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Creating the Electric Energy Economy

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CREATING THE ELECTRIC ENERGY ECONOMY

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My remarks will be directed to four points:

First, that energy is the life blood of our economy, and that its use or conservation is far from a simple matter of personal habits of waste or frugality. In other words, the vital role energy plays in the production of goods and services should be distinguished from its use in their consumption.

Second, that our excessive dependence on our two scarcest energy resources -- oil and natural gas -- is the core of the energy problem, both U.S. and worldwide.

Third, that limiting our time horizon to this winter, next summer, or even 1985, will lead us to commit major blunders in formulating our energy strategy and policy.

Fourth, that shifting to an electric energy economy founded on our most abundant resources -- coal and uranium -- is the only realistic, logical, long-term solution to the energy problem; and the only way to counter OPEC's control of the availability and price of oil.

Let's begin by looking first at the relationship between energy use and the health of our economy.

Energy is an essential ingredient of economic growth. Growth rates of energy and GNP have exhibited a remarkable lock-step relationship moving in almost complete synchronism during the past 20 years.

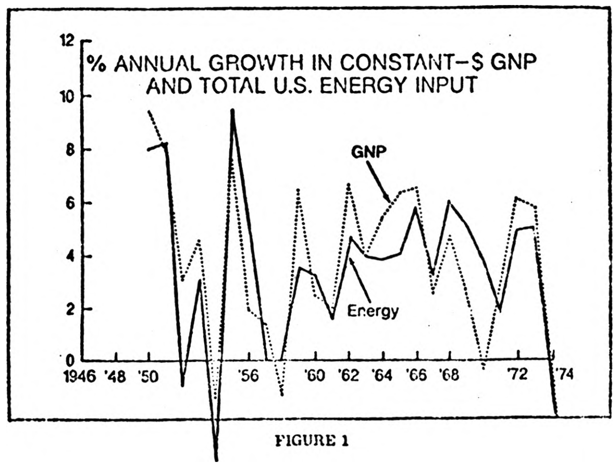

FIGURE 1

It would not be correct to say that the availability of energy causes economic growth, but economic growth certainly cannot take place unless adequate supplies of energy are available for the processing, manufacture, transportation, and sale of the various goods, products, and services that make up the gross national product. Thus the workings of the economy will be inhibited to the extent that energy is not available or is priced out of reach. It is sobering to note that during the unstable economic and energy conditions of 1974, both energy use and economic growth declined by the same two percentage points.

While a one-to-one lock-step relationship has existed between energy growth and GNP growth in the past, we believe that a modest degree of uncoupling between these variables is both possible and probable in the future. That is, some degree of energy conservation and price elasticity effect can occur without a corresponding drop in economic growth. Some housing is being reinsulated; automobile mileage will increase;

industry is taking steps to increase energy use efficiency. As a result, we project that these elasticity-conservation effects will cause the growth in energy to lag the growth in GNP by approximately 0.4 percentage point in the future.

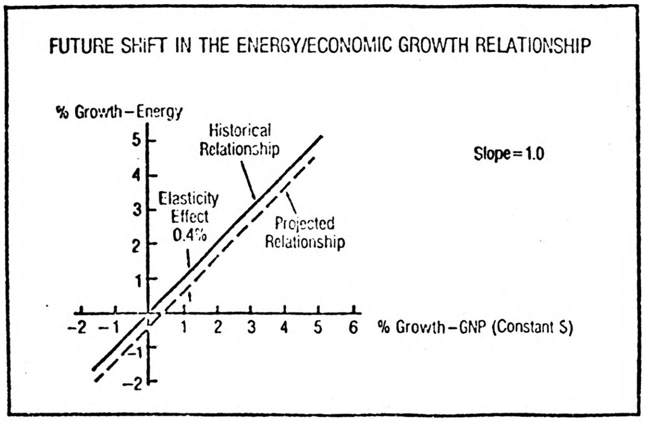

FIGURE 2

To project economic performance in the future, we have constructed a "potential GNP" as defined by the President's Council of Economic Advisors, adjusted for a 5 percent unemployment rate, reduced net productivity, and a steady decrease in labor force growth rate from the present level of 2 percent to less than 0.5 percent in the year 2000. We assumed that the economic recession would bottom out in the third quarter of this year, and that recovery would be slow. Even so, we found that the growth in constant dollar GNP over the next five years will have to average almost 6 percent per year in contrast to the historical rate of 4 percent if we are to get back to a 5 percent unemployment level by 1980.

