INTERSTATE: NATURAL GAS TENNESSEE VALLEY AUTHORITY

The Speaker's Rooms
U. S. House of Representatives
Washington, D. C. 20515

February 25, 1975

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The Honorable Harley Staggers
U. S. House of Representatives
Washington, D. C. 20515

Dear Harley:

I enclose for your consideration a copy of a paper from Mr. Don McBride, a Director of the Tennessee Valley Authority, stating his view of the energy situation generally and particularly as it relates to the future power supply of the TVA. Mr. McBride is a former head of the Oklahoma Water Resources Commission, and was chief adviser to the late Senator Robert S. Kerr when he was on the Senate Public Works Committee.

Sincerely,

Carl

The Speaker

CA/vst
Enclosure

THE TENNESSEE VALLEY AND THE ENERGY FUTURE: AN OVERVIEW

By

Don McBride

Director

Tennessee Valley Authority

February 1975

More than 30 years ago when America was anticipating the economic adjustments that would come with the end of World War II, the Twentieth Century Fund issued a report which began with these words:

> "Electricity is the chief activating force of the modern industrial world. Its importance, both in our economic and social life, is beyond all measurement. And, because its currents reach into the intimate corners of our homes as well as into our factories and farms, few of us indeed are free of their effects. As electric power is an essential industry in winning the war so also will it be in the achievement of the kind of postwar world that can make our sacrifices worth their cost."

This assessment is still valid today, except that the fabric of America is even more tightly enmeshed with electric energy. To list but a few of the revolutionary changes which have increased public dependence on electricity in postwar decades:

--Rural electrification has put an end to the era symbolized by the scrub board and the kerosene lamp. Electric power is an integral part of farm production as well as rural comfort.

--Television has revolutionized communications and entertainment.

--Climate control, represented by air conditioning, is essential to nearly every business, but indispensable in modern medicine and other technological and health situations.

--Computers do the bookkeeping for the Nation's immense credit and banking establishments and perform even more vital tasks in science and engineering.

--Factories run on electricity, and stop without it. The job of nearly every man and woman is dependent in some way upon it, whether it is the train or elevator that takes them to work, or the assembly line or metal reduction plant that would be quiet and cold without it.

Whatever affects the adequacy, reliability, and price of the Nation's electric power supply affects far more deeply the human values of the total American society.

FUTURE NEEDS

The United States will require increasing amounts of electricity in the coming years. The national rate of increase for all forms of energy use has averaged 4.3 percent a year--a rate which doubles total consumption in 17 years--while electrical power generation has been increasing at about 7 percent per year, doubling every 10 years.

To illustrate the kind of growth in the use of electricity that we face in the years immediately ahead, TVA has projected that the electricity needs of the Tennessee Valley will approach 200 billion kilowatthours by 1984--almost double TVA's total sales of electricity for fiscal year 1974 and about three times the region's requirement in 1964.

A study on U.S. Energy Prospects by a task force of the National Academy of Engineering completed late in 1974 states: ". . . the demand for energy in the United States could surge to the equivalent of 58 million barrels of oil per day (MBPD) by 1985--more than 55 percent greater than the 1973 consumption of 37.2 MBPD. However, if major initiatives are undertaken to conserve energy, the demand by 1985 could possibly be reduced to some 49 or 50 MBPD. . . ." Most similar studies come to the same conclusion: Despite our best efforts to reduce energy consumption, it is unrealistic to assume that such efforts will prevent substantial increases in future energy use.

One of the major reasons for increasing energy usage in the United States is population growth. For many decades it has been an exponential growth, working like compound interest, so that the increase in population each decade is successively larger than the year before.

Although the U.S. birth rate has slowed, population growth is not expected to end for some years to come, if ever. The 1972 report of the U.S. Commission on Population Growth and the American Future stated that even if immigration from abroad ceased and couples had only two children on the average--just enough to replace themselves--U.S. population would continue to grow for about 70 years.

It has also been projected on the basis of children already born that by around 1985 the number of households will be 34 percent greater, the labor force will be 25 percent larger, and the number of young consumers in the 25-34 age bracket will be 61 percent greater than today. In 10 short years TVA has projected it will be supplying electric energy to 7 million people--about 1 million more than today and 1½ million more than 10 years ago. Certainly it is realistic to assume that these people will require a great deal of energy, if a broader proportion of society is to gain better living standards.

