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ABSTRACT

A paper analyzed the opportunities for developing a vocational energy education program under existing legislation, summarized the present status of energy-related vocational education, and addressed major issues that need resolution before energy-related vocational education can be expanded. There is a particular lack of sufficient funding for current secondary level programs and little funding for developing new programs. While extensive curriculum and instructional materials development is taking place, this development is inadequately supported, duplicative, undocumented, and not shared within the field. Lack of clear distinction between vocational energy education and general education about energy is another problem impeding policy formation. Definition of vocational energy education will become feasible when the existing legal and institutional sanctions for vocational energy education (such as the National Energy Plan) and supportive education, the future energy supply, and short- and long-term job market analyses are related to current policies, legislation, and practices and to predicted educational needs. Research in all these areas and greater program dissemination efforts are needed. (Appendixes contain lists of vocational energy education sources, brief descriptions of vocational energy education and federal legislation, an analysis of future energy sources, and a historical perspective on definitions of vocational education.) (MN)

Information Series No. 220

ENERGY

Factors Influencing Vocational Education Policy

written by

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FOREWORD

Energy: Factors Influencing Vocational Education Policy analyzes the opportunities for program development under existing legislation, summarizes the present status of energy-related vocational education, and addresses major issues that need resolution before energy-related vocational education can be expanded. The author's recommendations include a stronger national sense of direction, greater dissemination efforts, and a proposed definition for vocational energy education.

This paper is one of six interpretive papers produced during the third year of the National Center's knowledge transformation program. The review and synthesis in each topic area is intended to communicate knowledge and suggest applications. Papers in the series should be of interest to all vocational educators including teachers, administrators, federal agency personnel, researchers, and the National Center staff.

The profession is indebted to Dr. Kenneth Ertel for his scholarship in preparing this paper. Dr. Lawrence Akers, U.S. Department of Energy, and Dr. John Doggette, Oak Ridge Associated Universities, contributed to the development of the paper through seminar participation and subsequent review of the manuscript. Recognition is also due Dr. Wilton Anderson, U.S. Department of Energy; Dr. Allen Suess, Purdue University; and Dr. Marla Peterson, The National Center for Research in Vocational Education, for their critical review of the manuscript. Staff on the project included Alta Moser, Shelley Grieve, Raymond E. Harlan, and Dr. Carol Kowle. Editorial assistance was provided by the Field Services staff.

Robert E. Taylor
Executive Director
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EXECUTIVE SUMMARY

The purpose of this paper is to assist vocational educators, policymakers, and state and national legislators as they make long range plans and policies for the development of energy-related vocational education. It analyzes the opportunities for program development under existing legislation and policy and summarizes the present status of energy-related vocational education.

The paper also addresses major issues that need resolution before energy-related vocational education can be expanded such as the lack of standardized definition, a strong direction for state and local educational agencies through national policy and legislation, and flexibility in funding. The effect of the uncertainty surrounding future energy resources and the lack of job market information in the energy field are discussed in relation to both long range vocational education planning and timely response to immediate human resource needs.

The paper closes with policy recommendations based on the author's proposed vocational energy education definition. These include recommendations on priorities, funding, and the development and dissemination of curricula and other program resources. Among the appendices are sections on pertinent legislation.

INTRODUCTION

The energy crisis is in full bloom. Energy auditing, building retrofitting for conservation, plant modification for the use of alternative fuels, heightened environmental concern about alternative fuel use (due to acid rain or nuclear fallout), changing job markets and skill requirements, and the development of new domestic fuel sources are all responses to the crisis. The crisis has affected American lifestyle, the jobs we do, and the people we educate for the world of work through vocational education.

Public announcements and operating procedures at the Department of Energy and the Department of Education theoretically encourage development of energy-related vocational education by state and local agencies. Some funds are available for vocational energy education under Public Law 94-482, the Education Amendments of 1976. But, as yet, no strong national leadership is present. There is no clear direction which would help state and local vocational educators make rational decisions about policies and the development of vocational programs or curricula.

Still, vocational administrators are being asked to report what progress has been made in the development of programs to train workers for energy-related jobs. They are asked to recommend local and state policies for program development. To be able to make rational recommendations, they must understand the emerging impact of national energy policies on vocational education. Vocational education program planning requires public input and analysis. State boards of education, advisory councils, commissions, and local school boards are required to hold open meetings and encourage citizen participation in educational decision making. In their considerations of policies, regulations, and plans for energy-related vocational education, these decision-making bodies will receive input from a wide variety of individuals, special interest groups, and advocates.

John Doggette (1980) has indicated that pressure to respond to political concerns is a major problem for energy educators. The large number of political constituencies which developed at the onset of national energy legislation currently seek to be served under the aegis of energy education. We need to get beyond the limited points of view of those special interests before appropriate evaluation of energy education materials, position statements, job analyses, and projections can be made.

Thus vocational planners and decision makers must screen all elements of public input and judge them as appropriate, worthwhile, and accurate.

Vocational educators must have enough background on energy matters to serve as "reality buffers" in the public decision-making process. Unquestionably, vocational specialists will be deciding a number of issues during the next decade on energy-related curricular content, on whether or not to develop technician training programs for emerging energy occupations, on state education department regulations, and on state and national policies, priorities, and appropriations.

Purpose

The purpose of this paper is to assist vocational educators and policymakers and state and national legislators as they make long range plans and policies for the development of energy-related vocational education. It analyzes the opportunities for program development under existing legislation and policy, summarizes the present status of energy-related vocational education, and addresses major issues which need resolution before energy-related vocational education can be expanded.

STATUS OF ENERGY-RELATED VOCATIONAL EDUCATION

Preliminary efforts (Ertel 1980b) to discover the response of vocational educators to the energy crisis showed the primary response to be largely at the classroom level, by teachers who have developed energy-related projects and taught energy concepts as an integral part of their ongoing programs. A closer look at some of the factors which have influenced this response, such as type and amount of funding, setting of priorities, and the nature of current programs, points out problem areas that must be addressed if vocational energy education is to be expanded and made effective.

Established Priorities

The Department of Energy (DOE) recognizes and supports a scattering of educational efforts whose overall impact falls far short of the potential. Its 1980 report, *Education and the Energy Crisis: Policies and Actions for the Department of Energy*, stated:

> . . . it is clear that the desired end of a properly informed citizenry is not being obtained..... partially because current efforts are as unfocused as they are and partially because the public has become inured to problems and resistant to many of the traditional means of education.
>
> In these circumstances, it has been found that no government agency is providing the energy education leadership which is required (p.I).

The report recommended that energy education represent a high DOE priority. It stated, "a clear imperative has emerged, to wit: the Department of Energy can and should take full advantage of the enormous opportunity which exists to employ aggressively education as a means toward achieving the energy goals of the nation" (p. 4). In June 1980, Lawrence Akers of the Education Division indicated that energy education was now a priority for the Department of Energy. It became apparent in the reorganization of the Energy Research and Development Administration (ERDA) into the Department of Energy that, within the system that provided for energy-related education, curriculum materials had been developed for levels from kindergarten through higher education, with the exception of technical-vocational levels. So, it was decided as a matter of policy to address the training of technicians in vocational education programs.

