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ENERGY SUPPLY AND DEMAND IN CALIFORNIA

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INTRODUCTION

It is a great pleasure to be here and to take part in this program on Coal Use in California. The program chairman asked that I talk about the petroleum industry's view of future energy supply and demand in California, but I must say there is not an industry view as such, at least not one that I am aware of. All I can do is represent a view of my own, which reflects some of the thinking of my colleagues at Atlantic Richfield Company, but for which I take full responsibility. It does not necessarily reflect the views of the Company or others in the industry. The issues I plan to discuss relate to California, but I am going to present some data that relates to Petroleum Administration for Defense District V, (PADD V), which is the West Coast of the United States - California, Alaska, Arizona, Hawaii, Nevada, Oregon, and Washington. California, of course, is the predominant energy user in this group.

What I plan to talk about are my views on future energy demand on the West Coast of the United States, how that energy demand translates into demand for major fuels, and identify the major uncertainties in determining what future demand may be. I will then discuss the major supply options that are available to meet projected demands and the policy implications that flow from these options.

There were some key assumptions that must be made in developing any projections about energy supply and demand. I would also like to point out that the data I will present is not a forecast, it is only a scenario - one view of what the energy economy might be, given the assumptions that I made. I certainly don't represent that this is the only possible view. The real world will probably be different, but I did make some assumptions that I believe are plausible about key determinants of energy supply and demand.

First, real GNP growth in the United States is assumed at 3.4 percent per annum over the next 15 years. This is a particularly important assumption as the prime determinant of energy demand is economic activity. The more people drive, the more steel you make, etc., the more energy you will need. Historically, the energy demand growth rate has been about equal to the GNP growth rate. In the future we expect the growth rate in energy demand to be somewhat less than the growth rate in real GNP, reflecting real progress in energy conservation. In this case I have assumed a 2.4-percent average annual growth rate for total U.S. energy consumption compared to a real economic growth of 3.4 percent.

I also made an assumption that real world oil prices would be level or "indexed," that is the OPEC price of oil would be constant when adjusted for inflation. U.S. oil prices are assumed to rise gradually to the equivalent of world price by the middle of the next decade, and U.S. natural gas prices similarly rise to the energy equivalent of oil, but continue to be controlled. I also assumed that coal use would be encouraged as a matter of Federal policy. Nuclear energy would continue to grow, although that growth would be somewhat constrained by policy and various delays in the licensing process.

ENERGY DEMAND

Table I shows projected energy demand by major market sectors, based on the above mentioned assumptions, for PADD V. What we see is an expectation that energy demand in the major market sectors will continue to grow, but it will grow more slowly than historic levels. The household/commercial sector will grow at a level that is consistent with expected population growth and household formation, and the industrial sector will grow just slightly less. The transportation sector will have a relatively low rate of growth. Gasoline demand is expected to flatten out as cars become more fuel efficient in keeping with Federal mileage standards, but that will be partly offset by an increase in miles driven and increased demand for diesel fuel and jet fuel.

The net result is final market demand growing about 2.2 percent per year over this period of time and total primary energy demand growth of 2.8 percent per annum, which can be contrasted to historic levels at around 4 percent a year before 1973. This marked improvement in energy consumption growth rates is a result of the assumptions about lower economic growth and expected progress on energy conservation. We have seen quite a bit of conservation already and we expect energy to be used even more efficiently in the future.

The electricity conversion losses shown separately represent the difference between the amount of energy that goes into producing electricity and the useable electric output. It is proportional to the growth in electricity demand

which is expected to be higher than the growth in total energy demand, or about 4.5 percent a year. It is slightly higher than the most recent projects of the California Energy Commission. Expectations of electricity demand growth have been falling consistently for several years and are now far below historic growth rates. This is an area of major uncertainty in the overall energy outlook and has important implications on policy choices relating to both coal and nuclear energy. What does seem clear is that electricity will continue to play an expanding role in our energy economy.

Having developed projections of energy demand by market, we must then ask which fuels we expect to provide this energy. Table II indicates the mix of primary fuels that I believe are consistent with the assumptions made and the projected market sector demands. Oil consumption grows at much lower than historic rates with the largest increase in the 1976-1980 period, reflecting an expectation that industrial users and utilities will be shifting away from natural gas toward oil. At the same time, total natural gas consumption grows slowly as industrial and utility demand declines, but the household/commercial sector grows modestly.