The consequences of not being ready to meet those needs are almost too drastic to contemplate. Our whole industrial economy runs on electricity. We have only to look at what happened during the coal miners strike in Great Britain in 1972 for a preview of what could happen in this country with any substantial curtailment of electric supply.

The strike, which lasted about six weeks, resulted in power cuts of up to 30 percent and blacked out some areas of the country for as much as 12 hours a day. Nearly three million workers were idled at the height of the strike and millions of others were placed on 3-day workweeks. The British government estimated that had the strike lasted two more weeks, up to 20 million workers would have been laid off and every home in the country would have been without power.

Thus, the future progress, growth, and well-being of the people of the Tennessee Valley region and the Nation depend to a great extent on how well we plan now to provide a continuous adequate supply of electricity at a price they can afford.

The importance of an adequate supply of electric power to our total national well-being--indeed to our very survival--cannot be overemphasized.

ENERGY SUPPLY AND DEMAND

If we are to maintain a sound economy, it seems clear that the Nation must reorient its present energy policies and practices to achieve some semblance of energy self-sufficiency in the years ahead.

At the present time the Nation's energy resources are not being allocated in the most effective and efficient way. Only about 17 percent of our energy needs are being met by coal; coal comprises about 80 percent of our identified energy reserves. On the other hand, oil and natural gas meet about 78 percent of the Nation's energy needs, while domestic reserves comprise only about 17 percent of the Nation's total.

Petroleum Products

Today 35 percent of our petroleum and petroleum products is imported and by 1985 there have been estimates that this will increase to 50 percent, unless domestic oil exploration is dramatically accelerated. The recent embargo on oil exports by the Middle East oil-producing nations, and the resulting escalation in price, demonstrates the impracticality of relying solely on foreign sources for fuels with which to meet the future energy requirements of the United States.

In looking at the history of the world petroleum market, the dominant event of the past decades has been the discovery of enormous quantities of very low-cost oil in the Middle East. Much of this oil can be recovered at costs far below that of domestic production, and until recently was delivered in the United States at a cost less than half that of U.S. crude oil. This has inevitably acted as a deterrent to exploration and development in the United States.

Unquestionably, the net effect of all the factors acting on petroleum exploration and production in the United States has not provided the impetus to develop a continuing domestic reserve and productivity. It is estimated that less than one-half of the oil in place has been discovered in the United States and its territorial waters. Although some new oil will be discovered inland, it is anticipated that most new oil will be found offshore and in Alaska. Estimates of the total vary from 100 billion to 400 billion barrels.

However, the two most promising areas for U.S. development, the Alaskan North Slope and our outer Continental Shelf, have been retarded by environmental objections. Construction of additional refineries and of the deep water port complexes necessary to receive and process super tanker cargos also has been delayed and in many cases cancelled because of economic conditions and other factors. Based on the best evidence to date, there appears little probability that within the next 10 years the U.S. can produce enough crude oil to meet its needs.

Coal

Considering our abundant reserves, increased coal production should be a major factor in reducing our dependence on foreign sources of energy. However, due to a number of factors, coal production has not expanded sufficiently to keep pace with requirements and America is currently experiencing a critical coal shortage.

In 1973 the Nation burned about 10 million tons more coal than was mined. Preliminary figures for 1974 indicate that the recent coal miners strike caused a loss in annual production estimated at 32 million tons and that total production will show no appreciable increase over 1973. Thus, the gap between supply and demand will be even greater. The shortfall in national coal production has been met by drawing from existing stockpiles. Obviously, the Nation cannot continue to have this kind of imbalance in supply and demand, particularly if coal is expected to help meet an increasing proportion of our total energy use.

Although there are undoubtedly many complex factors involved, legislation which has restricted coal mining has played a major role in creating the current shortage. The 1969 Federal Coal Mine Health and Safety Act was badly needed, but its enforcement has resulted in a serious drop in productivity in underground mines and has contributed to a reduction of the quality of coal. The 1970 Clean Air Act, if enforced, could render much of the coal produced in the eastern portion of the United States unacceptable for utility use after 1975 because of its high sulfur content.