In 1979, the Bureau of Occupational and Adult Education headed an effort to modify vocational education curriculum in order to incorporate basic energy awareness and conservation measures. Deputy Commissioner Daniel B. Dunham (1979) stated that vocational education had the potential to be a leader in the field of energy conservation. Orth and Russell (1980) of the National Center for Research in Vocational Education highlighted the identified need for energy-related curriculum development in their study of new and changing occupations. They emphasized that current energy shortages have intensified the need for accurate information on job creation and curriculum development needs. The National Center for Research in Vocational Education has included energy-related vocational education on its priority agenda.

At the regional level, the Northwest Vocational Education Curriculum Center, one of a network of six regional centers, proposed the formation of a consortium of vocational programs in the eight Northwest states in 1979. The purpose was to coordinate the planning, development, testing, and dissemination of energy-related curriculum materials. Support from the participating states was generated, a regional planning conference conducted, and a formal consortium was formed. In December 1979, the state directors of vocational education, meeting at the American Vocational Association (AVA) convention, unanimously supported a resolution encouraging the development of consortia in other regions and the passage of legislation to suppport them. Subsequently, educational leaders, particularly in the network of regional vocational education curriculum centers, began the process of forming consortia in their own regions in anticipation of potential national support and funding. Six consortia were formed with strong conceptual support from state directors of vocational education (see appendix A). Major purposes of the consortia are to bring together state leaders in vocational education in order to accelerate development of energy-related vocational education; to focus resources regionally on critical issues; to disseminate energy curriculum, resources, and materials quickly through established networks; and to stimulate federal legislation and resources for job training in energy fields.

The Department of Education is stimulating efforts to generate more energy-related activities in schools. Education Commissioner William Smith, in remarks prepared for a national energy education conference, called for better use of school curricula, research, and training programs to help the nation adjust from a condition of energy abundance to one of energy scarcity (Smith 1980). Smith urged educators to take the lead in changing attitudes toward the use of energy in a consumer-oriented society.

Vocational Energy Education Funding

The lack of a comprehensive vocational energy education policy is evident in the small amount of funding available. Vocational education policy relating to energy is expressed in the Education Amendments of 1976. Energy concerns are

specifically delineated in the Vocational Education Act under Subpart 2, Sections I20 and I23 (P.L. 94-482),* where grants can be made for energy programs. While these sections allow for the development of energy education, funding is limited to coal mining and solar energy programs at the postsecondary level.

While Sections I20 and I23 are the only sections where energy-related vocational education is mentioned specifically, astute vocational administrators have used other sections of the Act to support secondary level energy-related education (see appendix B). Particularly important is Subpart 3, Sections I30, I33, and I35, which provide funds for program improvement and supportive services. It is important to note that under Section 150, home economics vocational funds can also be used for consumer and conservation-oriented instruction.

There is often a distinction between state plan-committed funds and nonstate plan funds. State plan funds are those federal funds approved for funding in states under the aegis of the state plan for vocational education, a plan specifically for spending federal dollars in compliance with federal regulation and consistent with federal guidelines, priorities, and restrictions. The process, however, of spending these allocations in a manner consistent with the five-year and annual state plans, when most of those plans do not include energy, sets a nearly inflexible systemic barrier to the expansion of energy-related vocational education.

Most vocational education monies, however, are not federal funds. Nonstate plan funds are those state and local monies which can be spent in patterns consistent with state board of education policies. The vast majority, 9! percent in I978, falls into this category. It might seem that those funds would be available to meet the need for job training in energy. The fact is, however, that those funds are already committed for ongoing program operations, leaving very little local discretion for developing new programs in new technologies. In addition, the leadership effect of the use of federal state plan funds tends to dominate the policies and plans for spending state and local dollars as well. Federal priorities, such as affirmative action, bilingual programs, and the elimination of sex stereotyping, tend to become state and local priorities. Therefore, it is unlikely that local and state vocational education policies and plans will encourage and support the emergence of energy-related education until national policy and legislation provide direction and strength.

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*Vocational Education Act of 1963, Education Amendments of 1976, Pub. L. 94-482, 90 Stat. 2190 (Codified at 20 U.S.C. Section 2301 et seq.).

Current Vocational Energy Education Programs

At least two types of activity have shown that extensive curriculum and instructional materials development related to energy is taking place, but also that this development is inadequately supported, duplicative, undocumented, and not shared within the field. The AVA energy project (Ertel 1980b) described the grass roots movement of shop and classroom teachers working on energy-related projects. One conference held by the project, for example, uncovered an extensive list of individual and state-supported activities in twelve participating states (Ulrich 1980). The project report also showed the types of energy-related programs being funded by states as pilot or demonstration projects:

- Thirty-four solar energy programs
- Twenty-five programs to train for insulating or retrofitting homes
- Nineteen conservation programs
- Seventeen programs for teaching power mechanics
- Fifteen oil and gas technology programs
- Fifteen coal technology programs

The regional planning conferences conducted during the development of the six regional vocational energy curriculum consortia uncovered descriptions of energy-related curriculum needs and activities. In addition, many states have supported curriculum materials development as pilot projects using funds under Sections 120, 123, 131-133, 135, and 150 of P.L. 94-482. Some notable projects with regional impact have resulted in printed reports and materials for solar energy, conservation, and coal production. But few of these efforts have been documented or shared within the profession.

John Doggette (1976) anticipated the active establishment of training programs for energy careers by postsecondary institutions. His national survey of community colleges estimated the number of operational or planned programs, with 62 existing energy technology programs identified for six energy areas and 132 energy programs reported in the planning stages for eight other areas. The report described the type and extent of programs being developed by community colleges in each identified technology area, and indicated a planned two-fold expansion of energy technology programs. That rapid rate of growth in the number of energy programs, however, was not realized. A 1980 summary by Mahoney showed that postsecondary institutions had not been aggressive in developing technology programs related to energy. They have, however, expanded their offerings of seminars, classes, projects, and other activities not tied to degree programs. These results are consistent with the American Association of Community and Junior Colleges (AACJC) 1978 survey (Hamilton 1978) to identify existing energy technicians' programs, which identified 43

colleges with degree certificate programs. It also indicated, however, that 165 institutions were offering courses, seminars, workshops, and other energy-related activities not necessarily leading to degrees or certificates.

Michael Blackmon (1980), in developing a curriculum for training energy conservation and use technicians, assessed the status of energy-related educational programs operating in two-year technical institutions and the state-of-the-art of curriculum materials developed for these programs. Approximately four hundred schools offered specialized energy intensive training (e.g., solar mechanic, energy audits, insulation, and so on). But few programs were identified in which a comprehensive energy curriculum was offered, and no program designed to teach interdisciplinary energy technicians was discovered.

A Technical Education Research Center-Southwest study done by Blackmon (1980) judged that the impact of existing programs on satisfying employer needs was minimal because of the limited number and limited training scope of their graduates.

> Although findings indicate that, in the next decade, employers in this country will attempt to hire more than 73,924 well-trained interdisciplinary technicians, less than 2,000 program graduates impact the labor market each year; each of these is equipped through the indicated educational process with very narrow task performance capabilities and often with minimal employable skills and knowledge (p. 187).

