It is very difficult for a young man or a young woman with two or three years in teaching to move smoothly for a year into government and back because it isn't easy to work it out, but it is certainly something we have to get together and work on because there are a great many of these people that are interested in exchanging.

The other way that some people have worked on this is in summer programs. Some of our people are quite interested in working on the basis of summer programs with Federal and State governments.

We have time for about one more question if there is one.

MR. THOMAS: Governor Hobby, would you give us a one word answer as to whether or not an emergency energy crisis really exists in your opinion?

LT. GOVERNOR HOBBY: Yes.

MR. BENSON: On this business of interchange of people, one idea that has occurred to me—I've never

really pursued it yet with our Administration—is the possibility of tying this into the University sabbatical system.

If we can work out a system where we might pay the salary differentials or that sort of thing for people to go into the State government where they can be helpful, then I think that we could get a whole lot more movement than we have right now.

One of the problems is the guy moving. His family is here and his kids are in school and he doesn't want to go to Amarillo or even to Austin, if he lives in College Station.

I can understand these positions, so, some way or another, we have to make it desirable for him to do this. This, I think, is the side of the equation that we have to work on from the standpoint of people transfer.

GENERAL ROSE: Dr. Hudson, would you think that the FBA Intergovernmental Personnel Act needs to be revised to accommodate this more? Is that what you are referring to?

DR. HUDSON: I think what we need to do is get together, people like you and Jack Keese, and actually work through it one time. It may very well have in it the mechanism—

There is a difference in having that act on the shelf and having the mechanism worked out by which the red tape is easy to handle. I think perhaps we ought to do that.

I would certainly be interested in sitting down with you and talking about this thing.

DR. KEESE: Jim, I think probably, in the short range, while this other is being worked out, recognizing the problems that are on board, that the mechanisms exist today to utilize the resources of the universities to a greater extent than they are now being used just simply by closer interaction with the government. I think we can do a great deal more than we are doing.

GENERAL ROSE: But I think as a key point—at the meeting I just left, there is a clear, strong feeling and it is recognized by at least all the energy advisors of the governors around this country, this was a National Governor's Conference, that Texas is definitely in a leadership role, as Bill said.

The work we have done here in conservation, in the Energy Council, and in the University system is recognized by consumer states and producer states alike. I am concerned and interested in seeing some of this expertise get into the Federal system. So it may be utilized as far as resolving some of the problems of the country.

How can we get some sharp University of Houston, University of Texas people and people from business and industry who are doing this work and have this expertise in all these fields interchanged at the Federal level up and down the line into some of those Federal agencies that are going to be working on some of these problems at the national level.

DEAN GLOYNA: I must make a point of clarification here. It's a fact that there is more cooperation between the universities and State government today than there ever has been and there is an eagerness among the universities and the State government people to see this thing become more realistic.

It's also a fact of life that many of the interactions that we have seen in the past have come out of the hides, the budgetary hides, of the deans and presidents of these universities.

That cannot continue to exist. We do have several ways that we can approach this problem. One is through the various centers and institutes and this is an important route.

It is one that we must expand. Another route is what Dean Benson has suggested; this business of sabbaticals, for leave whereby the university can plan ahead and permit their people to participate with government and industry.

The fact is, we have no sabbatical policy in Texas. We are not quite up to par with some of our other major sister institutions around this country. We would be very happy to bring this into effect.

DR. HUDSON: One final thing on this point. There is a very strong working relationship in the transportation field between the Texas Highway Department, the Texas Transportation Institute and the Center for Highway Research.

We might look at this relationship as a working mechanism. Mr. DeBerry is here and he can speak for himself, but I believe that system is working very well.

It endures and I think on that basis that it does do a good job, as it has proved.

DR. BURNETT: I would just like to say that one of the problems I see in liaising with industry, which many

Mr. Al Glascock, Governor's Office of Planning and Coordination, and Dr. Pat Burnett, Department of Geography-UT Austin, listening to keynote address.

faculty members face, is the differential reward system between departments given to faculty members who are interested in that.

I would say, in Engineering it's an acceptable fact that it is desirable to liaise with business and government.

Within my own discipline and other social science disciplines this is not yet fully accepted, so one is caught in a crunch between one's professional obligations and one's own desires to do the liaising.

I think this is a very genuine problem from the point of view of the university faculty member. Maybe in your round table discussions you should perhaps consider that.

DR. HUDSON: That's very good. Thank you. I might say that—

FROM THE FLOOR: Could you summarize that statement?

DR. HUDSON: Pat said that one of the real problems that is faced is the differential attitudes or treatment within departments across a broad university—she's in Geography—that some of the attitudes in these disciplines is not conducive to this type of professional development and professional interaction at the industry and governmental level. Is that a reasonable summary, Pat, of what you said?

DR. BURNETT: Yes, and this is a general problem in trying to arrange the kind of interchanges you are suggesting; especially getting input from circles which, I think, most industry and government people these days do look for.

DR. HUDSON: I think we might say we attracted Pat from the General Motors Research Laboratories to the University here. She is in the Geography Department, but she is working very closely with us in the Council for Advanced Transportation Studies and it is through this kind of a mechanism that Dean Gloyna said that we hope to help bridge this gap.

Of course, we all have our own internal budgetary problems, but it does come down to budget. If we can increase our budget to support a larger portion of her salary, then we could help implement that kind of thing more quickly and better.

LT. GOVERNOR HOBBY: I would like to say that the University person with whom I have worked most closely over the years on State problems of various sorts, from welfare to educational finance, has been a geographer at the University of Houston.

DR. BURNETT: Maybe there is a variation between departments.

LT. GOVERNOR HOBBY: Perhaps that's so.

DR. HUDSON: I hate to cut this very interesting discussion off, but we do need to move on to the next portion of our program. Governor Hobby, we certainly appreciate your contribution here.

As you can tell from the intensive discussion that has followed, the group did. We know you have a busy schedule and if you find it necessary to slip out on us during the morning, we will certainly understand. Thank you very much.

DR. HUDSON: Our next speaker represents a large segment of transportation in Texas, by far the largest segment. He is a distinguished Engineering graduate of the University of Texas.

He is an active member of the American Society of Civil Engineers, the American Association of State Highway and Transportation Officials. He is also an outstanding citizen of the state of Texas.

It is my pleasure to present Luther DeBerry, the State Highway Engineer of Texas, to discuss "Transportation and Energy Issues."

"Transportation and Energy Issues"

MR. DeBERRY: Thank you, Ron. Dean Benson, Dean Gloyna, Walter, ladies and gentlemen, I am really honored to have a part in this conference today. I wish I felt confident that I had answers to solve all the problems we have in energy and transportation.

Of course, you know as well as I do that I do not have these answers and I don't believe they are readily available on a short term basis.

This will require a long term solution and it will not happen overnight. But that doesn't keep us from moving on and beginning the process and keeping a constant vigilance on some type of solution to it.

It seems fitting that two great universities should join to explore two of the most important factors involved in the lives of all Texans; energy and transportation.

If energy and transportation can be considered as twin issues, they must be considered as Siamese twins. They are inseparable. You can't really have one without the other and you can't have much of anything else without both of them.

Some very hard, real world factors should form the backdrop for exploration of these important issues. In the field of transportation, we have been offered some rather futuristic solutions to our problems, especially in the field of personal urban transportation that Dean Benson discussed.

Many of these proposed transportation systems assume the use of technologies that exist only in theoretical or experimental forms. They will be many years in becoming realities and some, perhaps, will never get off the drawing board.

Others, while technically feasible, are prohibitively expensive. Some existing systems provide little real service to the total community. I am thinking of certain rapid rail systems that primarily bring well-heeled commuters from the suburbs to the offices downtown, passing through innercity neighborhoods without providing those residents with much real transportation service.

In my view, Texas, with few exceptions, will continue to depend heavily on rubber-tired vehicles operating over rural and urban road systems.

Only the streets and highways and the motor vehicle provide a go-anywhere flexibility that will provide for the movement of people, goods and raw materials in a state like Texas with its long distances and low population density metropolitan areas.

At this time, there is no real alternative to the road-motor vehicle combination which will serve so many transportation needs so well. In the last analysis, it is difficult to really separate the impact of rural and urban roads.

An urban resident may think he has a small stake in rural roads until he goes to the supermarket to buy his week's groceries. Most of these products came to the city over a rural road.

On the other hand, one of the real transportation and energy problems facing us today is that of urban traffic congestion. It is true that we have problems in our urban area, but they are problems that can be met with realistic and efficient solutions.

The much maligned freeways are helping a great deal and there are many applications for public transportation that are yet to be fully developed. Freeways move large volumes of traffic more safely and more efficiently than conventional street networks.

Just imagine the chaos that would exist on conventional street patterns if freeways didn't presently exist. In most of our urban areas, freeways operate smoothly for 20 hours a day.

It's just in the morning and the evening rush hour periods that there is any real congestion. Some recent studies in Houston show that the average occupancy of cars on the freeway is only one and two-tenths persons.

Of course, this occupancy must be increased. Clearly, such things as carpooling, and park-and-ride bus services would serve to smooth out the traffic flow and save gasoline.

President Ford appears to be quite serious in calling for auto makers to design for a 40 per cent increase in gasoline mileage efficiency. This probably translates into smaller cars in the not too distant future.

Smaller cars occupy less road space and this, too, will help some in increasing the efficiency of our traffic facilities. Meanwhile, the states and cities can turn more and more of their efforts toward what could be called "loading" and "unloading" the freeways and the arterial street systems.

Think of the freeway as a large garden hose and the street network as a small bucket. Then, imagine directing the full stream of water from the hose into the bucket.

I think you can see what I mean about the problem of

unloading the freeways. Obviously, we will have to increase the capacity of that hypothetical bucket which is our street network and there are many useful remedies at hand for doing just that.

Such a realistic urban road program will encompass such things as widening some arterial streets where possible and, in some cases, the separation of grades at intersections, channelization, and providing turning lanes and other useful and relatively inexpensive means of smoothing out our traffic flow.

One-way street systems provide better traffic service and safety, especially where on-street parking is concerned. Revision of entrance and exit ramps of older freeway facilities will provide further relief in some cases; as will special bus ramps and similar types of operations.

All of these things are possible, feasible and could be made affordable in the near future. Also, there are improvements to the urban road systems that fit in beautifully with transportation systems providing circulation of traffic within an urban core area. Los Angeles has had an interesting experience with such a system.

Small energy-conserving buses circulate through the innercity areas, fed from parking facilities around the fringe of the core areas. Some motorists caught on to the idea of parking on the fringe and taking this bus system almost on their own, even before the official fringe parking areas were approved.

All of these relatively simple steps I have mentioned will provide better transportation and conserve energy in the near future. In the meantime, there are some continuing concerns that we in the highway transportation field share.

The first of these is safety. Our new roads have safety built into them. You have heard of the decrease of the total number of traffic fatalities since the lowering of speed limits and the urging of curtailed driving were instituted about a year ago.

For several years, however, fatalities in relation to the number of miles driven have been decreasing. This is due to such things as better driver education, the use of seat belts, and improvements in vehicle design.

It's also due to safety improvements on the highways, including wider and smoother surfaces, better grades and alignment and a number of innovations aimed at making crashes less lethal.

These include breakaway signs, and light supports and crash cushions. But, even one fatality is too many and one of the best safety measures possible is the reconstruction of old near-obsolete roads and highways, of which Texas has many miles.

We have a huge, unmet backlog of needs, most of which is reconstruction and the modernizing of old routes. We are not trying to pave the whole country; we simply want to provide good facilities on the travel corridors that already exist.

These needs are real and improvements are actively sought by local people, for the most part. Currently, we have a backlog of some $350 million worth of plans on the shelf waiting for financing on this type of facility.

Now, there never really has been an abundance of money available for highways. With impoundments and withholding on the Federal level—with the enormous increase in costs due to higher standards and soaring prices for the materials we use, we are falling farther and farther behind. We simply cannot continue to provide and maintain modern, adequate roads and streets to meet the needs of the State with the funding now available.

Along the same lines, inflation has sent maintenance costs sky-high. Maintenance is very closely related to safety and the convenience of the movement for people and goods and in directly related to the conservation of energy.

It also is related to protecting the large public investment in the highway system. In Texas, we have spent over $8 billion in the construction and maintenance of our highways since the Highway Department was established in 1917.

At today's prices, we estimate it would cost almost $33 billion to reproduce the system we have now. Considering that astronomical replacement cost, we cannot allow the highway system to decay and deteriorate.

One has only to look at the condition of many of the nation's railroads to see what happens when maintenance is deferred. On Eastern railroads, there are some sections of the track in such poor shape that trains operate over them under an eight mile per hour speed limit.

A government estimate says it would cost $5.8 billion to replace rails and ties alone. In short, it would take billions of dollars to rehabilitate the nation's railroads.

With many energy users switching to coal, it will be the railroads that will carry the increased coal production. We simply cannot let the highways go the same way that some of the railroads have gone.

Already, maintenance and operation of the highway

system claims more than half of the State dollars available to the Highway Department. It is conceivable that with the railroads more occupied with hauling coal, some freight now being transported by train could be transferred to trucks.

President Ford has called for the end of oil use to fuel power plants by 1980. Although some experts say it can't be done that quickly, some plants undoubtedly will convert to coal.

Nuclear plants are coming on more slowly, according to the Wall Street Journal, because of financing problems. These problems have forced utilities to defer construction of 15 plants nationwide.

Conversion to coal has some environmental hurdles to clear. Expensive scrubbing equipment is necessary because of the lack of low sulphur coal in most areas of the country.

If vast, low sulphur coal deposits in the Western states are allowed to be strip mined, then there will be a tremendous burden placed upon the railroad and other modes of transportation for means of getting the coal to major power stations in the more populous East and Northeast.

This points toward eventual re-allocation of energy to meet long term needs. Although gasoline and other fuel used in transportation are the most visible primary energy sources, transportation accounts for only 24 per cent of the total energy market. Electrical utilities account for slightly more of the market, approximately 25 per cent.

The remainder is divided among industrial uses, which use the biggest share, at 32 per cent, smaller portions for commercial and residential uses.

Of that 24 per cent of the energy market used in transportation, more than half—about 55 per cent—is used by automobiles, which is about 13 per cent of the grand total.

Trucks and buses use 22 per cent and the remainder is used by aircraft, in farm machinery and off-road vehicles, ships and boats and railroads. Increased use of trucks to move freight, especially agriculture produce, will make larger demands upon the energy supply.

Further, there is a continuing movement to disperse industries and population, made possible largely by good transportation over the country. There will be a greater movement of more people, more raw material and more finished products, even with expensive energy.

Unless someone comes up with some magical magnetically powered motor, the internal combustion engine will propel this increased traffic over the streets and the highways.

This will make for an increased demand for motor fuels, even with smaller cars, more efficient engines and efforts to curtail private automobile use in non-essential trips.

The only way to provide for these demands is to channel the fuels and other energy sources to the most appropriate users. In the long run, we must turn to nuclear energy for utility and industrial uses and reserve our finite supplies of fossil fuels for transportation.

This transfer is a logical way of making necessary reductions in oil consumption and bringing the nation closer to energy self-sufficiency. Such a transfer will be expensive, but so are all of the other less desirable alternatives.

Some alternatives could be expensive in other than monetary ways. Social planners already are trading on the still rather mild hysteria of the energy situation to sell expensive and unnecessary schemes such as some impractical mass transit systems.

Some alternatives require an almost total revision of the average American's life style to make them work. The single family home on its own piece of ground, that most Texans obviously prefer, would have to give way to high-rise housing blocks.

Otherwise, population densities would not be sufficient to make such transportation systems practical. Freedom of mobility, including the individual's ability to seek job and education opportunities in a wide area would be hampered, but with all our problems in transportation and energy, I don't believe we are that desperate now.

Through the efforts of logical, practical men and women, we can find real world solutions to our very real problems. Thank you.

DR. HUDSON: Thank you, Mr. DeBerry. Would you be willing to field a few questions, if there are some?

MR. DeBERRY: Of course.

MRS. FRUCHT: Mr. DeBerry, aren't you afraid with your huge garden hose that there won't be any garden left to water?

MR. DeBERRY: I don't quite understand what you are talking about.

MRS. FRUCHT: If you keep widening the street, centering everything around the freeways, there just won't be any garden left to water.

MR. DeBERRY: Well, less than one per cent of the total area is in the streets, highways and alleys of the State of Texas.

DEAN BENSON: That, of course, is a standard cliche of the opponents to continued development of the highway system. The fact of the matter is that it has little real validity.

The number of miles that we have of streets and highways in this country today is essentially no different than it was nearly 100 years ago and the amount of land involved is essentially no different than it was 100 years ago.

Man has always required arteries for commerce and for movement, even when he did all his movement by walking or riding a horse.

GENERAL ROSE: As you recall, this state passed the speed limit ahead of the Federal action in the interest of conservation of energy resources. Lloyd Benson is on or chaired the Sub-Committee, I forget which, but they have pursued this very hard, and there has been a great deal of action to get this done.

MR. DeBERRY: I might add one thing. The American Association of State Highway Officials with the approval of over 37 states, which is required on any policy procedure, is recommending an increase in truck weights: 18,000 pounds for single axle to 20,000 and 34,000 tandem which is probably sort of a compromise between what it is now and what some of the industry would like to have.

DR. DAVIES: I would like to address one question to Mr. DeBerry. You mentioned gasoline shortages and you mentioned the failure of solving congestion: Do you think that non-capital solutions such as setting aside bus lanes, staggered working hours or changing of zoning ordinances within the cities, would have an impact upon this topic?

MR. DeBERRY: I think it would have a very certain impact—working hours and certain types of ordinances. The exotic type operations may work fine in the long term, if the people are willing to ride them, but even the best estimate of the people developing these is seven per cent of that peak hour traffic.

That won't keep up with the increase. We have to have some other solutions, not that alone, because that isn't the ultimate solution.

DEAN BENSON: Our problem with the sort of solutions you are suggesting, which I think are the most practical of all, is that we haven't been albe to sell this to the American people.

I don't know how you do this, but you people in the social sciences are always wanting to help us out and people are supposed to be your problem.

Now, maybe you ought to tell us how we sell some of these things that seem perfectly sensible to us to the people. We don't know, frankly. Well, I would like to say that we are trying.

DR. HUDSON: Well, Dr. Davies is working very closely in this area with our Council and he is trying right in that very area.

MR. KIRK: Just a comment before my question. In talking about selling the American people, you know, someone mentioned earlier the love affair of the American people for the automobile.

I don't think we are going to sell them on getting out of an automobile. I think this is going to take some compulsory measures. Mr. DeBerry raised a lot of questions in my mind.

I agree with much of what he said and the gentleman back here, but I wonder what percentage of petroleum resources or what percentage of the use of petroleum in this country is associated with transportation; I'm sure that has been developed.

Then, I wonder what part the use of the private automobile in going to and from work and commuting plays in this total picture and, also, if there have been any estimates on the reducible part of that.

I certainly agree with Mr. DeBerry about the rail transit—mass transit thing. I don't really see that as feasible because it is an inflexible thing.

I can see, though, the use of buses. I don't think we are using them—they may have to be subsidized and all that, but has any work been done in the area of estimating the reduction of the use of automobiles through the use of buses or, perhaps, more efficient forms of transportation, raising the truck limits and that sort of thing?

MR. DeBERRY: I think some work is being done on it. Of course, you ask what percentage. According to the figures we have, the transportation field, all forms of transportation, uses 24 per cent of the petroleum, the energy in this country.

Of that 24 percent, the automobile uses about 55 of the 24. That would be back down to about 13 per cent overall.

MR. BRIDGES: We use about 25 per cent of the total energy and that works out to be about 50 per cent of the petroleum energy in the country in transportation.

Automobiles are about 55 per cent of that usage; about 17 per cent of automobiles are used for home-work trips, the balance being used in shopping, inter-city trips and things of this sort.

When you are talking about driving home-work, which is most of what mass transportation could take the load off of, you are talking about 17 per cent of the total vehicle miles.

MR. KIRK: Can you translate that into terms of a million barrels of petroleum?

MR. BRIDGES: Well, I'd have to work on that for a while.

MR. KIRK: Well, I understand that our current imports are 100 million barrels a day.

FROM THE FLOOR: Six million barrels per day or a little over 6.4 million barrels per day.

DEAN BENSON: There is a lot of misconception in this business of both energy and money conservation and transportation. You may want to talk to Mr. Bridges and study this extensively.

Bus systems are not all that good either. If you will stand around the city street corners, you will see a lot of buses going by with only two or three people on them and that's not very efficient either.

The truth of the matter is that our whole transportation system is highly inefficient. I believe your studies show, Saddler, that the automobile with three people in it is probably the most efficient form of transportation we have, from the standpoint of both cost and energy use, so you have the whole system here which, really, is not very sensitive to this problem of energy.

DR. HUDSON: Thank you very much. I will accept one more question from Jim Seamon. We are going to have to move on to Walter Wendlandt.

MR. SEAMON: I would like to comment briefly on two things which were said here. First, on the matter of bus use, I happen to live in an area where we have a bus lane.

That isn't in my part of town, but over on the Virginia side we have reserve lanes on Interstate 95. They let buses only and recently they let carpools only use the lane. This has been an effective solution.

It has brought a lot of people out of their automobiles and has certainly decreased the commuting time of people riding the buses because the buses go right on through while the automobiles jam up.

On the other hand, there is another side of the question. A recently published paper shows that women want rail transportation lines and the New Jersey-Philadelphia rail charter had a greater impact than the bus charter did in Washington D.C.

What we have here is a success story for both methods. I would like to make a comment to this gentleman over here whose name I didn't catch.

DR. DAVIES: Davies.

MR. SEAMON: I live in an area now where the social sciences have been pretty active. In the two years I have been in the Washington area, I have learned a lot about the people's attitudes up there.

They are quite a bit different. Those of you in the highway business may know that the citizens in Washington have fought just about every freeway to complete standstill.

On the Maryland side where I live, we have no freeway. My neighborhood civic action group has been fighting freeways since its inception.

The social sciences have been very successful up there, if you want to consider it a success, and I think I do consider it a success because it's what the people want.

Also, we are building a metropolitan rail transit system. It isn't running yet, but hopefully it's going to be better—

DEAN BENSON: With tax money?

MR. SEAMON: We are building with any money that

we can get. Hopefully, it will be better than BART because we are spinning away from the exotic controls. I would like to suggest that those here who are interested in this thing keep their eyes on the Washington area over the next ten years.

There is going to be an excellent laboratory for the question of how effective rail transit is, highways, and where the citizen's group comes into the picture. I think you will find it interesting.

DR. HUDSON: Thank you, Jim. I was in Washington two weeks ago and I asked a couple of people and we really came up with a solution. We decided that the Washington system, since it's so fouled up downtown and no one can get around it during the construction period, and the construction period is about four years, that when the system is completed, the congestion on the upper streets will be reduced, by removing the construction, so greatly that the system will automatically be a great success.

MR. SEAMON: It's Phase 1.

DEAN BENSON: I'm always amused by the simple solution: that the idea what is good for Washington is good for Amarillo or what's good for Washington is good for Austin.

Transportation is purely and simply, in my opinion, a local problem. When the local people begin to take a look at this problem in their home areas and decide what they want to do to solve it, then we will be able to get some reasonable solutions to these problems.

MR. SEAMON: I agree.

DEAN BENSON: If we keep on running to Washington, or the people in Amarillo to Austin, expecting to find solutions to these problems, I think we are in real trouble.

I think the best thing that could happen to us right now is for the Federal government to get completely out of the transportation business and the education business. I think these are the two best things that could happen in this country today and I say that seriously.

DR. HUDSON: Thank you. I am going to have to move on. Our final speaker for the morning session is a graduate of Texas A&M University. He has a law degree from the University of Texas.

He is a registered, professional engineer as well as a licensed attorney. He is past president of the National Conference of State Transportation Specialists, he is a good friend of mine and I am pleased to present Walter Wendlandt, Director of the Transportation Division of the Texas Railroad Commission. He will discuss "The Role of The Railroad Commission in a Scarce Energy Economy."

Mr. Jim Seamon, Rail Transportation Specialist for the Transportation Research Board, commenting on Mass Transportation Systems.

Mr. Walter Wendlandt addressing the Conference.

"The Role of the Railroad Commission in a Scarce Energy Economy"

MR. WENDLANDT: Thank you, Ron. Now, I would have expected at this stage of the program to have heard some Aggie jokes. You know, A&M has a reputation of firing the football coaches that don't win.

Over here they are more sophisticated. They fire the University President. I am not very sophisticated, but I do know to advise you that the views expressed herein are my own and may or may not be the views of my sponsoring insititution, the Railroad Commission of Texas, or my three bosses, Commissioners Langdon, Ramsey and Wallace.

They give me considerable latitude to speak my piece and I appreciate that. Chairman Langdon regrets that he could not be here because he has a prior commitment.

I have some serious doubts as to the values of prepared speeches as compared to the advantages of give and take panel-type discussions like we have had here.

The subject, "The Role of the Railroad Commission in a Scarce Energy Economy" might very well be phrased better as "In a Scarce Energy Economy, What is or Should Be the Role of the Railroad Commission?"

I shall direct my remarks to transportation and transportation regulations, but I must point out that I do not believe that we are scarce in energy. We definitely have a shortage of petroleum fuels, especially natural gas, at the price and in the quantity that we have been used to.

In my opinion, the problem is how we as a state and country adjust to medium or high cost energy with a minimum disruption to the economic health of this state and our nation.

It is going to take a very intelligent and responsible non-political approach of our leaders during the coming transitional period to prevent a socialistic take-over of our natural resource development and transportation facilities.

I believe very strongly in the capitalistic system, our profit-incentive system, if you will. I believe it to be responsible for the high standard of living that we enjoy in this country today.

I like to quote Jim Hogg. His words, in March of 1892, are prophetic of this conference; "Hereafter the great battles to maintain the liberties of the people must be fought in the forum of reason. It is well for the great army turned out year by year from the public schools to understand the cause of its training. Linked together with the common schools are inseparably connected the Agricultural and Mechanical College and the State University.

"In courses of study, there is no clash. In their operation, consistency and harmony prevail. To their advancement, the hopes, the pride and the money of the people lend succor."

Jim Hogg is and should be remembered for many things, but obviously the thing most people think about is his championing of the establishment of a Railroad Commission.

In his inaugural address, he stated the purpose of the Commission should be "to give freedom to commerce, security to the carriers and protection to the public."

I'll repeat that, "to give freedom to commerce, security to the carriers and protection to the public." Even in the very political atmosphere that followed his election when he was vigorously opposed by the railroad interests and prior to the time his legislative program would be enacted, Jim Hogg recognized that the public interest would be served if "the carriers had a certain degree of security".

Among other things, he stated that the Railroad Commission should have the power to prohibit and punish rebating, discrimination and extortion by carriers.

In 1929, the Motor Carrier Act was passed for the regulation of truck transportation. It reads like this: Section 22b, "Declaration of Policy. The business of operating as a motor carrier of property for hire along the highways of this State is declared to be a business affected with the public interest.

"The rapid increase of motor carrier traffic, and the fact that under existing law many motor trucks are not effectively regulated, have increased the dangers and hazards on public highways and make it imperative that more stringent regulations should be employed, to the end that the highways may be rendered safe for the use of the general public; that the wear of such highways may be reduced; that discrimination in rates charged may be eliminated; that congestion of traffic on the highways may be minimized; that the use of the highways for the transportation of property for hire may be restricted to the extent required by the necessity of the general public, and that the various transportation agencies of the State may be adjusted and correlated so

that public highways may serve the best interest of the general public."

A very common argument, and appealing argument because of its simplicity, is that the Railroad Commission and other state commissions and the Interstate Commerce Commission were established to combat the monopoly powers of the railroads; that the rise of truck, barge and air transportation has destroyed this monopoly and that regulation is, therefore, not now needed and, actually, adds costs to our transportation system.

This casual approach is based on a contrary-to-fact premise; that the various regulatory acts were passed to combat monopoly. Actually, they were passed to combat discrimination.

Jim Hogg, in his message that I quoted, talks about discrimination and not monopoly. The Texas Legislature, in 1929, talked about discrimination and not monopoly.

Three of the four sections of the original Interstate Commerce Act talked about discrimination. As a matter of fact, in the period of time immediately prior to the passage of the Interstate Commerce Act, there was intense competition among the railroads for traffic between major cities and from major shippers.

Those shippers in the rural areas and small towns, without a choice of railroads, were discriminated against; and it could happen again. The Railroad Commission is like the Highway System in many respects.

It is very visable, it is successful in most respects, but because of its successes and its visibility, it is subject to attack by those wishing to challenge the status quo.

For example, for many years it was the popular thing to challenge the Commission on its administration of the market demand statutes for prorating oil production.

Now that the policy of the statute and the Commission has been proven sound, the critics have moved to other areas. Now it seems that criticism is building on the Commission's administration of statutory entry controls of transportation.

A recent study we made indicates that 65 per cent of the contested applications which have gone to hearing have been granted all or in part. Another portion of Jim Hogg's inaugural address that I would like to quote reads like this.

"In her independent autonomy, Texas shall be sovereign and free in the management of her own domestic affairs. Cordially and with pride, she claims and feels an interest in the Federal Union as one of its important members.

"In all the power delegated to it, she cheerfully joins to the end that the general government may be honored and respected within its legitimate sphere.

"In the administration of her own affairs, she expects and demands recognition and respect.". Most of us can probably agree that the most efficient type of government would be a single Federal government, but the genius of our forefathers was to provide a system of checks and balances, not only between the three branches of the Federal government, but between the Federal government and the State governments and the individual citizen.

In my opinion, it has been this system of checks and balances which has protected us in this Watergate period of excesses by the Executive branch.

It disturbs me that some members of the transportation industry, in the name of efficiency, are willing to turn more intrastate jurisdiction over to the Feds.

I suggest that the industry, and those here, support the State Bar in its efforts to have passed the Administrative Procedure Act. The Governor has charged the Interagency Transportation Council with the development of a State Transportation Policy.

This has caused the council to review some long-standing concepts of State government. The Railroad Commission joins in this effort and pledges its support of this study.

In closing, I will quote from Professor Wallace I. Little, who expresses my feelings so well. "By some stroke of good fortune or some reward for high ideals, we have molded a workable relationship between government and business which provides the incentives of private enterprise and still avoids the chaos of destructive competition.

"It is not by coincidence that we live in the greatest economic abundance known to man and despite the cries of alarmists that forecast the demise of private enterprise through regulation, we retain, by the right of vote, the direction of our economic and political destiny.

"We should not be too eager to sell our heritage of this tried system for a bowl of psychedelic pottage. Regulation is not a fair weather institution. Private enterprise, with regulation, has shifted us from our original status of 13 bankrupt colonies, through continental expansion, the Civil War, the Industrial Revolution, the Great Depression and two World Wars.

Dr. Shane Davies, Department of Geography-UT Austin, addressing a question to Mr. Walter Wendlandt.

"It has proven that private enterprise can be modified to survive the greatest catastrophies of man and nature." Thank You.

DR. HUDSON: Thank you very much, Walter. I will field one or two questions for Walter if there be any. The hour approacheth. I'm sorry. We ran out of time, Walter, but is there a question?

DR. DAVIES: May I ask a question of you? I associate railways with passengers and people as well as with freight. I want to know how successful Amtrack can be in a state with the type of population distribution that Texas has; high density flows and low density rural areas.

Secondly, since Amtrak is a present day sort of public organization, do you think it should become completely nationalized?

MR. WENDLANDT: Well, I am not sure your question is not loaded, because I have been quoted about Amtrak. In my opinion, Amtrak is a failure. I think it had to be a failure except in the northeast corridor where you have extremely high population densities, but it is not economically feasible in Texas and in most parts of the country.

There is a very basic reason and that's that it is not economical. If you are in a hurry to travel, you are going to fly. If you are looking for cheap transportation, you are going to go by bus; that's the reason.

The bus systems provide extreme flexibility in scheduling. There is only one advantage of riding the railroad as opposed to a modern day bus and that is that, on a railroad, you can get up and walk up and down the aisle, you know, and remember back to the days when you were a child and you went to visit grandmother and grandfather on the railroad.

Now, as to whether it should be nationalized or not, no, I don't think it should be nationalized. The railroads are playing a very important part in the transportation of goods in this country.

I think most people tend to overlook what I think is a tremendous job that the railroads are doing. No, of course, there are problems with the railroads, especially in the Northeast, with the Penn Central situation being what it is.

Now, I don't take the position that all the problems of the Penn Central are due to regulation. In fact, I will debate that with anybody who wants to. I do think that there is a combination of events that resulted in the present Penn Central situation.

I don't believe that you solve anything by nationalization. I am reminded of the story about the cost of making a telephone call from New York to Los Angeles back in 1936 when it cost $2.85 and the cost of mailing a letter was three cents.

Well, now it costs 10 cents to mail a letter from there and the telephone rates have gone down from $2.85 to about 90 cents. I haven't been convinced of the efficiency of the Post Office Department either.

DR. HUDSON: Thank you, Walter, Thank you very much. I believe we need to close this session at this time. I will remind all of you of the reception on the patio and on the main floor here at 7:00 p.m. tonight.

We will have dinner at 8:00 with Congressmen Pickle and Teague as our guests at dinner. Those of you who do not have dinner tickets yet or do not have tickets for your spouses, please get that clarified before the afternoon session.

This afternoon, we will move into our session on the relationship between the locational and land use policy and energy and transportation policy, one of the many prongs of this problem that was mentioned this morning.

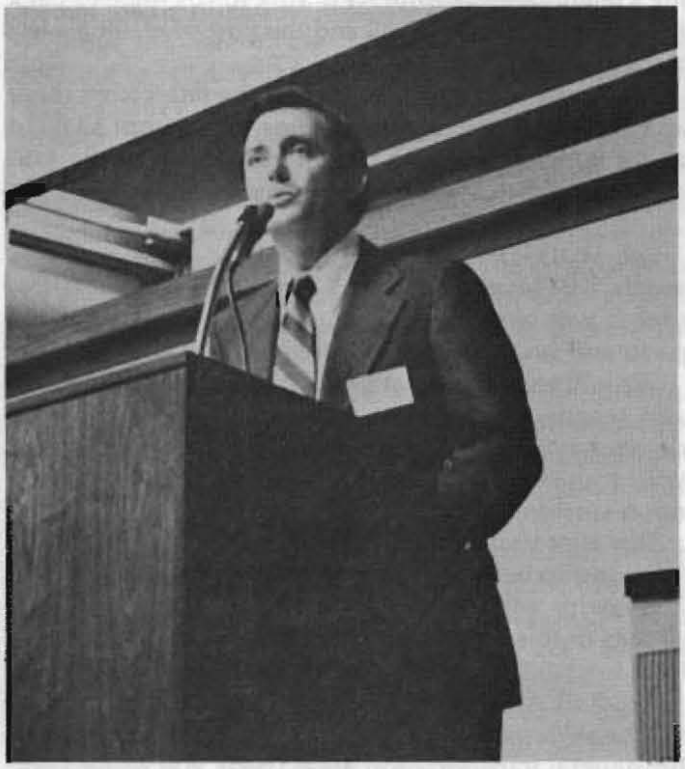
Mr. Bob Armstrong, the Texas Land Commissioner, will be with us. Tomorrow morning, we will move into the general transportation area. Thank you all for coming. We will see you at 1:30.

Afternoon Session
October 24, 1974

Phase II
"Locational and Land Use Policy Effects of Scarce Energy and Transportation"

DR. WALTON: Good afternoon and welcome to the first session entitled "Locational and Land Use Policy Effects of Scarce Energy and Transportation." I am Michael Walton. I will be moderator for this particular session.

This session is aimed at looking at some of the major issues that are facing such things as land use policy, locational analysis in terms of scarce energy resources and, particularly, the central relationship with transportation.



Commissioner Bob Armstrong addressing the afternoon session.

I think we are very fortunate this afternoon to have a very distinguished group of speakers to address this subject and also to be followed by a panel discussion which, I hope, will generate a lot of discussion from the floor; in fact, I'm sure it will, based upon the reaction of this morning's session.

The issues that we are dealing with are very complex. Although the title of the session is termed "long range effects", we are also much interested in the short or immediate effects, because one cannot separate the two, obviously.

We heard about several important issues this morning, such things as transportation, changes and new technology, new modes, land use policy, land use controls. Some of these issues tend to perpetuate myths, others address points that are of paramount importance to all of us today, particularly those who are involved in policy formulation.

It is unique, I think, in this particular point in history, that Texas is going through a period of developing policy in many different areas, transportation, land and what have you.

To kick off this afternoon's session, we are very fortunate to have an individual who is uniquely qualified to address such a topic as locational and land use policy.

He is a native of Austin, he received his law degree from the University of Texas and he has served in private practice and seven years in the House, State government.

Since 1970, he has served as Land Commissioner for the State of Texas. I think it is also unique that during his tenure in the House, he was responsible for many issues, many bills and programs aimed at conservation, land conservation, environmental concerns and major issues that are, indeed, important to this session.

The diversity of his honors and his experiences range from being recipient of a Field and Stream conservation award and an Outstanding Lawyer of Travis County award, to being a member of the Austin Woods and Waters Club and the Sierra Club.

In taking on the position of Land Commissioner, he created the first Environmental Planning Division within the General Land Office, in 1971. Since then he has initiated many environmental programs heretofore unforeseen in State government.

His topic today is "Land Management, the Other Piece of the Puzzle." It is an honor for me to present the Commissioner of the General Land Office, the Honorable Robert Armstrong.

"Land Management, The Other Piece of the Puzzle"

COMMISSIONER ARMSTRONG: Thank you very much, Dr. Walton. As is customary, I'll start with two illustrative stories. The first one concerns my good friend Bassett, who, as you can tell, is visibly really working on his talk.

He told me to take all the time I could, go as slowly as I could, because, when he got here and opened up his folder, he discovered that the notes he meant to bring to this meeting are somewhere in his office and now he is making them over again.

For some reason, that reminds me of one of my favorite stories about the minister—or rather the guy who always wanted to be a minister, but couldn't. But at least he wanted to pray at some point in a public gathering and, in the process, no one would ask him.

Just on the off-chance that he might be asked, he wrote down the best prayer that he could come up with, and he pasted it in the top of his hat so that if anybody ever asked him to give a prayer he could take off his hat and read it and everybody would think what a great ad lib prayer he was.

In any event, they didn't ask him and they didn't ask him until finally one time quite by surprise someone said, "Will you please give the invocation?" With that, he ran for the hat rack, came back and said, "Oh Lord, this ain't my hat."

Bassett, I will speak as slowly as possible and when you get up here, you will at least have a preface. I've heard him before and I'm not worried about him with or without his notes.

The second story I am going to tell, to start out with, is about two girl ostriches that were trying to cross the desert. They looked behind them and determined that there were two boy ostriches right behind their trail with only one thing on their mind.

They increased their speed, they started taking a zigzag course, but it soon became apparent that the male ostriches were much more persistent and much faster and aggressive and able, and they were going to get caught up with.

At some point or another, one of them turned to the other and said, "We can't outrun them. Maybe we had better hide." With that, they stuck their heads in the sand.

At this point, the boy ostriches came screeching up behind them and started looking around and said, "Where did they go?"

I told that at A&M not long ago and a guy came up after the speech and said, "Where *did* they go?"

In any event, for those of you who are fanciers of ostrich jokes, I'll tender that one up—and then follow it with this statement.

I think we have reached the point as a nation and in this state particularly where it is becoming increasingly apparent that you can't just stick your head in the sand and hope that something nice will happen.

I think you can think about that in relation to the joke, if you want to.

I do think that in asking me what I wanted to call this talk, I said that land management, I thought, had to be the other part of the puzzle, because while we have dealt as government with problems as they have risen—and government has a tendency to deal with problems in the times that they become critical—all too often without anticipating, without planning ahead—we have found that the critical problems arose in this order: air pollution, water pollution, water quantity and the availability of transportation came on the scene.

We are now just beginning to realize that perhaps this question of land, as a resource, may also be one of our problems. Unless you tie all of these together, in my judgment, in some sort of comprehensive effort, to look at all three as part of the puzzle, I don't think you can really have the whole picture.

It's very obvious in the areas that have had the problems and the question then becomes, "What do you do in a state that is still blessed with many, many freedoms from problems to avoid the things you see in those states which have had the difficulties and have attempted to deal with them?"

Now, I don't have to tell you where they are: California, obviously, Florida, New Jersey. Yet, you find pockets of Texas that are beginning to look like and respond to some of the difficulties in many of the same ways that some of the other states have had difficulty.

And you also find a great part of Texas which does not have any problems and these people are very fearful. The problems are not visible and so they say, "Let's don't do anything. We don't need any help. Keep out of here."

As far as agencies are concerned, government is concerned about that sort of thing and yet they deprive the people in the Houston area, the people along the lakes,

the people in this area of some tools in which to deal with our growth, and I think this is kind of the name of the game.

There are a lot of ways to approach it, but I think probably the most sensible way to approach it is to involve yourself in some sort of decision-making process as a governmental entity which is better than the decision-making processes that we have had in the past.

Look basically at the growth and development areas of this state and see who makes the decisions, and see how they are made. What do the planning commissions do and who runs those planning commissions?

How responsible have people been in the land development industry. How responsible have people been in government in terms of looking at a broader view than just how fast can we grow and what can we do to attract industry and what can we do about the economic base in our banks in this particular community.

Now, I don't think these things are wrong necessarily, but I think that what we find is that they have to be balanced off with some other considerations.

Unless you balance them off with the other considerations, then you are not really getting at your problem. One of the parallels that really kind of fascinates me is the apparent—at least in times past, and I am pleased to report this is changing slightly—great animosity that people in the farming and ranching communities feel toward any kind of land planning.

