

to once again wonder why we did not prepare well enough. It is hoped that the work of this conference will point the nation toward better and more improved contingency

policies and programs and will help reduce the impact of energy shortfalls that most surely can be expected in the future.

## Keynote Addresses

### Energy World Viewpoint

*Herman T. Franssen*

To give some perspective to our current view of the international energy situation, it is helpful to go back a few years and see how our understanding of the world's energy supply and demand has changed.

Apparently, we do not always improve our ability to forecast. Most forecasts made in the early 1960s were more accurate for 1985 than forecasts made later in the 1970s. In part, this is explained by the optimistic future outlook for continuing high gross national product (GNP) growth rates after the long period of high growth rates through the 1960s.

Equally important is the fact that forecasters failed to recognize the changing relation between GNP and energy consumption. Over about a 10-year period, the marginal rate of increase in energy consumption per unit increase in GNP has been cut nearly in half—from about 0.9 to 0.5. A large part of this drop is the result of shifts in growth from energy-intensive industries—that is, extractive industries, such as mining, and heavy-manufacturing industries—to less-energy-intensive industries, particularly service industries. Of course, energy price increases have also been important in providing an incentive for efficiency.

Almost no one in the 1960s recognized the potential impending international petroleum crisis. World reserves were continuing to be discovered through the 1950s and well into the 1960s at a more rapid rate than reserves were being depleted by world consumption. Even when oil supply interruptions occurred, such as in Iran in the 1950s, there was no crisis because alternative sources of supply were readily available. The major western oil companies, the Seven Sisters, had almost complete control of oil supply.

Not until U.S. oil production peaked and began to level off a decade ago did many people recognize that this favorable supply situation could not go on indefinitely. There had been some peaking of production levels in significant foreign oil fields in the past—for example, in some Latin American areas—but these events had little impact on U.S. thinking because they had always been overshadowed by new discoveries somewhere else.

Only one important geologist comes to mind who, during this period, recognized that production levels could not long continue to increase at the rate that consumption was increasing. M.K. Hubbard performed an analysis for the National Academy of Sciences showing that the rate of discovery of new reserves would soon have to peak and that world production levels would begin dampening demand within a relatively few years (see M.K. Hubbard, *Energy Resources*. Committee on Natural Resources, National Academy of Sciences, Washington, DC, 1962).

However, the generally optimistic view of the future market did not change until the early 1970s when conditions changed very rapidly. U.S. imports grew very rapidly as consumption continued to grow after U.S. production had peaked. And then came 1973—the year when the oil embargo hit and when natural gas production peaked. When natural gas production peaked and began to decline at the same time as we had declining domestic oil production, the declining natural gas production was translated into more demand for oil. Those who could not get the gas, mainly industrial users and utilities, had to switch to oil.

Domestic oil production continued to decline until Prudhoe Bay was brought into production several years later. And the net result was that we began to import a

great deal more oil in a very short period of time.

So it was then, when the embargo hit, that we really became aware for the first time that there was a major problem. In 1974, the U.S. government came up with a comprehensive energy plan for the first time. Project Independence, in its original form, would make the country independent of foreign imports by 1980. That was in May 1974. By November 1974, when the analysis work for Project Independence was finished, the study reported it could be done by 1985. The problem is that the study was much too optimistic about supply, and the forecast never materialized.

The Project Independence staff was also too high on forecast demand because they did not anticipate the high price increases that have occurred since. When these increases occurred, demand was reduced from its previous high annual rate of growth. Also, expected high economic growth rates did not materialize.

A large part of the error in Project Independence forecasts of demand was due to a failure to recognize the shifts that have been occurring in industrial growth toward the less-energy-intensive service industries, as mentioned previously.

Because the Saudi Arabians, after 1974, wanted to continue to accommodate us and because the Shah of Iran needed money for his ambitious development program, OPEC continued to produce more oil than the market needed after 1974. The result was that the price of oil in constant dollars declined through the end of 1978. It was not until the summer of 1979 that the price was back to where it was in constant dollars in 1974.

As late as the summer of 1978, most studies projected very stable prices through 1985, with perhaps some small increases after 1985. People in industry still did not get the message about what was happening to the world oil market. Companies like the Ford Motor Company and the Chrysler Corporation went more slowly in the development of energy-efficient cars than General Motors, largely because they had a poor perception of this international situation.

When the Iranian revolution occurred, Europe was having a very cold winter. In addition, oil stocks were very low because companies were expecting no substantial oil price increases in 1978. They had let their stocks go down, expecting that they could replenish them in the winter of 1979 at moderate prices.

So, when all these things happened at the same time, the demand for oil was quite substantial—everybody wanted to get all the oil they could get at almost any price. Spot prices rose to \$40/bbl, or even higher in some cases, and that was followed by the official OPEC price increases in the spring and summer of 1979.

In January 1979, projections were generally that the price of oil would go as high as \$20/bbl by the end of the year. In fact, the average price turned out to be much higher and was close to \$30/bbl by the end of 1979.

The outlook in the next year now is for slight increases in price. Oil demand is down by at least 2 million bbl/day in the industrial countries as a result of the recession in the United States. However, at the same time, OPEC production is down by about 3 million bbl/day from what it was last year. The primary reason is, of course, that Iranian production has been reduced—to about 1 million bbl/day

right now. It could be less than that but certainly not more.