Blackmon also indicated, "there are no suitably oriented, modularized curriculum materials for use in a broad-based interdisciplinary energy technology program for postsecondary schools" (p. 187).

Energy-related Problems for Vocational Educators

As indicated previously, one of the major problems regarding energy-related vocational education is that little sharing has taken place at regional or national levels or between programs within states. Doggette and Stevenson (1980) expressed concern about the lack of regional cooperation in energy program planning: "There is little interstate cooperation between schools when planning programs. Competitive programs often result in oversupply, especially when local needs are small" (p. 56). Though formally established through cooperative action by state directors of vocational education, the regional energy consortia presently have little strength. They are underfunded by the states and not supported nationally by funding, policy, or regulation. And work done on energy-related issues in the national vocational curriculum network is presently peripheral to its defined role.

A teacher searching the literature of vocational education would conclude that little work was being done, either in creating new programs or in developing

curricula and materials for inclusion in present programs, from the small number of citations present in the Educational Resources Information Center (ERIC) system. A June 1980 search of the ERIC system elicited only forty-seven instructional/curriculum documents related to vocational energy education. Twelve of those were modules of instruction for a secondary and postsecondary energy conservation curriculum; eleven were oriented toward technical content for a vocational curriculum; one was a description of a new technology program; five were modules for implementing the metric system in vocational education programs; one was a teachers' energy resource guide. The remainder were curriculum materials for specific vocational programs where energy-related content was an incidental component of the total report. In a more general search on vocational education energy policy, only 146 citations were reported. Those covered a broad range of reports, conference proceedings, journal articles, and position papers. Forgione and Kopp (1979) noted, "while some adequate curricula exist, schools either do not know how to gain access to them, or they are not sharing them" (p. 102).

Definition poses another difficulty for vocational education administrators. When asked to report progress in the development of energy-related vocational education, there is a complex of problems. The simple fact is that we do not know how much energy-related training is taking place in vocational programs, or what form it takes. Energy concepts (supply, utilization, and conservation) cross all fields of vocational education, but the present reporting system is designed to reflect enrollments in traditional vocational fields and not the competencies gained by students. Energy employment and training are not subsets of the regular data system of vocational education. Therefore, no data systems presently record what energy concepts and skills are taught at what level. Clearly then, a major problem is to define energy-related vocational education so it can be reported accurately (Ertel 1980b).

> Every state [contacted] indicated a problem in defining "Energy Education" for reporting purposes. If we only look at what the state plan says and at the traditional data systems the amount of energy related activities would appear smaller than it actually is. One of the problems associated with counting the number of programs and of students being served is the definition of what "Energy Education" means. . . .
>
> The inability to identify and report enrollments in new and emerging technologies was persistently reported as a detriment to vocational education. . . . Until a better definition of "Energy Education" is agreed upon, and a reporting process set up, the problem will persist (p. 8).

David Evans (February 1980), staff assistant to the U.S. Senate Subcommittee on Education and Human Resources, also indicated one of the difficult tasks in

working with proposed vocational education energy legislation to be a definition of vocational education in the context of energy education. While The Department of Energy Orgnization Act speaks of informing the public, increasing public awareness, and ensuring citizen participation, it does not provide explicitly for education programs. The management of the Department of Energy has evidenced mild interest in the encouragement of energy-related education programs as an important means of increasing the American people's understanding of the energy problem, but there is no express commitment (Mason 1978). Clearly, one cannot look to the Department of Energy for a substantial definition of either energy education in general, or of energy-related vocational education.

One of the complex problems of definition is the need to distinguish between vocational energy education and general education about energy. Teaching a carpentry class to modify a roof structure to accommodate active solar panels is vocational education. So is teaching the skills associated with adapting a water heater to use solar preheated water in a plumbing class. But is teaching general concepts and appropriate attitudes toward energy conservation vocational or general education? What elements of energy education are vocational education and, therefore, eligible for support by vocational education funds? Policymakers need to answer these questions.

AN EMERGING POLICY

Overall, the basic problem in forming policy about energy-related vocational education is the lack of a sense of direction. This lack creates the potential for misinterpreting job market analyses, trends, and industry pronouncements. In such a climate, vocational education planners need a perspective from which to view the factors which influence policy decisions. Wergin (1976) and Vickers (1973) have developed a process for policy evaluation which identifies variables that influence policymakers and the potential impact of those factors. Applying those processes and principles to energy-related vocational education, immediate areas of concern are highlighted. They include: (1) the legal and institutional sanctions in existence, such as the national energy plan and supportive legislation, (2) the future energy supply, and (3) short and long term job market analyses. When these factors are related to vocational energy education's current policies, legislation, and practices, and to its predicted needs, a definition of vocational energy education becomes feasible.

National Energy Plan

Former President Jimmy Carter's national energy plan was completed in June 1980 when the Energy Security Act was signed into law. The composite act originally consisted of five separate laws (P.L. 95-017 through P.L. 95-021) passed in October 1978. In June 1980 two additional laws were passed, the Crude Oil Windfall Profits Tax Act (P.L. 96-223) and the Energy Security Act (P.L. 96-294) (see appendix C). The objectives of the laws are the following: (1) to reduce dependence on foreign oil and vulnerability to supply interruption, and (2) to develop domestic, renewable, and inexhaustible energy sources.

The basic strategies for stimulating the anticipated transition in energy supply and use involve: (1) conservation and fuel efficiency to reduce the growth and demand for energy; (2) rational pricing of energy resources to allow domestic prices to reflect the higher world prices; (3) conversion from oil and gas use to coal and other conventional fuel sources; and (4) development of solar and other unconventional fuel sources. Fermoselle (1980a) delineated the objectives of three topics of the plan most likely to affect vocational education by providing jobs for vocational program graduates. He stated that the legislation's energy conservation objectives will be reached using a variety of programs, which include:

- Weatherization grants for low-income families
- Grant programs for schools and hospitals

- Energy [illegible] public buildings
- Efficiency standards for appliances
- Utility conservation program for residences
- Energy conservation loan program
- Vehicle fuel efficiency standards
- Residential insulation and conservation tax credits
- Residential solar-tax credits
- Gas guzzler tax

The substitution of domestic fuels for imported petroleum and gas will be achieved by using a variety of programs, which include:

- Prohibition of new oil and gas-fired boilers
- Restrictions on use of natural gas for boiler fuel
- Restrictions on existing coal-capable large boilers
- Pollution control loan programs
- Energy tax credits for businesses
- Denial of tax benefits for new oil and gas-fired boilers
- Deregulation of oil and gas prices

In order to increase domestic production of petroleum, natural gas, and coal, the plan calls for:

- Solar energy demonstration programs
- Stimulation of manufacture of solar equipment and lowering of the costs to make it more attractive for widespread use
- Solar energy loans
- Special tax credits
- Incentives for the development of geothermal resources

Future Energy Sources

The literature of the energy field is replete with conflicting estimates of energy source use, availability, and potential. In discussing policy issues associated with the development of solar energy concerns, respondents cited not only a lack of strong national policy but a great disparity in estimates of the potential for renewable energy systems.