What they say is, "Look, if we do a good job with our farm and our ranch—and we do—we're the greatest agriculture producer in the world—we have a great track record of being able to manage our land resources properly, and if everybody does that then all of these pieces are going to fit into the puzzle very happily and you are not going to have any difficulties."

The problem with that is when you get into an area of high density growth and high speed economic development, people seem to kind of forget what that farmer is doing, and what the farmer does every day when he gets up is he utilizes his land as a resource and he manages it.

This has to tie to things as simply as transportation. He doesn't put his barn at the absolute top of the hill because how do you get to the top of the hill when it's muddy and what kind of road system do you have and what is the additional cost to get there.

He doesn't put his barn at the bottom of the creek either because though it doesn't flood all the time, it's likely to flood. What he does is he manages his place as a resource.

He looks at its resource capability when he makes his decision for that location of various things. Now, I don't think it is too simplistic to say that we can do a better job of planning in our communities if we begin to look farther than we have done traditionally at the land as a resource in these communities.

What we do basically, if you will think back, is look at the land as a square on a map. Most zoning in the state of Texas is drawing a square and saying, "This is going to be the residential."

You draw another square and say, "This is going to be industrial. This is going to be apartments." But it's still a square on the map. Nobody has put in a subsequent thought very often and yet we are finding that these subsequent tools or additional tools are available to us basically through the Bureau of Economic Geology and their mapping program of soil capability.

These tools are available to us from the Soil Conservation Service. It's been in existence for many, many years. It has literally done pictures and maps of all the soil capabilities of the state of Texas, literally.

You have people in the coastal area who now have the capability of showing you where the erosion is going to take place, in case you have a beach front development.

We find some pretty scary things, frankly, that are taking place in the area around Houston in terms of subsidence. The extraction of water is not just causing the subsidence which people have faulted the government for not preventing or worried about because literally their land is sinking into the bay, but you also have people who are now concerned about certain faults which have been static for many years and are beginning to activate in downtown Houston.

Buildings which were built on the fault that they thought could handle the weight of that building are now beginning to cause, at least, some possible problems because of fault activation, because of some subsidence due to water extraction, maybe as much as ten to fifteen miles away.

These are all of the things that I think it is time for us to look at. Houston is in at the present time pretty much the exact position that you found Los Angeles in in the 1960's. It's the fastest growing major city in the United States of America.

The question becomes, "Do you follow the Los Angeles example or do you pay some attention to what you do in the area of planning?"

Now, frequently people say, "Well, do you want to do all this? Don't you just want to zone the state of Texas?" Well, the answer to that is "no" because, by and large, zoning hasn't worked very well.

I'm not sure we ought to limit what we do in terms of making these decisions to some sort of traditional zoning concept. I think it's time to look more at what the resource capability is and what the prospective act is going to be that is going to change that land use and try to decide whether this can be done—first, safely; second, in a non-environmental context so that it is sound; and, third, that we guarantee some things to that community such as open space, if that's what they want—and, incidentally, I don't suggest that anybody can just designate an open space.

I think that what you have to do, if you are going to have an area that cannot be developed is to go in as a community and purchase it at the fair market value just as a developer might do.

I think you might look at some innovative ways to cause open space to be desirable or advantageous. Some of the ways would be tax breaks. We are working on a prospective piece of legislation whereby someone could give their development rights, if they so desired, to their property.

This does two things. They get a tax break when they give the development rights just like a president might get if he gives his papers. Second of all, you get into a situation where if you want to leave it alone, maybe use it for ranching, instead of chopping it up, you get a break before you start dealing with the people who tax you on an ad valorum tax basis and, also, you get a break as far as people coming to you when you die and looking at high valuation for estate tax purposes.

Yet it serves the community because some of these areas in the state are areas that might better be left alone and undeveloped. All of these things are things that we are looking at and ways to develop that kind of thing back to the basic idea of planning and planning versus zoning.

I think that traditionally our zoning system for the reasons that I named a minute ago have not been really very successful. A lot of people in Houston say, "We're great because we are not zoned," but you have to remember also that the city of Houston has a planning staff that numbers in excess of 100 people.

While Houston is not zoned, it is still planned and, yet, I think what you have to have is a total combination of factors that have to go into this decision-making process.

Unless you consider water resources, unless you consider the land as a resource and transportation capability and availability coupled with energy as part of your planning function, I don't see how you really can get to where you need to be in terms of handling your growth problems.

We sit at a time when the Federal government is at least toying with the idea of a land management bill. I think it might be well to point out that the people who want this kind of legislation are people who really paid the price.

Arizona has fallen prey to a massive intrusion from development from basically outside sources. I think it's significant that the two bills are at war with each other, but the two sponsors of the major land use bills come from Arizona: Sam Stigler and Morris Udall.

I think it is also interesting to observe that where we go, in our effort to work with the Coastal Zone Management Act, the people who are in the Houston area, the people who are in Galveston, Brownsville, the places where the problems are and highly visible, the people want to cooperate, they want to do something about it.

The opposition, again, comes from the areas where it's just not very visible. In a way this is a shame because what happens there is that we are locking the gate after the cow is out and there is the place where the people want to do something; and in that same situation where the problem is not visible people say let's not do anything.

My answer to that is, "Fine, where we don't need it, let's don't do it." If you take Baylor County, about all you are really going to have to do is to try to make some decision that is rational that says that you don't put feed lots squarely on top of a water system, or an aquifer that is permeable that furnishes that city.

You can handle a lot of those problems that way. I think what you see is sort of a feeling that is beginning to come to this part of the country from the West.

Read the Wall Street Journal today, political analysis of the races in California, the races in Montana, the races in Colorado, and it is going to be pretty interesting to see how those things resolve because you have it just like this; the candidates aren't agreeing at all.

One is talking about whether or not that state is going to be a colony for the rest of the United States. The other one is talking about the fact that, "Yes, that may be true. We don't want to be a colony, but we want jobs for our kids and that's paramount and we don't care if we do extract all of our resources to air-condition New York. We want the money and we want the jobs and to heck with what happens to the state because it's not really worth very much anyway like it is."

It's very interesting and it's going to be very interesting to see what happens in the future. The interesting thing is that people are talking about this at all in the Western states.

I think that the Oregon no-growth concept is occasioned by a realization that some of these resources are very finite and I think this is the bottom line basic thing that has come to pass in the last two or three years.

Water and energy are both considered to be infinite and have certainly become a question of real concern. Denver probably is the major city with the best example of inadequate energy resources to meet their needs, and yet they are one of the fastest growing cities in the Southwest.

The gap, as I understand it, is greater than 10 per cent between supply and demand in the city of Denver. It's all fine when the weather is warm. It's critical when the freezes hit.

It's all fine as far as getting to work, with carpools up to a degree, but when you can't get the gas, it becomes critical when that shortage occurs, and that's what they have experienced.

I think we have to plan in the energy area. We have to plan in the transportation area and we have to plan this in conjunction with our other resource capabilities and I now add land as a resource which should be looked at in terms of its capability to see what kind of decision-making process we have in the future.

I think the Federal legislation in terms of land management is going to dictate that some attention be given to all of these various factors, because this is part of the thrust of the legislation that was proposed in the past.

I think it would be well to observe that that one bill only missed by about eight to ten votes. When you look at it in the context of the presidential situation at that time, where the President literally reversed himself from being four square for some sort of land management capabilities and indicating that it was the single most important piece of environmental legislation that his Administration could propose and then began to trade that position and Morton's position as a result of some pressure being brought on him by people who said, "We won't vote for impeachment if you will let this one go down the drain," you have to think that by the next session of the Legislature or the next session of Congress you are going to have a pretty good chance of this kind of bill passing.

My suggestion is that it doesn't make any difference whether that passes or not and that's what I have told the Legislative Committee. We are going to have to be alert to the problem. We are going to have to attempt, as a state, to make some rules that will accommodate various people in terms of what people do with their land that has a diminution of value to somebody else's land.

You know, there are all kinds of people who will say, "Well, maybe this will interfere with people's property rights." The problem is that when you have this kind of growth and development, you have people's property rights interfered with by virtue of the fact that you don't make the rules.

I think it is appropriate in these areas of high density growth and development that you have to begin to make some accommodation of all the community situations to what individuals do with their various properties as a matter of property right.

First of all, I don't think that anybody suggests that in this day and time because you own a piece of property you can put a feed lot or pig pen in the backyard in your city. Why? Because of what it does to your neighbor. I don't think anyone suggests, as a matter of private property rights, that you can put a 42-story building next to an airport in a major metropolitan area.

I don't think anyone suggests in this day and time that you have the right to put the feed lot on top of the aquifer that services a major city or to put some sort of polluting entity upstream from a user—for example, a stream used to water cattle in that particular stream.

For all of these reasons, we make rules about what we do with our property and how it bears on somebody else's right to use and enjoy and have value.

These are the things that are the hard questions; they are not easy, believe me. I think this is the kind of thing that requires a slow, basic commonsense approach.

Yet, on the other hand, you have a county like Val Verde that that made the decision that they were either going to let the developers run their county or they were going to run their county. They had a great asset in

the dam that was built, so that community asked the Legislature for extra-territorial jurisdiction to do zoning outside the city limits.

They have had some real agony with this program, but it has also been very beneficial. The first plan was unworkable, admittedly so. They came back with a compromise plan, but the ultimate result was that here, at least, in one county in Texas, people decided what they were going to do was to have some chance to govern their own destiny.

The ranchers were at the forefront of this movement, which is very interesting—and, as a result of this, I think you are going to see other counties that are going to pattern some of their actions after the Val Verde experience, because they are working this out pretty successfully.

I think another interesting political aspect of this is that the person who was responsible for the Val Verde plan is now the president of the County Commissioners' Statewide Organization, in a large measure because of his leadership, all in this area.

I think that most of your decisions can and should be made in a local area. If you don't, as I said before—if you don't take all these things into consideration in your planning, then I think you will have a great deal of difficulty in reaching the point you want to reach ultimately in terms of getting some genuine benefit out of your plan and maybe more significantly avoiding some of the problems that people have had in other states when they didn't do this type of and kind of planning.

It's a whole new ball game. It's going to be the kind of thing that isn't going to be welcomed in many areas, but I'm convinced—and the reason I speak out on the problem is that Texas has now reached the point where she can no longer afford to stick her head in the sand and hope something nice will happen.

There are too many examples of the prices we pay. I think, in sum, we are going to be able to get some legislative action out of the next session which will give us the ability, hopefully at least, in the extraterritorial jurisdiction to do some management on a commonsense local basis.

I don't think it has to be the kind of thing that is handled in a computer-technology-consulting-engineering-firm kind of way necessarily. I think there are great advantages to be had from this, but I think most of the problems are going to require much more, like a group of citizens who have good judgment and commonsense and who are willing to sit down around the table in courthouses, in school board rooms, and make some basic decisions about how they want their community to be.

This is taking place, frankly, all over the United States at the present time and it's taking place for a number of reasons. Mainly, it's because of the visibility of the problem.

I think this is the kind of thing that is going to be with us for some time. I commend you for addressing this kind of meeting to the energy-transportation aspect of it, because there can be no decision-making process which fails to take that into consideration in conjunction with the land area.

I come here, admittedly, as an advocate in the land area, but I don't think there is any less or greater responsibility in the land area than there is in the transportation-energy area, because I think they have to dovetail together.

At this point, I hope I have provoked your thinking without provoking you. I hope that the questions and answers will probably give us a chance to develop it a little more.

We started late. I am assigned, I believe, to five or ten after, so at this point I will keep it in that time limit and I hope you have had time, Bassett, to get your remarks together.

Dr. C.V. Wootan, Texas Transportation Institute, listens to Commissioner Armstrong speak about Land Management.

DR. WALTON: Thank you very much, Bob. Commissioner Armstrong will be with us through this afternoon and will moderate the panel discussion this evening.

Many of the questions which I am sure he has generated from his presentation will be answered during that session. The next speaker is Dr. Bassett Maguire, who is an Associate Professor of Zoology at the University of Texas.

Dr. Maguire is a noted ecologist and environmentalist in addition to his profession of zoology. He is a member of some 22 professional organizations which are quite interesting, from the World Simulation Organization to the Ecological Society of America to the British Ecological Society as well as the American Society of Zoologists.

He is a Fellow in the Texas Academy of Science, a Fellow in the American Association for the Advancement of Science. In addition, Dr. Maguire has made several presentations and reports for many governmental agencies, including Senator Baker's Committee on the United Nations Conference on Human Environment and to the Corps of Engineers meeting in Corpus Christi in September of last year on environmental impact on construction and maintenance of the deep port of Padre Island on behalf of the Texas Environmental Coalition.

It's truly an opportunity for us to have Dr. Maguire with us. His topic is "Neither Transportation nor Energy is the Problem." It is my privilege to present Dr. Maguire.

Dr. Bassett Maguie, Jr., Department of Zoology-UT Austin, preparing remarks for panel presentation.

"NEITHER ENERGY NOR TRANSPORTATION IS THE PROBLEM"

DR. MAQUIRE: This kind of meeting presents us with marvelous opportunities because it gets people of a variety of disciplines together to talk about some of our larger problems. It is only by cooperative efforts of this kind that these really complex problems can be looked at fully and intelligently; only in this way is there a real chance of arriving at adequate, if partial solutions in the near term, as well as better and more complete solutions in the longer term.

However, let me sound an important warning: Every time we start human beings looking at a problem, especially a complex problem in which we are personally involved, we very frequently tend to forget that we, (I, you, any of us), each look at the world through a very particular kind of distortion, as if we were wearing a very imperfect pair of glasses. Each pair of glasses has a particular kind of color and a particular kind of aberration, so that we see only part of the world, and in addition, that part which we do see is distorted. The kind of these glasses that each of us wears is determined by our individual history, culture, education, development, and so on, as well as by the fact that each of us is simply a human being.

The result is that I will have some blindness, and biases that won't agree with yours and you will have some that won't agree with mine. We also have ignorance about different things. If we can work together, and in the process can increase our breadth of vision and decrease the magnitude of our errors, we will have done something that is very important. It is also absolutely necessary that we pool our talents if we are to see enough of the truth to solve our larger and more complex problems.

The problem which we are dealing with in this symposium, is, as suggested in my over-the-phone chosen title, neither energy nor is transportation. It is rather the whole system of which these are only interacting parts.

By the whole system, I'm talking about the entire human-environmental complex. I'm talking about the complex made up of the water, the soil, the plants and animals, the men that are living in it, all of man's organizations and activities, and so on. All of these

parts interact strongly with the other parts. This human-environmental complex also, of course, includes the kinds of interactions which each of these sub-systems has within itself. It includes the kinds of things that men have in their heads, as well as the kinds of interactions that man, his organizations, and his machines have with the rest of the world.

Right now we are in the process of changing this human-environmental complex ever more rapidly by increasing the amount of power that we are applying to change the face of the earth in all sorts of ways.

We are digging it up, throwing it out, moving it about; we are changing it chemically, changing its temperature, and so on. We are also vastly increasing the speed and magnitude of the interactions between and within many of its various parts or subsystems. By improving our transportation and communication we are increasing the speed and strength of the interactions between the parts, and therefore also increasing the magnitude of the important and frequently determinative feedback loops between these parts. In doing these things, we are making the system as a whole much more complicated than it was and we are increasing its rate of change and decreasing its reaction time for some kinds of things (without affecting the amount of lag in other parts of the system).

The dangers of doing these things, amongst others, are that by making it more complicated, we are making it a lot harder to understand; by increasing the strength of the interactions and the rate of some, but not all of the processes, the system's stability will probably be reduced, perhaps considerably.

I am using the ecological systems which I work with as analogues of the larger system when I make these judgments. I believe they are good analogues for this purpose, and they suggest that the stability of any large system may have some inverse relationship to a number of *strong* interactions that occur between its various parts or subsystems. It may be that when interactions develop in an evolutionary manner, with much mutual accommodation occurring between the interacting subsystems during their development, that instability may be avoided.

This may be a useful analogue, and of course it could be a dangerous analogue, to the large, total, human-environmental system which we are talking about. I would guess that at present it may be a very useful and very important analogue. Therefore, what we have to do, it seems to me, is first of all to recognize the system as a single, functional human-environmental complex, and after we recognize it as such, to also treat it as such in both our planning and our actions.

With our very human and very limited vision and insight, no one of us can see much of the world very clearly. Obviously, therefore, what we are going to have to do if we are to deal effectively with the whole system is to bring together people, each of whom (hopefully) does see some little piece(s) of the system more clearly than the rest of us. Then we must fit the little clearly seen pieces together so that, in toto, we can see the entire picture pretty well. In addtion to utilization of the understanding of a number of people of "their" little piece(s), we must include maximum possible input of understanding of how each little piece interacts with the rest of the places to produce the entire system. Only then can we build the badly needed model of the whole system and its operation.

In a very general sense, the only way to take everything that is important adequately into account is to use the capacities of the computer tools that we now have and are developing. With these we may put together the tremendous amount of exceedingly varied input that must be provided. This necessary input concerns the function of all of the many little pieces of the whole system, and includes a consideration of them. With enough input, work and care then, one can end up with a model which will act, in real and important ways, the way that the world acts.

This model can be used as a very important tool, but we must be very, very careful. Models of the necessary size and power are very difficult to build and also difficult to check for errors. It is also all too easy to build biases into them (frequently unconsciously), and these biases may cause the model to work in erroneous ways which may also be very dangerous. I am not going to deal with some of these kinds of problems because the next speaker is going to show you some examples of how to misbuild some models which have some of the characteristics of the models I've talked about.

To build a proper model of the kind I have discussed one needs input from industry, from government, from all kinds of professionals, and input, as Commissioner Armstrong was saying a moment ago, from people.

This input from people is critical. It is as important—maybe even more important in some ways—as input from the various kinds of professionals.

Let us now briefly discuss a few kinds of ways that one might use to look at the system. If one looks at the

economics of the transportation part of our energy-transportation system, the costs of manufacturing of automobiles, obtaining the raw materials, selling the automobiles and the gas to run them, building the roads, and so on, our automobiles and trucks and their operation requires well over ten percent of the GNP of our country today. If one also looks at the entire human-environmental complex and concludes that the energy supply is very likely to be more severely limiting in the future than it is now, and therefore that the system is going to change to respond to this (possibly severe) limitation in energy—as I am convinced it will—one has a problem: This is the economic problem of changing a major fraction of the economic system of the whole country, a fraction which directly makes up more than 10 percent of the total (and by the time you get to looking at all of the ancillary things which are associated with automobiles and trucks, the fraction gets to be much larger). So what may happen?

What will happen if you see the problem, and without considering all the implications to others, and you go into this world and say (wihtout any preamble and without any indication of anything to help cushion the shock): "We have to change the system. We are going to cut down on the manufacture of automobiles by (say) 50 percent."—or "We are going to immediately reduce automobile size from average 4,000 pounds down to 2,000 pounds" (or to 1,200, or to whatever figure you choose), or you say both of these things because you know energy supplies will almost certainly fall off badly (unless fusion power is developed).

This statement is going to have an immense direct impact on a large number of people. They are going to say: "No!" There are enough people who would be critically affected by your proposed program so that together they will have a total political veto power over that program. This illustrates that what you have to do is to think simultaneously about a large number of the important parts of the human-environmental complex, and include a complete and careful consideration of these people and the problems which your program might pose for them, and take these things effectively into account in your program.

As examples, they need jobs. They may not want to move, yet many of them may recognize that they would have to move (assuming that they would have a job to go to) if your program were implemented. They want (need to) maintain the level of job seniority which they have earned. They need a wage which will provide adequately for their family and their needs, and these needs must be considered within the context of the household and purchasing patterns which they have developed. You may have to train them for new kinds of jobs. And so on. In sum, you have to provide for their needs, you have to move them, you must give them training, and whatever else is required to cushion the shock. You have to provide programs which will really do these things. Then you have to sell the package to them, to get them to believe that the program can work, that it will be effectively and properly applied, and that it (and not some more pleasant alternative) is necessary. Don't forget that you may be one of them someday.

The market mechanism alone is clearly not adequate to do this kind of job, and the job may need to be done. The market mechanism is very nice when it works when you have a completely free system (a really free economy), and for those things for which it will work.

There are important feedbacks in a free market system, these determine who makes how much, and they determine the price levels and therefore the allocation of goods and resources, and so on. But we have one problem in that our economy is not free: there are oligopolistic and monopolistic problems which have developed and which keep it from operating properly. There are governmental regulations formulated to help to ease various economic problems because some special group has been able to apply political clout. Thankfully, occasionally, if all too seldom, a large majority of an informal electorate makes up this pressure group. We have problems of many other kinds. One example is our balance of payment problem, which is an international problem partly caused by political considerations of other nations and groups of nations being used in the pricing of petroleum. In general, probably our resource acquisition difficulties are also going to become more severe in some additional sectors.

Let's also look briefly at another aspect of our transportation situation. This part of energy-transportation problem is a sociological problem. The automobile not only gives us the convenience of going where we want to go and doing the kind of things that we want to do when we want to do them, but it gives us a number of other things which are also important to many of us.

It can give us prestige. We can purchase (or tend to think we can purchase) an increase in regard which others have for us. Perhaps we should question the

allocation of some of our scarce resources toward this end.

Many of us also are interested in a high level of physical comfort—comfort which can be purchased in a large automobile. Perhaps there is also some level of comfort in our automobiles which we should not use our scarce resources to exceed.

There are also some other kinds of things that automobiles do for us or do to us that ought to be mentioned and which are parts of this larger system. Much of our courting and mating pattern of today is automobile dependent. Also, the kind of "neighborhood" that many of us have is dependent on the mobility we have, and which therefore is dependent on the automobile. For example, my "neighborhood", in the sense of the people with whom I interact daily (including weekends), is not made up of the people on my block. My "neighborhood" is made up of people with whom I have common interests: those who work with me, who sail boats, who share other sorts of interests of mine. They (my neighbors) are scattered all over the city. Many Americans have this kind of "neighborhood". This is a pattern that the automobile has had a large part in producing.

Much of our family structure and familial pattern is dependent on the automobile and the mobility it provides.

Also, the automobile is, in a sense, a little tank that we each ride around in. I was talking to a sociologist about this question yesterday and he suggested that, perhaps, social control has been diminished over the years as automobile transportation has become more and more important, because many of us do not have to stand on a street corner and wait for a bus, or go through a subway in New York City. If you have an automobile, you get in your little tank and drive; most places are still safe to drive around in even though you wouldn't dare walk around in some of them, especially at night. So you have a tank you can go around in, and you have both mobility and safety.

These examples briefly describe just a few of the kinds of interactions that the automobile has with (within) our social structure. Many more are also important. All of them must be adequately taken into account in planning for major changes in our energy-transportation system and in building a model of the total human-environmental complex.

Let us now look briefly at another energy related problem, the water problem. Because of the great relationship between energy and water, and between energy and transportation, there is therefore a strong relationship between transportation and water. The Colorado River, for example, already is over committed. The commitment of almost all of the water going down the Colorado River in a normal year had already been made to cities, industries, the estuaries, etc. before the people in Austin (and in several other cities) voted to support the construction of a nuclear plant on the lower reaches of the river. This plant will require an amount of water (for cooling purposes) which will cause problems because the total needed will then be in excess of what is available, especially in dry years. This is a pattern which is developing for many Texas rivers (especially those towards the west).

What will happen is that the water that had been set aside to provide for adequate freshwater input into the bays will be reduced (it has lowest priority—"the fish won't pay for it") and the salinity in the bays will climb to the point that in dry years, the salt concentration will be too high for the young finfish, shellfish, and shrimp that use the bays as nursery areas. If this occurs, it will cause a major reduction in both commercial and sports fish yield. Our major bay and coastal fisheries will severely decrease, with considerable loss of valuable food supply, of fishermen's jobs and income, and in sports fishing pleasure (and food).

To look at a very different, and hopeful aspect of the energy problem—there are yet untapped or little used energy resources. For example, there is a recent reasonable suggestion, at least as far as a "narrow view" economic analysis is concerned, that one can grow slash pine (which grows very rapidly), and use it to fuel the boilers in some of our power plants. This analysis shows the costs of buying land, tilling it, fertilizing it, buying trees, and doing all the things you need to do to grow pine as an agricultural product. You can then chip up the trees and branches and put the chips into the boiler and burn them at prices which are now cost competitive with the other fuels for the boilers. This could be important, because it is clear that if energy costs go a little bit higher than they are now that this pine plantation may be a very useful and economic way of meeting some of our energy needs.

One of the difficulties with this possible solution, however, is that it will take land—a problem which Bob Armstrong discussed earlier. One would have to consider where that land is going to come from. Is it, for example going to come from agricultural uses or from

other kinds of uses? Furthermore, it turns out that if you cut down a mixed hardwood forest, such as one finds over much of the Eastern part of our country, and replace it with this fast growing pine, the run-off is decreased by about 10 percent. Therefore, if there is a water shortage in the area—and there is in many areas—the availability of water to the cities and industries is decreased.

We have seen a few of the wheels within wheels within wheels in this complex energy problem. In addition, we could consider our energy and transportation problems as health problems, as political problems, and as other kinds of problems, but there is not time to do this here today. Remember, however, that in any adequate analysis all of these, and other unmentioned parts of the problem must be considered.

This morning I enjoyed the discussions of Mr. DeBerry and Mr. Wendlandt. I was somewhat disappointed, however, in what seemed to me to be their political response. They spent more time than I would like to have seen talking about how great the road system was and how good the railroads were, and less than I would like to have seen in talking about the problems of these transport systems, and of their costs in terms of men, material, energy and money under different kinds of regimes in which they could perform in the needed transportation functions.

It seems to me that this kind of meeting is a place where we need to start getting out some real stuff and putting it on the table and saying, "Now look, this is the best information I can give you, the best development of this part of the system I can come up with. Now, let's compare it with the other systems and put the systems together in various ways, and perhaps try several new approaches, and look at the costs and benefits of each."

In any event, it is clear that what we need to do is to put all the pieces of all the sub-systems of the human-environmental complex together into a model which relates them and their activities to each other properly, which doesn't make any of a number of kinds of important mistakes, including those discussed earlier, and use it to see how the system works and how it could work. Included in the critical criteria for this model are that it needs to be based on explicit consideration of present and possible future life quality of the people in the area for which the model is constructed, on adequate breadth and depth of input, and on consideration of long term as well as short term considerations (which means that the long term viability and competitive position of our country in the world must be included). Only with the melding together of these inputs and considerations can we build the adequate (and necessary) planning model.

Keep in mind that unless they know that their desires will be taken at least reasonably into account no one wants someone else to construct the planning model which will greatly affect their lives. You don't want me planning your life and I don't want you planning mine without this kind of input from whomever the plan is for. In the construction of a large planning model, everyone in the planning area (or at least their representatives) must take part. What we need to do is go out with the various techniques and procedures which are available (and to improve these considerably), and to ask people, using many kinds of approaches, both simple and subtle, to find out what their life quality components are—to find out what is important to them (and "we" are part of "them", so that our input concerning life quality is also included).

We know first of all, that survival is important to everyone. For this survival we need food, shelter, clothing, medical care, and so on. We need a degree of certainty that we will be able to have some minimum levels of these things in the future—for this we need a system which is predictable in major degree, and we need the potential of taking advantage, in at least some degree, of this (partial) predictability. This can provide some minimum level of feeling of safety for each of us. After (or along with) and equally ranked with these needs, we have a requirement for (pleasurable) interaction with other people. We are social animals. The first thing we usually take care of is our biological needs, and then we are concerned with our social needs.

To look at this in another way, we need to consider the frustrations and the satisfactions that people have now and that they might have in any modified system which we might design. We need to know how and why and how much frustration and satisfaction each person has or will have and how they are produced. Some planners are beginning to look at—or at least we are beginning to talk about looking at this aspect of human life.

In closing, I would like to emphasize that we have to do this immensely large and important job—we must bring together all necessary kinds of input, and during the whole process of building the model, we must pay a lot of attention to what life quality is and what it could be for the people living in the modeled area. We also

must carefully consider the need to maintain some minimum level of stability of the system in the long as well as in the short term. The alternatives to doing adequate planning (at the level outlined) include chaos, collapse, and/or totalarianism.

We have to get together to make this model, as no one or no small group has resources to do it. There are some efforts of this kind going on right now, in which there are people from across a wide span of disciplines, from government, from industry, from the public at large, and so on, who are working toward a model of the kind described.

One Texas project, for example, is working toward beginning the development of a model of this kind. Tentatively, it will consider the drainage basins of the Brazos, the Colorado, the San Jacinto Rivers as the planning area. I would like to ask any of you who find this kind of approach interesting to get in contact with me, so that we can all work on it together.

It's our problem, not yours, or mine, but ours; everybodies. And it is critically necessary, important, and urgent. Let's get going with it.

DR. WALTON: Thank you very much, Bassett. I think the diversity of philosophical views certainly enhances the goals of this session. Thank you. By the way, I think you can keep your honorarium even though you forgot your notes, which there is none.

DR. MAGUIRE: For what it is worth.

DR. WALTON: Right. At this time, we are scheduled for a break. Again, I encourage you to hold your questions. Perhaps Bassett will be able to remain with us also, so for those of you who would like to address a question to him, he will be available this afternoon.

I think there are coffee and drinks available in the back and I would like to re-assemble here promptly at 2:45.

DR. WALTON: Welcome back to the final portion of our meeting this afternoon. I think it is important that we now look at some of the techniques, the procedures for policy evaluation, policy forecasting.

In this regard, I think we are very fortunate to have Dr. Peter House and Mr. Ted Williams, Assistant Director and Program Manager, respectively, for the Washington Environmental Research Center, U.S. Environmental Protection Agency.

Both concentrate upon the strategic analyst's research, House having a Ph.D. in Social Science, Williams, a Masters in Mathematics. Both have been very active in fields of large scale modeling and policy analysis over the last ten years.

Unfortunately, their schedules prevent them from remaining throughout the duration of the session, so upon completion of their presentations, I would like to open the floor to questions on their presentations, "Large Scale Modeling" and "Policy Forecasting."

They will jointly make this presentation, I believe. At this time, I would like to introduce Dr. Peter House, who will kick off the presentation.

Dr. Peter House and Mr. Edward Williams, Washington Environmental Research Center, responding to questions.

"HOW TO PROPHESIZE AN APOCALYPSE: THE USE AND MISUSE OF LONG RANGE FORECASTING"

or

"RUN HENNY PENNY, THE SKY IS FALLING"

Chicken Little—A Fairytale

DR. HOUSE: After hearing the speakers this morning, the paper we prepared we changed during the lunch hour, for a lot of reasons, some of which, you know. Being interested in the strategic analysis and coming from Washington might be a clue.

After hearing the speakers that just preceded us, we decided that we might go back closer to what we thought we were going to do in the first place.

The terms that I have heard used during the last several papers and that I saw in the brochures which we got earlier are terms that are now very popular in the newspapers, terms like "long range", "scarcity", "crisis", "comprehensive", "computer models" and the like.

These are relatively new to most people's vocabularies, the term "crisis", for example. If we can follow up that thought brought out earlier, it might be said that some of the problems we are having now could be resolved by the fact that we may no longer have a free market economy and we are coming up to two choices as to how much we will go back to a recession economy or are we going to begin to do more long range—a little more planning.

The idea of scarcity to the general American is an idea that is somewhat alien to the Horatio Alger philosophy that he is brought up with. What I would like to talk about just for a few minutes as introduction is a system that Ted and I put together well over a year ago in response to a request from the Agency to look at a planning tool in addition to answering standard problems which the engineer and the economist looked at for a long period of time; in other words, efficiency criteria; how do we take a given amount of land or men or money or the like and allocate it best—best in the terms of most efficiently.

And add to that criterion the question, "Can we really get there from here?" We took a look at comprehensive plans, which we have done in the past, and said, "Okay, here's where we would like to be in the year 2000," and instead of sitting down with land use maps and coloring them in using five or six different colors and saying, "This is what your city is going to look like," and "This is what the transportation net is going to look like," and "Here's how many schools you are going to have," let's sit down and say, "Given the amount of resources that you have and so on, can you really make it, can you really go there from here and still maintain this elusive thing, the quality of life that your area would like to have?"

So just let me show you just for a minute here a model which we developed which is built on the ecologist's concept of carrying capacity. To use this in terms of an animal population is a very simple idea.

It just says that given a certain amount of resources in a particular area and a given population, how many of the species can be supported within this particular locale.

We took and talked about the government standards of growth models that we have seen in the past and said, "Okay, suppose we have a desired growth in the private and the public areas and we have a population growth of a certain level that either is an extrapolation of the past or a desired growth for the future."

Now, let's take these growth periods that we talked about and, through a system of production functions or through a certain series of logarithms which describe how these growth curves actually take resources from a particular area in trade with each other, let's now see what this is going to do through time.

That particular part of the system is very, very standard for any economist or growth theorist. It is one that has been used for a long period of time.

What we did was to add to that two other parts of a system. This one here is the one that we hear a lot about in the newspapers now; constraints which are set upon us by physical limitations such as energy or raw materials or labor or water or anything else.

This is a relatively new phenomenon that we have only heard about over the last several years, unless you happen to be a professional ecologist; it came in with the ecological movement.

It is an attempt to quantify the quality of life. In this case here, we took these two things here and we said, "Let the desires of a community or a world or a nation or whatever you like—but let's say a community in this case, this is what the community wants their future to be like."

"It wants a certain level of education, a certain number of roads, a certain degree of safety or anything else that you would like and it has this many resources available to it.

"Given the growth that they expect in terms of population and the like, can they really get there?" That is simply the system as it was set up, and it works fairly well and is a reasonably decent description of how society operates.

Well, building computer models is great fun and long range analysis is something that is important and comprehensive analysis is something that we are all going to have to do—so says somebody—but it became obvious to us, reading the number of publications that have come out recently, listening to policy level sessions and the citizenry, that very, very easily, long range analyses, particularly ones that take resources into consideration, end up to be doomsday analyses; in almost all cases, it looks like we can't get there from here.

And so we sat down, the two of us, and, for this paper, tried to say there are a number of pitfalls for doing long range analysis and, using this model, we are going to demonstrate for you six cases, all of which are basic assumptions, all of which are basic theories proposed by highly reputable people in philosophies or politicians or whatever else you would like or analysts and have been for a long time.

They are not new assumptions right now. Yet, taking the very same model, the very same data base and just changing the basic philosophy, you get completely different results. Ted, why don't you take over at this point.

MR. WILLIAMS: All right. Let's talk about the model as we have it here.

Our ability to "foresee' is still not improved a great deal from the days when our ancestors turned to soothsayers and wizards for a similar service. Our primitive forecasters had little known formal techniques and knowledge to rely upon and so, had to turn to magic and visions to ply their trade. There are numerous differences, as well as similarities, between the spells and incantations of the days of yore and the methodologies put forth to carry out a similar art today.

Recently, a study for the Environmental Protection Agency listed a number of the current techniques used over the past decade or so by various groups or scientists engaged in a series of studies, all headed under the rubric "futureology." There were at least two earlier studies on technology forecasting readily available to us. The first is the well known text by Joseph Martino entitled, "Technological Forecasting for Decisionmaking";[1] and the second, a comprehsive study done by a Washington based firm, the International Research and Technology Corp. on the same subject.[2] Since both of these studies as well as others, covered the topic of what kinds of processes, ranging from the Delphi technique through formal modeling, the EPA study was to review the pure techniques as well as go beyond and see how they were actually applied in the field.

It is not the intent of this paper to analyze any of the techniques noted above. On the other hand, the survey will serve to show that the method (forecasting by mathematical models) discussed in this paper is not unique and that the obvious weaknesses associated with the technique are being, or have been, investigated and mitigated more or less systematically by others. It is likely as the forecasting techniques evolve and are increasingly used on real world problems that they will actually be developed by less formal partitions than would be assumed by the above descriptions. Consequently, the resulting applied methods for specific problems would be combinations of the "pure" methodologies. One of these methodologies that is often chosen to be a part of these technique combinations is computer-based mathematical modeling; the subject of this paper.

It is the purpose of this paper to look, in some depth, at the potential for modeling the routes from the present into the future. We shall not be concerned with all

[1]Martino, J. *Technological Forecasting for Decisionmaking.* Policy Science Book Series, American Elsevier Publishing Co. New York, 1972

[2]*Forecasting, Planning, Resource Allocation Source Book,* IR&T, undated, unpaged.

of the various modeling tricks and techniques practiced today (although reference to a sampling of these will inevitably come up in the course of our discussion) but will be concerned with what we can learn about the future by using models. Further, because such a topic could lead us off in numerous different directions, we shall deliberately confine our discussion to an analysis which is "global" in scope. We use this term not to suggest that the subject matter will be another addition to the ever growing literature of world models[3] (although the discussion will be applicable to this group as well), but more to suggest the range of topics addressed by the procedure. Such global models might include regional variables as population, raw materials, pollution loads, the quality of life, the private and public sectors of the economy, and so forth. It is the attempt to deal with this wide scope that presents us with our first set of problems.

PROBLEMS WITH PREDICTING EVERYTHING

The age-old adage of "jack of all trades, master of none," is often ascribed to models which attempt to be comprehensive versus those which are more limited in scope. This statement is hypothesized from the assumption that because time, funds, and knowledge are always more or less constrained in any endeavor, it seems logical to assume that more information about fewer things ought to give greater forecasting accuracy. Personally, I am not convinced that this seemingly reasonable hypothesis has much validity in the present state-of-the-art due to inadequacies in our knowledge base at all grains—coarse or fine. However, to placate those who would raise a fuss in this regard, let us seek refuge in the assertion that accuracy is likely to be improved by adding to both depth and scope to all analysis techniques and grains as our science allows us. Our specific contribution to the day when all information required will be available will lie in the area of improving the algorithms to handle the full available scope. What is lacking in terms of definitive hard information will be assumed to be compensated in part by the way in which we construct and apply our forecasts. The lack of science is therefore to be overcome, not by illusion as practiced in the past, but by techniques akin to art; the innovative application techniques. It is this differentiation that we shall now turn to.

[3]McLeod, J. *Simulation in the Service of Society.* La Jolla, Calif. Vol. 4, No. 8, August 1974.

ASSUMPTIONS AND FORECASTS

Long familiarity (common sense) leads one to the eventual realization that the results of most modeling forecasts were built-in to the structure by the designer of the model. To demonstrate this we shall in this paper take the same model with the same basic data set, and progressively move it through six stages; ranging from pessimistic outcome, to one mitigated first by technology and then by adding on varying population growth measures and finally, to a forecast which utilizes a constantly changing cultural base to forestall a cataclysm. In the end we will attempt to synthesize these techniques into one which will be of use to present day decision makers. The model to be used in this exercise is conceptually described below.

A MODEL OF CARRYING CAPACITY

The state-of-the-system (SOS) model[4] is a conceptual attempt to weld the growth desires of a population with the limitations of the locale. The model has been designed to test various assumptions about the desired growth of an area for a set of side conditions (boundaries, constraints, or thresholds.) Feasibility is demonstrated if the desired growth can be achieved without violating the side conditions.

As examples of the side conditions, the model would translate higher-level laws (federal and state, for example, if the model is of a local government), health thresholds, natural boundaries and the local desires into quantitative side-conditions. Specifically, one could set values such as a minimum level of subsistence per family, a maximum unemployment rate, the various environmental standards, housing and other industrial-commercial codes, density levels and minimum education levels.

Such a model could be used to analyze at least three types of questions: (1) to test the ability of the present growth trends to achieve the goals of the locale; (2) to test the probable life of a system and discover the most viable and critical linkages and constraints; (3) to analyze the effect of different policy alternatives as starting points.

[4]Although modified considerably for purpose of this paper, the reader is referred to Williams, E.R. and House, P.W., *The State of the System (SOS) Model.* U.S. Environmental Protection Agency. GPO #EPA 600-5-73-013. February 1974, for more detail on the model. We shall not repeat the algorithm structures here.

STRUCTURE

The state-of-the-system model includes three major elements:

(1) Sectors of growth. This consists of three components: the population measured in terms of physical needs—i.e., as consumers; the private production sector; and the public services sector. The two latter components are measured in terms of level of expenditures for maintenance and production per year. The private sector and the public services sector each can be subdivided into component categories (e.g., heavy industry or education services). While the population growth is not divided into components, it can be partitioned into special need groupings in response to the relative levels of output by the components of the private and public sectors.

(2) Production component output. This refers to the output of regional economic systems during the period, which is available for regional consumption. Net export levels are included.

(3) Limitors and constraints, (on the regional system). These include the input limitors of resource availability and societal constraints representing demand levels placed upon private and public sector output to maintain an acceptable (or desired) level and quality of life (QOL).

The interaction of these three model elements is illustrated in Fig. 1. Using growth projections and estimates of output for each regional production component, the model provides an analysis of limitors on the production output, determining apparent shortages in resources or deficient quality in ecosystem media. The model also determines short-run failures in meeting level and quality-of-life demands.