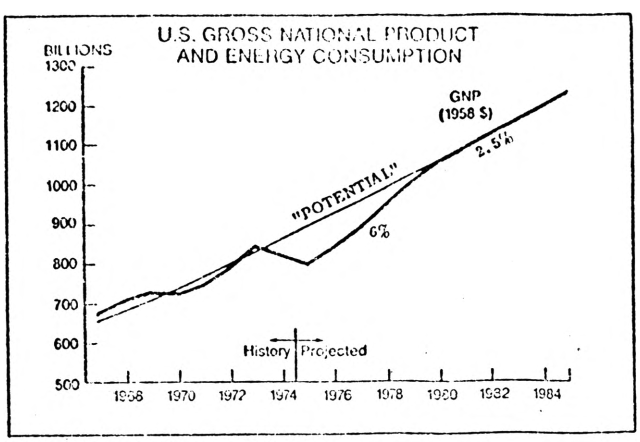

FIGURE 3

This high growth rate from the depressed starting point will have its counterpart in a high growth in energy requirements over this same period. Beyond 1980 both energy use and GNP growth should taper off to a 2-½ percent rate of growth per year in line with declines in population and labor force growth rates as projected by the U.S. Bureau of Census.

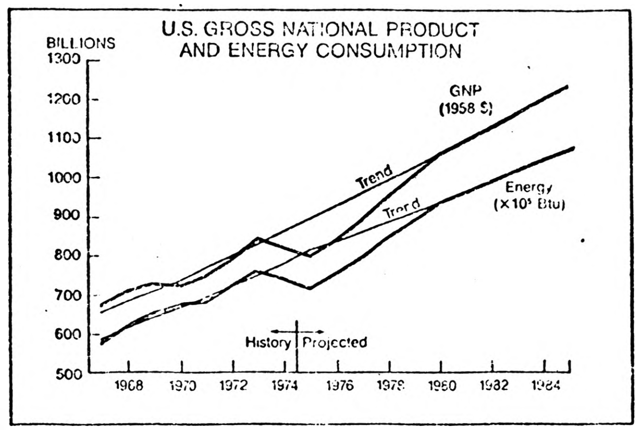

FIGURE 4

What this says, in effect, is that if economic recovery and reduced unemployment are to take place over the next five years, more energy must be made available and at a higher rate of growth than normal -- in the neighborhood of 6 percent per year compared to a recent historical growth rate of 4 percent per year. And this must take place at a time when we are facing the prospect of level or declining production of domestic energy fuels.

If we cannot make the energy available, then economic recovery will be choked off.

There has also existed a close relationship between the kilowatt-hour growth rate and the overall energy growth rate, with the kilowatt-hour rate running about 3.7 percentage points higher than the overall energy. If the economy recovers between now and 1980, we anticipate that the kilowatt-hour growth rate for this period will average approximately 9.4 percent per year in contrast to the historical rate of 7 ½ percent, in spite of both conservation efforts and the elasticity effect upon demand. The rate should drop back below the historical growth rate to an average of 6.2 percent in the first half of the 1980's.