> The Energy Information Administration has projected that by 1995less than 1 percent of the total U.S. energy supply will be contributed by new technologies ..... Yet the DOE Solar Domestic Policy Review as recently as December 18, 1978, has concluded that in the year 2000, only five years later, this contribution could be twenty times greater in terms of quads of energy produced. Clearly, such disparity of opinions must be understood and reduced (Renewable Energy Development 1980, p. 13).

Projections for future energy resources, supply, potential impact, and long term economic and environmental effects are still in a state of flux. For each author making projections, there are several critiques and alternative scenarios presented. When those projections are weighed (see appendix D), conservation is seen as having great potential for short and long term impact on supply; and solar power and coal are seen as the resources with longest term growth potential. In every case where the potential of coal was highlighted, however, warnings were also cited about its potential negative impact on the environment. In effect, the processes of converting to solar power and of conserving energy offer the best potential for employment in the near future. Those also are the energy areas most likely to affect the majority of graduates of our vocational schools.

Energy Job Markets

The national energy plan does not concern itself with issues of employment and training. Education for work in energy-related occupations was also not an element of federal policy expressed in the National Energy Act. This omission is an issue of concern for vocational education because the development of new energy sources, the move toward energy conservation, and the shift to renewable energy processes have caused employment shifts. Many traditional job markets are diminishing (e.g., automotive), new levels of demand have been generated in alternative markets (e.g., solar, coal), and configurations of needed job skills are changing (Seltzer 1980). Some reduction of the coventional work force has occurred, but overall, there appears to be general agreement that changes in energy supply and use will create more jobs than they eliminate (Sathaye 1979).

Vocational educators have not had adequate data, however, on which to base policy decisions in planning for these jobs. Since the first objective of

vocational education is to train for gainful employment, decisions about new programs for new energy techologies, new curricular alternatives, and new relationships should be based on predicted needs growing from short and long term job market analyses. States have not been active in generating the needed job market information in the energy field (Ertel 1980b). Thirty-three states indicated that no energy job surveys had been conducted under the auspices of the vocational education divisions of the state departments of education. Most of those states which have conducted surveys indicated a limited scope, such as for jobs in solar applications or in retrofitting houses. Fifty-four percent of the states and territories indicated that job market assessments were needed, but they were neither planned nor in progress.

The need for energy job market data has been persistently expressed by vocational educators. Daniels (1979) highlighted the lack of adequate job market analyses which can accurately predict the training needs for the future as the principal challenge to planning for careers in energy-related occupations. Daniels discussed a future-focused orientation to vocational energy education and urged use of a variety of future-oriented surveys and analysis procedures which forecast conditions and job markets. He indicated the traditional approach used in vocational education is inadequate.

> Traditional entry level job opportunities generally carry a definable set of competencies which are required of the employee. Vocational programs are usually developed from a basic set of assumptions about process and final product; such programs represent a "straight-line" engineering approach to vocational instruction. A major complication is added to program projections when energy-related programs, especially those directed toward the emerging solar and alternative energy sources, are the central activity focus. Few solar employers exist anywhere in the nation, especially when measured against the potential being predicted for the next decade. Thus, a "representative employer survey" in 1979 would yield spurious results for 1984 (Daniels 1979, p. 1).

Study at the Far West Laboratory for Educational Research and Development, funded through a 1977 research grant from the U.S. Office of Education's Bureau of Occupational and Adult Education, led to the conclusion there are many national futuristic projections of job markets. In general, they predict major expansion in solar and coal fields. Except for that general direction, the projections are not usable for local decision making. The energy markets tend to be local or regional and the national projections can seldom be disaggregated.

Though the traditional local or regional job/task analysis may be inadequate for long term projections in a transitional industry, such analyses are nonetheless a necessity for short term decisions about programs and directional policy. However, vocational education leaders across the nation do not have information which allows them to make even short term decisions with confidence.

Vocational education leaders have expressed fear of training people for nonexistent jobs. An often quoted example which justifies that fear is presented by Doggette and Stevenson (1980). They describe the problems caused by responding to early calls for generalized training as environmental technicians and technologists.

> . . . environment concerns have caused federal and state agencies and vocational schools and community colleges to conduct needs assessments; hold conferences; develop curricula; and train environmental technicians with skills in water, air, and soil pollution. Although experts projected great demand for graduates,the environmental technician never materialized as an occupation, and only programs that provided trained water and waste water plant operators placed their graduates. Multi-purpose programs have disappeared. Vocational education planners must be wary of projected long-term job markets which cannot be supported by local or regional job analysis (p. 52).

Rosenthal (1980) ended his discussion of future energy work force needs with the caveat, "it would be unfortunate if large numbers of young people prepared for a career in energy and only a few were able to find work in the field" (p. 27). He applied his U.S. Bureau of Labor Statistics experience and research to summarize employment trends in energy producing industries.

> (1) Employment in energy producing industries is a small part of total employment. (2) In several energy-producing industries employment declined from the 1950s through the late 1960s, stabilized and began increasing. (3) Individual energy-producing industries experienced different growth patterns as one type of energy appeared to be substituted for another because of changes in relative prices and because of other factors such as supply constraints and regulations (p. 24).

An often forgotten fact related to job market development associated with new technologies is the major growth in ancillary jobs. The development of new soft coal resources in an area like Wyoming is an excellent case in point, for it is the center of a mushrooming regional extraction industry. As new coal mines open and mining equipment operators and technicians have moved in, other categories of jobs have expanded. Truck drivers, mechanics, secretaries, accountants, sales representatives, food service personnel, carpenters, plumbers, cosmetologists, health occupations specialists, and other skilled craft workers are needed. Therefore, vocational education opportunities expand as well. In fact, every field of vocational education may be affected by the development of a new industry base, and thus vocational policymakers must respond not just in terms of the developing technology but also in terms of its impact on the total scope of vocational education.

Vocational educators must make short and long term program planning decisions based on information that is often incomplete and unreliable. These disparities in information have a direct relationship to vocational education policy and planning. Basic assumptions which underlie growth projections must be defined and verified before vocational educators can responsibly establish long range goals. Nickerson (1978) has noted that new developments in technology may take as long as two years or more to be factored into existing vocational education programs.

Predicted Needs for Vocational Energy Education

The question of whether a present or growing energy job market exists separate and distinct from the job market typically served by vocational education is an important one. A 1980 conference on Meeting Energy Workforce Needs (National Conference 1980) focused on (1) the best available assessment of future job opportunities in energy-related occupations and (2) programs and curricula available in areas where growth in energy-related career opportunities is projected. In general, national job market and energy specialists made pessimistic reports. The inference was clear: vocational education should go slowly in developing new energy-related programs.

Information regarding energy auditing would suggest such a conclusion. The 1977 Conservation Act requires public utilities to perform energy audits for customers. Compliance would suggest an immediate job demand in public utilities for energy auditors. In an attempt to respond quickly to the Act, many projects were developed to train energy conservation building auditors. Dowty (1980) directed one such program. She stated, however, that relatively little training is needed to do energy audits, and further, a great deal of that training will be done with present utility employees. Kenneth Picha (1980) reported that the public utilities have a cadre of highly skilled employees who are not fully utilized because of cutbacks in standard energy source facilities development. Those employees are being retrained by the utilities before new people are brought into the field.

