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ABSTRACT

Many implications exist for postsecondary educational institutions in the challenge of arriving at a responsible solution to the energy problem. The intent of the Energy Materials Conservation Education Act of 1975 is to call for a commitment by educators (community colleges, technical institutes, and trade and technical schools) to: (1) help prepare technicians and skilled persons for the energy fields, and (2) assist students in the process of changing attitudes. Recent changes in the field of education requiring adaptation are the surpluses/shortages in some occupational categories, equal employment opportunities, the community college movement, and growth of occupational education. Two-year postsecondary institutions will have important and unfolding roles in the energy crisis. The achievement of national energy self-sufficiency will increase the demand for scientists, engineers, technicians, craftsmen, construction workers, and machine and vehicle operators. Nuclear plants and petroleum refineries will require electricians, welders, and steam and pipe fitters. Employment levels by 1990 for crude petroleum and natural gas exploration may increase by 100,000 persons over 1970 levels. New energy technologies must be developed--synthetic fuels made from coal and oil shale, advanced fission reactors, fusion, and solar and geothermal sources. Likewise, there will be emphasis on finding ways to conserve energy. (EA)

POST-SECONDARY OCCUPATIONAL EDUCATION AND THE ENERGY CRISIS*

1975 will be remembered by post-secondary educators as the year of rising unemployment and emerging new occupations. It will also be remembered as a year of challenges and opportunities for expanding the services of the 1,200-plus two-year post-secondary institutions, and the approximately 10,000 proprietary schools to meet the needs of a Nation which had to change because the world was changing. And this challenge to post-secondary occupational education came at a time when the entire free world complained of inflation, increasing costs of education, world trade imbalances and the need for improved world markets. While the high cost of energy problems which skyrocketed into prominence with the Arab oil embargo of 1973-1974 is still with us, we have only recently seen signs which point to potential solutions -- somewhere in the future.

Should emerging manpower needs call for programs by our post-secondary institutions which differ radically from those presently being offered, what would be the general attitude of the community college administrators regarding this new responsibility? Are they willing to adjust priorities in order to meet the needs of some new energy industries for example? Dr. Edmund J. Gleazer, Jr.,

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President of the American Association of Community/Junior Colleges had this to say while being interviewed on the subject by a representative of the Federal Energy Office in April 1974: "Within 24 hours we can alert a national network of 1,200 post-secondary institutions to the Nation's skill needs. I can conceive of no technical of skilled training program that would be beyond such a national training capability."

Because of the many changes in occupations, in employment patterns, and in techniques for meeting job needs which have been noticeable in recent months, the support of the two-year post secondary institutions for national emergencies is most comforting. And there is reason to believe that we should continue to maintain flexibility in our training institutions regarding job preparation.

CHANGE -- IT'S HERE TO STAY

Science and technology, with the help of the computer, has triggered the knowledge explosion. The obsolescence rate of skills, ideas and information is increasing at a startling pace. It can be said that we are caught up in a giant tidal wave of accelerating change which shows signs of increasing as we go along.

Popular interest in this exciting rate of change has made Alvin Toffler's book, Future Shock, a best seller. He describes the bewildering choices facing the American people almost daily. He calls this the problem of "over-choice." He points to the supermarket with thirty-five kinds of honey, and the automobile industry with its numerous options for the prospective buyer.

Since change has become our way of life, educators must assist in preparing students for coping with change. Students must be skilled at acquiring advanced information about what lies ahead; they must make anticipation a habit.

Such a concept led to Alvin Toffler's latest book, Learning for Tomorrow, the Role of the Future in Education. It is a compilation of essays by leading educators, psychologists, and social scientists on varying aspects of teaching about the future. "The ultimate purpose of futurism in education," writes Toffler, "is to strengthen the individual's practical ability to anticipate and adapt to change."