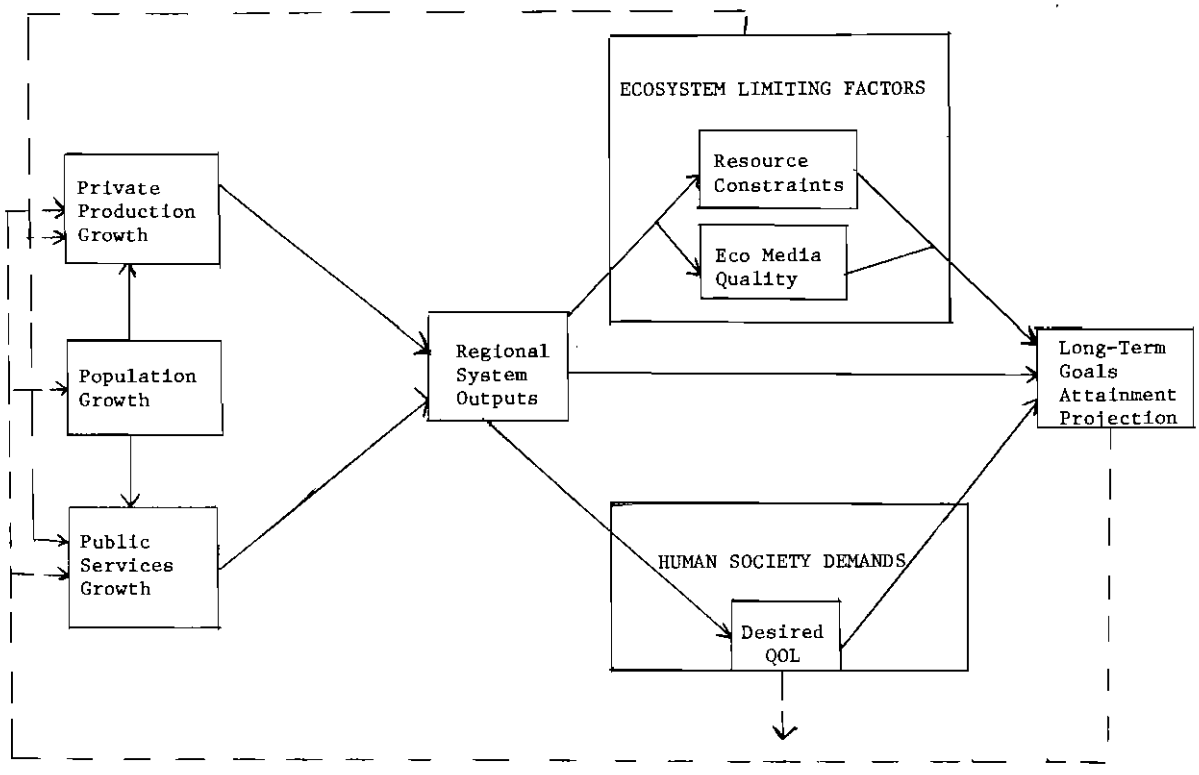


Fig. 1. Conceptual form of the model

MODEL FORMULATION

(1) System inputs. These inputs include total regional funds and allocation of expenditures to the private and public sector and the population size and age distribution.

(2) System outputs. These relationships translate the inputs to an overall demographic and economic picture of the region for the year considered.

(3) State of the System. These relationships are associated with the system limitors or constraints. They define the resource utilization and the quality of the environment.

(4) System adjustments. The relationships associated with the long-term goals provide the necessary adjustments and feedbacks when the state of the system is found to be incompatible with goals. (8)

Total production growth: The model takes its impetus for cyclic iteration from yearly growth and development rates. The efficacy with which the growth rates are changed by the feedback loops is the key to the success of the allocative portions of the model. However, while the growth rates can change, the total endogenous and exogenous inputs to the regional system cannot.

This level of regional funds sets an upper constraint on input to the production sectors and components for the current cycle. The process of funds allocation to production components is done subject to the condition that the funds of the components are equal to the total regional funds. The allocation process has two major steps. First, an expected allocation of funds is provided that the relative growth rates set and adjusted for each component in the past cycle are followed. Additional increase or reduction of growth rates is introduced as functions of net exogenous-funds-available and the population preference for goods or services.

The production sectors: The sectors of regional growth, other than regional population, are the production and services components of the private sector and the public sector. The dimension of growth for both sectors, and hence their input to the system, is the level of funds used annually to procure and transform resources into capital and ecosystem maintenance and sector production outputs.

For the private sector, production components are established; e.g., heavy-polluting industry, light-polluting industry, commercial goods and services, agriculture, and household-related industries. In the public sector, components include safety, defense and administrative services, health, and transportation/communication. In the model, each of these components has related with it at a yearly rate of growth.

The population sector. Population growth as such is not seen as significant in the sense of regional limits until it is related to territory—the larger the physical space in which the population is housed, the less pressure is exerted on the group in the sense of food and living space demands (5). The population is grouped into ages to represent such things as labor resources and to determine the expected consumption rates of the population affected by the size of the partitions. Included in this partitioning process are a number of factors that can be correlated to the regional outputs to represent the present socio-economic level of the society. Typical partition characteristics include:

- length of immaturity/educational time
- rates of short-term and long-term infirmity
- ratio of educational units to work units achieved in each age grouping
- death rates by age grouping
- size of worker force, further partitioned as:
  —employed, paid workers
  —unemployed, paid workers
  —workers not in paid status (housewives, volunteers)

The population characteristics are assumed to change directly with the production and services levels of the private and public sectors, e.g., shifting population elements from unemployed to employed.

SYSTEM OUTPUTS

The major measures to be used for system output are the expenditures of the various production components to produce the output. Expenditures for maintenance include capital depreciation, the costs of effluent treatment (5), and the annual rate of capital investment required. The maintenance components are obviously not constant over time.

RESOURCES IN THE MODEL

A key element in the State-of-the-System model is the

treatment of resources. SOS attempts to anticipate adaptive changes through substitution of resources of similar types (or strata), and to account for the discovery and (delayed) development of new areas of resources as a function of resource prices.

The idea of ecological accessibility as a limitor has meaning in resource constraints also. The availability of resources at any particular time is the result of the interactions among the nature and size of man's requirements, the physical occurrence of the resource, and the means of producing it. Estimates of the future availability of resources, therefore, require the assessment of economic and technological conditions, the level of production that would take place under different economic or technological conditions, and the nature and quantity of the total physical stock of both "renewable" and "nonrenewable" resources.

The model follows the traditional definitions of resources used in manufacturing and services, and considers eight resource groups: energy sources, natural resources (durable ores), agricultural resources, food and fibers), land, workers, capital (including R & D funds), air, and water. These eight groups can be divided into the categories of non-renewable resources (natural resources and energy sources) and renewable resources.

The following general rules can be associated with all resources represented in the SOS model:

(1) The available resources at any point in time can be associated with a unit procurement cost.

(2) At any period in time, the stockpile of a given resource in absolute terms is unknown. However, the quantities available as resource reserves at any unit procurement cost can be known.

(3) For any resource, the indication of a perceived resource crisis occurs when the present resource stocks can no longer produce a unit of the resource at the usual unit cost.

(4) The resources of ores, foods, fibers, and land have resource strata within the general resource category. Energy can be viewed as a single stratum. Within any stratum the mix of associated resources used to make up a single unit of that resource stratum is maintained without change unless a stock depletion signal occurs for a resource in that stratum.

(5) If a stock depletion signal for a resource or a stratum occurs, a check of allowable over-cost substitutions is made to determine if another acceptable resource mix or replacement can be made.

(6) For any substitution process, the full change may require several time periods. The appropriate resource mix is automatically used in production processes for each time period.

(7) In addition to the expansion of a critical resource base by substitution (which is not only nonlinear but asymptotic to some unknown upper limit), the availability of resource total stocks is checked to determine if the unit cost will cause a greater stockpile of the resource to be transferred to the reserve status. Such increments are carried out using a time delay function for activating the new reserve sources.

(8) The natural resources and sub-categories of other resources can include a recycling expansion of available ores. The rate of maintenance of a minimum unit cost from the complementary sources of extraction and recycling.

(9) In its present form, the original source of transportable resources (ores, energy, foods and fibers) is not considered.

AVAILABLE RESOURCES

A key feature of the models' consideration of resources is that the "available" reserve level is the amount that can be extracted (or otherwise obtained) at a relatively fixed unit cost (1). Thus, resource levels can be increased by improved processing techniques or by accepting a higher unit cost.

(1) Energy. At any time the total energy stock available to a region is the sum of the amount of the various energy sources.

(2) Natural Resources: Natural resources, like energy, are normally viewed as a nonrenewable

category. However, there are two important hedges in considering the actual stock reserve at any one time. First, for many of the ores a high level of substitution of other resources in the production process is possible. A second hedge available is the ability to recycle debris from processed and consumed goods to regain natural ore in the form of salvage. This procedure sets a resource reserve that is once again variable by cost, i.e., the recycling costs that will determine the level of ore salvage from the system debris.

(3) Land. Methods for expanding reserves of a land-use category are similar to other resources. The maximum potential for transformation at various cost levels is defined and, if added to the existent stock of land, represents the total stock level for a region at a given land cost. From these data, a resource reserve generation procedure (as used in nonrenewable resources) is possible. In this procedure land-use succession is activated for a given land use type as the unused reserve reaches a stock depletion warning level. At that time additional reserves for that land use are generated by a minimum cost algorithm. The major difference in this category from ores is that generation of new reserves in one land use category requires its removal from others.

(4) Agricultural Resources (Foods and Fibers); Based on resource availability, a greater emphasis should be placed on the agricultural portion of the resource base and on its output, food and fibers.

(5) Capital. Capital is also an important renewable resource used as an intermediate step between raw materials and final consumption.

(6) Labor. Labor as a resource is measured in work units. The partition for paid workers provides at any time the instantaneous maximum labor supply level. The labor cost is a function of the rate at which this level is utilized. Additional labor units can be generated as a function of this rate by transferring, in later time periods, work units from the population in training or in unpaid work activities.

(7) Air and Water. The model is not concerned with the "level" of air or water, but with their pollution.

LEVEL AND QUALITY OF LIFE

Major elements of the state of the system are measured in terms of societal perceptions—a set of judgments dealing with various components of level and quality of life. Our particular system must be area-specific and represent the planning system responsible for the adjustment of growth and output to achieve an acceptable state. Hence, only a general formulation of measures can be provided here.

In planning systems responsible for the achievement of the comprehensive plan goals, the procedure is reasonably straightforward. Each goal by itself is a specific threshold to be realized. The relative importance assigned the goals in the plan provides a set of weighting coefficients to determine priorities in establishing tradeoffs, given that total achievement of all goals cannot be accomplished. Thus, the only requirement in setting of goals is to restate the goals in terms of parameters developed in the model operations.

Another alternative is a planning system that requires achievement of certain minimum values to achieve an acceptable state. It involves supplementary measures relating to the resilience of the system in remaining above the minima. Each of the collection of measures has a dissatisfaction threshold and a resilience capability measured in terms of the relative level above the threshold. Unlike the first system where the measures are generated directly from the comprehensive goals, a set of measures must be selected in terms of the area-specific needs and desires of the society in the region. A minimum acceptable value, rather than a goal of achievement, is set. Of greater difficulty is the setting of relative weights to combine the measures. Instead, an iterative process can be carried out which measures the state of the system and then adjusts fund levels among the production components until all thresholds are met.

SYSTEM ADJUSTMENTS

If a given state of the system is found unacceptable, a set of adjustments needs to be effected to improve the situation. The adjustments are performed in the following order:

Short-term adjustments:

(a) short-term deferral of capital maintenance and/or
(b) expenditure of net export balances to achieve additional production output funds for the purchase of additional resources or the importation of goods.

Long-term adjustments:

(a) changing input/output production functions to achieve the minimum cost mix for components contributing to unacceptable value.
(b) reallocating the total projected funds level within a sector to better balance projected growth rates and needed outputs of deficient components.
(c) scheduling on a permanent basis the annual transfer of funds from one sector to the other and then repeating procedure (b).
(d) adjusting the rates and direction of net migration to reduce per-capita consumptions needs if significant unemployment exists in the region.

If none of the long-term adjustments produces a satisfactory correction of the projected state of the system, the system goals are modified to lower levels. This will allow a possibility of maintaining the regional growth projections at the cost of a less acceptable level and quality of life.

The system reaching its carrying capacity may merely suggest a short-run imbalance of the demand and supply of a specific resource. This imbalance can be corrected by changing the rate of extraction and distribution of the resource in question. If, on the other hand, the reaching of a depletion symptom at a particular point in time heralds the beginning of a serious shortage of a particular resource, there are numerous possible responses, such as:

- increase the rate of extraction, despite increasing costs
- supply from other regional systems at higher costs
- change the population's demand function
- change the growth rate of specific sectors in the system.

From this brief description of the model and its structure, we shall proceed to demonstrate the thesis of this paper; namely that the results of many of our present modeling efforts may or may not be accurate reflections of reality, but they surely are governed by the assumptions made in the analysis.

THE DOOMSDAY PARADIGM

Mathematically, it is trivial to note that the iteration of two interrelated variables through time, the larger fixed and the smaller growing at a rate that does not decrease, regardlessly how slow that growth is will eventually result in the reversal of the original situation. It does little to this basic postulate to either vary the rates at which the variables grow, or to add more variables. Eventually, the most rapidly growing variable will become dominant. In physical terms, this postulate might suggest that Nature which abhors a vacuum, is also intolerant of rigid stability.

This logic is the basis of forecasts from Malthus to those today which predict an exhaustion of one or more of our resources. Although there are various ways such a model could be constructed, we can hypothesize that one might take the following form (Figure 2).

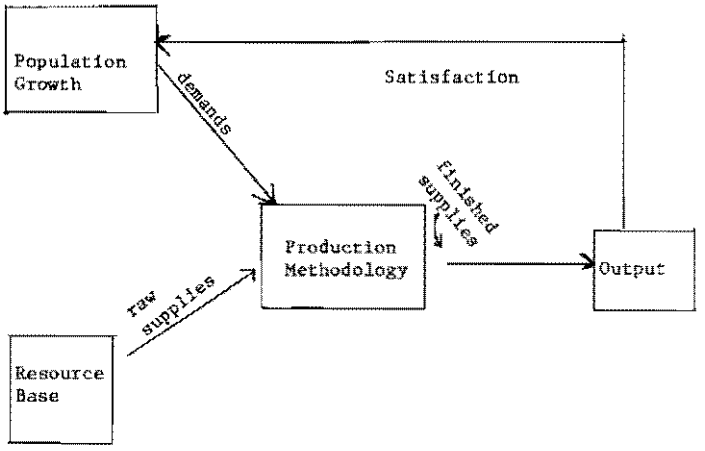


Figure 2

Population—Let us assume that we have an initial population of 200 million people. These people are born at a rate of .0182 per year and die at a rate of .0094. Taking migration also into account, their natural rate of increase is 2.2 million people per year.

For purposes of this scenario, the populace is divided into several age categories (each with its own birth, death, and migration rates) and also partitioned by its needs and resource contributions. For example, in the

first year of our forecast, 59 million people require education, 2.5 million are on welfare, 80 million are available for the labor force, and so forth.

There are a total of some twenty raw materials and such included in our model. Among these are iron, water, lumber, chemical, services, labor, the externalities of pollution, and so forth. These items are segregated on the basis of being either replenished each year (the number of workers or lumber, for examples) or exhaustible (coal or oil). The latter category has the possiblity of being expanded through more rapid depletion, but there is assumed to be some likely finite limit to the resource.

The productive methodologies are represented by some ten production functions—or sectors—which take the expressed needs of the populace and provide them goods and services; five private; including heavy and light industry, commercial, agriculture, and residential; and five public; including transportation, education, welfare, health, and safety. These services are assumed to be provided as they had been in the past. It is the rate of provision of these goods and services that will determine when our system will crash; if we assume that each year we shall want more and more of everything, the crash will be sooner but in any case, the rate chosen will not greatly influence the outcome. For illustrative purposes, we shall extend the recent historical growth rates, with no change.

ANALYSIS OF RUN 1

For illustrative purposes, we have taken the historical growth rates of funds availability and have slowed the rate of growth on a consistent basis for this and every run.

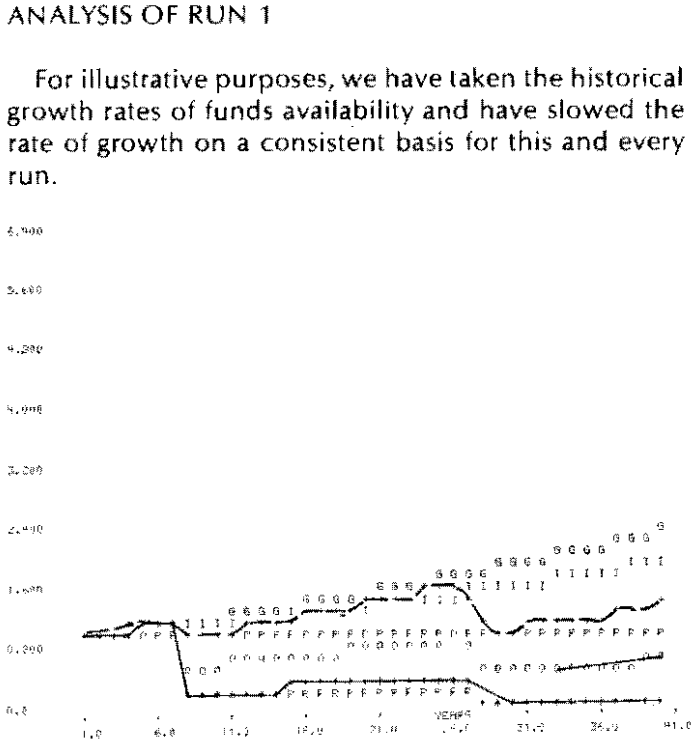


Figure 3 provides the forty year summary graph of this first case, providing a set of statistics as ratios to the initial year values. The statistics used here are:

- G is public sector funds
- \+ is public sector output
- I is private sector funds
- * is private sector output
- Q is the composite QOL measure, made up by weighting 11 individual demand measures
- P is population

The results of the first run reflects straightforwardly the basic assumptions. The funding patterns have no mechanism to cause change and therefore they provide smooth graphs of growth. The output of the private sectors (*) exhaust as predicted by the static data, the raw materials, mercury, in Year 7. Since four of the five sectors require this material production, private output immediately collapses to about 20% of the original private outputs. In Year 27, oil is also depleted and the private sector outputs become negligible.

The public sector requires mercury in only one of its five sector production functions, in a relatively slow growing sector. Thus, the Year 7 mercury depletion causes only a 15 percent output constraint. The Year 26 depletion has a greater effect on the public output depressing output 40% and affecting three output sectors.

The composite QOL measure after Year 7 recovers about 75% of its original value. Analysis of the more detailed measure provides the obvious insight that demands are not met in a balanced form, hence the true QOL is much lower.

Thus, we see that the rigid, non-adjusting assumptions provide an answer close to the static analysis. Early depletion of a necessary resource caused a general collapse of goods output and a lesson depression of service output. No method of adjustment was available to move from this early inevitable fate.

THE TECHNOLOGICAL FIX SCENARIO

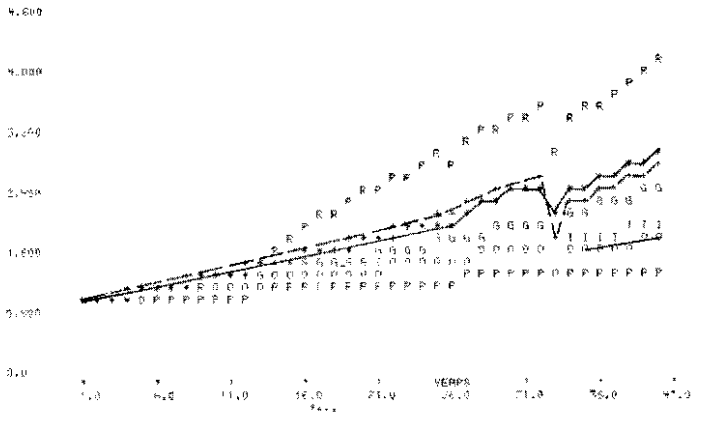
We shall next discuss a scenario that has variously been suggested as one which would mitigate against the blind enigma of resource depletion. The logic behind this philosophy, simply stated, is that the resource base is not really static but through greater use of increasingly advanced technology and increased

economic incentives, more resources can be found or exploited plus substitutions can be developed for many resources where natural limits are non-convertible. Certainly, there is much to be said for such arguments, particularly in Western Society where as far back as the Industrial Revolution, when mechanization apparently broke the man-land ratios that determined an agrarian societal size largely on the basis of the food supply.

To simulate the technological fix scenario we added the features of substitution of raw materials to the model and allowed the system to also substitute production functions to ones that were more economically suitable under the given resource constraints. Again, it is the timing and choice of these substitutions and alternate production functions that largely determine when the society will crash. In this scenario, if we are willing to engage in great optimism or science fiction, there could be no foreseen limit of man's existence. Although a comforting thought, an ever fruitful technology is not apt to be the answer all the time. For our purposes, we have chosen a limited number of substitutions and production functions and only permitted inclusion of changes that are believed to be possible in the next decade or two. Admittedly, a conservative tack but sufficient for illustrative purposes.

ANALYSIS OF RUN 2

Unlike the previous graph, the production system collapse does not appear and modest growth with some perturbation is produced throughout the forty year period. The model made some early adjustment to overcome the mercury and other scarce material depletions and maintains a smooth growth pattern until Year 31. The cost is essentially in greater use of other resources and fuels as reflected in the rapid increase of resources usage statistic. The problem is not fully gone however; in Year 33, a production dip occurs due to oil becoming scarce and although some recovery occurs, the production trends do not recover to those of the earlier years.



In comparison to the first graph, note that the QOL measure rises steadily until Year 30 and then its growth is somewhat moderated. Also the population statistic shows steady increase unlike the first run where outmigration matched the birth rate increases.

The pattern shown here is typical of technology-fix outputs of a finite fix set. The output can extend the period of growth; the sawtooth drops in levels will occur to flag a need for a fix; many recoveries are possible but finally the set of adjustments that are viable are exhausted and the output drops will be below original output levels.

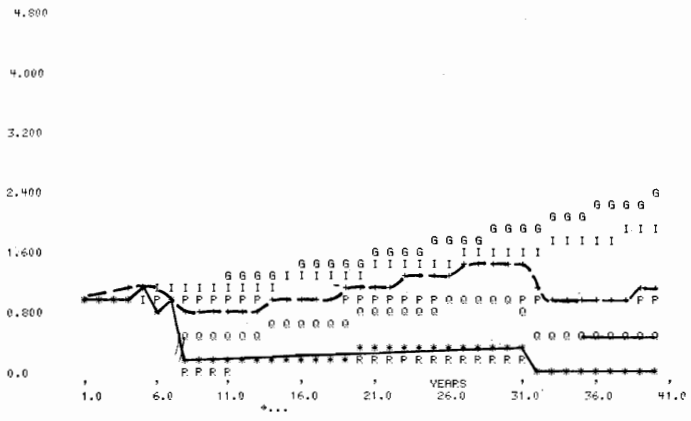
POPULATION POLICY

Population policy is historically nature's own adjustment means to limited resources. When a species outstrips its resource base, the anticipated reaction is for the numbers to decrease, through decreased births, exmigration, and ultimately increased deaths. Many man-created programs have encouraged the former two policies with the hope that a reduction in the number of people would allow the society to begin to establish sufficient surpluses to "take-off" into greater industrialization. This stratagem is therefore an extension of the previous one; increasing the resource base through technology.

On the other hand, there is much to be said for keeping a population that is in equilibrium with its environment through zero population growth. By definition, an equilibrium position is the optimum for survival of a populace in a particular locale, given certain living standards. Regardless of the rationale, for demonstration purposes we shall illustrate the impact of our limited growth scenario by adjusting the population to fit within the bounds determined by the resource base.

ANALYSIS OF RUN 3

Figure 5 provides the same data base as the first graph except the native birth rate is set equal to the death rate and immigration is set to zero. The results, much the same as for the first case.



On reflection this is not surprising since a ZPG adjustment system which may have utility in long term adjustment is not a useful short term measure by itself. And this effect is graphically illustrated here; the collapse due to mercury depletion still occurs in year seven; the impact still reduces the goods production to unacceptable levels. The slowed population growth policy does have some effect after a generation; the secondary collapse in the public sector now occurs in Year 32 rather than Year 27. Thus, although the same patterns must finally occur where the only system adjustment is population demand levels, we do see a longer performance time if collapse is a generation or more away.

This effect can now be combined with the effect given in the technology-fix scenario where the first major perturbation occurred with a production drop at Year 30.

COMBINING POPULATION POLICY AND TECHNOLOGY

This fourth situation is reminiscent of that found in several present day Western societies, including the United States. We have a combination of a declining or stable population and a technology which has changed the natural resource mix of the society, allowing a significantly greater man/land ratio than that of a simple agrarian society.

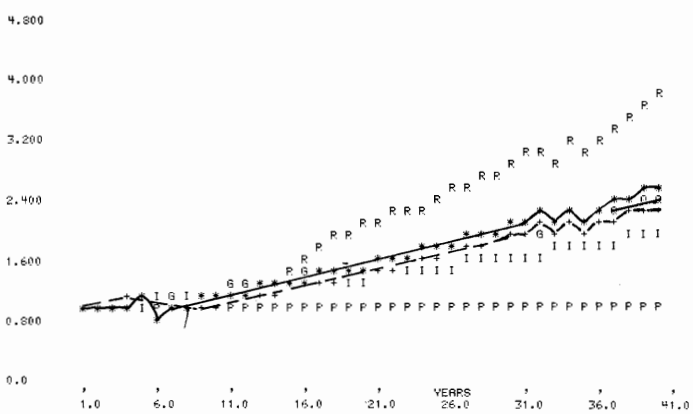
As with the Technological scenario above, the assumptions made will truly determine the societal future. With a stable population (able and willing to adjust demands downward to maintain a constant standard of living) and a set of very liberal assumptions concerning technological discovery and substitution, such a society could have a very long run. Again, we shall assume a more conservative technological future for our purposes.

ANALYSIS OF RUN 4

This fourth case, combining the adjustments of technology (Case 2) and reduced population growth (Case 3) does in fact moderate the effect noted in the later years of the run. The problem still exists, note that the output trends of both the public and private sector outputs are slowing as well as becoming more ragged. However, the single year drop of 30 percent is no longer produced.

A penalty was paid for this smoothing, however, and was paid early. Note the output reduction that occurred in Year 5 for both public and private sectors. The lessening of immigration due to the ZPG assumptions reduced the labor force, causing a rise in salaries above the salaries in the pure technology-fix scenario. The drop and the output growth trends from Year 5 to Year 35 cause the level of outputs to be 10-15 percent below the pure technology-fix case. Therefore, while smoother growth occurs, it occurs at a lower output level and when the two rates are approximately the same, the ZPG case shows at least as much raggedness as the non-ZPG case.

Resource consumption in the later years is much the same; hence the merit of ZPG versus other adjustment techniques over this period of simulation suggests population growth has an effect but certainly not a dominant effect on the system becoming more viable.



CULTURAL EXPECTATIONS

It is the contention of this paper that possibly the greatest weakness with most of the studies above (although all of the related paradigms have appeared in the literature at one time or another) is that they all assume the maintenance of a given-constant standard of living. This assumption means that resources will be absorbed at specified rates and societal decline is synonymous with being unable to sustain such a standard.

Such an assumption is an over simplification and cannot help but lead to conclusions that are erroneous unless described carefully. A more complete analysis would contend that a single person or groups of people are much more adaptable than the assumptions made in the above models would suggest. When things are going well and there appear to be surpluses, there is a tendency to increase the wants of the group, either across the board or selectively. Further, this increase in demands comes about in a ratchet-like manner; meaning that each new level of demands for satisfaction is associated with production having met the demands of an earlier level.

On the other hand, Aesop, in one of his many tales, relates the human characteristic to "sour grapes." This trait allows us to rationalize our required behavior to act as if it were desired all along. For example, it suggests that if wood is scarce, cultural substitutes will not only be found (in the technological sense) but that the society will change in demand patterns so that the lack of this resource will be overcome by the use of other materials in building and the like.

This cultural feature can be surrogated by using a measure referred to as the Quality-of-Life. Recent studies[5] have suggested that this measure is very difficult to quantify and there is still considerable disagreement as to how (or if) such a case can be constructed. Here, we shall make use of an ongoing study of the Stanford Research Institute[6] and define the QOL as a dissatisfaction measure; i.e., as the relative distance the society is from a set of standards or thresholds it sets up for itself. We shall use the culture of the United States as defined by various laws and customs to quantify the measure and will allow for changes in these thresholds (both greater and lessening) with the growth of the system through time.

With this point-of-view, added to the Scenario (#4) related above, it is very difficult indeed to picture a society that can get into terminal decay; for whatever is not handled by population adjustment, is overcome by technology; if not reduced by these, then it is redefined by the culture so that the "crisis" disappears as long as subsistence is met.

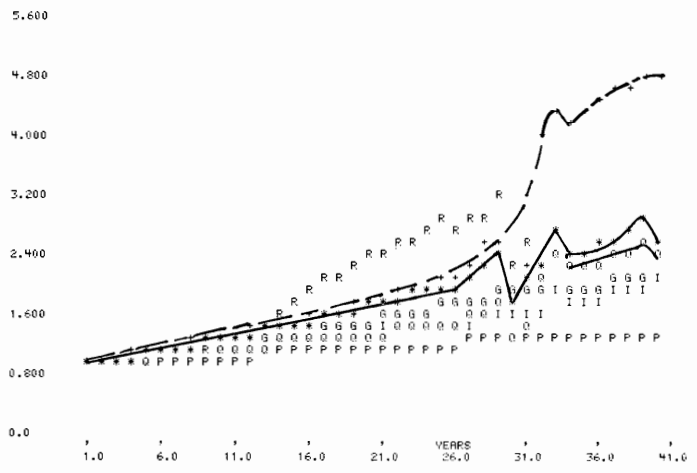
ANALYSIS OF RUN 5

As our fifth case then a new set of adjustment procedures in addition to technology adjustments is allowed. These include funds transfers between sectors plus changing of levels of output demands when the system demonstrates its inadequacy to meet the specific demand at the present expectation level.

Our graphs in this case show similar patterns to the technology-fix case through Year 26—that set of adjustments were sufficient to provide all needed system adjustments. During the last fifteen years of the run, the other non-technology adjustments were effected.

Due to the greater set of adjustments available, the system in Year 28, three years prior to the technology-only case, begins to show adjustments. A short term depressant on output is observed that puts into effect a shifting of funds from public sector areas to private sector areas. At the same time changes are made in the production forms for some public sectors allowing for an overall increase in public sector output at reduced funding levels.

The shifting of funds toward the private sector allowed a rapid recovery to the output growth trend provided prior to Year 26 and this trend is maintained.



[5]House, P.W. *The Quality of Life Concept—A Potential New Tool for Decision-Makers*, WERC, EPA, March 1973.
[6]Standard Research Institute, Draft Outline—*Quality of Life Indicators Based on Intolerability Thresholds.*

The QOL measure at the end of the simulation is running 50% higher for this case as compared to the technology-only case. All of the QOL measure components are being met adequately and the cultural expectations are shifting to expect future growth to be services oriented.

The penalty for having this new set of adjustment measures is increased raggedness in individual outputs. Since the system is shifting funds and modifying its cultural expectations, more short run perturbations are produced about the long term trend. The system allows not only for adjustments but also for overcompensations.

Generally, however, these true world additions to the system provide for greater hope for a successful long term run, even with the small number of adjustments given in our simple model.

WHITHER CRISIS?

Since we have held that the above scenario is conceptually the truest picture of how the long run future of a society is determined, how then do we explain crisis and societal collapse in a technological society? It is clear that the logical flaw in the above lies in the implicit assumption that adjustments will take place smoothly. In the majority of cases such an assumption is justified in a long run model, as the dislocations caused by system adjustments are not likely to be important in the long run. On the other hand, it is these very adjustments that can be looked upon as crises. The shift of a culture from two houses to one, from large cars to small cars, from public entertainment to television, and so forth is not apt to come about overnight. Most of the adjustments required are benign and, given the fact that the society is reasonably healthy, not apt to be overly troublesome. Bottlenecks and short-term distributional problems are therefore put forth as explanations for the possibility of crises, even in a highly flexible society.

Finally, there is the possibility that these intermittent adjustment crisis can be highly damaging and even fatal to a culture. A recent work suggested a possibility of cultural dullness on the part of a society that was experiencing repeated needs to adjust its cultural basis[7]. Continued perturbations in this manner might bring about a situation of anomie or normalessness with concomittant sluggishness in the adjustment mechanisms. Thus, the society may not be prepared to adjust when a true distributional crisis arises. Added to this could be a situation when a continuingly upward climbing ratchet in terms of major elements of the societal QOL caused successive strains in the technological and substitutional ability of the system.

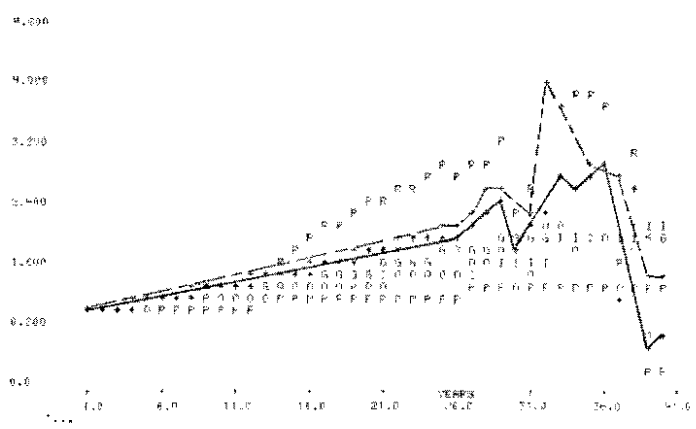
As with the previous scenarios, this situation is possible to simulate only in a pedagogical fashion because the variety of situations really attainable is very large. Consequently, in the scenario below we shall take the picture of the U.S. as presented in Scenario 5 and adjust it in such a fashion that its total resilience is low and the cultural and technological adjustment ability is slow to react.

ANALYSIS OF RUN 6

This graph depicts the effects of sluggishness, considered here as an unwillingness to lower specific and cultural learned needs.

Note that once again the run results through Year 20 are similar to the last graph and similar to the second, the technology-fix graph. Also as in the last graph, a set of fixes are set in motion that make required adjustments to provide additional funding and production adjustments to output sectors in trouble.

However, in the last run these adjustments included compensations by lowering expectations in areas that are not as critical. For this case those expectations are not allowed to be lowered. The results of the "guns and butter" syndrome is a rapid depletion of the critical resources, causing all expectations to be met well for three years, then all expectations to be slightly missed



[7]*Toffler, A. Future Shock.* Random House, New York, 1970.

for about 6 years and finally, a collapse of the outputs in the final 2 years of proportions similar to that which occurred in the first graph when no adjustments were allowed.

Thus, we complete our survey of six sets of assumptions by returning to a rigid resource use system due to an unwillingness of the demands of a specific area to be reduced. This rigidity of demand for output returns us to a prediction of collapse—not at seven years as the static data suggest but rather after many adjustments to meet the continuing demands, to a system that has exhausted other resources and hence collapses at Year 39.

Thus, our series of six runs suggests that a long term solution requires not only technology and funds transfers but also a requirement to change cultural expectations not only as rising wants but also to mitigate demands when necessary to moderate critical resource usage.

Audience listening to Dr. House and Mr. Williams.

SUMMARY

The six scenarios presented here are variously familiar to the reader depending upon his/her personal predilections on technical interests and training. It was not our intention to present these as a mere intellectual exercise but to relate each as a predictive scenario based upon existing real world data. As presented, the scenarios differed only in terms of their assumptions; the set of outputs was produced by the use of a single model, progressively modified to take into consideration the various assumptions.

The finding we have demonstrated could be simplistically reduced to a statement ascerting that care would have to be exercised in stating the assumptions behind a model's use. Undeniably true but not worth the length of this exposition.

More useful is the lesson to be learned from the seeming pendulum swing of potential results obtainable from a set of assumptions based on a long run vs. a short run purview. The earlier scenarios, although claiming to be long run in perspective, are logically faulty. One has only to study history and to observe the variety of cultural manifestations around the globe to be convinced of human adaptiveness. Equally instructive is the ability of man to change his technology (regardless of whether the rate of change will be slower or faster than it has been in the past). Possibly Western society will move away from an almost totally materialistic society and, because it has the potential for satisfying some equitable set of basic wants for all inhabitants, become more interested in service or philosophical pursuits. Such a society would not require ever growing productivity rates as in the past to adjust to its QOL trends. Herein lies one of the lessons. On the other hand, if this society is measured in terms of an idealized or present QOL pattern, it might fall far short of its specified goals and would, in an empirical sense, be said to be headed for collapse. In truth, since it has changed its cultural norms (or QOL) it has ceased to exist in terms of its former measure, however, this cannot be termed a "collapse" except to those who would not want a change from some traditional growth or state. In short, this type of "collapse" is equated to societal change and is an example of intellectual panic or subjective bias of the worst kind.

Equally instructive however, has been the discussion of Scenario six which points out one of the pitfalls of long range forecasting. Although true that the rules followed by those who would construct such predictions are different in many ways from those who are interested in day-to-day analyses (or the futurist is more interested in trends and cycles) it is possible to overlook potential short run adjustment situations that could have serious repercussions for the society, that are not overcome in the long run, but would normally be assumed away by the forecast assumptions. Consequently, the allegation that today's situation requires only that a long range viewpoint be added to standard policy analyses can be faulty. Analyses require not only long range and short range analyses, but also trend analysis so that the long range view be cognizant of short run phenomena; taking them into account selectively as they maintain an impact on the long-term trend. There will be much resistance to such efforts, as data and theory are weak. It is much more comfortable to draw profound conclusions from elegant models and take refuge in statements which proffer that the only error likely from this simplifying practice will be of

magnitude. As we have illustrated here, such errors can also be ones of direction. It is suggested here that the fact we should take the more accurate general long run model of the United States is one of optimism and adaptability. However, because of the short run distributional or bottleneck-type dangers cited above, research will have to be carried out to discover ways to monitor these adjustments for unfavorable short and long run synergistic effects. The more sophisticated we become and the more we ask for our citizens, the more careful we shall have to be of our policy choices. Assuming that the recurring crises of the past three years or so have been real, such monitoring cannot begin too soon. As with all devices, structural problems in our society have a better chance of being corrected if they are diagnosed in time.

Obviously, I can produce a quite different set of results, but we thought that it would be of some use to present that idea. May we take any questions?

MR. DUNNAM: In all your models, we didn't see infinite projections. It looked like to about Year 41, it was optimistic and then started down which indicates that, say, about Year 40 you are going to begin to get into serious resource problems, which are basic materials in almost any case, aren't you?

MR. WILLIAMS: Certainly, I can build some cases where that would not happen. It turned out, if you will look at that fifth case, it does go on for another ten years.

Whether it goes 12 or not, I can't tell you. I only ran it to 50 years. Obviously, I was using some computer printouts and they seemed to cut nicely to fit on these pages.

FROM THE FLOOR: Does that take into account any kind of recycling?

MR. WILLIAMS: Yes it does. We have six scarce resources working and we have a number of other elements working. It does take in the idea of exhaustible resources, exhaustible resources that have recycling connected with them, items such as fibers and foods where we are replacing over a period of time and, in fact, allowance of cycling.

It turns out three of our resource categories have land differentiations and we can resolve a situation there, perhaps, where we run out of land based on a limited set of assumptions.

DR. HORNBY: I got the suspicion as I looked at those charts, and I've looked at some similar to these in the past, that the old Malthusian policy is coming through.

DR. HOUSE: That was the first scenario.

MR. WILLIAMS: That would be Scenario No. 1.

DR. HOUSE: The purpose of this would be to show that if you don't adjust for substitutions or cultural expectations, it's a trivial mathematical statement and pretty much the Malthusian phenomenon.

Obviously, if you start with the basic assumption and build your model that way, you are going to come up with that kind of a conclusion. It is going to crash.

It really doesn't take a very big computer model to do it. In fact, you could probably do it faster with a pencil and a piece of paper. If you start with that basic assumption, you end up with that basic conclusion.

MR. ARMSTRONG: What are your per annums? Are you taking the actual data and you start out and say, "We are going to use these people within this nation, this nation's capability," or are you reaching outside the U.S.

DR. HOUSE: This is the U.S. First of all, this is a test model for us and we used a group of 40 or so of us in Washington who sat down and put it into the system at this particular time.

It's being reloaded now for another study which is more closely calibrated. The purpose of this is not to say that the world would end in seven or 40 years or anything like that.

The purpose of this was to demonstrate that the assumptions are all important and, as you know, you can drive the system in a completely different way by just starting in the beginning, and this points out Dr. Hornby's point, you can decide that that's the way it's going to go.

It's very easy to build a system that will end up that way regardless of how complex it is. The citizenry and the policy-makers who actually make use of models have to fear less, probably, the technical model than they do the assumptions built into it by the people building the model.

It seems that the overlap has to be there probably less than the overlap in the technical part of it itself.

DR. WALTON: Thank you very much, Dr. House and

Mr. Williams. Again, thank you very much for coming to Texas. We very much appreciate your presentation and your being with us.

At this time, I would like for the panel members, if they would, to come down and take their place on the podium so that we can begin with the panel discussion.

We have asked, as an integral part of this, that each of the panel members make a short five minute presentation as a reaction, perhaps, to some of the discussion which has ensued here.

Following that, Commissioner Armstrong will field the questions and then summarize. I think you will agree that we have assembled a most interesting panel for our discussion and reaction to the theme or themes, if you will, that have been set by the previous speakers.

It's a pleasure for me to introduce as our first panel member, Mr. John J. Roark, who is the Director of Transportation Planning for the North Central Texas Council of Governments. He is an alumnus with a Master's Degree from Texas A&M.

I must say that he has been instrumental in developing one of the foremost transportation planning programs that exist in any council of governments in the United States today. John, it's a pleasure.

MR. ROARK: I thought it might be most interesting for you, rather than giving a few remarks about the various comments that were made previously, to go over some of the conclusions that we have reached in a regional transportation planning program in the Dallas-Fort Worth area.