In other energy areas, however, appropriate actions for vocational educators in response to job market predications are not as easily determined. Should vocational educators actively identify new and emerging technologies and train technicians to perform in anticipation of projected employment surges? New careers such as solar energy technician, for example, have been described and new program development supported based on optimistic job market projections.

All writings analyzed by the author have emphasized that solar installations are labor intensive. For the same dollar cost, or for an equivalent energy output, solar is the process that will use increased human resources. Thus, as solar energy use develops, more trained personnel will be needed. Meg Schacter (1979) of the U.S. Department of Energy projected an increase in employment

through installation of new solar technologies. She suggested, "for the same amount of energy, solar heating systems create two to eight times more direct jobs than conventional power plants" (p. 17).

It is also reported that high-impact conservation programs would create more jobs than the building of new power plants to generate the equivalent amount of energy (Grossman 1979). In a discussion of renewable energy resources, Sklar (1980) analyzed the tremendous employment potential and advantages of scale that renewable energy technologies offer. He stated, "the most significant real possibilities occur in combining the solar option with conservation" (p. 139).

The study "Jobs From the Sun" (1978) found that solar energy means jobs and economic growth for California. Solar is a potential boom industry; solar jobs will not displace existing jobs. Active solar systems require conventional backups, thus will "add" to existing work. The study findings indicated that feasible uses of solar for space and water heating between 1981 and 1990 could generate, in California, 376,815 new jobs yearly with a $41.2 billion increase in personal income, a $19.8 billion tax saving and a $10.2 billion saving in imported capital.

But there has not always been agreement on energy-related job projections. According to Bartlett (1980), many of them have been imprecise, optimistic, and speculative estimates of hypothetical job demand. This is true in regard to solar energy. Forgionne and Kopp (1979) stated, "In solar energy, employment statistics vary widely but there is general agreement that the industry will influence existing occupations to a greater extent than [it] will create new occupations." For example, there will probably be localized and extensive development and installation of solar devices in locations such as San Diego County, California, where it is required that solar hot water heating be installed in all new housing construction. In the short term, though, it appears that the installation will be done by people presently in the construction labor force.

Albright (1980) stated that 96 percent of the skills required in the active solar field are those skills already taught in traditional heating, air conditioning, and ventilating curricula. For passive solar work, the majority of the needed skills are taught in traditional carpentry and bricklaying programs. Rosenthal (1980), who focused on vocational education opportunities growing from solar installations, also urged expansion of existing trade programs rather than the creation of new programs:

> From a human resource perspective, solar energy systems set in residences and building is one of the few new areas requiring workers; but it involves skills found in workers already trained—plumbers, pipefitters, and sheet metal workers. There may be no need to establish new programs, although in some localities there may be a need to expand existing programs (p. 27).

The persistent theme throughout the literature is that we need to train more carpenters and more heating, ventilating, and air conditioning specialists, not generalists in solar technologies.

The issue, then, is how quickly and to what extent should vocational education respond to an emerging demand? Consider, for another example, the wind power technologies. Researchers and planners suggest that an immediate and massive "tool-up" is needed to train technical specialists to design, develop, sell, install, and service wind power generating units. Should vocational education respond to those futurist projections and design new curricula, start new programs, and generate large enrollments in anticipation of a growing demand?

As a first step, consider the nature of the tasks to be performed and determine who will do them. If the massive expansion and use of wind power which is predicted does develop, the first level of tasks will be in the design and in the development and testing of blades, generators, converters, and connector systems. The second category of tasks will be in manufacturing parts and in assembling, marketing, warehousing, and distributing units. The third category of activities will be in sales, installation, and service. The design, development, and testing of innovative wind power generating systems will be done by engineers, with associated roles for financiers, lawyers, and industrial developers. Few jobs will be generated using the skills for which vocational education typically offers training. The manufacturing and assembly of parts will use many unskilled or semiskilled persons working on assembly line jobs. In those jobs, training is usually provided by the industry at the work station.

Short term projections suggest that manufacturing and assembly will be done in small batches (300 1000) where workers with multiple skills will be needed. Skills for working with and shaping laminates, plastics, fiberglass, and metals, as well as for installing electrical units, connectors, and other diverse components will require knowledge of many materials and processes. Blueprint reading and job sequencing will be basic skills, and job demand will be regional and locally specific. This type of operation will be similar to operations found in boat or helicopter building.

It is at the sales, installation, and service stages where vocationally trained persons will be needed. There will be a need for a sales force with the marketing and technical skills to deal with an emerging technological product. In addition, there will be a need for entrepreneurs—owners and developers of small firms to sell, install, and service the equipment. At the installation stage, different skills are needed. Most installations will encompass setting up and connecting pre-packaged standard units. There may be a few cases requiring the individual adaptation of standard units; however, most tasks will involve measuring, building, and setting forms for footings and assembly of prefabricated tower units, and leveling of mounting tables. Then, assembled power generating units and blades will be mounted and electrical connections made to converters or to household connector systems. In general, one cannot anticipate many

installations requiring design skills. Most of the required tasks can be performed by graduates of present-trade programs, with only minor changes in their basic skills training.

A new concensus seems to be emerging regarding the perceived response vocational educators should make to energy job demands. At the 1976 Energy Technology Training Conference, cosponsored by the U.S. Energy Research and Development Administration and the American Association of Community and Junior Colleges, controversy was reported over the extent to which existing programs should be modified to meet emerging needs and the extent to which new programs would be required. That controversy seems no longer to exist in 1980. Community colleges have slowed down the development of new technology training programs (Mahoney 1980). They presently are supporting conferences, workshops, and courses to serve energy education needs, but are not creating extensive new curricula for anticipated energy technology careers.

This is consistent with the view of the Office of Vocational and Adult Education of the Department of Education which has encouraged retrofitting present curricula rather than emphasizing new technologies. Daniel Dunham (1979) stated:

> We have concluded through some studies and research which have been undertaken over the last several months that it is not enough to focus only on the energy-related technologies, that is the new and emerging energy-related occupations. We must first move to modify the present curriculum in all occupational areas and remodel instructional skill training practices at the secondary school, the community college, and at other post-secondary institutions to the end that we teach energy-related skills in each occupation (p. 177).

John Doggette and Wayne Stevenson (1980) of the Manpower Research Program, Oak Ridge Associated Universities, analyzed the impact on labor demand by various energy activities. Impact was discussed by industry, occupation, and geographical region. For each area, existing programs were reviewed and suggestions made for future developments. They predicted that energy supply and production changes will create jobs through growth, but will not drastically change the nature of the jobs or the training necessary for performance. What will be needed is more skilled workers with an understanding of energy supply, use, and conservation. Picha (1980) made similar predictions:

> We don't need "energy" technicians. There is no present or future likelihood of a job market for wind power technicians, synthetic fuel technicians, solar technicians, or other narrow focus energy technicians. What we need is more mechanical technicians, refrigeration technicians, carpenters, plumbers, sheetmetal workers and boiler makers to build the developing alternative energy production resources.

Picha further suggested that every technician's training program at any level include energy literacy, supply, and conservation.