Coal and nuclear energy now make a small contribution to total West Coast energy supply, but are starting to grow rapidly. This rapid growth rate is expected to continue from their very low base. Even by 1990, however, the total coal and nuclear contribution will be only slightly larger than gas, and only about half that of oil. The projected coal consumption is primarily for electricity generation. It reflects specific plants under construction or planned that are all outside of California, with the largest number in Arizona. Nuclear energy has a spectacular growth rate due to the small base. However, these projections were prepared before the recent decisions on the Sundesert nuclear plant, so that the 1990 number does include a contribution from that plant that will not be realized. Some would argue that the exclusion of Sundesert will be offset by lower electricity demand, while others have proposed coal fired plants in California, the topic of this Conference. Hydropower is expected to return to normal levels with small capacity increases. Other sources (solar, geothermal, wind, etc.) show a fairly large growth rate starting from a very small base. While growing rapidly, the contribution to total energy of these other sources will be still quite small in 1990.

It is important to note the mix of energy in 1990. You see that oil and gas are still our major sources of primary energy, even though others are growing more rapidly. If we truly want to understand the outlook for coal, we need to assess it in relation to nuclear and other new energy forms, but we must also look at how the traditional fuels – oil, gas, and coal – relate to one another in the fuels market. As one of our purposes today is to identify issues for further analysis, I would like to suggest a careful look at the market economics that drive the choices people make between fuels. For example, we have recently noticed that in many of the major industrial centers of the United States, including those on the West Coast, the price of natural gas for industrial users is equal to, or in some cases higher than, residual fuel oil. This is a significant change from historic patterns in which gas was generally much cheaper due to FPC price regulations. What we are seeing now is evidence that some large industrial users are shifting from natural gas to fuel oil, not because of the threat of gas curtailments, but because of economics. The threat of curtailments in recent years did cause some users to install dual fuel capabilities in their boilers so they could burn either fuel if necessary. Once they have the dual fuel capability, they can shift fuels on a short-term basis based on the cost and availability of oil and gas at any point in time. We expect this trend to continue in the near/medium term, with both industrial and utility users shifting from gas to oil. This movement will be accelerated by anticipated Federal legislation prohibiting natural gas use for most electricity generation.

In the longer run, we expect to see fuel shifts toward coal in the industrial and utility markets. Based on our current perceptions, it appears that coal will be the economically preferred fuel for most new industrial or utility boilers in the future, including the cost of Clean Air Act compliance. However, there is a great deal of uncertainty regarding future fuel prices and the specific requirements of state Clean Air Act implementation plans.

Any attempt to assess future energy demands must recognize the major uncertainties that we face, especially in both State and Federal policies that impact energy production and use. I have already mentioned Clean Air Act implementation in terms of its possible impact on coal use. It will also have an important impact on the use of oil as a fuel, especially in California. Many facilities on the West Coast today burn residual fuel oil that has sulfur contents higher than may be allowed in the future. Changes in sulfur content limitations will change the market competitiveness of both high- and low-sulfur oils and has implications for the industry's ability to refine sufficient amounts of low-sulfur residual fuel on the West Coast. If low-sulfur residual fuel is in short supply, this may increase industrial demand for natural gas and reverse the recent trends toward oil in the industrial sector.

Natural gas availability is also an issue in California today. Current sources of gas are declining and will have to be augmented by developing new gas resources, importing LNG, and increasing imports from Mexico. The level of gas supply ultimately available will influence the level of demand for gas and, through market substitution effects, demand for other fuels.

Another major uncertainty, well documented in other papers at this conference, is our declining expectation for electricity demand. A major part of this uncertainty is related to expectations for energy conservation and solar energy. Most energy analysts expect major contributions from conservation and solar energy near the end of the century, but there is great disagreement about earlier periods. Part of the difficulty is how to do analysis of something we're not used to doing. We do not have a lot of experience or a good track record in doing analysis of energy conservation or applications of new techniques such as solar energy. There is also great uncertainty about

costs and the development of new equipment and materials. Thus, it is not a question of whether we like it or not, or want it or not, it is a question of how effective we can be today in realistically analyzing the potential in these two important areas.