In our own field of education, let us consider for a moment some recent changes which called for adaptation. It should be noted that in some cases adaptation was obviously painful. For example, consider the effects of:

1. Surpluses in some occupational categories, shortages in others
2. Equal employment opportunities--especially for women and minorities
3. The growth of the community college movement

4. The growth of occupational education

5. The shifting role of the two-year post-secondary institution.

Other changes within the recent past which have called for adaptation by practically all Americans are:

1. The energy crisis
2. Rising unemployment
3. The rising cost of living
4. Inflation

When President Ford reported to the Congress a few weeks ago on the State of the Union, he said, "I've got bad news, and I don't expect any applause." But the President did more than dwell on bad news in describing the problems of the Nation and the world. He pointed out, "The moment has come to move in a new direction." He then presented a program of things to be done to enable the United States to get beyond the difficult times of today and move toward a future where it will be easier to manage the related problems of jobs, inflation, and energy. He then outlined several programs that should drastically reduce our dependence on foreign energy supplies by 1985. He established a domestic goal of 1 million barrels of synthetic fuels and shale oil production per day by 1985, together with an incentive program to achieve it. He further envisioned:

...200 major nuclear power plants

...250 major new coal mines

... 30 major new oil refineries

... 20 major new synthetic fuel plants

...the drilling of many thousands of new oil wells

...the insulation of 18 million homes

...construction of millions of new automobiles, trucks, and buses that use much less fuel.

Such planning by the chief executive of the land surely has implications for post-secondary occupational education in America.

THE ENERGY CRISIS: IMPLICATIONS FOR POST-SECONDARY OCCUPATIONAL EDUCATION

Having gone through the sobering experience of empty gasoline pumps during the Arab embargo last year, the two-year post-secondary institutions in America have been asking: What will the manpower needs of the various energy industries be if production of domestic energy is increased to meet the national needs? What will be the role of the community colleges, technical institutes, area vocational schools, trade and technical schools, and other less-than-baccalaureate post-secondary institutions in providing the technical and other skilled manpower which will surely be needed by the growing energy industries?

A review of such studies as the Project Independence Task Force Labor Report (November 1974); the National Planning Association's "Impact of National Environment and Energy Polices on the Demand for Scientists and Engineers," (August 1974); and various Department of Labor studies relating to manpower needs for the growing energy industries to the year 2000 leaves no doubt that many of the post-secondary schools are already in educational programs that will soon be expanding to keep pace with demands. However, projecting future manpower requirements for the many energy industries, by years, to 1985 at this moment in history is especially difficult due to the paucity of reliable data on the subject.

The scope of any effort to identify and forecast manpower needs for the expanding energy industries encompasses many diverse and complex industries, ranging from coal through synthetic energy processes, many without precedence. Some new energy technologies have never been in commercial production. Others have only limited performance as demonstration plants on which to base manpower needs, and perhaps have yet to produce energy. The list included coal, oil, gas, nuclear, fossil fuel utilities, oil shale and derived synthetic fuels. Although there is little doubt that many of the two-year post-secondary institutions have important and affirmative roles to play in the energy crisis, it appears that this role will unfold gradually rather than with explosive suddeness.

Manpower and Energy Industries

There are two prevailing schools of thought regarding the energy crisis. One is that American ingenuity will soon resolve the problem by coming up with clean, abundant, cheap, efficient substitutes for the conventional energies now in use. The other is that the energy crisis will continue for years; change from present types of energy will come about slowly, tediously, and only after vast sums of money have been spent in research and development work. At this moment in history, the signs, unfortunately, seem to favor the latter position.

Achieving energy self-sufficiency -- that is, to be invulnerable to any threat of an oil cutoff -- is an enormous undertaking. The demand for scientists, engineers, and technicians for researching, exploring, building, aand maintaining energy facilities is expected to increase substantially. The energy activities where labor needs are most likely

to increase are coal, natural gas and petroleum exploration and extraction; petroleum refining; oil shale conversion; synthetic fuels from coal, and the development of additional fossil-fueled and nuclear electric power plants.

The construction trades will be increasingly in demand as facilities are built throughout the energy industries. Additionally, many workers in both engineering and the skilled trades will be required to maintain and operate energy facilities. Job opportunities will call for shifting of locations. But the American labor force is noted for its mobility and diverse skills.

Inherent in the problem of estimating manpower inventories and future needs is the high mobility of skilled workers. Also, the dynamic and changing character of our society, economy, and labor markets increase the difficulty of predicting labor demand. Furthermore, the American work force also possesses a high degree of skill transferability which further complicates labor supply estimation.

The energy industries require a high proportion of engineers, technicians, craftsmen, and machine and vehicle operatives. This high ratio of skilled workers reflects the technical and highly capital-intensive nature of energy production.

