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# Solar Thermal Power Generation

## Quarterly Update October-December 1977

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# SOLAR THERMAL POWER GENERATION

## A BIBLIOGRAPHY WITH ABSTRACTS

QUARTERLY UPDATE OCTOBER-DECEMBER 1977

PREPARED BY THE

ENERGY INFORMATION PROGRAM

of the

TECHNOLOGY APPLICATION CENTER

APRIL 1978

THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO

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# INTRODUCTION

As the information explosion in solar energy gains momentum, the bibliography reflects this growth. Sections 10,000 Energy Overviews; 12,000 Economics and Law; 16,000 Wind Conversion; and 19,000 Hydrogen Production and Other contain the most documents for a quarterly update in that particular section since our first bibliography was compiled in 1974. Sections that show moderate growth are 13,000 Thermal Power and 15,000 Ocean Thermal Differential. The total number of citations (495) for this issue is the largest of any single quarterly update. We appreciate comments and suggestions the reader may have that would improve the utilization of this bibliography consequently resulting in a more reader-responsive publication.

Geoffrey C. Bell
Technical Editor

## GUIDE TO USE OF THIS PUBLICATION

A number of features have been incorporated to help the reader use this document. They consist of:

-- A TABLE OF CONTENTS listing general categories of subject content and indexes. More specific coverage by subject title/keyword and author is available through the appropriate index.

-- CITATION NUMBERS assigned to each reference. These numbers, with the prefix omitted, are used instead of page numbers to identify references in the various indexes. They are also used as TAC indentifier numbers when dealing with document orders; so please use the entire (prefix included) citation number when corresponding with TAC regarding a reference. An open ended numbering system facilitates easy incorporation of subsequent updates into the organization of the material. In this system, numbers assigned to new citations in each category will follow directly the last assigned numbers in the previous publication. The citation number of the last reference on each page appears on the upper right-hand corner of that page to facilitate quick location of a specific term.

-- A REFERENCE FORMAT containing the TAC citation number, title of reference, author, corporate affiliation, reference source, contract or grant number, abstract and keywords. The reference source tells, to the best of our knowledge, where the reference came from. If from a periodical, the reference source contains the report number assigned by the issuing agency, number of pages and date.

-- An INDEX OF AUTHORS alphabetized by author's last name. A reference's author is followed by the reference's citation number. For multiple authors, each author is listed in the index.

-- An INDEX OF PERMUTED/KEYWORDS affords access through major words in the title and through an assigned set of keywords for each citation. A reference's title is followed by the reference's citation number. In the indexes, all the words pertaining to a reference are permuted alphabetically. Thus, the citation number for a reference appears as many times as there are major title words or keywords for that reference. The permuted words run down the center of an index page. The rest of the title or keywords appear adjacent to a permuted word. Since a title or set of keywords is allowed only one line per permuted word the beginning, the end, or both ends of a title or set of keywords may be cut off; or, if space permits, it will be continued at the opposite side of the page until it runs back into itself. A # indicates the end of a title or set of keywords while a / indicates where a title or set of keywords has been cut off within a line.

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# 10,000 ENERGY OVERVIEWS

ST77 10143 A QUALITATIVE STUDY OF CONSUMER ATTITUDES TOWARD ENERGY CONSERVATION

(Bee Angell and Associates, Inc., Chicago, IL), Nov 1975, EDB-77:093335, PB-254564, Avail:NTIS PC$4.50

The findings represent the qualitative assessment of attitudes that were explored and obtained in different regions of the country from a broadly-based cross-section of the population. The intent of the project was not to suggest either a definitive or an exhaustive data base. Rather, the task was viewed as directional. As such, its intent was to provide stimuli for the formulation of hypotheses based upon the exploration of attitudes, first-hand, by utilizing valid and reliable qualitative research techniques.

(ENVIRONMENT, FUEL-CELLS, PUBLIC-RELATIONS)

ST77 10144 ASHRAE TRANSACTIONS, VOLUME 82, PART 2: PROCEEDINGS OF THE ASHRAE ANNUAL MEETING, 1976

Anon, (ASHRAE, New York, NY), ASHRAE Trans, V 82:633, pt 2, 1976, Proc of Annu Meet, Seattle, WA, June 27-July 1, 1976

No abstract available

(AIR-CONDITIONING, REFRIGERATION, HEATING, VENTILATION)

ST77 10145 BALANCED PROGRAM PLAN. VOLUME 8. ANALYSIS FOR BIOMEDICAL AND ENVIRONMENTAL RESEARCH

(California Univ., Berkeley, CA), V 8, Oct 1976, ERDA-116(vol. 8), EDB-77:105419

The Balanced Program Planning (BPP) effort was initiated by the Division of Biomedical and Environmental Research (DBER) of ERDA to identify and develop a research plan for investigating the environmental impacts associated with energy technologies being developed by ERDA. "Environmental impacts" is taken here to refer to pollutants, health effects, ecological effects, socioeconomic and long-term impacts. As defined for the BPP effort, solar energy includes tidal and hydroelectric as well as the more usual categories of solar thermal conversion, photovoltaic conversion, wind energy conversion, ocean thermal conversion, bioconversion, and heating and cooling of buildings. The tides are, of course, more properly considered lunar. Narrative descriptions of the solar energy conversion categories are given. Included are discussions of the technological approaches, planned timescales for development, and potential environmental concerns. The program units that are proposed as the basis of the DBER Balanced Program Plan are given. In the interests of brevity and credibility only program units for those environmental effects that are related to technologies under active development, and that are judged to be appropriate for DBER supported research are included. Program units for research on what are generally considered to be the positive environmental impacts of solar energy, the avoidance of the well-known deleterious impacts of existing non-solar sources of energy, are not included. Research on such positive (i.e., avoidance of negative) impacts of solar energy is not included because the assessment of the negative impacts to be avoided by the use of solar technologies must be researched individually for each of the non-solar energy technologies. Instead, the assessment of the impacts of the solar energy alternative are given so that the benefits of energy scenarios including solar technologies can be correctly assessed in cross-technology studies.

(ENVIRONMENTAL-IMPACTS, OCEAN-THERMAL, PHOTOVOLTAIC, HEATING, THERMAL-POWER, TIDAL, UNITED-STATES, WIND)

ST77 10146 COMPARING NEW TECHNOLOGIES FOR THE ELECTRIC UTILITIES

(ERDA, Washington, DC), 257 p., Sept 12, 1976, ERDA-76-141(Dr),

It is probable that the nation's single greatest investment in energy in the future will be in the area of electricity generation, transmission, and distribution. The transition from research to practical electric utility use results from investment decisions of businesses to build new energy sources. ERDA's decision to include various technologies in its research program will be based on consideration of the total societal costs and benefits. This study has concentrated on the choices that would be faced by the users of the technologies - the electric utilities. Given the magnitude of electric utility related R, D and D and ERDA's central role, an overall strategic framework is required to set direction and guide investments. In developing a framework for evaluating the potential contributions of new technologies, the study identifies six concerns to the electric power sector: wide range of possible growth rates of electric generating capacity; availability of capital; rate of fuel price escalation; availability of oil to utilities; imposition of stricter environmental constraints; and potential political

constraints on major technical options. Base-load technologies were considered for conventional, advanced fossil, nuclear, geothermal, solar, and fusion systems.

(COMPARATIVE-EVALUATIONS, ALTERNATIVE-RESOURCES)

ST77 10147 CONSERVATION GETS A STRONG PLAY

Electr. World, V 187:42-43, N7, Apr 1, 1977, EDB-77:088550

At a recent seminar on pending energy conservation legislation and regulations conducted by the American Society of Heating, Refrigeration and Air Conditioning Engineers, three things were clear: much thought will continue to be given to the area of financial incentives by the federal government for conservation measures and for solar heating and cooling / a model energy conservation code has been developed and is "out for review" / and ASHRAE's proposed energy-conservation standard for existing buildings is moving steadily to completion and acceptance. The new House of Representatives has introduced 14 bills to allow tax credits to homeowners and businessmen for design, structural, and equipment changes dictated by the energy shortage. Six bills have been introduced in the Senate calling for energy tax credits of various sorts. At least four of these bills in the House and Senate deal with installation of solar heating and cooling equipment. These bills run the gamut of financial mechanisms, with direct tax credits for solar users probably the most visible. Proposals of loan guarantees and other financial incentives are contained in several of these bills even though federal and state government incentive options for solar heating and cooling of buildings ready by May, 1977. The model code groups have developed code provisions reflecting energy conservation standards. A comprehensive program of the code (the ERDA-sponsored program involving the National Conference of States on Building Codes and Standards) is out for comment. A review of the 90-75 Standard reveals that it conflicts with existing legislation, especially in the areas of insulation and ventilation.

(CONSERVATION, FINANCIAL INCENTIVES, GOVERNMENT POLICIES, LEGISLATION, REGULATIONS)

ST77 10148 CONTENT ANALYSIS AND INTERPRETATION OF FIVE REGIONAL HEARINGS TO DETERMINE CURRENT STATUS AND FUTURE NEEDS OF IN-SCHOOL ENERGY EDUCATION

(Educational Testing Service, Princeton, NJ), 45 p., Aug 1976, FEA/D-77/162, PB-266 260/9WE

Hearings were conducted for the Federal Energy Administration by the contractor in Atlanta, Boston, Chicago, Dallas and Portland, Oregon with a total of 245 participants. Results indicate the need for development of proper attitudes toward energy consumption and the need for a scientific understanding of energy principles and energy conservation through classroom programs at all levels. It is recommended that energy education goals, with curriculum programs and materials, and adequate teacher training programs, be developed with an interdisciplinary approach.

(CURRICULUM-PROGRAMS, INTERDISCIPLINARY-APPROACH)

ST77 10149 CREATING ENERGY CHOICES FOR THE WESTERN REGION

(ERDA, Washington, DC), 36 p., 1976, CONF-760597, ERDA-76/1(PM-3), EDB-77:067963

Shortly after the publication of ERDA-48, A National Plan for Energy Research, Development and Demonstration: Creating Energy Choices for the Future, the Energy Research and Development Administration held a series of regional meetings to provide the public with an opportunity to exchange information and opinions about Federal energy planning. To obtain similar evaluation of and comments on ERDA-76-1, ERDA is holding a second series of regional meetings. The need for these meetings is based on the belief that the ultimate decisions about the level of energy to be consumed in the country and the technologies to be employed will be made by the nation as a whole. This iterative approach allows the public, industry, universities, and state and local government to voice their opinions about the nation's energy policy. In May 1976, ERDA, in conjunction with the Western Governors' Regional Energy Policy Office, sponsored hearings in Denver, Colorado. The states involved were Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Utah, Arizona, New Mexico, and Nevada. The agenda, which was drawn up to reflect the major concerns of this region, focused on energy conservation, synthetic and fossil fuels technology development and commercialization, environmental and socio-economic impacts of energy resource development, solar and geothermal energy, and intensive electrification. A number of issues were defined and discussed in each of these areas, and a range of important, and often conflicting, opinions were expressed on energy planning, funding priorities, and environmental impacts. These opinions and viewpoints are summarized in this document.

(REGIONAL MEETINGS, TECHNOLOGY-DEVELOPMENT, COMMERCIALIZATION, ENVIRONMENTAL, SOCIO-ECONOMIC-IMPACTS)

ST77 10150 ENERGY FACT BOOK 1976. CHAPTERS 1 THROUGH 21. TECHNICAL REPORT

(Tetra Tech, Inc., Arlington, VA), July 15, 1976, EDB-77:081870, AD-A--028284
Avail:NTIS
The Energy Fact Book - 1976 summarizes the present U.S. energy situation / energy R and D legislation / federal government energy R and D / and foreign energy R and D. It includes a brief description of the various processes and developments related to hydrocarbon fuels, synthetic fuels, non-hydrocarbon energy sources and energy conservation.

(ENERGY-SOURCES, GEOTHERMAL, HYDROGEN, LEGISLATION, RESEARCH-PROGRAMS)

ST77 10151 ENERGY FACT BOOK, 1977 - ENERGY SOURCES, TECHNOLOGY, AND CONSERVATION

(Tetra Tech, Inc., Arlington, VA), 437 p., N00014-76-C0239, TETRAT-A-642-77-306, AD-A038802, N77-29624
The Energy Fact Book-1977 summarizes the present U.S. energy situation; energy R and D legislation; federal government energy R and D; and international energy R and D. It includes a brief description of the various processes and developments related to hydrocarbon fuels, synthetic fuels, non-hydrocarbon energy sources and energy conservation.

(ENERGY POLICY, ENERGY-TECHNOLOGY, REGULATIONS, GEOTHERMAL)

ST77 10152 ENERGY IN DENMARK 1990-2005

(International Federation of Institutes for Advanced Study, Copenhagen, Denmark), Sept 1976, INIS-MF--3366, EDB-77:082031, US sales only
Avail:NTIS
Denmarks energy situation is investigated. It is shown that it is possible to reduce the rate of growth of energy consumption from a historic rate of 3-5 percent per year to under 1.5 percent per year within the next fifteen years, and that this can be done without harm to the general economic development. It is said that on the contrary, a reduced growth in energy consumption would be of considerable advantage to the economy also with regard to ensuring supplies and protecting the environment.

(ECONOMICS, CONSUMPTION, ENERGY POLICY, FORECASTING)

ST77 10153 ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY QUARTERLY REPORT, OCT-DEC 1976

(Applied Physics Lab., Johns Hopkins Univ., Laurel, MD), 37 p., Sponsored by ERDA, N00017-72-0-4401, APL/JHU/EQR/76-4, AD-A038096, N77-29623
This volume contains a record of the activities of the Applied Physics Laboratory in the development of energy sources and energy storage methods. The larger number of articles describe APL activities that assist the Planning Office of the Division of Geothermal Energy (DGE) of ERDA. Efforts in this field are concentrated on resource assessment and utilization in DGE region 5 (the states east of the Rocky Mountains, excluding Texas and Louisiana). The other sections describe three efforts (1) design of a community annual storage energy system, (2) developmental work on polycrystalline silicon solar cells, and (3) design and experimental work on a system to use ocean thermal energy.

(ENERGY POLICY, STORAGE, SOLAR-CELLS, GEOTHERMAL, IOWA, KANSAS, MINNESOTA, MISSOURI, NEBRASKA, NORTH-DAKOTA, OCEAN-ΔT)

ST77 10154 ENERGY RESEARCH AND DEVELOPMENT

(New Zealand Energy Research and Development Committee, Auckland, New Zealand), 15 p., 1976, EDB-77:067964, NP-21435
The New Zealand Energy Research and Development Committee was formed in 1974 to promote and support energy R and D in government departments, universities, research associations, and the private sector. The Committee established a series of priorities to assist it in deciding on projects that should be funded. A consortium has undertaken a study of the Rakaia River to determine the potential of the river for power generation and for irrigation. Four contracts have been let on investigations of solar energy, and two contracts have been let on the potential of wind energy development. Energy demand from the meat, pulp, and paper industries is reported. The Committee is concerned with energy policy and with a small group conducting detailed studies of various energy scenarios. The Committee administers the energy research that is conducted under the Joint US/NZ Agreement for Scientific and Technological Cooperation; several joint projects are under-way, mainly on geothermal energy.

(NEW-ZEALAND, IRRIGATION, WIND, ENERGY POLICY, GEOTHERMAL)

ST77 10155 ENERGY: WHERE WE'LL BE BY THE YEAR 2000

Commer. Am., V 2:4-7, N10, May 9, 1977, EDB-77:106608

The Department of Commerce's Office of Energy Programs predicts an energy scenario for the year 2000. The study sees a continued heavy reliance on imported oil despite stronger public support than some other experts expect for President Carter's energy-saving proposals or such other measures as are adopted. The forecast presents what is considered to be the most likely U.S. energy picture (supply/demand balances) for the years in question. Second, the forecast contains detailed sector breakdowns of both fuel sources and consumption sectors (residential, commercial, industrial, transportation, and electrical generation). These breakdowns, moreover, take into account the fuel specificity for each energy use, and the fact that energy forms are not perfectly interchangeable. Third, the forecast is carried out to the year 2000. Extending the forecast to this point helps to demonstrate the impact that sustained implementation of current energy policies will have on the nation's energy future. Finally, the forecast takes special account of the diminishing U.S. fossil fuel resource base. Oil and gas particularly are finite and depletable and, towards the end of the century, will be increasingly costly and difficult to recover. This latter factor has not always been recognized in forecasts of this type. After a review of all energy sources and energy conservation measures, the forecast concludes that no single energy source can be excluded. The key finding is that, even with the lower rate of energy use projected in the forecast, domestic energy supply (especially oil and gas) will not keep pace and reliance on foriegn imports will continue and even increase.

(ENERGY POLICY, FORECASTING, MARKET, UNITED-STATES)

ST77 10156 ENERGY: WHO'S DOING WHAT - LIST OF 200 GROUPS COMPILED BY NATIONAL PARK AND RECREATION ASSOCIATION

(National Recreation and Park Association, Arlington, VA), Jan 1977, EDB-77:081873, NP-21719

Approximately 200 U.S. citizen groups, companies, and nonprofit agencies that are involved in some type of energy work are listed. The list was compiled as a service to interpreters and naturalists in parks around the nation participating in an experimental effort to encourage the use of energy conservation themes in park programs (the Park Project on Energy Interpretation). The organizations included were selected because they have programs or facilities that may be of educational value to citizens. They embrace a variety of political and philosophical solutions to energy problems. For example, pro-nuclear as well as anti-nuclear groups, and high-technology-oriented corporations and low-technology, self-sufficient approaches are included. The compilation is arranged alphabetically, by state, although all states are not represented.

(DATA-COMPILATION, ENVIRONMENTAL-IMPACTS, GEOTHERMAL, LEGAL-ASPECTS, PUBLIC-RELATIONS, UNITED-STATES, WIND)

ST77 10157 INTERNATIONAL ENERGY AGENCY BACKGROUND AND CURRENT ACTIVITIES

(ERDA, Washington, DC), 49 p., Dec 1976, ERDA-77-21,

The Office of International Affairs of the Energy Research and Development Administration (ERDA) is planning to issue periodic status reports covering all major continuing international activities in which ERDA is involved. A series of background documents on the international agencies and organizations conducting those activities is being prepared to provide a framework for the status reports. This background document highlights the energy research and development activities currently being conducted under the auspices of the International Energy Agency in which ERDA, the Nuclear Regulatory Commission, the U.S. Bureau fo Mines and the U.S. Geological Survey of the Department of the Interior, and the Environmental Protection Agency are participating. This document outlines the background, objectives, and organizational structure of the International Energy Agency and then briefly describes the history, objectives, scope, current status, and other pertinent data on its 15 energy research and development working parties and the cooperative projects they are conducting. Future reports will update the status of ongoing projects and provide information on proposed new energy research and development activities.

(OBJECTIVES, ORGANIZATIONAL STRUCTURE, SCOPE, COOPERATIVE PROJECTS)

ST77 10158 RESEARCH AND ADVANCED DEVELOPMENT - 1977

(JPL, California, Inst. of Tech., Pasadena, CA), NASA-CR-152689, 114 p., JPL Basic Research Review, JPL-PUBL-77-5, NAS7-100, N77-23894/7SL

Current status, projected goals, and results of 49 research and advanced development programs at the Jet Propulsion Laboratory are reported in abstract form. Areas of investigation include: Aerodynamics and Fluid Mechanics, Applied Mathematics and Computer Sciences, Environment Protection, Materials Science, Propulsion, Electric and

Solar Power, Guidance and Navigation, Communication and Information Sciences, General Physics, and Chemistry.

(TECHNOLOGY-ASSESSMENT, RESEARCH-PROJECTS)

ST77 10159 LONG-RANGE FORECASTING PROPERTIES OF STATE-OF-THE-ART MODELS OF DEMAND FOR ELECTRIC ENERGY. VOLUME I. Final Report

(Charles River Associates, Inc., Cambridge, MA), 452 p., Dec 1976, EPRI-EA-221(V.1)
One concern of the Electric Power Research Institute is the development and application of improved methods of forecasting and analysis of energy demand, especially of the electricity demand. This report communicates the results of a highly focused and selective study of the state-of-the-art in mathematical models of the demand of electric energy, with emphasis on econometric models. The main focus of the study is an appraisal of the performance of eight (four residential, one commercial, and three industrial) econometric models. Related research is directed toward compilation of an annotated bibliography of extant models of electricity consumption; presented in a separate volume. Following the introduction and summary, Chapter 2 identifies and explains the models tested, Chapters 3 through 10 synthesize the evaluations of the individual models and identify the models that show promise for further development. Chapter 12 discusses the implications of the results for forecasting, and recommendations for EPRI development of forecasting models are made. Residential models by Anderson; Halvorsen; Mount, Chapman, and Tyrrell; and Houthakker, Verleger, and Sheehan were tested. The commercial model by Mount, Chapman, and Tyrrell was tested. Industrial models by Mount, Chapman, and Tyrrell; Fisher and Kaysen; and Anderson were tested.

ST77 10160 LONG-RANGE FORECASTING PROPERTIES OF STATE-OF-THE-ART MODELS OF DEMAND FOR ELECTRIC ENERGY. VOLUME II. ANNOTATED BIBLIOGRAPHY

(Charles River Associates, Inc., Cambridge, MA), 44 p., Dec 1976, EPRI-EA-221(V.2)
This bibliography has been collected and annotated for the purpose of informing interested load forecasters, analysts, and other researchers of the content of extant research on electricity demand. The purpose of the bibliography is to survey the literature rather than to review individual studies in depth; therefore, only outlining major elements of methodology and major conclusions. The literature search was completed in 1974. Three major selection criteria were employed. First, the bibliography focused on studies that are not explicitly short run (less than five years) in orientation. Second, it was decided to exclude large-scale energy models. A number of energy models include an electricity sector. However, the electricity-consumption submodels incorporated in the energy models tend to be highly summary in nature and not well suited to the needs of the practicing forecaster. Third, the bibliography is largely limited to published materials that are available to all electricity demand researchers. Proprietary models and forecasting studies conducted by individual utilities or state public utility commissions were not reviewed. (For illustrative purposes, one utility forecast was included.) Fifty-two items are included in the annotated bibliography; an additional reference list of 35 items is also included.

ST77 10161 MID-TERM AND LONG TERM ENERGY TRENDS - ANNUAL REPORT, 1975-1976

(Federal Energy Administration, Washington, DC), 164 p., PB-264740/2, FEA/F-77/089, N77-27559
Avail:NTIS
Positive energy accomplishments for the nation and her citizens in fiscal year 1976 are described. The mid-term outlook and long-term trends for the various energy sources are noted. A list of contracts awarded and a summary of information-gathering activities are included.

(ENERGY POLICY, REGULATIONS, LONG-TERM TRENDS, CONTRACTS)

ST77 10162 NATIONAL ENERGY EXTENSION SERVICE ACT OF 1976 - FROM COMMITTEE OF THE WHOLE HOUSE

(Committee on Science and Technology, U.S. House), Washington GPO Rept. Together with Additional Views to Accompany H.R. 13676 from Comm. on Sci. and Technol., 94th Congr., 2D Sess., 88 p., July 19, 1976, H-REPT-94-1348 GPO-57-006, N77-77916
No abstract available

(CONGRESSIONAL-REPORTS, ENERGY POLICY, ENERGY-TECHNOLOGY)

ST77 10163 NEW OPTIONS IN ENERGY TECHNOLOGY; PROCEEDINGS OF THE CONFERENCE, SAN FRANCISCO, CA, AUGUST 2-4, 1977

152 p., 1977, Conference Sponsored by the American Institute of Aeronautics and Astronautics, Edison Electric Institute, and Institute of Electrical and Electronics Engineers, New York, American Institute of Aeronautics and Astronautics, Inc., For Individual Items See A77-41552 to A77-41570, A77-41551, Members $20, Nonmembers $27.50

The contributions comprise an overview of the present status and developmental outlook of nonconventional and prospective energy sources. Practical advances bringing commercial implementation nearer, and cost analysis, are emphasized. Satellite solar power, ground-based solar power, hydrogen energy storage, energy storage in compressed air reservoirs, thermal energy storage, MHD systems combined with combustion of fossil fuels (particularly coal), fuel cells, electrochemical storage batteries, laser-induced fusion, Tokamak and other fusion reactors, wind power, ocean thermal energy conversion, and improved energy management in fossil fuel (coal, petroleum) systems are discussed in papers dedicated to each of those topics. Nitrogen oxide emissions control and a high-temperature helium gas-cooled reactor combined with a closed-cycle gas turbine are also discussed.

(ENERGY-TECHNOLOGY, TECHNOLOGY-ASSESSMENT, FUEL-CELLS, STORAGE, HYDROGEN)

ST77 10164 NEW ZEALAND ENERGY RESEARCH AND DEVELOPMENT COMMITTEE

(New Zealand Energy Research and Development Committee, Auckland, New Zealand), June 1975, CONF-7505135-1, EDB-77:100475

This publication, identified as Newsletter No. 2 contains a transcript of the speech by Dr. C.J. Maiden, Chairman, NZERDC, to the 2nd New Zealand Energy Conference, May 22-24, 1975 in which he expressed his views to support a coordinated energy policy. Because of New Zealand's diverse resource base, many future configurations are possible, he says / what is needed are the social, economic, and environmental consequences relevant to each configuration. This task could be realized through comprehensive modeling or using the scenario approach. He then reviewed some work accomplished at a scenario workshop of the ERDC at Auckland earlier / a large number of ideas for scenarios were developed, covering a side range of growth (high, medium, and low) in energy supply and demand. The publication then reviewed data on the Joint U.S./New Zealand Agreement for Scientific and Technological Cooperation. Areas covered in information exchange include: geothermal and energy modeling, oil from coal, heat pumps, geothermal brine injection, motor travel, solar energy research, wind energy, and energy from waste.

(ECONOMICS, ENERGY MODELS, ENERGY POLICY, ENVIRONMENTAL-IMPACTS, FORECASTING, GEOTHERMAL, SOCIAL-IMPACT, TECHNOLOGY-TRANSFER, WIND)

ST77 10165 1976 ENERGY FACT BOOK

(Tetra Tech, Inc., Arlington, VA), 1975, AD-A--029331, EDB-77:088540
Avail:NTIS

The shortage of petroleum products recently experienced made most Americans aware of the fact that the energy resources of this nation are not unlimited. What may not yet be apparent to the casual observer is that the total energy consumption of our nation must continue to increase even if we establish a successful conservation program, and that we are faced with a frightening spectrum of implications associated with such an increase in total energy consumption on the one hand, and the conservation programs we must institute, on the other. This energy fact book is a guide to some of the current and potential alternative sources of energy that can be exploited in planning for a crisis-free energy equilibrium.

(ENERGY-EQUILIBRIUM, FORECASTING, UNITED-STATES)

ST77 10166 1976 ENERGY RESEARCH AND DEVELOPMENT INVENTORY FOR THE STATE OF MISSOURI

(Missouri Energy Agency, Jefferson City, MO), 1976, EDB-77:093414

The Missouri Energy Agency has compiled an inventory of 150 statewide R and D projects involved with energy as a first step in opening communications channels between groups involved. The projects will be kept informed of research activities and funding opportunities. Most funds originate with ERDA and the National Science Foundation, with contributions from the Electric Power Research Institute, Gas Research Institute, et al. Projects are listed in broad categories of agriculture, electric energy analysis and utilization studies, fossil fuel, nuclear energy, solar, wind, miscellaneous, and pending. Listings include the organization, names of principal investigators, title of project, funding source, dollar amounts, and duration of project. Programs in electric, fossil fuels, and energy analysis and utilization studies are emphasized. Most projects, with the exception of those pending, are scheduled to be completed before 1980.

(FINANCING, RESEARCH-PROGRAMS, WIND)

ST77 10167 1976 NATIONAL ENERGY OUTLOOK. EXECUTIVE SUMMARY

(FEA, Washington, DC), 1976, FEA/N--76/100, EDB-77:106578, GPO PC$0.60
No abstract available

(ENERGY POLICY, FORECASTING, LEGISLATION, PROJECT-INDEPENDENCE)

ST77 10168 POLAR ENERGY RESOURCES POTENTIAL. REPORT PREPARED FOR THE COMMITTEE ON SCIENCE AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, SECOND SESSION BY THE CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS

(Committee on Science and Technology, Washington, DC), 1976, GPO, EDB-77:106518
The study covers both Antarctic and Arctic energy resources including oil, coal, natural gas, hydroelectric power, geothermal energy, oil shale, uranium, solar energy, and wind power. The environment, geology, topography, climate, and weather are also treated. Consideration is given to the international relations involved in energy resource exploitation in both polar regions, and the technologies necessary to develop polar resources are discussed. The potential resources in each area are described. Resource potentials south of 60 degrees in Antarctica and north of 60 degrees in the Arctic are summarized.

(ALASKA, ANTARCTIC-REGIONS, ARCTIC-REGIONS, CANADA, ENVIRONMENTAL-IMPACTS, FINLAND, FORECASTING, GEOTHERMAL, GREENLAND, ICELAND, INTERNATIONAL, SWEDEN, USSR, WIND)

ST77 10169 PUBLIC WORKS FOR WATER AND POWER DEVELOPMENT AND ENERGY RESEARCH APPROPRIATION BILL, 1978. PART 5 - US ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION (FUEL CYCLE RESEARCH AND DEVELOPMENT AND URANIUM ENRICHMENT ACTIVITIES, LIQUID METAL FAST BREEDER REACTOR, SOLAR GEOTHERMAL AND ADVANCED ENERGY SYSTEMS, STATEMENT OF THE ADMINISTRATOR)

(Committee on Appropriations, U.S. House), 972 p., Washington GPO Hearings Before a Subcomm. of the Comm. on Appropriations, 95th Congr., 1st Sess., Mar 9, 1977, GPO-86-101, N77-82262
Avail:Comm. on Appropriations
No abstract available

(CONGRESSIONAL-REPORTS, ENERGY POLICY)

ST77 10170 RESULTS OF AN OPINION SURVEY ON THE 1977 BUDGET PROPOSAL OF THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

(Committee on Interior and Insular Affairs, U.S. Senate), 72 p., Washington GPO Survey by ERDA Printed by Comm. on Interior and Insular Affairs, 94th Congr., 2D Sess., Mar 1976, GPO-68-272, N77-78927
Avail:Comm. on Interior and Insular Affairs
No abstract available

(CONGRESSIONAL-REPORTS, ENERGY-TECHNOLOGY, ENVIRONMENT, GEOTHERMAL)

ST77 10171 STRATEGIC PLANS FOR ENERGY RESEARCH AND DEVELOPMENT, FY 1976-FY 1981

(California Univ., Berkeley, CA), Sept 1976, TID-27291, EDB-77:067965
This guidance charts the course for the future direction for the Lawrence Berkeley Laboratory (LBL). ERDA approves the following institutional aspects for LBL: (1) LBL would maintain its strong capability in present basic science programs, but redirect and expand its activities on a selective basis into applied research and technology-developed programs with a goal of achieving a level of activity in these new programs comparable to those of the basic program / and (2) these applied programs would provide a basis of support for ERDA project management teams managing engineering development and demonstration projects. Three important actions that the Lawrence Berkeley Laboratory must undertake as it evolves into this new role are delineated, namely: to collaborate with engineering colleges and various social science departments at the Univ. of California Berkeley campus / increase its contacts with industry, utilities, and state governments / and participate with the San Francisco ERDA Operations Office and ERDA Program Offices in project management responsibilities. Developmental work being performed at LBL is described for the various areas and disciplines.