A final uncertainty that can impact the outlook for energy demand are policy decisions on energy supplies, such as nuclear and LNG. The level of energy supplies and the form in which it is available, will flow through to the demand for energy and impact peoples' choices for fuels. I have already discussed this in terms of gas versus oil. Likewise, the availability and relative price of electricity, partly determined by decisions about siting nuclear and coal-fired power plants, will influence future demands for both electricity and competing energy forms.

ENERGY SUPPLY

Assuming the preceding is a reasonable view of potential energy demands, what are some of the supply options that may be available to us in this century? As noted earlier, the major source of energy in California will continue to be oil and gas, contributing over half of the West Coast's primary energy in 1990. Thus, while the most interesting issues for policy in California today are coal, nuclear, solar, and other alternatives, we also have to think about developing the extensive oil and gas resources that are potentially available in California, especially offshore. In the near to medium term, policy choices related to oil and gas may be more leveraging than others and it is appropriate to talk about them even though we are a coal conference. Table III indicates a possible scenario for oil supply in PADD V consistent with the assumptions and demand estimates shown in Tables I and II. PADD V oil production is going to be rising fairly sharply within the next several years, but nearly all the increase is outside California, primarily the North Slope of Alaska. California production is relatively flat including an assumed high level of production from the Elk Hills Petroleum Reserve. We see imports dropping dramatically from what they were before the start-up of the Trans-Alaska Pipeline. The important point, however, is that there will still be imports of oil for the West Coast because of the need for the low-sulfur oil that I referred to earlier. The expected flow of imports is essentially all low-sulfur crude oil, which can be readily refined to low-sulfur residual fuels that meet California limits on sulfur content. Due partly to the peculiarities of existing Federal price control regulations, the economics of importing low-sulfur crude oil are superior to the economics of building additional desulfurization capacity for high-sulfur California or Alaskan crude oil.

Given our earlier assumptions about oil demand, there is a potential excess oil availability on the West Coast that could be shipped east of the Rocky Mountains to PADDS I thru IV. It is important to note having that oil available on the West Coast is not a supply "surplus" in national terms. The continuing need for imported oil on the East and Gulf Coasts is far in excess of total West Coast oil production. The real need is for economic transportation systems to move the oil eastward.

In Table IV we see California production of natural gas rising based on a number of assumptions about the leasing of offshore areas for oil and gas exploration and success. We expect Alaskan gas supply to increase even faster assuming that the pipeline system to bring the North Slope gas to the lower 48 is completed by the mid-1980s. Most of that gas will be shipped to the eastern part of the United States and a portion will move to California. While the availability of gas on the West Coast is increasing rapidly, demand is increasing slightly over this time period, so there's still a need for large supplies of natural gas from PADDS I - IV and imports. The question is where is that going to come from? Today most of it comes via interstate pipelines from Texas and New Mexico. However, this traditional supply is declining and will probably not be able to fill the need, especially in California. Thus, we expect it to be augmented by new supplies of gas from Alaska, Mexico, Canada, some LNG, and possibly some synthetic gas. I believe that the indicated need for gas can be met, but it cannot be met easily. It will also be expensive. It is going to require aggressive actions by the gas utilities and by policy makers in California to insure that the necessary quantity of gas is available.

To return now to the subject of today's meeting - coal, I would like to repeat my view that coal supply is not an issue for California. There is certainly plenty of coal resources available nearby. The ability to mine and transport the coal to California is there. The real question is coal demand. Will California want to use coal, especially for electricity generation? That's the policy question and reason for this conference. But this issue can only be addressed in terms of its potential impact on implementation of the Clean Air Act. Can coal station emissions be controlled in an effective and adequate way? What will be the impact of coal fired power plants on ambient air quality? Answers to these questions and resulting policy choices about Clean Air Act implementation will largely determine the level of coal use.

We must also consider policy choices about other fuels. In earlier sessions of the conference, people discussed the need for electricity and the trade off between coal and nuclear in providing new base load capacity. If the choice is to forego (or to limit) nuclear generating capacity, then there is that much more need for other sources of electricity, and coal is the most likely choice, since it appears to be the most cost effective alternative for producing large amounts of base load capacity. But once again we face the uncertainty of whether coal can meet our clean air standards and whether they can accommodate the large-scale coal use that some have suggested. If large-scale coal use turns out to be environmentally unacceptable, then the pressure will return once again to oil and natural gas for electricity generation. Those are two fuels which, I expect, are not only going to be scarce fuels but very expensive fuels. Most incremental oil supplies for California are going to come from outside the state and will be expensive. Incremental gas supplies will also come primarily from outside the state. As we look at the possible options: LNG has siting problems, Mexican gas

has pricing problems, Canadian gas has political problems, Alaskan gas has transportation problems, and synthetic gas has cost and regulatory problems. All these incremental sources have problems that may translate into higher costs, and the average cost of gas for California is probably going to be much higher than it is today.