As a result of the uncertainty of a continued return on investment in new mines, coal operators in the East have been reluctant to expand production and there now exists a coal shortage. This shortage has been compounded by a shortage of transportation equipment. The railroads and barge lines have been affected by the same uncertainty in regard to future markets as the coal industry and have not placed orders for sufficient equipment.

With the demand outstripping supply, coal users have been forced to bid against each other, causing coal prices to increase as much as five to six times what they were two years ago. The average delivered cost of coal to TVA doubled from around $4.50 per ton 5 years ago to about $9 per ton last year, but in recent months TVA has been forced to pay as much as $35 per ton--and some utilities made spot purchases in the $50 to $60 per ton range. TVA fuel costs for the fiscal year ending next June 30 are expected to approach $476 million, up about $144 million from the previous fiscal year and the largest single item in the agency's power system costs. These increased costs must ultimately be passed along to the consumer in the form of higher electric rates. In TVA's case, each $1 per ton increase in the average cost of coal burned adds $40 million to the agency's fuel bill.

The problems associated with supply and cost and the mining and burning of coal were important factors in TVA's decision that nuclear power offered the best means of meeting the region's power growth needs in the decades just ahead.

NUCLEAR POWER - OUR BEST ALTERNATIVE

After more than 30 years of research, development, and large-scale demonstrations, nuclear power plants are now being utilized on a rapidly increasing scale by electric utilities in the United States. Over 50 percent of new power plant orders since 1970 have been going nuclear. Today, some 53 licensed nuclear generating units with about 35.8 million kilowatts of generating capacity are on line--representing some 8 percent of total U.S. electric generating capacity.

In the Tennessee Valley region, TVA has undertaken the largest commitment by a single utility in the entire Nation to nuclear power generation. This commitment, taken only after a thorough examination of the safety, environmental and economic factors involved, is made to assure the region a dependable supply of electricity during the coming decade.

In total, TVA's nuclear commitment between now and 1984 involves 17 reactor units at seven plants. These units will have a combined generating capacity of more than 21 million kilowatts--the equivalent of the capacity of all the dams, steam plants, and gas turbines operating on the TVA system as late as June 1973.

These nuclear units, plus planned hydro pumped-storage capacity, will virtually double the TVA electric power system--from some 24 million kilowatts to some 47 million kilowatts--between now and 1984. Almost half of TVA's total capacity in 1984 will be nuclear.

The first of TVA's nuclear units went into commercial operation in August 1974 at the Browns Ferry plant in northern Alabama, and the second Browns Ferry unit is expected in commercial operation at any time. The third unit of the three-unit plant is scheduled for operation in early 1976. Six additional units are under construction, two each at the Sequoyah and Watts Bar plants in east Tennessee and at Bellefonte in north Alabama. Four units have been proposed for a site near Hartsville in middle Tennessee. Orders have been placed for equipment and fuel for the last four units, and detailed siting and environmental studies are under way concerning proposed plant locations.

Any assessment of nuclear power, to be useful, must be comparative; the question is, compared to what? Until perhaps A.D. 2000, the major choices are nuclear power, fossil fuels, or nothing, in varying proportions. At this time there are no other alternatives to light water nuclear reactors such as TVA is building to supplement fossil fuels in meeting our short- and mid-term electric energy needs. There are other alternatives on the horizon such as nuclear fusion and possibly solar power that may be available in the long-term future. But the technology for utilizing both these potential power sources on a large scale is simply not available today, and at this point there is no way of knowing when they will be ready.

It must be emphasized that coal, as our Nation's most abundant fossil fuel resource, will continue to generate a large portion of this country's electric energy for many years to come. The Federal Energy Administration's Project Independence Report estimates the Nation's known coal reserves at about 434 billion tons--enough coal to last over 800 years at 1973 consumption levels. Even with its massive commitment to nuclear power, TVA expects to burn between 35 and 40 million tons of coal yearly at least until 1985.