There is general agreement (Rosenthal 1980, Albright 1980, Grossman and Daneker 1979, Picha 1980, Stobaugh 1979, and Yergin 1979) that job market changes will call for more traditionally trained tradespeople, people who need energy-related concepts and skills added to the regular curriculum. When competencies associated with building, installing, and servicing energy-saving devices were analyzed, most were already in established vocational education curricula. Support is also given to the position that vocational education should be retrofitting existing curricula to incorporate energy-related competencies—that vocational education should be very cautious about creating new programs for new technologies (National Conference 1980, Mahoney 1980, Picha 1980, and Doggette 1980).

Toward a Definition of Vocational Energy Education

From the preceding discussions, it can be seen that vocational education is just beginning to respond with training alternatives to the energy crisis. As of the summer of 1980, no major policy changes, no dominant innovative program thrusts, no enrollment surges or coordinated curriculum changes had taken place. It is essential that educators understand the reasons for this. For one, the national energy plan goals do not mention either general or vocational energy education. The national energy acts do not provide directions to educators, nor do they provide funds for energy education. It is, therefore, the implied responsibility of vocational education to establish its own policy. The overriding question, then, is what is vocational energy education? That is, how can it be defined in terms of present vocational education laws, regulations, practices, and programs and at the same time be consistent with the current national energy plan?

A definition of energy-related vocational education must take into account the historical momentum (see appendix E) toward a more flexible definition. It must consider the reality posed by the present law, one section of which restricts use of funds to coal and solar energy programs at the postsecondary level. It must also consider the limited options offered under the program-improvement and supportive-services sections of current legislation, and at the same time respond to the initiative of local schools that are infusing energy-related concepts and skills into ongoing programs.

In the context of the present vocational education legislation, practices, and regulations, and in concert with the continuing trend toward program flexibility, the following operational definition of energy-related vocational education is posed:

> Vocational energy education is education for work related to increasing the energy supply, to utilizing energy resources

efficiently, or to conserving energy. Its purpose is to help students develop related skills, abilities, understandings, attitudes, work habits, and appreciations. It is taught in all vocational education programs at all levels.

POLICY RECOMMENDATIONS

Based on the proposed vocational energy education definition, the following recommendations are presented. They consider priorities, funding, research, and the modification, development, and dissemination of curricula and other program resources. They include recommendations for national, regional, state, and local agencies and for immediate and long term actions. It is recommended:

That the definition of energy-related vocational education presented in this paper be refined and communicated to the field. The definition should show time relationship between energy sources, energy use, and conservation and vocational education programs. Presently, confusion exists as to which components of energy education are general—education for energy literacy and informed consumerism—and which are specifically job-related knowledge. These distinctions are necessary for policy formation and decision making related to the use of current federal and state vocational education funds.

The distinctions are also necessary to help vocational educators report enrollment in energy-related skill training programs. Neither the states nor the Department of Education know the form and extent of energy-related education. They do not know because the small present impact is merged with and lost in the statistics of traditional vocational programs. To plan for and assess future progress, data systems and base-line data are needed now. A strong, generally accepted definition will be an important base in the needed national study of the status of vocational energy education.

That states conduct market analyses of potential jobs in energy fields and assist local districts in using those analyses when making policy, program, or curriculum decisions. The complex futuristic studies providing optimistic industry-wide projections have not proven useful to vocational administrators and policymakers. The available macrodata patterns can seldom be disaggregated to reflect state and local markets. There is seldom any direct relationship between the data base and the job skills mix needed for vocational program planning. With better estimates of job markets, local programs could be initiated more effectively. There could then be clear indicators of the energy job/training linkages needed, alleviating the concern expressed by vocational educators of their unwillingness to train persons for nonexistent jobs.

That research be conducted to identify the skills and knowledge needed for competent performance in existing and potential energy-related jobs. Much energy training, especially for jobs related to solar and other renewable energy sources, can be implemented by retrofitting present trades curricula. But

confusion has existed about the nature of the skills required for new technologies that have emerged.

That local agencies seek ways to modify and retrofit existing curricula to teach energy-related skills, concepts, and attitudes to all vocational students. Local agencies should go slowly in developing new programs for apparently emerging technologies. Job market and task analyses should be completed before programs for new energy-related technologies are developed. All vocational education teachers should be provided up-to-date inservice education on the development, source, use, and conservation of energy and be given help in infusing those concepts into their curricula.

That states support and participate in interstate program planning and curriculum development. Competitive programs often result in oversupply, especially when local needs are small. Duplication of design and development of curriculum materials is wasteful of limited time, talent, and money. A persistent expression of a need for regional planning, financing, and support for job market analyses, curriculum development, dissemination, and coordinated program planning comes from the field. That need is reinforced when one looks at the regionalized energy supply situation and the localized intensity of demand.

That states and local education agencies also share on a wider basis retrofitted and new curricula related to energy-related jobs. The paucity of disseminated reports of known curriculum and research projects indicates vocational educators are not sharing the results of their work. Such failure encourages duplication of effort and is a waste of funds and talent. (See appendix A for existing agencies that seek to facilitate the sharing of energy education resources.) Inservice professional development programs should be organized to properly prepare teachers to use appropriate knowledge, skills, and attitudes about energy sources, use, and conservation in the curricula. Present teachers need to be kept up to date on technological advances and energy curriculum materials available. They are the ones who will be teaching energy-related concepts to vocational education students in the foreseeable future. They must be able to anticipate and prepare for improvement in energy-related processes, while teaching fulltime in traditional vocational education programs.

That vocational education legislation (P.L. 94-482, Sections 120 and 123) be amended to allow use of funds for energy-related activities at the secondary level and for program development related to all energy fields. Present legislation restricts use of funds to the development of programs in coal mining technologies and solar applications. Funds are further restricted to postsecondary and adult programs, even though the majority of vocational education enrollments are at the secondary level. There should be opportunities to respond to the potential job market demand with training programs that meet job market needs in all emerging energy resource pools and at the program level with the greatest response potential.

That energy-related vocational education be identified by the Congress as a program of national significance in the next vocational education funding reauthorization. The leadership potential generating from the power of unequivocal, clear, concise policy statements in the form of a federal priority will stimulate states to analyze their need for energy-related vocational education. Since state policies, operating practices, and funding patterns have historically followed the leadership generated by the programs of national significance, it will enhance the probability that strong energy policy statements will be included in state plans for vocational education.

That each state and territory include in its state plan for vocational education a policy statement concerning education for employment in energy-related jobs. Presently, only 40 percent of the states have energy education noted in its state plans. The state plan is not only the formal plan or contract for using federal dollars, it is also the document which provides direction and policy for the expenditure of state and local funds. Unless a commitment is expressed in the state plan, there is little likelihood that state and local resources will be used for vocational energy education.

That more funds be provided to states in unencumbered form, so that ongoing program activities in energy-related vocational education can be supported. States have indicated an inability to "tool-up" for the emerging training demand because not enough funds are available and because funds are earmarked for meeting programs of national priority. Such systemic and operational barriers make programmatic change extremely cumbersome and cause extensive time lags in responding to emerging demands or crisis situations. State leaders need more flexibility in responding to new priorities.