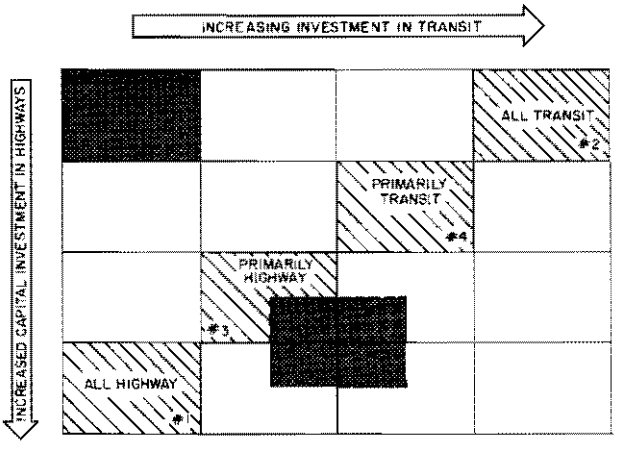
In this, we attempted to look at alternative transportation systems, beginning with the existing urban infrastructure, and project the influence of each transportation system on the distribution of population and employment within the area.

I have identified, in matrix form on this slide, the different alternatives that were evaluated. In the matrix, an increasing highway investment is shown vertically from top to bottom. Similarly, an increasing investment in transit is shown horizontally from left to right. Alternatives varied from a Do Nothing Alternative to either an All Highway or an All Transit Alternative. In between is what we call the Primarily Transit Alternative which is a combination, but principally has more investment in transit than in highways, and the Primarily Highway Alternative, in which highway investment predominates. Alternative #6 is a combined system and builds upon the Primarily Highway Alternative.

These are slides which we developed with the Regional Planning Coordinator of the Texas Highway Department and the local governments and which were used in presenting to the local policy group the conclusions from evaluating the six alternatives.

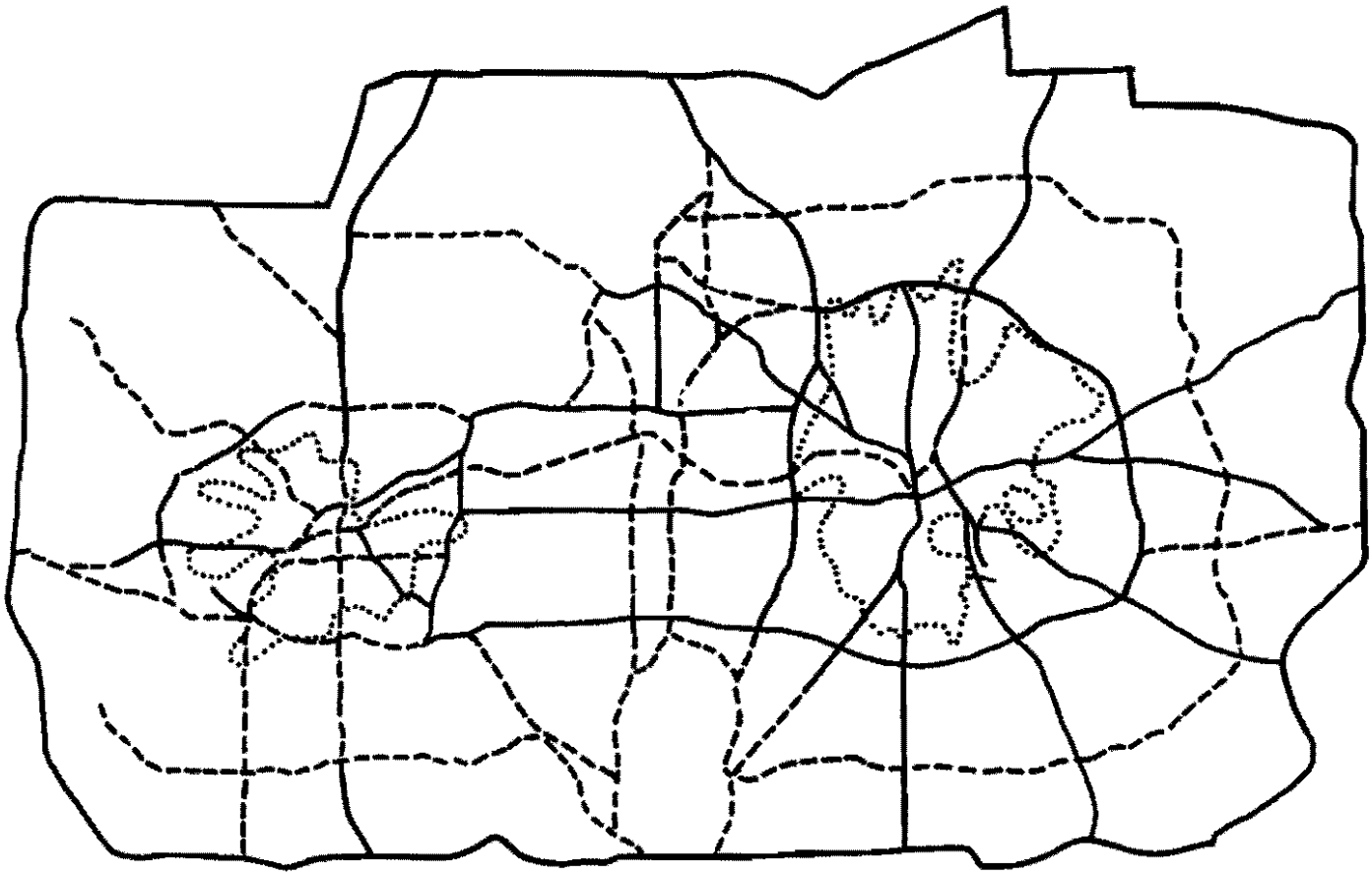
To give you an idea as to the extent of the system, the All Highway Alternative, Alternative #1, is shown on this slide, with the red lines indicating the existing freeway system. To orient you, this is the Dallas area; this is the Tarrant County or Fort Worth area. The black dashed lines indicate the proposed test freeways in the All Highway Alternative. The dashed red lines indicate the proposed improvements to existing freeways. The blue dashed area is the existing and future transit service area under the All Highway Alternative. This level of service, of course, was assumed to be maintained in its present form.

MULTIMODAL TRANSPORTATION ALTERNATIVES FOR 1990



At the other end of the spectrum, of course, is the All Transit Alternative, Alternative #2. In this case, the black lines indicate the existing freeway system, which, in this alternative, was assumed to also be the future freeway system. The blue line indicates a separate guideway transit system. The light dotted lines indicate the expanded transit service area, and the darker dotted lines indicate premium bus service, i.e., bus in mixed flow to major employment centers.

What we attempted to do under all six alternatives was to project various impacts which could be expected in 1990, should the alternative under consideration be implemented as the transportation system for



FREEWAYS

EXISTING - NO IMPROVEMENT

EXISTING - TO BE IMPROVED

NEW CONSTRUCTION

1990 SYSTEM ALTERNATIVE NO. 1
ALL HIGHWAY

the region. This involved the use of an urban growth simulation model to distribute a fixed population and employment under each alternative. Travel models were used to project trip generation, trip distribution, and assigned volumes. Projections were then made of congestion, air pollution, energy consumption, and accessibility.

To give you more of the comparisons among the six alternatives, this slide shows the capital cost of each alternative in 1974 dollars. The red bar indicates the capital investment in highways; the purple bar indicates the capital investment in transit. For example, in the All Highway Alternative, no investment in transit, some $2 billion was spent for highways. In the All Transit Alternative, there was a $2.2 billion investment in transit and none in highways.

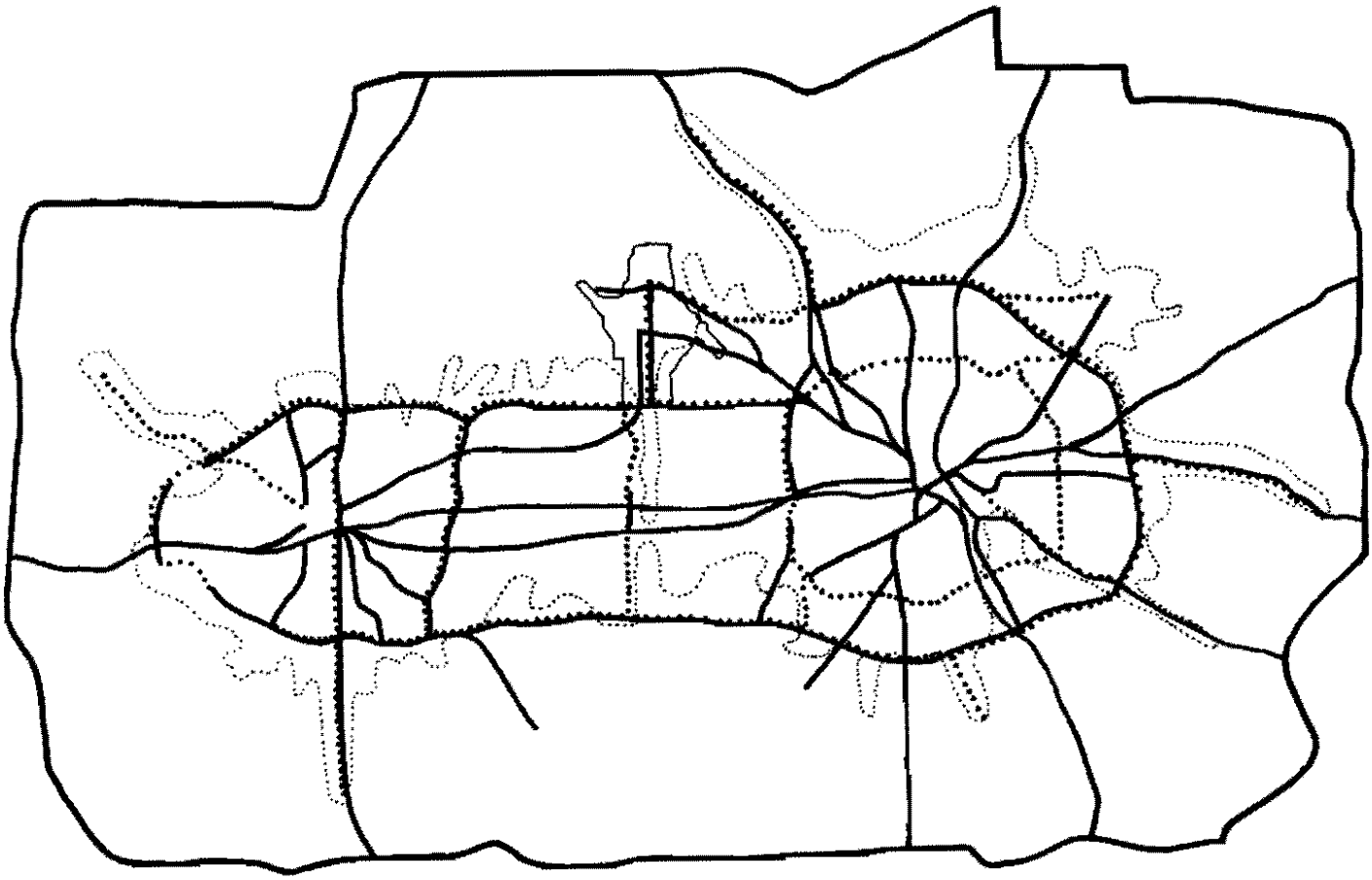
Let's look very briefly at the modal split analysis. Looking again at the six alternatives on this slide, the yellow bars are the total trips, the percentage indicating the per cent of the total trips attracted in transit. For example, the All Highway Alternative could expect to attract to transit approximately 1.8 per cent of the total trips. The All Transit Alternative could expect to attract to transit approximately 7.1 per cent of the total trips. The green bar indicates the work trips and, again, the percentage of the work trips attracted to transit.

Now, let's look, because our conference is dwelling on energy, at some of the projected impacts on energy consumption.

We were, in some instances, surprised in the results of the projected energy impacts. This slide projects the anticipated energy consumption under each alternative system. The dashed line indicates the estimated current level of daily transporation energy in BTU's. The yellow portion of the bar indicates the energy consumption in transit in the various alternatives, with the blue portion of the bar indicating the energy consumption by the automobile.

I think the significant thing here may be two-fold; (1) that the two highest are the All Transit and the Do Nothing Alternative—in the way of total energy consumption; and (2) that there is very little significant difference between the total energy that would be consumed daily by all of the six alternatives.

Let's see if we can look at that and begin to go through the rationale of our conclusion on some of these. This slide shows a computer plot of the daily trip table for 1990 under Alternative #6. This peak would indicate the Dallas central business district. This peak would indicate the Fort Worth central business district and the trips attracted to each CBD. What we found, in looking at the influence of transit in the All Transit

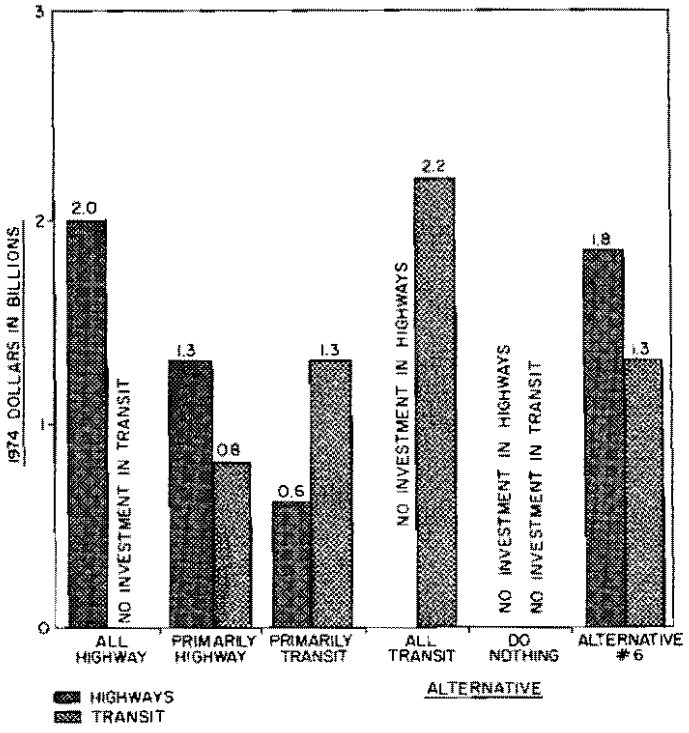


—— EXISTING FREEWAYS

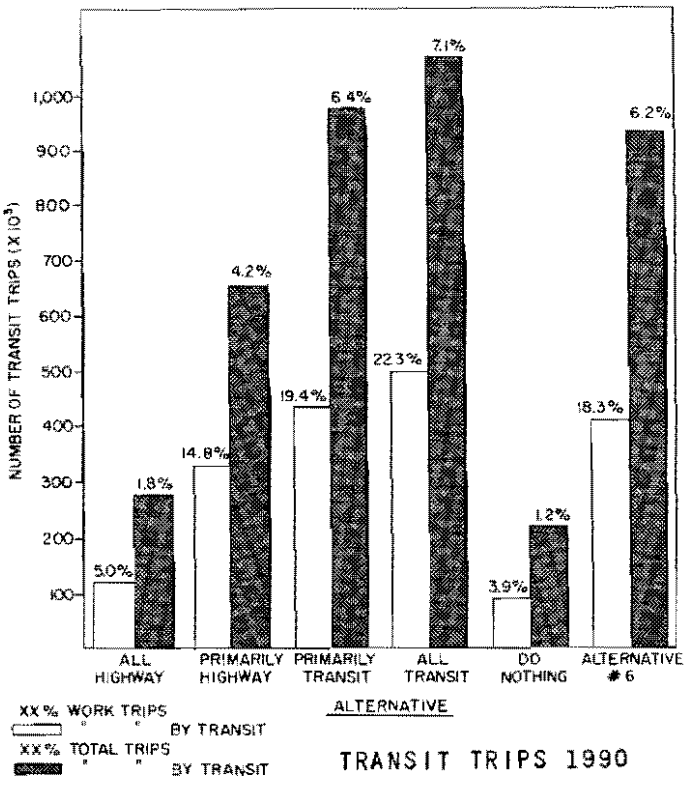
– – – FIXED GUIDEWAY TRANSIT

· · · PREMIUM BUS SERVICE

1990 SYSTEM ALTERNATIVE NO. 2
ALL TRANSIT



ONE-TIME CAPITAL EXPENSES



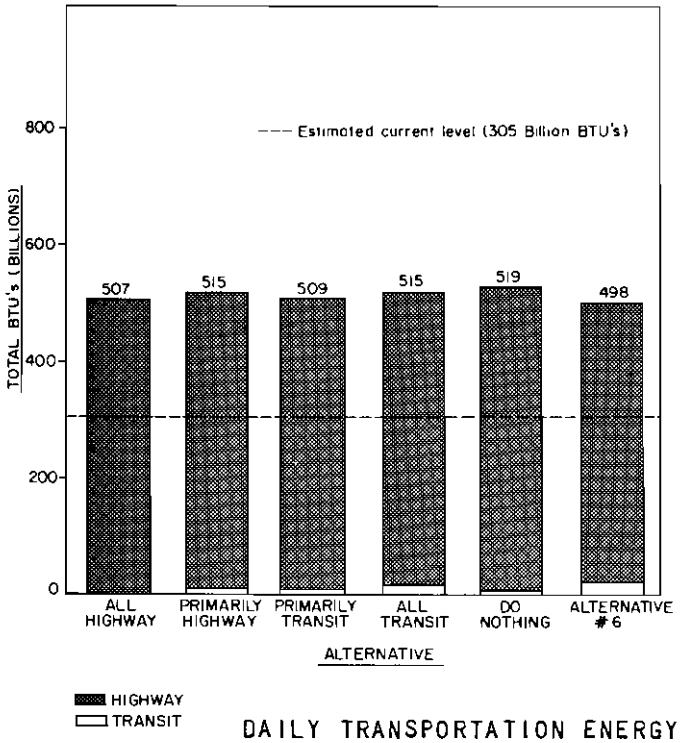
TRANSIT TRIPS 1990

Alternative and Alternative #6, was that the number of jobs in the central business districts, because of increased accessibility over alternatives with less transit, increased in the All Transit and Alternative #6 over the Do Nothing and the All Highway Alternatives. The additional transit system to the central business districts attracted a large number of the additional work trips, but did not attract all, so the others had to utilize the freeway system. This, of course, contributed to the congestion so that even by constructing a major transit system, with our development as now exists or will exist, the congestion resulted in higher total energy consumption in the transit alternatives than in, perhaps, the All Highway or Do Nothing Alternative.

Let's look at another phenomenon among the six alternatives. In this slide, we have a comparison of the All Highway, All Transit, Primarily Transit, Primarily Highway, and Do Nothing Alternatives in the average vehicle trip length. Again, the significant thing is that the vehicle trip length was longer in the All Transit and the Primarily Transit Alternatives than it was in the other alternatives, principally because of the employment in the central business district and the necessity of a longer trip length from suburban locations to those points.

One of the goals that is espoused by some is a reduction of total vehicle miles of travel to seek a reduction in energy consumption. This slide gives a total of daily vehicle miles among the alternatives. We will see in the All Transit and Primarily Transit Alternatives, a reduction in total VMT. This, of course, is the result of the mode split and the attraction of riders to transit.

Even if we should reduce total VMT, it could very well be that the vehicle trips remaining, because of congestion—again, necessitated by higher concentrations of employment in the central business district—might not be the most efficient. This next slide shows automobile energy efficiency in BUT's per auto-passenger mile, considering vehicle occupancy. It will be noted that the efficiency is highest under the All Transit and Primarily Transit Alternatives, which would mean that even though we might reduce total VMT, the trips remaining might not act as efficiently in energy consumption as if maybe some of the other alternatives,

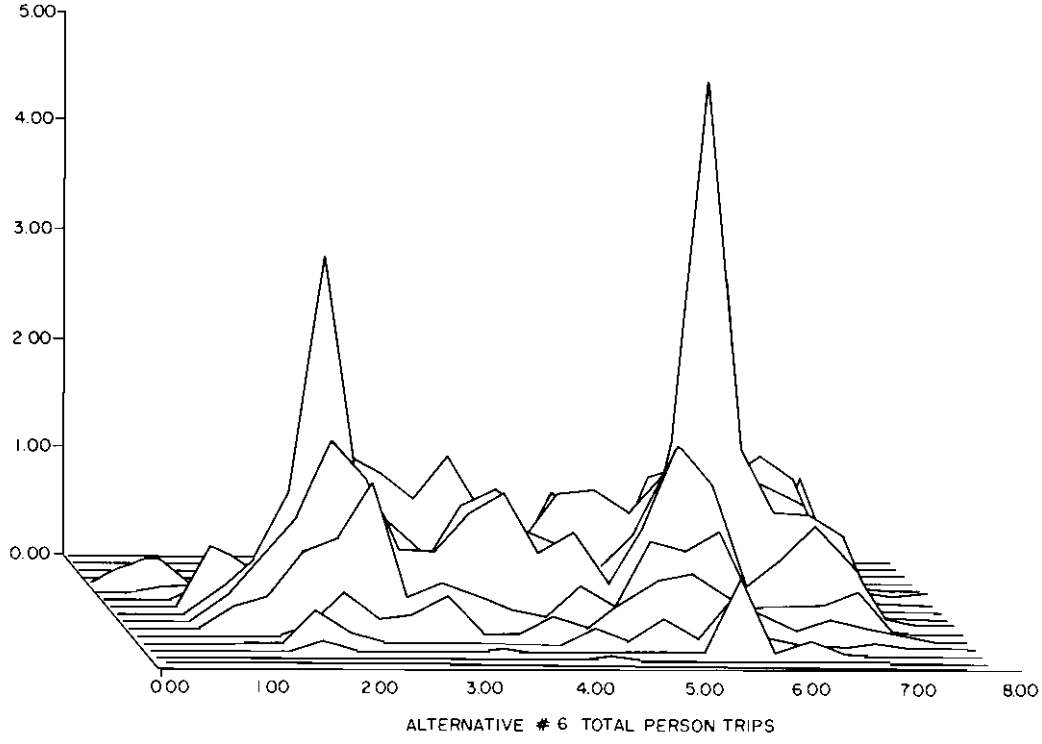


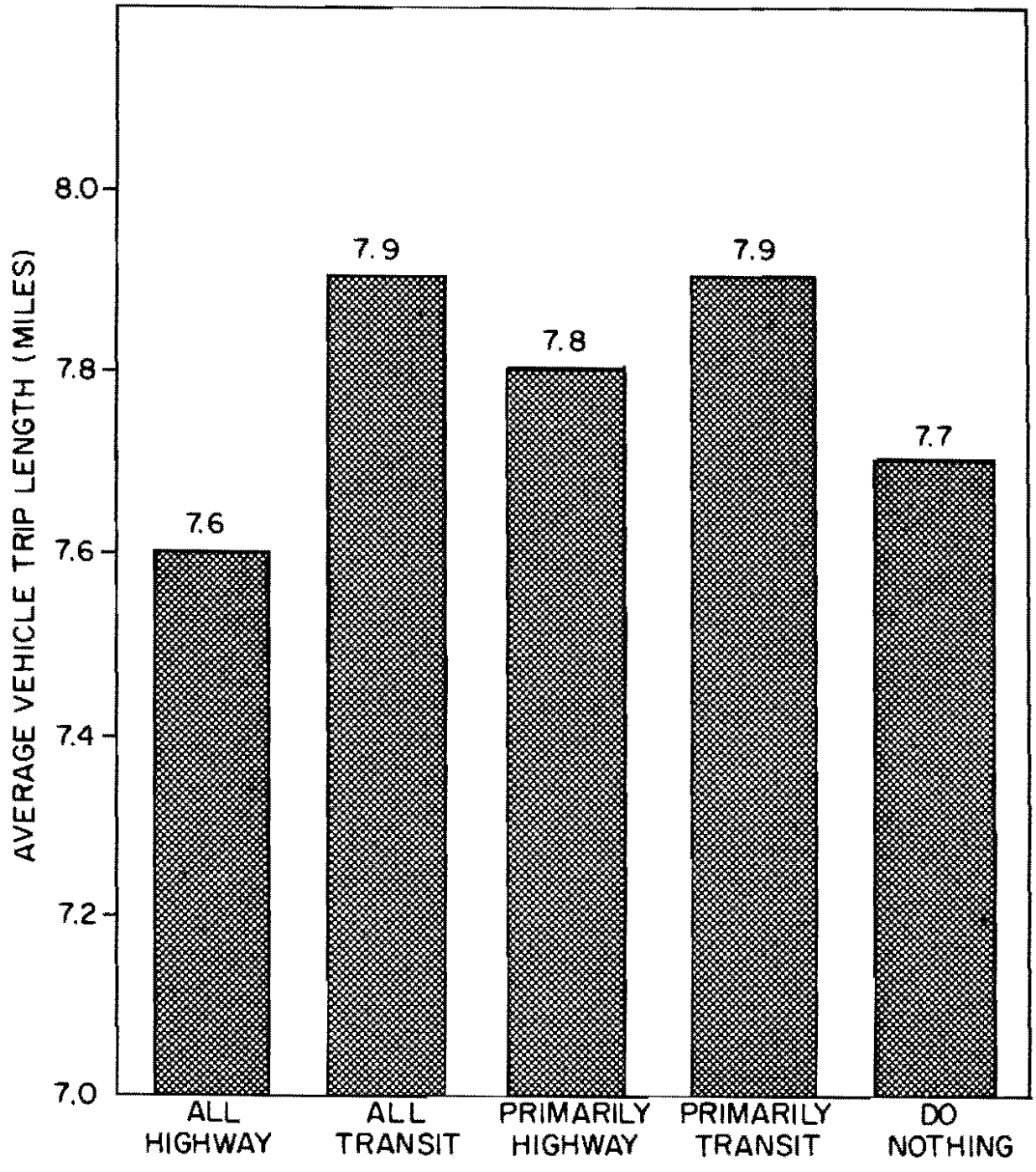
DAILY TRANSPORTATION ENERGY CONSUMPTION 1990

such as the All Highway Alternative or perhaps even the Do Nothing Alternative.

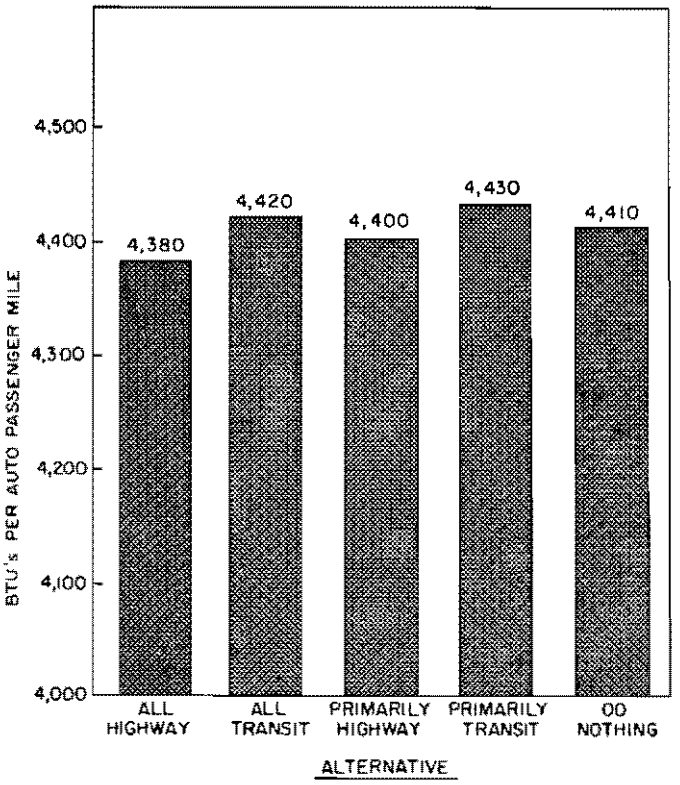
Conclusions? I think we have concluded that to take a criterion by itself, total VMT, for example, and establish this as our planning criterion for energy consumption might, in many instances, not be the best way to go. If we are to change energy consumption, it probably will be necessary to combine our transportation planning with planning in other functional areas, perhaps, to smooth out some peaks. The Do Nothing Alternative, which would distribute these peaks more evenly (or perhaps circumferential freeways that will locate jobs closer to the place of residences) or perhaps housing polices that would encourage higher density development closer to the concentrations of employment in the central business district might be appropriate actions to consider if reduction in energy consumption is the primary consideration.

Which is best? I certainly don't know. These are some of the projections that we tried to lay before the decision makers. I think these, in some degree, emphasize or strengthen the point that was made earlier, i.e., the problem is bigger than just transportation. Thank you very much.

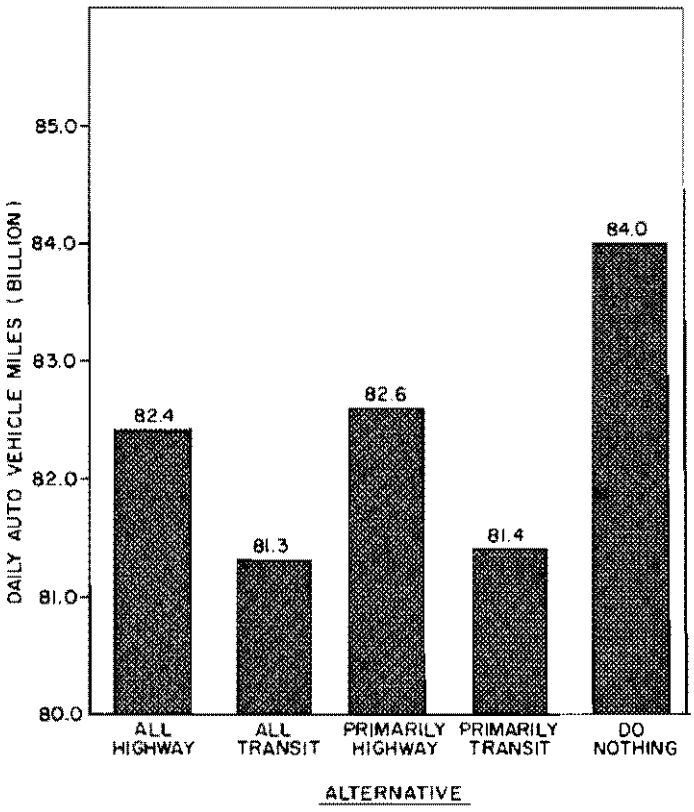




AVERAGE VEHICLE TRIP LENGTH



AUTOMOBILE ENERGY EFFICIENCY



DAILY AUTO VEHICLE MILES

DR. WALTON: The next panelist is Mr. Scott Romney, President of Lakeway in Austin. Scott was born in Michigan, he has a degree in Economics from Michigan State and a law degree from Harvard Law School.

He has practiced law in New York City and has had a continual interest in real estate and development. Early in 1973, he joined the Lakeway Company as president and their chief executive officer.

Lakeway, as you know, is a wholly-owned subsidiary of Alpert Corporation, a diversified real estate company based in Dallas. The Lakeway Company is a development company of a total resort community of approximately 5,600 acres on Lake Travis, 20 miles west of Austin. It's a pleasure to introduce Scott Romney.

MR. ROMNEY: Well, I've certainly enjoyed the remarks I've heard so far. I found this last discussion in particular to be enlightening to me. I don't know if I can be of great benefit to you in your study of transportation and energy and the impact.

One of the things that I am more concerned with involves the short range aspects of transportation and energy. As Case said, in economics, in the long range we are all dead, and in considering the economic climate we are in today, most of the real estate developers are more concerned about the short range than we are the long range.

Of course, that isn't perhaps the best thing that should happen. One of the things that I am concerned with and that—because I perhaps don't know very much about these topics—is our ability to cope with the magnitude of some of the problems we have today.

It concerns me whether we have the ability, whether one person, when we put all these variables together—and there are so many variables—when we put them together, do we have the ability to understand, can we manage our economy and our transportation and energy and so forth.

Secondly, I think that one of the things that I am more concerned with now is recession and inflation, as I mentioned. Of course, energy has had an enormous impact upon those factors, in my opinion.

The change of wealth from this country to the Arab nations has been astronomical in the last couple of

years. I think it will have an enormous impact upon us all in that regard, so that aspect of energy has to be considered when you are thinking of the impact of energy in the long range.

After all, if we had had this much transfer of wealth in any other century besides this one, we would have had an enormous outbreak of war and struggle of various types.

I am not suggesting that that should happen, not at all, but I am suggesting that it is a major revolution in terms of the change of wealth, the transfer of wealth.

Now, some of the impact upon ourselves at Lakeway—of course, we are just 20 miles from Austin and so we may not have seen it as much as some of the other developments, but let me mention a couple of things that I see out there.

First of all, for a small thing, we have seen an increase in our hotel business because I think people are coming to hotels, resorts more in their own area rather than traveling.

We see the people are building just as many homes as before at Lakeway because people still have to retire, most people still want to find a place that is a little bit out of town, a little bit out of the ordinary to live in.

We see a tremendous and dramatic increase in our cost to do business, in paving and doing everything that we are trying to do; provide housing and so forth. Those things have increased tremendously, particularly when we are planning future homes with insulation, air flow and trying to reduce the use of energy.

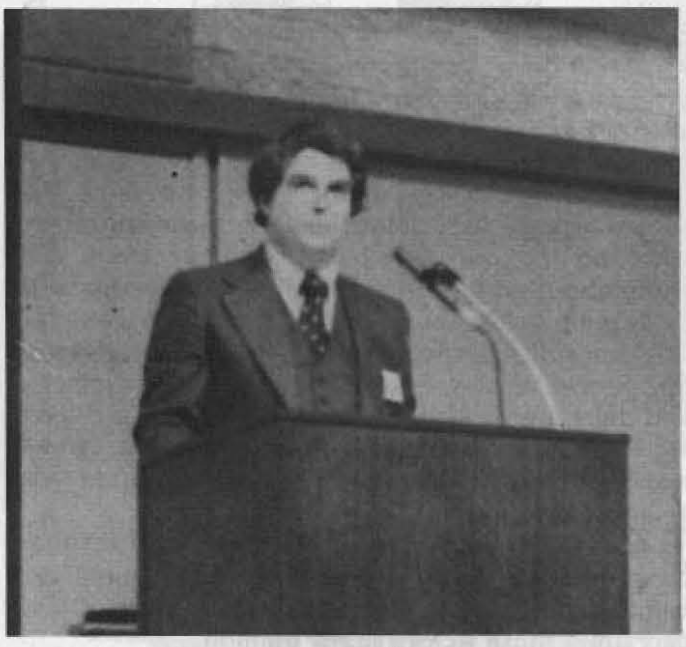
We see a tremendous increase in our costs of business. I think nationwide we are seeing some of the present trends—some of the past trends—continue.

I think this is particularly enlightening with regard to the discussion on transportation we just heard about the Dallas-Fort Worth area. I don't see the fact that we are having a scarcity of energy slowing down too much the move to the suburbs.

I think there will still be the move to the suburbs and people will still want to have total communities with shopping and the office buildings and so forth in the suburban areas.

I think that there will still be a movement of people from the North to the South and I think we are seeing those things. I also believe that people will want to live where there is recreation.

The way I see many of the things that the energy crisis or the energy costs have caused, they haven't had a change in that direction. Now there is a dramatic change that has taken place in the business that I am in



Dr. C. Michael Walton, Department of Civil Engineering-UT Austin, introducing Mr. Scott Romney, President, Lakeway, Austin, Texas.

Mr. Sam Dunnam, The Dunnam Company, discussing implications of transportation and energy on Urban development.

that is caused not only by energy but by recession and inflation and by, particularly, government regulation.

These factors of regulation, recession, inflation, and energy have meant—there is one thing that may have been good for the country— a lot of the fast lot sales programs and dirt sales programs and cutting up of land and selling it to others is really virtually at an end.

It's at a standstill because of all of these factors; regulation, recession, inflation and energy. Many of those companies have gone bankrupt or will be going bankrupt in the short term.

Many substantial developers of, perhaps, quality projects in outlying areas have had terrific problems and will continue to have terrific problems so it does have a tremendous effect on some of these communities.

Therefore, I think in my business, the resort business, I think what is going to happen in the future is that only those who have large resources of cash to make sure the developments are real communities in the beginning and not promised communities that never occur, but that are places that people can enjoy now and live in and get the full environment of working, living and recreation at the same time, will be able to survive.

Of course, that points to a development like ours, being one that we think will withstand the tide. I do think that the energy crisis and the fact that many of these places are so far away from metropolitan areas has reduced, significantly, affecting that industry, the recreational lot sales industry, which, I don't think Lakeway is anymore.

That basically covers all the comments that I have to give to you about energy. I will be happy to answer any questions later.

DR. WALTON: Thank you, Scott. The next panelist is Mr. Sam Dunnam of the Dunnam Company, Austin, Texas. Sam is a native of Houston. He received his Bachor's from SMU and his Master's from Rice and is now doing advanced study at the University of Chicago.

Mr. Dunnam has been in the real estate business in Austin since 1961. He is a member of the Urban Land Institute, the International Council of Shopping Centers, and the Austin Board of Realtors.

I believe that Sam is most noted as the co-owner and developer of the Northcross Mall which is an enclosed mall of approximately 400,000 square feet being built within Austin.

It is the newest and, perhaps, one of the largest that we have in this area of the country. It's a great deal of pleasure to present Mr. Sam Dunnam.

MR. DUNNAM: Thank you very much. It is a pleasure to be a part of this conference. I am glad they still let land developers on the University campus.

We are an endangered species, as Scott said. I feel that very much. However, in our company, I might say that we are very much concerned with long term land use.

Unlike Scott's company, we are not planning to go out and buy great spreads of land and enter 30-year programs, although I have been in a ten-year one that was planned to be a four-year one.

We, rather, study the urban economy and see where needs develop for new things. We plot population and income. We are interested in sociological trends, preferences and this sort of thing.

Some data like these, namely the plotting of population trends in Northwest Austin, induced us, some ten years ago, to option about 50 acres of land, which we were eventually able to increase to about 86 acres, and begin planning a major shopping center.

Unfortunately, right as we began to get under construction, Austin had its first bad winter of energy curtailments and we became very, very interested—mainly out of just economic self-interest—in seeing what we could do almost on an ad hoc basis as the building was designed.

Now, I will get into some of the things that we did later, but in trying to think of the themes of this conference, energy, transportation and land use, which is our area, I tried to see if I could get some thoughts together that could tie these things together, these central concepts.

I think if you will look at energy consumption overall, one thing faces us and it has been said over and over again and will continue to have to be said and action will have to follow the speech.

That is, that we have to conserve energy, we have to cut that down. There is just no getting away from that fact at all.

These curves that these gentlemen showed us show what's going to happen if we continue. We need to look at overall U.S. energy consumption. It's useful to think of it, particularly if we are thinking of transportation as one aspect of it. Energy is used for the purposes of mobility, in other words, for getting from one place to another. This is transportation, so you can look at all

the logistics of energy consumption and conservation for getting around. I think that in John's charts and graphs here, that were very interesting and enlightening, we certainly do have a set of tools to deal with this thing.

Another great area that we can look at in energy consumption is the static use of energy. This is the energy consumed in places like office buildings, shopping centers and our homes.

Our experience, of course, was primarily concerned with the second. However, it is not unconcerned with the first, either. When we think about building a shopping center, the first thing we think about is accessibility.

You think you get finally to some thoughts that if you build X square feet in a shopping center or any kind of urban complex that has to be supported with consumer dollars, you have to know where those dollars are and will they come and how accessible are they and is it probable that there could be enough services and goods offered in a building of a certain size that has to have certain square footage sales to pay its bill and can it be a profitable investment.

We are very much concerned with transportation because of that and we just can't ignore it. Now, if you tie together energy, transportation and land use and assume that energy just absolutely has to be conserved, you come back and look at transportation from a human needs standpoint in this way.

Transportation is getting from one place to another. We don't just drive around to be doing that. Transportation is always for a purpose. We go from one place to another for a certain reason.

Now, what motivates us to go is all the human activities which all of us are engaged in; working, living, shopping, visiting, recreation, medical purposes and what have you.

There is just a long catalogue of them. If you relate that back to land use, the purpose for which a piece of land is used, you get to zoning, and we find that our zoning laws, particularly our suburban laws, in the post war years, have tended to separate land uses.

A home owner didn't want a shopping complex and an office building near him—or at least too near him, anyway. So we have gotten great splashes of land that are all residential and people like them that way.

As the suburban growth really took off in the fifties and sixties, these things jumped way out and, suddenly, you got what I called the Los Angeles Code of Development, where the farther out the living got, the farther away from work and other sources, you found there were more trips generally and the longer the trips were.

Soon the shopping center really developed by taking the shopping back out to the residential areas. We see this occur in office buildings and I think you mentioned it, too, when you showed the very, very high peaks of transportation required when you concentrated the jobs in the central business district.

Your model showed what some of us have suspected for a long time; that perhaps if we distribute these land uses around it a little bit, have some work centers scattered around, that might be a beneficial thing.

That's the type of study that John had that was very, very useful and I think can continue to be a planning model. We do need to take a look at our zoning practices and in looking at zoning and overall land use consider it from the number of trips standpoint.

Those of us in the shopping center industry are a little dismayed right now about some of the environmental protection agency's so-called multi-source regulations that are about to come out now, in about January of 1975.

What these really say is that if you are going to build anything that has over 500 parking places or 500 cars gathered together at one place, you have to go get a permit.

There is a strong hint that concentrations are going to be discouraged and that these permits will be difficult to get. Of course, they are thinking about the exhaust fumes that are gathered in one place, I guess, and, certainly, this isn't good.

Now, we don't like air pollution anymore than anyone else does, but we think the culprit here, perhaps, is the internal combustion engine and not the concentration of human activities.