(ENVIRONMENT, GEOTHERMAL, RESEARCH-PROGRAMS)

ST77 10172 SYNOPSIS OF PROCEEDINGS: ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION PUBLIC MEETING, "THE MIDWEST PERSPECTIVE". CREATING ENERGY CHOICES FOR THE FUTURE

(ERDA, Washington, DC), 1976, ERDA-76-1(PM-4), EDB-77:106523

Shortly after the publication of ERDA-48, a national plan for energy research development and demonstration: Creating Energy Choices for the Future, the Energy Research and Development Administration (ERDA) held two regional meetings to provide the public with an opportunity to exchange information and opinions about federal energy RD and D planning. To obtain similar evaluation of and comments on ERDA 76-1 (an updated version of the plan), ERDA held a second series of regional meetings. The need for these meetings is based on the belief that the nation as a whole will make the ultimate decisions about the amount of energy to be consumed in the country and the technologies to be employed in the nation's energy future. At this meeting in Chicago, Illinois, the states involved were Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, West Virginia, and Wisconsin. The agenda, drawn up with the aid of a regional steering committee to reflect the major concerns of this region, focused on the nuclear fuel cycle / coal and synthetic fuels utilization / biological and environmental risks / solar, geothermal, and advanced energy systems / energy conservation / and government, industry, and the public interest. Numerous issues were defined and discussed in each of these areas, and a range of coordination. These opinions and viewpoints are summarized.

(ENERGY POLICY, ENVIRONMENTAL-IMPACTS, FORECASTING, GEOTHERMAL, SOCIO-ECONOMIC-FACTORS, TECHNOLOGY-TRANSFER)

ST77 10173 URGENT NEED FOR ENERGY POLICIES

Petroleum Economist, V 44:82-83, N3, Mar 1977

In its World Energy Outlook 1977 Report, the Organization for Economic Cooperation and Development makes several proposals for energy policies. Measures to increase energy production should include - elimination of price controls on crude oil and natural gas, accelerated granting of oil leases and production licences, moderation of environmental constraints on new energy development, incentives for secondary and tertiary oil recovery techniques, active promotion of coal utilization by removing demand constraints and developing international trade, and government support for project development in solar energy, coal conversion, and extraction techniques from shale oil and tar sands. With more vigorous energy policy measures, the U.S. could reduce net oil imports from 485 million tons expected in 1985 to 215 million tons. The main doubt about this potential arises from the pressure to reduce or to postpone nuclear programs.

(ENVIRONMENTAL-CONSTRAINTS, INCENTIVES, INTERNATIONAL)

ST77 10174 US NAVY ENERGY R AND D PROGRESS REPORT, OCT 1976-MAR 1977

(Tetra Tech, Inc., Arlington, VA), 141 p., N00014-76-C-0239, TT-A-872-77-316, AD-A03-9546, N77-30623

This U.S. Navy Energy R and D Progress Report summarizes the progress and accomplishments of the Navy Energy R and D Program for the period from October 1976 through March 1977. This report complements the U.S. Navy Energy R and D Program Plan, FY 1977-FY 1982, published in October 1976.

(CONSERVATION, MANAGEMENT-METHODS, GEOTHERMAL)

ST77 10175 WHICH STRATEGY FOR ENERGY

Petroleum Economist, V 43:450-451, N12, Dec 1976

Western governments must begin to think about a long term energy policy. A recent study in foreign affairs by Amory B. Lovins merits careful consideration. It suggests that much greater reliance should be placed on energy economy and efficiency in use through the avoidance of waste, greater use of co-generation, and changes in habit leading to greater energy conservation. Lovins' second main suggestion is that greater reliance should be placed on the unconventional sources that are largely ignored in current long term projections. They include solar heating and cooling and new techniques for the conversion of agricultural, forestry and urban wastes into methane and other fuels. These options, however, are not indefinitely available. Every delay implies a further capital commitment and reduces the possibility of exercising these options.

(LONG-TERM, CONSERVATION, CAPITAL-COMMITMENT, COMPARATIVE-EVALUATIONS, ECONOMICS)

ST77 10176 FISSION ENERGY AND OTHER SOURCES OF ENERGY

Alfven, H., (Royal Institute of Technology, Stockholm, Sweden), Facing Up to Nuclear Power, A contribution to the Debate on the Risks and Potentialities of the Large-Scale use of Nuclear Energy, Francis, J.M., (Heriot-Watt Univ., Edinburgh, United Kingdom), Abrecht, P., eds., Saint Andrew Press, Edinburgh, 1976, EDB-77:066231

The disadvantages associated with fission energy (plutonium health hazards, radioactive waste disposal, use of uranium and plutonium as nuclear weapons) are considered. The use of fossil fuels, fusion energy, solar energy and geothermal energy as serious alternatives are mentioned and it is remarked that a large amount of complete work and much money have been invested in fission energy whereas modest efforts have been made to develop other forms of energy. Environmental and sociological aspects are considered.

(ECONOMICS, ENERGY POLICY, ENVIRONMENT, GEOTHERMAL, PUBLIC-RELATIONS, RESEARCH-PROGRAMS)

ST77 10177 OBJECTIVE VIEW OF TOMORROW'S ENERGY SUPPLY

Anderson, R.J., (Battelle Memorial Inst., Columbus, OH), ASHRAE J., V 19:42-43, N3, Mar 1977, EDB-77:106606

Reduced energy consumption is the only way to buy the time needed for developing new energy sources and avoiding a final energy crisis. This means that Americans must change their attitudes and accept the reality of diminishing conventional sources. The search for substitutes means finding new ways of providing the energy that account for 94 percent of the current use. A realistic look at supplies of petroleum, natural gas, and coal is reassuring only until the end of this century. Costly conversions to liquefied gases must be made, but no full-scale plants are operating yet. Nuclear energy has been hampered by high costs, delays, and public resistance to such an extent that, even with compromises, it can not bear more than 10 percent of the energy share by the year 2000. Public confidence in the ability of science to solve problems results in an unrealistic belief in instant technological solutions that doesn't correlate with the true status of energy research and development. Strict conservation, then, will be needed to bridge the gap between the new energy the public anticipates and the amount technology can provide.

(COMMERCIALIZATION, DEMONSTRATION-PROGRAMS, ECONOMICS, FORECASTING, PUBLIC-RELATIONS, RESEARCH-PROGRAMS)

ST77 10178 ENERGY STATISTICS: A GUIDE TO SOURCES

Balachandran, S., (University of Illinois, Champaign, IL),(Council of Planning Librarians, Monticello, IL), 1976, EDB-77:106452, PC$5.00

This publication compiles a selected and annotated guide to 162 national and international sources of statistics covering all forms of energy such as coal, electricity, natural gas, nuclear power, petroleum, solar, and other miscellaneous types. Each form is dealt with separately, the first listing covering composite sources - sources whose coverage extends to all forms of energy. A subject index and a directory of publishers are also included.

(BIBLIOGRAPHIES, DATA-COMPILATION, GEOTHERMAL, GLOBAL-ASPECTS, INDEXES, OCEAN-ΔT) WIND)

ST77 10179 ENERGY OPTIONS TO THE YEAR 2000

Balzhiser, R.E., (Electr. Power Res. Inst., Palo Alto, CA), Chem. Eng., NY, V 84:72-90, 1977

No abstract available

(GEOTHERMAL, HYDROTHERMAL)

ST77 10180 PRESENT STATUS AND DEVELOPMENT TRENDS IN THE TOTAL ENERGY ECONOMY

Bauer, L., (Tech Univ, Vienna, Austria), Elektrotech Maschinenbau, V 94:14-19, N1, 23 refs, Jan 1977, In German

Data are presented on the consumption of energy per capita. Detailed information is given for Austria and Switzerland and East and West Germany. Estimates of future consumption vs potential sources are included. Waste utilization, use of hydroelectric power generation, geothermal energy, solar radiation and nuclear energy alternatives are reviewed.

(ENERGY-RESOURCES, CONSUMPTION)

ST77 10181 ENERGY FAMINE IN LATE 20TH-CENTURY AMERICA

Behrens, C.E., (Library of Congress, Washington, DC), 1977, EDB-77:106604

The remainder of the century is seen as a period of transition, when substitutions for oil and gas will be planned for and initiated and serious energy shortages should be anticipated. Studies made since the 1973 oil embargo all point to a series of worldwide crises due to unpredictable demand, long lead times for new energy source development, and miscalculations in capital investment. Conservation efforts can reduce some of the shortages, but not without economic strains. Regulations governing end-use efficiency, environmental protection, import quotas, taxes, investment incentives, and basic policy decisions on limiting growth will all complicate the situation. This review of energy resources examines the potential of combined government programs and higher prices for reducing energy consumption and the probability that the substitutes will not be adequate to replace imported oil if it should be restricted and when it is depleted. Neither coal nor nuclear power supplies are seen as likely to be interrupted, but in that event the burden on imported oil demand will be formidable. Projections of various studies estimate U.S. energy consumption at a wide range from 100 to 187 quads per year by the end of the century depending on the assumed direction of policy decisions.

(ECONOMICS, ENERGY POLICY, ENVIRONMENTAL-IMPACTS, FORECASTING, FOREIGN POLICY, SOCIAL-IMPACT)

ST77 10182 ALTERNATIVES TO OIL AND GAS THROUGH ENERGY MANAGEMENT

Belding, J.A., (ERDA, Div. of Conservation Research and Technology, Washington, DC), New York, American Institute of Aeronautics and Astronautics, Inc., p. 4-11, 1977, In New Options in Energy Technology; Proceedings of the Conference, San Francisco, CA, Aug 2-4, 1977, AIAA 77-1006, A77-41551 19-44, A77-41553

The vital importance of improved energy production and reutilization management in helping to meet energy needs is discussed in relation to short-term candidates for replacing petroleum and natural gas, solar power, nuclear power, and coal. Electric power utilities, transportation, large industry, commercial/residential uses are covered in relation to the problem addressed. Energy management, energy efficiency enhancement, conservation cost/benefits, cost-time analysis, investment in conservation, waste heat utilization, and applications of advanced fuel cells in major power systems are dealt with.

(ENERGY POLICY, ECONOMICS, ENERGY-TECHNOLOGY, FUEL-CELLS, MANAGEMENT-PLANNING)

ST77 10183 ISPRA: THE WAY AHEAD

Bishop, G.R., (Commission of the European Communities, Ispra, Italy, Joint Research Centre), Phys. Bull., London, V 28:26-27, N1, Jan 1977, EDB-77:100411

The Coming Four Years Program of Ispra, the largest of the four European Commission's joint research centres, is outlined. Compared with the program just completed this shows a considerable strengthening of the Reactor Safety Program (almost half the budget), the redeployment of resources in nuclear materials management previously employed on three related programs, an increase of work in solar energy, maintenance of the level of effort on hydrogen, metre standards and classical environmental science, and consolidation of the work on remote sensing with satellites. Staffing levels at the centre are given.

(HYDROGEN, ENVIRONMENTAL, RESEARCH-PROGRAMS, EUROPE)

ST77 10184 DENMARK'S ENERGY SUPPLY 1990-2005

Bjoernholm, S., Hansen, A., Holm, A., (International Federation of Institutes for Advanced Study, Copenhagen, Denmark), Mar 1976, INIS-MF--3375, EDB-77:082032, In Danish

This report treats distribution and supply against a background of alternative energy demands. An evaluation is made of how the efficiency of supply and distribution can be improved so as to reduce energy losses occurring here. An important question is that of combined power-district heating plants (utilization of waste heat). Nuclear power is compared with conventional power plants and power-heating plants. The share of energy consumption that may be adequately covered by natural gas is evaluated. Using this as a basis, calculations are made regarding the suitability of natural gas as part of the energy supply, taking investment requirements into consideration. Furthermore, possibilities are discussed for using solar and wind energy in a longer perspective.

(ENERGY POLICY, FORECASTING, WIND)

ST77 10185 ALTERNATIVE DANISH ENERGY PLANNING

Blegaa, S., Josephsen, L., Meyer, N.I., Sorensen, B., (Tech Univ of Denmark, Lyngby, Denmark), Energy Policy, V 5:87-94, N2, 10 refs, June 1977

In 1976 the Danish government published an energy plan for Denmark for the period up to 1995 with nuclear power plants. This paper describes the main features and data of an alternative energy plan and compares it with the official government plan. The alternative plan excludes nuclear power but includes the application of solar and wind energy, decentralized fossil fuel plants with combined power production and district heating.

(ENERGY POLICY, DENMARK, RESOURCES-ANALYSIS, ECONOMICS, DECENTRALIZED-POWER, WIND)

ST77 10186 BRIEFING BOOK ON THE ENERGY SITUATION IN NEW ENGLAND

Brainard, J.P., Munson, J.S., Palmedo, P.F., (Brookhaven National Lab., Upton, NY), 138 p., Oct 1976, Microfiche copies only, BNL-21918,

This briefing book is designed to give a concise overview of the facts of the energy situation in New England and of attitudes within the region towards current energy issues. Many of the central problems of U.S. energy policy are manifested in the region in a magnified form. The region entered the period of energy shortages and increasing prices in an economically declining condition. Energy prices were already high in 1970, 30% higher than the rest of the country; the difference increased to 38% by 1974. With essentially no indigenous energy resources, New England is an energy-importing region. For various reasons it is also more dependent on petroleum than other regions of the country and, at the same time, distant from domestic petroleum-producing regions. The result is that over 60% of the fuels it consumes is imported from abroad. Although the future supply of energy to the region is critically dependent on energy-resource policies, policies related for example to coal and oil shale development, the region's concerns cluster around policies and technologies that are perceived to have a more direct impact on its energy welfare. Thus, energy conservation, solar energy, nuclear power, offshore oil development and, in general, the price of energy to the region are paramount issues of concern and debate. Following the Introductory chapter, these issues are discussed in four additional chapters: The Energy Situation in New England; Regional Energy Issues; Energy-Related Institutions; and State Legislation.

(ECONOMICS, ENERGY POLICY, REGIONAL PLANNING)

ST77 10187 ENERGY SITUATION IN NEW ENGLAND

Brainard, J.P., Munson, J.S., Palmedo, P.F., (Brookhaven National Lab., Upton, NY), 57 p., EY-76-C-02-0016, BNL-50580, N77-26650

A concise overview is given of the facts of the energy situation in New England and of attitudes within the region towards current energy issues. Many of the central problems of U.S. energy policy are manifested in the region in a magnified form. The region entered the period of energy shortages and increasing prices in an economically declining condition. Manufacturing activity and jobs were being lost to other regions of the country, and personal income was increasing at significantly slower rates. With essentially no indigenous energy resources, New England is an energy-importing region; over 60 percent of the fuels it consumes is imported from abroad. Although the future supply of energy to the region is critically dependent on energy resource policies, policies related for example to coal and oil shale development, the region's concerns cluster around policies and technologies that are perceived to have a more direct impact on its energy welfare. Energy conservation, solar energy, nuclear power, offshore oil development and, in general, the price of energy to the region are discussed.

(ECONOMICS, ENERGY POLICY, REGIONAL-PLANNING)

ST77 10188 ENVIRONMENTAL IMPACTS OF NONFUSION POWER SYSTEMS

Brouns, R.J., (Battelle Pacific Northwest Labs., Richland, WA), 130 p., Sept 1976, BNWL-2027, EDB-77:069998

Data were collected on the environmental effects of power sources that may be competitive with future fusion reactor power plants. Data are included on nuclear power plants using HTGR, LMBR, GCFR, LMFBR, and molten salt reactors; fossil-fuel electric power plants; geothermal power plants; solar energy power plants, including satellite-based solar systems; wind energy power plants; ocean thermal gradient power plants; tidal energy power plants; and power plants using hydrogen and other synthetic fuels as energy sources.

(WIND, OCEAN-THERMAL, TIDAL, HYDROGEN, COMPARATIVE-EVALUATIONS)

ST77 10189 PUTTING ALTERNATIVE SOURCES OF ENERGY INTO PROSPECTIVE

Budenholzer, R.A., Lavan, Z., (Illinois Institute of Technology, Chicago, IL), Civ. Eng., NY, V 47:71-73, N1, IEEE Transactions on Power Apparatus and Systems, V PAS-96: 1190-1195, July-Aug 1977, Institute of Electrical and Electronics Engineers, American Society of Mechanical Engineers, and American Society of Civil Engineers, Joint Power Generation Conference, Buffalo, NY, Sept 19-23, 1976, EDB-77:106520, EDB-77:082154, A77-42633

Proposed alternate forms of energy are compared with traditional energy sources for their possible respective contributions to meeting the nation's energy needs over the next several decades. Sources of energy consumption (residential/commercial, industrial, transportation, and electric power generation), estimated reserves of fossil fuels, and uranium fuel reserves are tabulated. The alternative sources discussed are nuclear power, hydroelectric and tidal power, oil shale and tar sand, synthetic fuel, geothermal energy, ocean thermal gradients, solar energy, and wind energy.

(ENERGY POLICY, ENERGY-TECHNOLOGY, FORECASTING, COMPARATIVE-EVALUATIONS, GEOTHERMAL)

ST77 10190 STRUCTURAL DESCRIPTIONS OF ALTERNATIVE ENERGY FUTURES

Bullard, C.W., (Illinois Univ., Urbana, IL), 1977, COO-2865-7, EDB-77:106576

Long-range energy policy analysis requires a mechanism for characterizing key structural features of a nation's economic system. It is shown that energy-analysis techniques are well-suited to such applications, particularly over time horizons beyond the reach of econometric methodologies. Trade-offs between aggregation and uncertainty are discussed as a function of time horizon. For alternative energy futures, special attention is given to the assessment of impacts on lifestyles, technology, and employment.

(LIFESTYLES, ECONOMETRICS, ECONOMICS, ENERGY-ACCOUNTING, ENERGY MODEL, ENERGY POLICY, FORECASTING, SOCIAL-IMPACT)

ST77 10191 THE MORAL EQUIVALENT OF WAR

Carter, J., Vital Speeches, V 43:420-423, N14, May 1, 1977

Americans must attack the problem of the energy crisis and this difficult effort amounts to the moral equivalent of a war. The heart of the energy problem is that demand for fuel keeps rising faster than our production, and a comprehensive plan must be undertaken to correct the situation through such means as reduction of gasoline consumption by 10 percent, insulation in 90 percent of American homes, use of solar energy in 2½ million homes, and establishment of a strategic petroleum reserve. The specific steps by which these goals can be attained are outlined. The proposals fall into some central categories - conservation, production, conversion, development, and fairness. Each category is enlarged upon. A new department of energy should be established without delay, as fragmentation of authority and responsibility for such a program is dangerous and unnecessary.

(COMPREHENSIVE-PLAN, ENERGY POLICY, UNITED-STATES)

ST77 10192 THE ENERGY PUZZLE - A LIGHT AT THE END OF THE TUNNEL

Commoner, B., The New Englander, V 23:26-30, N9, Jan 1977

We are running out of energy that we can afford. The Energy Research and Development Administration (ERDA) plan will not stabilize prices, but it will help to defeat stabilization. Enhanced recovery of gas and oil will increase production costs and lead to higher prices. Operational costs of nuclear plants rise faster than the same costs of coal fired plants. Handling reactor wastes will be more expensive and coal conversion energy production is ten times higher than for coal mining. Breeder technology, still young, will increase the costs of energy conversion. Thus, ERDA efforts will not result in a national energy program with stable prices. The only source of energy that can do that is solar energy - given 3.4 percent of ERDA's non military research budget. Photovoltaic cells now cost $12-$14 per watt. Wind energy and ocean thermal cells are also economical.

(PHOTOVOLTAIC, WIND, OCEAN-THERMAL, COMPARATIVE-EVALUATIONS, ECONOMICS)

ST77 10193 CHOOSING ALTERNATIVE ENERGY SYSTEMS UNDER CONDITIONS OF UNCERTAINTY

Costello, D., (Midwest Research Inst., Kansas City, MO), Proceedings of the Second Annual UMR-MEC Conference on Energy, Morgan, J.D., ed., Western Periodicals Co., North Hollywood, CA, 1976, EDB-77:081883

A methodology for simulating the decision process of an investor deciding between alternative energy systems is presented. The approach assumes the investor bases his decision on cost (or rate of return) and risk. Risk is treated directly in the model

and not reduced to a certainty equivalent. The rate of return-risk characteristics of many system combinations allows them to be eliminated as viable choices to the investor without reference to his personal attitude toward risk.

(ECONOMICS, ENERGY MODELS, ENERGY POLICY, FORECASTING, GEOTHERMAL, WIND, RISK-ANALYSIS)

ST77 10194 ENERGY RESOURCES AVAILABLE TO MAN

Curran, S., (Strathclyde, University, Glasgow, Scotland), Physics in Technology, V 8:138-143, July 1977, A77-41422

An overview is presented of options in energy utilization, efficiency in resources exploitation for energy, safety and liabilities, and public acceptance. The use of vast amounts of stored energy in industrial societies is pointed out, and contrasted to the stable ecosystem and highly efficient use of replenishable (solar) energy by the Tsembaga (New Guinea). Alternative energy sources are outlined (energy in waves, earth's interior, wind, solar energy).

(ENERGY-SOURCES, GEOTHERMAL)

ST77 10195 ALTERNATIVE ENERGY SOURCES

Daey Ouwens, C.C.H.T., (Technische Hogeschool Eindhoven, Netherlands), 1975, Symposium on Key Questions About the Fast Breeder Reactor, INIS-MF-3141, EDB-77:067953, In Dutch

After a review of the present difficulties in energy provision, alternative energy sources to nuclear and fossil energy sources are reviewed. Of these, solar energy seems to be the most promising. In general, an energy provision based on small decentralized units is recommended.

(COMPARATIVE-EVALUATIONS, ENERGY POLICY, FORECASTING, DECENTRALIZED-POWER)

ST77 10196 RESEARCH AND DEVELOPMENT IN THE INTERNATIONAL ENERGY AGENCY

De Bruine, R.F., Energiespectrum, Netherlands, V 1:39-46, N2

The agency was formed in 1973 and its main functions are to investigate coal technology, solar energy, thermonuclear fusion, waste heat utilization reactions using process heat, hydrogen production, wind power, geo-thermal energy, ocean thermal gradients and other possible sources of energy. A list is given of the special responsibilities of the various member countries, and of the general co-ordination. A considerable amount of basic research is in progress on all the above subjects.

(HYDROGEN, WIND, OCEAN-THERMAL, GEOTHERMAL)

ST77 10197 THE IMPACT OF THE NEW ENERGY TECHNOLOGIES

Decker, G.L., (Dow Chemical Co., Midland, MI), Mechanical Engineering, V 99:24-27, May 1977, A77-33124

Contributions of various forms of energy deemed commercially practicable by the end of the century are projected to meet an energy demand of 185 quads (quadrillions Btu). All contributing sources are charted for comparison, with the brunt borne by clean burning of coal, improved nuclear technology, coal liquefaction, coal gasification, and savings through some modes of conservation. Fusion and hydrogen technologies do not figure, being judged not commercially practicable by the turn of the century. Little contribution is expected from such novel sources as solar power, biomass combustion, geothermal energy, or breeder reactors. No one source is credited with more than 15% of the total coverage of energy needs by the year 2000.

(ENERGY-TECHNOLOGY, HYDROGEN, FORECASTING, BIOMASS)

ST77 10198 ENERGETICS OF THE UNITED STATES OF AMERICA: AN ATLAS

Drysdale, F.R., Calef, C.E., (Brookhaven National Lab., Upton, NY), 444 p., Sept 1976, BNL-50501

A description of the United States' energy system is presented in the form of thirty-one maps and eight major tables. The county has been chosen as the basic unit for reporting estimations of many energy, demographic, and economic variables.

(DEMOGRAPHIC, ECONOMIC)

ST77 10199 WHAT THE NEW WHITE HOUSE CAN DO ABOUT ENERGY

Falck, E., Smartt, L.E., Public Utilities Fortnightly, V 98:17-21, N12, Dec 2, 1976
Three essential objectives of any effective energy program are - intensified energy conservation and elimination of energy waste, accelerated development of solar energy to replace depletable fossil fuels, and accelerated conversion of large industrial and utility power plants from oil and natural gas to coal or nuclear energy. A new administration will have the opportunity to change the public attitude from one of cynicism to cooperation with respect to cooperation in an all out energy conservation program. It must prove itself determined to promote and protect the public interest in an adequate energy supply. A reorganization of the executive branch would be useful in avoiding duplication and wasted effort in the energy field. Solar research should be expanded, and the conversion of power plants from oil and gas to coal should be accelerated.

(OBJECTIVES, CONSERVATION, PUBLIC-ATTITUDE)

ST77 10200 PROCEEDINGS OF FIFTH ANNUAL SYMPOSIUM ON ENERGY RESEARCH AND DEVELOPMENT

Falconer, D., Gerber, B., Magee, W., (Dept. of Army, Edgewood Arsenal, Aberdeen Proving Ground, MD), Jan 1975, EO-SP--74026, EDB-77:073999
This report contains papers presented at the Fifth Annual Symposium sponsored by the Chemical and Biological Division and the Chesapeake Chapter of the American Defense Preparedness Association. The symposium was held at Bolling Air Force Base, Washington, DC on 13 and 14 March 1974. Papers were presented by speakers from the Department of Interior, the Atomic Energy Commission, National Science Foundation, Department of Defense, American Petroleum Institute, National Coal Association, Environmental Protection Agency, and Universities and Industry. The presentations covered energy research and development programs, energy sources, energy and the environment, and energy systems analysis.

(ENVIRONMENTAL-IMPACTS, HYDROGEN, PHOTOSYNTHESIS, RESEARCH-PROGRAMS, UNITED-STATES, WIND)

ST77 10201 THE ROLES OF AEROSPACE ORGANIZATIONS IN ENERGY DEVELOPMENT OR CAN AEROSPACE SUCCESS BRING SUCCESS IN ENERGY

Finger, H.B., (GE Center for Energy Systems, Washington, DC), AIAA Paper 77-1001, 5 p., AIAA, EEI, and IEEE, Conference on New Options in Energy Technology, San Francisco, CA, Aug 2-4, 1977, A77-41855
To cope with energy shortages, the U.S. needs to reduce its reliance on imported oil, emphasize fuel conservation programs, increase its use of coal and fissionable fuel, and support research and development of alternate energy systems. The Aerospace Industry has already undertaken research into solar electric power generation, wind-generated power systems, and microwave transmission of space solar energy. Solar heating and cooling, fuel cells, and centrifuge technology for uranium enrichment seem economically viable systems, but their cost and performance competitiveness will be determined in the marketplace. Suggestions for improving the rate of development of viable alternate systems include collaboration between the Aerospace Industry and businesses having expertise in marketing; the organization of large-scale testing facilities; and government aid when high-risk development programs are involved.

(ENERGY-TECHNOLOGY, ECONOMICS, FUEL-CELLS, WIND)

ST77 10202 THE PROBLEMS OF GAS UTILITIES AND THEIR SOLUTIONS

Fleming, R., Jr., Public Utilities Fortnightly, V 99:24-28, N10, May 12, 1977
The present problems with the gas utilities began with the marketing of interruptible quantities of gas which were sold at a price near cost. This was successfully used to sell large volumes of gas. However, in the 1960's additional volumes of gas began to decline, and during the same period the Federal Power Commission began to regulate the interstate market. The low gas prices led to decreased exploration for new sources which has resulted in today's shortage of natural gas. The main source of relief will have to come from rate increases to induce incentives for development of new reserves. 'Inverted' or tilted rates have been suggested to avoid waste while maintaining a sufficient demand for gas. Also, the inclusion of storage gas costs would be of benefit. Finally, supplemental sources of energy such as solar energy must be developed.

(UTILITIES, INTERSTATE-MARKET, INCENTIVES)

ST77 10203 ENVIRONMENT AND MAN: VOL. 1: ENERGY RESOURCES AND THE ENVIRONMENT

Fletcher, W.W., Lenihan, J., (Univ. of Glasgow, Dept. of Clinical Physics and Bio-Engineering, Glasgow, Scotland), New York: Academic Press, 194 p., 1976
No abstract available

(ECONOMICS, POLITICS, ENVIRONMENTAL-MANAGEMENT)

ST77 10204 ENERGY CONSUMPTION AND THE MELTING OF THE POLAR ICECAPS

Fong, N., (Lakeside High School, Atlanta, GA), GA. J. Sci., V 35:17-19, N1, Jan 1977, EDB-77:106511
Continued increase of world energy consumption could lead to the inudation of coastal cities in 100 years due to the melting of the polar icecaps. The catastrophe can be averted if solar energy is used as the principal energy source.

(COASTAL-REGIONS)

ST77 10205 THE NASA ENERGY CONSERVATION PROGRAM

Gaffney, G.P., (NASA, Office of Facilities, Washington, DC), AIAA Paper 77-1005, 3 p., NASA, Washington, DC, AIAA, EEI, and IEEE, Conference on New Options in Energy Technology, San Francisco, CA, Aug 2-4, 1977, A77-41571
Large energy-intensive research and test equipment at NASA installations is identified, and methods for reducing energy consumption outlined. However, some of the research facilities are involved in developing more efficient, fuel-conserving aircraft, and tradeoffs between immediate and long-term conservation may be necessary. Major programs for conservation include computer-based systems to automatically monitor and control utility consumption; a steam-producing solid waste incinerator; and a computer-based cost analysis technique to engineer more efficient heating and cooling of buildings. Alternate energy sources in operation or under evaluation include solar collectors; electric vehicles; and ultrasonically emulsified fuel to attain higher combustion efficiency. Management support, cooperative participation by employees, and effective reporting systems for conservation programs, are also discussed.