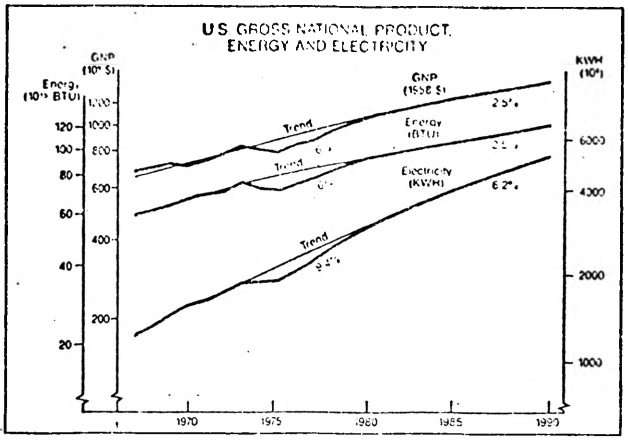

FIGURE 5

How would those kilowatt-hours be generated? After a slow start as a result of the recent cancellations and delays, nuclear energy will rapidly take on an increasing share, reaching 40 percent in 1990. Coal's share will remain relatively constant until the early 1980's, and then increase to over 50 percent in the late 1980's.

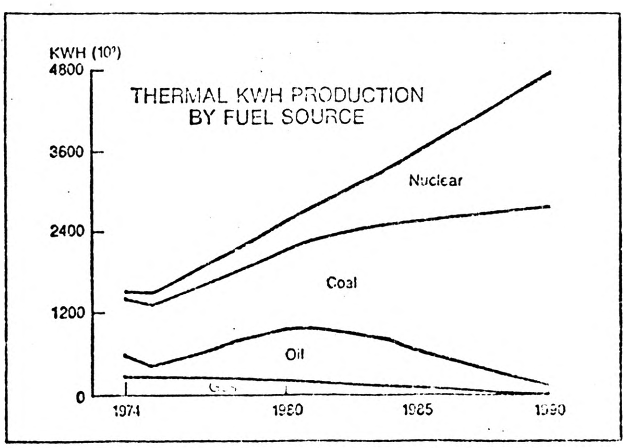

FIGURE 6

For the rest of this decade, we see natural gas declining as a fuel for power generation. The only fuel whose supply can be increased rapidly enough to provide the kilowatt-hour growth to 1980 is oil, and this increase must be imported. This unfortunate result is, of course, a direct consequence of the coal-fired and nuclear power plant delays announced last year, plus the inability to expand coal production fast enough.

Utility oil burn will have to increase by a factor of three from one point four million barrels a day, to just about four million barrels in the early 1980's. This runs directly counter to administration efforts to reduce dependence upon imports of oil, but is necessary if brownouts and economic slowdown are to be avoided.

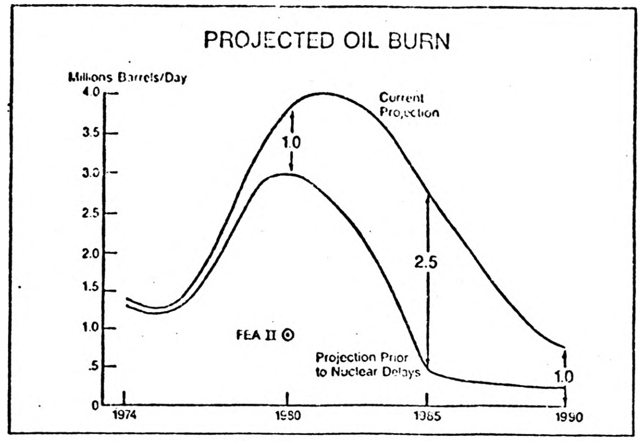

FIGURE 7

This large increase in oil consumption for electric power generation would have been one million barrels per day less had it not been for deferrals and cancellations of nuclear capacity additions last year. By 1985 the difference in the projected oil burn caused by the nuclear delays and cancellations is 2 ½ million barrels per day.

Only a massive increase in coal production and a return to an accelerated nuclear program will make it possible to bring electric utility oil consumption down to one million barrels per day by 1990. The full significance of this added burden on oil imports to meet the needed growth in electric kilowatt-hour demand is best perceived by looking at the total energy picture.

Examining the total use of energy in the U.S. in 1972, it is evident that ours is a fossil fuel energy economy, with direct combustion of oil and gas the dominant mode of end use. Electricity generation accounts for 25 percent of total energy input, but only 10 percent of oil consumption.