Some trends have already been established. Nuclear plants and petroleum refineries both require substantial numbers of electricians, welders, and steam and pipe fitters. A stepped up nuclear plant program would call for technicians in support roles with engineers and scientists. Specific shortages have already been indicated for reactor operators and instrumentation control technicians.

Because our petroleum resources are to be redeveloped to bridge the gap until new technologies are operative, employment levels by 1990 for crude petroleum and natural gas exploration may increase by 100,000 persons over 1970. There are presently shortages of oil drilling rig workers. Of course, petroleum engineers, geologists and geophysicists should be in demand.

As oil shale is developed, so will the need develop for chemical and civil engineers, draftsmen, electricians, ironworkers, boilermakers, insulators, and as always, steam and pipe fitters. For synthetic fuel production, engineering designers, civil, chemical, and mechanical engineers, electricians, boilermakers, welders, mechanics, and steam and pipe fitters will be in special demand. Welders, boilermakers, electricians, and steam and pipe fitters will be needed for fossil-fueled electric generating plants, as well as electrical engineers. Mining engineers, mechanics, and equipment operators will be needed in the coal industry.

Most noticeable is the demand for an unprecedented number of steam and pipe fitters in all energy industries. Steam and pipe fitters are apprenticed through the plumbers' unions, which are aware of the potential shortage. Whether it be oil refineries, coal gasification plants, fossil-fueled electric generating plants, oil shale facilities, or nuclear power plants, at least 25 percent of the building craftsmen on the job could be fitters, assuming accelerated development in answer to our energy predicament. Other craftsmen expected to be in particularly heavy demand to construct and, to a smaller degree, operate and maintain energy facilities are ironworkers, boilermakers, electricians, insulators,

millwrights, and welders.

. Major Principles of Energy Development

Not only can we anticipate the emergence of new energy technologies in the near future, we can look for increased use of some of our present fuels. Dr. Robert C. Seamans, Jr., Administrator of the newly formed Energy Research and Development Administration said in his address to the Electric Power Research Institute in Washington, D.C. in February:

> "In the future, we may also have to depent on electrical conversion to take over some of the work being done directly by our dwindling domestic supplies of oil and natural gas."

He pointed out that the responsibility for producing energy involved an equal responsibility for finding ways to conserve it.

There are three major principles of energy development suggested by Dr. Seamans if we are to maintain our way of life.

> ...First, we must conserve energy. This will call for sacrifice in the short run and technological innovation in the long run.
>
> ...Second, we must practice more efficient use of today's fuels -- by substituting more plentiful fuels for those that are scarce, and by developing technologies that will enable us to make better use of our two most abundant fuels, coal and uranium.
>
> ...Third, we must proceed to develop more advanced energy technologies for the time, ten years hence, when conventional sources of oil and gas will provide a smaller proportion of our fuel requirements than the nearly three-fourths of our energy which they currently supply.

. Energy Conservation - Our First Hope

Reducing energy consumption will call for cooperative participation at all levels of government and by people in all walks of life. What is

called for is a blend of efforts. Conservation must become a way of life in America. Motorists and home owners, businesses and industries, schools and colleges -- all must be of one mind on the subject of energy conservation. How soon can more power plants be changed from oil to coal? Is public transportation or carpooling adequately encouraged for the community workforce? Is the auto industry shifting to gas economy cars fast enough?

In one of his earlier speeches President Ford said, "I ask each of you to apply our most abundant natural resource --American ingenuity-- toward including energy conservation in your life. This goal is not to change our standards of living, but to ensure that as we enjoy our American way of life, we are not wasteful and that we use our energy resources wisely. Each person has a part to play in this effort. I ask each of you to play your part."

The United States' energy consumption has been estimated as eight times the world average. Accustomed as we have become to cheap and abundant energy, we have had little peacetime experience with organized attempts to reduce energy. The only serious restrictions on energy supplies in this country were experienced during the oil embargo of October 1973, and during wartime. Fuel was not affected in World War I, but tires and gasoline were rationed during part of World War II.

The lack of experience with energy conservation measures is attributed to its low cost in recent years. From 1950 to 1970, the U.S. Gross National Product doubled in constant dollars and total energy consumption increased at the same rate. Electricity consumption quadrupled during the same period

although the population increase was only 40 percent. Obviously, the increase was in per capita consumption.