(ENERGY-TECHNOLOGY, NASA-PROGRAMS, ECONOMICS)

ST77 10206 STATISTICAL UTILITY THEORY FOR COMPARISON OF NUCLEAR VERSUS FOSSIL POWER PLANT ALTERNATIVES

Garribba, S., Ovi, A., (Milano, Politecnico, Milan, Italy), Nuclear Technology, V 34: 18-37, June 1977, Consiglio Nazionale Delle Ricerche, CNR-75,01172,11,115,4858, A77-35015
A statistical formulation of utility theory is developed for decision problems concerned with the choice among alternative strategies in electric energy production. Four alternatives are considered nuclear power, fossil power, solar energy, and conservation policy. Attention is focused on a public electric utility thought of as a rational decision-maker. A framework for decisions is then suggested where the admissible strategies and their possible consequences represent the information available to the decision-maker. Once the objectives of the decision process are assessed, consequences can be quantified in terms of measures of effectiveness.

(ENERGY POLICY, ECONOMICS, STATISTICAL-ANALYSIS)

ST77 10207 EDITORIAL RESEARCH REPORTS ON EARTH, ENERGY, AND ENVIRONMENT

Gimlin, H., ed., (Congressional Quarterly, Inc., Washington, DC), 1977, Collection of 10 Reports, EDB-77:106510
This compilation of 10 editorial research reports (published in the past two years) appraises many of the environmental, ecological, and energy issues that have arisen and are being debated. They make an assessment of the subject such that the reader may determine if the nation is doing for the issue what should be done and if fast enough. The ten papers are: Solar Energy by John Hamer / Nuclear Waste Disposal by Sandra Stencel / Ozone Controversy by John Hamer / Coastal Zone Management by Mary Costello / Pollution Control: Costs and Benefits by John Hamer / Forest Policy by John Hamer / Western Water: Coming Crisis by Tom Arrandale / Alaskan Development by John Hamer / Environmental Policy by John Hamer / and Job Health and Safety by Helen B. Shaffer. Some of the individual papers have already appeared in EAPA.

(ALASKA, COASTAL-REGIONS, ECONOMICS, ENVIRONMENTAL-EFFECTS, REVIEWS)

ST77 10208 FUTURE PROSPECTS OF ENERGY SUPPLY. II. ALTERNATIVE SOLUTION POSSIBILITIES TO COVER THE DEMAND

Grathwohl, M., Naturwiss. Rundsch., V 30:82-94, 1977
No abstract available

(GEOTHERMAL, ALTERNATIVE-REVIEW)

ST77 10209 CREATING A WELCOME FOR AEROSPACE ENERGY TECHNOLOGY

Grey, J., (American Institute of Aeronautics and Astronautics, Inc., New York, NY), Astronautics and Aeronautics, V 15:44-47, July-Aug 1977, A77-42561
The role of the Aerospace Industry in developing alternate energy sources is discussed. In spite of the relatively limited funding presently allotted by the Energy Research and Development Administration (ERDA) to aerospace technologies, and the small size of the aerospace component within the total energy research effort undertaken by private industry, there are many areas in which aerospace expertise is needed, including advanced combustion technology aimed at nitrogen oxide control and lower combustion noise levels; gas turbine systems, and first wall systems for magnetically contained fusion power plants; aerodynamic design to reduce fuel consumption; metallic, ceramic, and composite materials for high temperature and pressure environments; photovoltaic cells and collector/absorber systems for energy storage and transmission; transport and design of space-based solar power systems (SSPS); and ocean thermal energy conversion systems. In particular, development of SSPS, which presently receives very low funding, deserves additional attention.

(ENERGY POLICY, STORAGE, GEOTHERMAL, OCEAN-THERMAL, TIDEPOWER, PHOTOVOLTAICS)

ST77 10210 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE, VOLUME 38, 1976

Haigh, B., ed., Proc Am Power Conf V 38, For Meet, Chicago, IL, Apr 20-22, 1976, Publ by Illinois Inst of Technol, Chicago, IL, 1486 p., 1976
Papers dealing with such topics as: advanced energy concepts including solar and wind; economics, planning, and siting; pumped storage; and energy storage were presented.

(GENERATION, TRANSMISSION, DISTRIBUTION, NUCLEAR POWER, STORAGE, ELECTRIC POWER)

ST77 10211 EARTH, WATER, WIND, AND SUN: OUR ENERGY ALTERNATIVES

Halacy, D.S., Jr., Book, Harper and Row, NY, 1977, EDB-77:106712, PC$8.95
The author does not see any of the alternative energy sources as magic substitutes for fossil fuels like oil, coal, and gas. Instead, these alternatives - geothermal power, water power, wind and solar energy - together can help provide an energy solution. For each alternative, a history of its development and use is presented / its actual power contribution as well as its potential, both in wattage and as a percentage of projected U.S. and world needs are given / the strong points and drawbacks of the energy source are listed / and its accessibility, feasibility, and ecological impact are summarized. Energy from the earth is essentially geothermal and takes one of four forms: dry steam, wet steam, hot rocks, and geopressured deposits. The source can produce power via turbines or the heat can be used directly. Iceland projects that by 1980, 65 percent of its homes will have hot water from geothermal production at 60 percent of the fossil-fuel cost. Energy from the sea and other water can be harnessed by means of hydropower, tidal power, and sea thermal energy. Biofuels include wood and other burnable biomass, methane and other gases, waste organic material, and some liquid fuels. Wind power is again being investigated / new kinds of windmills are being developed. Solar energy may become a major source of fuel as fossil fuels diminish. Halacy discusses and explains the three basic kinds of solar energy: thermal, photovoltaic, and photochemical.

(PHOTOVOLTAIC, PHOTOCHEMICAL, GEOTHERMAL, GLOBAL-ASPECTS, OCEAN-THERMAL, TIDAL-POWER, WIND)

ST77 10212 PROGRAM DOCUMENT FOR ENERGY SYSTEMS OPTIMIZATION PROGRAM 2 (ESOP2). VOLUME 1 - ENGINEERING MANUAL

Hamil, R.G., Ferden, S.L., (Lockheed Electronics Co., Houston, TX), NASA-CR-151422, 53 p., NAS9-15200, LEC-9764-VOL-1, N77-25631
The energy systems Optimization Program, which is used to provide analyses of Modular Integrated Utility Systems (MIUS), is discussed. Modifications to the input format to allow modular inputs in specified blocks of data are described. An optimization feature which enables the program to search automatically for the minimum value of one parameter while varying the value of other parameters is reported. New program

option flags for prime mover analyses and solar energy for space heating and domestic hot water are also covered.

(ENERGY POLICY, MIUS, ECONOMICS)

ST77 10213 ENERGY TECHNOLOGY 4 - PROCEEDINGS OF THE ENERGY TECHNOLOGY CONFERENCE, 4TH, 1977

Hill, R.F., ed., Proc of the Energy Technol Conf, 4th, Washington, DC, Mar 14-16, 1977, Publ by Gov Inst, Inc, Washington, DC, 484 p., 1977
The topics discussed were: legislation, policy planning, regulating and planning for new technology, solar programs and industry, conservation in houses and industry, small business procurement problems, solar energy perspectives, ERDA procurement trends, solar heating and cooling, biomass, and future prospects for energy technology.

(ENERGY POLICY, ENVIRONMENTAL-PROTECTION)

ST77 10214 ENERGY RESOURCES: A SCIENTIFIC AND CULTURAL DILEMMA

Hubbert, M.K., (US Geol Surv, Reston, VA), Bull. Assoc. Eng. Geol., V 13:81-124, N2, 16 refs, 1976, EDB-77:106590
Today's large-scale use of energy and power is reviewed, and three principal energy inputs into an overall system are pinpointed, by far the biggest being the solar input. Energy from fossil fuels is examined in detail, and the basic facts concerning the exploitation and utilization of these fuels are reviewed. Also discussed are other sources of energy for industrial use: solar radiation and its direct and indirect uses, geothermal power, tidal power and nuclear power. Finally, ecological aspects of exponential industrial growth are considered, and the limits to such growth are defined.

(TIDAL-POWER, INDUSTRIAL-GROWTH, COMPARATIVE-EVALUATIONS, ENVIRONMENTAL-IMPACTS, FORECASTING, GEOTHERMAL, GLOBAL-ASPECTS)

ST77 10215 STATE-OF-THE-ART REVIEWS AND BIBLIOGRAPHIES ON ENERGY (A BIBLIOGRAPHY WITH ABSTRACTS)

Hundemann, A.S., (NTIS, Springfield, VA), 128 p., June 1977, NTIS/PS-77/0520/5WE
Citations to bibliographies, state-of-the-art reviews, and literature surveys on various aspects of fossil fuels, wind, solar energy, hydrogen, geothermal energy, nuclear energy, and batteries are presented. A few citations pertain to electric power.

ST77 10216 UNCONVENTIONAL ENERGY SOURCES

Johnson, L.R., Simmons, G., Peterson, J., (Northwest Energy Policy Project, Portland, OR), 278 p., 1977, NEPP-III-B, PB-268 301/9WE
This report reviews available literature and current state-of-the-art on unconventional energy sources: geothermal, biomass, ocean, wind, solar. It estimates quantities of energy available to the Pacific Northwest (Oregon, Washington, Idaho) and the costs of recovering and utilizing energy from these sources. The summary contains projections of the contribution of unconventional sources to Northwest energy needs. An annotated bibliography is included.

(GEOTHERMAL, BIOMASS, WIND, OREGON, WASHINGTON, IDAHO, BIBLIOGRAPHY, LITERATURE REVIEW, OCEAN-THERMAL)

ST77 10217 WHY U.S. ENERGY POLICY HAS FAILED

Johnson, W.A., (George Washington Univ., Washington, DC), NSF/PRA-7501111/12/6, 42 p., Apr 1976, PB-268 402/5WE
This report analyzes recent federal energy policy, focusing on repeated reorganizations of the policy-making establishment, the forces of the policymakers, and restrictions on employment of energy industry expertise in the government.

(POLICY-ASSESSMENT)

ST77 10218 FEDERAL ENERGY POLICY: A CONFLICT OF INTERESTS

Johnson, W.A., (George Washington Univ., Washington, DC), NSF/PRA-7501111/6/5, 40 p., Oct 20, 1975, PB-268 403/3WE
This report examines various conflicts of objectives in federal energy policy making.

(ENERGY-POLICY)

ST77 10219 NONTRADITIONAL SOURCES: A SAMPLER

Kaplan, G., IEEE Spectrum, V 14:49-54, N2, Feb 1977, EDB-77:068097
Markedly different energy situations exist in Israel, France, and the United Kingdom. Israel has no conventional fossil fuels and France has hardly any, while Great Britain, beginning in 1979, is expected to have a surplus of oil and gas that should last 15 to 20 years as well as a substantial coal reserve - which should provide the British with adequate time in which to develop the so-called alternative energy sources. Unlike Israel, both France and Britain have advanced commercial nuclear power technology, while Israel has an abundance of solar radiation not shared by parts of France and most of the United Kingdom. In essence then, Israel is stressing the use of solar energy to heat water for consumption in the home, for space heating and cooling, and for solar ponds - the ponds are an original scheme for generating process heat and electricity. France, with the world's most advanced solar furnace, is involved in solar-thermal power development as well as in research to reduce the cost of photovoltaic conversion, and also has geothermal heating systems in operation and under construction. In Britain, new and promising schemes to extract energy from ocean waves are being examined, and geothermal resources are being assessed.

(ECONOMICS, FRANCE, GEOTHERMAL, ISRAEL, PHOTOVOLTAICS, SOLAR FURNACES, SOLAR-PONDS, UNITED-KINGDOM, WAVE-POWER, COMPARATIVE-EVALUATIONS)

ST77 10220 ENERGY POLICY FROM AN ENVIRONMENTAL PERSPECTIVE

Krutilla, J.V., Page, R.T., (Resources for the Future, Washington, DC), Options and Considerations, Cornell University Press, Ithaca, NY, Energy Supply and Government Policy, Kalter, R.J., Vogely, W.A., eds., 1976, EDB-77:106615
Recommendations are made for formulating a new energy policy based on a reappraisal of options and a balance of conservation and new energy supplies that takes into account the related costs of health, environment, investment risk, and intergenerational equity. The three factors affecting market decisions on energy development are competition between energy industries, the market share of these industries, and environmental costs. Market decisions based on private costs and geared to private profits have not considered the public welfare. Conservation in the long-term represents a significant step toward balancing energy consumption and social costs. In the short-term, however, the energy needed to operate an industrial society must come from improved technology, supported by major R and D programs. Environmental costs have become more apparent as pollution has overloaded ecosystems, new wastes have been introduced, and increasing land surfaces have been disturbed to extract materials. These costs are ethical as well as economic concerns. The scheduling and timing of energy development allows the adjustment of these costs in ways that can work either for the welfare or the detriment of society. A broadly based decision-making process is developing, but it needs greater public participation and industry responsiveness. A critical review of fossil, non-fossil, and non-nuclear energy options is needed.

(ECONOMICS, ENERGY POLICY, ENVIRONMENTAL-IMPACTS, LAND-USE, PUBLIC-RELATIONS, SOCIAL-IMPACT, SOCIO-ECONOMIC)

ST77 10221 CONSENSUS FORECAST OF U.S. ENERGY SUPPLY AND DEMAND TO THE YEAR 2000

Lane, J.A., (Oak Ridge National Lab., TN), Feb 1976, ORNL/TM--5369, EDB-77:106584
Methods used in forecasting energy supply and demand are described, and recent forecasts are reviewed briefly. Forecasts to the year 2000 are displayed in tables and graphs and are used to prepare consensus forecasts for each form of fuel and energy supply. Fuel demand and energy use by consuming sector are tabulated for 1972 and 1975 for the various fuel forms. The distribution of energy consumption by use sector, as projected for the years 1985 and 2000 in the ERDA-48 planning report (scenario V), is normalized to match the consensus energy supply forecasts. The results are tabulated listing future demand for each fuel and energy form by each major energy-use category. Recent estimates of U.S. energy resources are also reviewed briefly and are presented in tables for each fuel and energy form. The outlook for fossil fuel resources to the year 2040, as developed by the Institute for Energy Analysis at the Oak Ridge Associated Universities, is also presented.

(COMMERCIAL, DEMAND-FACTORS, CONSUMPTION, FORECASTING, GEOTHERMAL, HYDROELECTRIC-POWER, RESIDENTIAL)

ST77 10222 ENERGY PROSPECTS IN THE NETHERLANDS

Latzko, D.G.H., (Delft Univ. of Tech., Netherlands), Delft Prog. Rep., V 1:1-24, Dec 1976, EDB-77:093492
The world situation on energy supplies is surveyed briefly, including problems that might arise concerning production and transport / then, the energy situation in the Netherlands is treated. For the purpose of this article, only relevant primary sources of energy, those whose large-scale utilization had been demonstrated to date, viz., fossil fuels, hydroelectric power, uranium in light-water reactors, and solar

radiation came up for discussion. For the pronounced growth in total consumption the model proposed by A.A. De Boer (Econ. Statist. Rep., 59, No. 2954,469-71(1974)) and inspired by the Dutch Economist Prof. Tinbergen was adopted. This model assumes a gradual decrease in the annual growth to 1 or 2 percent about the year 2012. On the basis of this model, meeting the resultant demand for energy until the turn of the century is investigated.

(ENERGY-BALANCE, ENERGY MODELS, FORECASTING, GEOTHERMAL, NETHERLANDS, WIND)

ST77 10223 BRACE RESEARCH INSTITUTE, ANNUAL REPORT, (1976)

Lawand, T.A., D'Ombrain, G.L., (MacDonald Coll. Montreal, Quebec, Brace Research Inst.), Solar Energy, Annual Report No. M32, V 53:44, Photo, 10 DWG., Aug 1976, W77-07242

The Brace Research Institute of McGill University concentrates its research on eliminating the salt content of sea water so that it may be used for irrigation, and on developing methods for making desert or arid land available for agricultural purposes. The Institute's annual report discusses its myriad research and development activities. For example, the principal thrust of the Institute's overseas sector in the past year has been their role in the establishment of a rural energy centre utilizing renewable energy resources in Senegal. The Institute undertook a study on the possibility of meeting the village's basic energy requirements for cooking, some lighting, and water supply pumping through solar, wind, and biogas energies. Negotiations are pending with other underdeveloped countries for a program of similar activities. Due to its unique expertise in both solar and wind energy, and saline water conversion, the Institute has played a major role as a consultant in the field of international technical collaboration. The Institute disseminated a considerable number of do-it-yourself leaflets, plans and specifications of simple equipment for the conversion of natural energies to useful purposes. The Institute also participated in the United Nations Habitat Conference, and demonstrated its new version of a solar steam cooker.

(WIND, DESALINATION, IRRIGATION, ARID-LANDS, TROPICAL-REGIONS, UNITED-NATIONS CONFERENCE, COOKER)

ST77 10224 ENERGY TO THE YEAR 2000 - MORE MAY BE LESS, AND CONSERVATION MAY BE MORE

Madrid, N.R., Across the Board, V 14:64-75, N2, Feb 1977

With oil production expected to peak in the 1980's, new forms of energy and new laws for conservation will have to be employed. Research and development is needed for conservation in the fields concerning building, transportation production processes, and all activities that use energy. Alternatives to the diminishing oil supplies involve the stepped up use of coal, water power, electricity, solar energy, and the use of biomass - organic energy resources ranging from municipal wastes and wood fibers to ocean kelp. Nuclear power is plagued with rising costs of uranium ore plus the public's fear of nuclear waste disposal and leakage. The future of nuclear power will most likely follow the results of political debate. Greater conservation can be achieved through the development of renewable resources and recycling technologies, implementation of known techniques, deregulation of energy prices, and the use of taxes for control of fossil forms of energy consumption.

(BIOMASS, RENEWABLE-RESOURCES, RECYCLING-TECHNOLOGIES)

ST77 10225 UTILIZING ALTERNATIVE ENERGY SOURCES IN FRANCE

Magnien, M., (Electricite De France, Paris, France), International Journal of Energy Research, V 1:55-67, Jan-Mar 1977, A77-35923

The relative merits of various alternative-energy sources are discussed with particular reference to their suitability in the French context. The case is presented for decentralized solar power as against centralized solar-power production, and some test installations in France are described. The potential for geothermal power is examined, and it is shown that the resource is essentially nonrenewable. A history of wind generation in France is presented, and power extraction from the seas is discussed, with particular reference to the Rance tidal-power schemes. While the public romance with alternative-energy schemes is accepted, it is pointed out that this may only last for as long as their implementation is on a small scale.

(TIDE-POWER, WIND, ENERGY POLICY, ENERGY-TECHNOLOGY, DECENTRALIZED-SOLAR, CENTRALIZED-SOLAR)

ST77 10226 ETA: A MODEL FOR ENERGY TECHNOLOGY ASSESSMENT

Manne, A.S., (Harvard Univ., Cambridge, MA), Bell J. Econ. Manage. Sci., V 7:379-406, N2, 32 refs, Autumn 1976, EDB-77:082036

This article explores some of the options by which the U.S. could move away from its present heavy dependence upon oil and gas toward a more diversified energy economy.

Through nonlinear programming, the model incorporates both own- and cross-price elasticities of demand. In this way it allows for price-induced interfuel substitution and energy conservation. Among the supply options studied are direct combustion of coal to generate electricity / conversion of coal to synthetic fuels / nuclear energy - first from the light water reactor and later from the fast breeder / hydrogen via electrolysis / and distant-future technical options such as fusion and central station solar power (aggregated and described only as an "advanced technology"). Each energy source has its own cost parameters and introduction date, but is interdependent with other components of the energy sector. For example, the amount of coal consumed in electric power plants can affect the marginal cost of production - and hence the cost of coal-based synthetic fuels for nonelectric energy. The converse is also true. Thus, it is not sufficient to look at individual technologies in isolation / an attempt is made here to compare their effects upon the system as a whole.

(THERMAL POWER, ENERGY POLICY, HYDROGEN-PRODUCTION, NONLINEAR-PROGRAMMING, COMPARATIVE - EVALUATIONS)

ST77 10227 ENERGY SUPPLY TO THE YEAR 2000 - GLOBAL AND NATIONAL STUDIES - BOOK

Martin, W.F., Cambridge, MA, MIT Press, 418 p., 1977, A77-46093, PC$29.95

The book reports the results of energy supply studies, conducted as an international project and involving over seventy-five people from fifteen countries. Methods were developed for estimating energy supply and demand through the year 2000 and for integrating them. A description is provided of the methodology and major conclusions of the supply studies. Individual global overviews are included for oil, natural gas, coal, nuclear energy, other fossil fuels, and renewables such as hydroelectricity and geothermal and solar energy. Individual national supply studies are discussed, giving attention to Canada, Denmark, Finland, France, the German Federal Republic, Italy, Japan, Mexico, the Netherlands, Norway, Sweden, the United Kingdom, and the U.S.

(ENERGY-SOURCES, ENERGY-TECHNOLOGY, FORECASTING, GLOBAL-OVERVIEWS)

ST77 10228 ENERGY SOURCES FOR TOMORROW. NON-NUCLEAR-NON-FOSSIL PRIMARY ENERGY CARRIERS. PT. 1. MEETING THE ENERGY DEMAND IN THE FUTURE AND THE IMPORTANCE OF NON-FOSSIL AND NON-NUCLEAR PRIMARY ENERGY CARRIERS

Meliss, M., (Kernforschungsanlage Juelich G.M.B.H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung), Umschau Verl., Frankfurt Am Main, Germany, F.R., 1976, EDB-77:088547, In German

In the study in question, the regenerative primary energy sources, solar energy, wind, tidal power, geothermal power and hydro-electric power are examined. The theoretical, technical and economical potentials of these primary energy sources for a future energy supply not only in the world but also in the Federal Republic of Germany, are analyzed in particular. In this context, the state of technology and the future development possibilities of the utilization technologies of these primary energy sources are described, and suggestions are made for a programme promoting further development and introduction into the market. These suggestions ought to be a basis for an exhaustive discussion with technical experts from interested associations and industrial enterprises, so that prompt measures and undertakings for further necessary research, development and demonstration resources can be put into effect. The study also forms an important basis for the new programme 'Energy Research and Technology 1977 Until 80.' This first part deals with the subjects energy demand, energy reserves, and the possibilities of meeting the demand through the energy carriers solar energy, geothermal energy, hydroelectric power, wind energy, tidal power and bio-chemical energy.

(COMPARATIVE-EVALUATIONS, FEASIBILITY-STUDIES, FORECASTING, GEOTHERMAL, GERMANY, HYDROELECTRIC, TIDAL-POWER, WIND)

ST77 10229 ENERGY SOURCES FOR TOMORROW. NON-NUCLEAR-NON-FOSSIL PRIMARY ENERGY CARRIERS. PT. 2. UTILIZATION OF SOLAR RADIATION ENERGY

Meliss, M., (Kernforschungsanlage Juelich G.M.B.H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung), Umschau Verl., Frankfurt Am Main, Germany, F.R., 1976, EDB-77:087188, In German

Proceeding from a description of solar energy availability, the terrestrial and orbital, biological and chemical utilization of solar energy is analyzed, with reference to the theoretical, technical, and economical possibilities of a future energy supply not only for the Federal Republic of Germany but also for the world. Based on that, suggestions are made for an advancement programme on further development and market introduction. The fields of energy storage and energy transport, related to the utilization of solar energy, are dealt with in the same way.

(AVAILABILITY, BIOMASS, FLAT-PLATE, FUEL-CELLS, STORAGE, PHOTOVOLTAIC, THERMAL-POWER, GERMANY)

ST77 10230 ENERGY SOURCES FOR TOMORROW. NON-NUCLEAR-NON-FOSSIL PRIMARY ENERGY CARRIERS. PT. 3. UTILIZATION OF WIND ENERGY

Meliss, M., (Kernforschungsanlage Juelich G.M.B.H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung), Umschau Verl., Frankfurt Am Main, Germany, F.R., 1976, EDB-77:087267, In German

The 3rd part of the programme study 'Non-Nuclear-Non-Fossil Primary Energy Sources' supported by BMFT evaluates the possible winning of energy from the wind and then deals with the ways to obtain measuring data of the wind. The study is global, related to Europe and especially to the FRG. In the following chapters 1) the historical development of the wind energy converters is explained / 2) free-driving and wind turbines with a shell and their power values are discussed, 3) the advantages and disadvantages of several wind converters is estimated. The calculation of the conversion efficiency, the availability of secondary energy and the technically utilized wind energy potential is based on the two-wing wind converter with horizontal axis. Fundamentals are wind energy utilization systems of 2 mW and 1 mW and small systems. Relatively briefly explained are ways to store the secondary energy produced. Electro-chemical, heat- and pump storages and pressure-air-storage gas turbines are discussed. The chapter 'Aspects of Utilization' shows briefly environmental effects and aspects of security and then deals with cost determination for systems of different power and with the costs necessary for research and development. The report ends with recommendations and proposals for research and development.

(AVAILABILITY, COMPARATIVE-EVALUATIONS, GERMANY, ROTORS, WIND, STORAGE)

ST77 10231 ENERGY: THE CONTINUING CRISIS

Metzger, N., Book, Thomas Y. Crowell Company, NY, 1977, EDB-77:106603, PC$12.95

The author offers no technological panaceas, but examines the gap between energy need and supply. Appraisals are made on nuclear fission / the breeder reactor / gas and oil from coal / solar energy / geothermal power / and conservation. Included in these appraisals are comments on the background and history of each of these sources of power / on the demographic and geographic factors pertinent to the successes and failures of each / on the failures of government policies, both past and present / on the environmental impact of exploiting different energy supplies / and on the costs of using future energy resources. The really pertinent issue, as Mr. Metzger points out, is whether the United States can properly prepare for new technologies that will be needed to face fossil-fuel shortages. The author says, "With all our expertise, we have become stymied by our inability to link plans to action and by our entanglement in a regulatory net of our own making. Instead of trying to solve the miasma of red tape, to explore the new technological avenues, and to conserve energy, our attention has been directed almost exclusively to enlarging - and using up evermore quickly - our supply of current resources." Other topics discussed are the building industry and why it has been so slow to promote solar energy / what happened to the electrical utilities as they encountered a technological plateau / the rise of OPEC / and the looming crisis in resources. Water will be needed for coal gasification, but water itself is in short supply.

(AVAILABILITY, CONSUMPTION, ENERGY SOURCES, GOVERNMENT-POLICIES, LAND-USE, WATER-RESOURCES)

ST77 10232 FLORIDA ENERGY DEMANDS

Muir, W.T., (National Oceanic and Atmospheric Administration, Miami, FL, Atlantic Oceanographic and Meteorological Labs.), (Florida Power and Light Co., Miami, FL), 1974, Proceedings of the MacArthur Workshop on the Feasibility of Extracting Useable Energy from the Florida Current, Stewart, H.B., Jr., ed., CONF-740252, EDB-77:105374

Energy demand and demand growth rates for Florida are reviewed. Plans for meeting future energy demands are discussed and a system is described which would use electric power generated by the Florida current.

(GULF-STREAM, WATER-CURRENT POWER)

ST77 10233 PROSPECTS FOR U.S. ENERGY SELF-SUFFICIENCY

Nelson, T.W., (American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., NY), 1976, EDB-77:093486

Reliance on foreign oil imports and the fact that it is increasing steadily is unsound both for the U.S. economy and national security. Despite recent efforts to promote energy conservation and efficiency, demand for energy is expected to continue to rise with economic growth, increase in population, and improvement in environmental conditions and living standards. Therefore, to avoid even greater reliance on imports domestic energy production must increase. U.S. oil and gas production will supply a smaller and smaller percentage of U.S. oil and overall energy demand / then coal and nuclear energy, and later solar and synthetic energy sources will have to be developed. A sound national energy policy must be developed Mr. Nelson feels, to eliminate waste

in energy use and to encourage greater exploration and production of gas and oil, better use of coal and nuclear energy, and the development of solar and synthetic energy. At the same time, to encourage exploration in the U.S. as well as a smooth flow of the imports that is needed, he says national policy should foster a strong oil and gas industry, working free of the threat of discriminatory legislation, including divestiture ligislation, and price controls which create negative incentives.

(DIVESTITURE, ENERGY POLICY, FORECASTING, LEGISLATION)

ST77 10234 PROSPECTS FOR ENERGY FROM ALTERNATE SOURCES IN CANADA

Oosthuizen, P.H., Rush, C.K., Can Nucl Assoc Annu Int Conf, 16th, V 3: Nucl Energy and the Public, Toronto, Ontario, June 13-16, 1976, Publ by Can Nucl Assoc, Toronto, Ontario, p. 3-30, 8 refs, 1976

This paper reviews the major alternate energy sources which will become available to Canada in the future. These sources include: solar energy; wind energy; tidal energy; geothermal energy; ocean temperature gradient energy; wave energy; and biomass energy.

(ENERGY POLICY, WIND, GEOTHERMAL, STORAGE)

ST77 10235 FUEL CYCLES FOR ELECTRICAL POWER GENERATION. PHASE I. TOWARDS COMPREHENSIVE STANDARDS: THE ELECTRIC POWER CASE

Pigford, T.H., Keaton, M.J., Mann, B.J., (Teknekron, Inc., Berkeley, CA), Jan 1973, PB-258523, EDB-77:087327, N77-77163

An illustrative data base for estimating environmental effluents from alternative technologies for thermally generated electrical power is presented. The data are to illustrate characteristics and possible magnitude of effluents to various environmental media and to illustrate the effect of choices of technology on the media effluents. The entire fuel cycle for each alternate technology is examined, representative sources of environmental effluents at each step in the fuel cycle are identified, and material and environmental quantities are indicated on a representative flow sheet for each means of generating electric power i.e., (1) light-water nuclear reactors, (2) low-sulfur bituminous coal, (3) residual fuel oil, (4) natural gas, (5) high-sulfur coal, with coal gassification and sulfur removal, (6) high-sulfur coal, with $SO_2$ recovery by wet-limestone scrubbing, (7) geothermal steam, (8) breeder fission reactor, (9) solar energy and, (10) thermonuclear fusion.