From our view, the concentration of human activities in one place is an enjoyable way to cut down the number of trips and that's the real bottom line you look at in conserving energy.

Dr. Maguire spoke of the scattering of his friends and his interests. If you scatter the shopping of shoes and the shopping of suits to the shopping of hi-fi components all over the city, you may cut down the overall air pollution at one point due to the internal combustion engine, but you have really increased the number of trips and the number of purposes that people are going to have to make trips to different places.

So we don't think that the concentrated, mixed use

complex—and I will use that term—is a bad thing, particularly when it is in close and readily accessible.

We find ourselves going more to what we call the galleria-type models, which is a mixed use. You have offices, recreation, shopping, medical centers all concentrated in one place.

These centers, finally, can be tied together by systems like we are seeing in the Dallas-Fort Worth Airport where you take your automobile, get there and use an internal transportation system.

We hope the EPA will take a look at this and will hang the penalty around the neck of the true culprit, which, we think, is the internal combustion engine.

However, if we get away from transportation and come back to energy consumption in static areas, which will be buildings, we see that there are certain things that can be done.

We did it in planning Northcross Mall. I'll mention only three. If there is further interest in these, I will be happy to answer your questions. One is the use of natural light without heat. We are fortunate the way our land was laid out that our center was going to have primarily a very long access along the east-west direction so we had a lot of north exposure.

We simply designed in this center a lot of north-facing unilateral clerestories which let in the north light without all the heat. We were able to save almost 90 tons of air conditioning through this device alone because we were getting light without the sun ray through the glass that would have caused us to put in more air conditioning.

We were able to increase for actually a very small cost the amount of insulation. We were able to decrease the heat factor on the building roof from .15 which has been customary to .10 and this saved considerable energy.

We required all tenants, which wasn't in our thinking at first, to insulate any exterior walls in their space and this could save some more.

The other thing that we did was to really reduce the overall amount of light in the common areas. If you reduce the level of light and you get people in a large place, the eye opens up a little bit more and makes more use of available light.

By keeping our light level in the central areas in our mall to about 15 to 25 foot candles, we are able to turn on the front of the store a little bit more so that the store itself then does not have to blast light inside to enable the customer to see it.

We discovered in doing this—by working with a national lighting consultant out of Washington—that—or the people who manufacture light bulbs—have not been very informative in writing light specifications for building.

We put out a lot of these data and looked at the efficiency of various lamps. We tried to talk our retailers into reducing their light levels. One way we did this was showing them how much it costs and how much they could save.

We related lighting loads to air conditioning and then we figured air conditioning bills for different size stores and we had a lot of success in convincing our retailers that we were going to reduce the amount of light in the common areas and they could then, for the same relative difference, reduce the amount of light in their stores and with the customers' open eye, they could see the goods just as well.

I would say that we have probably cut watts per square foot in a lot of the retail stores by at least as much as 30 per cent. These are some very kind of ad hoc things that we were able to do even once our building had been laid out.

They were just quick fixes. Of much more interest, of course, are the longer range things that can be done and simply must be done for this country to get by at all.

If you look at the long range thing, I think that the only final solution is solar energy. We have to take the rays of the sun and start converting that directly into heating, cooling and, hopefully, electricity that can be stored.

There are some very exciting things going on right now. I know that both Corning and PPG have some very intensive research programs going on for the use of solar heating-cooling systems where the total heating and cooling load of the building can be handled pretty well by the use of the sun's energy.

If you want to know how much that is, in Northcross Mall, the air conditioning alone is 50 per cent of the center's total energy consumption.

If we could accomplish all this with solar, there would just be a tremendous energy savings in the U.S. Any of you that have flown into a city at any time, just look down at all the rooftops; acre after acre of rooftops, which we insulate, put different colored shingles on, and then we have to take a machine and burn precious petro-chemicals for air conditioning and heating the space inside when the sun could do it for us naturally.

I don't know a great deal about some of the advanced research being done in solar energy, but I would certainly make a plea, especially to those of you who are at the University of Texas and who are engaged in research and development, to, for goodness sake, pursue the nuclear, if you will.

That has some environmental problems, but let's look at solar because so far as I can see, that's almost a pure good guy. There's almost no environmental pollution or wastage at all, if we could take the sun as plants do directly and use it for our own needs.

For the real estate developing industry, I think we are going to have to support research in this and buy it, be experimental with it and certainly encourage it and hope that we can get it in five to seven years before we get some of these curves that show us just running out of oil altogether. Thank you.

DR. WALTON: Thank you very much. Our final panelist is Dr. Harry Hornby who is Chief of the Special Studies Office for NASA-Ames Research Center in California.

Harry is responsible for the technology assessment of energy, intercity type transporation and nuclear waste disposal. He was formerly head of the Office of Exploratory Research and Problem Assessment for the National Science Foundation.

He was educated in England at Liverpool University, London University and the University of Paris and has been a Princeton Fellow in public and international affairs. It's with a great deal of pleasure that I introduce Dr. Harry Hornby.

DR. HORNBY: Unlike my fellow panelists, I did not prepare a speech for you today; instead, equipped myself with a few Vu-graphs I thought might fit my reactions to whatever was said by the earlier speakers. I am happy to say they do and I will introduce them later.

First, let me comment on the morning speakers. They evinced a strong anti-federal sentiment; as your first speaker from the federal establishment, I feel obliged to defend federalism. Now, likely I understand what the speakers were getting at, and share their concerns, but they chose to condemn the concept, not the malaise.

The great strengths of these United States are twofold: the essential ambivalence between federal government and private enterprise and the fostering and promotion of technology development. In the past, federal governance has set up the ground rules for the private sector to go in after and make a profit—the federal government has subsidized desirable national outcomes—and the alliance of government and entrepreneur has then made great profits for all to enjoy. It wasn't free enterprise, it was subsidy in the national interest, and usually it was a military interest. For example, take agriculture. In 1787 (I believe), Jefferson wrote Madison a letter proposing that the Western frontier be developed for agricultural purposes. Jefferson was concerned that the British, the Mexicans, or even the French, might sneak in through the backdoor and jeopardize the thirteen states. His reason for pushing back the frontier was national security. The United States adopted the doctrine and established the Land Grant Colleges to aid, abet and subsidize agriculture. (Texas, of course, was a principal beneficiary.)

Technology developments in agriculture were prolific and far reaching. They led to the enormous agricultural productivity that later was to be the power base for U.S.A., the superpower. Inventors and innovators were assisted by patent laws designed to encourage risk taking. They were further assisted by yet another important federal action—the captive market development using, in most cases, military procurement. Military were dispatched to the outermost Western settlements to be fed and clothed by the pioneering citizenry at taxpayers expense—another subsidy. Probably, no commercial jet aircraft would exist today had not U.S.A.F. developed jet bombers and then procured them in quantity. Funds for risky high technology developments do not come easily in the private capital markets. The military process served therefore to inspire investor's confidence. His risks were lowered and he was assured of an initial market.

The military are not popular today so it is difficult for them to continue this important function that has served us so well in the past. My discussion with America's youth convince me they believe in a strong America but they feel our great military strength is a necessary evil and should be pushed into the background. We should try to project a non-militant image by building up our other strengths such as agricultural technology to help feed the world. It may be that it behooves other federal agencies than D.O.D. to help provide this captive market for technological innovation? Possibly we at NASA can help? Already, we develop and procure weather, earth resource and communications satellites until the private sector can step in profitably. There are

other things we can help in, including energy and transportation.

Lets turn to what's wrong with government. A certain intransigence and intertia is no different from private enterprise problems. I'll mention the medical and legal fields and give one example from each: the near-fervor with which many of the medical profession oppose use of apricot kernels as a prophylactic and control for cancer; the near-fervor with which many of the legal profession oppose no-fault insurance. These are private sector people busier defending their $70,000 median salaries than subscribing to their professional code of ethics. So also in the federal bureaucracy, we see examples of this sort of professional version of the Parkonson syndrome: "professional self-interest expands to occupy the resource available for the service it is supposed to provide." For my druthers, all federal regulatory agencies could be abolished now. They are counter-productive and the economist in me tells me there is a better way to acheive all their objectives.

I can only appeal to the sociologists among you to work on this problem of low productivity in the service sector, government and private alike. Modern society's complex institutional set-ups do not breed responsiveness. It goes a lot deeper than the federal government alone.

Another federal weakness is planning ineptitude. The federal government today will not plan. Jefferson planned. Yet today we lack science policy, we lack technology policy; even the machinery of science policy guidance in the Executive has been dismembered. I think we are suffering from a period of political arrogance in which we have virtually ignored social values and societal options in determining our courses of action—such values are the cornerstone of legitimate science and technology policy. Lower levels of government need an organizational structure that will garner their respect, coordinate their efforts and provide evidence of the coherence of federal policies. Planning requires we address the interlocking and interwoven tasks of coordination, sponsorship, incentivation and advocacy of science and technology. We don't have it. We will not plan. Hence, we manage by crisis, muddling our way from one mess to the next and always getting deeper into the hole as the tyranny of long lead times (ten years to correct anything) compounds crisis upon crisis. The critical issues facing Americans today call for more, not less, attention to the planning and support of technology development, our great national strength. The alternative is a steady diet of diminished losing standards for all of us.

I've taken a lot of time on that point. Let me switch gears and turn to my first chart. Things that use a fixed track will always look bad to a systems analyst. So much dedicated real estate idle so much of the time. Land use, the theme of this session, is the key. Ships please me because they sail anywhere at sea and so do airplanes. What about airships, lighter-than-air ships? They might be useful today for several tasks including the direct transfer of produce from the San Joaquin Valley of California, say, to consumers in Japan, Europe and the developing nations. Agricultural products we can trade for oil. The nuclear industry presents problems of safety and waste disposal that cause some uneasiness. For reliability, I'd like to see reactor pressure vessels made in factories as we made hydrogen tanks for Saturn boost rockets. Then they are too big to be transported five or six hundred miles to the site along conventional highways or railbeds. Maybe a lighter than air craft could effect the transfer from factory to site with no special facilities.

The last panelist, Sam Dunnam, talked about solar energy. It is no panacea. True, the solar heating and cooling of buildings is promising and may pay off eventually. It is important because 40% of energy usage goes for space heating and cooling, mostly in industry. The problem with solar energy is that it is so diffuse. Collection costs are thereby uneconomically high in terms of both hardware and real estate usage (land use management again). Solar thermal electrical power generation has been studied at the University of Arizona and elsewhere, for example. At sea level, sunny locations get 250 watts per square meter (atmospheric phenomena take the rest). With the sort of inefficiencies that arise in a platinized aluminum one-way mirror and heat transfer to a turbine arrangement, plus the duty cycle, it takes 75,000 square miles of West Texas, New Mexico or Arizona to provide ten years increment in national energy needs, two billion kilowatts. This is an area the size of England. The whole thing is too consumptive in land to bother much with as a major supplement to conventional power. It may be useful on a small scale in special situations. We need concentrated energy sources such as coal and uranium. U.S.A. has enough coal to supply our energy needs for a thousand years. Western coal, in particular, lies in seams 250 feet thick, and is low in sulfur. Trouble is it presents problems in getting it out. We could let Wyoming and Col-

"The whole business is economically unsound, gentlemen. With a train of this length and forty miles of track, we find that only .0568 percent of the track will be in use at any given time, representing a constant idle investment of 99.9432 percent."

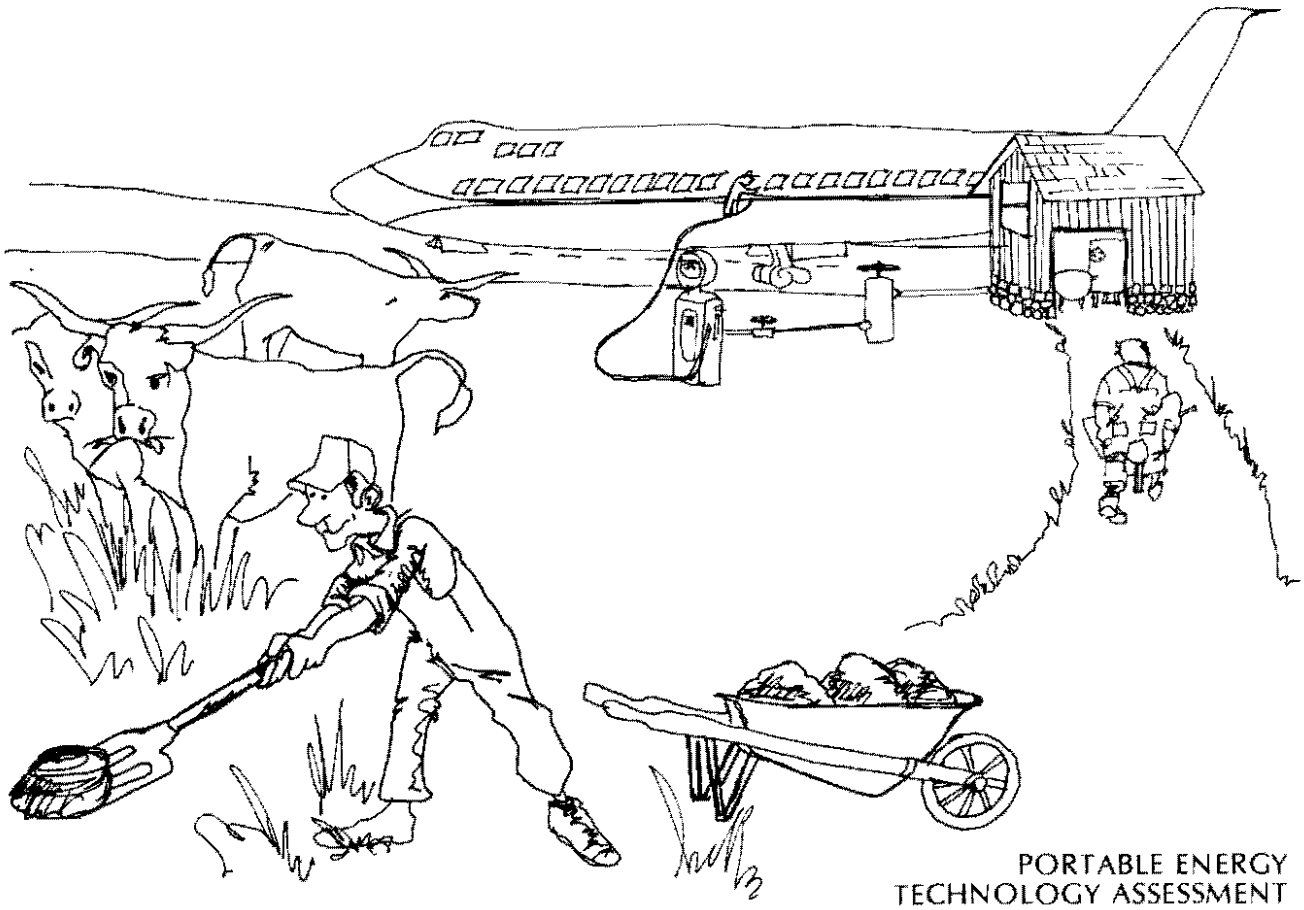
orado settle two hundred feet below where they are now, I suppose. Maybe they never would know the difference!

Nuclear fission is also a tough one. Based on current accident statistics, two trucks and one train transporting plutonium or other activities will be involved in major accidents in U.S.A. every year by the year 2000. In the subsequent confusion, I can imagine the "crazies" making off with a few kilograms of the stuff. The potential for blackmail is then something that makes international diplomacy like a child's game. We may need a new, different type of transportation system for this job.

One thing is evident—we can't afford to waste.

Let me turn to the next chart. If the oil problem gets much worse, this is the way we may have to power our airplanes in the future. Texas has an advantage with its longhorns. Clearly though, the effluent from humans, bestial and biological refuse generally, and industrial waste that has energy value must be recycled. Collected waste averages 300 BTU/lb. Animals are inefficient engines. They consume 96% cellulosic material and exude 92% cellulosic debris. This high organic content must be reworked otherwise we ought to replace livestock with soybeans as a direct least energy intensive source of protein.

Professor Maguire titled his talk "Neither Transportation nor Energy is the Problem". Not the cause, maybe, but certainly the effect. Energy and transportation provide much of our pollution problems; in this sense, they are the villains. What we need to do is to control



the environmental onslaught. We must be on top of the situation selecting our technology to bring benefits within acceptable limits of onslaught to our environment. That is the important tradeoff. A systems approach is required with massive simulation of an interdisciplinary nature. All due respect to Denis Meadows, Brookings, Wharton School and the rest, but no way can you simulate the behavior of 215 million stubborn, fiercely independent, irrational Americans with five to two hundred equations! The situation is much more complex. We have the computer technology to do something of the order that is needed thanks to the military need to process information on potential actions by our enemies. The memory capacity, speed, data processing and display capability of today's computers let us perform realistic simulations. NASA can help—our simulation competence is the finest anywhere and I think the agency should be directed to get itself involved. The economy can be moved if we know what the process is and can experiment with and simulate incentives before writing the laws.

Americans buy tanks, except in California. We buy foreign. Why do Americans want tanks? It seems to me they are displaying an implicit distrust of their neighbors. This is a paradox in a society built on neighborliness. Perhaps our sociologists could look into that one too. The auto industry must go to the smaller car or to the aluminum or composite structured car if any sort of energy conservation is to be attained in the transportation field. I suggest an effluent or displacement tax to push them a bit.

Finally, if Dr. Maguire can persuade everyone to want pine, this must send up land values in the better growing areas. I'd like to discuss where these are with him so I can make my investment promptly. Thank You.

DR. WALTON: Thank you. At this time, we would like to open the floor to questions to the panelists. I have asked Commissioner Armstrong to field the questions and direct them to the appropriate member of the panel and then summarize this session. At this time I will turn this over to Commissioner Armstrong. Any questions?

DR. KEESE: If you are going to be planning for land use or for energy or for any other purpose, for that matter, we are going to have some goals. What kind of goals are we looking at with respect to land planning, the way you see it?

COMMISSIONER ARMSTRONG: What we have done in the Interagency Natural Resources Council is to set up a Land Resource Committee. One of our first tasks is to try to identify those goals.

What we have done in the State thus far is to try to analyze the problem areas. I think this is one method that is suitable. What most people have come up with, so far as identification, is that the problem areas in Texas exist in four principal areas.

One is the coastal zone, where you have 80 per cent of the population of the United States living within close proximity to the coast.

Texas is almost within that figure. The second area is the river systems where you have a tendency for people to come and to settle, and your extra-territorial jurisdictions outside your cities are your third area, where you have virtually no rules once you get outside the five-mile area.

That fourth is kind of a broad category which they call significant natural areas; Capote Falls, Edge Falls, etc., where a decision has to be made—are these going to be purchased by the State for the use of everybody because of their significance or are they going to be developed around and be for the use and benefit of a very few people that happen to be there.

What we think one goal to be is to look at your areas of problem where we have little or no capability of handling those problems and give the decision-making process to the people who live in that area.

I think most of these decisions that are indicated are going to be local, but some of the goals have to be set up. Now, a lot of these people say—I think they give us credit for being farther along then we really are in terms of how you make these determinations.

Kerrville, for example, has made a determination about how it wants to grow. They have said, "These are our goals. We want no industrial expansion that is going to cause pollution problems, that is going to extract water from the rivers. In fact, we don't want any industrial expansion at all other than the minimum it's going to take to preserve a certain economic base and to provide certain services. We just don't want to be that way."

I think there are going to be some cities in some areas that are going to set their goals to expand, but what they need, so far as a goal, is probably some plant siting capability.

They are going to need some capability to evaluate resources in many of the ways that we have seen ex-

hibited here, so that they grow within their resource capability.

I think these are the kinds of goals that you set up for yourself. Some communities are going to have different ideas about what they are going to want to be than others.

Right now, it seems that most of these communities as they develop just kind of follow their nose and I think that should be avoided; their noses.

DR. KEESE: Let me ask one further question. You may give it to John Roark, however. It seems like, in all of these meetings, that we tend to look at the whole complex problem and tend to sit back and say, "It's too complex to solve."

Yet there are lots of parts of it, very small segments of the problem that can be solved fairly simply, and solutions can be found that are practical and will contribute to an overall solution to the energy problem or whatever.

A real good solution to this, for example—or an example of this, is the situation of the commuter transportation problem. If you look at an entire city and you try to serve everybody in the same way—it reminds me of a situation in one community—I won't call the name, John, out of respect—where you have one park-and-ride situation that works beautifully because the people on one end are near the end of that, they want to ride it, they go to the same area, they work together all day, they don't mind riding together and so forth and so on.

You put in the same thing in another portion of town and it doesn't work, probably because the people don't go to the same place to work; it isn't the same setup.

I think there are specific solutions, but I don't think you can just slap them down and apply them anywhere.

COMMISSIONER ARMSTRONG: I don't think there is any question about it. I think the reason the Federal government has failed frequently with their approaches is because, one, they have moved too hastily and, two, they have tended to pass one 40-page statute that is designed to make rules for every community, even though that community may have totally different problems from others.

They equate Snyder with Los Angeles so far as the reading of that statute is concerned and I think one reason that they have been somewhat more amenable to local judgement and local control as a means of solving problems—which is reflected with the Coastal Zone Management Act, where they really give us a free reign as a state, where they say, "Go ahead and pass it in the local communities if they can solve the problem,"—is because they have recognized that some of these just basic 40-page statutes that attempt to deal and equate all the communities in the nation under certain rules are just not working too well.

Perhaps their philosophy of the Federal government is beginning to change in the sense that they have thus far—at least the Coastal Zone Management program is leaving us to try to work out some problems instead of trying to do it all themselves, recognizing the thing you are talking about.

DR. HORNBY: I would like to comment on an experience in Europe. Europe has never been the beneficiary of the highway system that the United States has and, hence, it felt the intense traffic congestion, probably harder than we did.

The result of that has been that European corporations have gone to systems where people work their own hours. Most of them now have designed their work loads in such a way that an individual can arrive when he wants to and leave when he wants to.

There is usually a small guide that he spend roughly three particular hours of the day in the office or at his place of work and over roughly a one month period put in 168 hours on the job.

The average work week in Europe is 42 hours. The system is working beautifully from what I gather because the individual looks at the traffic in his area and decides when he will minimize an effort of getting to work, so you are getting much more efficient use of your transportation systems under those circumstances.

I would like to see some of that flexibility of work hours introduced in the United States. I think it would help tremendously.

DEAN BENSON: This is fine for certain kinds of work, but for other kinds of work it's absolutely useless. You can't run an assembly line that way, for instance.

The major problem which they have in assembly lines is absenteeism.

DR. HORNBY: Believe it or not, it is an assembly line where they found it was effective. They have a computerized assembly line so they can operate with a cer-

tain number of holes in their assembly line, people.

It's a fairly complex system, but it has been developed by most of the major engineering works in Germany for work, for example. This assembly line is very, very effective in terms of flexibility of work hours.

The advantage is that it manages to keep the assembly line going 24 hours a day, in many cases.

DEAN BENSON: Why don't you sell it to General Motors?

DR. HORNBY: We don't have a Federal incentive with General Motors at the present time to do anything.

COMMISSIONER ARMSTRONG: There is one thing that has happened in the State government. We have now changed arrival time and leaving time to be more flexible. You can work from 7:30 to 4:30 if you want to, or from 8:30 to 5:30, and it has considerably reduced the congestion around the buildings during traffic time. That may be an idea.

MR. DUNNAM: If I might interject just the same thing to apply to the use of buildings; school buildings, I guess, come up as the key example here. They are used nine months of the year fairly intensely and for three months of the year their use, even at the University, is only about 50 per cent.

Now, we can certainly do something about that rather than build more and more schools and use them in the same way always.

DR. MAGUIRE: I would like to ask if there is any possibility that one of the things that you are looking at in your problem of getting people to move on to public transit systems is the thing that was mentioned earlier by someone concerning who lives where and where the transit systems are and some people might use the park-and-ride car and others won't

Is there any information on the likelihood that there is really—that this can work if one takes into account the long feedback, the long lag in the system, so that after a transit line is established, going from point A into an area with certain firms, that people will tend to move to that transit line so that in time—and maybe it will take a decade or two—there would be a considerable build-up of use of the transit system and a concomitant decrease in the congestion that the automobiles make. Is there any information on this?

MR. ROARK: Let me respond to some of the things we did. I apologize for the very hurried summary of what we have done. We attempted to project the distribution of population and jobs as a result of the transportation systems to 1990.

Surprisingly enough, there was little significant difference between the distribution of population as a result of either the all transit or the all highway alternative, principally because of the tremendous freeway system and the undeveloped area that has good access because of that freeway system where you won't see much change until 1990.

Now, if you projected this on to 2000, you might get a different development pattern around an all transit investment, for example. I think the question in our minds is, do you want to wait that long to get that response?

I think this leads us to a flexible type transit system; buses for example, buses on busways that can be implemented rather rapidly that can contribute to the problem, but if you could see a redevelopment over a long period, it should easily be transitioned to a fixed rail system if the demand existed.

DR. MAGUIRE: Have you considered any mechanisms of strongly encouraging people to use these public transit systems, mass transit systems. You know, rationing gasoline is the one that comes to mind, for example.

During the war, when rationing occurred, my casual observation—and I don't have any data at all—seemed to indicate that there was a tremendous decrease in the use of personal vehicles and an increase in mass transit.

If things get tough enough again, we may be faced with this. Have you thought about that?

MR ROARK: No, we did not. We did increase the price of gasoline so that it would be affected by the free market choice of travel. I think we will assume as you have assumed that if the energy is not there to drive the individual's automobile transit will take up the slack—or should be in the position of being able to take up the slack. We did not do any specific studies.

COMMISSIONER ARMSTRONG: Did you do any studies that would be designed to look at who would use this system were the system complete? I ask this in this context. There has been a lot of evidence to show that in a city like Austin, for example, the real purpose of the transit system, until very, very recently—when

the students actually took it into their own hands and set up the bus system for themselves, recognizing where they lived and the University and central location—that most of our transit system was designed to get the black people and brown people to the west side homes to work for 60 cents an hour, and that's the only people who use the transit system.

The transit system doesn't run very well where people work in Austin. It seems to me that if you had, one, the availability and, two, the kind of bus, if that is what you are going to use, that would be attractive and you might have a lot less hesitancy to use it. Did you put that factor into it?

MR. ROARK: We did. We did it geographically more than anything else, but we have segregation. This would hold true. We have attempted to look at existing transit accessibility to jobs and existing highway accessibility to jobs.

I think we can prove that probably we never will enjoy in the future the highway accessibility to our jobs that we have right now. In the North Dallas area, there is a tremendous accessibility to jobs by highways, but if you plotted the existing accessibility by transit, it was confined to a very small area in the Dallas core.

By changing the various alternatives, we did see transit accessibility, greatly expanded, that would cover all areas and not just a specific area.

Even in the all highway alternative, we saw a decreasing of the most accessible areas by highway accessibility.

DR. WOOTAN: May I make a comment on this, to both points, Dr. Maguire's and the response that John gave? In the first place, I think we are very dependent upon alternatives. In our early years, practically our entire city formation was based on the availability of transit because there were no really good alternatives.

As long as we have acceptable alternatives, then this dependence upon a housing form which is geared to transit has not really ever come about and would not, probably, come about under free will conditions.

Now, the same, I think, is true about the black-brown ridership. They have fewer alternatives; consequently, they ride available transportation regardless of the quality of the service provided by that transportation because there are really no alternatives available to them.

It's a question, I think, of both alternatives and the quality of service of the alternative that may be provided to the rider. I think this may speak to both of those points.

MR. DUNNAM: I would like to ask a question of John. When you talk about transit, what modes of transit were you talking about, train or bus or mixed modes or what?

MR ROARK: It was all mixed modes. The all transit, for example, had a lot of fixed rail systems, most of them radial from the central business district.

There was a lot of premium bus, bus in mixed flow and a lot of feeder bus to support this. As we moved down the line to, say, primarily highway, we saw less dependence or less input of fixed rail and more on a bus system.

The most sophisticated system was the rail rapid system that was shown in the all transit alternative.

MR. DUNNAM: Well, I would like to put a further proposition to you to see how you react to it. I was in New York City one time and planned to go from the upper part of the island to the lower part and got caught in Grand Central in a cab.

I wanted to see if there were other people in the same predicament. There were one or two people sitting in a cab and the cab was moving about five to six miles an hour and they were probably as late as I was.

It occurred to me then that perhaps one of the fallacies with mass transit for certain kinds of uses is the mass part of it, that, sociologically, people like to move about in small groups and have a lot of choices in what they move in.

If you look at the automobile in this sense, you can see its attractiveness. I began to visualize something that I think a lot of research is going to have to be done on—the horizontal elevator, which is a very small, lightweight module that can be made of fiberglass or aluminum and either hung or mounted or perched on top of a central motor that might last for 30 years.

You press buttons, you have alternatives and maybe it will hold up to six people like the American passenger car. The modules could be replaced, the body part of them, quite frequently, kept new and be made very cheaply.

I think you could have them coin-operated where you could go so many blocks north and so many blocks east or west and get off very close to your destination and walk.

I don't know if sophisticated systems like this are taken into consideration. I think these remarks about the automobile being used as a tank for a protective device is true.

We don't like to be thrown in with a lot of other people. There are a lot of problems in the subways, and we will do it under controlled conditions, a long trip or something like this, but not for short trips around the city.

COMMISSIONER ARMSTRONG: If you really want to try that, go to the Dallas-Fort Worth airport.

DR. HORNBY: I have an anecdote relative to that. NASA conducted a study which showed rather clearly that against the base line, which is current habits, we can save about one-third of the total energy used per day by going to a sort of integrated, interdigitated transportation system.

We can save 50 per cent of the energy today by eliminating the airplane in the northeast corridor of the United States. When we examine the data—and admittedly we have a slight parochial interest, but examining them in terms of the sociological impact and human needs, the very thing that Sam has stressed, we decided that we could save the one-third, but we couldn't save the one-half. The airplanes have to stay.

DEAN BENSON: I don't have a question, but there is a system that I spoke of this morning that the University of West Virginia proposed to do just what you are talking about.

We have been working on that system now, I guess, with government funds for some five or six years and the Federal government is now in the process of abandoning that system.

It apparently does not work very well, so evidently we do not have this technology yet.

MR. DUNNAM: My skepticism about these systems not working is that when a concerted effort is made in specialized communities to make it work, such as Disneyland or Disneyworld in Florida, it seems to work beautifully.

DEAN BENSON: Now, those systems don't do what you are talking about. They haul large numbers of people on a fixed system from one place to another.

MR. DUNNAM: Well, you have various modes. I think those probably are some of the best transportation or mass movement systems that have ever been designed. They were designed for a profit, for an amusement park that wanted to maximize its profits. To do so, it had to get that large number of people per day to a number of places.

DEAN BENSON: But people in Austin don't live in amusement parks.

MR. LEACH: I would like to speak briefly to this gentleman's point. One thing that is not necessarily necessary is that these things be confined to tracks.

Vehicles could be developed which are not railroad vehicles. Primarily, I prefer to ask Dr. Hornby a question. I am very interested in the NASA capabilities to simulate.

I can't think of any organization that I would rather have working on the energy problems. You seem, however, to give solar energy a pretty short trip and I would like to ask you two questions concerning that.

First of all, solar thermal, and you were particularly down on it. First of all, are solar wind experiments being conducted by NASA, can you comment on those projects?

DR. HORNBY: Yes, I think it is necessary to conduct the windmill type work NASA is doing. Solar wind is useful in areas where nature has amplified the wind and amplified the energy.

When you have the uniform density—the solar constant again—when you have normal wind conditions, even in relatively windy areas where there is little amplification by natural topography there simply isn't enough energy in the wind to make a windmill velocity factor.

We are talking about thousands of dollars per kilowatt when operating an operation for just three hours a day, say, in the afternoon, for most areas.

That gets you into the tens of thousands of dollars per installed kilowatt and even nuclear is only $500 to $600 per installed kilowatt.

You are increasing the cost of your electrical energy or whatever the energy by factors you can't tolerate except in these special isolated areas and there are a few of them.

The windmill research is useful because it will provide us with a mechanism for exploiting the wind where the wind can be exploited.

MR. LEACH: The second part of the question is that you seem to be using sort of obsolete collector data. Can you express this in terms of a ratio between building area and prior power requirements?

Obviously, no one would expect solar energy to provide all of the energy, but, where you can relate it specifically to builder use, do you have figures that are, perhaps, more easily understood?

DR. HORNBY: The only data I have are from the work of the University Arizona, the sort of one-way mirror, the platinized aluminum solar thermal collectors.

70,000 square miles of Arizona were actually used. This was simply to satisfy the same constraints that I came up with in a ten years' growth, so my numbers were based on an actual study of ten year growth for the Western United States. This includes Texas, incidentally. It does not include the northeast corridor.

MR. LEACH: Well, in your ten year growth, you assumed— you neglect any savings in energy.

DR. HORNBY: Yes, that study did neglect the conservation savings and recycling of energy savings.

MR. LEACH: Probably one of the better men in solar wind is George Learf and his experiment and collectors can now handle heating and air conditioning loads in a building using only one-third of the area of the building for a collector which is significantly better than, I think, that you are putting out.

DR. HORNBY: Hopefully, I favored solar heating for buildings. I think that has real promise, but I would say this. It's also very important because at least forty per cent of our total energy demand currently is nothing more than heating or cooling of buildings, industrially, primarily.

Residential is a small part of it, like six or seven per cent of it. My feeling is that one way to augment the solar, which will probably take a few years before it's available to us, will be to take the advice of my colleagues and wear a sweater in cold weather.

DR. KEESE: I have a question for Mr. Romney and I don't know how to ask the question. He was talking about the effect on the development market, on the developers, of energy shortage, the inflation and so on. What is the magnitude of this? What effect is it going to have? Are these people going bankrupt? How much money does it take out of the market and what is going to be the side effect?

MR. ROMNEY: Well, I was speaking basically right now of the resort business, but all real estate right now, most of the real estate right now, as is the automobile business, is in a state of recession.

I believe Chrysler said yesterday that production was cut 30 per cent through the first 15 days of October. Somebody was trying to get them to cut by 15 per cent, but they cut to 30 per cent in October because of the reduction in the business.

I don't know what the long range effects are. I would expect economists to know. I think one of the significant effects in real estate is that there is going to be a whole new distribution of capital in real estate.

I believe that real estate developers have been able in the past to finance their projects on maybe 110 per cent. They get 100 per cent of the money needed to develop the project and ten per cent for a little walking around money.

I think this is going to end and developers are going to have to put more of the equity money in, themselves, and that's going to have a large impact upon the kind of developments that are started in the future.

I also think there is going to be a more institutionalized form of real estate investment, with larger institutions having more of an impact and controls on developing real estate in this country.

I think that is because of the recession and because of the regulation which takes a great deal of time and effort to work with—and whether much of it is good and the need for environmental impact itself is—I think the day for a lot of the small real estate developers is out. I think that's one of the big setbacks. I was interested in this discussion on the use of mass transit.

After living in New York for three years, I thought it was one of the most de-humanizing experiences of my life to ride the subway everyday to work. You sort of stand there and you're numb.

You are trying not to look at anybody or have any feelings for anybody in the subway. One of the great things about leaving New York is that all of a sudden people become much more friendly and I think one of the real reasons is because you don't have to ride in mass transit all the time.

I used to get to work in the morning and the sweat would be totally through my clothes by the time I got to my office on Wall Street, so I do think there is a tremendous—and even when I go to the Dallas-Fort Worth air-

port and even when Surtran is riding properly, it has a similar effect there.

There is a real social barrier, at least in my case. I think it is with everybody else. The automobile is the best thing. It gives them more freedom of movement, freedom of control of their own circumstances over anything else we have.

Whether it's proper or not, whether it's right from an energy conservation source, that's the situation. In New York, they use it because you have that high concentration, you have that peak of all of these office buildings in downtown New York, but you don't have that peak in Austin or Dallas or these other cities because they are not land-locked and consequently the office buildings have been moving out to the periphery of these cities.

The city that I am from, in Detroit—there hasn't even been a factory built in Detroit for almost forty years. That's why the automobile production is going elsewhere, because all the factories are going outside of the city.

Consequently, people are moving outside of those cities and you are getting more of this distribution effect because of the suburban deal and that makes the ability of mass transit to cope with the need for suburban transportation less useful and less economical and you go back to find some other substitute to make the automobile work more efficiently in terms of transportation.

MR. BRIDGES: I would like to make one comment. I entirely agree that mass transit goes with very high density. I entirely agree with Mr. Romney, but the only other thing people seem to think of is mass transit and New York subways.

There are major subway systems in other countries of the world and I would say they work very, very well. I have been in London for several years and I have been in several West European cities and they have very, very good transit systems and they work very, very well. I think we are making a very big mistake if we only look at New York City and its subway system.

MR. ROMNEY: I'm just saying what I prefer. Maybe other people prefer differently. I lived in London a couple years myself and I prefer, just from a social standpoint, even though I believe firmly in mass transit—I would like to see the highway funds and the Federal money go more into mass transit and so forth. Politically and economically, I'm all for that, but on the other hand, one of the big obstacles is that people have more enjoyment in riding their automobile than they do in riding in mass transit.

MS. GREIG: Well, I think the way they are doing with desegregation in Austin, that they ought to take some taxes and show them these other transportation systems because there is only one alternative here and I don't think there is anything enjoyable about the car in rush hour.

The only people who wave to each other are truck drivers and Greyhound bus drivers and I don't see what the sociability is, what the plus is. You can't read or do anything like that. The people in the morning session were the people who stated they want the car, but people only know one thing in Texas and so I don't think this is true.

MR. LEACH: I would like to try, Bob, to combine these ideas which is more what I was getting at earlier about transportation. We are hung up on rails and more of us are hung up on automobiles, but it is conceivable that Dr. Hornby could get together with GM and with Ford and interface the problems so that you have a small untank-like vehcile which could climb onto a carrier which would distribute you and you could still use your automobile.

You could even have a trailer hitch on the back of it so long as you don't have to have that enormous protection built around you. As long as they are not capable of enormous speeds, they could be used in closely contained areas and you can have your cake and eat it too.

You have your automobile that's beautiful, fancy and chromy, if you wanted, but it doesn't need to weigh 5,000 pounds or 10,000 pounds.

DR. KEESE: I wanted to respond to the statement that Texans haven't ever known any other form of transportation. I have this comment. In the history of Texas, we have lived through all the forms of transportation that have been proposed at one stage or another of our history.

DR. BETAK: I don't have any questions. I just have some comments which are observations on some things that have been said. First of all, I have a small familiarity with Detroit.

While there is no doubt that a good deal of the indus-

tries are moving out, I have a suspicion that it probably has something to do with a problem we call segregation, which has been operating quite significantly.

MR. ROMNEY: Yes, I think that's been the major problem.

DR. BETAK: Secondly, I am dubious, after some various exposures, of the kinds of links that might evolve between GM and Ford and other institutions in terms of developing these alternative modes.

I think it is a great idea, but somehow or other, General Motors and Ford, when it gets down to the crunch, you know, they have their little thing that they want to sell and hustle, whatever it might be.

Finally, I guess, I would like to make the observation that the automobile that we all tout happens to be nothing other than a composite of attributes which we seem to find desirable.

It is completely feasible to design some other set of vehicles which contain those composites of attributes which are not private automobiles and which probably can move around and do the same job and they don't have to be owned by any of us and maybe they might even be sociable.

I don't like the business of my driving down the road every day racing past somebody, waving my fist at them because they have cut me off, et cetera. That's hardly sociable.

About the only sociability you get is when you come to a crunch at the intersection.

MR ROMNEY: Well, I don't mean to defend the automobile industry, because I don't want to get into that posture. My posture is that I don't think that a better alternative to that has been found yet, that if there is a way to reform that one, that would be what I would think would be the best thing to do.

I think Dr. Hornby can think of a few incentives for GM that would make them want to go to the steel companies and so forth that could cause them to try to reform their vehicles.

None of the other alternatives in these communities outside of New York and some of these other communities that have mass transit have proved workable.

This is part of what Mr. Roark is saying with regard to Dallas; it isn't the total solution for Dallas, either.

DR. HORNBY: Can I just put in one quick cautionary word here? I don't think we can be too careful here about change. There is a real reason for this. Currently, energy growth needs, just to stay where we are, are going to consume at least $100 billion a year and conceivably more of capital.

That exhausts just about all an economist would call a marginal compensative incentive to save in the United States. You can't really internalize that within the oil companies despite their large profits apparently; it has to come from the market capital sector.

As I see it, this means that very few other industries, if we give a reasonable priority to energy, are going to have the capital they need. Change is going to come very slowly in transportation as in everything else because of this hiatus that we are in with respect to our energy needs, et cetera.

MR. OLSEN: I was wondering—this may be a loaded question—but what sort of legislative change do you think would have to go into the legislative phase that would give local communities incentive in Texas?

COMMISSIONER ARMSTRONG: Well, as I indicated, the need isn't in the communities. Most of the communities have some capability; a zoning commission, a city council with police or authority to regulate, to zone and that kind of thing.

The questions I raised are, would those communities be better off being more sophisticated in their approach given additional technological capability, which we are now developing, and given a new perspective, which is what I try to term looking at land as a resource and defining its capability in making these decisions about how they grow.

I think where you see the Legislature address itself to the problem, at least in this session, will be toward giving extra-territorial jurisdiction such that these problems that I tried to point out that are outside the city's control will be reachable.

Basically, with the exception of the development that has reached the proportion where Federal control is applicable—out-of-state sales and that kind of thing, outside of water quality which is prevalent in some development problems—all the rules are off once you get outside the city.

I think the Legislature will move to plug that gap. You know, there are people who say that the Environmental Protection Act right now, were they to go ahead and move within the language of that Act, is broad enough to really be a land use bill.