However, as technology for producing synthetic liquid and gas fuels from coal develops, coal will be increasingly used as a substitute for our dwindling supplies of oil and natural gas in the vital petrochemical industries and other critical areas. As such, it will probably become too valuable a fuel for electric power generation.

On January 16, 1975, 32 of the country's most eminent scientists, 11 of them Nobel Prize winners, issued a statement on energy problems. As a part of that statement, they assessed the roles of coal and nuclear power in meeting this country's energy needs. That portion of their statement is reproduced below:

"The U.S. choice is not coal or uranium; we need both. Coal is irreplaceable as the basis of new synthetic fuels to replace oil and natural gas.

"However, we see the primary use of solid fuels, especially of uranium, as a source of electricity. Uranium power, the culmination of basic discoveries in physics, is an engineered reality generating electricity today. Nuclear power has its critics, but we believe they lack perspective as to the feasibility of non-nuclear power sources and the gravity of the fuel crisis.

"All energy release involves risks and nuclear power is certainly no exception. The safety of civilian nuclear power has been under public surveillance without parallel in the history of technology. As in any new technology there is a learning period. Contrary to the scare publicity given to some mistakes that have occurred, no appreciable amount of radioactive material has escaped from any commercial U.S. power reactor. We have confidence that technical ingenuity and care in operation can continue to improve the safety in all phases of the nuclear power program, including the difficult areas of transportation and nuclear waste disposal.

"The separation of the Atomic Energy Commission into the Energy Research and Development Administration and the Nuclear Regulatory Commission provides added reassurance for realistic management of potential risks and benefits. On any scale the benefits of a clean, inexpensive, and inexhaustible domestic fuel far outweigh the possible risks.

"We can see no reasonable alternative to an increased use of nuclear power to satisfy our energy needs.

"Many of us have worked for a long time on energy problems and therefore we feel the responsibility to speak out. The energy famine that threatens will require many sacrifices on the part of the American people, but these will be reduced if we marshal the huge scientific and technical resources of our country to improve the use of known energy sources."

Reliability of Technology

After initial shakedown, experience to date indicates that today's nuclear plants are an extremely reliable source of power, in many instances outperforming comparable coal-fired plants. Experience with Browns Ferry Unit 1 indicates that it will be one of the most trouble-free units in the TVA power system. Since July 1, 1974, Unit 1 has been available for service about 85 percent of the time, an unusually

high level of reliability for a large steam-electric unit. The average availability of TVA's larger coal-burning units has been about 72 percent.

Cost

When TVA began building nuclear power plants in the late 1960's, one reason was the projected cost advantage over continuing to build power plants that burn coal. This advantage for nuclear power appears even stronger today because of the tremendous increase that has taken place in coal prices, plus the costly environmental support equipment required on coal-burning steam plants.

Unit 1 at Browns Ferry will generate about 7 billion kilowatthours a year in normal operation at a total cost of about $43 million. The cost in 1973-74 for an equal amount of power from TVA's coal-burning plants was nearly $50 million, and that amount is much larger today due to recent coal price increases. Nuclear fuel at Browns Ferry is currently running the equivalent of about $3 per ton for coal as contrasted with average coal costs at TVA steam plants of around $12 per ton. The latter figure (up from $7.46 in 1973 and $8.61 in 1974) is expected to continue to increase substantially as more and more high cost coal is purchased and burned.

The nuclear power plants that will follow Browns Ferry on the TVA system will have successively higher construction costs because of the rising trend that is taking place each year in construction costs nationally. But even with today's inflation and the anticipated higher cost for future nuclear plants, the gap between nuclear and coal-fired power plants is expected to grow much wider. In fact, TVA's present estimates are that coal-burning power plants built to produce power in the 1980's would be nearly twice as expensive, in cost per kilowatthours of power produced, as the nuclear plants TVA is now planning for that period.

Safety

As with any new technology, especially a technology as complex and as difficult to understand as nuclear energy, thoughtful people have raised the legitimate question: Are nuclear power plants safe? Experience and the overwhelming weight of scientific evidence indicates that the answer is "yes."

In an accumulation of more than 200 reactor years of operation, no licensed nuclear power plant in the United States has ever caused property damage or injury to the public or operating personnel from any nuclear-related accident. However, for those who want absolute and final assurance that any activity of man, including nuclear power, carries no risk, such assurance is not available.