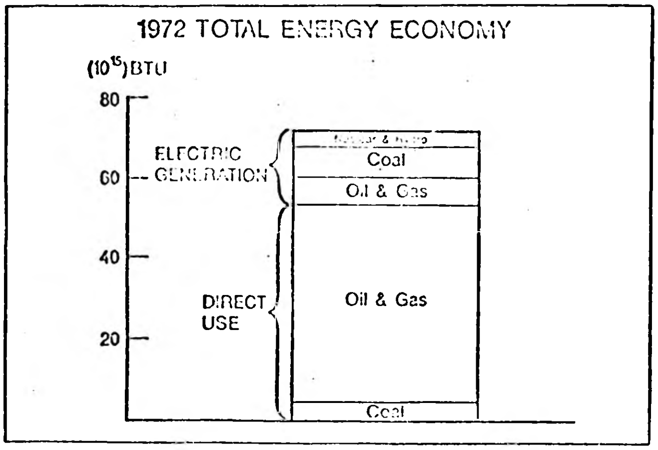

FIGURE 8

A comparison of the nation's ultimately recoverable energy resource base with our present pattern of consumption makes the root of our energy problem dramatically clear.

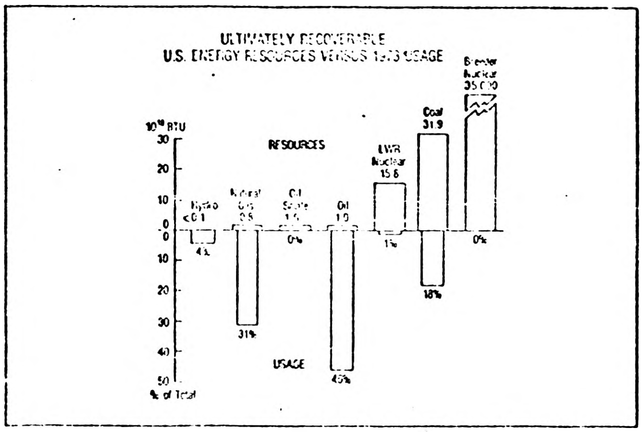

FIGURE 9

We are relying on oil and natural gas, our least plentiful energy resources, for nearly 80 percent of our energy needs, and neglecting our most abundant resources, coal and uranium. With breeder reactors, our energy resources from uranium are over one-thousand fold greater than coal, petroleum, natural gas, and oil shale combined.

At current growth rates, exhaustion of U.S. and world oil and gas resources is highly probable within 50 years. If we are to deal effectively and realistically with the coming energy crisis, we must sharply reduce our excessive dependence on oil and gas by shifting to energy sources that are more plentiful -- uranium and coal.

Let's look now at our forecast of total energy demand through 1990. It is based on full recovery of the economy by 1980, with GNP and energy growth rates tapering thereafter from 6 percent to 2.5 percent. Looking at the supply side, we assumed the maximum production rates for oil and natural gas from domestic resources would steadily decline, and that coal production could more than double. Nuclear's contribution was assumed limited to a level consistent with present utility planning, including the recent unfortunate delays and cancellations.

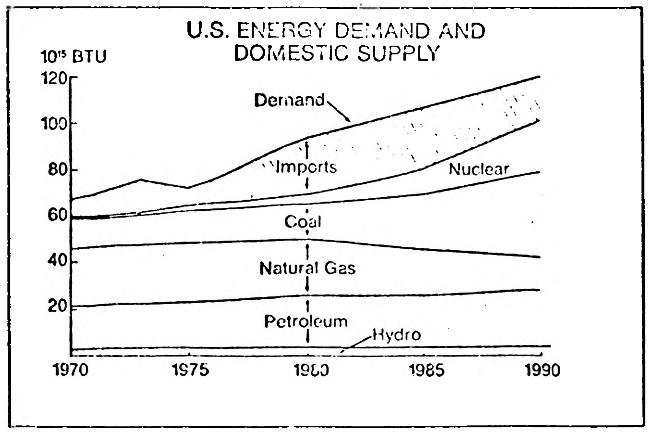

FIGURE 10

Here is the alarming picture we found. Although oil imports are projected to fall significantly this year, the start of the economic recovery will begin to drive them right back up again. By 1980, far from being reduced, they will be almost double the 1973 level at a cost of 50 billion dollars annually. Let there be no mistaking this message; if imports are choked off by tariffs, quotas, boycotts, or other actions, the ability of the U.S. economy to recover is in severe jeopardy.