(ENVIRONMENTAL-EFFECTS, TECHNOLOGY-ASSESSMENT)

ST77 10236 ALTERNATIVE ENERGY - MAJOR NEW EFFORTS AT DEVELOPMENT

Rahmer, B.A., Petroleum Economist, V 44:56-57, N2, Feb 1977

Although solar energy can today only be utilized on a minor scale, chiefly in low energy applications, there appears to be favorable prospects for its eventual development into a highly important source of power. One of the most promising devices for sun power utilization is the photo voltaic cell which converts sunlight directly into electricity. The U.S. plans to bring the present price of 20 dollars per watt down to 40 cents per watt by 1985. Flat plate collectors could be technologically and economically feasible in large helio electric plants. Their efficiency would have to be greatly increased by absorbing mirrors. Geothermal energy may be able to supply 1 percent of Britain's energy needs by the end of the century. The potential generating capacity of all the world's tidal basins is equivalent to barely one third of the hydro power already installed. Wave power is being primarily studied in the UK, where there are favorable conditions.

(GEOTHERMAL, TIDAL, WAVE, GREAT-BRITAIN, REVIEWS)

ST77 10237 ALTERNATIVE ENERGY SOURCES

Ruiter, J.P., Elektrotechniek, V 53:183-195, N4, Mar 1975, EDB-77:087249, In Dutch

The possibilities of some nonconventional energy sources such as solar radiation, tidal energy and geothermal energy are described. Also the sources derived from the solar radiation such as wind, temperature differences in the oceans and organic wastes are included in this survey.

(GEOTHERMAL, REVIEWS, TIDAL-POWER, WIND, BIOMASS, OCEAN-THERMAL)

ST77 10238 ENERGY SUPPLY OF THE FEDERAL REPUBLIC OF GERMANY

Schmidt-Kuester, W.J., Wagner, H.F., (Bundesministerium Fuer Forschung Und Technologie, Bonn, West Germany), Erdoel Und Kohle Erdgas Petrochemie Vereinigt Mit Brennstoff-Chemie, V 30:301-313, July 1977, A77-43566, In German

Attention is given to strategies for planning energy research and development programs, focusing on both primary and secondary energy demand, and considering such energy sources as coal, nuclear fission (particularly fast breeder reactor technology), solar, and new sources such as wind and geothermal energy. The problems and potentials of new energy technologies such as solar heating, coal gasification, and controlled fusion are considered with a discussion of time horizons (up to 1985 and up to 2000). The potential uses of nuclear energy are discussed in detail.

(ENERGY POLICY, FORECASTING, ECONOMICS)

ST77 10239 NEW ENERGY REVIEW BY THE COMMON MARKET

Smeulders, A.A.J., Energiespectrum, Netherlands, V 1:64-69, N3, 1977

The new programme of the European Community for the Investigation of Energy Resources and the Use of Energy, promulgated in August 1975 by the Council of Ministers, is presented and discussed. The Programme encompasses saving of energy, production and use of hydrogen, solar energy, geothermal energy, system analysis and models. Details of the Programme and of the community organisations dealing with the various items are given.

(ENERGY-RESOURCES, GEOTHERMAL, SYSTEM-ANALYSIS, HYDROGEN-PRODUCTION)

ST77 10240 INTERMEDIATE ENERGY TECHNOLOGY IN CHINA

Smil, V., (Univ. of Manitoba, Winnipeg), Bull. At. Sci., V 33:25-31, N2, Feb 1977, EDB-77:081960

China, the largest and most populous of all the developing countries, has been concentrating on developments in coal mining, hydroelectric generation, and biogas production and now the latest addition is the use of solar energy. Providing fuel and electricity for development of diverse local light industries, for agricultural modernization and for household consumption, these projects while small are introducing modern technology in a way that allows for large-scale labor participation and reduces capital investment to the essential minimum. The part of the energy output for private consumption helps to raise the standard of living in China and to ease household work / many peasants acquire various basic technical skills, which are necessary for more sophisticated work to be done in the future / local production of a substitute fuel and electricity, previously produced by large enterprises, brings not only considerable savings but also greatly reduces the need for energy-intensive transportation and transmission of primary energy. Environmental implications of small energy projects are mostly positive: the availability of coal, electricity and biogas reduces or even eliminates the need for using firewood, grasses or crop residues as fuel, which means they can be used for composting or as fodder or conserved. The role of the small dams for irrigation and flood control might be, in many instances, economically more important than power generation. The same may be true about improvement of hygienic conditions and concomitant reduction of infections and parasitic diseases due to biogas generation. Biogas fermentation also yields an excellent fertilizer, representing further savings. While effective large-scale utilization of solar radiation faces difficult obstacles, simple solar furnaces are economically viable and can be used intermittently for household cooking, space and water heating, cooling, water desalination and crop drying.

(BIOSYNTHESIS, CHINA, DEVELOPING-COUNTRIES, TECHNOLOGY-TRANSFER, NET-ENERGY)

ST77 10241 THE REPORTING OF FEDERAL RESEARCH AND DEVELOPMENT RESOURCES APPLIED TO INNOVATION

Soergel, D.G., (DGS Associates, Inc. Washington, DC, National Science Foundation, Washington, DC , Government Studies Group), NSF-ORDER-77-SP-0443, 32 p., 1977, PB-266 765/7SL

The report presents a system of reporting federal funding of research and development which is based on the design progression phases of the innovative process. The research objectives of the report are to realign federal R&D expenditures to the phases of innovation in which such expenditures are incurred, of locating different types of performers within the innovative process, and of illustrating such realignments for the solar energy mission of the ERDA. The study is limited to investigation of federally funded R&D resource expenditures in hardware production areas. The conceptual approach to design progression reporting is based on six supply-oriented design progression phases within the innovative process and a demand-oriented category of mission needs and goals which is delineated through six mission levels. As an illustrative example, current federal R&D resource data for the solar electric technology mission is realigned to this conceptual framework.

(TECHNOLOGY-INNOVATION, METHODOLOGY, FINANCING)

ST77 10242 ENERGY SYSTEMS OPTIMIZATION PROGRAM (ESPO) USERS GUIDE, UPDATE 4, VOLUME 1

Stallings, R.D., Fernden, S.L., Riley, E.S., (Lockheed Electronics Co., Houston, TX, Dept. of Applied Mechanics), NASA-CR-151484 TM-4084-VOL-1 LEC-5041, 165 p., NAS9-15200, N77-82632
Avail:NTIS
No abstract available

(COMPUTER PROGRAMS, ENERGY POLICY, OPTIMIZATION)

ST77 10243 NON-NUCLEAR NON-FOSSIL ENERGY SOURCES

Stoy, B., (Rhein-Westfael Elektrizitatswerk, Essen, Germany), VGB Kraftswerkstech, V 57:1-8, N1, 22 refs, Jan 1977, In German
Soil, underground water, river water, atmosphere, and solar radiation as energy sources are compared with each other with reference to technical systems, to their utilization, economy in comparison with competing energy sources, availability, and effects on ecological factors.

ST77 10244 THE CARTER ENERGY PROGRAM

Strauss, P., Financial World, V 146:15-20, 47, N8, Apr 15, 1977
President Carter's proposed energy program is expected to sharply raise oil and gas prices, to emphasize the use of coal, to give tax incentives for insulation, and to propose new rate structures to curb electricity growth. Natural gas prices will go higher and incentives will be granted for developing coal extraction technology. Gas guzzler cars will be heavily taxed, and appliance efficiency standards will be proposed. While the program will cost business more, it is not expected to seriously harm productivity. Industries involved in the solvent refined coal process, such as Gulf, and the fluidized bed combustion process, such as Exxon, and solar energy, such as Grumman, stand to benefit. The gas guzzler tax is expected to hurt U.S. auto makers, manufacturers of recreational vehicles, and oil companies. Analysts believe that the program stresses conservation too much when capital formation should take precedence.

(TAX INCENTIVES, CONSERVATION, REVIEW)

ST77 10245 STUDIES OF NATO - CCMS ON ENERGY SAVING

Van Der Wart, R., (Energieonderzoek Centrum Nederland), Atoomenerg. Haar Toepass., V 18:296-304, N11, Nov 1976, EDB-77:088588, In Dutch
Under the auspices of NATO the CCMS (Committee on the Challenges of Modern Society) has instigated a series of pilot studies, which are tabulated. A list is also given of Dutch organizations involved in the studies. Technical work described in detail includes studies on energy projects, especially low-pollution power systems, solar and geothermal energy and the adoption of rational uses. A note is included on the international industrial data base and the electric utility load management project. Progress has been made on standardization of international terms.

(ENERGY POLICY, INTERNATIONAL RESEARCH-PROGRAMS)

ST77 10246 ENERGY RESEARCH OVERVIEW - ALTERNATIVES FOR ENERGY DEVELOPMENT

Vogenthaler, T.J., (Colorado Energy Research Institute, Golden, CO), American Astronautical Society, San Diego, CA, p. 1223-1237, 1977, In Space Shuttle Missions of the 80's; Proceedings of the Twenty-First Annual Meeting, Denver CO, Pt 2, Aug 26-28, 1975, AAS 75-280, A77-36526 16-12, A77-36555
Energy research projects are surveyed with attention to procedures for improving the yield from both traditional and proposed energy sources. With respect to oil fields, tertiary recovery is possible, involving the introduction of steam, in situ combustion, carbon dioxide, miscible flooding agents, or surfactants. Improved methane drainage and continuous haulage of coal would increase coal mine productivity. The problems involved in in situ retorting of oil shale are discussed. The shale must first be broken up and then heated to about 900°F to convert the solid organic material to oil. The salient problems in using other sources of energy are also considered.

(ENERGY-TECHNOLOGY, FORECASTING, GEOTHERMAL)

ST77 10247 ENERGY: ITS NATURAL LIMITS AND ABUNDANCES

Von Arx, W.S., (National Oceanic and Atmospheric Administration, Miami, FL, Atlanta Oceanographic and Meteorological Labs.), (Woods Hole Oceanographic Inst., MA), 1974, Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy From the Florida Current, Stewart, H.B., Jr., ed., CONF-740252, EDB-77:105373

Energy and power are defined in terms of commonly used units. Orders of magnitude of world power requirements and available resources are discussed. The physical limits to the utilization of various natural power resources are described and the resources best suited for development are suggested.

(CONSUMPTION, REVIEWS)

ST77 10248 THE SWING TO ELECTRICITY - WHY AND HOW

Wilkinson, G., (Westinghouse Canada Ltd. Hamilton, Ontario, Canada), Cim Bull., Canada, V 70:85-89, N777, 1977, Cibuba.
Coal and uranium are developed as the major fuel sources to meet medium-term energy needs, followed by fusion and solar energy for the long term.

(SOLAR-ELECTRICITY, MEDIUM-TERM)

ST77 10249 'FREE' AND RENEWABLE ENERGY SOURCES

Wise, C.E., Machine Design, V 49:22-24, 26-28, May 26, 1977, A77-34306
Wind, solar, geothermal, ocean, and bioconversion energy systems are discussed. The ERDA 1978 budget request for energy research is examined, and estimates of the future contribution of different modes of energy generation are provided. Bioconversion projects considered involve wood and wood scraps, alcohol fermentation, agricultural wastes, and marine crops. It is suggested that energy options be assessed so that appropriate research programs can be organized.

(ENERGY-TECHNOLOGY, BIOMASS, ENERGY POLICY, GEOTHERMAL, WAVE, WIND)

ST77 10250 THE PROSPECTS FOR RENEWABLE ENERGY SOURCES

Witwer, J.G., (Stanford Research Institute, Menlo Park, CA), Water, Air, and Soil Pollution, V 7:175-180, Feb 1977, Peninsula Professional Societies, Environmental Pollution Symposium on Practical Alternatives to Present Urban Life, 5th, Menlo Park, CA, May 12, 13, 1976, A77-42858
As the reserves of depletable fuels are consumed, their prices will increase, thus making renewable energy sources more cost competitive. SRI has evaluated the potential uses for and costs of renewable energy sources and compared them with other energy sources currently being utilized. These economic estimates serve as a basis for discussing the possible contribution that solar energy sources can make to the U.S. energy system. Some of the technical, environmental, and institutional problems associated with each of these solar energy forms are reviewed.

(ENERGY-TECHNOLOGY, BIOMASS, ENERGY-REQUIREMENTS)

## 11,000 SOLAR OVERVIEWS

ST77 11134 ERDA AUTHORIZATION, FISCAL YEAR 1977. PART 2 - SOLAR ENERGY

(Committee on Science and Technology, U.S. House, Subcomm. on Energy Res., Development and Demonstration), 422 p., Washington GPO Hearings Before Subcomm. on Energy Res., Development and Demonstration of Comm. on Sci. and Technol., 94th Congr., 2d Sess., No. 72, Feb 5-6, 1976, GPO-72-884, N77-75333
No abstract available

(ENERGY POLICY, HEATING, FEDERAL-BUDGETS)

ST77 11135 HARNESSING THE SUN

Shell Mag., V 3:4-6, 1975, EDB-77:073005
A description is given of Shell's participation in the Solar One Project, the construction of an experimental house at the University of Delaware Institute of Energy Conservation.

(HOUSES, SOLAR-CELL, HEATING, SHELL-OIL)

ST77 11136 NATIONAL PROSPECTS FOR SOLAR ENERGY USE

Eng., Cornell Q., V 11:27-29, N3, Autumn 1976, EDB-77:068098
ERDA proposes a realistic goal of having solar energy produce 8 to 10 percent of national energy needs by the year 2000. ERDA-sponsored research and demonstration projects are studying installations in all parts of the country. Three types of solar collectors (flat-plate, evacuated tubular, and concentrators) are under study. Special-purpose projects include photovoltaic cells for small-scale power generation in isolated areas, inflatable collectors for drying grain, and solar furnaces for test materials. Indirect collection of solar energy is available in wind power, ocean gradients, and organic wastes. Mass-produced equipment and large geographical areas will be necessary for any large-scale projects. An ultimate system could involve solar collectors on satellites with microwave generators and receiving antennas on earth. Solar energy was the topic in one of a series of lectures held at Cornell Univeristy in conjunction with two mini-courses.

(SMALL-SCALE, WIND, FORECASTING, GOVERNMENT-POLICIES, PHOTOVOLTAIC, RESEARCH-PROGRAMS, COLLECTORS, UNITED-STATES, BIOMASS, OCEAN-THERMAL)

ST77 11137 PROJECT SAGE - SOLAR ASSISTED GAS ENERGY PROJECT. UNITED STATES SPECIAL FORMAT REPORT

(Southern California Gas Co., Los Angeles, CA), 84 p., Sponsored by ERDA, DSE/4691-76/1, N77-29614
The purpose is to give a preliminary description of project SAGE, the Solar Assisted Gas Energy (SAGE) water heating system currently being tested and evaluated in southern California. A statement of the goals and objectives of the SAGE water heating program, a general description of the project in addition to system performance data, evaluations and economic analyses of the various pilot studies, and field test installations are reported.

(SOUTHERN CALIFORNIA, ECONOMIC, HEATING)

ST77 11138 RESEARCH ON NONFOSSIL FUEL SOURCES

Anon, Gas World Gas J, V 181:526-527, 529-531, N4694, Sept 1976
This article reviews the Chicago Institute of Gas Technology's involvement in the development of nonfossil energy sources: energy from the sun, wind and ocean, and the conversion of waste and plant life to methane and of water to hydrogen.

(FUEL-CELLS, HYDROGEN, WIND, OCEAN-THERMAL)

ST77 11139 SOLAR ENERGY. JAN 1955-DEC 1976

(Defense Documentation Center, Alexandria, VA), 211 p., Apr 1977, DDC/BIB-77/03, AD-A038 600/3WE, N77-80796
This bibliography is a selection of unclassified and unlimited distribution references on Solar Energy. These citations of reports present information on performance characteristics, fabrication, development of power levels and energy conversion. Corporate Author-Monitoring Agency, Subject, Title and Personal Author are provided.

(BIBLIOGRAPHY, FABRICATION, CONVERSION)

ST77 11140 SOLAR ENERGY APPLICATIONS, SYSTEMS, EXPERIENCE; LECTURE AND DISCUSSION MEETING, ESSEN, WEST GERMANY, FEB 4, 1977, REPORTS

Essen, Arbeitsgemeinschaft Solarenergie, 77 p., 1977, Meeting Supported by the Arbeitsgemeinschaft Solarenergie, DCAF A002631, For Individual Items See A77-39977 to A77-39990, A77-39976, In German
The technology and the principles of operation of solar collectors are considered along with the possibilities for the solar air conditioning of buildings, the use of plastics in systems of solar technology, the utilization of solar energy for power-supply applications, and the future of solar-thermal small-scale power stations. Attention is also given to the solar system in the solar house Dornier/RWE in Essen, aspects concerning the design and the operation of solar houses, problems of energy storage related to the utilization of solar energy for space heating, heat pumps in solar installations, the calculation and optimization of solar-energy systems which provide hot water, and a study concerning the economy of solar heating systems.

(CONFERENCES, ENERGY-TECHNOLOGY, STORAGE, HEAT-PUMPS, PLASTICS, COLLECTORS, HEATING, HOUSES, ECONOMICS, SMALL-SCALE)

ST77 11141 SOLAR ENERGY: A UNITED KINGDOM ASSESSMENT

(Royal Institution, London, England), Book, 1976, EDB-77:079973
A panel convened by UK-ISES to analyze all aspects of solar energy systems and to assess the potential for solar energy utilization and research and development needs in the UK and for export is reported. Topics covered include: solar energy in relation to other energy sources / international solar energy research and development program / the physical nature of solar energy and its availability in the UK and other countries / thermal collection, storage, and low-temperature applications / solar energy and architecture / solar thermal power systems / solar cells / agricultural and biological systems / photochemical systems / social, legal, and political considerations with particular reference to the UK / and future policy on solar research and development for the UK.

(AVAILABILITY, POLITICAL, ECONOMICS, HEATING, TECHNOLOGY-ASSESSMENT, UNITED-KINGDOM)

ST77 11142 SOLAR ENERGY ENVIRONMENTAL AND RESOURCE ASSESSMENT PROGRAM - SUMMARY REPORT

(ERDA, Washington, DC), 53 p., ERDA-76-138, N77-22621
The goals, mission, and organization of the ERA program are presented. The four ERA program areas are environmental assessment, technology assessment, resource assessment, and material assessment. This report defines the scope of activities within each of the above program areas. Project summaries or abstracts for all projects are included.

(TECHNOLOGY-ASSESSMENT, ENVIRONMENTAL, MATERIAL-ASSESSMENT)

ST77 11143 SOLAR ENERGY IN AMERICA'S FUTURE: A PRELIMINARY ASSESSMENT

(ERDA, Washington, DC), Mar 1977, DSE/115--1, EDB-77:093575
The report documents a Stanford Research Institute study of the potential roles that solar energy technologies could have for meeting U.S. energy needs over the next 45 years. Computer simulations of different energy supply projections were developed by varying the input parameters of energy demand and energy costs. Three of these projections were chosen to be developed into broader scenarios - that is, richer scripts of the future. First, the implementation measures required to realize these scenarios were delineated. Then, the economic, socio-economic, socio-political, and environmental issues associated with different energy futures were identified, and these issues were compared among the three scenarios. Finally, six major societal issues were synthesized from an analysis of the scenarios. These issues and the three scenarios were evaluated from the perspectives of individuals in different perceptual frames-of-reference.

(COMPARATIVE-EVALUATIONS, ECONOMICS, ENERGY POLICY, ENVIRONMENTAL-IMPACTS, FORECASTING, GOVERNMENT-POLICIES, SOCIO-ECONOMIC-FACTORS, UNITED-STATES)

ST77 11144 SOLAR ENERGY RESEARCH INSTITUTE; OVERSIGHT HEARINGS

(Committee on Science and Technology, U.S. House, Subcomm. on Energy Res., Development and Demonstration), 412 p., Washington GPO Hearing Before Subcomm. on Energy Res., Development and Demonstration of Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 46, Oct 22, 1975, GPO-65-506, N77-75713
No abstract available

(CONGRESSIONAL-REPORTS, ENERGY POLICY, ECONOMICS, ENERGY-TECHNOLOGY)

ST77 11145 SOLAR ENERGY SYSTEMS: THE PRACTICAL SIDE

Archit. Rec., V 158:128-134, N3, Aug 1975, EDB-77:092564
A review of their current status and a discussion of the factors that critically affect economics are presented. Design procedures for solar systems are validated.

(CURRENT-STATUS, ECONOMICS)

ST77 11146 SOLAR PROGRAM ASSESSMENT: ENVIRONMENTAL FACTORS

(ERDA, Washington, DC), Mar 1977, ERDA-77-47/5, EDB-77:092565
This report presents and prioritizes the major environmental, safety, and social/institutional issues associated with the further development of solar total energy systems (STES). Solar total energy systems represent a specific application to the federally-funded solar technologies. To provide a background for this analysis, the basic concepts of STES are reviewed, as are their resource requirements. The potential effects of these systems on the full range of environmental concerns (e.g., air and water quality, biosystems, safety, social/institutional structures, etc.) are then

discussed in terms of both their relative significance and possible solutions. Although the development of STES will contribute to environmental problems common to any construction project or energy-producing technology (i.e., air pollutants resulting from cooling tower "drift"), only those impacts unique to the solar portion of the technology are discussed in depth. Finally, an environmental work plan is presented, listing R and D proposals and a NEPA work plan that might help clarify and/or alleviate specific environmental problems. Analysis based on system of 1000 single-family residences.

(CENTRAL-RECEIVERS, CONSTRUCTION, COOLING, ENVIRONMENTAL-IMPACT, STORAGE, LAND-USE, LEGAL-ASPECTS, PHOTOVOLTAIC, SAFETY, SOCIAL-IMPACT, POLLUTION, HEATING, THERMAL-POWER, WATER-HEATERS, WATER-QUALITY, WORKING-FLUIDS)

ST77 11147 USABLE ELECTRICITY FROM THE SUN

(NASA, Lewis, Cleveland, OH), NASA-TM-74624 SE-104, 12 p., N77-81939
No abstract available

(SOLAR-CELLS, ECONOMICS, FORECASTING)

ST77 11148 WINONA - THE NEW VISION

Futurist, V 11:81-82, N2, Apr 1977
To explore what a community would look like if all the fantasies of appropriate technologists were utilized in its design, the energy design studio of the University of Minnesota School of Architecture selected Winona, MN a small city with 27,000 inhabitants, and assigned its students the task of redisigning the community so that it would maximize the utilization of increasingly scarce energy resources. Most of the vision is based on the utilization of technologies such as solar collectors, wind generators, food production units, and composting toilets which are commercially available. Three likely phases of transition are foreseen - stage one - limiting the needless waste of fossil fuel energy and expansion of household and neighborhood food production, stage two - conversion to energy systems that do not require fossil fuels, and stage three - the development of new social patterns.

(ENERGY DESIGN-STUDIO, COLLECTORS, WIND, FOOD-PRODUCTION, SOCIAL-PATTERNS, COMMUNITY-DESIGN)

ST77 11149 PROSPECTS FOR SOLAR ENERGY UTILIZATION IN IRAN - PHOTOTHERMAL METHODS

Ali Mansoori, G., (Univ of Illinois, Chicago Circle, IL), Iran J. Sci. Technol., V 5: 55-73, N2, 49 refs, 1976, EDB-77:092613
The state of the art of the photothermal methods of solar energy utilization is reviewed and it is shown that many of these techniques are applicable in Iran due to both the favorable climatic conditions and the technological developments of the country.

(ECONOMICS, FEASIBILITY-STUDIES, HYDROGEN, COLLECTORS)

ST77 11150 SUMMARY REPORT: AN EXPLORATORY STUDY OF COST TARGETS FOR SOLAR ELECTRIC POWER PLANTS

Anderson, T.D., Bowers, H.I., Delene, J.G., Fuller, L.C., Kaplan, S.I., (Oak Ridge National Lab., TN), 34 p., Mar 1977, ORNL/TM-5787, EDB-77:080022
A preliminary evaluation was made of the economic goals that need to be achieved in the solar-electric R and D and demonstration programs so that solar can become a viable component of our national electric energy production system. Solar electric technologies considered are: solar thermal conversion, solar photovoltaic, wind energy conversion, and ocean thermal. Target costs were developed for selected applications of solar by comparison with known means of accomplishing the same end results. The known technologies were assumed to be fossil and nuclear energy sources.

(ECONOMIC, PHOTOVOLTAIC, WIND, OCEAN-THERMAL, COMPARATIVE-EVALUATIONS)

ST77 11151 PROSPECTS OF SOLAR TECHNIQUES

Bossel, U., Mitteilungsbl. Dtsch. Ges. Sonnenenergie, V 1:5-10, N3, May 1976, EDB-77: 072864, In German
A description of possibilities of utilization of solar energy and of the chances of its economic application is given.

(ECONOMICS, FORECASTING, HEATING, COLLECTORS)

ST77 11152 SOLAR ENERGY: AN OVERVIEW

Cherne, J.M., (TRW Systems and Energy, Redondo Beach, CA), J. Vac. Sci. Technol., V 12:975-983, N5, Sept 1975, EDB-77:072863

A summary of the present state of solar-energy utilization is given together with estimates of future developments. Among the subjects covered are solar-thermal conversion, photovoltaic conversion, wind energy conversion, bioconversion, and ocean thermal-gradient power. Energy costs are included in the discussion. It is concluded that rapid developments are likely in the next decade.

(BIOMASS, ECONOMICS, OCEAN-THERMAL, PHOTOVOLTAIC, THERMAL-POWER, WIND)

ST77 11153 EXECUTIVE SUMMARY OF THE NATIONAL SOLAR ENERGY WORKSHOP OF THE ERDA DIVISION OF SOLAR ENERGY AND THE STATE ENERGY OFFICES

Christensen, D.L., Stuhlinger, E., (Alabama Univ., Huntsville, AL), 25 p., July 1976, TID-21337, EDB-77:080034

This report summarizes the activities and results of the National Solar Energy Workshop held in Huntsville, Alabama, on May 19 through 21, 1976. The workshop was sponsored for the express purpose of providing a forum for state participatory planning in solar-energy programs having national implications. Each of the states was invited to attend and 30 states, Puerto Rico and Canada, were represented at the workshop. The workshop was organized and structured to place emphasis on solar radiation collection and solar heating and cooling programs. It also formulated the Federal and State governmental interactions deemed necessary to meet National goals.

(UNITED-STATES, CANADA, PUERTO-RICO)

ST77 11154 CHEMICAL ENGINEERING AIDS SOLAR ENERGY

Chubb, T.A., Mil. Eng., V 68:456-459, N446, 1976, EDB-77:072978

There is substantial promise in the application of chemical engineering principles to large-scale collection of solar energy for production of electricity. Experimental work on energy storage and solar furnace chemical reactors is needed to evaluate practicability. Subsequent engineering for mass production of solar collection field components will then determine the economic feasibility of this approach to solar power compared with alternate options for energy procurement.

(ECONOMICS, EUTECTICS, STORAGE, COLLECTORS, THERMAL-POWER)

ST77 11155 ELECTRIC UTILITY SOLAR ENERGY ACTIVITIES, 1976 SURVEY

Cleary, L.D., (Electric Power Research Inst., Palo Alto, CA), 83 p., EPRI-ER-321-SR, EDB-77:066087, N77-28598

The results of a survey to determine the scope and extent of solar energy projects sponsored by electric utilities are presented. Brief descriptions of the active operations along with information contacts are listed for each participating utility. Included for cross-reference is a list of the utilities involved with projects designated by category and an address list of the utilities.

(PROJECT-PLANNING, SYSTEMS-ANALYSIS, UTILITIES, PROJECT-SCOPE)

ST77 11156 SOLAR ENERGY: MYTHS AND MOTIVES

Commoner, B., (Center for the Biology of Natural Systems, Washington University, St. Louis, MO), Hosp Pract., V 12:48-53, N2, Feb 1977

No abstract available

(CONSERVATION, UNITED-STATES)

ST77 11157 SINGLE TECHNOLOGY PITFALL

Cottingham, J.G., (Brookhaven National Lab., Upton, NY), 9 p., 1976, CONF-760657-1, BNL-21491, EDB-77:072872

As a first step toward cost reduction six principles are suggested to enhance the solar energy cost picture: use solar energy as a supplement; find a year round application for your collector system; reduce the material content per unit area of collector; generate higher temperatures - make better use of second law of thermodynamics; develop commercial size air conditioning units first for economy; and adapt solar energy to current energy handling technology. The "baby power tower" collector at Brookhaven is sketched and used to illustrate these principles.

(ECONOMICS, EFFICIENCY-ENHANCEMENT, APPLICATION-REVIEW)

ST77 11158 ECOLOGICAL CONSIDERATIONS OF THE SOLAR ALTERNATIVE

Davidson, M., Grether, D., Wilcox, K., (California Univ., Berkeley, CA), Feb 1977, LBL-5927, EDB-77:092566

The main solar technologies are considered including solar thermal power, photovoltaic cells, ocean thermal power, wind energy, solar heating and cooling, bioconversion, and agricultural and process heat. The direct and indirect ecological and environmental impacts of these technologies are discussed.

(BIOMASS, ENVIRONMENTAL-IMPACTS, OCEAN-THERMAL, PROCESS-HEAT, SOLAR-CELLS, HEATING, WIND)

ST77 11159 SOLAR POWER SYSTEMS

Denton, J.C., (Energy Associates, Belton, TX), Energy Conversion, V 16:181-198, N4, 1977, A77-42895

A review of the principal solar power systems is presented. The nature of the solar energy source is discussed starting from the energy output of the sun and covering briefly the important atmospheric effects to characterize the available solar energy on the earth's surface. The various methods for capturing solar energy are presented flat-plate, concentrating, photovoltaic, and other collectors. Energy storage methods are presented briefly for thermal, chemical, electrical, and mechanical storage approaches. An application of solar power systems in interaction with a conventional electrical utility system is presented in terms of mode of operation (base, intermediate, and peaking), reliability, capacity displacement, and energy displacement. An economic evaluation of selected solar power systems compared to conventional electrical generation plants is presented. Conclusions are drawn as to the conditions under which solar power systems may become economically competitive. A preliminary indication of market capture potential is discussed.