Preliminary results of a two-year reactor safety study sponsored by the Atomic Energy Commission and directed by Dr. Norman Rasmussen of the Massachusetts Institute of Technology compares the risks from nuclear power with the risks from other non-nuclear activities. Two basic findings from the study are:

--The likelihood of reactor accidents is much smaller than many non-nuclear accidents having similar consequences.

--The consequences of potential reactor accidents are no larger, and in many cases, are much smaller than those of non-nuclear accidents.

SOME OBSTACLES TO DEVELOPMENT

Of increasing concern to the nuclear industry in the United States is the possibility that without an acceleration in this country's capacity to produce nuclear fuels, production capability will not be able to meet uranium fuel requirements in the 1980's. Areas of particular concern to the industry are uranium exploration, mining and milling, uranium enrichment, and spent fuel reprocessing.

Delays in plant licensing and construction are additional deterrents to the full utilization and development of nuclear power in this country.

Exploration, Mining and Milling

The source of nuclear electric generating plant fuel is uranium ore. Uranium ores, like all minable natural resources, are depletable and of finite size. Atomic Energy Commission estimates show that the United States has 520,000 tons of uranium reserves producible at a cost of $15/lb. or less and an additional 1,000,000 tons of potential resources producible at this cost. Without an acceleration in the rate of exploration for new uranium reserves, these identified reserves will be depleted by A.D. 2000. In addition, the Project Independence Report of the Federal Energy Administration concluded in late 1974 that existing uranium mining and milling capacity of 18,000 short tons per year does not meet the 1980 requirements.

Forewarned by problems with its coal supply, TVA has for some time been securing uranium supplies under long-term contracts to meet its projected nuclear fuel requirements. Of a total requirement through 1980 of 31.5 million pounds of uranium, TVA had acquired all but 2.5 million pounds by September 1974; unfilled requirements for the period from 1981 through 1990 were 49 million pounds.

In addition, three years ago TVA entered into a program of acquisition of uranium reserves and of actively exploring for uranium in the United States as an additional means of supplying the fuel to its reactors. This program is presently being pursued in several western states.

As previously stated, the Nation's domestic uranium reserves are finite; some day they will be exhausted if we continue using our present type of reactors. It is for this reason that TVA, along with Commonwealth Edison of Chicago and the Atomic Energy Commission (now the Energy Research and Development Administration); and with the support of the entire electric utility industry, is planning to build the Nation's first large-scale demonstration nuclear breeder reactor at Oak Ridge, Tennessee.

With the breeder, there is substantial increase in fuel utilization efficiency--the prospect of utilizing perhaps 60 percent of the potential energy in uranium instead of 1 or 2 percent as in present light water reactors. With this efficiency, the life of U.S. uranium supplies would be stretched from decades to centuries. The project cost is high--$1.736 billion for the total program through 1987--but the dividends could be much higher. If commercial breeders can be introduced by the late 1980's, the Atomic Energy Commission estimates a savings in power costs of $50 billion by the year 2020--in addition to the energy insurance and independence the breeder could provide.

Uranium Enrichment

Naturally occurring uranium is composed of two types of uranium atoms or isotopes--U-235 and U-238. Only 0.7 percent of natural uranium is the U-235 isotope. The other 99.3 percent is U-238. A concentration of fissionable U-235 in the range of 1.5 to 3.5 percent is normally required for today's reactors. The enrichment process boosts the U-235 concentration to the desired level.

Existing enrichment capacity in the United States is confined to three Government-owned plants. Based on present projections for nuclear power growth, about 30 times the present capacity will be needed by A.D. 2000. This would represent a very large commitment by the private sector, or possibly the Government, with a long-term payback of investment. Total enrichment investment could approach $20 billion.

Spent Fuel Reprocessing

Unlike conventional fuels, the energy source in a nuclear power plant can be recycled in part--used again and again. Somewhere between one-fourth and one-third of the uranium-235 which was in the reactor fuel originally is still usable at the time the fuel bundles are removed. In addition, some of the original uranium has been transformed by that time into another element--plutonium--which is also a fissionable material. Reprocessing salvages these residual fuel materials for reuse.