That the Department of Education establish clear and unequivocal policies and regulations to support the development of training for energy-related jobs. There exists considerable confusion about the Department of Education's policy relative to energy education. Some policy statements suggest that education's role should be oriented toward consumer education, while others stress training for new skills in emerging technologies. Some education policy statements call for retrofitting present curricula with energy-related competencies, yet present federal regulations favor starting new and exemplary programs rather than supporting the modification of existing curricula. Because of this apparent lack of consistent policy, the Office of Vocational and Adult Education is not perceived as being aggressively supportive of energy-related vocational education. There is no present position reflecting support across all vocational fields and services. Firm commitment at the national level is needed. A clear concise policy statement from the Department of Education would provide leadership and direction to state departments of education for the development of vocational energy education.

APPENDIX A: VOCATIONAL ENERGY EDUCATION SOURCES

Three of the resources available to aid in the coordination and dissemination of energy-related vocational education materials are the National Network for Vocational Energy Education Coordination, the Educational Resources Information Center (ERIC), and the National Center for Research in Vocational Education.

National Network for Vocational Energy Education Coordination

Western Region Vocational Energy Education Consortium
Western Curriculum Coordination Center
University of Hawaii
2444 Dole Street
Honolulu, HI 96822
(808) 948-7989 or 948-7834

American Samoa, Arizona, California, Hawaii, Nevada, Trust Territory of Pacific Islands, Government of Northern Marianas

East Central Vocational Energy Education Consortium
East Central Network/Illinois
Vocational Curriculum
Sangamon State University
Springfield, IL 62708
(217) 786-6600

District of Columbia, Indiana, Illinois, Maryland, Michigan, Minnesota, Ohio, Virginia, West Virginia, Wisconsin

Southeast Vocational Energy Education Consortium
Southeast Curriculum Coordination Center
Mississippi State University
Research and Curriculum Unit
Drawer DX
Mississippi State, MS 39762
(601) 325-2510

Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee

Northeast Vocational Energy Education Consortium
Pennsylvania Vocational Education Department
Commonwealth of Pennsylvania
333 Market Street
P.O. Box 911
Harrisburg, PA 17108
(717) 783-6529

Delaware, Maine, Massachusetts, New Jersey, New York, Pennsylvania, Puerto Rico, Rhode Island, Vermont, Virgin Islands

Midwest Vocational Energy Education Consortium
Midwest Curriculum Coordination Center
State Department of Vocational and Technical Education
1515 West 6th Avenue
Stillwater, OK 74074
(405) 377-2000, ext. 252

Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, New Mexico, Oklahoma, Texas

Northwest Vocational Energy Education Consortium
Northwest Curriculum Coordination Center
Commission for Vocational Education
Building 17, LS-10
Airdustrial Park
Olympia, WA 98504
(206) 753-0879

Alaska, Colorado, Idaho, Montana, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming

Educational Resources Information Center (ERIC)

ERIC is a national information system which provides ready access to educational literature by online computer searching and a printed index, *Resources in Education (RIE)*. It is the primary retrieval source for energy curriculum and related materials that would be otherwise difficult to obtain from standard sources. Suggested descriptors for an online search would be energy education, energy conservation, and energy, in addition to vocational education.

The National Center for Research in Vocational Education

- *Dissemination and Utilization Program* The D&U program assists vocational educators in locating, sharing, and using some of the best educational research and development resources available. It identifies and screens products developed at the federal, state, and local levels with a focus on priority concerns, including energy.

- *National Center Clearinghouse* A program improvement database at the National Center Clearinghouse maintains information about state and federally administered vocational education research and development projects and products. The program improvement database, soon to be online, can retrieve descriptions of projects receiving federal funds, including energy projects.

APPENDIX B: VOCATIONAL ENERGY EDUCATION LEGISLATION*

Energy-specific Legislation

Section 123 (a) states that (1) Funds available to states under Section 120 may be used to make grants to postsecondary educational institutions to carry out programs for the training of miners, supervisors, technicians (particularly safety personnel), and environmentalists in the field of coal mining and coal mining technology, including acquisition of equipment necessary for the conduct of such programs; (2) Grants made under this section shall be made pursuant to applications which describe with particularity a program for the training of miners, supervisors, and technicians in the field of coal mining and coal mining technology, including provision for supplementary demonstration projects or short term seminars, which program may include such curriculums as (A) the extraction, preparation, and transportation of coal, (B) the reclamation of coal mined land, (C) the strengthening of health and safety programs for coal mine employees, (D) the disposal of coal mine wastes, and (E) the chemical and physical analysis of coal and materials, such as water and soil, that are involved in the coal mining process.

Section 123 (b) states that funds available under Section 120 may also be used to make grants to postsecondary educational institutions to carry out programs for the training of individuals needed for the installation of solar energy equipment, including training necessary for the installation of glass-paneled solar collectors and of wind energy generators, and for the installation of other related applications of solar energy.

Energy-related Legislation

In Section 130, grants are authorized to states to assist them in improving their vocational education programs and providing supportive services. These grants may be used in accordance with five-year State Plans and annual program plans for: (1) research programs as described in Section 131; (2) exemplary and innovative programs, per Section 132; and (3) curriculum development programs as described in Section 133.

Section 131, Research (subset a-3), authorizes contracts to be let for "improved curriculum materials for presently funded programs in vocational education and new curriculum materials for new and emerging job fields. . . "

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*Vocational Education Act of 1963, Education Amendments of 1976, Pub. L. 94-482, 90 Stat. 2190 (Codified at 20 U.S.C. Section 2301 et seq.).

Under Section I32, Exemplary and Innovative Programs (subset a), "funds may beused for contracts as part of the comprehensive plan for program improvement mentioned in Section I3I (a) for support of exemplary and innovative programs . . ."

Section I33, Curriculum Development, states that funds available under Section I30 (a) Program Improvement and Supportive Services may be used for (I) "the development and dissemination of vocational education curriculum materials for new and changing occupational fields . . ."

Section I35, Vocational Education Personnel Training, makes funds available (a-I) "to train or retrain teachers, and supervisors of teachers in vocational education in new and emerging occupations."

In subpart 5 of the Act, Section I50, Consumer and Homemaking Education, grants can be made to states to "(I) emphasize consumer education, management of resources . . . to meet current societal needs, and (2) ancillary services, activities . . . . curriculum development, research, program evaluation, special demonstration, and experimental programs, development of instructional materials, exemplary projects."

APPENDIX C: FEDERAL ENERGY LEGISLATION

National energy legislation passed in 1978 included five acts which Stevenson (1980) summarized:

- **The National Energy Conservation Act** To provide for regulation of interstate commerce so as to reduce the growth of demand for energy through (a) energy conservation and (b) development of solar and other alternate energy sources.

- **The Power Plant and Industrial Fuel Use Act (Coal Conversion Act)** To promote the use of fuels other than oil and natural gas in the production of energy in new and existing electric power plants and other major fuel-burning installations.

- **The Public Utilities Regulatory Policies Act** To alter price and other regulations on public utilities in such a way as to encourage conservation and efficient use of electricity and to improve wholesale distribution of electric power while maintaining equity in the rate structure.

- **The Natural Gas Policy Act** To eliminate the distortions caused by two-tiered (interstate/intrastate) pricing of natural gas and to remove "outmoded regulatory burdens" associated with sales in interstate markets.