(ECONOMICS, ENERGY-TECHNOLOGY, COLLECTORS, PHOTOVOLTAIC, SOLAR-FLUX, STORAGE)

ST77 11160 SOLAR ENERGY: THERMAL PROCESSES

Duffie, J.A., Beckman, W.A., (Pfriemer, Muenchen, Germany, F.R.), 1976, EDB-77:066094, In German, Also available in English

The book discusses all aspects of solar energy which might be important for its practical use. The contents are characterized by the chapter headings / Extraterrestrial Solar Radiation, Solar Radiation on the Earth Surface, Solar Radiation: Measurements, Data and Estimation, Selected Information on Heat Transfer, Radiation Properties of Opaque Materials, Radiation Permeation Through Semitransparent Materials, Flat Plate Collectors, Focussing Collectors, Energy Storage, Modelling of Solar Processes, Water Heating, Cooling with Solar Energy. Also, some remarks are made on Solar Ponds, Solar Power Stations and on Water Desalination by Means of Solar Energy. Finally, reference literature is given for all chapters.

(COOLING, FLAT-PLATE, STORAGE, HEAT-TRANSFER, WATER-HEATERS, HEATING)

ST77 11161 PROPOSED OBJECTIVES FOR A SOLAR ENERGY DEVELOPMENT PROGRAM IN ILLINOIS

Dunwoody, J.E., (Illinois Dept. of Business and Economic Development, Springfield, IL), Mar 1975, PB-260558, EDB-77:105396, N77-80177

The state of Illinois initiated the development of a solar energy program by drafting a plan for the development of a solar energy program in Illinois. This document outlines the general areas of activities proposed under the Illinois solar energy development program.

(ENERGY POLICY, GOVERNMENT-POLICIES, RESEARCH-PROGRAMS)

ST77 11162 SOLAR ENERGY: FEASIBILITY OF ITS UTILIZATION AND PERSPECTIVE

Egidi, A., Pallottino, G.V., (CNR, Frascati, Italy), Elettrotecnica, V 63:121-130, N2, Feb 1976, EDB-77:066117

A review is given of the concrete possibilities of solar energy utilization. After a discussion of the general characteristics of solar energy, a wide field of applications already in the development phase is considered ranging from solar houses, solar thermal machines, to solar stills and heliohydroelectric plants. The characteristics of the solar cells are then considered along with the realizations and the research in the field of optimizing their efficiency and at reducing the cost of fabrication. An account is given of the research on solar energy that is going on in various countries.

(SOLAR-CELLS, HEATING, RESEARCH-PROGRAMS, UTILIZATION-REVIEW)

ST77 11163 SOLAR ENERGY, ITS CONVERSION AND UTILIZATION

Farber, E.A., (Florida, University, Gainesville, FL), Cocoa Beach, FL, Canaveral Council of Technical Societies, p. 4-1 to 4-4, 1977, In Space Congress, 14th, Cocoa Beach, FL, Apr 27-29, 1977, Proceedings, A77-35301 15-12, A77-35316

The availability and characteristics of solar energy are considered. Attention is given to the determination of the solar properties of material with the aid of a solar calorimeter, aspects of solar water heating, solar house heating, solar air conditioning systems, solar distillation and fresh water production, cooking and baking by means of solar furnaces, solar engines, questions of solar to electric conversion, and electric vehicles whose batteries can be charged with solar energy.

(ENERGY-TECHNOLOGY, COOLING, HEATING, ENERGY POLICY, AVAILABILITY, SOLAR FURNACES)

ST77 11164 SOLAR ENERGY: ONE WAY TO CITIZEN CONTROL

Fritsch, A.J., ed., (Center for Science in the Public Interest, Washington, DC), 1976, EDB-77:093576, PC$8.00

This report presents a case for the localized and decentralized use of solar energy. It discusses solar technologies, analyzes government programs for developing solar energy, and presents a philosophy of local citizen control of energy resources. Although the southern parts of the U.S. receive more solar radiation than the northern sections, all parts of the country are bathed in enormous amounts of solar energy. Successful solar buildings in New England have proven solar energy is viable all over the nation. Residential solar space heating is cheaper than electric-resistance heating in all parts of the country and is competitive with natural-gas heating in most of the country, according to this report. Rising competitive fuel prices will further enhance the viability of solar heating, as will coming developments in thermal storage technology. It is felt that, with proper development, solar electricity can become economically competitive with conventionally generated electricity in five to ten years. Solar electricity units can be integrated into "total energy systems" which supply both heat and electricity. Solar total energy promises to be versatile, flexible, highly efficient, and economical. Sometime in the future, hydrogen produced from solar energy and water may become a prominent source of energy. The qualities of both solar energy and solar technologies suggest that solar energy is best harnessed in small, decentralized applications. Ownership of solar energy equipment can turn the citizen and the community into an energy producer instead of just an energy consumer. Local community development of solar energy can bring control of the energy supply away from the giant energy industries and back to the citizens.

(DECENTRALIZED, COMPARATIVE-EVALUATIONS, GOVERNMENT-POLICIES, PUBLIC-RELATIONS, HEATING, TECHNOLOGY-ASSESSMENT)

ST77 11165 SOLAR ENERGY: WHERE ARE THE OPPORTUNITIES

Glaser, P.E., (Arthur D. Little, Inc., Cambridge, MA), Aware, V 77:2-5, Feb 1977, EDB-77:068100

Solar energy, while it is clean and abundant, presents policy and technological challenges to make it an efficient and economic alternative energy source offering U.S. energy self-sufficiency. Public interest in solar climate control will increase as equipment enters the marketplace and is accepted. Solar water heaters, space heaters, and air conditioners are in use in a number of countries in private installations and public demonstration projects. The six-component systems include solar collectors, a medium for thermal storage, a conventional energy source interface, a heat-actuated air conditioner, a heat pump, and auxiliary equipment. Large capital investment is expected to decrease and be off set by pay-back periods of 5 to 10 years for users. An organization of 100 companies is defining a technology base, market potential, and a data base. Government policies to provide economic incentives will encourage solar investment and help make it competitive. The solar energy industries association and the international solar energy society are actively working to raise public awareness and provide information. Business opportunities should develop for manufacture, distribution, and merchandizing of components. In the long term, small-scale applications are forecast for wind energy as costs for wind generators are reduced, ocean thermal gradients as materials research continues and effective heat exchangers and turbines are designed, solar cells for isolated areas and satellite power plants, and eventually solar thermal power plants on a large scale.

(COMPETITION, DEMONSTRATION, ECONOMICS, ENERGY POLICY, ENVIRONMENTAL-EFFECTS, INCENTIVES, RESEARCH-PROGRAMS, WATER-HEATERS, HEATING)

ST77 11166 SOLAR ENERGY AND BIOLOGY - FOR FUEL, FOOD, AND FIBER

Hall, D.O., (King's Coll. Univ. London, London, England), Trends Biochem. Sci., Pers. ed., V 2:99-101, 1977
No abstract available

(REVIEW, BIOMASS)

ST77 11167 CHEMICAL METHODS OF SOLAR ENERGY CONVERSION

Haneman, D., (Sch. Phys. Univ. New South Wales, Kensington, Austria), Proc. R. Austria Chem. Inst., V 44:37-41, 1977
No abstract available

(REVIEW)

ST77 11168 ENERGY: THE SOLAR PROSPECT

Hayes, D., Worldwatch Pap., V 11:5-79, 1977
Avail:Worldwatch Institute, Washington, DC
No abstract available
(RESEARCH-NEEDS, SOLAR-ECONOMY)

ST77 11169 SUN, WIND, AND WASTE HAVE A ROLE TO PLAY. RENEWABLE ENERGY SOURCES MERIT CONTINUING STUDY

Higgin, R.M.R., (Ontario Ministry of Energy, Toronto), North. Miner, p. C6-C8, Sept 23, 1976, EDB-77:082153
Renewable energy sources in Canada are not viewed as alternatives to coal, oil, gas or electricity, but may have a place in the energy future dependent on the economics as a supplement to conventional energy sources, particularly for local point-of-use applications. It appears that renewable energy systems will be expensive, have high front-end costs, and require supplemental systems and conservation (in view of the cost). Solar-heated houses built in southern Ontario with government assistance are described. Such houses are not economic yet, even with life-cycle costing. Windmills, including Darrieus rotors, are being studied and experimented with. Possibilities of converting wastes (sawdust, etc.) to a low-Btu gas by pyrolysis are being investigated to produce energy, reduce disposal costs, and lessen environmental impact.

(ENVIRONMENTAL-IMPACT, BIOMASS, CANADA, ECONOMICS, ENERGY POLICY, FORECASTING, HEAT-PUMPS, HOUSES, BUILDINGS-OFFICE, HEATING, WATER-HEATERS, SWIMMING-POOLS, INSULATION, WIND)

ST77 11170 SOLAR ENERGY: 1976

Hodges, L., Neff, J., (Iowa Energy Policy Council, Des Moines, IA), June 1976, NP-21386, EDB-77:066093
In this report, the Iowa Energy Policy Council attempts to describe some uses to which solar energy is being put in spring, 1976, and to anticipate some further future uses. It is recognized that the report probably is not complete / while efforts were made to survey all such applications of solar energy in the state, there are activities of which the EPC and its staff may not be aware. Therefore, contributions of information are solicited which may further enlighten Iowans of uses and applications of solar energy to Iowa's particular demands.

(HOUSES, IOWA, RESEARCH-PROGRAMS, HEATING, WIND)

ST77 11171 SOLAR ENERGY PROSPECTS GROW FOR US SOUTHWEST

Jeffs, E.J., Energy International, V 14:17-21, 32, June 1977, A77-36049
In connection with the disappearance of oil and gas, the traditional energy sources of the region, there appears to be every incentive to develop solar energy for domestic and industrial use in the U.S. southwest. The various approaches for the utilization of solar energy are discussed, taking into account its direct application to water and sapce heating and to air conditioning, the generation of electricity with the aid of photovoltaic principles or by means of electric generators driven by steam obtained with solar energy, and the indirect collection of solar energy in the form of biomass. Attention is given to flat plate collectors for houses, advantages of a use of liquid sodium in solar tower systems, and the distributed collector system.

(BIOMASS, REGIONAL-PLANNING, COLLECTORS, STORAGE, PHOTOVOLTAIC, HEATING, UNITED-STATES)

ST77 11172 SOLAR ENERGY POWERED SYSTEMS: HISTORY AND CURRENT STATUS

Jordan, R.C., (Univ of Minnesota, Minneapolis, MN), ASTM Stand. News, V 3:13-18, 46-47, N8, Aug 1975, EDB-77:092567

A survey of the development and prospects for better conversion systems of solar energy is presented.

(SURVEY, FORECASTING, REVIEWS, TECHNOLOGY-ASSESSMENT)

ST77 11173 HELIOTECHNIQUE AND DEVELOPMENT

Kettani, M.A., AMBIO, V 5:190-192, N4, Nov 1976, EDB-77:072866

This paper describes the proceedings of the International Conference held on November 2-6, 1975 at the University of Petroleum and Minerals, Dhrahran, Saudi Arabia, with the main theme "Heliotechnique and Development." The conference was sponsored by La Cooperation Medirettaneenne Pour L'Energie Solaire" (COMPLES). About 120 papers were presented in 15 sessions.

(DESALINATION, STORAGE, GREENHOUSES, INTERNATIONAL-ORGANIZATIONS, SAUDI-ARABIA, COLLECTORS, HEATING)

ST77 11174 TESTS OF A COMBINED WIND AND SOLAR POWER PLANT UNDER NATURAL CONDITIONS

Khallyev, K., Seiitkurbanov, S., Bairamov, R., (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR), Akademiia Nauk Turkmenskio SSR Izvestiia, Seriia, Fiziko-Tekhnicheskikh, Khimicheskikh I Geologicheskikh Nauk, p. 110-114, N1, 1977, A77-35415, In Russian

A combined wind and solar energy system based on principles outlined by Baironov et al., (1976) was tested at a watering station in the Bakhardenskyi region over a six-month period. Results are compared with calculations based on the mean amounts of solar and wind energy available in that area. The mean output of the wind-driven generator was 418.5 kW/hr, compared with a theoretical value of 720.0 kW/hr; corresponding fugures for the solar-driven generator were 526.1 kW/hr and 794.2 kW/hr. Poor weather conditions during two months adversely affected the performance of the system. However, results are sufficiently encouraging to indicate a promising role for such systems in power production for rural and isolated areas.

(ENERGY-TECHNOLOGY, WIND, ANNUAL-VARIATIONS, ARID-LANDS, REMOTE-REGIONS)

ST77 11175 RURAL ENERGY CENTRE FOR AFRICA USING SOLAR, WIND, AND BIOGAS ENERGIES

Lawand, T.A., Alward, R., Saulnier, B., Budgen, H.P., Brunet, E., (McGill Univ., Ste. Anne De Bellevue, Quebec), Sharing the Sun: Solar Technology in the Seventies, Böer, K.W., ed., V 9, 1976, American Section of the International Solar Energy Society, Cape Canaveral, FL, EDB-77:105539

A rural energy centre utilizing solar, wind and biogas energies in order to satisfy the basic energy needs, has been designed for a typical village in Senegal. The parameters of site selection, and the balance between the supply and demand for energies are discussed. In the centre, energy will be supplied for water pumping and potabilization, cooling and some lighting. The energy required for cooking is about 80 percent of the total demand. All social, technical and economic factors have been considered in making the selection of equipment needed. The concept of an appropriate technology approach has been followed in undertaking the study.

(ANAEROBIC-DIGESTION, ECONOMICS, METHANE, RURAL-ENERGY-CENTERS, COOKERS, WATER-HEATERS, WIND)

ST77 11176 WHAT NEWS DOES ONE FIND UNDER THE SUN IN FRANCE

Le Vaguerese, P., (Centre Technique Des Industries Aerauliques et Thermiques (CETIAT), 69 - Lyon, France), Klima Kaelteing., V 3:15-18, 1976, EDB-77:087187, In German

The amount of energy used in France for heating purposes corresponds to 35 x $10^6$ tons of fuel oil / on the average this is 675 kg/inhabitant. This quantity is considerable, yet compared with the sun energy radiated onto the country as a whole on the average, it looks very modest. Therefore, it is attempted to show the facilities which exist in France to utilize sun energy, and explain the problems, opportunities of development and targets for solar energy research.

(HEATING, RESEARCH-PROGRAMS)

ST77 11177 PENETRATION ANALYSIS AND MARGIN REQUIREMENTS ASSOCIATED WITH LARGE-SCALE UTILIZATION OF SOLAR POWER PLANTS. Final Report

McKoy, G.C., (Aerospace Corp., El Segundo, CA), Aug 1976, PB-257546, EDB-77:098501, PC$5.00
Avail:NTIS

Studies of solar plants operating as part of a conventional electric utility network have shown that additional margin (backup capacity) is required for the solar plants to prevent network loss-of-load probability from exceeding established criteria. Computer simulations of network operation were carried out taking into account the availability for service of both solar and conventional plants as a function of scheduled maintenance and forced outage events. Solar plant capacities up to approximately one-third of the network capacity were examined.

(BACKUP-CAPACITY, COMPUTER-CALCULATIONS, POWER-PLANTS)

ST77 11178 SUN POWER AN INTRODUCTION TO THE APPLICATIONS OF SOLAR ENERGY - BOOK

McVeigh, J.C., (Brighton Polytechnic, Brighton, England), Book, Oxford and New York, Pergamon Press, 217 p., 1977, A77-33967, PC$10.50

A geographical survey of current solar energy activities and applications is provided and the characteristics of solar radiation are examined, taking into account global direct and diffuse radiation, spectral distribution, radiation measuring instruments, and data from a radiation measurement network. Water and air heating applications are considered along with space heating applications, thermal power and other thermal applications, methods of economic analysis, wind power, some practical heating applications, photovoltaic cells, biological conversion systems, and photochemistry.

(ENERGY-TECHNOLOGY, RADIATION-DISTRIBUTION, HEATING, BIOMASS, PHOTOVOLTAIC, COLLECTORS, WIND, ECONOMIC)

ST77 11179 SOLAR ENERGY IN AUSTRALIA

Morse, R.N., (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), AMBIO, V 6:209-215, N4, 1977, A77-45499

Solar energy research and development programs in Australia, designed to generate as much as 20% of the nation's energy needs by the year 2000, are discussed. Rates of consumption for national reserves of petroleum, coal, and natural gas, as well as for imported fossil fuels, are given for 1975 and forecast for 2000. High-efficiency solar heat generators, operating at temperatures up to 150°C, may eventually be capable of supplying 40% of the nation's heating requirements; solar water heaters for residential purposes may fill 60 to 80% of that requirement. An industrial process using solar power in the conversion of wood cellulose to ethanol, a possible substitute for petroleum-derived fuels in transportation systems, is also described. In general, energy production combining both solar power methods and conventional techniques seems likely to prevail in Australia through the year 2000.

(ENERGY-TECHNOLOGY, COMMERCIAL, DOMESTIC, RESEARCH-DEVELOPMENT, HEATING, FORECASTING)

ST77 11180 RECENT SOLAR ENERGY TECHNOLOGY

Noguchi, T., (Solar Res Lab, Gov Ind Res Inst, Nagoya, Japan), J Fuel Soc Japan, V 55: 729-737, N5, 1976, In Japanese

The use of solar energy in developed countries chiefly centers on solar thermal conversion, photovoltaic conversion, as well as on solar heating, cooling and hot water supply. An overview is given of worldwide solar energy research. The present status of the solar energy programs under the Project Sunshine are discussed. A prospectus for solar in developing countries is also given.

(HEATING, JAPAN)

ST77 11181 ERDA OVERVIEW

Peters, W.C., (ERDA, Pittsburgh, PA), Solar Energy in Pittsburgh: A Look at Reality and Prospects, Peters, W.C., Mulvihill, J.W., eds., May 25, 1976, CONF-760522, EDB-77:105394

The ERDA organization is briefly discussed, and information on the ERDA solar budget is presented. Some of the more important and interesting projects in the ERDA solar energy program are discussed.

(BUDGETS, RESEARCH-PROGRAMS, UNITED-STATES)

ST77 11182 SOLAR ENERGY - PROMISES AND PITFALLS

Peterson, R.B., (Grumman Energy Systems), AIAA Paper 77-1022, 15 p., AIAA, EEI, and IEEE, Conference on New Options in Energy Technology, San Francisco, CA, Aug 2-4, 1977, A77-41856

Although solar energy systems cannot be justified economically as providers of 100% of a home's heating requirements, combinations of solar heating and conventional utilities for space and hot water heating are feasible. Studies by MITRE-ERDA and the Office of Technology Assessment indicate that in most parts of the U.S. solar heating is now competitive with electricity; in many areas, tax incentives may make it competitive with oil and gas systems as well. However, there is need for government rating of the efficiency and durability of solar energy collectors and rating of the Btu output of solar energy systems, so that consumers may better judge their efficacy. A demonstration home equipped with heavy insulation and a solar energy system was found capable of obtaining 40-50% of its space heating needs from solar heating, as opposed to 20% without the insulation. Thus, good insulation practices and elimination of tax penalties for solar heating installations will increase their viability as economical systems.

(HEATING, HOUSES, ECONOMICS, CONVERSION-EFFICIENCY, INSULATION)

ST77 11183 OPPORTUNITIES OF SUN ENERGY UTILIZATION IN GERMANY

Pielke, R., (Eisenbach (K.) Und Oelflam G.M.B.H., Frankfurt Am Main, Germany, F.R., Klimaabteilung), Klima Kaelteing., V 3:3-6, 1976, EDB-77:087186, In German

Sun energy engineering has progressed rapidly within a few months. Although other countries with a high number of sun hours per annum have been using more or less systematically sun energy for quite a time, the people in central Europe had to undertake first of all fundamental research work. It is the beginning of an undoubtedly very great development, yet the trading in sun energy has already begun. The opportunities of sun energy utilization which exist are indicated.

(COLLECTORS)

ST77 11184 ECONOMICS OF SOLAR AND WIND ENERGY SYSTEMS FOR LARGE SCALE POWER GENERATION

Ramakumar, R., Allison, H.J., Hughes, W.L., (Oklahoma State Univ., Stillwater, OK), University of Oklahoma, Stillwater, OK, 1974, Seventh Annual Power Technology Conference, EDB-77:072873

A case is made for the continued development of solar and wind energy systems to provide viable alternatives to fossil fuels in the years to come. A simplified economic analysis of solar and wind energy systems of the type being developed at Oklahoma State University is presented and the calculated generation costs in mills per kWh are compared with those of conventional fuel-burning systems for different fuel costs, load factors, and interest rates. The results show that certain aspects of solar and wind energy conversion can, at present, generate energy at costs competitive with conventional systems and that more favorable conditions can be expected in the future as fossil fuels become scarce and fuel costs further go up as predicted.

ST77 11185 FUNDAMENTALS OF SOLAR-ENERGY SURVEY DEVELOPMENT

Salieva, R.B., (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR), Geliotekhnika, p. 61-77, N6, 1976, Applied Solar Energy, V 12:45-57, N6, 1976, Translation, A77-41910

No abstract available

(ACTINOMETERS, RADIATION-DISTRIBUTION, COMPUTER SIMULATION, MATHEMATICAL MODELS)

ST77 11186 THE UTILIZATION OF SOLAR ENERGY IN CENTRAL EUROPE

Schreitmueller, K.R., (Deutsche Forschungs- Und Versuchsanstalt Fuer Luft- Und Raumfahrt, Institut Fuer Technische Physik, Stuttgart, West Germany), DFVLR-Nachrichten, p. 856-857, July 1977, A77-45461, In German

The reported investigation shows that an economic utilization of solar energy under the climatic conditions of central Europe in a number of application areas is presently already possible. However, for such a utilization, it is necessary to select the components of the considered system with care and to employ optimal dimensions. Approaches for determining optimal system dimensions are discussed, taking into account the importance of model calculations for evaluating the effect of the individual parameters. An implementation of the discussed approaches is illustrated with the aid of an example involving the use of a solar energy/oil hybrid heating system for a one-family house.

(ENERGY POLICY, ENERGY-TECHNOLOGY, EUROPE, ECONOMIC, HEATING)

ST77 11187 EXPLOITATION OF SOLAR ENERGY

Sobel'man, I.I., (P.N. Lebedev Physics Institute, USSR Academy of Sciences), Sov. Phys. - USP., V 19:758-764, N9, Sept 1976, Engl. Transl., EDB-77:072874

The problem of transforming the energy of solar radiation into heat and electricity is reviewed. The main attention is devoted to the possibility of heating up to fairly high temperatures, approx. 500°C, at which modern heat engines, turbines, etc., ensure efficient transformation of heat into electricity. Schemes are examined which are based on the use of comparatively simple concentrators of solar radiation and selective collectors. It is shown that, in addition to selective coatings, selective gas collectors are of great interest. The possibility of constructing large solar power stations is considered. At the end of the review, approximate estimates are given of the possible cost of a solar power station and the prospects for increasing the competitiveness of solar energy are discussed.

(REVIEWS, CONCENTRATORS, HEATING, LARGE-SCALE)

ST77 11188 REVIEW OF SOLAR ENERGY RESOURCES

Spencer, D.F., (Oregon State University, Corvallis, OR), 1975, EDB-77:072868

Magnitude and deployment schedule of energy resources is reviewed.

ST77 11189 OVERVIEW OF SOLAR ENERGY RESEARCH AT CARNEGIE-MELLON UNIVERSITY

Toor, H.L., (ERDA, Pittsburgh, PA), Solar Energy in Pittsburgh: A Look at Reality and Prospects, Peters, W.C., Mulvihill, J.W., eds., May 25, 1976, CONF-760522, EDB-77:105477

The research program at Carnegie-Mellon University on ocean thermal energy conversion, solar cells, and solar heating and cooling is outlined.

(OCEAN-THERMAL, RESEARCH-PROGRAMS, SOLAR-CELLS, HEATING, COOLING)

## 12,000 ECONOMICS AND LAW

ST77 12061 CARTER'S CONUNDRUM - WILL ENERGY CONSERVATION THROTTLE ECONOMIC GROWTH

Business Week, p. 66-72, 77, 80, N2480, Apr 25, 1977

It is believed that President Carter's energy policy will evolve around conservation, much to the chagrin of business, economists, consumers, and environmentalists. The fact that fuel resources, particularly oil, are being rapidly depleted and that energy alternatives, such as solar and nuclear power, are remote makes conservation the only alternative. Studies have found that greater productivity can be achieved without a growth in energy supplies if more efficient use is made of energy for example, by investing in better equipment. Such an investment is still cheaper than putting money into oil. Americans use much more energy than people in other nations such as Sweden with comparable living standards. Institutional barriers, such as cheap building processes to cut costs, also impede conservation.

(ENERGY-ALTERNATIVES, INVESTMENT, INSTITUTIONAL-BARRIERS)

ST77 12062 COST OF ENERGY FROM UTILITY-OWNED SOLAR ELECTRIC SYSTEMS. A REQUIRED REVENUE METHODOLOGY FOR ERDA/EPRI EVALUATIONS

(JPL, Pasadena, CA), June 1976, EDB-77:092601, N76-28647
Avail:NTIS PC$5.00

This methodology calculates the electric energy busbar cost from a utility-owned solar electric system. This approach is applicable to both publicly- and privately-owned utilities. Busbar cost represents the minimum price per unit of energy consistent with producing system-resultant revenues equal to the sum of system-resultant costs. This equality is expressed in present value terms, where the discount rate used reflects the rate of return required on invested capital. Major input variables describe the output capabilities and capital cost of the energy system, the cash flows required for system operation and maintenance, and the financial structure and tax environment of the utility.

(CAPITAL-COST, CASH-FLOWS, ECONOMICS, MATHEMATICAL MODELS, PUBLIC UTILITIES)

ST77 12063 INTERIM POLICY OPTIONS FOR COMMERCIALIZATION OF SOLAR HEATING AND COOLING SYSTEMS

(ERDA, Washington, DC), Apr 1977, ERDA-77-62, EDB-77:105426
The major incentive policy options available to accelerate market penetration of solar heating and cooling (SHAC) systems are reviewed. The policies described provide alternative methods for enhancing the impact of the Solar Heating and Cooling Demonstration Program. Specific policies or a set of policies are not recommended. Feasible policy options designed to overcome existing barriers to commercial acceptance and market penetration are identified and evaluated. This report is divided into the following seven sections, each dealing with a key problem area relating to the widespread use of SHAC systems: Economic and Financial Incentives / the Solar Energy Public Utility Interface / Legal and Regulatory Issues / ERDA Patent Policy / Building Codes, Standards and Warranties / Marketing, Manpower, Consumer and Environmental Issues / and Regional Aspects of the Incentives Program. Within each of these areas the important potential barriers to the commercialization of SHAC systems are identified, assessed, and evaluated.

(FINANCIAL INCENTIVES, LEGAL-ASPECTS, MARKET, PATENTS, PUBLIC UTILITIES, REGIONAL-ANALYSIS)

ST77 12064 NEW HAMPSHIRE SOLAR HOME COOPERATES WITH UTILITY

(Total Environmental Action, Harrisville, NH), 1977, EDB-77:093578
The construction, design, environmental impact, and energy demand factors of a solar home being built in southwestern New Hampshire are summarized. The Goosebrook energy-conserving solar home construction costs are comparable to a conventional home in that area. The heating costs are reduced due to: compact design with judicious placement of doors and windows / extra insulation in stud walls and on the exterior surface of the basement walls / triple glazed windows on east, west, and north / extensive sealing of construction joints / passive solar heating collection from large quantities of glass on the south side backed by 6' tubes of water for heat storage / inexpensive, site-built, solar trickle collector system with a combination storage, heat transfer, and heat delivery system that increases the trickle collectors efficiency by being able to utilize low storage temperatures / and a megatherm off-peak backup heating system, purchased from the Public Service Company of New Hampshire. This final feature, the installation of the megatherm unit, is especially significant for two reasons. For the first time, such a backup is being used in conjunction with solar features in a New Hampshire home. This installation will directly address the issue of compatibility between solar buildings and electric utilities / one of the most complex and controversial topics in the burgeoning solar energy industry. Through a combination of good energy conservation practices, the use of two simple solar energy systems, and the megatherm unit, Goosebrook will use less than twenty percent of the energy required by most other three bedroom houses in southwestern New Hampshire.

(CONSTRUCTION, DEMAND-FACTORS, ECONOMICS, ENVIROMENTAL-EFFECTS, FINANCING, HOUSES, OFF-PEAK-ENERGY-STORAGE, PUBLIC UTILITIES, HEATING)

ST77 12065 SOLAR COST STUDY DOWNGRADES POWER TOWER CHOICE - JPL STUDY SHOWS ALTERNATIVES JUST AS COST-EFFECTIVE

Electr. Light Power, Boston, V 54:18, N12, Dec 1976, EDB-77:105471
A study, performed by the Jet Propulsion Lab., shows that some of the alternative solar central-station concepts discarded by ERDA are just as cost-effective as the "Power Tower" when all costs are considered. The Power Tower concept was selected after initial studies by the National Science Foundation in 1974 and showed its cost advantage to be 20 to 50 percent over the nearest distributed design approaches, such as parabolic trough or dish. The more comprehensive cost analysis by JPL, which includes such factors as energy storage and dry cooling, shows the cost advantage of the Power Tower disappears. JPL does not suggest that the alternatives should replace the Power Tower in ERDA's plans - only that they deserve more attention - and funding.

(COMPARATIVE-EVALUATIONS, STORAGE, THERMAL-POWER, ECONOMICS)

ST77 12066 SOLAR HEAT LIGHTS UP A NEW INDUSTRY

Business Week, p. 142-150, N2483, May 16, 1977
Due to rapidly escalating fuel prices and President Carter's energy tax proposals, solar heating now appears destined to become a billion dollar business in the 1980's. Last year solar heat companies had estimated sales of $70 million. Now small companies who pioneered in the field are finding competition from such giants as GE, GM, and ITT. The biggest inroads are being made by systems designed to provide hot water for domestic purposes because such installations can pay for themselves faster than solar space heating. Common to all solar systems are shallow 'flat plate' collectors, usually mounted on the roof facing the southern sky. One square foot of collector area is needed to

heat one gallon of water per day and 4 square feet of collectors are needed to heat each 500 feet of floor space. Another problem for the solar industry is the resistance it may encounter from electric utilities.