Let's now look at what a true maximum commitment to nuclear power could do for this picture. When I say a true maximum commitment I mean a fully enacted and funded national policy to utilize uranium as rapidly and as extensively as is physically possible to do. A program of putting facilities in place quite similar to a NASA-type space effort, with the cessation of all legal and environmental delaying tactics which are so costly to the country today. If we would do this today, you will notice that by 1990, it is possible for us to almost reduce our imports to zero.

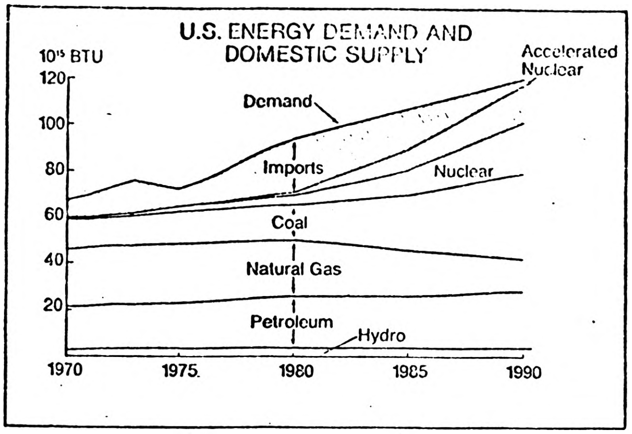

FIGURE 11

We have no real choice between now and 1980 except to live with the rapid rise in petroleum imports, but unless the proper decisions are made now, this situation will continue throughout the 1980's as well. To eliminate this perpetual high reliance on oil imports, immediate actions must be taken toward expanding the role of nuclear and coal, and to do that we will need to utilize a greater fraction of our total energy in the form of electricity.

But, the shift to an electric energy economy entails much more than merely substituting coal/nuclear for oil and gas in the generation of electricity. Instead, it also requires the substitution of electricity for the direct combustion of oil and gas at the point of energy end-use wherever this is technically and economically feasible.

Because electricity is the cleanest, most versatile, efficient, flexible, and convenient energy form at the point of use, there are many opportunities for such substitutions.

Under the policy of electric substitution, oil and gas would be reserved for critical, non-substitutable end-uses such as jet aircraft, large trucks, agricultural machinery, long-distance automobiles, drugs, fertilizers, and petro-chemicals.

Here is the way we used oil and gas in the U.S. in 1972. If we focus on the first four items -- transportation, space heating, process steam, and direct heat in industry -- we are looking at nearly 80 percent of the total direct use of oil and gas. If we are to achieve any significant reduction in the demand for oil and gas, we must do it in these areas.

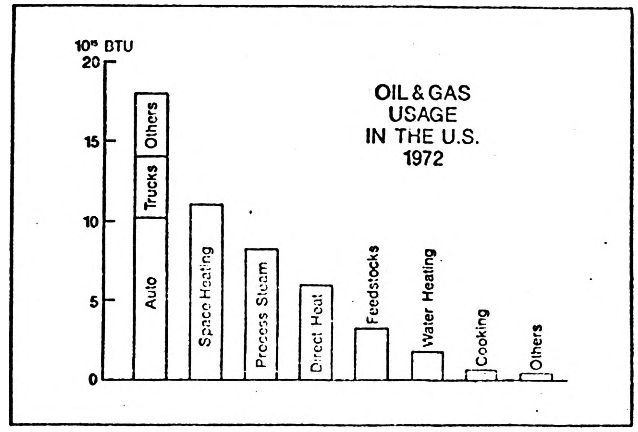

FIGURE 12

Here is a summary list of some of the more important and promising opportunities for electric substitution in each energy sector. The heat pump is seen to have wide applicability, and can play a key role in res-