One example is the high density parking situation that Sam referred to and there are others. John Dixon writes a pretty interesting article that if EPA wanted to move to land use, it wouldn't take any additional legislation. They just haven't chosen to do that, and, frankly, I hope they don't.

I hope the Legislature has been studying, through committee, the land use question and that they are coming up with some ideas, certainly power plant siting has already happened.

I think you may have some plant siting, but I think most of it is going to take the form of study or prospective legislation with, maybe, a study committee being set up by the legislature. It will move pretty slowly.

MR. SMITH: I had sort of gotten the impression that people have been sort of reinvented here and that it is a political problem getting them developed. The government hasn't been talking to General Motors and so forth. I don't think that's the case.

It seems to me that the reason people movers or horizontal elevators or whatever we call them have not been developed is simply because even they cannot provide the flexibility that the automobile does.

They may provide some flexibility in the highly congested areas, and, if they do, then they are going to have to compete, I guess, with rapid transit as the other alternative for high congested areas, but it isn't feasible yet, is it, to think of building people mover systems in Austin, Texas, or Georgetown or smaller towns even than that? It's going to be a long time before we replace the automobile.

COMMISSIONER ARMSTRONG: I think that probably is what some of the substance of what we all have been talking about is. I would also suggest to you that if you don't think we are having at least some slight problems, if you have a 5:15 plane to catch, you are really eight or nine minutes driving time from the airport. If you will start right now, I bet you won't make it by six and these are some of the things that I think we are now coming up against. Well, let me do this. I have been asked to summarize. I'm not going to presume to do that. I think all of you heard everything within the last two hours.

I think maybe perhaps we have gained more from the questions and answers than perhaps we would have by going through a summary. I would like to comment just briefly on a couple of the statements.

John suggested that the mass transit system is one that has been considered in his area. I would add one additional comment. It may not be pleasant to ride the particular modes of conveyance that we have seen in New York City, such as the subway, but I would also tell you that it is apparent to me, having been to New Haven and a couple other places, that there are some people who ride the commuter trains that, from the looks of them when they get off the train, have had a good time.

This reminded me of the senator who recently, if you read the newspaper, was voted by the Senate staff as the dumbest senator in the United States and he responded, "No, that's not true. I'm not, and besides even if I was the dumbest senator, I'm still plenty smart. Besides that, the third point, all we're supposed to do as your elected officials is to reflect the will of the public and I have been home and I can tell you that I know the public's will.

"As a matter of fact, there are only three issues that are really important and they all begin with 'I'. They are impeachment, inflation and energy."

I do detect two basic points. One is that there seems to be at least some questioning about what I will characterize as Detroit, but that perhaps we could do better in the kinds and types of vehicles that would use our existing transportation system than we do now, as particularly relates to energy; whether this is something the government should concern itself with or whether that's something that the people should make demands on, by their buying habits or along those lines, I don't know.

Frankly, I see that if the problem is clear and that if the graph is going to go up and go down, perhaps somebody should take some regulatory initiative to try to ameliorate that drop in the graph at some point.

It's perfectly clear from all the work we do in supply and demand on the Governor's Energy Advisory Council that the waste factor has to be considered as at least as important as the supply factor, finding new sources and that sort of thing.

We must do better in our economic use of these fuels. The other thing that seems to be prevailing is that it isn't an easy one, this problem we've discussed today.

It isn't one where you can look at it myopically, and then what do you do? It's fine for us to talk. Somebody used the example of the elephants that were making love. There is a lot of noise, a lot of commotion and a lot of action, but then nothing happens for about two and a half years.

Perhaps what we need to do is to look at the government in some other way. I just talked to a gentleman at lunch before I came over here. He is in charge of the Governor's program. One thing he worries about is that we are going to have a great study and it is going to be great.

A lot of people have had input into it but unless we can take that study and do something besides put it on the shelf and say, "Man, didn't we address ourselves to the problem," unless government can then take what we have found out and do something, then are we really getting anywhere?

I think this is the kind of challenge that may be even greater than the identification of the problem or all the ideas that come out; you know, how do you even coordinate it?

Are you still going to fight between the Land Office for water development, the Road Commission, the Highway Department? Can we do it? I'm really worried about the Feds every time I go up there because—and I'm not cussing them unnecessarily—I'm just saying that there are feelings between Interior fussing with Commerce, Agriculture talking about Interior, where if you don't talk to all of them, the two that you didn't talk to hate you for seeing the one you did see and you become known as a provincial that deals with Interior.

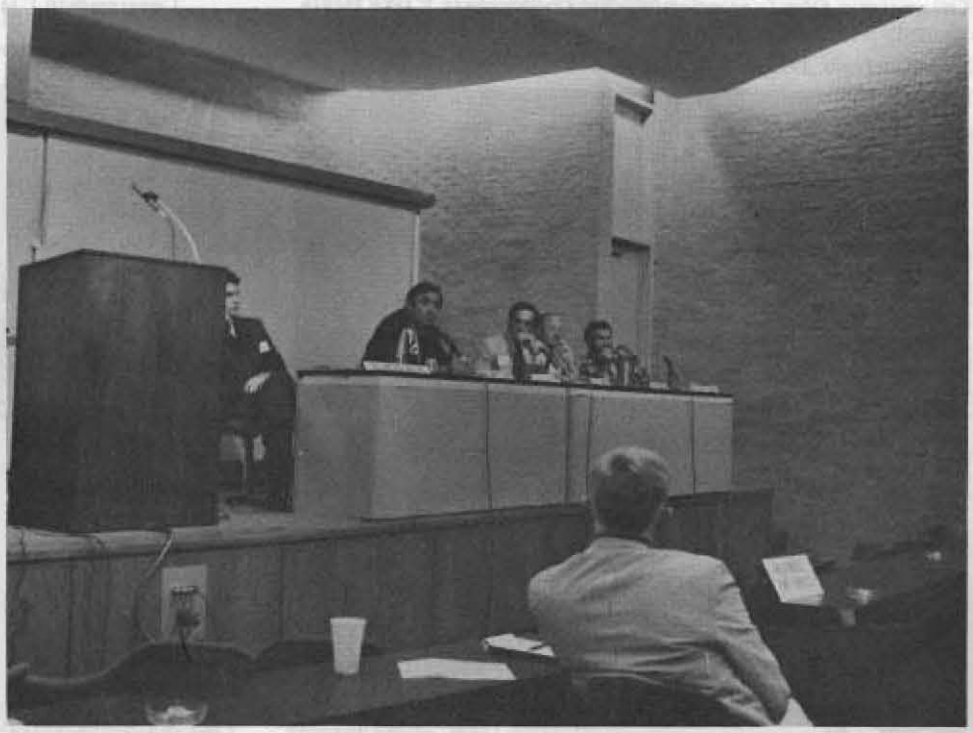
All this stuff just really is a worry to me, and, frankly, I hope we don't do this in Texas. I hope we have some capability to motivate and to mobilize our governmental function in the area where it should function a way that doesn't make the same kind of thing I see too much of up there.

Well, that is sort of a brief capsule summary. We're getting out by five minutes after five so that you can go down and catch the commuter train and ride it out and back, if you want to drink on it.

I very much appreciate this opportunity to have been here.

DR. WALTON: Thank you very much, Commissioner Armstrong. Ladies and gentlemen, I would like to express our appreciation for your attendance here today. Please remember that the reception and dinner will begin promptly at 7:00 o'clock this evening, and tomorrow morning, beginning at 9:00 o'clock, we will begin the phase on economic and policy constraints of scarce energy on the future of transportation. Thank you.

Dr. Harry Hornby, NASA-AMES.



Panelists respond to questions during the afternoon session.

Congressman Olin Teague introducing Congressman J. Jake Pickle.

Congressman J. Jake Pickle addressing Evening Banquet.

Dr. W.R. Hudson, Dr. Ed Todd, National Science Foundation, and Mr. Joe King, Chancellor's Council-University of Texas, at the Evening Banquet.

Dr. Ronald Briggs, Department of Geography—UT Austin, Dr. Harry Hornby, NASA-AMES, and Dr. Pat Burnett, Department of Geography-UT Austin enjoy conversation at the Evening Banquet.

EVENING SESSION

October 24,1974

BANQUET SPEECH

THE HONORABLE J. (JAKE) PICKLE, U.S. CONGRESSMAN

Conferences of experts generally oscillate between two extremes—between marvelous images of what *could* be and depressing scenes of what *will* be if changes are not made soon. Often the pessimistic view holds sway. A serious study usually reveals complex, seemingly insurmountable obstacles between the problems preceived today and the solutions for tomorrow. I believe your conference is turned to the positive approach.

Yet nothing could be more understandable than a touch of pessimism whenever anyone takes a serious look at our own national transporation system. It is, frankly, a mess. I cannot in truth even call it a national transportation system. And the hand-in-glove inflation and energy situations have only made an old wreck look more rusty.

Few objectives are more important than tackling our transportation ills. Transportation is one of the more pervasive and influential sectors of our economy and of our daily lives. Transportation accounts for about one-fifth of our GNP; it brings in about 17 percent of our taxes; it represents nearly 10 percent of our privately owned tangible assets; it empoys over 13 percent of our civilian workforce; it consumes 75 percent of our rubber, 56 percent of our petroleum, 30 percent of our steel.

All of this is by way of saying anyone who expects to control inflation-energy problems by cutting the federal budget—and doing nothing about transportation—is fooling himself. Anyone who expects to control inflation-energy problems through taxes and volunteer programs—without radical surgery on our uses and abuses of transportation—is just nibbling at the bullet. Anyone who hopes to use the Mexican—or some future—oil find as a crutch to continue the status quo is putting his head and his shoulders in the sand. And anyone who thinks the changes needed will be easy simply because they are technologically feasible simply hasn't looked at the problem.

Transportation is one of those areas where the first difficulty is not agreeing on a solution but deciding which problem to tackle first.

If colossal volume were all that mattered, the United States transportation network would be home free. Unfortunately—especially where energy is concerned—the volume only adds to the problem. Few domestic problems of our time have been worried over more—yet seen less real progress—than the Transportation Problem. Maybe it is symptomatic of the depth of the issue that these two great Thanksgiving rivals represented here tonight would lay aside their traditional emnity to see if perhaps two collective heads can be better than one. I think it can be.

It is also encouraging.

If we look only at the technological facts of the problem, complicated by the political mess we have inflicted on our transportation system, and hampered by the natural resistance toward change, then the future is indeed bleak. But history is full of magnificent detours and sudden departures from predicted destinations. Arnold Toynbee makes the point that the greatest of all historical forces are put into motion when the people decide to pit themselves against serious challenge. The greatest changes of this century were not predicted: No one could have predicted Aldolph Hitler—or the incredible spirit of the British people holding out against him when all of Europe had fallen. No one could have predicted the effect of Franklin Roosevelt rekindling self-confidence in ourselves and thereby snuffing out the smoldering fires of social and political revolution threatening to destroy our own democracy in the economic chaos of the early thirtys. Nor could anyone forsee the impact of Thomas Edison, Henry Ford, Alexander Graham Bell, Sir Alexander Fleming, Pierre and Marie Currie, Jonas Salk.

This conference is encouraging because it and the transportation programs which brought you here are—just possibly—a kindling of the kind of spirit which will at long last get some results in the reordering of our transportation.

The topic of this conference implies one major assumption—that energy supplies for transportation

will be increasingly scarce and expensive. An unpredictable happening could alter much of what we say here—a widespread development of hydrogen-powered vehicles or a refinement of a very cheap solar cell powerful enough to run an auto or even a train or a plane. But even so, I think it is safe to say that for the next decade or two transportation is going to be reliant basically on petroleum, petroleum is going to be expensive, and some changes are going to be made whether we like it or not. And I think it is safe to say that some aspects of our transportation will change no matter what the fuel situation because of pressures from environmental and land use constraints, housing costs, and myriad other social and economic factors.

The most obvious focal point when one mentions energy—or petroleum—shortages and transportation is the automobile. For while transportation consumes well over half of our petroleum, highway carriers consume well over 80 percent of transportation's share. This is critically important in a State like Texas, which developed during the automobile age. Cities, communities within cities, housing, and businesses are spread around throughout our State in a way that makes us almost totally dependent on our streets and highways for either passenger or freight transportation. Significantly, Texas has for years envisioned the great Interstate Highway system as only a beginning—planning in addition a more extensive freeway network linking the major cities of the State. That, of course, would also mean more cars, trucks and buses, more suburban towns, more commuters, and more use of petroleum. I would hasten to add, however, that it is exceedingly important how we link up our big cities and our country town—that we do have a city transportation problem *and* a rural transportation problem.

Quite frankly, I would not see expensive petroleum alone causing a great transformation of this trend that emphasises the automobile. It would curtail it, modify it, but not radically alter it.

Other social and economic forces are at play here, too, however, and the combined effect may be pointing toward new directions.

For several generations Western civilization has been on a proud, confident growth binge—more children, more food, more goods, more energy. The naturalist Jacques Costeau thinks that now we are experiencing a new awakening—and that this new view on world growth feels an awful lot like a raucous hangover. Many people in the industrialized countries would agree with him. Of course, while we are painfully reviewing the littered remains of the morning after, many underdeveloped nations are still most anxious to get to the party. Their desires—and their haste to join the industrialized nations in luxury—will create additional pressures on the world's resources with each passing year.

Many see environmental concerns as a fad which will vanish before the cost and inconvenience of the clean-up and the necessary controls to keep it clean. However, I think that a good environment has now come to be regarded by the bulk of our citizens as a natural right—almost as one of the Constitutional rights envisioned by the founding fathers. There will be resentment against some efforts, but I see no real retreat from an overall environmental concern. In these critical days, we must continue to clean up—hopefully with common sense, even as we conserve.

The isolated big home consumes much energy itself and represents the epitome of an energy-consumptive life style. It will become more and more expensive—both for the individual and for society—and therefore less and less desirable. How it is replaced will have great influence on the forms of transportation which rise to prominence in the coming decades. And, of course, different areas of the country will find various combinations and solutions to fit their own needs.

Texas likely will not be one of the first to make radical changes in her transportation system—not because she is slower than anyone else but because she, like other states and areas developed after the automobile, faces the most radical changes in making any switch. Finding solutions to high cost, scarce energy in our sprawling state will require all the imagination and commitment this room, and others like it, can muster.

In the total national scene, some trends are already visible—and others are notable for their lack of visibility.

U.S. highway traffic consumes a great amount of energy—but it also moves over a fifth of our intercity freight and accounts for almost 90 percent of our passenger miles. We can expect our highways to play a prominent role in our transportation for some decades to come. Key to developments here likely will be the word *conservation*. Down the road will be technological developments that will reduce the average family dependence on the auto. For instance, each home may be

equipped with an appliance that combines the TV set with a desk computer and xerox machine. It could not only serve as a television but print out the daily newspaper and permit its owner to receive radioed letters, review the shelves of a nearby grocery store, order foods and dry goods, pay bills, balance the checkbook, and provide color-video telephone service.

But such contraptions are still a while away and conservation remains the key today.

I do not think that adequate conservation will come voluntarily. In the case of passenger miles, old habits have proved hard to break, easy to resume. In the case of freight traffic, many changes must be made in regulatory agency mandates and in the capital structure of trucking before major inroads can be made.

Gasoline consumption has gone down a *bit*—and stayed down a *bit*—with the recent price hikes. But carpools remain a novelty, buses still run empty, experimental forms of transit like the jitney, the dial-a-bus, remain mostly experimental, fringe parking areas lie bare.

It is true that the semi-division of the Trust Fund in the 1973 Federal Aid Highway Act, and the existence of the 1974 Mass Transit bill now pending in the Congress are handwriting on the wall that moves will be made away from the private auto.

But it is also true that, in general, traffic conditions have to be really abominable and the alternative superlative by comparison before motorists will voluntarily forsake their private cars. Our own U.T. shuttle bus system and the Linderwold Line between New Jersey and Philadelphia are two good examples. Across the country, however, car bans, commuter taxes, regulations concerning size of and gasoline mileage in new cars, and other punitive incentives may well be the only means to force an adequate curtailment in auto use.

Disillusionment with the total wonders of the highway have brought a renewed interest in our railroads, for railroads clearly are the most fuel-conserving means of transportation other than river barges. But the problems with our gas-guzzling autos read like a Dick and Jane reader compared to the mess our railroads are in. A start is being made in the Surface Transportation Act, now reported out of the House Commerce Committee. But even this $2 billion loan program to buy freight cars and refurbish decaying railroad beds is really only a start. Deferred railroad maintenance alone is now estimated at close to $6 billion. In addition, railroads face tremendous management-labor problems. Disgruntled shippers are taking over many routine maintenance and inspection jobs, and financial woes beset the railroader wherever he turns.

Airlines will have to move away from the multiple flights at the same time and may have to cut back service to many smaller towns—leaving this for taxi-runs or other forms of transportation policy.

Present regulatory arrangements offer neither the benefits of a free market nor those of a well-managed cartel. All rail traffic—but only about one-third of truck volume and one-tenth of barge volume—are now under control. Rules and mandates formed by a bygone era when the railroads held a virtual monopoly over freight movements have added irony and anachronism to the modern problems of transportation.

In the early 1920's, when railroads already were beginning to lose business to trucks, the Interstate Commerce Commission ordered railroad rate hikes by as much as 40 percent. So-called "umbrella" rates, designed to share traffic among competing modes, have also resulted in misallocation of traffic when the effect is seen from a conservation viewpoint. Reduced competition has discouraged technological development and managerial initiative. The value of service pricing principle—where rates are set proportionate for the *value of goods shipped* rather than to the *cost* of hauling them—prevents truckers from cutting rates in order to fill empty trucks on return trips. Consequently, only about half of common carriers have full loads in both directions. Rail car utilization stacks up even worse, and private carriers are full both ways less than 10 percent of the time. Rate regulations have retarded the use of unit trains, containerization and other innovations. Intermodal transportation and equipment is still being winked at—and avoided.

CAB restrictions on setting lower fares have sometimes reduced competition in the airlines to offering trivial luxuries such as more and more elaborate inflight movies, lavish meals, and free cocktails. I think you will see more consolidation—more coordination and more conservation in the airline industry than perhaps any other mode of transportation. The big International Airport at Ft. Worth-Dallas may be one of the last great Regional Airports—no matter what San Antonio may want or suggest.

In spite of all this, a lot of opposition to de-regulation comes from the carriers themselves, reluctant to cut the apron string. I do not want de-regulation, per se, but

regulatory agencies must not be used solely to protect the regulated industry.

Something must be done, however.

Most of all, whatever else is done, we must make a serious effort truly to integrate our national transportation system. We cannot continue to treat each carrier as though it were a separate entity and as though its use had no impact on the rest of society. But in transportation today the old Ben Franklin admonition "We must all hang together, or most assuredly we will all hang separately," applies painfully well. I have argued for and Congress has asked for a national transportation policy for years. Yet we have seen only delay, procrastination, and a total lack of result. Until the people are educated to realize the impact our transportation mess has on their pocketbooks and their daily lives, I fear the road is nigh impossible—for most people now have little or no idea really how their goods are brought to them. The concern you are showing here is most encouraging to me. This is a good beginning. I hope that you and others like you will at last get the forces rolling to demand action on an integrated national transportation policy.

Since President Johnson recommended, and the Congress established, the Department of Transportation, it was hoped that this act alone might put under one big tent our transportation problems, goals, and objectives.

That was not the case. We simply added one more layer, although admittedly some additional coordination does prevail today. We still have airlines under the CAB, the trucks and railroads under the ICC, and maritime still is independent as a Spanish galleon.

Many of us feel that this is not the best and we talk about it in the Congress and yet when we had a chance for re-organization in the House of Representatives committee structure this past month, we further split jurisdictions by putting surface transportation under Public Works and the railroads continued under the Commerce Committee. Additionally, research and development for transportation is split in at least three different committees.

This signifies again the the problem is immense. But over and above that, we still cling to jurisdictional jealousies.

Because of the extreme complexities of the transportation system, we are making slow integrated progress, even as we are making giant new discoveries in the various modes of transportation.

I think we recognize that we cannot easily re-locate an airfield that was properly perhaps built at the right location thirty years ago. And we cannot re-lay track lines without exorbitant cost because we know they ought to be re-layed. And our highway system has developed almost set patterns of directions which allow little leeway.

What we can do, however, is determine that one voice or one agency can decide these problems in a coordinated and related manner. And until we are willing to put our punch in one glove, we will not have the kind of integrated system we need. It seems incongruous that this may be the fact even as we are on the verge of magnificent development.

I see light and fast Amtrak systems, perhaps magnetically elevated and propelled by linear induction, and trans-urban systems that will squirt us—tubelike—between cities.

I see subways for most of our major cities, including Austin.

I see the feeder airfields with helicopter and helipads playing a vital transportation role.

I see city delivery systems becoming even as important as mass transit systems.

But I also see mass transit being given proper attention in the days ahead.

And close behind may well be the vertical take-off vehicles used for civilian purposes much like carrier planes operate in the military today. Perhaps solar or hydrogen cells will force us into a new break-through. These new means are practically within our grasp but they will serve us least efficiently unless we can integrate our system.

Institutions like the University of Texas and Texas A&M University can give us new insight into many of these possiblities and I am proud to see these two institutions working together.

Dr. Lymon Reese, Department of Civil Engineering-UT Austin, Congressman Dale Milford, and Mrs. John Davis.

Morning Session

October 25, 1974

MR. BRIDGES: Good morning. I would like to welcome you to the final morning session of the Joint Conference on Long Range Implications of Scarce, Expensive Energy on Transportation.

This conference is the second Joint Conference on Transportation sponsored by the two Universities. This morning's session concerns the economic and policy constraints of scarce energy on the future of transportation.

Yesterday, we discussed the impact of expensive energy on land use, the environment and the subsequent impact on transportation systems.

Last night at a very pleasant dinner, we were privileged to hear from two of the most able congressmen in the Texas Delegation and I think all of us enjoyed, particularly, Congressman Pickle's remarks concerning the transportation industry.

Today, we are going to turn to more specific topics on how the transportation system will adjust to the immediate future. We know now that there will be many changes in the transportation system; cars will be smaller and more trips will be made on transit.

Additionally, many changes will be made in the goods distribution system. Agricultural products are now a major user of transportation, particularly in Texas, and will remain so now and in the future.

If our forecasts of energy utilization between now and the end of this century are correct, energy goods will become a major user of our land transportation system.

These goods are currently a major user of our waterways. Because transportation is a major consumer of energy, using about 25 percent of our total energy and up to 50 percent of our petroleum energy, transportation is looked to as a major sector to conserve energy.

Much emphasis is placed on the transportation energy conservation. The Texas Transportation Institute is currently working on two transportation energy conservation studies.

One study is on energy importation and the subsequent impact on transportation and the other is a study on the land use impact of scarce energy, all for the Governor's Energy Advisory Council, which Governor Hobby spoke about yesterday.

Before we call on our first speaker, I guess as is the usual case in any conference of this kind, plans do not run as they are supposed to, necessarily, particularly at transportation conferences, so that Dr. Gramm will be on the program immediately after the break this morning rather than on the program first.

If you will, just make that change in your program; everyone else will move up one slot and Dr. Gramm will be on the first thing after the break.

First, this morning, I would like to introduce to you a young man from the Bureau of Business Research at the Universtiy of Texas at Austin.

His name is Bob Lockwood. He is an energy specialist and radio coordinator with the Bureau of Business Research. He has a Bachelor's Degree from Rice University and a Master's Degree from the University of Houston.

He has served previously as an editor of the U.S. Study Commission on Texas and Houston in 1960 and 1961 and is a co-producer and moderator of the "Texas Business Review", a weekly radio interview distributed throughout Texas since January, 1972, and is an author and commentator on "Energy and Man", a weekly radio program distributed nationally.

He is also a member of the Energy Technology Assessment Committee of the Center for Energy Studies at the University of Texas. Without further introduction, I would like to present to you this morning, Mr. Bob Lockwood.

Mr. Robert Lockwood, Bureau of Business Research—UT Austin, addresses Morning Session on Transportation Futures.

"Policy and Plausibility in Transportation Futures"

MR. LOCKWOOD: Technologic, economic and institutional elements relate the transportation and energy industries in the United States. In the foreseeable future as in the past century, therefore, these industries must share a common fate.

The parade of proposed transportation and energy futures suggests that planners enjoy a huge range of choice in selecting goals and allocating resources.

This apparent profusion of options misleads citizens especially, for two reasons: first, because institutional influences, more than others, will determine both transportation and energy futures; and, second, because institutional and other limitations effectively reduce to a handful the plausible options for planners.

For at least the next decade, policy and other constraints have already shaped the terrain of the future. Even for the years after 1985 or 1990, transportation-energy planning in Texas and the United States must proceed within technologic, economic, social, and political limitations that already foretell the general aspect of future transportation/energy landscaping.

Severe limitations and great vulnerability arise from the fluid-based energy economy of the United States. The structure of energy production and consumption in the United States since 1850 illustrates the exploding contribution of fluid fuels.

The structure of consumption during this century exaggerates the liquids-production trend and dampens the rise of natural gas. These and related effects arise from the status of the United States as a new importer of liquid fuels and a net exporter of natural gas and coal.

Until the twentieth century, the transport-fuel economy was dominated by solids—wood and coal. As late as 1930, solid fuels contributed 40 percent of domestic transport requirements.

By 1940, the share of fluid fuels—mostly liquids—had risen to almost two-thirds. The share of liquids and gases attained 80 percent in 1950 and rose above 99 percent by 1959.

Technical constraints qualify the physical dimensions of transportation-energy, such as the supply of land, water, and energy materials. Many of the most urgent policy problems concern assessments of energy resource bases.

Through their near-term significance in a fluid-based energy economy, petroleum liquids and gases have inspired intensive efforts aimed at quantifying the undiscovered producible resources of crude oil, natural gas and natural gas liquids.

Using largely the same data, several investigators have reached remarkably different conclusions concerning the undiscovered quantities of oil and gas.

In the long run, the only significant assessment is the one that proves correct. For now, though, the vital question is which of these assessments will be regarded as correct by government.

If generally high numbers are accepted by government planners, national policy might work largely to encourage the domestic petroleum industry, ideally shoring up reserves of conventional fossil fuels, watering down the adverse effects of rising oil and gas imports, and alleviating the national balance-of-payments problems.

If the conservative assessments are adopted, though, Federal energy policy probably would be aimed at building emergency oil storage capacity, increasing oil and gas imports, encouraging the development of synthetic fuels capacity and elevating prices or taxes or both.

The most significant technological constraint on the transportation-energy economy of the future, though, affects time horizons. The farther any technology remains from commercial application, the greater the investment required to make that technology commercial, or to demonstrate that it cannot be made commercial.

Near-term demands, however, will always limit the share of research and development funds invested in long-range, technologies. Even if stopgap, dead-end technologies alone were available in the short run, many of the resources of society would have to be invested in these dead ends, so long as they could yield any return on investment.

From the point of view of an economist, these are problems of investment theory involving explicit or effective social decisions concerning the present discounted value of future returns. If present values are judged too low, investments in future technologies will not occur, at least not according to theory.

During the next several years, much of the technical effort of the energy and transport industries will have to be concentrated on the improvement of existing technologies.

The stretching out of the transition to a nuclear-electric energy base, the renewed emphasis on the production and use of domestic coal and petroleum resources, rising costs and increasing investment in environmental protection—these and similar influences will focus a larger share of innovative resources on traditional technologies and fuels.

Recent economic and political shortages of energy goods and other resources, together with inflationary and other pressures on all economic goods, have dramatized certain trends in the energy industries and perhaps quickened the pace of certain transitions, many of them institutional.

Through a combination of circumstances, including decentralized utility regulation and historically lower fuel and labor costs than some other regions, most electric utilities in Texas have so far escaped the full effects of the problems facing most power companies in the United States.

Table 1

Structure of Primary Energy[1] Production, by Form, United States, Selected Years, 1850-1970

(Percentages)

Year	Fluid fuels: Liquids[2]	Fluid fuels: Gases	Fluid fuels: Total	Solid fuels[3]	Other[4]	Total
1850	-	[a]	[a]	100.0	-	100.0
1860	0.1	[a]	0.1[a]	99.9	-	100.0
1870	0.7	[a]	0.7[a]	99.3	-	100.0
1880	2.9	[a]	2.9[a]	97.1	-	100.0
1890	3.6	3.6	7.2	92.5	0.3	100.0
1900	3.7	2.6	6.3	91.2	2.5	100.0
1910	7.1	3.2	10.3	86.6	3.1	100.0
1920	11.2	3.8	15.0	81.8	3.2	100.0
1930	22.1	9.1	31.2	65.6	3.2	100.0
1940	29.7	11.3	40.9	55.7	3.3	100.0
1950	32.1	19.2	51.3	44.4	4.4	100.0
1960	35.0	32.4	67.4	28.9	3.7	100.0
1970	31.6	38.6	70.1	25.3	4.6	100.0

[1]Excluding animate energy.
[2]Crude oil and natural gas liquids.
[3]Coal and fuel wood.
[4]Hydro and nuclear electricity.
[a]Natural gas data unavailable or less than 0.05 percent

Sources: Sam H. Schurr and Bruce C. Netschert, **Energy in the American Economy, 1850-1975** (Baltimore: Resources for the Future, Inc., 1960), p. 500; U.S. Bureau of Mines, **Annual Petroleum Statement, 1964,** p. 26; U.S. Bureau of Mines, **Monthly Petroleum Statement, December 1973,** p. 33; data for fuel wood production/consumption in 1960 and 1970 estimated.

One hedge against these difficulties has been provided by the participation in joint ventures of privately owned utilities with public power interests. These combinations can take some advantage of low interest, tax-free municipal or state-backed bonds.

If an increasingly large proportion of new utility construction in Texas consists of nuclear capacity, regional economic differentials probably will shrink, even if they fail to disappear.

Land and labor costs may remain somewhat lower in Texas than in the nation as a whole. Reactor manufacturing and other nuclear technology, however, are concentrated so highly outside Texas that regional cost differentials, where they exist, may hurt more than help Texas utilities and consumers through higher transportation costs for large, heavy components and for radioactive material, for example.

Thus, Texas may not long remain insulated from the influences, some of them basically technological lags, that affect the electric utility industry so profoundly.

Social and political limitations on alternative courses of energy development promise to become increasingly difficult to disentangle. Recent disruptions in energy

Table 2

Structure of Energy Consumption,[1] by Form, United States, Selected Years, 1850-1970

(Percentages)

Year	Fluid fuels: Liquids[2]	Fluid fuels: Gases	Fluid fuels: Total	Solid fuels[3]	Other[4]	Total
1850	-	[a]	[a]	100.0	-	100.0
1860	0.1	[a]	0.1[a]	99.9	-	100.0
1870	0.3	[a]	0.3[a]	99.7	-	100.0
1880	1.9	[a]	1.9[a]	98.1	-	100.0
1890	2.2	3.7	5.9	93.8	0.3	100.0
1900	2.4	2.6	5.0	92.4	2.6	100.0
1910	6.1	3.3	9.4	87.4	3.2	100.0
1920	12.5	3.8	16.3	80.1	3.6	100.0
1930	24.9	8.2	33.1	63.6	3.3	100.0
1940	30.8	10.6	41.4	55.0	3.6	100.0
1950	38.4	17.0	55.4	40.0	4.6	100.0
1960	43.8	27.8	71.6	24.8	3.6	100.0
1970	43.5	32.4	75.9	19.8	4.3	100.0

[1]Apparent consumption: production plus imports minus exports.
[2]Crude oil, refined products, and natural gas liquids.
[3]Coal, coke, and fuel wood.
[4]Hydro and nuclear electricity plus net imports of electric power.
[a]Natural gas data unavailable or less than 0.05 percent.

Sources: same as for Table 1, except for Schurr and Netschert, pp. 511-513.

markets, such as the Arab oil embargo of 1973-1974, actually represent the creakings of ancient social and institutional timbers.

Within the United States, special interests, even those outside traditional power bases, easily find avenues to public attention and public policy-makers. The automobile, for example, has been the central issue in a confusing debate waged for years.

In the context of energy crises, opponents, or reformed addicts, of the private automobile economy have argued correctly that structural and quantitative changes in the private transport economy could effect huge savings in energy consumption, either directly or through shifting an increasing share of motor vehicle consumption into other sectors.

The most persuasive case against the plausibility of severely curtailed use of private automobiles is that of Kenneth E. Boulding: "The automobile . . . . is remarkably addictive. I have described it as a suit of armor with 200 horses inside, big enough to make love in.

"It is not surprising that it is popular. It turns its driver into a knight with the mobility of the aristocrat and perhaps some of his other vices. The pedestrian and the person who rides public transportation are, by comparison, peasants looking up with almost inevitable envy at the knights riding by in their mechanical steeds.

"Once having tasted the delights of a society in which almost everyone can be a knight, it is hard to go back to being peasants. I suspect, therefore, that there will be very strong technological pressures to preserve the automobile in some form, even if we have to go to nuclear fusion for the ultimate source of power and to liquid hydrogen for the gasoline substitute."

Such an incentive, in fact, may well reinforce the already strong sense of social purpose that keeps driving the controlled fusion program. As one of the only two alternative future sources of almost unlimited energy supplies—the other is solar—nuclear fusion offers not only the future hope of profuse supply, but also the promise of environmental desirability and a sufficiently prolific source of electricity to provide a fluid fuel, hydrogen, to meet the technological preference for fuels in liquid or gaseous form.

Social drives less powerful than the desire to sustain the private automobile economy have probably accomplished more historically than would be involved in the Boulding scenario.

As the final arbiter of the size and thrust of future energy development, public policy will be informed and qualified, but not determined, by technologic, economic, and social limits and issues.

Thus, future policy decisions frequently will appear, at least to some, to be arbitrary and irrational. Unilateral political decisions—embargos, nationalization—will continue to intrude upon and frequently distort the national and international energy economies.

Bumper stickers,"Let the bastards freeze in the dark," will continue to mirror both genuine issues and the unproductively low level of most public debate on these issues.

Commentators on energy policy, who represent a bewildering variety of political and other positions, have frequently agreed that a central energy agency with broad powers ought to be established in the Federal government.

If a permanent agency of this sort is established, and federal policy is no longer proliferated and diffused through other agencies, many commitments of the United States will necessarily become more explicit and less contradictory.

The establishment of a national central energy agency probably will arouse more opposition within the government than outside it. Proponents of centralization include both friends and foes of Federal involvement.

The Ford administration moved in the direction of centralized Federal energy efforts October 11, when the President signed into law the Energy Reorganization Act of 1974.

This Act created a cabinet level Energy Resources Council, to exist two years or less. The council will expire upon the organization of a Department of Energy and Natural Resources, probably built around the present Department of the Interior.

An interim organization, the Energy Research and Development Administration, ERDA, will function along with the present Federal Energy Administration. ERDA, which begins its formal existence within 120 days of President Ford's appointment of its chief, will consolidate almost all Federal energy-research programs, except those of the Federal Energy Administration.

The Atomic Energy Commission was abolished by the action of October 11. Its research programs will be carried out by ERDA and its regulatory functions by a new Nuclear Regulatory Commission.

The lack of continuity that could be imposed on a central Federal policy by changes in the White House

and in Congress might be less severe in the future than in the past.

Much of the historical energy policy of the United States could only be called policy by default; the government allowed certain developments by refusing to intervene, or, more often, the Federal establishment did not hesitate to use existing non-Federal institutions to further Federal policy.

When prorationing of crude oil production to market demand represented a significant policy instrument, Texas and Louisiana controlled not only a large share of national oil and gas production but also most of the surplus productive capacity.

So long as these states produced less than their capacity, the unused capacity represented a significant increment of national as well as regional petroleum supply.

The knowledge that prorationing states with surplus productive capacity would hold their production at or below market demand, according to their laws, was useful to Federal policy makers.

Little surplus capacity now exists anywhere. For November 1974, the Texas Railroad Commission established the market demand factor at 100 percent for the thirty-second consecutive month.

In Oklahoma, Texas and Louisiana, this pattern has been repeated over the last few years. One effect of the practical disappearance of surplus petroleum productive capacity in the major prorationing states has been the loss of a largely unacknowledged, unofficial, and unwitting policy instrument of Washington energy planners.

The sphere in which the Federal government can exercise energy policy through others has largely disappeared. Pessimism regarding the prospects for effective national energy policy is still not misplaced, but considerably more incentives for such a policy exist now than in the recent past.

Given the existing constraints on energy planning, their relative significance and their mutual dependence, one can construct a plausible energy production/consumption mix for the near future.

One sixth of the net new supply of energy for the United States in 1973 comprised imports. Because Texas is still a net exporting region of energy goods, the Texas consumption mix would appear to be more flexible than that of the United States.

Much of the control of the size and the flow of net exports lies outside the state, however, or at least outside any central authority, such as the State government.

These constraints make the consumption mix in Texas almost as inflexible as that of the United States. When changes occur, they do not ordinarily come about rapidly.

The consumption table suggests the most plausible energy consumption mix in Texas and the United States for 1985. Consumption will continue to rise, though more slowly.

Texas will remain a net exporter of energy materials. The production/consumption difference will enlarge for crude oil and other petroleum liquids but shrink for natural gas.

The greatest structural changes will occur in the consumption mix, 25-30 percent of which will comprise coal and lignite, much of it imported.

Throughout the United States, the share of petroleum fuels in the consumption mix will more nearly approximate the production pattern by 1985. Coal in some form will maintain a roughly constant share but a rising volume of consumption. Production of coal in 1985 will continue to yield an exportable surplus.

Considering the limitations, the most plausible future for Texas energy production—plausible as of the end of 1974—would yield increasing production through most of the seventies and a 1985 level not much above that of 1970.

Table 3

Actual and Plausible Future Consumption of Energy Materials, Texas and United States, 1970, 1975, and 1985

(Percentages)

	1970		1975		1985	
Form of energy	Texas	United States	Texas	United States	Texas	United States
Petroleum liquids*	24	45	28	48	20	38
Petroleum gases	75	34	70	31	50	27
Coal, lignite, and coke	1	19	2	18		20
Hydroelectric					30	4
Nuclear	...	2	...	3		10
Other sources†	...		...			1
Total	100	100	100	100	100	100
Quantity (10^{12} Btu)	6.8	65.4	7.6	76.8	10.6	94.1

*Crude oil and natural gas liquids.

†Shale oil, coal-based fluids, solar sources, etc.

Sources: standard published data and projections, such as those of the U.S. Atomic Energy Commission and the U.S. Bureau of Mines, and unpublished studies by the Bureau of Business Research at The University of Texas at Austin.

markets, such as the Arab oil embargo of 1973-1974, actually represent the creakings of ancient social and institutional timbers.

Within the United States, special interests, even those outside traditional power bases, easily find avenues to public attention and public policy-makers. The automobile, for example, has been the central issue in a confusing debate waged for years.

In the context of energy crises, opponents, or reformed addicts, of the private automobile economy have argued correctly that structural and quantitative changes in the private transport economy could effect huge savings in energy consumption, either directly or through shifting an increasing share of motor vehicle consumption into other sectors.

The most persuasive case against the plausibility of severely curtailed use of private automobiles is that of Kenneth E. Boulding: "The automobile . . . . is remarkably addictive. I have described it as a suit of armor with 200 horses inside, big enough to make love in.

"It is not surprising that it is popular. It turns its driver into a knight with the mobility of the aristocrat and perhaps some of his other vices. The pedestrian and the person who rides public transportation are, by comparison, peasants looking up with almost inevitable envy at the knights riding by in their mechanical steeds.

"Once having tasted the delights of a society in which almost everyone can be a knight, it is hard to go back to being peasants. I suspect, therefore, that there will be very strong technological pressures to preserve the automobile in some form, even if we have to go to nuclear fusion for the ultimate source of power and to liquid hydrogen for the gasoline substitute."

Such an incentive, in fact, may well reinforce the already strong sense of social purpose that keeps driving the controlled fusion program. As one of the only two alternative future sources of almost unlimited energy supplies—the other is solar—nuclear fusion offers not only the future hope of profuse supply, but also the promise of environmental desirability and a sufficiently prolific source of electricity to provide a fluid fuel, hydrogen, to meet the technological preference for fuels in liquid or gaseous form.

Social drives less powerful than the desire to sustain the private automobile economy have probably accomplished more historically than would be involved in the Boulding scenario.

As the final arbiter of the size and thrust of future energy development, public policy will be informed and qualified, but not determined, by technologic, economic, and social limits and issues.

Thus, future policy decisions frequently will appear, at least to some, to be arbitrary and irrational. Unilateral political decisions—embargos, nationalization—will continue to intrude upon and frequently distort the national and international energy economies.

Bumper stickers,"Let the bastards freeze in the dark," will continue to mirror both genuine issues and the unproductively low level of most public debate on these issues.

Commentators on energy policy, who represent a bewildering variety of political and other positions, have frequently agreed that a central energy agency with broad powers ought to be established in the Federal government.

If a permanent agency of this sort is established, and federal policy is no longer proliferated and diffused through other agencies, many commitments of the United States will necessarily become more explicit and less contradictory.

The establishment of a national central energy agency probably will arouse more opposition within the government than outside it. Proponents of centralization include both friends and foes of Federal involvement.

The Ford administration moved in the direction of centralized Federal energy efforts October 11, when the President signed into law the Energy Reorganization Act of 1974.

This Act created a cabinet level Energy Resources Council, to exist two years or less. The council will expire upon the organization of a Department of Energy and Natural Resources, probably built around the present Department of the Interior.

An interim organization, the Energy Research and Development Administration, ERDA, will function along with the present Federal Energy Administration. ERDA, which begins its formal existence within 120 days of President Ford's appointment of its chief, will consolidate almost all Federal energy-research programs, except those of the Federal Energy Administration.