(HEATING, ELECTRIC UTILITIES, INDUSTRY-PROJECTIONS)

ST77 12067 STATE ENVIRONMENTAL ISSUES SERIES. ENERGY CONSERVATION. POLICY CONSIDERATIONS FOR THE STATES

(Council of State Governments, Washington, DC), 55 p., Nov 1976, RM-595, PB-267 857/1WE

The report seeks to balance studies and recommendations for state actions by focusing on potential institutional and market constraints to those recommendations. It analyzes trends in state energy conservation activities, identifies general assumptions underlying these actions, and discusses some policy considerations for state involvement in energy conservation efforts. It offers a critical examination of energy conservation opportunities and problems in the two program areas which are the major target of state energy conservation efforts. These are the regulation of public utilities for energy conservation objectives and improved efficiency of energy use in buildings. The research agenda identified by the report focuses on informational needs and institutional or capacity building required for effective state energy conservation programs.

(PUBLIC UTILITIES)

ST77 12068 TECHNOLOGY ASSESSMENT AND FORECAST. SIXTH REPORT

(Patent and Trademark Office, Washington, DC), June 1976, PB-254188, EDB-77:093410, Avail:NTIS PC$7.50

The document reviews 15 technologies which are the subject of heavy patenting by foreign resident inventors and 22 technologies with high patent activity. Included are seven special reports prepared by patent examiners in such subjects as catalytic treatment of exhaust gases, four channel sound systems and surface acoustic wave devices. Patent activity is reviewed in solar energy technology, the production of energy from waste material, and wind generation of electricity. Economic activity and patent activity are compared in six industries.

(REVIEW, PATENT-ACTIVITY, WIND, LEGAL-ASPECTS)

ST77 12069 ACCOUNTING METHODS FOR NEW-TECHNOLOGY NON-UTILITY ENERGY INSTALLATIONS

Appleby, A.J., (Lab d'Electrolyse du CNRS, Meudon, Bellevue, France), Energy, Oxford, V 2:317-319, N3, 2 refs, Sept 1977

Inflation of energy costs, an important factor in determining the overall rate of inflation in the economy, promises to become a major influence in determining future fuel price increases. A mortgage-repayment formula reduces the initial impact of new-technology energy costs compared with formulas used in conventional accounting. In addition, it is advantageous for technologies requiring longer write-off times, and may be particularly useful for small non-utility (e.g. solar) energy installations.

(ENERGY UTILIZATION)

ST77 12070 SOLAR ENERGY AND ELECTRIC UTILITIES - CAN THEY BE INTERFACED?

Asbury, J.G., Mueller, R.O., (Argonne National Lab., IL), Science,(USA), V 195:445-450, N4277, EDB-77:066086, W-31-109-ENG-38, ANL/ES-52, N77-28601

The economics of solar systems that interface with electricity supply systems are discussed. First, adopting the implicit assumption of many solar system designers of abundant supplies of low-cost off-peak electricity, systems studies of several of the more important solar energy applications are presented. It is shown that much of the electricity supply savings claimed for solar energy systems stem from the storage, rather than the solar, component of the system. Second, employing a standard economic representation of the periodic load problem, the general problem of interfacing solar energy and electric utility supply systems is examined. The general conclusion is that solar energy systems and conventional electric utility systems represent a poor technological match. The basic problem is that both technologies are very capital intensive.

(ECONOMICS, INTERFACE, OFF-PEAK ELECTRICITY, CAPITAL-INTENSIVE)

ST77 12071 INTEGRATION OF SOLAR GENERATION INTO ELECTRIC UTILITY SYSTEMS

Ballance, J.W., (Southern California Edison Co., Rosemead, CA), Braun, G.W., (ERDA, Washington, DC), New York, American Institute of Aeronautics and Astronautics, Inc., p. 76-83, 1977, In New Options in Energy Technology; Proceedings of the Conference, San Francisco, CA, Aug 2-4, 1977, AIAA 77-1020, A77-41551 19-44, A77-41562

The value of solar thermal power plants to an electric utility system has been determined. The relationship between solar power plant values and solar thermal storage levels, mix of other resources, and the level of solar generation in the system are described. The operating characteristics of solar generation are discussed, and strategies for optimizing the value of solar generation are described. Current maximum cost levels (in dollars) for solar generation are presented, and target levels for component costs are discussed.

(STORAGE, THERMAL-POWER)

ST77 12072 FIRMS FEAR ERDA IS MISSING THE BOAT ON NEAR-COMMERCIAL TECHNOLOGIES

Cannon, J., Malefatto, A., (Inform Inc., NY), Energy Res. Rep., V 2:1-4, N11, Nov 1976, EDB-77:082158

Government and industry disagree on the pace of development for numerous energy technologies according to a survey of 142 companies conducted by Inform, Inc. Eleven solar companies insist that wide application of their technology and products is possible today, but that economic and institutional barriers remain. The authors feel that the federal government has done little to overcome obstacles in the attitude of builders or bankers, or provided any incentives for the public to install solar systems / rather, it is concentrating on funding $80 million of demonstrations designed to prove by 1981 what many companies already believe: that solar heating and cooling works. The cost of direct conversion of sunlight to electricity with solar cells is now prohibitive, but it is forecast that the cost will be cut by 1985 through such techniques as fabrication of silicon in sheets or by improving cutting methods. Motorola predicts large-scale application of solar cells on buildings by the 1980's. Martin Marietta and ERDA agree that rising fuel costs will make ocean thermal plants competitive with fossil-fuel and nuclear power plants by 1985. Other forecasts about commercialization at all are pessimistic. Results of the survey also indicate industry sees ERDA's effort as hesitant in bottoming cycles for recovering waste heat. ERDA is expecting several large gasification plants to be commercial by the mid-1980's, but many development companies find themselves stalled by technical and economic problems. The same situation exists for coal liquefaction. The funding situation for these technologies is reviewed.

(INSTITUTIONAL-BARRIERS, COMMERCIALIZATION, ECONOMICS, FEASIBILITY-STUDIES, HOUSES, OCEAN-THERMAL, SOCIAL-IMPACT, HEATING)

ST77 12073 GEOPOLITICS OF ENERGY. VOLUME I. '1976-2000'

Conant, M.A., Gold, F.R., (International Energy Inc, Great Falls, VA), 169 p., Oct 1976, AD-A038 683/9WE

This study highlights and interprets those aspects of energy supply which will engage the interests of states from now until the early decades of the 21st Century. The study traces and amplifies themes which will preoccupy the great industrial states until such time as solar power, nuclear fusion or other energy sources relieve them of the challenge of securing access to adequate and continuous supplies of energy. This study also discusses and makes recommendations on energy policy options which would give the United States and allies greater assurance of energy supply.

(ENERGY POLICY, UNITED-STATES)

ST77 12074 GEOPOLITICS OF ENERGY. VOLUME II. OVERVIEW AND OPTIONS

Conant, M.A., Gold, F.R., (International Energy Inc, Great Falls, VA), 87 p., Oct 1976, AD-A038 684/7WE

Contents: Considerations Affecting U.S. Energy; The Nature of the Threat: Emergency Situations; The Nature of the Threat: Longer Term Supply Security Measures; Limiting Vulnerability: The Domestic Component, and International Implications and Options; Nuclear Energy; and Policy Recommendations.

ST77 12075 CONSIDERING SOLAR ENERGY DEVICES - INSURANCE SHOULDN'T BE A PROBLEM

David, G., Business Insurance, V 11:6, N1, Jan 10, 1977

Despite recent expressions of concern, businesses and institutions that have installed solar equipment report that they have had no difficulty obtaining insurance. Furthermore, manufacturers report no problems in getting product liability coverage. The National Association of Mutual Insurance Companies has enumerated the possible

risks of such equipment, including fire hazards from collectors which can reach 300 degrees, hail damage, and property damange from anti freeze used in systems. Nevertheless, none of the firms contacted by the magazine reported any difficulty in coverage, among them the city of Santa Clara, CA and Huffman Heating in St. Paris, OH. Solar energy for homes appears to be one of the few energy innovations that does not present grave problems for insurers. People who buy the systems seem to provide roofs strong enough to support the extra weight.

(LIABILITY-COVERAGE)

ST77 12076 ECONOMIC ANALYSIS OF SOLAR TOTAL ENERGY SYSTEMS

Denton, J.C., (Energy Associates, Belton, TX), Energy Conversion, V 16:199-204, N4, 1977, A77-42896

An economic analysis of a solar total energy system is provided on basic investment analysis principles. Assumptions and simplifications of procedure are stated. Assuming that the technology becomes technologically mature in 1990, the first system built (of the type analyzed) is anticipated to have a net present value just over $53 million based on a 25 yr economic lifetime and forecasted values for inflation rage, energy escalation rate, cost of capital, cost of operations, cost of maintenance, depreciation, construction time, costs of gas and electricity, and capital cost. A specific case is analyzed. Error and sensitivity analyses are not included.

(INVESTMENTS)

ST77 12077 MINIMUM COST SOLAR THERMAL ELECTRIC POWER SYSTEMS: A DYNAMIC PROGRAMMING BASED APPROACH

Duff, W.S., (Colorado State Univ., Fort Collins, CO), Eng. Optimization, V 2:83-95, N1, 1976, EDB-77:072979

A dynamic programming methodology is presented for finding minimum cost solar thermal electric power systems (STEPS). The objective of the study for which this technique was developed was to identify designs of STEPS concepts that were most promising in terms of projected cost per kilowatt hour of electricity generated.

(COMPARATIVE-EVALUATIONS, THERMAL-POWER)

ST77 12078 SOME INSTITUTIONAL FACTORS AFFECTING MIUS - A CASE STUDY AND ANNOTATED BIBLIOGRAPHY

Elder, J., (NBS, Washington, DC), 66 p., June 1977, NBSIR-76-1103, PB-268 425/6WE

This report considers some of the institutional factors which might affect the development and implementation of an innovative utility project and in particular of a Modular Integrated Utility System (MIUS). A case study of the planning and implementation stages of a major utility project was undertaken along with several studies of less complex utility projects. An annotated bibliography exploring the literature on institutional response to existing or proposed utility projects and to innovation in general is included.

ST77 12079 PERVERSE ECONOMIC INCENTIVES AND ENERGY CONSERVATION

Gill, G.S., (Oak Ridge National Lab., TN), Energy, Oxford, V 1:445-450, 1976, EDB-77:088587

The salient economic and institutional incentives which provide perverse economic signals to energy consumers, thereby causing national energy consumption to be excessive relative to what it would be in the absence of these perverse incentives are surveyed. Salient examples of these perverse incentives inlcude artificially low energy prices due to regulated natural gas and oil prices and only partially internalized energy related external costs, non-cost justified declining block rate structures and many other subsidies. Numerous regulatory requirements such as those imposed by the Interstate Commerce Commission, also exist which promote wasteful patterns of energy use. The main argument presented is that historically the U.S. energy consumers have responded to many sets of incorrect price and non-price signals. This has led to the emergence of a wasteful energy use pattern. The best course to encourage energy conservation, therefore, is to remove these root causes of excessive use. The policy of providing off-setting financial incentives tantamounts to fighting effects rather than curing causes and is, therefore, unlikely to be too effective in the long-run.

(ECONOMICS, SOCIO-ECONOMIC-FACTORS)

ST77 12080 DIVESTITURE - COMPETITION OR NATIONALIZATION - WILL AMERICAN INDUSTRIES REMAIN FREE

Halbouty, M.T., Vital Speeches, V 43:379-382, N12, Apr 1, 1977
Vertical divestiture would break up the larger petroleum companies into smaller functional units. Horizontal divestiture would make it illegal for oil and gas companies to diversify, to own or help develop other energy resources such as coal, oil shale, geothermal steam, solar power, or uranium. The first and most fundamental objection is that these divestiture proposals are based on false claims of monopoly, excessive concentration, and unreasonable prices and profits. Not a single one of those claims even approaches the truth. One thing is certain - divestiture would forever eliminate any possibility of this nation adequately providing its future energy needs. The real issue in the debate on divestiture is freedom. The Federal Energy Administration conducted a study of six international oil compaines and six government run oil firms. Without exception, the government controlled companies offered a textbook example of economic inefficiency.

(LEGAL-ASPECTS)

ST77 12081 STRATEGIES FOR LEGISLATIVE CHANGE

Hamburger, R., (National Research Council, Washington, DC), NSF-RA-760006, Alternatives in Energy Conservation: The Use of Earth Covered Buildings, Moreland, F.L., ed., To Encourage Earth-Covered Construction, July 14, 1976, EDB-77:093496
The author reviews public policy changes related to energy conservation that would encourage more use of earth-covered buildings / more specifically the public policy changes which could be enunciated by legislative changes. Others have explored specific legislative changes such as tax incentives, zoning, public assistance, etc. This review discusses how one might go about getting these changes implemented. There are at least two assumptions which are made in this discussion. The first assumption that earth-covered structures will provide a net conservation of energy. Stated another way it is assumed that the extra energy which may be required to construct the earth-covered structure will be more than offset by a reduction in the use of energy during the structures operating life plus the savings in not having to use certain materials (insulation, etc.) which require energy in their manufacture, transportation to the site, and installation. The second assumption is that for certain purposes, earth-covered buildings are the best approach for conserving energy and at least as effective as other approaches for the basic use for which they are being designed. With these assumptions the question is how to get legislators to take such action as required in the public interest (and to conserve energy) so as to encourage the greater use of subsurface space. Though the first step is to recognize the realities the legislator faces, this is the last step in the process. The first step in the process is to identify the need (in this case the conservation of energy by building earth-covered structures). The second step is to find an owner who perceives a financial advantage to having such a building. The third step is to find financing. Without all three of these steps, it is useless to seek legislative changes since without the need and the demand there is no reason for the legislation.

(EARTH-COVERED BUILDINGS, GOVERNMENT POLICIES, LEGAL-ASPECTS, LEGISLATION, FINANCIAL INCENTIVES, NET-ENERGY)

ST77 12082 HEALTH AND ECONOMIC COSTS OF ALTERNATIVE ENERGY SOURCES

Hamilton, L.D., Manne, A.S., (International Atomic Energy Agency, Vienna, Austria), 1977, IAEA-CN-36/448, EDB-77:083606, US Sales Only
Avail:NTIS
National energy policy requires realistic totaling of costs in assessing energy alternatives. The Biomedical and Environmental Assessment Division (BEAD) at Brookhaven is estimating biomedical and environmental costs of energy production and use. All forms of energy, including new technologies, are being considered. Beginning with a compilation of pollutants from the energy system, the various paths to man are traced and health effects evaluated. Excess mortality and morbidity in the U.S. attributable to a total fuel cycle to produce 6.6 x $10^9$ kWh - about a year's production of a 1000-mWe power plant - are being estimated. Where enough information is available, estimates are quantitative. In some instances only the nature of the potential hazard can be described. This assessment aims at providing initial estimates of relative impacts to identify where the important health hazards in each fuel cycle arise, thereby identifying key areas for judging the total costs of alternative energy sources, and those areas of research likely to improve the accuracy of the estimates. It was thus estimated that the production of electric power from all sources in the U.S. in 1975 was associated with between two to nineteen thousand deaths and twenty-nine to fourty-eight thousand disabilities / this is roughly between 0.2 and 2 percent of total deaths in U.S. ages 1-74. The estimated health effects associated with a total fuel cycle standardized to produce $10^{10}$ kWh electric power were: from coal estimated deaths 20-200, estimated disabilities 300-500 / from oil estimated deaths 3-150, estimated disabilities 150-300 / from gas estimated deaths 0.2, estimated disabilities 20 / from

nuclear estimated deaths 1-3, estimated disabilities 8-30. The differences in the year 2000 between health impacts of the U.S. energy system under normal growth expectations and under conditions of a nuclear moratorium were estimated.

(ENVIRONMENTAL, AIR-POLLUTION, CARCINOGENS, COMPARATIVE-EVALUATIONS, ECONOMICS, ENERGY POLICY, FORECASTING, HEALTH HAZARDS, SOCIOLOGY)

ST77 12083 SECOND BEST PRICING POLICIES FOR AN EXHAUSTIBLE RESOURCE

Hanson, D.A., (Massachusetts Inst. of Tech., Cambridge, MA), Am. Econ. Rev., V 67: 351-354, N1, Feb 1977, EDB-77:081958

In the theory of exhaustible resources, the classical result, originally derived by Harold Hotelling (J. Polit. Econ., 39:137-75 (1931)) is that the scarcity rent of the resource must increase at the rate of interest. The scarcity rent is the market price of the resource less extraction costs. At the depletion time, the market price must be equal either to the zero demand price or the cost of a perfect substitute, assuming no adjustment costs in switching to the substitute. The substitute may be either a natural resource with a higher extraction cost or a backstop technology. The Hotelling result is a price equilibrium condition in a competitive asset market (Solow, Amer. Econ. Rev. Proc., 64:1-14 (1974)). It is also an efficiency condition for allocating the resource over time in a first best world. However, Solow raises the possibility that contraints creating a wedge between interest rates may be important considerations in the resource allocation problem. In a second-best world it is not at all clear how fast the scarcity rent of the resource should increase from a social viewpoint. However, for one simple case the analysis of this problem is straightforward. Suppose consumption is determined by a Keynesian consumption function with marginal propensity to consume (1 - s) / s is marginal propensity to save. With consumption determined in this behavioral manner, savings may be inadequate to reduce the market interest rate to the point where it is equal to the social rate of time preference. It is argued here that for this case the scarcity rent of the resource should increase at a rate equal to a weighted combination of these two interest rates.

(CUNSUMPTION-RATES, ECONOMIC-IMPACT, SOCIAL-IMPACT, TECHNOLOGY-ASSESSMENT)

ST77 12084 IS THE RIGHT TO LIGHT A CALIFORNIA NECESSITY?

Harris, W.R., (Rand Corp., Santa Monica, CA), 31 p., AD-A026660 P-5558, N77-75766

No abstract available

(LAND-USE, LAW, REGULATIONS, HEATING)

ST77 12085 MORTGAGE BANKERS CAN BENEFIT FROM GOVERNMENTS' ENERGY SAVING INITIATIVES

Hodges, A.A., Mortgage Banker, V 37:51-54, N6, Mar 1977

The sudden increase in government interest in incentives for energy conservation will have a major impact on the building and lending industry. The major problem the federal government will face in implementing its new laws will be the enforcement of uniform construction standards in regions with climatic differences. However, one positive outcome of uniformity may be cost reductions in building materials due to standardization. A number of incentives for solar energy investments may be less effective than ordinary measures, such as heavier insulation and storm doors and windows. However, property tax incentives encouraging solar heating have been approved in 11 states. The message is clear. Energy efficiency can save money by reducing operating costs, and energy conservation can reinforce a profitable, secure investment. Lenders and builders should take full advantage of these legislative initiatives.

(INCENTIVES, HEATING)

ST77 12086 POWER STATION ECONOMY UNDER DANISH CONDITIONS. A REPORT ON THE ECONOMICS, EMPLOYMENT AND MONETARY ASPECTS OF ATOMIC POWER STATIONS, DECENTRALIZED STATIONS PRODUCING BOTH ELECTRICITY AND HEAT, AND WIND ENERGY SYSTEMS

Hvelplund, F., Linderoth, H., Handelshoejskolen I Aarhus, Denmark, 1976, INIS-MF-3369, EDB-77:081574, In Danish, US Sales Only
Avail:NTIS

An analysis is presented based on Danish conditions of economics, employment, and monetary aspects of the wind energy, oil/coal/gas, and atomic power technologies. It is concluded that atomic power is not advantageous in Denmark.

(COMPARATIVE-EVALUATIONS, DENMARK)

ST77 12087 SYSTEMS METHODOLOGY FOR ASSESSING THE DEMOGRAPHIC IMPLICATIONS OF ENERGY DEVELOPMENT

Jacobsen, J.J., (Battelle Pacific Northwest Labs., Richland, WA), 56 p., Sept 1976, BNWL-2084(RAP-6)

The objective of the Pacific Northwest Regional Assessment Program is to estimate changes in the Region's environmental, socioeconomic, and health status that could result from various energy development or conservation scenarios. Battelle, Pacific Northwest Laboratories, uses a dynamic simulation model to help evaluate pertinent issues in the Northwest (Alaska, Idaho, Montana, Oregon, Washington, and Wyoming). One of the primary sectors of this model is the demographic sector, which provides the needed demographic information to other model sectors. Specifically, it traces the effects of various energy development scenarios on employment and population growth. The demographic sector simulates the interactions among the population, birth rate, death rate, net migration rate, and jobs available in the Region from 1960 to 2020. The population is disaggregated so that age-specific birth and death rates, age-specific propensity to migrate, and age-specific labor force participation rates can be used.

(ENVIRONMENTAL, SIMULATION MODEL, JOBS)

ST77 12088 PENDING ENERGY LEGISLATION

Johnson, W.A., (George Washington Univ., Washington, DC), NSF/PRA-7501111/8/6, 12 p., July 1975, PB-268 336/5WE

This report was prepared in mid-1975 at the request of the National Science Foundation. It lists and discusses various bills that affected the U.S. energy position then pending before the U.S. Congress.

ST77 12089 IMPACT OF ALTERNATIVE ENERGY FORMS ON PUBLIC UTILITIES

Keith, F.W., Jr., (Alabama Power Co., Birmingham, AL), In NASA, Marshall Space Flight Center Proc. of the ASPE/MSFC Symp. on Eng. and Productivity Gains from Space Technol., p. 19-31, See N77-30273 21-31, N77-30275

The investigation of alternative energy sources by the Electric Utility Industry is discussed. Research projects are reviewed in each of the following areas; solar energy, wind energy conversion, photosynthesis of biomass, ocean thermal energy conversion, geothermal energy, fusion, and the environmental impact of alternative energy sources.

(ENERGY-TECHNOLOGY, GEOTHERMAL, HEATING, WIND, BIOMASS, OCEAN-THERMAL)

ST77 12090 SOLAR SHADE CONTROL - NEW LAW FOR A NEW TECHNOLOGY

Kraemer, S.F., Felt, J.G., Energy Communications, V 3:213-230, N3, 1977, A77-36764

The potential utility of solar collectors in providing a pollution-free energy source for residential and commercial buildings renders the formulation of legislation to protect such devices from shading during peak sunlight hours highly desirable. It is argued that simplest and most direct approach to the protection of a solar collector from a shadow is to be found in the inherent right, under the Police Power of a Sovereign, to declare such a shadow a public nuisance. A model Solar Share Control Law affecting only trees ans shrubs is provided.

(PUBLIC LAW, SHADOWS, COLLECTORS, TREES)

ST77 12091 A SIMPLE MODEL FOR SOLAR ENERGY ECONOMICS IN THE U.K.

Landsberg, P.T., (Southampton, University, Southampton, England), Energy, UK, V 2: 149-159, June 1977, A77-36245

Questions concerning the suitable financial support of solar energy research and development in the UK are considered. An approach is discussed for eatimating minimum efficiencies for the economic viability of solar energy conversion by thermal or photovoltaic means. Equations are provided concerning the maximum annual outlays on research, development, and construction permitted by considerations of economic viability. The investigation is limited to questions of economics in which solar energy conversions are regarded as complementing other sources of energy.

(MATHEMATICAL MODELS, UNITED-KINGDOM, PHOTOVOLTAIC, COLLECTORS)

ST77 12092 ECONOMIC COMPETITIVENESS OF WINDMILLS

Lapin, E.E., (Aerospace Corp., Los Angeles, CA), Energy Conversion, V 16:213-220, N4, 1977, A77-42898

The conditions under which windmills become competitive with the generation of electric power from fossil fuels are examined. The influence of cost of construction,

financing arrangements, and the future cost of fuels is shown. Energy storage and network arrangements for mills are considered briefly, as are alternate uses for mills, e.g., the utilization of mill output directly for heating or for the production of a fuel.

(STORAGE)

ST77 12093 ENERGY - THE SUN AND ECONOMICS

Larson, A.H., (Delphian Found., Sheridan, OR), Chemistry, V 50:12-13, 1977
No abstract available

(EDUCATION)

ST77 12094 ENERGY CONSUMPTION AND ECONOMIC WELL-BEING

Linden, H.R., (Inst. of Gas Tech., Chicago, IL), International Gas Union, London, 1976, Thirteenth World Gas Conference, EDB-77:106703
The historical role of energy use in the social and economic progress of mankind is reviewed and related to current energy policy issues. The conflicting aims of energy conservation and of economic growth are analyzed in some detail with particular reference to the developments following the 1973-74 oil embargo and precipitous increase in world oil prices. The growing importance of natural gas in the world energy balance is considered in the light of difficulties encountered when supply can no longer meet growing demand and decisions have to be made on alternate means of supplementation. In this regard, the issue of the relative economics of electric energy supply and the direct use of hydrocarbon fuels from either petroleum or synthetic sources is considered.

(ECONOMETRICS, ENERGY POLICY, CONSERVATION, SOCIO-ECONOMIC-FACTORS)

ST77 12095 SOLAR ENERGY: POTENTIAL POWERHOUSE FOR JOBS

McCallion, T., Worklife, V 1:3-6, N8, Aug 1976, EDB-77:080048
The employment implications of a fully developed solar heating and cooling industry are discussed briefly.

(EMPLOYMENT-IMPLICATIONS, ECONOMICS, MARKET, HEATING)

ST77 12096 SOLAR ENERGY APPLICATIONS AND RELATED LEGISLATION

Mongitore, D.A., (New York State Assembly Scientific Staff, Albany, NY), 39 p., May 1975, SS-503, PB-267 901/7WE
This report presents the areas in which there is the greatest potential for state legislative action which would promote the use of solar energy in New York State. The report first describes those solar energy systems which have the greatest potential for use in New York State. The problems facing widespread implementation of these systems are enumerated, and legislative proposals which address these problems are detailed in light of existing legislation in other states and their impact on solar energy use in the State.

(NEW-YORK)

ST77 12097 ENERGY AND INCOME IN ARKANSAS

Opitz, J.H., Troutman, F.H., (Arkansas Univ., Little Rock, AR), 34 p., May 1977, EDA/OER-77/017, PB-268 291/2WE
This study examines the impact of the use of different energy sources on income for the state of Arkansas. The rising price of energy affects income directly, through higher prices for goods and services, and indirectly as energy-using industries shift their location to energy producing states. Arkansas, with personal income lower than the national median, and presently an importer of energy, faces a significant loss of income if energy prices continue to rise and if reliance on present sources of energy persists. The study examines the economic impact of using coal (primarily Western low sulphur coal) and Arkansas lignite (lower in energy content and higher in sulphur).

(PERSONAL INCOME, ECONOMIC-IMPACT)

ST77 12098 ENERGY POLITICS OF FRANCE

Ornano, M.M., Tech. Mod., V 68:11-12, N1, Jan 1976, EDB-77:068023, In French
No abstract available

(ECONOMICS, ENERGY POLICY, GEOTHERMAL, TAXES)

ST77 12099 SOCIAL RISKS AND THE ENERGY OPTION

Orr, D., (Univ. of North Carolina, Chapel Hill, NC), Sci. Public Policy, V 4:179-183, N2, 15 refs, Apr 1977, EDB-77:106624

A Minimax Strategy is proposed to deal with the possibility of large-scale disaster while pursuing energy options, none of which is without risks and uncertainties. Re-adjustments of energy-consumption levels can lower capital demands enough to avoid irreversible commitments to high-risk technologies. The four requirements of a society using the Minimax Strategy are: (1) commitment to conservation, (2) re-structuring to promote efficiency, (3) new social values and standards, and (4) a gradual replacement of conventional with renewable energy technology. Some proposals, such as that of beaming microwaves to earth from satellites, are not only capital-intensive but introduce new risk potential. A better approach is seen to be a small-scale, decentralized society that minimizes the impact of accidents while maximizing the resilience and democracy of human development. A society operating under sustainable energy offers, by including citizen involvement in public policy, opportunities for creativity in individuals and institutions.

(SMALL-SCALE, DECENTRALIZED, ECONOMICS, ENERGY POLICY, ENVIRONMENTAL-IMPACTS, SOCIAL-IMPACT, SOCIOLOGY)

ST77 12100 THE IMPACT OF TAX INCENTIVES AND AUXILIARY FUEL PRICES ON THE UTILIZATION RATE OF SOLAR ENERGY SPACE CONDITIONING

Petersen, H.C., (Utah State Univ., Logan, UT), NSF AER74-09043-A01, NSF APR-75-18004, NSF/RA-760025, 110 p., PB-252538, N77-73079

No abstract available

(MARKET RESEARCH, HEATING, COMPUTER SIMULATION, INCENTIVES, MATHEMATICAL MODELS)

ST77 12101 SURVEY YOUR PLANT'S ELECTRICAL POWER NEEDS AND SAVE

Relick, W.J., (Society of Mfg. Engineers, Dearborn, MI), 1975, NP-22059, EDB-77:106886

The cost of electrical power is rising dramatically while cutbacks in supply are increasing with demand growth. It is timely and imperative to begin a program to trim excess power costs and wasted power from your plant's operating overhead. An important tool in a power saving program is the electrical survey using graphic instruments. How to conduct such a survey and the selection of proper instruments and accessories is discussed.

(ECONOMICS, CONSERVATION, INDUSTRIAL PLANTS)

ST77 12102 ECONOMICS OF ALTERNATIVE ENERGY SOURCES

Ryle, M., (Cambridge University, Cambridge, England), Nature, V 267:111-117, May 12, 1977, A77-33755

Partly because of large fluctuations in demand, the replacement of oil and gas fuels currently used to heat buildings in the UK by nuclear-generated electricity would seem to require the construction of about 250 gW of additional capacity by the end of the century, which does not seem feasible. If short-term (150-hour) energy storage in the form of heat is developed to a sufficient extent, the generating capacity required to fulfill peak demand could be reduced by half. With the same amount of short-term storage, however, other sources of energy, obtained from wind, wave, or tidal power, might become viable alternatives. It is suggested that the value of North Sea oil and gas to the chemical industry should lead, for economic reasons, to an early reduction in their consumption as fuel.

(HEATING, TIDEPOWER, STORAGE, WIND)

ST77 12103 ANALYSIS OF THE CALIFORNIA ENERGY INDUSTRY

Sathaye, J., Ruderman, H., Sextro, R., Benenson, P., Kunin, L., Chan, P., Kooser, J., Ben Dov, Y., Green, B., Clear, R., (California Univ., Berkeley, CA), Jan 1977, EDB-77:093478

The energy-supply system for California is an integral part of the state's economy, both in terms of energy as a commodity and in the economic effects of expanding requirements for new capital and man-power in the energy sector. It is this notion of an expanding energy system that forms one of the motivations for many of the energy policy discussions and formulations currently taking place. Some of the questions to be addressed are (1) if the energy system is to expand, by how much, and in what particular areas of supply, (2) what are the policy ramifications of certain changes as opposed to others, and (3) what are the major economic effects of changes in energy supply system plans. The purpose of this study is to: (a) describe quantitatively the California Energy Industry and its relationship to the California and U.S. economies, (b) provide the analytic capability for determining the direct and indirect employment

and income impacts resulting from a given energy future for California, and (c) demonstrate and test the methodology with scenarios that embody varying combinations of conventional energy technologies, new energy technologies and energy conservation measures. The methodology developed is generally applicable to any set of specified changes. In this report three alternative energy futures for California are selected in order to quantify their resulting economic impacts.