The Project Independence Report estimates that recovering usable uranium by reprocessing spent nuclear fuel could reduce new uranium requirements by about 15 percent and enrichment service requirements by about 20 percent. However, while over 2,000 metric tons per year of reprocessing capacity is scheduled to be in service by 1977-78, this capacity is only adequate through 1980 and meets only half the 1985 requirements. Each new 1,500 metric ton per year reprocessing plant is estimated to cost about $200 million.

Licensing and Construction Delays

A significant contributing factor to the current energy crunch has been the licensing and construction delays which have kept nuclear power from carrying the load it would have been able to carry by this time.

Until about two years ago, Atomic Energy Commission and industry projections were about 150 million kilowatts of nuclear generating capacity by 1980 and about 300 million kilowatts by 1985. As a result of these delays, which have stretched out nuclear plant completion schedules from five or six years to nine or ten years, new forecasts project that under most likely conditions only about 100 million kilowatts of nuclear power will be in operation by 1980, and only about 250 million kilowatts by 1985.

In terms of relative fossil fuel displacement, the 50 million kilowatt forecast difference in 1980 is equivalent to about 1.4 million barrels of oil per day or about 127 million tons of coal per year. Thus, this nuclear plant slippage is quite serious indeed.

SOME COURSES OF ACTION

While there are many conflicting opinions over how we are to go about it, there is a consensus that the Nation must begin taking positive action today if we are to meet the energy requirements of the future. Some of the fundamental steps which can be taken now are relatively simple to state, but much more difficult to accomplish.

First, the importance of adopting energy conservation as a way of life--the so-called "conservation ethic"--must continue to be emphasized and will play a role in reducing unnecessary energy consumption. However, much larger opportunities for reducing waste and improving energy efficiency lie in the reduction of oil and gas usage through substituting electricity, using our more abundant resources of coal and uranium as fuel. While such substitution for oil and gas resources does not reduce demand, it does serve the objective of energy self-sufficiency and a cleaner environment. Further savings can be achieved by the utilization of more efficient energy-conserving technology in the construction of industrial, commercial, residential, and transportation facilities.

Second, steps must be taken immediately to increase domestic natural gas and oil production and thereby reduce U.S. dependence on foreign sources, although we must continue to utilize these sources to an extent whenever it is economically and politically feasible to do so. One key to accelerating domestic oil exploration using known technology is the establishment of a better economic climate that would lead the producer to expect to recover higher costs where it is necessary to take greater risks or to operate in a more expensive manner or area.

Third, far greater use must be made of U.S. coal reserves than has been done in the past. Some method must be found to guarantee investment in new coal mining and coal transportation equipment in order to increase coal production and provide for its transportation. This might be accomplished by changing the implementation of the Clean Air Act to permit the use of alternate control measures to ensure meeting ambient air quality standards, thus allowing use of higher sulfur coal, or possibly a Federal action which would guarantee an investment by a coal producer. At the same time, standards for thermal discharges should be reexamined to determine if the benefits to the environment resulting from these requirements will be substantial enough to justify the additional costs to the Nation's consumers.

Fourth, policies concerning land use, economic incentives, regulatory standards and imports should encourage exploration efforts for uranium. Prompt action should be taken to ensure that enrichment and reprocessing capacity in the United States will be sufficient to meet projected needs.

Finally, procedures should be explored to reduce the delays currently encountered in the planning and construction of nuclear power plants. A recent study by a National Academy of Engineering task force concludes that the present lead time of 9 or 10 years could be cut to 6 or 7 years without sacrificing safety. The nuclear industry, including manufacturers, architect-engineers, and utilities, must persist in the effort to standardize designs, and increase reliability and quality.

Inherent in any plan for meeting this Nation's energy needs must be the realization that we can overcome the problems we are presently facing through decisive

action. Our coal and uranium reserves ensure us of adequate energy resources for many hundreds of years, and we have the technology and the means to develop these resources with proper concern for the environment, for conservation of resources, and for public health and safety. The energy requirements of the future should provide us with the stimulus for making decisions today which will enable us to maintain the trajectory toward an even better standard of living tomorrow.