- **The Energy Tax Act** To provide incentives consistent with the purpose of (a) The National Energy Conservation Act and (b) The Coal Conversion Act.

In 1980 two pieces of legislation were added to the National Energy Act.

- **Crude Oil Windfall Profits Tax Act** To impose a windfall profit tax on domestic crude oil, to increase the time and amounts of conservation and renewable tax credit incentives, and to relieve economic burdens on low-income families produced by escalation of energy prices.

- **Energy Security Act (known also as the Synthetic Fuel Act)** To achieve energy security by encouraging, fostering, and subsidizing production of synthetic fuel from domestic resources; to reduce dependence on imported oil and gas through the development of biomass and alcohol energy; to encourage use of renewable energy resources; to encourage energy conservation and use of solar energy; to encourage use of geothermal energy; and other purposes.

APPENDIX D: ANALYSIS OF FUTURE ENERGY SOURCES

An energy project at the Harvard Business School has established a historical perspective, clarified the issues in the energy debate, and suggested a national course of action for challenging the energy crisis. As the project sees it, none of the four conventional sources of domestic energy—oil, coal, natural gas, or nuclear—can supply much more energy than they do now. "We are faced, then, with the choice of importing more OPEC oil, which can only make a bad situation worse, or make a genuine move toward conservation and low-technology solar energy" (Yergin 1979b). Other researchers concur with this analysis.

- **Oil** Stobaugh (1979) analyzed the problems associated with oil as a continuing energy source. He concluded, "To the extent that any solution at all exists to the problem posed by the peaking of U.S. oil production and the growth of imports, it will be found in sources other than oil" (p. 55).

- **Natural gas** Analysis (Bupp and Schuller 1980) of the supply, production, use and future of natural gas led to the conclusion that the nation should not plan on greater quantities of natural gas to stop the rise in oil imports. It will be a challenge to find enough new gas to maintain production at current levels.

- **Coal** Horwitch (1979) has described the rediscovery of coal as an energy source and analyzed its short and long term potential for impact on the energy future. Despite its much-touted abundance, coal will not become our major near term solution to the energy problem Its use, however, will grow and it will play an increasingly important role in certain sectors. But coal's potential long-run strength—new, strong participants and new kinds of technological innovation—is gradually emerging. The industry is more vigorous than it has been for decades; it is no longer isolated, and a larger, rich, and diverse set of firms now participate. Finally, the government is beginning to encourage the development of new technologies. The strategy for coal is clear: to concentrate on long term answers, especially through technological innovation, while seeking acceptable ways to utilize coal's steady short term growth. Despite its long term potential stemming from new technologies and new industries in coal, Horwitch concluded that it is clear coal cannot be the transitional energy source.

- **Nuclear** Although nuclear power was once described as having the potential to make massive contributions to our energy needs, attacks on

the nuclear industry for failing to develop feasible, safe, and acceptable methods for disposing of waste materials have been most effective in stopping development of new nuclear generating facilities. The end result is that "nuclear power offers no solution to the problem of America's growing dependence on imported oil for the rest of this century" (Bupp 1979, p. 135).

- **Conservation** Daniel Yergin (1979a) identifies conservation as the key energy source for the near future. "The United States can use 30 or 40 percent less energy than it does with virtually no penalty for the way Americans live" (p. 182). Yergin's analysis of the potential impacts from conservation in building and retrofitting homes and businesses for energy conservation highlights the trade and skill areas of concern to vocational educators. His analysis shows clearly that there can be astounding short and long term impacts from conservation.

- **Solar** Because of the oil embargo, solar energy has become a serious alternative source of energy. Maidique (1979) said, "We believe that given reasonable incentives, solar could provide between a fifth and a quarter of the nation's energy requirements by the turn of the century" (p. 183). He discussed the near term and middle term potential of solar technologies with special emphasis on solar heating as a new growth industry with immediate impact on the job markets in the building trades.

APPENDIX E: DEFINITIONS OF VOCATIONAL EDUCATION—A HISTORICAL PERSPECTIVE

Early definitions of vocational education and its components were narrowly specific and based on a need to provide a labor market pool of skilled workers. In addition, the early definitions sought for control of vocational education in order to keep it separate and distinct from other programs. While its "separateness" ensured program strength, vocational education became less flexible in terms of serving new populations, new purposes, and new technologies.

In his book *Foundations of Vocational Education: Social and Philosophical Concepts,* Thompson (1973) described the development of the legal structure and various phases the field went through in response to its then-contemporary definition. According to Thompson, the growth of vocational education can be traced through the definitions that have been applied to it, with different facets of the definitions emphasized in different eras. At various points in its history, vocational education has been defined in terms of its program utility, its enrollees, the level at which it was offered, the economic needs of the social system, and the human resource needs of the nation.

The emergence of a new, broader vocational education perspective began with the 1963 Amendments. While nearly all the changes emphasized expansion and not flexibility, some progress toward serving new populations in different settings for alternative purposes can still be seen. However, the National Committee on Secondary Education in 1967 concluded that modification of traditional definitions and requirements within vocational education was needed to allow for expansion and variation (1967).

The legal definition of vocational education, which determines how the federal government desires its monies to be spent, is undergoing the same gradual evolution. The legal definition, which stresses the need to develop pools of human resources, usually deemphasizes other aspects of the definition. For many years, the legal definition of vocational education was very narrow, forcing programs to be monolithic in character and uniform in structure. The new legal definition growing from the 1968 Vocational Education Amendments, however, recognized "new" and "emerging" occupations, in addition to the "recognized occupations" required by the definition that existed as late as 1963. It is to be noted, however, that the legal definition still emphasized (1) vocational education primarily as a high school and post-high school function, (2) useful and productive activities,

(3) the expectation that graduates would enter employment related to their area of training, (4) the "tracking" of those who elect vocational education, and (5) the institutionalization of teacher experience, schoo equipment, and school facilities (Thompson 1973).

The progress toward a broader definition of vocational education continued through the Education Amendments of 1976, which made possible the use of funds for teaching consumer-oriented content in home economics programs and identified new populations for special funding attention. In general, the 1976 Amendments moved toward flexibility in creating alternatives for emerging occupational specializations. Furthermore, vocational education policy related to energy is also expressed in the Education Amendments of 1976 (P.L. 94-482). Energy concerns are dealt with in Sections 120 and 123, the Energy Section, and in the Supportive Service Section where grants can be made for research, and for exemplary and pilot programs. (See appendix B for more complete citations of the energy-related sections of P.L. 94-482.) According to Section 123, funds available under Section 120 of P.L. 94-482 may also be used to make grants to postsecondary institutions to carry out programs for training those individuals needed for installation of related applications of solar energy. The critical point, however, is that Section 120 is primarily for training in the coal mining industry. Further, funding is specifically for postsecondary programs. Therefore, vocational education opportunities at the secondary level must presently grow from the limited options offered under the program improvement and supportive services clauses of the Act.

In light of these historical developments, this author has posed the following operational definition of energy-related vocational education.

> Vocational energy education is education for work related to increasing the energy supply, to utilizing energy resources efficiently, or to conserving energy. Its purpose is to help students develop related skills, abilities, understandings, attitudes, work habits, and appreciations. It is taught in all vocational education programs at all levels.

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