(MAN-POWER, EMPLOYMENT, CAPITAL, ENERGY POLICY, FORECASTING, OCCUPATIONS, TECHNOLOGY-ASSESSMENT, WIND)

ST77 12104 AN ECONOMETRIC ANALYSIS OF ENERGY OVER THE NEXT 75 YEARS

Schmitt, R.W., Bendaniel, D.J., Stewart, P.J., (General Electric Co., Schenectady, NY), Manne, A.S., (Stanford University, Palo Alto, CA), IEEE Transactions on Power Apparatus and Systems, V PAS-96:1353-1361, July-Aug 1977, Institute of Electrical and Electronics Engineers, American Society of Mechanical Engineers, and American Society of Civil Engineers, Joint Power Generation Conference, Buffalo, NY, Sept 19-23, 1976, A77-42637

The mix of base-load power generation systems expected from various energy sources over the next 75 years is studied. The longer-run projection is recommended as a corrective for short-range forecasts ignoring some constraints which emerge only in the long run. Lead times for significant contributions of new and presently untested technology to electrical energy demand are taken into account; research expenditures on highly speculative energy technologies (fusion, solar electric, and MHD) are not expected to yield results in less than half the time covered. The prediction model accounts for electrical and nonelectrical energy, price-induced energy conservation, and substitution of energy forms. Liquid-metal-cooled fast breeders are assumed as the nuclear power workhorse in the scenario.

(MATHEMATICAL MODELS, FORECASTING, ENERGY POLICY)

ST77 12105 SOLAR ENERGY: POLICY AND PROSPECTS

Schulze, W.D., Ben-David, S., Katson, R., Noll, S., Roach, F., (New Mexico Univ., Albuquerque, NM), NSF/RA-760577, 188 p., July 1976, PB-267 986/8WE

This report is concerned with the economic feasibility of near-term solar energy sources with energy price decontrol. Section 2 sets up decontrolled energy prices for the United States on a state-by-state basis. Sections 3, 4, and 5 demonstrate near-term feasibility for solar residential space heating, for the full application of solar energy to a mixed load community in the Southwest, and for an application of solar process heat to industry. The concluding section returns to the issues of financing solar energy and offers an alternative policy strategy in the event energy price controls continue.

(ECONOMIC, DECONTROL, UNITED-STATES, HEATING, MIXED-LOAD COMMUNITY, PROCESS-HEAT, FINANCING)

ST77 12106 WILL ENERGY PACKAGE SLOW ECONOMY?

Sommer, D.W., Industry Week, V 193:81-82, N3, May 9, 1977

Although industry's reaction to President Carter's energy proposals was mixed, it seems clear that the economic implications of the program will be negative - but minimally so. The Wharton Econometric Forecasting Associates Inc. of Philadelphia believes that the impact on real gross national product (GNP) next year is likely to be minimal, but by 1979 a constant dollar GNP could lose nearly $4 billion of potential growth. Wharton believes the value of the prize will significantly offset the price - lower dependence on foreign oil, stabilization of gasoline consumption, and increased use of coal and solar energy. The Argus Research Corp. of New York and Merrill Lynch Economics Inc. are more pessimistic about the economy in the grips of the energy package and Kidder, Peabody and Co. Inc. is more optimistic. A Kidder, Peabody, and Co. economist believes that real growth prospects for 1978 have actually improved.

(ECONOMIC, FORECASTING)

ST77 12107 SOLAR COLLECTOR MANUFACTURING ACTIVITY. JULY THROUGH DECEMBER 1976. SEMI-ANNUAL REPORT

Stoll, R.D., (FEA, Washington, DC), 26 p., FEA/B-77/135, PB-266 985/1SL

This report contains the results of a survey of private firms that have manufactured and sold solar collectors during the second half of calendar year 1976.

(HEATING, INDUSTRY-SURVEY)

ST77 12108 INPUT-OUTPUT CAPITAL COEFFICIENTS FOR ENERGY TECHNOLOGIES

Tessmer, R.G., Jr., (Brookhaven National Lab., Upton, NY), 32 p., Dec 1976, BNL-50608
Input-output capital coefficients are presented for five electric and seven non-electric energy technologies. They describe the durable goods and structures purchases (at a 110 sector level of detail) that are necessary to expand productive capacity in each of twelve energy source sectors. Coefficients are defined in terms of 1967 dollar purchases per $10^6$ Btu of output from new capacity, and original data sources include Battelle Memorial Institute, the Harvard Economic Research Project, The Mitre Corp., and Bechtel Corp. The twelve energy sectors are coal, crude oil and gas, shale oil, methane from coal, solvent refined coal, refined oil products, pipeline gas, coal combined-cycle electric, fossil electric, LWR electric, HTGR electric, and hydroelectric.

(COMPARATIVE-EVALUATIONS)

ST77 12109 ACCESS TO SUNLIGHT

Thomas, W., (National Academy of Sciences, Washington, DC), Solar Radiation Considerations in Building Planning and Design, 1976, CONF-7504120, EDB-77:105395
Legal aspects of solar rights are discussed in general terms, ranging from the "Doctrine of Ancient Lights" to the Right to Light Act of 1959. Such concepts as the "Grumble Line" and negative easements are mentioned.

(LAND-USE, LAWS, LEGAL-ASPECTS, SOLAR-RADIATION)

ST77 12110 ECONOMIC ASPECTS OF U.S. ENERGY INDEPENDENCE IN THE COMING DECADE

Timmerhaus, K.D., Weitzel, D.H., (NBS, Washington, DC), Paper D-1 in Advances in Cryogenic Engineering, V 22:166-179, 1977, Pub. in Proceedings, International Cryogenic Materials Conference (1st), Kingston, Ontario, Canada, July 22-25, 1975, PB-267 225/1WE
There is no doubt that energy is a subject on the minds of many today. A great deal of what is being said about energy not only bears repeating, but requires careful evaluation and should be followed by constructive action. Energy research and development will play a central role in most of this nation's scientific, technological, and industrial endeavors for years, if not decades, to come. This is true not only because of the overwhelming importance of energy to the nation but because our energy problems-both immediate and long-range are complex. It is also true because the urgency of dealing with these problems must be brought home to the public and to people at all levels of responsibility in government, industry, and education. These problems have not vanished with the end of the oil embargo and the disappearance of lines at the gas stations. The United States will be living with them and working to solve them for a long time. Before turning to some of the solutions that might be considered for the coming decade, it is useful to make a few observations to illustrate the national and global impact of the energy situation.

ST77 12111 LATENT ECONOMICS

Tomkins, R., Wilson, M.G.J., Applegate, G., O'Shea, J., Burch, C.R., Parsons, I.T., Severn, R.T., (Imp Coll of Sci & Technol, London, England), Engineering,(London), V 216:405-411, 413-415, N6, June 1976
Schemes to make use of power going to waste in waterfalls, tides, winds and sunlight have always been a question of economics. With the increased costs and conservationists' warnings that stocks are not limitless, re-appraisals are underway of 'renewable' resources. Various aspects of the subject and how it is being dealt with in England are discussed, including solar energy, rotary generators, conservation and windmills.

(ENERGY-RESOURCES)

ST77 12112 ASSESSING THE POTENTIAL FOR OPTIMAL UTILIZATION OF OFF-PEAK POWER. VOLUME I. EXECUTIVE SUMMARY. FINAL REPORT

Walukas, D.J., (Westinghouse Research Labs., Pittsburgh, PA), Dec 29, 1975, PB-254774, EDB-77:093554
Avail:NTIS PC$3.50
A one-year four-task study and demonstration for assessing the potential for optimal utilization of off-peak power are described.

(DEMONSTRATION-PROGRAMS, PEAK-LOAD PRICING, ECONOMICS)

ST77 12113 ASSESSING THE POTENTIAL FOR OPTIMAL UTILIZATION OF OFF-PEAK POWER. VOLUME II. ELECTRICAL LOADS OFFERING MAJOR POTENTIAL FOR THE USE OF OFF-PEAK POWER. FINAL REPORT

Walukas, D.J., (Westinghouse Research Labs., Pittsburgh, PA), Dec 29, 1975, PB-254775, EDB-77:093555

Tasks 1 and 2 of a one-year study and demonstration for assessing the potential for optimal utilization of off-peak power are described. Three subtasks were performed in the completion of task 1: (1) study all of the major end uses of electric power, (2) determine the major potential uses of off-peak power, and (3) describe historical patterns of operation and make future projections. The effort in task 2 was divided into three subtasks: (1) analyze potential off-peak power use option for: (a) economic considerations to the utility, builder or manufacturer, and uses, (b) design characteristics, including safety, comfort, bulk / weight, and esthetics, (c) effects on the environment, (d) implementation problems and solutions, (e) research and long-term development required for implementation,and (f) economic, employment, and social costs and benefits / (2) describe the energy conservation potential of each off-peak power use option /.(3) determine the off-peak power use option best suited for a pilot demonstration.

(DEMONSTRATION-PROGRAMS, ECONOMICS, SOCIOLOGY)

## 13,000 THERMAL POWER

ST77 13114 ADVANCED THERMAL ENERGY STORAGE (TES) SYSTEMS. INTERIM SUMMARY REPORT, RESEARCH PROJECT 788-1

(Boeing Engineering and Construction, Seattle, WA), Nov 1976, EPRI-EM-256-SY, EDB-77:087245
Avail:NTIS PC$4.00

In December, 1974, EPRI initiated research for high temperature gas cooled central receivers for solar energy which included a contract (RP377-1) to Boeing Engineering and Construction (BEC) for receiver conceptual design of energy storage systems compatible with the higher temperature (816°C vs. 550°C) gas turbine systems. In February, 1976, an EPRI/ERDA program coordination was initiated to examine in greater detail the technical feasibility of high temperature thermal energy storage (TES). The two advanced systems are a phase change energy storage with inorganic salts and a reversible thermo-chemical reaction energy storage system A third system, a sensible heat pebble bed energy storage system, was investigated as a near term benchmark. The phase change concept offers the most economic incentive primarily as a result of its high storage density. Major technical barriers involve storage media and container material compatibility testing. The thermo-chemical concept is the most attractive from a plant control flexibility standpoint. The major technical uncertainty is the required catalytic $SO_3$ dissociation reactor.

(PAHSE-CHANGE, COMPARATIVE-EVALUATIONS, ECONOMICS, EUTECTICS, PERFORMANCE TESTING)

ST77 13115 AN ASSESSMENT OF ENERGY STORAGE SYSTEMS SUITABLE FOR USE BY ELECTRIC UTILITIES

Aware, p. 13-15, Mar 1977, A77-36982

The considered investigation shows that in the near-term hydro pumped storage, thermal storage integrated into a conventional power plant, and compressed air storage with combustion turbines appear technically and economically feasible. In the intermediate-term (1985-2000), advanced battery storage and hydrogen storage appear technically attractive and potentially economic. In the long-term (beyond 2000), superconductive magnetic energy storage systems could become technically feasible and might prove to be economic.

(FEASIBILITY-ANALYSIS, NEAR-TERM, INTERMEDIATE-TERM, LONG-TERM, ECONOMIC)

ST77 13116 ASSESSMENT OF ENERGY STORAGE SYSTEMS SUITABLE FOR USE BY ELECTRIC UTILITIES. VOLUME III. Final Report

(Public Service Electric and Gas Co., Newark, NJ), 112 p., July 1976, EPRI-EM-264(V.3)

This volume provides an expanded treatment of the material on conventional and underground pumped hydro found in Volume II of this report. Hydro pumped storage is a commercial reality. Many plants have been built and their costs and characteristics are well known. Nevertheless, there is a need for further research and study, particularly with respect to underground pumped storage. The possibility of using excavated caverns or abandoned mines as the lower reservoir in a pumped storage system opens up

opportunities for use of higher heads and possibly larger capacities. It also extends the area in which hydro pumped storage might be economically developed, and at the same time has environmental advantages. This report describes the current state of development for both conventional and underground pumped hydro and characterizes for each typical, or expected, unit sizes, head, efficiency, charge/discharge ratio, reliability and availability, storage capacity, turnaround time, life, and siting potential. Principal findings are that: hydro pumped storage is a well-developed, mature technology; where suitable sites are available for two surface reservoirs, no technical obstacles exist to impede implementation; underground reservoirs may extend the areas where hydro pumped storage can be used; and further development of high head equipment will be desirable for use in high head underground plants.

(RELIABILITY, CAPACITY, SITING, ECONOMICS, COMPARATIVE-EVALUATIONS)

ST77 13117 CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM. COLLECTOR SUBSYSTEM ANNUAL TECHNICAL PROGRESS REPORT

(Boeing Engineering and Construction, Seattle, WA), 45 p., Nov 14, 1976, SAN/1111-76-4, EDB-77:080029

In the Boeing collector subsystem concept, operating with a central receiver installation, circular membrane reflectors formed with aluminized polyester film, direct sunlight to the central receiver. Transparent air-supported plastic enclosures protect the lightweight reflectors from the environment. Reflectors are individually aimed with a 2-axis gimbal, driven by digital-controlled stepper motors. Minicomputers, at various locations in the heliostat field, provide signals to the stepper motors. Additional details of the collector subsystem design for both the Pilot Plant preliminary design (PD) baseline and research experiments is given. As part of this effort, three heliostats and a drive and control assembly are being fabricated and tested to provide design data and verification of the PD. In addition, an extensive evaluation program is being conducted on the key plastic materials used in the protective enclosure and reflector. Performance tests on large-scale heliostats are being conducted at a desert test site in northeast Oregon. Items completed during the past quarter include: fabrication of protective enclosures (domes) and reflectors; installation and initiation of environmental testing of two domes at Boardman, Oregon; and a major portion of assembly/integration tests on the collector subsystem, including domes, reflectors and the drive and control assembly.

(PILOT-PLANT, PLASTIC, DESERT TEST)

ST77 13118 CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM, PHASE 1 - FINAL QUARTERLY PROGRESS REPORT, PERIOD ENDING 31 MAR 1976

(Martin Marietta Corp., Denver, CO), 118 p., SAN/1110-76/1, MCR-76-131, E(04-3)-1110, N77-27550

Both twenty-five mirror and nine mirror heliostats were designed for the collector subsystem. The detail design of the 5 mW research experiment receiver was further developed. A preliminary draft of the detailed test plan for the receiver subsystem research experiment was prepared and the detailed design of the thermal storage subsystem continued. A preliminary environmental analysis was completed for the Pilot Plant. Optimization studies of the electrical power generation system were initiated. A preliminary cost analysis was prepared for the 10 mWe central receiver solar thermal Pilot Plant. This task required the development of a cost accounting structure and a definition of all of the costs associated with the design, construction, checkout, and two year test of the Pilot Plant.

(ENVIRONMENT-EFFECTS, HELIOSTATS, PILOT-PLANTS)

ST77 13119 CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM. PHASE 1 - 10-MW ELECTRIC PILOT PLANT

(ERDA, Washington, DC), 29 p., SE-103, N77-82637

No abstract available

(ENERGY POLICY, STORAGE, HELIOSTATS)

ST77 13120 HIGH-TEMPERATURE STORAGE PROCESSES REQUIRE RESEARCH IN MANY DISCIPLINES

Energy Res. Rep., V 3:1-3, N8, Apr 18, 1977, EDB-77:081999

Fluidized solids, above-ground pressurized hot-water storage, underground constant-pressure stores, and organic liquids are discussed for their energy storage capabilities.

(COMPRESSED-AIR, ECONOMICS, FEASIBILITY-STUDIES, RESEARCH-PROGRAMS, WORKING FLUIDS, COMPARATIVE-EVALUATIONS)

ST77 13121 HIGH-TEMPERATURE THERMAL ENERGY STORAGE: WORKING GROUP A

Energy, Oxford, V 2:59-69, N1, Mar 1977, EDB-77:100431

It is concluded that high-temperature heat storage offers great potential for reducing capital costs and saving premium fuels and could be extremely important in solar energy applications. It was generally agreed that the greatest near-term potential for energy saving lies in the more-efficient utilization of industrial process heat and the integration of power generation, process heat production, and waste heat recovery for space heating. For most effective use of capital, the best near-term potential involves improved storage of heat produced by off-peak power for house heating. The technology closest at hand is sensible heat storage. Based on potential benefits and probability of success, the most promising areas are: pressurized water storage / sensible heat storage in organic liquids for feed water heating / packed solid beds / and fluidized solids. Above-ground storage of hot water is in use now, but great potential exists for large-scale storage in underground strata. Technologies with good long-term prospects involve latent heat storage and chemical storage schemes. The most promising areas involve: inorganic phase change materials (e.g., fluoride eutectics) and chemical heat pipe (e.g., Eva-Adam). Further development of latent heat-storage systems, especially work on corrosion prevention, heat-transfer problems, and systems development should be encouraged, in order to take advantage of the superior storage capabilities of these materials. To adapt the chemical heat pipe principle to lower-temperature sources (e.g., LWR), the development of alternate chemical storage systems should be encouraged.

(ECONOMICS, COMPARATIVE-EVALUATIONS)

ST77 13122 INVESTIGATION OF STORAGE SYSTEM DESIGNS AND TECHNIQUES FOR OPTIMIZING ENERGY CONSERVATION IN INTEGRATED UTILITY SYSTEMS. VOLUME 1. (EXECUTIVE SUMMARY). Final Report

(Battelle Columbus Labs., OH), Mar 10, 1976, EDB-77:088605, N76-22662
Avail:NTIS PC$4.00

Integrated utility systems (IUS) have been suggested as a means of reducing the cost and conserving the nonrenewable energy resources required to supply utility services (energy, water, and waste disposal) to developments of limited size. The potential for further improving the performance and reducing the cost of IUS installations through the use of energy storage devices is examined and the results are summarized. Candidate energy storage concepts in the general areas of thermal, inertial, superconducting magnetic, electrochemical, chemical, and compressed air energy storage are assessed and the storage of thermal energy as the sensible heat of water is selected as the primary candidate for near term application to IUS.

(COMPARATIVE-EVALUATIONS, MIUS)

ST77 13123 INVESTIGATION OF STORAGE SYSTEM DESIGNS AND TECHNIQUES FOR OPTIMIZING ENERGY CONSERVATION IN INTEGRATED UTILITY SYSTEMS. VOLUME 2: (APPLICATION OF ENERGY STORAGE TO IUS). Final Report

(Battelle Columbus Labs., OH), Mar 10, 1976, EDB-77:088606, N76-22663
Avail:NTIS PC$5.50

The applicability of energy storage devices to any energy system depends on the performance and cost characteristics of the larger basic system. A comparative assessment of energy storage alternatives for application to IUS which addresses the systems aspects of the overall installation is described. Factors considered include: (1) descriptions of the two no-storage IUS baselines utilized as yardsticks for comparison throughout the study / (2) discussions of the assessment criteria and the selection framework employed / (3) a summary of the rationale utilized in selecting water storage as the storage systems / and (5) an assessment of IUS with water storage in alternative climates.

(COMPARATIVE-EVALUATIONS, MIUS)

ST77 13124 INVESTIGATION OF STORAGE SYSTEM DESIGNS AND TECHNIQUES FOR OPTIMIZING ENERGY CONSERVATION IN INTEGRATED UTILITY SYSTEMS. VOLUME 3. (ASSESSMENT OF TECHNICAL AND COST CHARACTERISTICS OF CANDIDATE IUS ENERGY STORAGE DEVICES). Final Report

(Battelle Columbus Labs., OH), Mar 10, 1976, EDB-77:088607, N76-22664
Avail:NTIS PC$8.00

Six energy storage technologies (inertial, superconducting magnetic, electrochemical, chemical, compressed air, and thermal) were assessed and evaluated for specific applicability to the IUS. To provide a perspective for the individual storage technologies, a brief outline of the general nature of energy storage and its significance to the user is presented.

(COMPARATIVE-EVALUATIONS, MIUS)

ST77 13125 STEAM GENERATING USING SOLAR ENERGY. SOLAR POWER PLANT SHOULD SUPPLY ELECTRICITY AND WATER - CONCEPT OF THE DFVLR AND MAN

VDI (Ver. Dtsch. Ing.) Nachr., V 30:16, N40, Oct 1976, EDB-77:092603, In German
No abstract available

(PARABOLIC REFLECTORS, THERMAL-POWER)

ST77 13126 TECHNICAL AND ECONOMIC FEASIBILITY OF SOLAR AUGMENTATION FOR BOILER FEEDWATER HEATING IN STEAM-ELECTRIC POWER PLANTS

(Franklin Inst. Research Labs., Philadelphia, PA), Nov 1976, COO-2864-1, EDB-77:080028, Avail:NTIS PC$5.00

This report presents the results of a five-month study on the technical and economic feasibility of augmenting the heating of boiler feedwater in steam-electric power plants by solar energy. The study was confined to investigating the possibility of retrofitting existing oil- or gas-fired steam plants with solar collection systems available now or in the near future. The use of four representative solar collectors was investigated in connection with different methods of single degree of freedom sun-following motions. For all collectors, daily sun-following without seasonal adjustment of tilt was found to be cost-effective. Solar augmentation of boiler feedwater heating does not constitute a cost-effective method of fossil fuel conservation. Under the most favorable conditions, an investment of $1200 or more is required to save one barrel of oil per year. Even if all potentially suitable power plants were equipped with solar augmentation, the resultant saving in oil and gas represents less than one-quarter of one percent of the current U.S. consumption of these fuels. A national survey of fossil fuel-fired steam-electric plants was conducted as a part of this study, and summary data are presented for each state.

(FEASIBILITY-STUDIES, RETROFITTING, THERMAL-POWER)

ST77 13127 UNDERGROUND COMPRESSED AIR ENERGY STORAGE

Andersen, R.D., Mitchell, A.S., (Fenix and Scisson, Inc., Tulsa, OK), Oklahoma State University, Stillwater, OK, 1976, Frontiers of Power Technology Conference, EDB-77: 067985

The compressed air energy storage (CAES) concept utilizes off-peak electrical energy to compress and store air in an underground receiver for later release into fuel-fired gas turbines that are used to supply power for generators during the peak load demand cycle. The advantage of having a pre-compressed air supply for the fuel-powered turbine is primarily one of fuel economy, as a substantial part (up to 70 percent) of the power produced by the turbine under conventional operations is used to compress the air for the turbine inlet. With the air already compressed during the off-peak cycle, a three-fold increase of useful electrical power is possible, or to put it another way, only one-third as many turbo-generators are necessary. Turbo-generator fuel requirements are correspondingly reduced and this may be the dominant factor in the development of compressed air storage. This paper presents the conclusions of a study to determine the economic and technical feasibility of utilizing various underground geologic environments for compressed air energy storage. These conclusions are based in part on work recently completed for ERDA. Participants in the study were General Electric Company, Fenix and Scisson, Inc. and United Engineers and Constructors, Inc. The Electric Power Research Institute is funding an ongoing effort by the same team for the conceptual design of a CAES facility for a specific site on the McIntosh Salt Dome in southwestern Alabama. The main emphasis of this paper is to describe the construction methods and design criteria for a CAES cavern in domal salt.

(ECONOMICS, FEASIBILITY-STUDIES, SITE-SELECTION)

ST77 13128 UTILIZATION OF SOLAR RADIATION AT LARGE SOLAR POWER PLANTS WITH HYDRAULIC STORAGE

Aparisi, R.R., Teplyakov, D.I., (State Power Eng Inst im. G.M. Krzhizhanovskii, USSR), Geliotekhnika, p. 3-10, N1, 1977, In Russian

The problem of storage of the energy produced at solar power plants requiring daily, seasonal and annual storage volumes as hydraulic storage is reviewed.

(PUMPED STORAGE, THERMAL-POWER)

ST77 13129 OPTIMUM CONCENTRATION RATIO FOR A SOLAR CENTRAL-RECEIVER ELECTRIC POWER PLANT

Baughn, J.W., (California, University, Davis, CA), Bergquam, J.B., (California State University, Sacramento, CA), ASME, Transactions, Series A - Journal of Engineering for Power, V 99:490-491, July 1977, A77-41865
No abstract available

(THERMAL-POWER)

ST77 13130 HEAT PIPE CENTRAL SOLAR RECEIVER. SIMIANNUAL PROGRESS REPORT, MARCH 1, 1976-AUGUST 31, 1976

Bienert, W.B., Wolf, D.A., (Dynatherm Corp., Cockeysville, MD), Nov 1976, COO/2839-1, EDB-77:092605
The objective of this program is the development of a solar-to-gas heat exchanger for a central receiver power plant. The concept is based on the use of heat pipes to transfer the concentrated solar flux to the gaseous working medium of a Brayton cycle conversion system. An open air cycle with recuperator and a turbine inlet temperature of 800°C (approximately 1500°F) was selected as the optimum choice. It yields a conversion efficiency of approximately 32 percent and an overall solar-to-electric efficiency of 20 percent. The light weight of gas turbine equipment opens the being of the cavity type and one being an external receiver. The required thermal diffuser heat pipes use liquid metal as the working fluid. The optimum size is approximately 5 cm in diameter and 2 to 3 m in length. The design axial heat flux is 10 $mW/m^2$ which corresponds to a heat transfer rate of 20 kW per heat pipe. The theoretical foundations of these heat pipes have been developed and subscale prototypes have been tested successfully. The radial and axial heat fluxes of the prototypes met and exceeded the requirements for the full-scale heat pipes.

(BRAYTON-CYCLE, CENTRAL-RECEIVERS, PERFORMANCE TESTING, RESEARCH-PROGRAMS, TOWER-POWER, WORKING FLUIDS)

ST77 13131 100 MWE SOLAR POWER PLANT DESIGN CONFIGURATION AND PERFORMANCE

Blake, F.A., (Martin Marietta Aerospace, Denver, CO), NSF AER-74-07570, San Diego, CA, American Astronautical Society, p. 1293-1300, 1977, In Space Shuttle Missions of the 80's; Proceedings of the Twenty-First Annual Meeting, Denver, CO, Aug 26-28, 1975, Part 2, AAS 75-288, A77-36526 16-12, A77-36556
Design parameters for a proposed 100 mWe solar power plant include layout area, 405 acres (8 modules of 45 acres for solar energy collection and 1 module of 45 acres for power plant site); 1840 heliostats in each of the 8 collector modules, with each heliostat being 400 sq ft in area; the turbine-generator would be one unit rated at 100,000 kWe operating on 1250 psig, 950°F steam; air-cooled condenser; tower-mounted heat exchanger system would involve 8 units mounted along south border of modules, with a tower height of 400 ft or 450 ft above lowest elevation mirror; and the boiler/superheater would have a cavity configuration with 20 sq ft apertures. Design features and the projected performance are examined in detail.

(ECONOMICS, RESEARCH-DEVELOPMENT, THERMAL-POWER)

ST77 13132 SOLAR ENERGY SUN TRACKER

Blitz, D., Mar 22, 1977, US Patent 4,013,885, EDB-77:105475
A sun tracking Servo system is disclosed in which individual mirrors are tilted to redirect incoming sunlight towards a solar energy receiver. Mirror steering is accomplished by providing the mirror with a central aperture and/or lens to form images of both the sun and receiver behind the mirror and by lining up the IR image of the solar receiver with a reflection of the image of the sun from a reflecting back surface of the mirror by rotating the mirror about its central aperture. Image alignment is detected by a sensor behind the mirror which is in line with the aperture and the receiver. Each mirror is provided with a projection screen type imaging surface affixed to and spaced from the back side of the main mirror onto which an image of the sun is formed. In one embodiment a limited aperture reflector is positioned on the back of the mirror to reflect the sun's image from the projection screen to a stationary combined solar image and receiver image detector only when the mirror is pointed in the proper direction. In another embodiment, the solar/receiver image detector is moved to compensate for motion of the solar energy receiver such as that caused by sway of its supporting tower or shifting of the mirror gimbal supporting structure, thereby keeping the solar/receiver image detector centered along the line between the aperture of the mirror and the instantaneous position of the solar energy receiver.

(ALIGNMENT, CENTRAL RECEIVERS, HELIOSTATS, TRACKING, PATENT, TOWER-POWER)

ST77 13133 AUTOCORRELATION AND STOCHASTIC MODELLING OF INSOLATION SEQUENCES - FOR SOLAR THERMAL SYSTEMS

Brinkworth, B.J., (University College, Cardiff, Wales), Solar Energy, V 19:343-347, N4, 1977, A77-44479

The output of solar thermal systems is sensitive to variations in the solar energy input. Among the important features of these variations is their sequential character, which has not hitherto been taken into account. It is shown that the sequential characteristics of the daily insolation can be represented in simple numerical terms, derived from the autocorrelation functions of a straightforward stochastic model. Synthetic sequences can then be generated, which match the long-term characteristics of the insolation with respect to its sequential properties, as well as to the seasonal trend and the variance of the fluctuations.

(CLOUDS, STORAGE, MATHEMATICAL MODELS)

ST77 13134 PROCESS AND DEVICE FOR THE CONVERSION OF LOW-TEMPERATURE HEAT INTO DRIVING FORCE OR ENERGY

Brola, G., Oct 7, 1976, German (FRG) Patent 2,611,890/A//, EDB-77:093625, In German

About 60-75 percent of the energy used in industry is emitted into the environment as waste heat with a low thermal potential. With this invention, waste heat, the heat of geothermal hot waters, and solar heat are to be made usable. The conversion of this heat into propulsive power or energy with a higher thermal potential is to be carried out by the introduction of this heat into a thermodynamic cycle working with two streaming media or fluids. The primary medium should be condensable and is expanded for energy production. Saturated hydrocarbons and fluorinated hydrocarbons are to be used as primary medium in accordance with the desired temperature. Air serves as secondary medium, preferably. The produced heat is to be utilized especially for air conditioning. The further claims describe different kinds of methods and devices for the carrying-out of the binary thermodynamic cycle.