The Atomic Energy Commission was abolished by the action of October 11. Its research programs will be carried out by ERDA and its regulatory functions by a new Nuclear Regulatory Commission.

The lack of continuity that could be imposed on a central Federal policy by changes in the White House

and in Congress might be less severe in the future than in the past.

Much of the historical energy policy of the United States could only be called policy by default; the government allowed certain developments by refusing to intervene, or, more often, the Federal establishment did not hesitate to use existing non-Federal institutions to further Federal policy.

When prorationing of crude oil production to market demand represented a significant policy instrument, Texas and Louisiana controlled not only a large share of national oil and gas production but also most of the surplus productive capacity.

So long as these states produced less than their capacity, the unused capacity represented a significant increment of national as well as regional petroleum supply.

The knowledge that prorationing states with surplus productive capacity would hold their production at or below market demand, according to their laws, was useful to Federal policy makers.

Little surplus capacity now exists anywhere. For November 1974, the Texas Railroad Commission established the market demand factor at 100 percent for the thirty-second consecutive month.

In Oklahoma, Texas and Louisiana, this pattern has been repeated over the last few years. One effect of the practical disappearance of surplus petroleum productive capacity in the major prorationing states has been the loss of a largely unacknowledged, unofficial, and unwitting policy instrument of Washington energy planners.

The sphere in which the Federal government can exercise energy policy through others has largely disappeared. Pessimism regarding the prospects for effective national energy policy is still not misplaced, but considerably more incentives for such a policy exist now than in the recent past.

Given the existing constraints on energy planning, their relative significance and their mutual dependence, one can construct a plausible energy production/consumption mix for the near future.

One sixth of the net new supply of energy for the United States in 1973 comprised imports. Because Texas is still a net exporting region of energy goods, the Texas consumption mix would appear to be more flexible than that of the United States.

Much of the control of the size and the flow of net exports lies outside the state, however, or at least outside any central authority, such as the State government.

These constraints make the consumption mix in Texas almost as inflexible as that of the United States. When changes occur, they do not ordinarily come about rapidly.

The consumption table suggests the most plausible energy consumption mix in Texas and the United States for 1985. Consumption will continue to rise, though more slowly.

Texas will remain a net exporter of energy materials. The production/consumption difference will enlarge for crude oil and other petroleum liquids but shrink for natural gas.

The greatest structural changes will occur in the consumption mix, 25-30 percent of which will comprise coal and lignite, much of it imported.

Throughout the United States, the share of petroleum fuels in the consumption mix will more nearly approximate the production pattern by 1985. Coal in some form will maintain a roughly constant share but a rising volume of consumption. Production of coal in 1985 will continue to yield an exportable surplus.

Considering the limitations, the most plausible future for Texas energy production—plausible as of the end of 1974—would yield increasing production through most of the seventies and a 1985 level not much above that of 1970.

Table 3

Actual and Plausible Future Consumption of Energy Materials, Texas and United States, 1970, 1975, and 1985

(Percentages)

	1970		1975		1985	
Form of energy	Texas	United States	Texas	United States	Texas	United States
Petroleum liquids*	24	45	28	48	20	38
Petroleum gases	75	34	70	31	50	27
Coal, lignite, and coke	1	19	2	18		20
Hydroelectric					30	4
Nuclear	...	2	...	3		10
Other sources†	...		...			1
Total	100	100	100	100	100	100
Quantity (10^{12} Btu)	6.8	65.4	7.6	76.8	10.6	94.1

*Crude oil and natural gas liquids.

†Shale oil, coal-based fluids, solar sources, etc.

Sources: standard published data and projections, such as those of the U.S. Atomic Energy Commission and the U.S. Bureau of Mines, and unpublished studies by the Bureau of Business Research at The University of Texas at Austin.

A considerable gross increase in the production of petroleum liquids in some regions will be required merely to offset the decline in other regions.

Thus, a more or less stable production of crude oil and natural gas liquids, at least through the mid-eighties, implies considerable success in finding and producing new crude oil and natural gas liquids.

Similarly, the production of natural gas would stabilize or increase slightly by 1985. Although the share of lignite would triple between 1975 and 1985, solid fuels would make up only three percent of the 1985 production total.

Increasing at an effective annual rate of about two percent during 1974-1985, the production of primary energy materials in the United States would rise about 1985 to about 86 trillion BTU.

Although the contribution of petroleum liquids would fall during this period, the absolute level would rise, primarily reflecting the beginning of production in Arctic Alaska and the finding of enough new crude oil and natural gas elsewhere to outstrip production declines in certain regions.

This table suggests the probability that nuclear and miscellaneous sources will contribute a tenth to primary energy production in the United States in 1985.

Such a figure surely represents the upper limit of optimism for both nuclear-electric power and such alternatives as shale oil and coal-based fluids. At least one breeder reactor will probably be under construction though not operating.

Although statements such as those in these two tables about the year 1985 appear dogmatic, they are relatively conservative, at least as they refer to the mix of energy sources.

Perpetuation of the recent trend toward slower growth of nuclear power and prolonged electric-utility dependence on coal might continue through 1985. Even in this event, the respective shares of coal and nuclear power in the energy mix projected for 1985 would not change much, since the share of various forms of coal was already expected to increase and the projected share of nuclear power is small.

Thwarted expectations of rising domestic production of petroleum fluids would change the mix slightly. Greater departures from the predictions could be expected from voluntary or involuntary reductions in oil and gas imports or from the conjunction of disappointing production and lowered imports, but these changes would probably affect the level of consumption more than the mix.

Capital and other resources do not exist in the United States or anywhere else to enable policy makers and energy companies to implement all of the large scale efforts, with their differing thrusts, that are favored by various interest groups.

Several groups, though, exercise at least enough influence to dilute each other. In these circumstances, the most plausible policies are those that produce relatively slow changes and relatively mild shifts of emphasis.

External influences will continue to produce occasional dramatic effects. In terms of genuinely large and significant change, however, 1985 is simply too close to offer significantly different alternatives from those now apparent and already in process. Thank you.

Table 4

Actual and Plausible Future Production of Primary Energy, Texas and United States, 1970, 1975, and 1985

(Percentages)

	1970		1975		1985	
Form of energy	Texas	United States	Texas	United States	Texas	United States
Petroleum liquids*	43	33	43	30	42	27
Petroleum gases	57	40	56	42	55	33
Coal and lignite	#	26	1	23	3	26
Hydroelectric	#		#		#	4
Nuclear and other†	...	1	...	5	#	10
Total	100	100	100	100	100	100
Quantity (10^{12}Btu)	16.2	62.8	17.1	63.7	16.5	86.0

*Crude oil and natural gas liquids.
#Less than 0.5 percent.
†Shale oil, coal-based fulids, solar sources, etc.
Sources: standard published data and projections, such as those of the U.S. Atomic Energy Commission and the U.S. Bureau of Mines, and unpublished studies by the Bureau of Business Research at The University of Texas at Austin.

MR. BRIDGES: Thank you, Bob. As I mentioned before, we are all aware that expensive energy is going to cause many changes in our transportation system.

We would like to spend the next portion of our program looking into the detailed effects that the energy shortage and expensive energy may have on two particular forms of transportation, the motor truck industry and the rail industry.

We are all aware of the 55-mile speed limit which has already caused a productivity change in the trucking in-

dustry. The extent of this productivity loss may be debatable, but no one can doubt the existence of the lost productivity.

Also, as I have mentioned earlier, we are aware that the rail industry currently stands to benefit from the changing use of energy. Three Texas cities have already signed contracts for coal to be imported from the Northern Rocky Mountain states; Austin, Amarillo and San Antonio.

Some persons have also indicated that the railroads may benefit from expensive energy in that they use less energy than trucks. However, I have noticed that the relative rates between rail and truck are about the same as their relative energy intensiveness.

Thus, as energy goes up in price, the relative rates, those that exist between the two industries now, may not change and, thus, we would not expect it to receive a change or shift in the demand for the use of one to the other because of that fact.

I thought that the best possible source to look to to find out the long-range energy impacts on an industry would be to invite spokesmen for the industry.

I would like to extend Ed Kiley's regrets that some commitments caused him to have to not be with us this morning, but I think we have a very able spokesman for the motor carrier industry, Mr. Robert Floyd.

Mr. Floyd has his Master's Degree in Political Science from the University of Arizona. He has joined our Texas Motor Transportation Association in 1973 and he serves as Director for Agency Liaison.

In this he serves as liaison for the Texas Motor Transportation Association, with the Texas House of Representatives, the Railroad Commission and the Department of Public Safety and the State Highway Department and other agencies that may regulate or have an interest in the truck and bus industry.

I would also like to say that Robert has been a great help to other state agencies such as the Texas Transportation Institute in furnishing us information that we have used for several of our studies. It is a great pleasure to introduce Mr. Robert Floyd.

Long Term Impact of Energy Shortage on Trucking Industry

MR. FLOYD: Thank you. I appreciate the opportunity to speak to you on behalf of the Texas truck and bus industry.

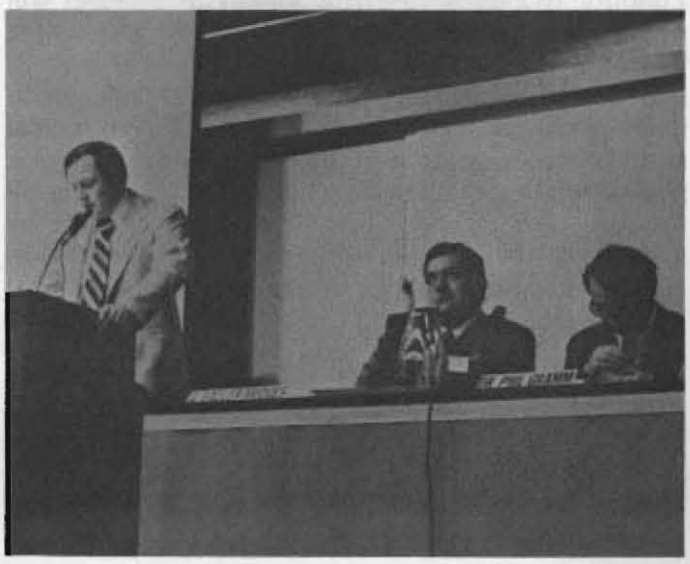
To gain a bit of perspective into the potential long term impact of the energy shortage on the trucking industry, let me recall for a moment the impact of the past year on our industry.

When fuel supplies—the very life blood by which the motor transportation industry operates—began getting scarce in 1972 and 1973, truck and bus operators were among the first industries to feel the full impact.

We are an industry, as you know, that literally runs on gasoline and diesel fuel. As prices started escalating, long term fuel contracts were first renegotiated. In some cases, they were canceled.

Operators found it more and more difficult to satisfy all of their fuel needs on the road. Finally, under the allocations program implemented by the Federal government, truck and bus operators found themselves limited to guaranteed supplies that were frequently grossly inadequate to meet their current needs.

As a direct result of the energy shortage, many small truck operators were driven out of business. while larger operations were able to survive, many were crippled by the crisis.



Mr. Robert Floyd, Texas Motor Transportation Association, discussing the Impacts on the Trucking Industry.

This matter came to a head as the nation was exposed to a taste of what a national transportation crisis could be like when independent owner-operators organized a truck strike last fall in protest against the rising cost of fuel and the difficulty in obtaining adequate supplies.

While the methods they employed to demonstrate their plight were by and large objectionable, they did focus the eyes of our nation on the problem.

Keeping this immediate past in mind, I think we can comment—within limits that are practical—concerning the long term impact of the energy shortage on the trucking industry. I see certain areas in particular that should be recognized for their potential impact.

First—and this is being all too simple—will be the cost and availablity of fuel. To speculate on the availability of fuel will lead us nowhere and I will not dwell on it.

Many factors are involved, ranging from the Arabs to environmental concerns and from exploration incentives to the capacity of the Federal government to reach decisions based on common sense.

The cost of the fuel, if it is available, will be significant. In the early part of summer 1973, diesel prices on the road in Texas were in the neighborhood of 30 cents a gallon.

By last fall, in many parts of the country, they had risen to over 60 cents. Now, even though prices have decreased to some extent, diesel on the road in Texas truck stops still ranges in the neighborhood of from 45 to 50 cents a gallon.

It is reasonable to assume that the prices of fuel will continue to escalate over the long term, and this will continue to have a major impact on Texas trucking operations in the future.

A second influencing factor will be the policy decisions made by legislative bodies and governmental regulatory agencies both at the Federal and State levels.

One of the issues being talked about today at all levels of government, including recent remarks by President Ford, would have a particularly significant impact on the trucking industry and upon the national economy as a whole.

This is the subject of deregulation. Proponents of deregulation and critics of the Interstate Commerce Commission contend that deregulation would save shippers untold billions of dollars; the savings of which could ultimately be passed on to the American consumer.

Increased competition, it is argued, would drive transportation costs down and strike a blow at inflation. This claim is not documented and we reject it completely.

It is claimed that there is too much empty mileage by trucks. Yet, for example, the latest figures show that all regulated motor common carriers had only 4.4 percent empty mileage.

You have to keep in mind that one fellow's back-haul is another fellow's front-haul, and robbing Peter to pay Paul makes no more sense now than it ever has.

Peter, the regulated carrier, would be left with the empty haul and his obligation to serve all shippers—large and small. Paul would be free to haul the freight, on a pick and choose basis, without any statutory obligations at all; all privilege and no responsibility.

Another area of governmental decision-making that highlights the impact of the energy shortage on the trucking industry, and other modes of transportation as well, concerns recent attempts to determine the relative energy efficiency of different types of transportation.

One highly questionable approach has been the simple process of comparing the number of tons hauled per mile per gallon of fuel. This is, at best, a deceptive approach and should be kept in its true perspective.

By concentrating solely on quantity is to ignore important differences in the quality of transportation services. Among the factors that make some transportation services more costly and valuable than others are speed, flexibility, frequency and completeness of delivery.

Generally speaking, the types of traffic being handled by each mode of transport today reflect the economic efficiency of each mode, including its energy efficiency.

Since transportation consumers have a free choice among different modes of transport at a variety of prices, it must be assumed that they choose a particular service because it best meets their needs.

This point should be uppermost in the minds of government officials when consideration is given to the relative benefits of switching commodity traffic from one mode of transportation to another.

A final area, one that was touched on briefly yesterday, that will have a critical bearing on the trucking industry's ability to exist during the fuel shortage or, perhaps to put it a better way, to survive, is the granting of relief from the outmoded weight restrictions under which the industry is now being forced to operate.

Our industry is being penalized, and the consumer as

well, because of our inability to utilize our equipment at its maximum capabilities.

During the past year, several states recognized this need and issued emergency weight limitation relief to the motor transportation industry.

At present, legislation is pending before the Congress that would grant such relief on our system of interstate highways. The logic behind these increases is this.

It allows one truck to transport what previously would have taken one and part of a second. The fuel saving is obvious. For example, in California last year, some emergency permits were issued for the transportation of agricultural products.

Analysis of the program showed that seven trucks were carrying the same amount of produce that previously required eight, undisputedly a saving in fuel consumption.

And that same philosophy, more goods transported by one truck using the same amount of fuel, is one of the primary reasons why Texas truck and bus operators are asking for increased weights on the Texas road system.

These then, cost and availability of fuel, correct government policy decisions and relief from the outmoded weight restrictions, are key factors that will affect the motor transportation industry's ability to meet energy shortages on a long term basis.

The basic question posed by the energy shortage is how can we meet our national transportation requirements with the least expenditure of energy. Maximum transportation energy efficiency will only be realized when each form of transport is allowed to perform those services it can handle best. Thank you.

MR. BRIDGES: I know that many of you will have questions, both of Robert and our next speaker. Both of them are going to serve on a panel at the end of this session, so, rather than interrupting at this time for questions, I would appreciate it if you will hold your questions until the panel begins.

Next, we would like to turn to the railroad industry, and I think we are very fortunate this morning to have from the Association of American Railroads, Dr. Leland Case, who is a Senior Research Economist for the AAR.

He has been with them for about one year. He has his Ph.D. from Northwestern University and has taught at Virginia Tech. He is currently on leave from Brigham Young University to be with the Association of American Railroads.

Dr. Case has done a considerable amount of research, particularly in the area of inland waterway transportation, so that he knows quite a bit about this area in addition to his rail interests. With that, I would like to introduce you this morning to Dr. Lee Case.

Dr. C. Michael Walton, Department of Civil Engineering—UT Austin, and Dr. William J. Dunlay, Department of Civil Engineering—UT Austin;

Dr. Lee Case, Economicst, American Association of Railroads.

Impact of Energy Shortage on Railroad Industry

DR. CASE: Thank you, Sadler. It's good to be here today to discuss the future of the railroad industry in light of the energy crisis. I think that perhaps we can stir up a little controversy here today.

I have some areas of agreement and some areas of disagreement with my colleagues in the trucking industry. I hope we can discuss some of these issues.

INTRODUCTION

The energy crisis has brought some new and, I think, deserved attention to the nation's railroads. By now, we have all heard how the energy shortages promised to bring new life to this troubled industry. We read headlines such as, "Energy Sweepstakes: Rails, the Easy Winner," or "Energy Shortages to be the Salvation of the Railroad Industry." By now, we have also heard that the railroads have roughly a four to one energy advantage over motor trucks, that they are close if not better in energy efficiency than barges when circuity is considered.

It is important to note, as well, that railroads offer certain environmental advantages over other transport modes. Many people seem satisfied that circumstances have ushered in a new era of optimism and good will for the railroads.

However, we may have forgotten some of the serious problems that yet remain to be solved, such as the Northeast rail crisis, the problem of low rates of return, and the problem of deteriorating plant and equipment. There is the problem of too low rates, particularly on agricultural commodities, and there is also the continuing encroachment of heavy motor truck competition.

In fact, if I were to write a headline or if I were to, perhaps, give a theme or title to my talk today, it would be: "Railroads and the Energy Crisis: The Final Blow."

That is, it is my contention—and what I will argue today—that the energy crisis and the politics and policies which flow from it may, unwittingly provide, in the name of energy conservation, the final death blow to the nation's private railroad industry.

There are many things which disturb me about the current energy situation and its impact on the railroads. For example, there is the possibility as the demand for and the prices of goods and energy increase, that demands for bulk commodities, and the demand for the movement of longer haul commodities, will decrease relative to the total freight market. These, of course, are key rail markets. If, as has been proposed, rail traffic should increase to absorb traffic diverted from the motor trucking industry, it can only do so at increased cost. We have congestion in our yards, we have difficulty in obtaining materials such as ties and rails, and the car supply industry is currently running one to two years behind meeting our needs. Rail capacity is not excessive as most believe; a lesson we, perhaps, should have learned from the Russian grain situation.

I don't have time to discuss all these issues today, but I want to focus on one area which distresses me the most—and that has to do with motor truck and railroad competition and the policy milieu, or madness perhaps, growing out of the energy crisis.

Truck Costs

To develop my thoughts on this particular matter, I would like to spend just a few moments and report on some research that is being done in the group that I am working with, the Staff Studies Group at the Association of American Railroads and on some work being done at Harvard University by Dr. Daryl Wyckoff.

In the process of reporting on this research, I hope to clear up a very common misunderstanding about the nature of truck-rail competition.

The ICC regulated motor common carriers of general commodities are often mistakenly equated to the motor carrier industry. This is because of their visibility and the relatively large size of some of these common carriers and also due to the fact, I suppose, that they are the ones that make the most extensive reports to the Interstate Commerce Commission.

In fact, this regulated segment of the trucking industry handled only about 30 percent of the intercity truck transportation produced in 1970. Another nine percent of this transportation was handled by regulated carriers of special commodities. The remainder, the majority, was produced by non-regulated, for-hire carriers and by private carriers transporting their own goods. The important differences between these groups in their operating characteristics, their behavior and the markets served are too often ignored.

While it is true that the regulated motor common carriers carry some truck load freight, these carriers are not generally competitive with railroads because of the largely less-than-truck-load markets in which they

specialize. In fact, such carriers, particularly those who have developed exceptionally effective pick-up and delivery and terminal operations, are potential rail customers for substituted TOFC service, even more so in view of the reduced intercity truck productivity resulting or brought about by the energy crisis.

It has been estimated that owner-operators produce approximately 100 to 160 billion ton miles per year; that is, somewhere between 25 and 40 percent of total intercity trucking production.[1] There is necessarily some waffling on the percentages because no one really knows what this group of the industry is doing (there are no records kept—at least that are available publicly). A portion of this output is produced under truck load sub-contract with regulated carriers, but most of this trucking is produced as truck load carriage of commodities exempt form ICC regulation or through the "grey area" illegal hauling of commodities subject to ICC regulation.

It has been estimated that there are as many as 250,000 of these small operators, most of whom only operate one truck. As small operators, they cannot afford the investment in facilities, crews, or delays associated with LTL freight.

It is further speculated that the owner-operator might represent a market of from 80 to 120 billion ton miles of freight diverted from rail. This may be of even greater importance than the simple ton mile figures suggest because it is also suspected that the traffic under discussion is relatively attractively rated.

As an intercity carrier, moreover, much of the business of the owner-operator lies in making cost competition, primarily for the railroads, as opposed to the heavy emphasis on service competition typical of the regulated motor carrier.

The key to success as an owner-operator is his line-haul productivity. For example, while the average is about 90,000 miles per year per truck traveled, nearly 50 percent of the owner-operators achieve in excess of 125,000 miles per year (this is one individual), and some are known to have made as high as 200,000 miles per year.

As to private carriers, it is estimated that they provide approximately 30 percent of the intercity truck-ton miles, depending upon the actual share of the owner-operators. While these carriers are in business to provide transportation of their own goods, some of them may also provide for-hire transportation of ICC exempt commodities to achieve balance of movement. Typically, however, most private carriers carry a balanced, base-load traffic and then tender their peak-load, imbalanced and small shipment traffic to common carriers; both truck and rail. The freight that the private carrier retains for his own fleet is thus precisely that freight which is most desirable to both rail and motor truck common carriers.

Many private carriers profess that the decision to enter transportation of their own goods, as a subsidiary activity to their main line of business, stems from the failure of the public carriers to provide adequate service. Closer inspection often reveals that straightforward transportation cost considerations are equally if not more important.

The point that I am trying to make here is that the cost of long distance truck load transportation is already at or below a large share of our existing rail rates for many commodities. Contrary to common belief, railroads do not compete significantly with regulated, regular route common carrier trucks. They compete rather, with private carriers, with irregular-route carriers using owner-operator drivers, and with unregulated, non-union driver operations that move traffic only in full truckloads. These carriers have costs well below those of the large common carrier motor trucks. Table 1 is a summary of some of the research using our truck cost model that has been done. You are all familiar, I'm sure, with the oft-quoted estimate of motor carrier costs in the range of six to eight cents per ton mile. These costs pertain to the costs reported by the large regulated common carriers that make reports to the ICC. These costs are *not* reflective of the costs of the private operators and the owner-operators that we have just discussed.

As you can see in Table 1, the railroads probably should not be in the business of hauling canned goods at all. You can also see that truck costs on bulk commodities are down to, and in some cases, below rail rates. Note that motor carriers are very competitive in certain grain markets. You can also see that the ability to compete is critically affected by the success a trucker has in making a return trip with a loaded truck. As we continue, remember the importance of the backhaul in determining costs.

[1]These estimates, and others which follow are taken from a forthcoming study of the Owner Operator Trucking Industry by Daryl Wyckoff of Harvard University.

TABLE 1
RAIL RATES VS TRUCK COSTS
(CENTS PER TON MILE)

DISTANCE (MILES)	RAIL RATES	GRAIN — TRUCK COSTS (Empty Backhaul) 25%	75%
200-400	3.2-3.5		
		2.4	3.4
400-1200	2.5-2.7		

DISTANCE (MILES)	RAIL RATES	COAL — TRUCK COSTS (Empty Backhaul) 100%
200-300	2.2-2.9	
		4.0
500-600	1.6-1.8	

DISTANCE (MILES)	RAIL RATES	CANNED GOODS — TRUCK COSTS (Empty Backhaul) 0%	50%
200-300	4.0-4.4		
500-700	3.2-3.5	2.2	3.1
1100-1500	2.6-2.7		

DISTANCE (MILES)	RAIL RATES	STEEL — TRUCK COSTS (Empty Backhaul) 25%	75%
175-225	4.4-5.5		
400-550	2.9-4.9	2.9	4.1
900-1050	2.8-3.1		

Source: AAR STAFF STUDIES ESTIMATES

Backhaul Regulation

The area of truck-rail competition, which I think has received the most attention in the wake of the energy crisis is the problem of the empty backhaul in motor trucks. I think, at this point, the railroads and our friends from the common carrier trucking industry can find some substantial measure of agreement.

You may recall that at the last pre-summit meeting of economists, there was a 21 to 20 vote in favor of repealing laws and regulations that impede competition and efficiency. Among 22 such candidates for repeal were restrictions on what trucks may haul and what routes they may take. Indeed there are several proposals before Congress and before regulatory bodies that would have exactly these effects in mind. Proposals put forward include relaxing the 15 percent restriction on agricultural co-ops to allow greater return haulage in terms of tonnage of regulated commodities. This is embodied in legislation introduced by Senator Mansfield.

In addition, there are a wide range of related proposals to allow various kinds of cross-leasing of equipment and drivers between different types of operators; thereby breaking down existing regulatory distinctions. For example, there are proposals to allow common carriers to lease both equipment and drivers from private carriers or to allow the owner-operators to trip lease to common carriers or a proposal to deregulate certain commodities, making them available to exempt haulers for return hauls.

In isolation, these proposals look good. If private truckers can substantially reduce their empty return ratio, they can claim to have saved fuel and can hold themselves out as doing their part for the energy crisis. Closer examination of these policies reveals that they may be self-defeating. What we have is a clamor of all the special interest motor carriers climbing on the energy bandwagon saying, "If you will help me by eliminating my empty backhaul, I will be more efficient and save us all some energy."

This fallacy is that attempts of individual carriers to save energy may not result in any savings at all. It seems beyond dispute that as one views the U.S. economy in terms of traffic flows, that there are regions of net production and outflow and regions of net consumption and inflow. If so, the nation's traffic is unbalanced. Unless everything moves in a pipeline—and not a capsulized pipeline either—there is an empty backhaul problem; someone has to bear this backhaul. Current regulatory practice defines the degree of competitiveness or exclusiveness of the different carriers and thus implicitly fixes the average amount of the empty backhaul they must bear for society. Only to the extent that we assume that cross-hauling exists will reallocating the backhaul effect any savings or increases in efficiency.

As one looks at the pattern of freight shipments, excluding for the moment bulk and special commodities, which typically have one way moves, it is possible to imagine an hierarchy of backhaul avoidance. Based on the several figures which are available, the backhaul pattern would be as follows: At the top of the list would be the regular route common carriers and the irregular route common carriers who, due to their policy of selective solicitation, have reduced their empty return ratios to the order of 10 percent or less. Five and one-half percent has been often quoted as representing these carriers.

At the bottom of this hierarchy would be the railroads whose non-bulk empty return ratio has been estimated at about 76 percent. (For all railroad traffic, the empty backhaul ratio, by the way, is about 86 percent.)

In between would be the other types of motor carriers, depending upon the exact type of operation in which they engage, most doing somewhat worse than the common carriers but not as bad as the railroads; probably the worst of these truckers in terms of backhaul ratios would be the exempt grain haulers.

To the extent that the deregulation policy proposals eliminate cross-haulings, they perhaps are to be applauded as efficiency improvers; although one wonders, perhaps, where the reformers are when it comes to changing regulatory constraints that force the railroads to cross-haul empty cars. But if no cross-haul exists in motor trucking, and indeed no hard evidence exists to show that it really does or that it is very extensive, or if the policies do not eliminate it, then there is no advantage to be gained by reallocating the backhaul between various classes of motor trucks. If this is the case we simply have the classic income redistribution problem which requires essentially a political solution.

Note also, that regardless of the existence of cross haulage, the carriers that stand to gain the most are the rail-competitive trucks; the private carriers, the agricultural haulers, the other owner-operators. The losers are the following; the regular route common carriers, the irregular route common carriers whose loaded backhauls are extremely high and who would stand to lose traffic to these other groups of motor carriers, *and* the railroads. The railroads' backhaul may increase or decrease, but as a direct result of these policies the railroads will not face carriers with substantially lower costs.

Thus, as we deregulate the backhaul, traffic is diverted from the energy-efficient railroads to the heavily subsidized, less energy-efficient trucks.

Truck Weights

A second policy area seems also to be in conflict with societal energy goals; the current pressure to increase allowable gross vehicle in axle load weights on the Nation's highways. A major proposal to increase vehicle weights to 90,000 pounds is now before the House Public Works committee. A similar Bill which would raise vehicle weights to 80,000 pounds has been already passed by the Senate.

The proposals to increase allowable truck weights cannot be justified on the basis of a fuel shortage inasmuch as the railroads are admittedly the more efficient users of energy. Less efficient use of available fuel in the performance of transportation service should not be encouraged by additional subsidy which further lowers the cost of rail competitive truck transportation.

Let's look again at the Rate Cost Comparison in Table 2. We estimate, for example, that increasing gross vehicle weights to 80,000 pounds, the smallest increase proposed, takes the railroad out of the shorthaul grain business, even with low empty return ratios.

If a substantial return haul traffic can be found for long haul grain trucks as, for example, would be done by the proposals to increase the exemption on regulated commodities for agricultural haulers, the railroads will be out of the long haul grain business as well. This is traffic thought to be captive to the railroad industry.

If you have any question about this, take a look at the unloadings at major grain exchanges, now; before any of these changes have gone into effect. For example, the rail share, currently, of deliveries to the Minneapolis Grain Exchange is now at about 47 percent. Some of that, of course, is very short-haul, non-rail competitive grain. But the largest portion is what is thought to be captive rail traffic.

Increases in gross vehicle weights would further remove the railroad from the canned goods type of traffic, would sharply reduce our steel traffic and push heavy trucks into the fringes of the long and short haul coal traffic. What traffic remained would move at lower levels of profitability to the railroads.

Keep in mind that we are not talking about common carrier trucks. These are the owner-operator or private truckers competing costwide with the railroads and being given a big boost by the Government.

Highway User Taxes

A recurring question which continually plagues the discussion of rail versus truck competition is the degree to which the trucking industry, or its various parts, are subsidized by Federal and State highway user taxes. The FHWA asserts that trucks, in total, pay their way at the Federal level. However, the FHWA admits that many trucks, notably bulk carriers, do not pay their way, but the degree, location, timing and amount of such distortions is not known.

FHWA relies on antiquated data and sometimes unclear logic in making their analysis. Further waffling occurs when the issue of highway maintenance expense is mentioned. The FHWA feels that maintenance is a problem reserved to the various states and shows little interest in determining the extent and distribution of maintenance cost and subsidies.

TABLE 2

RAIL RATES VS TRUCK COSTS
(CENTS PER TON MILE)

GRAIN

DISTANCE (MILES)	RAIL RATES	TRUCK COSTS PRESENT (Empty Backhaul) 25%	75%	PROPOSED (Empty Backhaul) 25%	75%	GCW (000)
200-400	3.2-3.5			2.2	3.0	80
		2.4	3.4	1.9	2.7	90
400-1200	2.5-2.7			1.6	2.2	108

COAL

DISTANCE (MILES)	RAIL RATES	TRUCK COSTS PRESENT (Empty Backhaul) 100%	PROPOSED (Empty Backhaul) 100%	GCW (000)
200-300	2.2-2.9		3.6	80
		4.0	3.1	90
500-600	1.6-1.8		2.6	108

CANNED GOODS

DISTANCE (MILES)	RAIL RATES	TRUCK COSTS PRESENT (Empty Backhaul) 0%	50%	PROPOSED (Empty Backhaul) 0%	50%	GCW (000)
200-300	4.0-4.4			2.0	3.0	80
500-700	3.2-3.5	2.2	3.3	1.8	2.6	90
1100-1500	2.6-2.7			1.5	2.2	108

STEEL

DISTANCE (MILES)	RAIL RATES	TRUCK COSTS PRESENT (Empty Backhaul) 25%	75%	PROPOSED (Empty Backhaul) 25%	75%	GCW (000)
175-225	4.4-5.5			2.6	3.7	80
400-550	2.9-4.9	2.9	4.1	2.3	3.2	90
900-1050	2.8-3.1			1.9	2.6	108

Source: AAR STAFF STUDIES ESTIMATES
Rail Rates From Tables 6-9

A Bureau of Public Roads study,[2] *Allocation of Highway Cost Responsibility and Tax Payments*, does show that the heavy rigs or so-called combination trucks fall short today of paying their fair share of highway construction costs. The shortage is on the order of 23 percent. The publicly subsidized and inequitable advantage enjoyed by the heavy motor trucks rigs today would be substantially increased under the pending bills to increase allowable gross vehicle weights.

According to the Federal Highway Administrator, Governor Tiemann,[3] a 10 percent increase in the single-axle limits and a 6.2 percent increase for tandem axles would result in a 20 percent increase in maintenance costs. This was in his testimony given in February of 1974. Proposals to increase user taxes have not been forthcoming to go along with the proposed increases in weights.

Indeed, one does not have to be a railroad to be concerned about increasing truck sizes and weights. Are you, as a taxpayer, interested in putting the Nation's grain or coal traffic on the highways; especially in light of the energy crisis?

It seems clear that the options and alternatives which must be chosen as a result of energy shortages have not been carefully considered by the policy makers. We have not been successful in getting the Department of Transportation and the Federal Highway Administration to seriously consider the costs and the alternatives involved.

Current policy changes will have the direct effect of taking traffic off the railroads. The effects of this will be to do the following: One, increase traffic hauled by the subsidized barge and truck modes, thereby increasing the size of the needed subsidy; secondly, increase the consumption of energy in the transportation sector; thirdly, accelerate the bankruptcy of the Nation's rail system. Thank You.

MR. BRIDGES: Thank you, Lee. I think that should generate some questions for a panel discussion later on this morning. Perhaps after such a well presented and thought-provoking speech as that, we will take our morning break.

I think you will find soft drinks and coffee available on the patio and we will be back here about 10:25. Thank you.

MR. BRIDGES: Welcome back for our final two speakers this morning and also for our panel discussion which will proceed immediately following our speakers.

Our next speaker is, I think, somewhat of a friend of mine. He is a Professor of Economics over at Texas A&M University. He has done a considerable amount of energy related research for the National Science Foundation, for the Arms Control and Disarmament Agency.

Dr. Gramm is a special consultant to the Canadian Ministry of Natural Resources on Taxes and the Environment. In addition to several articles that he has written in professional journals and some in the *Wall Street Journal*, he was also called on by the U.S. Congress to testify before them on the energy crisis.

I think you will find that Dr. Gramm will be a very exciting speaker and he should generate some questions, also, for our panel discussion. I would like to introduce to you Dr. Phil Gramm.

[2]Oehman, John C., and Bielak, Stanley F., *Allocation of Highway Cost Responsibility and Tax Payments*, 1969, Bureau of Public Roads, Federal Highway Administration, U.S. Department of Transportation, May 1970, p. 12; Table 25, p. 74.

[3]Testimony of Norbert T. Tiemann, Administrator, Federal Highway Administration, before Subcommittee on Transportation, Senate Committee on Public Works, Feb. 20, 1974.

Energy in Perspective

DR. GRAMM: I would like to focus my comments today upon what I think is the fundamental issue involved in assessing the severity of our energy crisis and in assessing what sort of public policy the existence of this crisis calls for.

The fundamental question, as I see it, and the fundamental question that has received little attention from the Federal Government and from private groups is the following question.

Is our current shortage the result of economic constraints or is it the result of political constraints? If it is the result of economic constraints, if we stand at the end of the petroleum age, as is often asserted, then there may be some foundation for the arguments for a government policy of active research and of active participation to abate this very critical problem in the shortest possible time to eliminate the disrupting impact that it might have on the American economy.

If, on the other hand, our problem is the result of political constraints, then it seems that a policy of deregulation and a policy of government withdrawl from the energy area or at least a reassessment of those political constraints is in order.

In economics, we know something about resource crises. In fact, we have had, in recorded history, numerous instances of resource depletion. We have had two excellent cases of energy crisis.

The first occurred during the Middle Ages in Europe as a result of the stripping of the land for agriculture. In the Middle Ages, Europe gradually ran out of wood for fuel.

There was a persistent price pattern established during that period that has characterized every economic crisis in terms of resource depletion in recorded history. That is, for 300 years the real price of wood in what appears to be constant purchasing power dollars gradually, but persistently, rose.

We had an energy crisis in American history in the nineteenth century and that energy crisis was in whale oil. Now, whale oil doesn't sound like a very important product today, but in 1820 it was the principal source of artificial lighting, it was the principal source of quality industrial lubrication.

We saw, from 1820 to 1866, a rise in the real price of whale oil of over 400 percent. In 1820, one did not need a computer to predict that there was an energy crisis. All he had to do was look at the rising price of whale oil. Now, I will not, in my brief time, go into a lengthy discussion of how these crises produce new fuel; the wood shortage in Europe producing the coal age which in turn generated the Industrial Revolution, and the whale oil crisis giving rise to incentives that ushered in the petroleum era.

I would like to try to draw a contrast between our current situation in energy and the secular movement of real energy prices in the American post-war period with the price pattern that has been historically found when a resource has become increasingly depleted.

Economists do not and have not historically taken much stock in what people say. In economics, as in politics, talk is cheap but we do take prices very seriously and it is in terms of markets that real shortages result and are indicated in the form of rising prices.

In general, neither a review of the secular price trend of energy in the American post-war period nor a review of our resource inventory provides any clear or positive index that we are faced with severe economic constraints on the production of fuel.

From 1950 to June 1973, real energy prices fell drastically in the United States. If one begins in 1950 and goes out and takes the price of energy resources used by the American consumer, if he weights those prices by the level of use it is a simple matter to generate an energy price index. If the energy price index is deflated to eliminate the impact of general price inflation by dividing the index by the wholesale price index, that is, to get a constant purchasing power dollar price of energy, a rather startling pattern of prices since 1950, is found.

From 1950 to 1955, real energy prices in constant purchasing power dollars fell by 3.1 percent. From 1955 to 1960, real energy prices in constant purchasing power dollars fell by 3.7 percent. From 1960 to 1965, real energy prices fell by 6.5 percent. From 1970 to June 1973, on a five-year basis, real energy prices fell by 9.4 percent.

Such a price pattern indicates that technological improvement and production efficiency have, on a secular basis, been offsetting resource depletion and that energy on a secular basis since World War II has become more plentiful rather than more scarce.

Not only do falling real energy prices on a secular basis belie the notion of an energy crisis produced by economic constraints, but a review of our basic resource inventory is impressive.

We have, for various reasons, most of them related to political constraints, explored only five percent of the

continental shelf, which geologists tell us could be the richest petroleum find in history.

We have, in Naval reserves in California and Alaska, as many proven reserves as currently exist in the continental United States.

We have, in operating and shut-in wells, 80 percent of the oil that has ever been discovered in America; 290 billion barrels of oil in place, most of which can be recovered at current technology, much of which can be recovered at current price.

We have in shale deposits and tar sand deposits in North America the potentiality of producing one and a half trillion barrels of petroleum substitute at the right price and the right technology.

We have had the capacity to gasify coal since 1840 when the process was developed to generate a substitute for whale oil and we could clearly use this process commercially if it were economically feasible to do so.

We have natural gas reserves in well defined locations that could provide a 50 year supply at a free market price. We have, since World War II, invested billions of dollars in nuclear energy, in government programs, and only today at higher petroleum prices is nuclear energy becoming an economically viable substitute for conventional fuel sources.

We have virtually untouched the near boundless supply of solar and thermal energy.

The source of our economic problems today, that is, economic energy problems, is political constraints and not economic constraints, and there are principally two: one, the Arab embargo and the subsequent cartel pricing in policy and, two, the disruption of the profit system within the U.S. oil and gas industry in the post-war period. Political constraints have stifled production incentives, raised costs and restricted use of available resources.

Let's look first at natural gas. As late as the 1930's natural gas was a waste product. Demand for it was not sufficient, so when it was discovered in the search process for crude petroleum, it was often flared into the atmosphere. At the end of World War II, with rapid growths in energy demand, as America grew, we saw the development of what could have become a nationwide distribution system for natural gas. Natural gas became America's glamour fuel and it was a glamour fuel for two reasons. One, it was cheap and two, it was clean burning.

Beginning in 1954, we saw a marked change in America's energy growth patterns. In 1954, the Supreme Court ruled that the Federal Power Commission should regulate natural gas prices and beginning on a field by field basis, the Federal Power Commission attempted to regulate price.

In 1961, it gave up this task as being functionally impossible and it, therefore, imposed an across-the-board price ceiling on interstate sales of natural gas by imposing a wellhead price significantly below the free market level.

There was a great deal of talk in 1961 and 1962 that the Federal Power Commission had somehow been able to extract the monopoly profit of the American gas industry because production, at imposed price ceilings, did not fall off. But very quickly the result of this price ceiling became evident because while it was still profitable to produce gas from existing wells, it was no longer profitable to go out and look for new natural gas so that from 1961 to 1970, we saw a steady decline in drilling for natural gas, a steady decline in investment and we saw a leveling off of production. As America grew and as energy demands grew and as natural gas suppies failed to grow, we were forced to turn to an alternative fuel source.

The goal of natural gas price regulation was consumer benefit. The fundamental question is did the consumer benefit? The clear and irrefutable answer is no.

When the supply of natural gas did not grow at the pace of demand growth, consumers in non-producing states, were forced to turn to an alternative fuel source. That alternative fuel source has principally been heavy oil. Now, there are several important things to note about heavy oil. Number one, we import a lot of it.