During this period there was an increase in demand for more and larger single family homes and cars. The move to the suburbs, away from railways and bus routes, was also a result of low cost and abundant energy supply.

But all this must now change. Citizens in all walks of life in America are urged to turn down their thermostats during the winter, repair steam leaks, drive slower, travel less, put up storm windows, adjust air conditioning, heating, lighting and other energy uses in buildings. All of these can be accomplished with relatively little capital investment.

Transportation habits must change for many. Carpooling is a must for those who can. The use of trains, buses, subways, bikes, barges, and shoe leather must expand, planes, trucks, and single-occupant cars must be used less.

Almost 80 percent of the energy used for passenger transportation and about 55 percent of the energy used in total transportation (both passenger and freight) is used by the private automobile. Columnist Jack Anderson stated (December 15, 1974) that "Automobiles alone use 28 percent of our oil, which amounts to 13 percent of our energy." He suggested that regular tune ups, properly inflated tires and better driving habits could improve gas mileage by more than 10 percent in existing cars. His column also advocated lightweight cars with high mileage engines for increasing gas mileage in America.

Thirty-two percent of all energy used in the United States is consumed in the buildings sector. Of this, 70 percent is consumed in residential structures, and 30 percent in commercial structures. Some potential energy saving measures are: Thermostat setback heating (68 day/60 night); water heating (120); air conditioner (78); reduce hot water use by 1/3; have furnace and air conditioner tuned up. Other homeowner investments that are potential energy savers: insulate ceilings, weather strip, calk and install storm windows and doors on existing homes.

New Energy Technologies

Since the present major energy sources used in the United States and the rest of the world will soon be providing a smaller proportion of our fuel requirements, new energy technologies must be developed. "Synthetic fuels made from coal and oil shale, advanced fission reactors, fusion, and solar and geothermal sources all suggest the range of energy concepts that must be explored," said Dr. Seamans in his February address reported above. Add to these the advancements that have been reported by wind power, steam powered buses, the "super" flywheel and cars that are powered by compressed air, and other promising prototypes for an idea of things to come in energy.

The technology for converting coal to gaseous and liquid form is already well advanced. The cost factor at this moment remains a problem. The same can be said for oil shale conversion. Atomic energy, whether by "fission" or "fusion" is frequently represented as the ultimate solution to mankind's energy supply problems. Successful

development of either system would result in an essentially inexhaustible supply of energy. Unfortunately, some technological problems persist, as do some of the safety hazards associated with nuclear energy, but their role as important producers of future energy seems to be assured.

Expensive equipment and facilities are needed to collect and convert solar energy into usable forms. Two areas of potential application are heating and cooling of buildings and generation of electricity. A satellite solar power station concept has been proposed. This scheme would use solar cells in synchronous orbit at an altitude of 22,500 miles for generating power to be transmitted to the ground via a microwave beam. The satellite solar cells would be in continous sunlight, undiluted by atmospheric interference. Other less sophisticated solar energy schemes have been demonstrated, any or all of which could carry a substantial portion of America's energy needs of the future.

Geothermal energy is heat emanating from the earth in the form of natural steam, hot water, and hot dry rock. Although found in only a few places in the United States, the potential for generating electricity in substantial quantity is promising.

The total amount of wind energy is enormous. Favorable sites, however, are limited. NASA predicts that windmills could supply between five and ten percent of the Nation's total electrical energy needs by the turn of the century. What appears to be needed at the moment is an appropriate energy storage system to accommodate wind-powered generators.

The flywheel, long considered an energy storing device by engineers, has also been attracting attention in the news media as a "superflywheel" capable of powering everything from zero emission commuter autos to cordless hand tools. The 70-passenger Oerlikon Electrogyro bus produced in Switzerland in the early 1950's is an example of flywheel powered transportation. Several models of the Oerlikon remained in service in Switzerland and in South Africa for 17 years. What limited the bus was the inefficiency of its flywheel which took as much as two minutes to be brought up to its maximum speed of 3,000 rpm. This can be translated into 800 feet per second or about 550 mph -- for the flywheel, not the bus. The speed of the flywheel is important, for the faster it spins the more energy it stores. The superflywheel would be supersonic. Numerous other energy prototypes are being tested or are in various stages of development.