ELECTRIC SUBSTITUTION OPPORTUNITIES

Sector	Function	Electric Substitution
Residential and Commercial	Space Heating	Resistance Heat, Heat Pump
	Water Heating	Resistance Water Heating, Heat Pump
	All Other	Available
Transportation	Auto (Short-Haul)	Electric Auto
	Bus (Urban)	Electric Bus
	Truck (Local)	Electric Local Delivery Vehicle
	Rapid Transit	Electric Rapid Transit
	Rail	Railroad Electrification
Industrial	Process Steam	Resistance Boiler, Electrode Boiler, High-Temperature Heat Pump
	Direct Heat	Resistance, Induction, Dielectric, and Radiant Heaters, Arc Heater
	Space Heat	Resistance Heat, Heat Pump, Waste Heat Recovery

FIGURE 13

idential, commercial and industrial space heating, water heating, and process steam. It is cost competitive and more energy efficient than an oil or gas furnace. Electric furnaces are already widely used in the metals and glass industries, and will increase as gas and oil prices and availability worsen. Short-haul electric vans and buses are feasible, and can be improved as battery technolgoy progresses. These, along with greatly expanded electric mass transit systems and electrification of railroads, can gradually reduce the heavy demand for oil in the transportation sector which now amounts to over 60 percent of total consumption.

Adoption of a systematic program of accelerated electric substitution would make it possible to reduce oil imports to essentially zero by 1990. This in turn would require an additional 300 GW of electric generation, bringing the total to 1500 GW, of which 700 GW would be nuclear.

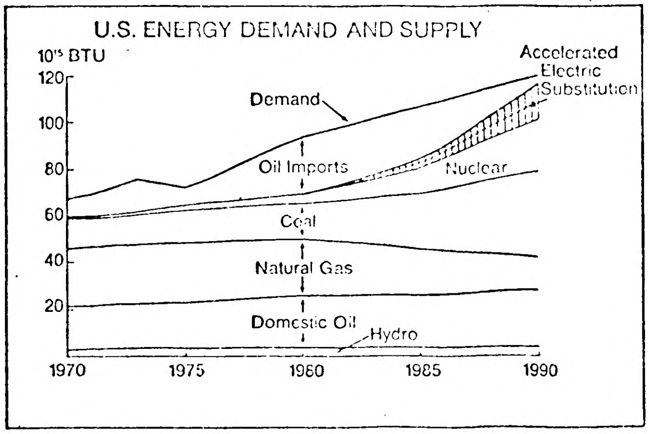

FIGURE 14

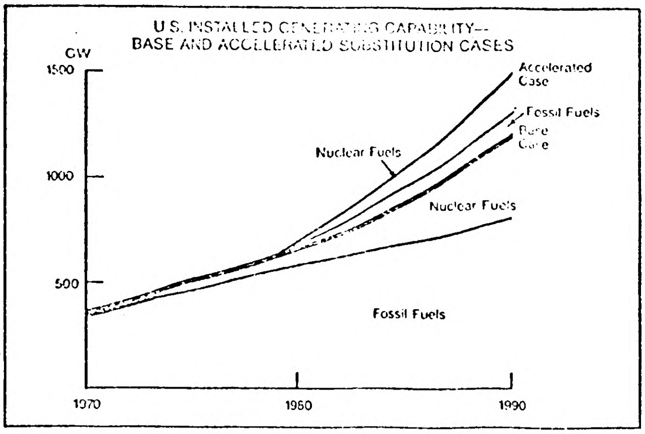

FIGURE 15

The accelerated use of electricity is the only option, the only alternative to a growing dangerous level of dependence upon imported energy and the intolerable balance of payments which that would involve.

The future of the U.S. economy is at a critical crossroads. The path to economic recovery and growth, and the steps required to assure adequate energy to support the recovery and growth, seem very clear. We must accept the necessity for relying upon increasing oil imports through the late 1970's, but we should initiate aggressive programs today to accelerate the production and utilization of coal and nuclear energy. This requires a shift to electricity as the nation's primary end-use energy form.