In 1972, 89 percent of all finished petroleum products imported into the United States was heavy oil. 46 percent of all petroleum imports, including crude oil, was of heavy oil

Number two, economists estimate that heavy oil sells at approximately twice what natural gas would sell at in a free market.

The Federal Government, by regulating natural gas prices at the well head has achieved several undesirable results: (1) it has stifled the development of a cheap and plentiful domestic energy resource, (2) it has created foreign dependence by the U.S. consumer on foreign oil imports, and (3) it has produced a double input wholesale price of energy to the American consumer outside producing states. In a very real sense, our foreign dependence today has not been produced by

the failure of the American producer to produce oil and gas. It has been dictated by government restrictions which have impeded production.

Basically, the same picture can be painted of the American oil industry, but to begin that discussion one has to look at what was happening in the United States in 1969.

In 1969, we were incurring the most prolonged period of rapid price inflation in American history since the Civil War. That has, unfortunately, today become the most prolonged period of rapid price inflation in American history.

In 1969, instead of balancing the budget, slowing the growth and the money supply and eliminating the fuel to the fires of inflation, the Federal government sought an easier and more political expedient policy and that policy was wage and price controls.

We in economics know a lot about wage and price controls. In fact, we have a fragmented history of them that goes back five thousand years. Not one has ever worked in history.

The important thing about wage and price controls with regard to America's energy supply was that beginning in 1969, petroleum became a target industry for jawbone price controls and in 1971, it became a target industry for mandatory wage and price controls.

The logic of government was simple. "If we can freeze the price of petroleum products, since petroleum products are used in the production or distribution of almost all goods, we can therefore slow the rate of price increase."

From 1967 until 1972, the price of energy resources in America rose by about nine percent. Production costs rose by 30 percent and the rate of return on investment in the petroleum industry fell, in 1972, substantially below the rate on prime commercial paper.

International oil companies funneled investment funds to international operations which could produce and sell on a free world market. Domestic producers went out of business.

We have today, for example, only half as many drilling rigs operating in the United States as we had 20 years ago. I think it is interesting to note that since the Arab embargo, since the artificial rise in petroleum prices, we have seen a rebirth in the investment process in the American oil and gas industry. Drilling in January was at a ten year high and it has expanded as quickly as it could since that period given the constraints on the production process, that is, the shortage of tubular steel, which, by the way, was caused by the under-pricing of tubular steel in the Phase One price controls.

Another area of government interference that is often neglected with regard to Government intervention in slowing domestic production is the restriction of output produced by Government by holding resources off the market. I refer here to Naval reserves. Estimates are that we have, in Naval reserves, in Elk Hills, California, in Teapot Dome, in Naval Reserve No. 4 in Alaska, entombed 30 billion barrels of petroleum.

The Government is today holding out of production some of the best, if not the best, petroleum finds in the continental United States.

About four months ago, I did a study for the National Science Foundation. In that study, I sought to determine what the gain or loss has been to the American people in holding these reserves.

I decided to start, not at the beginning of the Naval reserves in 1909, but to start at what was a historic period, until it was overshadowed by Watergate, and that is the Teapot Dome scandal.

In 1922, when Albert Falls illegally leased part of the Teapot Dome Naval Reserve, petroleum was selling at $1.61 a barrel. Let's assume today, for comparison purposes, that petroleum is selling at $10 a barrel.

Let us assume further that these reserves could be sold at 10 percent of their market value; 10 percent because of the presence of production costs and because of the impact of increased supply on price.

Now, it is interesting to compare what these reserves are worth today at $10 a barrel and what we might have done with the funds in 1922, had we sold them at 10 percent of $1.61 a barrel, if we had sold the Naval reserves, or the drilling rights to them, in 1922, and we had invested in investment projects yielding six percent, instead of holding the reserves idle the American people would have an investment worth $70 billion more than the value of the Naval reserves today.

If, on the other hand, we employed an eight percent discount rate or an eight percent rate of return, which is about half the rate of return in manufacturing before taxes for this period, the American people have lost a whopping $234 billion; more than half of the National Debt.

Even employing high MIT projections for crude oil, when these projections are viewed in terms of current inflation rates and current interest rates, the American people are losing heavily every day that this petroleum is artificially held off the market.

I don't need to say a lot about environmental restrictions. Everybody knows that they have slowed offshore exploration and production, that they have raised costs and that they have delayed the development of new petroleum finds in the continental shelf and in Alaska. They have, in that process, created foreign dependence.

In light of our new situation we certainly need to ask ourselves: "Are these restrictions worth what we are paying for them?" What we are paying for them is lower domestic production, foreign dependence, higher prices and lower economic growth.

Since Government controls and regulations have caused our current problems, it seems unlikely to me that more Government regulation and more Government controls are going to solve our problems.

It also seems to me that as facts have come to replace political rhetoric since the Arab oil embargo, it has become increasingly clear that Government stupidity and not industrial collusion has produced our energy problems.

The Congress, during the embargo and during the cartel pricing arrangements, has been far more concerned about spreading the misery of shortages and higher prices than it has been about getting on with the job of increasing domestic oil and gas production. Despite all the talk of shortage, despite all the talk of economic disruption, the Congress has taken no definite action that would be productive toward increasing short-run supply of domestic oil and gas.

We have therefore wasted a year in our attempt to try to stimulate domestic production. While Federal funding of basic research in producing and conserving conventional fuels and new fuels can help provide a long-run solution, it cannot and will not solve our short term problem.

If we really want to be independent of foreign suppliers—and I am not convinced that this is a feasible, achievable or a desirable policy, but if anyone is serious about this at all, it seems to me that the only Federal policy that will achieve this goal is to deregulate natural gas, open the continental shelf for drilling, lease the Naval reserves, review environmental restrictions and allow the free market system to work.

The Federal Government, however, has been more concerned with petroleum profits, which are below the average rate of return on manufacturing, by the way, than it has been about price and availability.

Now, in conclusion, it seems to me that the petroleum age is going to come to an end; there is no question about that. All ages come to an end and the petroleum age is going to come to an end as did the Stone Age. It seems to me that if one looks at resources and prices and not at political rhetoric, that this petroleum era is not going to end in this century if our Federal Government will allow the free market to work.

The doomsdayers say that we are living on a space ship and that on this space ship that resources are fixed. Well, in a technical sense, that is true, but let us remember that this space ship was built by a master engineer and that it is very well equipped.

In fact, cursory geological surveys indicate that, simply, in the first mile of the Earth's crust, we have more than a million times the amount of energy supplies that we have used.

Technology is not fixed, technology is growing at an ever increasing rate. I think we need to remember that doomsday predictions are nothing new, that indeed I date them back to the time of the ancient Greek science and philosophy and this was a philosophy that viewed resources as given.

Science held this view until about 100 years ago and, finally, what average men employing their wit in trying to produce goods proved, modern science finally recognized, and that is that resources are not fixed, that resources depend on science and technology and that as science and technology change, old resources become valueless and non-resources become valuable resources.

We need only remember that for the man who ran naked in the forest, the only mineral resource was a sharp stone. Yet, by using resources which to that man were valueless, we were able to walk on the moon.

Now, what this indicates to me is that there is no justification for this new gloom that certainly we are all going to be cold and in the dark. We face the same economic constraints we have always faced. Our problem is the new political constraints which have bound us before we have ever bounced up against these economic constraints.

Now, I can't really stand up here and talk about this without going a little bit into this debate about what new energy positions dictate as far as transportation is concerned.

I think first we need to know what kind of position we are in with regard to energy. We may be coming to the end of the petroleum era. This end of an era may be different than all the others we have exhibited in histo-

ry. That is, instead of a long warning which has been the case in every other single depletion problem, it may be that we have suddenly reached the end without any previous price signals. I doubt it, but the point is that we will not know until we allow the market system to function and until we make use of our current resources. In the meantime, it seems to me to be idle speculation to be running around and saying that because energy prices have changed, we must change our transportation system and do so radically, that we must run out and subsidize high efficiency users of energy and that we must penalize low efficiency users.

What the hell does high efficiency and low efficiency mean if it isn't determined in terms of a free market. It seems to me that if we let prices rise, then high efficiency users would find their relative cost position changed and would be advantaged by a free market. If we let prices rise to reflect real supply and demand situations, low efficiency users would find that they face higher costs and they would therefore be disadvantaged in terms of their economic positions.

It seems to me highly dangerous to allow special interests to jockey for special positions out of a real or imagined crisis. It seems to me that competition has served us well in any area that we have ever employed it.

It seems to me equally obvious and equally well documented in history that regulation has been a failure from the first day that we ever introduced it until today. I applaud the fact that economists have endorsed deregulation. It is 20 years overdue if it is not 100 years overdue. Thank you very much.

MR. BRIDGES: Thank you, Dr. Gramm. Our next speaker is from the University of Texas. He has a Master's Degree in Business Adminisntration from the University.

He is an author of the *Transportation Atlas of the Southwest* for the Council on Advanced Transportation Studies, an author of several articles in the "Texas Business Review." I have known Charlie for some time now and I treat him also as one of my better friends. He will speak to us this morning on the future role of rail transportation. Charlie Zlatkovich.

Dr. Phil Gramm, Department of Economics, Texas A&M University.

The Future Role of Rail Transportation

MR. ZLATKOVICH: Well, I have one slightly depleted resource here which seems to be the time, but we will go as quickly as we can.

To begin this presentation, I would like to state a premise that the type of rail transportation system that we should be developing in this country is the type system that we would build today to meet tomorrow's needs if we had no rail transportation system. Obviously this is not the case. We do have a railroad system, and it would not be practical or desirable to eliminate the existing system to start over and build another one. What we can do is work toward making our existing railroad system into a system geared to meeting the needs of tomorrow.

During the 1950's, a short article entitled "If Railroads Did Not Exist, the United States Would Have to Invent Them," was circulated by the railroad industry. Later in the 1950's and during the 1960's, it is questionable whether or not very many railroads would have been built had none existed. It is possible that a specialized, heavy-duty type of highway designed for exclusive use by commercial vehicles would have evolved to do many of the jobs that are done by railroads. These special highways might have had many of the characteristics that we associate with railroads such as trains of trailers and semi-trailers and greater size and weight limits than prevail for commercial vehicles that must share the highways with private automobiles and other traffic. Indeed, given the institutional problems and inefficiences of the current railroad industry, such a highway system may yet evolve.

There are, of course, advantages inherent in rail transportation that make the further development of our railroad system worthwhile. One of these advantages is the efficiency of rail transportation in the use of energy, which is destined to become more significant in an era of scarce, expensive energy. A number of economic and policy constraints indicate that we will have a rail transportation system in the future. What we need to do is to rebuild our rail system for the future.

The railroad system that we have today is not a system designed for tomorrow. It is a system designed and built as a result of conditions that existed in an ever-more-distant past. Our railroad system was constructed in an era when there was no other effective means of overland transportation. It was constructed in an era of seemingly inexhaustable natural and financial resources. It was constructed in an era when railroad promoters and speculators could reasonably expect to realize substantial gains. Few of the conditions existing in the United States during the era of railroad construction still exist today.

During the nineteenth and early twentieth centuries, the population and economic activity of the United States was concentrated in the Northeast. The major cities were compact and built around railroads and navigable waterways. Since alternative transportation did not exist, many railroads were built to serve the area. There were fewer people and less economic activity in the South and even less in the West, so there were fewer railroads built in these areas. These conditions are a major contributing factor in the current state of financial health of the railroad industry. The railroads of the Northeast were built to meet the total transportation needs of an area that had no other transportation at the time, but now has abundant alternative transportation. The railroads of the South and West are better off today in part because they are fewer and farther between. They have also benefited from the economic development of these areas.

During the years since the end of the railroad construction era, major changes have occurred in the economy of the United States. One of the more notable changes has been the decline of the economic importance of the railroad industry. Many generally used indicators of railroad activity tend to conceal or minimize the decline. For example, rail revenue freight tonnage volumes have held up well in recent years, reaching the highest level since 1947 in 1973. Rail revenue freight ton-miles reached an all-time record high in 1973, indicating that while railroads may not be carrying quite as much freight as at some times in the past, they are carrying that freight over longer distances. Viewed by themselves, such statistics indicate that the railroad industry is holding its own. Viewed in terms of the share of the freight transportation market, the railroad picture is not so bright. While railroads accounted for nearly 75 percent of the nation's intercity freight ton-miles in 1929, they now account for less than 39 percent of the freight traffic.

The railroad industry decline becomes even more pronounced when viewed in comparison with the overall economy of the United States. One measure of the overall economy is contained in the national income accounts which measure the aggregate earnings of labor and property that arise in the current production of goods and services by the nation's economy. As recently as 1929, the earliest year for which such data are available, the railroad industry held a position of tremendous economic importance. The railroad industry accounted for 5.25 percent of all national income, an amount more than three times as large as the portion accounted for by the entire Federal government. Obviously times have changed. The percentage of national income accounted for by the railroad industry has declined steadily, reaching an all-time low of .90 percent in 1973. The railroad industry is still a large industry by any standard, but its decline in relative economic importance is without parallel in recent American economic history.

There are many reasons for the relative decline of the economic importance of rail transportation in the

United States. As competing modes of transportation, especially highway, benefited from technological progress and large-scale public investment, improved service enabled them to attract much of the traffic that had formerly moved by rail. The railroads were left with a traffic mix composed largely of bulk commodities. These commodities consist largely of the primary products of agriculture, forestry, and mining. Such products accounted for more than 44 percent of all rail revenue carloadings in 1973. The 44 percent does not include the secondary processed products, such as grain mill products and lumber and wood products, which are also substantial contributors to rail freight traffic. The leader of all rail traffic commodity groups is coal, which accounted for more than 16 percent of all rail revenue carloadings. Agriculture, forestry, and mining are segments of the U.S. economy that have also declined significantly in relative economic importance during the past half century at the same time that the railroad industry was increasingly dependent on them for freight traffic. There are signs of a changing trend in the relative economic importance of these industries since 1971.

The changing economic geography of the United States has also had an adverse effect on the railroad industry. While population and economic activity are concentrated in the nation's metropolitan areas, that activity has become increasingly dispersed within those metropolitan areas. The relative economic growth of the South and West at the expense of the Northeast has already been mentioned as part of the Northeast railroad problem.

The railroad system that has survived these changes and exists at the present time is not, in my opinion, the type of system that we would build today to meet tomorrow's needs if we were starting over. I doubt that we would create a Balkanized system comprised of 67 major entities and several hundred smaller ones that in many instances both compete with and are mutually dependent on one another. I doubt that we would build five fairly direct parallel lines between Chicago and Omaha, or between Dallas-Fort Worth and Houston. I doubt that we would build substantially more miles of railroad line in Illinois or in Pennsylvania than in California, a state with about three times the land area and nearly twice the population of either Illinois or Pennsylvania. I further doubt that we would build enough railroad track to construct over 100 lines across the continent, but not have a single operating company running trains across the continent.

Even though the existing rail system differs from the type of system that we would build today, it can be transformed into the type of system we will need to meet tomorrow's needs, or at least into a reasonable facsimilie of such a system. We already have most of the routes, right-of-way, and equipment that we need. What we need to do is to make better use of them. It can be argued that we have been moving in the right direction for several years. We have reduced the extent of our excess rail line mileage by about 50,000 miles since the peak of railroad development. The merger movement has reduced the number of operating companies somewhat. However, we are not moving fast enough nor always in the right direction. The Rock Island merger case has dragged on for a decade and there is still no light at the end of the tunnel. There is a good chance that the Rock Island will join the Penn Central in bankruptcy before the case is settled.

Indeed, in my opinion, there are other railroads that will follow the Penn Central into bankruptcy soon if action is not taken. An industry whose rate of return on net investment topped three percent only once in the last seven years cannot attract the capital that is needed to rebuild or even to maintain our railroad system. I think that we are moving toward nationalization of the rail system. For practical purposes both Amtrack and Conrail are nationalized railroad organizations. Nationalization of the rail system seems to be regarded with considerable dread across the nation, but many of the proposed counter-measures to nationalization amount to little more than a "bail out" or are not politically feasible for other reasons.

I believe that there is an alternative to nationalization of the rail system that is at least worth careful examination. Basically, the alternative is public ownership of the tracks but not the trains. Under this system, which might be nick-named "Unirail," the government would acquire the railroad right-of-way and track, but operation of the rail service would remain a function of private enterprise. Such a move would place rail transportation on the same basis as air, highway, and water transportation in the United States, all of which involve private operation over publicly-owned rights of way.

There are some obvious problems associated with such a system, and there are some obvious advantages. The question of operating rights—who gets to run over which tracks—would have to be resolved. Train dispatching procedures would have to be improved. While significant, the dispatching problem is not insur-

mountable. Equitable arrangements would have to be worked out for the transfer of the property, adjustment of local property taxes on the facilities, and the maintenance, dispatching, and other personnel involved.

The advantages of the plan include the opening of the door to the development of a modern, nationwide rail network—the type of system that is needed to meet tomorrow's transportation needs. The public would assume the responsibility for the maintenance of the rail lines whose continued existence is deemed to be in the public interest, but whose operation may not be economically self-sustaining. Given access to the publicly-owned facilities, new operators could bring a spirit of innovation to the railroad industry. Safety would be enhanced by the return of the tracks to proper condition. The continued deterioration and threatened loss of key links in the national rail system could be halted.

A logical step in the development of the rail system which could be accomplished with or without the public acquisition of railroad rights-of-way would involve classification of rail routes somewhat similar to the classification system applied to the highway system. The heart of the rail system would be a nationwide network of rail lines somewhat similar in scope and function to the Interstate Highway system. The Interstate Highway System consists of about 42,5000 miles of freeway. Many of the Interstate Rail System routes would probably parallel the Interstate Highway System routes. The same combination of economic and transportation requirements, national defense considerations, and the political process would influence selection of the exact routes. Through rail traffic now moving over less direct or otherwise inferior rail routes would be concentrated on the Interstate Rail System in the same manner that through highway traffic is concentrated on the Interstate Highway System. The increased traffic volumes on the Interstate Rail System routes would justify such improvements to the routes as multiple main tracks, centralized traffic control, welded rail, and electrification. Electrification of high-density rail main lines would enable the use of coal, nuclear, or other energy sources instead of the diesel fuel now used for most rail operations. The concentration of through traffic on the Interstate Rail System would conserve scarce maintenance resources now allocated among a number of parallel and duplicative rail lines. Railroad lines not included in the Interstate Rail System would perform a function similar to that of the primary and secondary highways not included in the Interstate Highway System. I believe that the rail system that would result would be a system capable of meeting tomorrow's transportation needs.

There is another step that could be taken almost immediately by the existing railroads that would offer significant benefits in service and in energy conservation. This is the development of a better rail-highway intermodal service. Most of the current intermodal services offered by the railroads are competitive with all-highway services on a cost basis, but not on a service basis. A new concept in rail piggyback operation involving the use of fixed consist trains operating of a direct, point-to-point basis between major teminals would be competitive with all-highway service on a service basis as well as a cost basis. These trains would operate in a manner similar to that of the modern containership. They would load at one terminal, proceed directly to the destination terminal without intermediate switching, unload, and reload for the return trip. Innovations such as reservations for space on board the trains, rates based on space occupied rather than commodity and weight factors, and incentive pricing could be implemented for such a service. Use of the basic terminal-to-terminal service would be available to anyone with a trailer or container of goods to move; a motor common carrier, a contract carrier, or a private shipper. Optional service extras such as the use of trailers or containers for customers needing them, local pickup and delivery at either end, and other special services could be priced according to their cost. The service would represent a significant improvement over conventional rail-highway intermodal service and would also aid in the conservation of energy compared to all-highway transportation. The proposed service is however somewhat unconventional and does represent a departure from the "tonnage first, service last" philosophy that has characterized many railroad operations. I believe that one of the best opportunities facing the railroad industry lies in the area of improved intermodal transportation service.

In conclusion, it is my opinion that rail transportation can play an expanded role in our transportation system provided that we can adapt our rail system to meet existing and future conditions. While I am not optimistic about the financial prospects of the railroad industry as it is currently organized, I believe that outright nationalization of the railroads can be avoided by placing rail transportation on the same basis as our other

transportation modes. I believe that we should pattern the future development of our rail system after the highway system, and especially that we should develop a main-line railroad network comparable in scope and function to the Interstate Highway System. I think that improved intermodal transportation service represents a major opportunity for the railroads at the present time, and that the opportunity will be enhanced with the passage of time. In a rational allocation of our national transportation resources, rail transportation is worth developing. We can make our existing railroad system into a system geared to meeting the needs of tomorrow. Thank you.

MR. BRIDGES: Thank you, Charlie. We now come to the point of our program that I think many of us have been waiting for and that is our panel discussion.

Before I open the floor up for questions, there is one member of our panel this morning who has not had an opportunity to speak. I feel that it is only fair that he make a few introductory remarks before we begin the panel discussion.

Jim Seamon is a Rail Transportation Specialist with the Transportation Research Board of the National Research Council. Jim has a degree in Electrical Engineering from the University of Texas.

He spent seven years with the Southern Pacific Railroad and has been with the Transportation Research Board for two years. He has served on two AAR committees; primarily, the one on Automatic Car Identification.

He is a member of the AREA and the IEEE. I would like to introduce to you at this time Mr. Jim Seamon. Jim?

MR. SEAMON: Thank you very much. I should correct one thing. I was with the Missouri Pacific rather than the Southern Pacific. I want to try to put the railroad problem a little bit in perspective.

I think we ought to review what has happened over the last few years. Going back and starting with World War II perhaps as a significant point.

Looking at the railroads today, I think we find pretty general agreement that our railroads are not in good shape. Generally, our railroads suffer from low earnings, poor service, over-capacity on many main lines, unneeded branch lines, terminal congestion, deferred maintenance, capital shortages and, according to some of the critics, bad management.

Some people would add labor problems and government regulation to this list and also subsidized competition. The widely publicized car shortage, to the extent that it truly exists, is, I believe, a symptom of the above problems rather than a problem itself.

Also, we should not overlook the merger movement and the tendency to diversify into conglomerates; a tendency which some people associate with the shortage of capital.

Let's take a look at the impact of technology on railroads since World War II. Improvements have been primarily aimed at cost reduction. Dieselization, welded rail, Centralized Traffic Control, heavier cars and unit trains have been motivated by cost savings.

They have, however, brought improved service and improved main line capacity as fringe benefits. No corresponding increases have been realized in terminal capacity, although yard improvements have helped.

Low earnings have led to deferred maintenance. After a brief burst of streamliner activity in the late forties, passenger trains have declined to almost nothing and in so doing have further increased the available capacity of the main lines.

Between World War II and the present, I think we should look at the general transportation system in the country briefly. Let's look at the record on transportation at this time.

The airlines were in a period of generally profitable operations, expansion of airports and facilities, introduction of jet aircraft and general expansion of operations.

The highways, of course, were in a general expansion and improvement stage. We saw the development of the Interstate System, we had expansion of automobile operations, expansion of trucking operations and generally profitable trucking operations.

The waterways saw the development of the St. Lawrence Seaway, the general continuation of river development, the expansion of barge operations and generally profitable barge operations.

On the railroads profitability was mixed, some are in bankruptcy, most have had poor earnings through this time period. We have experienced loss of market share in freight, almost total loss of the passenger business. We have seen mergers, branch line abandonments, and contraction.

While three modes of transportation have been expanding and growing, one has been contracting. Perhaps it is informative to look at the government policies down through this period.

We find that according to the government policies, the airways have airport and air navigation development generally supported by the government. Some airways had direct subsidy for a time, especially local service carriers.

On highways, we have expansion of highways in general through various forms of government funding and, of course, we have the Interstate System and Highway Trust Fund.

Waterways have the St. Lawrence Seaway and the canalization of rivers proceeding with Federal funding.

Now, for the railways, what do you say? There was no advocacy or promotion role toward the railroads during this time. The government policy toward the railroads, other than regulation and taxes, was largely one of "Let them alone".

The government did get concerned when strikes or car shortages approached crisis proportions. Now, recently something has happened. We formed the United States Department of Transportation a few years ago and the Federal Railroad Administration.

I think we should look at what has happened since then. The establishment of the U.S. Department of Transportation and the Federal Railroad Administration for the first time placed the government in the role of advocate or promoter of railroads, at least to some degree, or at least in a role other than that of a regulator.

Let's look at some of the important happenings since the U.S. Department of Transportation was established. As a result of severe passenger losses to the railroad industry, and of the desperate situation of the Penn Central, the government created Amtrak to run the passenger trains.

Also in the passenger area, various state governments have begun supporting, and in some cases, promoting commuter services.

Our government in the last decade has become increasingly concerned with the protection of the environment from both the construction and the operation of objectionable transportation facilities.

Now, we have the energy crisis. Not only the unavailability of fuel but the impact of imported oil on the balance of payments and the environmental cost of increased fuel production have of necessity, become factors of critical importance to the government.

Since the government is now concerned about the environment, about the energy situation and about the railroads, we can expect more consideration of the role of the railroads in our nation.

As government money is pumped into the railroads, we can expect that research, planning and the systems approach will become commonplace in the railroad industry.

In short, railroading will no longer be left to the railroaders. I would like to make a comment or two about energy. We have lived for some time in an era of low cost energy; be that real or artificial, it was low cost.

Because energy was low cost, we have made certain trade-offs that have increased our energy consumption. We have used natural gas or fuel oil rather than more expensive insulation in home building.

We have chosen the flexibility and service of the truck rather than the energy efficient freight train for goods movement.

We have chosen the energy intensive comfort of the automobile rather than capital intensive but energy efficient mass transit systems.

Even on the railroads we find we have chosen the energy intensive diesel locomotive rather than capital intensive electrification. Now, however, the availability and the cost of energy are changing and our trade-offs must change accordingly.

Contrary to what we might wish, our supplies of energy are not unlimited. The earth has a core of molten iron, not of oil. One fact should be obvious to all: the faster we consume energy resources, the sooner they are gone.

If we must conserve energy, and I firmly believe that we must, we must make our efforts where they will be the most effective.

Since transportation is a large user of energy and of petroleum energy in particular, energy conservation in transportation can be very effective in contributing to overall energy conservation.

The railroads will not play a large role in energy conservation for the simple reason that the railroads do not consume a significant part of our total energy.

Nor will shifting of freight from barge and truck to the railroads contribute significantly to energy conservation in the near future because it will take years of improvement of the railroads to make any such significant shift practical.

We, as a nation, must make our energy conservation efforts where they will do the most good. It would appear to me that the most significant short-term gains can be made by reducing urban automobile traffic, particularly commuter traffic.

This would be accomplished by shifting commuters

to buses or, where rail systems exist, to rail transit systems or commuter trains.

Over a long time period, we can build rail transit systems and commuter rail facilities. I would like to think of the railroads as making a major contribution to and also receiving major benefits from energy conservation, but I just frankly don't see it happening that way. Thank you.

MR. BRIDGES: Thank you, Jim. I would now like to open the panel up for questions from the floor. I would like to remind you that as you rise and ask your question, please give your name for the record.

DR. WOOTAN: Phil, would you care to speak to the short-term dislocations in the process of transferring from one resource to another; either from an historical standpoint or sort of what we might look for as we move into a different process?

DR. GRAMM: Well, I guess the best way to comment on that would be to note that we have a lot of people saying, "We've been fuelish." "We have built without insulation, we have opted for convenience in going to automobiles, away from public modes of transportation."

I think we have done these things, not because we are stupid, but because real energy prices were falling and falling sharply until June, 1973. Therefore, within the frame of reference of relative prices, up until very recently, it didn't make sense, for example, to use thermal glass in construction in the Southwest and it did not make sense to use thermal glass in construction to a large extent in other parts of the country in attempting to save energy.

Why did we move to the personal automobile away from mass transportation? What were we trying to save? Well, we were trying to save the scarce resource of the time, the resource that was rising in price rather than falling as energy was and that resource was time, labor.

Now, we have come to a transition period whereby our old energy resource is playing out and there is not an energy resource currently developed to take its place. If real energy prices, therefore, begin to rise on a secular basis, this is going to dictate a tremendous change in the make-up of our society.

It is not a change that will fail to occur if we don't implement a lot of regulations. How are we to stop individuals from driving their cars and put them on the bus or the train?

Are we going to shoot them if they don't make the transition? Are we going to use police power to force people to do this? I think that is a fundamentally important question.

Now if, however, we allow prices to reflect costs, then consumers will find gasoline rising in price, they will find private modes of transportation a disadvantage relative to public modes and individuals out of their own self-interest will respond, depending upon how valuable their time is.

Now, I think a very important point to note—and this is a point I haven't heard any discussion even within the Federal government—is that our whole capital stock is geared toward cheap energy. The value of this capital stock is largely dependent upon cheap energy. If our situation is fundamentally changed, that means that our three-plus trillion dollar capital stock in this country has taken a tremendous nosedive and that therefore, this transition period is going to be very expensive and very difficult.

The point, I guess, to summarize, is that if the adjustment is needed and if prices are allowed to rise, it will occur. It seems to me that the best method of achieving these goals, if they are optimal, is to allow individuals within economic constraints, within their constraint of price, to choose.

I certainly am opposed to forcing people to do things. It just isn't the way we do business in this country.

MR. BRIDGES: I wonder, as a personal matter, in shifting demand from higher priced energy and let's say particularly gasoline—I know prior to and even after the energy shortage of this past winter, there were many people in the oil industry primarily who indicated that the demand for energy and particularly gasoline was inelastic, that there was nothing we could do to change the fact that gasoline consumption was going to increase at six percent per year regardless of price, have you, or any studies that you know about, made any sort of measurements on exactly what might be the approximation of—

DR. GRAMM: I haven't seen any studies. I know the FEO has done a lot of work, but it is clear that demand has fallen off, as price has risen.

We in economics have always known, that price makes a difference in terms of consumption.

I think, indeed, with these higher prices, that we are

going to see a lot more adjustment. If I, for example, own a Lincoln and prices have gone up in my town; gasoline is selling at 42 cents a gallon. I'm not going to go out and sell my Lincoln and take a big capital loss on it this year, but if gasoline prices continue to edge up, I'm not going to buy another Lincoln.

I think it is this adjustment process that will produce a tremendous amount of fuel economy. It is my opinion that the savings we have had this year with regard to the use of scarce energy resources—increasing scarcity indicated by rising prices—has been the result of those prices and not as a result of any campaign slogans used by the government to induce people to cut back on spending. People have cut back because it's more expensive.

MR. WENDLANDT: Dr. Gramm, I agree with a lot of what you say. I guess I disagree with some of what you say. I would like for you to put yourself in the post-World War II era where the Railroad Commission entered into its so-called no flare orders, which prevented a great deal of flaring of natural gas.

It seems to me that your philosophy would be, "We'll just let anybody flare whatever they want to." Is that correct?

DR. GRAMM: No, that is not my philosophy. I would say that my basic philosophy is the following thing, to allow production to respond to demand, to allow free market prices to be the major allocators of resources.

I am not for a moment advocating that we should not, for example, impose constraints and costs on producers relative to the destruction, for example, of the environment that they cause.

I think that the optimal policy is to establish a system through the courts whereby damaged parties can sue and collect when the environment is damaged.

I am not saying that we should suddenly throw out all this regulation, but I would point—It's hard for me to begin in 1940. My thoughts on regulation and on intervention tend to drift back to the 1870's when regulation started.

Railroads were said to be a monopoly and the evidence of this was that they were charging multiple prices, we started regulating the railroads and multiple prices grew by about 2,000 percent. Then the trucks came along as highways developed and the reason for regulating the railroads was gone, basically, but we didn't deregulate the railroads. We regulated the trucks. Then the airlines came along and the reason for regulating the railroads and trucks was gone, so far as specific types of carriage, high value, low weight, but we didn't deregulate the trucks and railroads, we regulated the airlines.

What I am saying is not that we can suddenly neglect where we are. The question is, which direction should we be going in, not that we should suddenly deregulate everything.

The question is, what sort of indicators do we want to use. I think my basic position is that we must attempt to coordinate Federal policy with market forces for two reasons: one, they work better when you do and, two, market forces give the regulator a lot of information. I think that is basically my position.

MR. WENDLANDT: I am going to send you a copy of my speech yesterday. I think you have fallen into a trap that a lot of people do about the basis of the adoption of the Interstate Commerce Act and the basis for regulation.

I have admired you since I first started reading your papers and I agree and am glad that you have backed off in this answer from your earlier position that you are going to do away with all regulation.

DR. GRAMM. Well, let me say, sir, that I don't remember ever making a statement that I was going to do away with all regulation.

MR. WENDLANDT: Well, you ended up your speech that way.

DR. GRAMM: I ended up my direct speech, as I remember, by saying that competition has historically been very productive and that regulation had been a total failure. It does not follow from those two statements that, therefore, we should totally eliminate regulation.

MR. WENDLANDT: Well, we will let the record speak for itself when it comes out.

MR. OLSEN: Would it be appropriate to direct a question to Mr. Zlatkovich?

MR. BRIDGES: It would.

MR. OLSEN: I was intrigued by your concept of build-

ing a rail system similar to the Interstate Highway System. The question is—you seem to have a considered opinion that the new rail system should parallel the, if I heard you right, Interstate System.

Wouldn't it be better, with proper land use and development of the country, to have a nonparallel rail system?

MR. ZLATKOVICH: Sir, I think what would probably happen is that in a lot of cases it would parallel the highway system more or less because that's where the traffic is along a lot of those Interstate routes, like we have Interstate Highway from New York to Chicago. I think we would have an Interstate Railway from New York to Chicago. In actuality, a lot of the better lines do, in fact, already parallel the Interstate Highway routes.

Another part of the question is, as I mentioned, you would have some of the same non-economic processes that work there; that is, some areas would say, "Well, we need to be on this," and since that is the way the process works, it would probably go that way.

It is more of a speculation than a statement that in each case it should absolutely parallel. In fact, there is some mileage on the Interstate Highway System that, in my own mind, is really questionable, and I think the very subject of where those routes should be is a much more complex one than I probably made it.

MR. BRIDGES: I was kind of under the impression that the highways had been built to parallel with the railroads. I would like for Lee Case to comment also on Charlie's proposal as regards the Interstate Railroad System.

It is one that particularly seems a little bit counter to the last few acts of the Federal government, where the government has taken over the operations of the railroad, in the case of Amtrak, to one where they own the rails and let the railroads do the operating, which seems, I guess, a strange thing for the Federal government to do; let the railroads run the railroads.

DR. CASE: Yes, I would like to comment on that. Dr. Gramm just gave us a quick outline of the regulatory history, where the railroads were regulated and then—the reasons for regulations, perhaps, have somewhat subsided—instead of deregulated, the trucks were regulated, and so on and so on.

I guess, in a sense, we are trying to duplicate this with respect to the subsidy issue. You know, we've subsidized the inland waterway industry, we've subsidized the trucking industry, we've subsidized the airline industry; and now the railroads are in trouble so maybe the thing we ought to do is provide a national rail system of some kind, provide the roadbed for the railroads.

Well, I really hope that we don't do this. I think this would be a disaster for a number of reasons.

I might point out first, that the nature of the proposals that I have seen so far with respect to a nationalized roadbed do not offer the railroads any kind of subsidy at all.

The proposals always include some kind of charge for the roadbed. In our estimation, these charges would probably exceed what it is we are paying now, or, indeed, what we would pay even if millions were not being deferred in some portions of the network.

There are basic problems, of course, with the government providing this kind of service. We think it is going to be more costly to the railroads than it is now.

There are the inherent problems of a bureaucracy, the problem of political influence, what railroads are going to be built. We will have the tendency to gold plate certain aspects of the rail network, probably, beyond what is really necessary to provide the service.

There is another problem with the nationalization of the railroad bed that, perhaps, we ought to think more carefully about. In all proposals we have seen, no one has really ever talked about what it is going to cost the public to do this.

You can't just have the roadbed; we are just not going to turn it over to the government and let them fix it up and then sell it back to us. That isn't going to happen.

The government is going to have to pay for the roadbed. We are currently preparing some estimate of what this is going to cost. Just to scrap that amount of rail will cost about $10 million.

That doesn't include anything for the real estate or any of the other things that go along with this. It is going to be a very expensive proposition and it isn't clear to me that the taxpayer ought to or wants to pick up that kind of a tab to further the cause of the railroad industry.

Finally, there are the operating problems. I don't know a great deal about these, but one of the things we can be sure of that will happen if there is a nationalized roadbed is that there will be a requirement, as there are in the other subsidized and Federally-provided rights-of-way for other modes of transportation, to allow pri-

vate carriers to use the roadbed and so then you will have the prospect of—You know, not only do we complain about the Bulkanization of the railroads and certain kinds of problems of fragmentation and so on, but with the nationalized roadbed, you are not going to be able to keep the private carriers off.

You are going to have General Motors running their own trains and U.S. Steel running their own trains, the oil companies running their own trains. All of these cause a myriad of operating problems.

All of these once again would do for the railroads as is done by the private truck interests to the common carriers: take away the base load traffic that the common carrier depends upon for his revenue.

The railroads are having enough trouble doing this now. The motor carriers have already taken away a good bit, or most, of all of the traffic that we have formerly depended upon to subsidize our obligations to society, so to speak, as a common carrier; to allow private carriers, as we would have to on a nationalized roadbed, would certainly increase that problem.

I think it would be a disaster. We are not asking for that kind of help. It would be far easier, by the way, to simply buy up the equity in the railroad industry.

If you want to nationalize the industry, the easiest way to do it is to buy the equity. It would be far less expensive than buying the railroads outright through condemnation.

MR. BRIDGES: Thank you. Are there other questions?

MR. CAFFREY: I talked with Mr. Kirk yesterday about the nationalization of the railroad rights-of-way. I was wondering how he felt about the comments of Dr. Case.

MR. KIRK: Well, I am not on the panel and I realize the lateness of the hour. I share some of the views of Mr. Zlatkovich and, of course, I share some of the views of Dr. Case.

That is a pretty equivocal answer. I am also very much impressed with the ills of regulation as described by Dr. Gramm. The railroad problem is a really formidable one and I think the solution is going to be a really complex one.

I think there is no escaping that the Federal government is going to have to participate to a considerable degree in the solution to the railroad problems; whether it is in the ownership of rights-of-way, or whether it is in the removal of property taxes on rights-of-way for the railroads.

Whatever the form may eventually be, it is going to require a major action or participation by the government, probably more or less in the forms now proposed in the Research Transportation Act.

MR. BRIDGES: Are there other questions or comments? If there are none, we would like to thank each one of you for coming to our conference. This is the second conference that has been put on jointly by the University of Texas and Texas A&M University on the subject, generally, of energy and transportation.

I think that it has been a very good conference, one where we have seen some very thought-provoking presentations by several people, including our Lieutenant Governor and the Deans of both of our Colleges of Engineering.

There were several very good and, I think, very thought-provoking speeches. I believe this morning has truly been the highlight of the conference, not just because an Aggie had the privilege of being a moderator of the conference, but because I think this topic is one which is one of very real interest to all of us.

Michael, do you have any words that you would like to say on behalf of the University of Texas as our host institution?

On behalf of Texas A&M University, I want to thank all of you for attending and I want to thank, particularly, those people who have participated in our conference as speakers.

I think that we have learned a lot from you. Dr. Walton?

DR. WALTON: Thank you. I'll not attempt to summarize, but to say that we certainly appreciate the participation of all of you in our program. The program, as you know, was diversified. It was very intentionally set up that way, to stimulate action.

Obviously, the short-range benefits of such a conference as this are difficult to measure. The long-range effects can only be determined by the stimulation that we have been able to provide each of you and have transmitted in your actions.

I hope that future conferences such as this will be conducted and that they will again have the same flavor of stimulating thought and interaction.

On behalf of the Conference Committee of both Universities, we would like to thank the speakers and our panelists who participated in the conference and all of you for participating.

I think the proceedings of the conference will be most intriguing and we look forward to their publication. This concludes our meeting. Thank you.

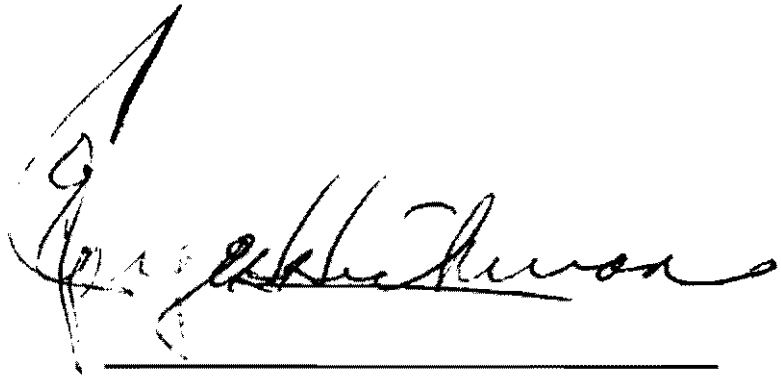
CERTIFICATE

THE STATE OF TEXAS
COUNTY OF TRAVIS

I, GEORGE H. HICKMAN, Certified Verbatim Reporter, the undersigned Notary Public in and for Travis County, Texas, do hereby certify that the above entitled Joint Conference was conducted at the Joe C. Thompson Conference Center, Austin, Texas, as hereinbefore set out.

I FURTHER CERTIFY that the proceedings of said hearing were reported by me, accurately reduced to typewriting under my supervision and control and, after being so reduced, were returned to the Joe C. Thompson Conference Center, Austin, Texas.

GIVEN UNDER MY OFFICIAL hand and seal of office at Austin, Texas, this ____ day of November, 1974.



George H. Hickman, CVR, Notary Public
in and for Travis County, Texas