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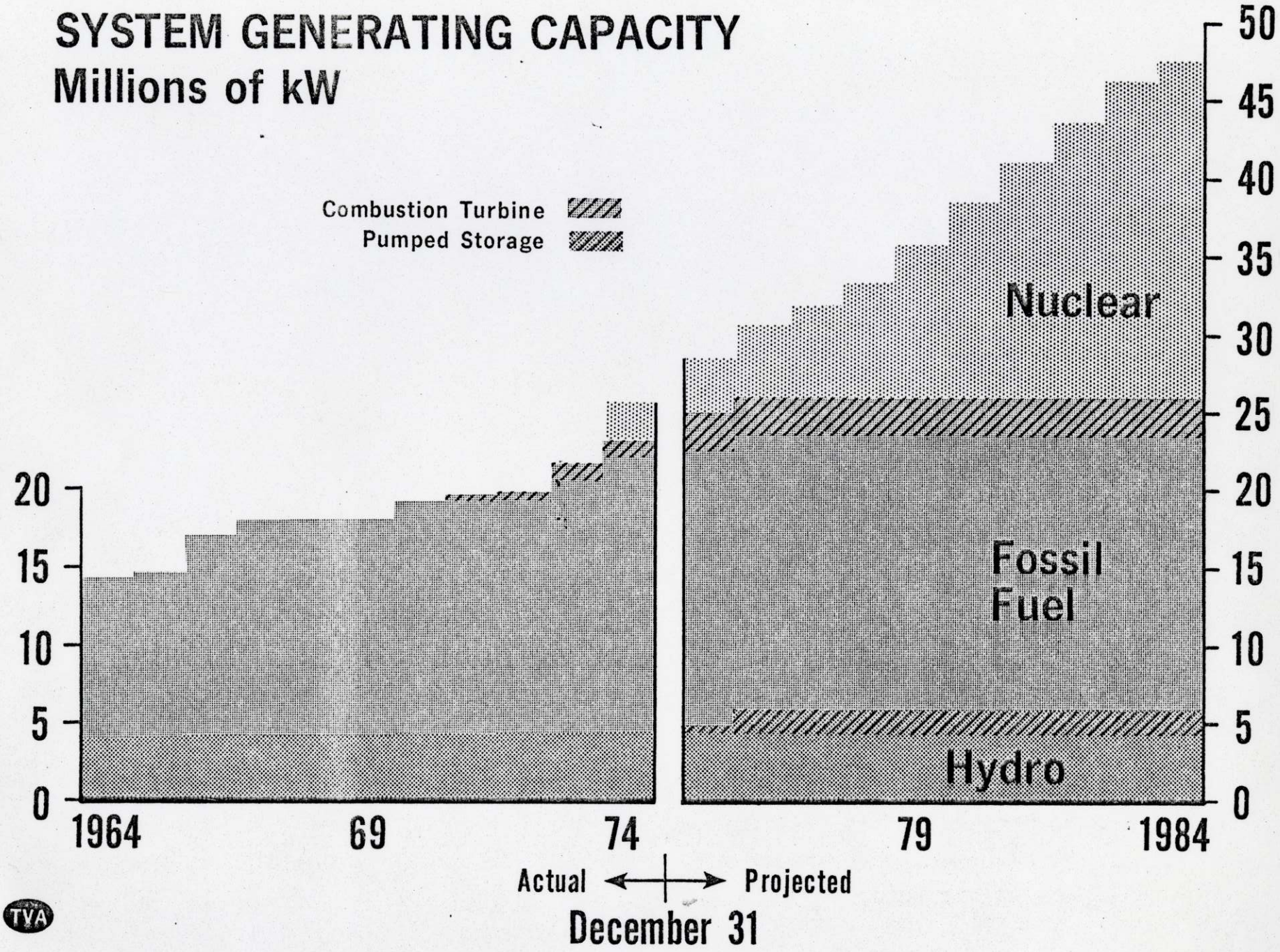
SYSTEM GENERATING CAPACITY
Millions of kW



GENERATING CAPACITY ADDITIONS

Millions of kW