CONCLUSIONS

In summary, California energy policy makers face a number of critical choices during the next few years that will impact both energy supply and energy demand over several decades. The pivotal choices, and those with greatest long range impact, are probably those decisions related to electric generating capacity, especially the choice of building nuclear and/or coal fired power plants. Decisions that result in inadequate new generating capacity will probably result in increased demand for oil and gas, fuels that are likely to be both scarce and expensive in coming decades. While it is clear that we must work to develop solar, geothermal, and other renewable forms of energy as rapidly as possible, most observers believe that these sources are not capable of meeting all of our incremental and replacement energy needs during this century. While new forms of energy must be vigorously pursued, prudent planners and policy makers cannot assume good luck in their development. The long-run transition to renewable energy requires vigorous development of fossil fuel resources and electrici , generation from coal and/or nuclear energy to see us through the next several decades. To be truly effective, California energy policies need to balance these near-term and long-term goals, while recognizing the many uncertainties and unknowns that are involved in attempting to make any assessment about the future. Finally, California energy policies will be most effective if they reflect both the national and international energy situation. California is no more capable than any other states of "going it alone" on energy policy. We are major importers of both crude oil and natural gas and will continue to be so in the future. It is important that California develop policies that are both pragmatic and responsible in meeting the needs of her own citizens while reflecting the national and international nature of energy problems.

Table I. Potential Energy Demand in PADD V, By Market (10^{15} BTU)

Market	1972	1976	1980	1985	1990	Average Annual Growth Rate 1976 – 1990
Household & Commercial	2.1	2.1	2.4	2.8	3.2	3.0%
Industrial	2.1	2.1	2.3	2.6	3.0	2.7
Transportation	3.0	3.2	3.5	3.6	3.7	1.1
Market Demand	7.2	7.3	8.2	9.0	9.9	2.2
Electricity Conversion Losses	2.0	2.2	2.7	3.4	4.1	4.5
Primary Energy Demand*	9.2	9.5	10.9	12.4	14.0	2.8

*All columns may not add due to rounding.

Table II. Potential Energy Consumption in PADD V, By Fuel (10^{15} BTU)

Fuel	1972	1976	1980	1985	1990	Average Annual Growth Rate 1976 – 1990
Oil	4.4	4.8	5.5	5.8	5.9	1.5%
Gas	2.9	2.4	2.4	2.5	2.7	0.7
Coal	0.2	0.4	0.7	1.1	1.4	8.8
Nuclear	0.06	0.1	0.4	0.8	1.5	21.4
Hydro	1.6	1.7	1.8	1.9	2.0	1.2
Other	0.03	0.1	0.1	0.3	0.5	13.5
Total Primary Energy	9.2	9.5	10.9	12.4	14.0	2.8

Table III. Potential Oil Supply* in PADD V

Supply (MBD)	1976	1980	1985	1990
Domestic Production	1.1	2.3	2.9	3.1
(Of Which California	(0.9)	(1.0)	(1.0)	(1.0)
Imports	1.1	0.5	0.5	0.5
Other	0.2	0.2	0.2	0.2
Total Supply	2.4	3.0	3.6	3.8
PADD V Consumption and Product Exports	2.4	2.7	2.9	3.0
Shipments to PADD I–IV (Including Products)	-0-	0.3	0.7	0.8

*Includes lease condensate and natural gas liquids.

Table IV. Potential Natural Gas Supply in PADD V (BCF/D)

Supply	1976	1980	1985	1990
California	1.0	1.1	1.4	1.7
Alaska	0.5	0.7	2.9	5.2
Total	1.5	1.8	4.3	6.9
Less Shipments Out	0.1	0.1	1.8	3.1
PADD V Avails	1.4	1.7	2.5	3.8
PADD V Demand	6.5	6.4	6.8	7.2
Gas Requirements From PADD I–IV & Imports	5.1	4.7	4.3	3.4