Also, some other countries have cut back their production, and they are now determined to maintain the real price and, in fact, to make slight adjustments upward in the years to come. What that means is that it is going to be more difficult to get out of the recession than it was in the previous period. When the industrial countries as a group again move out of this recession, or out of a period of slow growth, into a normal growth path, then they will hit against the ceiling in OPEC oil production. Then, prices will rise again.

I expect that the decline in gasoline demand due to price increases will be less than the decline in U.S. oil production so that the net effect will be increased demand for oil imports from the transportation sector. What this means is that our dependence on foreign oil in the years to come—through the mid-1980s and possibly beyond—is not likely to change much from what it has been in the recent past.

The problem is that nations cannot really afford this very high-priced oil. What happens is that we pay for it in dollars; they deposit most of it in the bank because they cannot absorb all that revenue. It is like writing a check to somebody who does not cash it. When these countries start cashing in, then we have to deliver goods and services to them. We are writing a check on the future; our children will have to pay for it.

Much more serious is that most of the oil that we import comes from the Middle East, which is a rather unstable part of the world. The very heavy influx of capital breeds instability, as it has done everywhere in the world. The area is also unstable because of unresolved questions related to the Arab-Israeli conflict and continued Soviet aggression in the whole region from North Africa to the Persian Gulf.

All these factors add tremendous pressures and uncertainties as to these countries' ability and willingness to continue to produce as much oil as the market demands. If they do not, then, of course, the price will adjust—the price will rise much faster than the 3-5 percent/year in real terms that most people are projecting now.

We need a great deal more time in the industrial countries to make the transition to coal and nuclear power and other sources of energy. Even if time permits, there are certain limitations on how much of a shift to coal, nuclear, and other sources can occur because of environmental problems, political constraints, and other factors.

Further complicating the potential for shifting to alternative energy sources is the fact that we need liquid fuel for transportation. Therefore, we have to go into the synthetic fuel business at some point. The lead time required to develop the technology and build the plants and the very high capital cost of synthetic fuels present truly staggering hurdles. Perhaps even more formidable than the technical and economic challenges is the public opposition to nuclear power and, perhaps, synfuels to be overcome.

So what it really looks like when you assess all these obstacles is that the industrial countries are not likely to reduce their dependence on Middle Eastern oil through the mid-1980s and beyond—maybe through 1990. After that, I really cannot forecast.

Because of this dependence, the chances are probably better than 50 percent that there are going to be more

interruptions in supply in the Middle East. If these interruptions occur, they will lead again to higher prices, and those higher prices, in turn, will add to inflation and will reduce GNP. The consensus forecasts of 3-5 percent price increases that I mentioned earlier are all based on the assumption of business as usual. The effects of future interruptions will be to make prices rise above the 3-5 percent/year range.

Another major factor contributing to a longer-term negative outlook is that, in general, industry is projecting lower oil reserve additions worldwide. We are projecting an annual discovery rate of about 15 billion bbl and an annual consumption rate of about 20 billion bbl. If you are an OPEC member and you see that happening year after year, then you know fairly certainly that world oil reserve additions have peaked and are on a decline path. This trend means that sometime in the future the value of your oil is going to go up, and nobody really knows what that value is going to be.

There have been many studies that have attempted to estimate the long-range price of oil by focusing on the cost of alternative sources of energy. But much information is speculative. We used to say that shale oil would sell at \$5/bbl, or even as low as about \$3.50/bbl in the early 1970s. Now we are talking about \$35/bbl. Each time the price of oil goes up, the cost of all alternatives seems to get more expensive too; the same is true for liquid synfuels, alcohol, and other options. Forecasting the cost of alternatives and, therefore, how they will compete with oil prices is very speculative. So my guess is that OPEC does not really have a solid basis for long-range planning any more than the industrial countries. They will continue to act on a year-by-year basis and see what the market will bear.

The only empirical basis that we have for estimating the cost of producing liquid fuel from coal is the South African experience. We know that the cost of the plants there was very high. We also know that, if you were to build the same plants today, they would be much more expensive than when they were first built. This tells you that, if you leave it to private industry alone, it would be a long time before enough synfuel plants could be built because of the high capital cost and the continuing high cost of capital. What is needed first is an energy mobilization board with powers to fast-track the approval process, to reduce lead times, and to provide some certainty that the plants can be built. Then you have to get some form of money from the government to get plants started. You will not get much enthusiasm from industries to put money into synfuel plants right now. The cost is very high and the benefits are not too clear. For example, it may cost up to \$100 000/bbl of daily capacity in capital cost to build a synfuel plant to produce about 50 000 bbl/day. By contrast, to add a 50 000-bbl/day well in the biggest field in Saudi Arabia will cost about \$2000/bbl in capital cost. That is a 50-to-1 ratio in required capital costs.

Within OPEC itself, consumption is likely to continue to rise. This, in turn, will mean that exports will fall if these countries hold total production down—as is expected. Therefore, you will have increased foreign competition among industrial countries and, possibly, the Soviet bloc for the remaining available oil. Such competition could result in higher prices and, possibly, political crises.

## Energy: An Overview

*Milton Pikarsky*

I am pleased to be with you and to share with you an overview of our national energy and transportation problems. My objective is to expand your understanding of the elements of these critical issues and to challenge you, in

your deliberations during this conference, to identify alternatives that will be helpful in responding to energy emergencies.

Today, we are at a turning point in history. Our nation