The Garrett Energy Storage System is a unique flywheel device that recovers and stores some of the energy normally wasted in braking a rapid transit car. The stored energy is transformed into useful electrical power to accelerate the vehicle as it leaves the station. There is sufficient power stored to enable the car to proceed to the next station in the event of line interruption.

The "Energy Pack" is now being tested on two New York City subway cars under a grant from the U.S. Department of Transportation's Urban Mass Transportation Administration. If installed on every car, it would cut vehicle electrical power consumption in the subway system by 30 percent -- the equivalent of about 1,000,000 barrels of oil a year --

so more cars can be added with no additional power requirement. It also reduces subway tunnel heat, since much of the heat normally dissipated in braking is being converted to useful energy.

. In Conclusion

The challenge of the century for our engineers, scientists, a d technicians is to come up with a responsible solution to the energy problem in the United States. The implications for the postsecondary educational institutions are limited only by their ingenuity and resourcefulness.

We are now face to face with reality --- no longer can we take for granted that energy will remain cheap and abundant. Remaining fuel resources must be used judiciously. Conservation is an "in" word. We must continue to search for new sources of energy. For the longer term we hope that these sources are clean, renewable, abundant, and safe. To the extent that our postsecondary institutions accept the challenge of the energy crisis, skilled manpower in America will hasten the day of independence from foreign energy imports.

The effects of the 1973-74 Arab states oil embargo were global. It was inevitable that education would be called upon to play an active role in the energy crisis which followed.

On January 20, 1975, Mrs. Patsy Mink, Congresswoman, Hawaii, introduced a Bill, H.R. 1708, which, if passed, would authorize the Secretary of Health, Education, and Welfare to make grants to conduct special educational programs and activities aimed at achieving "conservation and nonuse of energy and materials, and for other

related purposes." While it is premature to speculate on the future of this particular Bill, some of its content are worthy of note. Included in the purposes of Energy Materials Conservation Education Act of 1975 is the following:

> "...to provide improved career, vocational, and technical education programs; to provide for community education programs;...to provide training programs for parents, teachers, other educational personnel, youth and guidance counselors, community leaders, labor leaders, industrial and business leaders...; to encourage the development of new and improved courses and curriculums..."

The intent of the Act calls for a commitment by educators at all levels to address the energy problem. If the community colleges, technical institutes, trade and technical schools, and other two-year post-secondary institutions, both public and private, are to make their greatest contribution during this period of limited energy resources, they must not only help prepare the thousands of technicians and skilled persons for the energy fields, but they must assist in the process of changing attitudes. Faculty and students must somehow accept as "good" the idea of taking a bus or subeay, or of forming carpools and doing more walking. Sticking to the 55-mile speed limit should be cheerfully accepted. At home they should turn off lights, T.V.'s and radios when not in use. Attics and windows should be insulated; doors kept closed. And health should be carefully guarded; sickness cuts productivity.

The post-secondary and adult occupational education programs must tune in to the shifting job opportunities evolving as a direct result of the changing focus in the energy fields. The need for a better interface with the real world by post-secondary educators was never greater.

to the Washington Post report of November 24, 1974. There's that American ingenuity again!

. Environmental Control Education Should Be Stressed

But in all of the excitement and determination to develop alternative ways of providing energy that will reduce our dependence upon foreign imports, we must bear in mind the high cost of water and air pollution. Our postsecondary educational institutions must continue to stress environmental career education and pollution control with assorted ecological types of programs. Water and wastewater technology has already contributed greatly to the cleaning of many of our polluted rivers and lakes in recent years. Environmental technologists are credited with making Pittsburgh and London "beautiful cities." Our postsecondary institutions must continue to assume responsibility for preparing technicians in all areas of environmental control including air pollution control, noise pollution control, solid waste management, water and wastewater treatment, radiation pollution control and land reclamation.

. In Conclusion

Finally, improved communications for postsecondary educational institutions is essential if the future energy needs are to be met. They must have a better understanding of the role of the Federal government as an independent and major source of changes in demand for energy engineers and technicians. Only an informed network of postsecondary schools and colleges can be expected to provide a graduate mix that will match the real needs of future energy and energy-related industries.