(BINARY FLUID-SYSTEMS, CLOSED-CYCLE, WORKING FLUIDS, THERMAL-POWER, PATENT)

ST77 13135 THERMAL ENERGY STORAGE AND UTILIZATION SYSTEM

Cahn, R.P., Jan 18, 1977, US Patent 4,003,786, EDB-77:081835

The power output from a nuclear power plant or fossil fuel power plant operating under constant reactor (or furnace) and boiler conditions is varied by regulating the rate of turbine extraction steam and primary high pressure steam used to heat boiler feed water (BFW). During periods of low power demand excess extraction steam is drawn off to heat excess quantities of boiler feed water. One portion of the BFW is fed to the boiler while the other portion is used to reheat a low vapor pressure (LVP) organic material which is stored under an inert atmosphere at atmospheric pressure in a high temperature storage location means. During periods of high power demand BFW preheat duties would be taken over entirely by the moving LVP organic material, moving from hot to cold storage location means, use of extraction steam for BFW reheat being curtailed and such untapped extraction steam being allowed instead to expand itself fully in the turbines. The boiler at all times receives a constant amount of uniformly preheated BFW.

(OFF-PEAK, PATENT, WORKING FLUIDS, SYSTEM-REVIEW)

ST77 13136 PROCESS FOR ADAPTING A HEAT SOURCE AND A THERMAL MACHINE BY TEMPORARY HEAT STORAGE

Cahn, R.P., Nicholson, E.W., Dec 15, 1975, French Patent 2,295,537/A//, EDB-77:100175, In French

The process described is intended to ensure the efficient use of the heat from a nuclear reactor or from a furnace burning fossil fuel at constant power, and of a boiler in a power station comprising a multi-stage steam turbine, the steam extracted from the turbine being used for pre-heating the boiler feed water. This process is most flexible with a varying load. It includes the high temperature storage of the excess heat energy in a low vapor pressure storage liquid (hydrocarbon oils, molten salts or liquid metals) at atmospheric pressure when the demand is low / then, when the energy demand is at its height, the reduction of steam extraction from the turbine with simultaneous utilization of the hot heat storage liquid for the various maintenance heating functions of the power station by heat exchange, so that the heat can expand totally in the turbine with generation of energy.

(PATENT, LATENT-HEAT, THERMAL-POWER)

ST77 13137 SOLAR ENERGY APPARATUS AND METHOD

Clark, R.O., Dec 21, 1976, US Patent 3,998,056, EDB-77:080058
Method and apparatus for converting solar energy to mechanical or electrical energy includes an enclosed fluid containing field of pipes and a reservoir in fluid communication therewith. During the daylight hours, solar produced heat impinges upon the field causing the fluid therewithin to expand. The expanding fluid escapes from the field via a pipe through which it is conducted to the reservoir through a fluid turbine to produce rotational mechanical energy. During the nighttime, the volume of the fluid contracts, reversing the process. The fluid at night returns from the reservoir to the field, again being conducted through the turbine to produce mechanical rotational energy in the process. Throughout the entire process, the fluid remains in a substantially incompressible state.

(PATENT, STORAGE, HEAT ENGINES, WORKING FLUIDS)

ST77 13138 SOLAR ENERGY AND ENERGY STORAGE - FRENCH BOOK

Dumon, R., (Heurtey, S.A., Paris, France), Paris, Masson Et Cie., Editeurs, 143 p., 1977, A77-36104, In French, PC$15.20
The centrality of the problem of storage of solar energy to cope with day/night alternation, inclement weather, and cloudiness or cloud passages that render solar energy input variable and unpredictable is addressed, and advances in energy storage pertinent to large-scale solar energy use are reviewed. Energy storage in general, storage of nuclear energy and solar energy in particular, and problems specific to solar energy storage are covered. Modes of energy storage discussed include hydraulic pumping, pressurized vapor batteries, compressed air, inertial storage, electromagnetic storage, electrochemical batteries, hydrogen storage, and thermal storage. Varieties of heat storage facilities for different temperature ranges are discussed. Photosynthesis, corrosion, and various heat-transfer media are dealt with.

(COMPRESSED-AIR, HYDROGEN, PHOTOSYNTHESIS, LARGE-SCALE, COMPARATIVE-EVALUATIONS)

ST77 13139 SANDIA STUDIES FOR ERDA CENTRAL RECEIVER THERMAL ELECTRIC POWER PROJECT - SOLAR GENERATING SYSTEM

Eicker, P.J., Brune, J.M., (Sandia Laboratories, Livermore, CA), Instrument Society of America, Pittsburgh, PA, p. 632-635, 1976, In Modeling and Simulation, Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, PA, Apr 26-27, 1976, Part 1, A77-38176 17-66, A77-38208
Studies underway for the ERDA Central Solar Thermal Electric Pilot Plant Project are outlined. The factors under consideration in evaluations of the economic impact of the central receiver solar thermal power system are discussed. Procedures used in margin analysis and transient response analysis are described, together with the system operation model and mirror field models.

(ECONOMICS, BOILERS, TRANSIENT-RESPONSE, MIRROR-FIELD MODELS)

ST77 13140 HEAT ENGINE

Feurer, B., Beschorner, F., Aupor, H., Mar 20, 1975, German (FRG) Patent 2,340,269/A//, EDB-77:101279, In German
A heat engine with heat injection from outside, particularly a hot gas engine, is described. A heater is arranged in the flow path of the working medium, to which the heat produced by an outer combustion system is taken. The heat can also be taken from a heat store, which is charged via an outside combustion system, e.g. from waste gas. This ensures good running of the hot gas engine during the charging of the heat store, as this is only charged with waste gas in practice. As the charging process is separate from engine operation, no regulating process is required to adapt the charging process to all operating conditions. By the process according to the invention, an improvement of the efficiency of the hot gas engine can be achieved.

(PATENT, CONTROL-EQUIPMENT, STIRLING ENGINES, STORAGE)

ST77 13141 LOW-PROFILE HELIOSTAT DESIGN FOR SOLAR CENTRAL RECEIVER SYSTEMS

Fourakis, E., Severson, A.M., (Honeywell Systems and Research Center, Minneapolis, MN), Solar Energy, V 19:349-356, N4, 1977, NASA-Supported Research, A77-44480
Heliostat designs intended to reduce costs and the effect of adverse wind loads on the devices were developed. Included was the low-profile heliostat consisting of a stiff frame with sectional focusing reflectors coupled together to turn as a unit. The entire frame is arranged to turn angularly about a center point. The ability of the heliostat to rotate about both the vertical and horizontal axes permits a central computer control system to continuously aim the sun's reflection onto a selected target.

An engineering model of the basic device was built and is being tested. Control and mirror parameters, such as roughness and need for fine aiming, are being studied. The fabrication of these prototypes is in process. The model was also designed to test mirror focusing techniques, heliostat geometry, mechanical functioning, and tracking control. The model can be easily relocated to test mirror imaging on a tower from various directions. In addition to steering and aiming studies, the tests include the effects of temperature changes, wind gusting and weathering. The results of economic studies on this heliostat are also presented.

(WIND-LOADS, COMPUTER CONTROL-SYSTEM, TRACKING, WEATHERING)

ST77 13142 THE RATE OF MASS TRANSFER IN A SOLAR REGENERATOR

Gandhidasan, P., Sriramulu, V., Gupta, M.C., (Indian Institute of Technology, Madras, India), Letters in Heat and Mass Transfer, V 4:185-192, May-June 1977, A77-39109

A study of the effect of a moving liquid film and an air stream on gas-phase controlled convective heat and mass transfer has been made, which would find widespread application in devices which utilize solar energy. The governing equations for air phase have been solved for various values of the ratio of liquid to air velocity. Profiles of velocity, temperature, and concentration as well as their gradients are presented. The results, compared with experimental findings obtained with mass transfewr being extended to the liquid phase as well, show an encouraging trend.

(TEMPERATURE-DISTRIBUTION, VELOCITY-DISTRIBUTION, MATHEMATICAL MODELS, WORKING FLUIDS)

ST77 13143 CLOSED CYCLE, HIGH-TEMPERATURE CENTRAL RECEIVER CONCEPT FOR SOLAR ELECTRIC POWER

Gintz, J.R., (Boeing Co., Seattle, WA), Feb 1976, PB-254399, EDB-77:092606
Avail:NTIS PC$6.00

The report presents the detailed results of a study into the technical feasibility of a high temperature central receiver in a solar plant employing closed cycle helium as a heat transport fluid. Feasibility was examined in terms of system life, efficiency, cost and technology requirements. These considerations are implemented in the conceptual design of a preferred receiver and its components for utilization in a solar plant of 100 megawatt electrical power output. The rationale is provided which supports the configuration, equipment arrangement, and material choices. A thermal cycling test simulating a 30-year lifetime of the receiver heat exchanger at temperatures to 816°C (1500°F) and at 34 Bar (500 Psi) helium pressure, confirmed the material choice. A preliminary design of a model receiver, appropriately scaled to 1 megawatt of thermal energy into the receiver, is presented as a candidate for early test. The report also contains system/supporting subsystem definition for employing the preferred central receiver in a solar plant, and recommendations for further development efforts.

(100-1000 MW, TOWER-POWER, WORKING FLUIDS, FEASIBILITY-STUDIES)

ST77 13144 COMPOUND PARABOLIC CONCENTRATORS FOR SOLAR-THERMAL POWER SEMIANNUAL PROGRESS REPORT, JAN-JUNE 1975

Giugler, R.M., Rabl, A., Reed, K., Sevcik, V.J., Winston, R., (Argonne National Lab., IL), 26 p., W-31-109-ENG-38, ANL-75-52, N77-75723

No abstract available

(CONSTRUCTION, MATHEMATICAL MODELS)

ST77 13145 APPLICATION OF SOLAR ENERGY IN THE HIGH-TEMPERATURE RANGE

Gnugesser, E., Mukherjee, S.K., Riebold, G., (Kraftanlagen A.G., Heidelberg, Germany, F.R.), Brennst.-Waerme-Kraft, V 28:470-474, N12, Dec 1976, EDB-77:072980, In German

The possibilities of solar-technological application for processes with operating temperatures above 100°C (373°K) are discussed, and the present state of the technology is described. Cooling, sea-water desalination, process heating and solar-thermal power stations are such processes. The specific properties of the concentrating collectors are also mentioned.

(DESALINATION, PROCESS-HEAT, CONCENTRATORS, THERMAL-POWER, TECHNOLOGY-ASSESSMENT)

ST77 13146 CONJUGATED CYCLES OF SINGLE-LOOP SOLAR ENERGY REFRIGERATING PLANTS

Grilikhes, V.A., Evseev, V.S., Chikovani, V.V., Geliotekhnika, p. 50-58, N1, 17 refs, 1977, In Russian

More than one thermodynamic cycle in single-loop thermal power plants can be considered from general topological and thermodynamic aspects. Conjugated cycles in

solar energy refrigerating plants and in radiant energy concentrators with radiation heat removal into the environment are organized.

(THERMAL-POWER)

ST77 13147 CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM, PHASE 1. CDRL ITEM 10. THIRD QUARTERLY TECHNICAL PROGRESS REPORT, 1 APRIL 1976-30 JUNE 1976

Hallet, R.W., Jr., Gervais, R.L., (McDonnell Douglas Astronautics Co., Huntington Beach, CA), July 1976, SAN-1108-76-3, EDB-77:105473

Results of analysis and design efforts by McDonnell Douglas Astronautics Company (MDAC), Rocketdyne, Stearns-Roger, Inc., Sheldahl, Inc., and the University of Houston between 1 April 1976 and 30 June 1976 on ERDA Contract No. EY-76-C-03-1108 are summarized. This is the third quarterly technical progress report published on the Phase 1 Central Receiver Solar Thermal Power System Contract. The dominant activities during the reporting period have involved the preparation of test facilities for the subsystem research experiments and the fabrication of the test hardware. Summaries of these activities are presented. Alternative design approaches for the 10-mWe pilot plant system and the current pilot plant project schedule are also presented and described.

(10-MW, CONSTRUCTION, STORAGE, PILOT-PLANTS, TEST-FACILITIES)

ST77 13148 SOLAR COLLECTION MODULE TEST FACILITY, INSTRUMENTATION FLUID LOOP NUMBER ONE

Harrison, T.D., Dworzak, W.R., Folkner, C.A., Jr., (Sandia Labs., Albuquerque, NM), 40 p., Jan 1977, SAND-76-0425, EDB-77:087238

This document provides information needed to establish the interface between Fluid Loop No. 1 of Sandia Laboratories' Solar Collector Module Test Facility and an item to be tested on the loop. While data on mechanical, electrical, instrumentation, and fluid loops are not sufficient to enable complete planning for every possible test, they are judged adequate to enable initiation and completion of interface specifications with a minimum of additional data and effort. Fluid Loop No. 1 is designed to evaluate collectors and components of collectors using Therminol 66 as a heat transfer fluid. Fluid Loop No. 1 will deliver heat transfer fluid to the test item at temperatures from 20°C to 315°C (70°F to 600°F) at flow rates from 0.1 gpm to 10.0 gpm at pressures up to 0.51 MPa (75 psig). Fluid Loop No. 1 has a weather station and an HP 2116 minicomputer which is capable of directing the test, acquiring data, and performing calculations.

(MINICOMPUTER, CONTROL-SYSTEMS)

ST77 13149 SOLAR POWER PLANT

Horton, P.F., Feb 8, 1977, US Patent 4,006,594, EDB-77:073032

A solar power plant is described, having a means for collecting solar heat and a means for applying the heat so collected to a selected portion of a plurality of expansile-contractile members movably mounted between two wheels set at a desired angle on to the other, said wheels being rotatably mounted upon a frame. Heating or cooling a member causes either expansion or contraction of the member with a resultant linear force being developed between corresponding points on said wheels / said linear force being translated into rotational force as the wheels rotate in such direction as to relieve the linear force. Successive heating and cooling of said members enables continuous rotation of the wheels and a resultant work output. A power take-off unit is provided.

(PATENT, HEAT ENGINES, THERMAL-POWER, MECHANICAL-CONVERSION)

ST77 13150 1-MW SOLAR BOILER TESTED

Howell, Y., Sunworld, p. 7-9, Feb 1977, A77-36349

Design and testing of equipment for a 1000 kW solar furnace facility to be operated in the French Pyrenees are described. The Pilot Plant will promote studies of high-temperature properties of metals and ceramics. The furnace is the only existing facility large enough to test components for solar 'power tower' systems. The solar energy receivers, the array of 63 heliostats in tiers with mirrors tracking the sun's motion across the sky under control by sensors in the reflected beam, the 1 mW boiler (8 ft tall, 10 tons), parabolic concentrator, focal sheet, and furnace buildings are described. Initial test results verified design and operational procedures. Future scale-up plans are mentioned.

(SOLAR-FURNACES PILOT-PLANT, SCALE-UP PLANS)

ST77 13151 METHODOLOGY FOR SITE SELECTION OF A SOLAR TOTAL ENERGY LARGE SCALE EXPERIMENT

Hunke, R.W., (Sandia Labs., Albuquerque, NM), Mar 1977, SAND-77-0248, EDB-77:105491
The development of the evaluation criteria for a site (a parcel of real property with a development-apparatus, equipment, facilities, etc.) for a solar total energy, large scale experiment is described. The large scale experiment's desired characteristics are described. The evaluation criteria are given together with an algorithm for the calculation of the expected value of proposals.

(1-TO-3 MW-THERMAL, 200-TO-500 KW-ELECTRICAL, DEMONSTRATION-PROGRAMS, STORAGE, HEAT ENGINES)

ST77 13152 SYSTEM FOR COLLECTING AND UTILIZING SOLAR ENERGY

Jahn, A., Dec 21, 1976, US Patent 3,998,206, EDB-77:080024
A novel and simplified system and apparatus is disclosed herein for efficiently collecting and utilizing solar energy. Fundamentally the invention employs a reflector-supporting medium or frame which is mounted for orbital travel. A large substantially parabolic reflector unit is mounted on said supporting medium for swinging or oscillation. A stationary boiler or generator is immovably supported on an upstanding rigid post or tower and has a spherical, exterior, heat-absorptive surface. Preferably, a heat-insulated shield member is employed, surrounding most of the exterior of the spherical boiler and rigidly supported from the reflector unit.

(PATENT, BOILERS-DESIGN, PARABOLIC REFLECTORS, THERMAL-POWER, TRACKING)

ST77 13153 HEAT MIRRORED SOLAR ENERGY RECEIVERS

Jarvinen, P.O., (MIT, Lexington, MA), AIAA Paper 77-728, 6 p., American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, NM, June 27-29, 1977, USAF-Sponsored Research, A77-39506
Transparent heat mirrors that transmit in the visible and reflect in the infrared, being developed at the M.I.T. Lincoln Laboratory for Solar Energy Applications, include such film types as metal, semiconductor, composite layer, and thin-film microgrids. The improved performance realized in a windowed, high temperature (1000-3000$^{o}$F) cavity receiver by heat mirrors are evaluated. Theoretical predictions for an idealized heat mirror cavity show potential operating efficiency improvement of 20 to 30 points depending on incident sun levels and cavity operating temperatures. Existing heat mirrors approach the efficiencies predicted for ideal heat mirrors.

(INFRARED-REFLECTION, LIGHT-TRANSMISSION, PERFORMANCE TESTS, CAVITY-RECEIVER, HEAT MIRRORS)

ST77 13154 CONCEPTS FOR CENTRAL SOLAR ELECTRIC POWER GENERATION

Kintigh, J.K., (Black and Veatch Consulting Engineers, Kansas City, MO), 1974, Univ. of Oklahoma, Stillwater, OK, Seventh Annual Front of Power Technology Conference, EDB-77: 066088
It is concluded that the best design concept for central solar electric generation is the central receiver system in which solar radiation is redirected by an array of heliostats and collected at one central receiver which is supported by a tower. The solar energy is absorbed as heat by this central receiver and heat is transferred into the working fluid. The uncertainties associated with the production of central solar electric power are not those of technical feasibility but involve economics and the compatibility of solar power plants with existing electrical systems. It is consequently difficult to predict the impact of central solar electric generation on the future of the electric utility industry. The major economic issue related to solar electric generating plants is their high capital cost.

(UTILITY, CENTRAL-RECEIVERS, ECONOMICS, HELIOSTATS, TOWER-POWER)

ST77 13155 SOLAR THERMAL POWER PLANTS

Kleinrath, H., (Tech Univ, Vienna, Austria), Elektrotech Maschinenbau, V 94:19-29, N1, 15 refs, Jan 1977, In German
Various collecting systems are discussed and compared: flat plate collectors, concentrating collectors, and the tower concept. Power-plant projects are presented, including an American central tower power plant capable of generating 250 Mw. A similar Swiss project rated at 50 Mw is also described.

(CENTRAL-TOWER, COMPARATIVE-EVALUATIONS)

ST77 13156 ERDA'S CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM STUDIES

Lippy, L.J., Heaton, T.R., (Martin Marietta Corp., Denver, CO), In NASA. Marshall Space Flight Center Proc. of the ASPE/MSFC Symp. on Eng. and Productivity Gains From Space Technol., p. 95-123, See N77-30273 21-31, N77-30279

The utilization of solar energy for electrical power production was studied. Efforts underway on the central receiver solar thermal power system are presented. Preliminary designs are included of Pilot Plant utilizing large numbers of heliostats in a collector field. Safety hazards are also discussed, as well as the most beneficial location of such a plant within the United States.

(HELIOSTATS, CENTRAL-RECEIVER, THERMAL-POWER, SAFETY HAZARDS, UNITED-STATES)

ST77 13157 THREE GIANT MIRRORS WILL TRACK THE SUN IN TEXAS POWER UNIT

Lobrovich, M., Public Power, V 35:20-21, N2, 1977, EDB-77:105472

Citizens of Crosbyton, Texas are cooperating with Texas Tech University and industry to develop a solar generating plant after suffering from natural gas shortages and subsequent price increases. Funded by ERDA, the project will offer a practical solution for other small towns lacking or unable to afford conventional fuels if it is successful. The fixed mirror / distributed focus (FM / DF) design uses three 100-yard hemispherical mirrors as collectors rather than a large number of small mirrors focusing on a central collector. A steam boiler suspended in the bowl will track the sun, and steam from circulating water will be piped to a conventional turbine generator. Costs of the project are estimated at $18 to $22 million for the 5,000-kW plant. Information on soil composition, wind, sunlight hours, and materials will be collected by the university for the next 30 months, when construction will begin. Public enthusiasm is high in Crosbyton because local cotton farmers need power for irrigation. Smaller versions of the municipal plant could be adapted for use in cooperative irrigation projects in arid agricultural areas.

(5-MW PLANT, ECONOMICS, IRRIGATION, PUBLIC-RELATIONS, COMMUNITY-POWER)

ST77 13158 ELECTRO-STORAGE HEATING BY MEANS OF LATENT HEAT

Marcus, J., Sept 2, 1976, German (FRG) Patent 2,506,818/A//, EDB-77:100428, In German

The invention deals with electro-storage heating using the conversion heat between the liquid and solid state of crystal soda ($Na_2CO_3 + 10H_2O$) or glauber salt ($Na_2SO_4 + 10H_2O$). This substance is filled into glass blocks which are glued to each other using cold-hardening polyester resin, after the resistance cable to be electrically heated has been placed between them. The glass blocks are closed after filling with the above-mentioned substances using a black crystallization-inducing stopper penetrating into the glass block.

(PATENT, SODIUM CARBONATES, SODIUM SULFATES)

ST77 13159 SOLAR THERMAL ELECTRICITY - POWER TOWER DOMINATES RESEARCH

Metz, W.D., Science, V 197:353-356, July 22, 1977, A77-40647

The Energy Research and Development Administration (ERDA) has tended to favor development of centralized solar thermal generating plants at the expense of smaller scale intermediate-temperature systems, though, according to a report from the Office of Technology Assessment (OTA), the large solar electric plant, such as the 'Power Tower' presently being promoted by ERDA and the Electric Power Research Institute (EPRI), may not necessarily produce energy more efficiently than small on-site facilities. Features and costs of the heliostats being designed for the 'Power Tower' by various companies are compared. Subsidiary problems in developing the 'Power Tower', including design of the boiler, and construction of the tower itself are also discussed.

(ENERGY-TECHNOLOGY, CENTRALIZED, ON-SITE, DECENTRALIZED, ECONOMICS)

ST77 13160 APPARATUS FOR CONVERTING SOLAR ENERGY INTO MECHANICAL ENERGY

Neidigh, R., Nov 2, 1976, US Patent 3,989,417, EDB-77:073031

An apparatus for producing mechanical energy utilizing the sun's rays is disclosed. The apparatus includes a continuously rotating structure having a plurality of thermally actuated pump units, consisting of a temperature sensitive cell and a piston assembly, mounted thereon. A focusing means concentrates solar rays on a number of the cells causing the expansion of material contained in each cell, resulting in the extension of a piston rod, the compression of a cylinder within the piston assembly and the transfer of fluid contained therein to a high pressure accumulator for operating hydraulic motors or the like. When rotated from under the focusing means, the cell cools resulting in a decrease in volume of the expansible material and a retraction of the piston rod causing fluid to enter the piston assembly from a reservoir. The pump unit

is thus prepared for another cycle of operation beginning when the rotatable structure has completed a full revolution and the cell is again exposed to the focused rays of the sun.

(PATENT, CONCENTRATORS, HEAT ENGINES, THERMAL-POWER)

ST77 13161 OFF-PEAK THERMAL STORAGE IMPROVES CUSTOMER/UTILITY LOAD FACTOR

Owens, K., Electr. Light Power, Boston, V 54:27-28, N11, Nov 1976, EDB-77:106681
Public Service of New Hampshire is convinced that electrically heated, thermal storage systems can save the company considerable money in deferred capital expense and can help increase the company's return on investment through an improved system load factor. To date the company, by virtue of 15 thermal storage installations, has been able to shift about 8500 kW of potential on-peak demand to actual off-peak consumption. This kilowatt figure is about one percent of the New Hampshire utility's peak load and a load factor improvement that could save considerably in pruchase power costs the first year to benefit both utility and customer. James F. O'Malley, Director of Marketing for PSNH, explained that, "The only sizable controllable load in a commercial facility is the building's heat and hot water requirements. If all that thermal energy can be supplied by a system that consumes only electric energy during off-peak hours, a rather large block of electric energy can be moved from our daily peak hours to the off-peak night hours. We are presently testing the megatherm thermal storing system in 15 installations around New Hampshire and are excited about the result so far."

(MEGATHERM-SYSTEM, NEW-HAMPSHIRE, ECONOMICS, LOAD-MANAGEMENT)

ST77 13162 APPARATUS FOR GENERATING POWER USING ENVIRONMENTAL TEMPERATURE DIFFERENTIALS

Peters, M.F., Dec 7, 1976, US Patent 3,995,429, EDB-77:080023
A system is described of generating electric power derived from the energy of the sun, the atmosphere, the ground or the heat stored in ground water, whichever provides the greatest temperature differential with another adjacent source of energy. During the daytime when the sun is shining, a solar absorber composed of a plurality of black pipes may provide the heat necessary to generate power. At night when the air temperature is lowered, a set of pipes in the ground or in a lake may provide the heat necessary to extract power by using the low temperature of the environment. A third source of heat such as geothermal heat, stored heat or a heat pump may be part of the system. Switching means are used to convert from one system to another depending upon which system has the greatest temperature differential.

(PATENT, STORAGE, THERMAL-POWER)

ST77 13163 DYNAMIC CONVERSION OF SOLAR-GENERATED HEAT TO ELECTRICITY. VOLUME 2 - EXECUTIVE SUMMARY - Final Report

Powell, J.C., (Honeywell, Inc., Minneapolis, MN), NASA-CR-134723, 102 p., NAS3-18014, N77-76546
No abstract available

(ENERGY POLICY, MONTE-CARLO-METHOD, THERMAL-POWER)

ST77 13164 USE OF DATA PROCESSING INSTALLATIONS FOR ENERGY STUDIES IN INTERCONNECTED SYSTEMS

Pozar, H., (Univ Zagreb, Yugoslavia), OZE Oesterr Z Elektr, V 30:15-25, N1, 22 refs, Jan 1977, In German
Operation studies relating to an interconnected system require a large amount of calculation work and data storage where interconnected systems are treated to include both hydro and thermal generating plants. The situation becomes more complicated where storage and pumped storage exist in an interconnected system.

ST77 13165 SUPPORT STRUCTURE FOR SOLAR ENERGY CONVERTER

Radebold, R., Jan 11, 1977, US Patent 4,002,158, EDB-77:072981
A plurality of solar energy conversion units, each with a reflecting mirror, are disposed on top of a stem or reed-like tower composed of a bundle of major supply tubes each terminating in a conversion unit plus mirror combination with additional tubes provided in the stem for up and down transport of gases and liquids. Particularly buoyant mirror constructions and anchoring facilities for the bundle are described.

(PATENT, ANCHORING, PARABOLIC REFLECTORS, THERMAL-POWER)

ST77 13166 SOME EFFECTS OF PUMPED STORAGE ON SYSTEM RELIABILITY

Rattray, W.G., Cave, D.J., (South of Scotland Electr Board, Glasgow, Scotland), IEE Conf Publ, London, Conf on Reliab of Power Supply Syst, London, England, Feb 21-23, 1977, Publ by IEE, London, England, p. 51-55, N148, 2 refs, 1977

Pumped storage plants offer advantages as: system frequency regulation, provision of spinning and short notice reserve. The inclusion of pumped storage significantly reduces overall system reliability. A computer model has been employed to simulate system operation.

(COMPUTER MODEL)

ST77 13167 WHY A HELIOSTAT?

Russell, G.F., (Mann-Russell Electronics, Inc., Tacoma, WA)

The Heliostat which performs the directory functions, has a newly developed "Shadowfax" Director Head which is both cheap and effective and can hold the collector carriage regularly to an accuracy of within only a small part of one degree of arc. The software for a computer program to do this simple job would involve predetermining, storing and retrieving directional data for each moment, each day, both in Azimuth and Elevation for each location in the country which is separated apart by only a few feet, and would cost a prodigious sum.

(COMPUTER PROGRAM, TRACKING, ECONOMICS)

ST77 13168 HEAT ACCUMULATOR FOR OPERATION WITH ELECTRICITY OR SOLAR ENERGY

Schmid, A.W., July 17, 1975, German (FRG) Patent 2,401,859/A//, EDB-77:067887, In German

A heat accumulator for temperatures between 373°K and 3,273°K is described. The accumulator material is a graphite or coal mass. The accumulator core is surrounded by graphite reflector shells for heat insulation. The outer shell of the accumulator is a steel vessel. Heat transport by gas molecules and oxidation of the graphite are prevented by evacuation of the steel vessel and several flushings with argon. If solar energy is to be stored, the accumulator is fed via a coal-graphite bowl which is heated up by solar energy and transports its heat energy to the accumulator through further graphite bowls.

(PATENT, COAL GRAPHITE-MASS, GRAPHITE REFLECTOR SHELL, STORAGE)

ST77 13169 METHOD FOR THE UTILIZATION OF SOLAR ENERGY

Schneider, H., July 8, 1976, German (FRG) Patent 2,454, 555/A//, EDB-77:073030, In German

The method consists of solar energy being caught in a collector and utilized to heat a substance which, in comparison to water, has a relatively low boiling point. The steam that is produced is then released in steam engines of any desired type and subsequently condensed and circulated back to the collector.

(PATENT, HEAT ENGINES, WORKING-FLUIDS, THERMAL-POWER)

ST77 13170 SOLAR REACTOR STEAM GENERATOR METHOD AND APPARATUS

Scragg, R.L., Parker, A.B., Solar Heated Reaction of Hydrogen and Chlorine, Dec 21, 1976, US Patent 3,998,205, EDB-77:080055

A solar reactor steam generator is disclosed which includes a concrete housing with reactor chamber, tubular heat exchanger, solar sight glass, and solar intensifier. In one embodiment, the reactor chamber is cylindrical. Inside the chamber is a heat exchanger which consists of a single pass helical tube stack which absorbs and conducts convective, conductive, and radiated heats of reactions to liquids or vapors inside the tube. A solar intensifier, such as a parabolic reflector, is mounted on top of the reactor housing. It collects and intensifies solar rays, then guides them down through a solar sight glass, mounted in top of the housing, into the reactor chamber, onto a reflector cone which disperses solar rays throughout the chamber. Hydrogen, chlorine, and atmospheric oxygen are piped into the reactor chamber via tubing. The hydrogen and chlorine react with controlled explosive violence when exposed to the solar rays. It should be understood that high intensity lamps can be used in the absence of solar rays. In another embodiment of this invention, carbonaceous blocks with single pass tube configurations are used in a rectangular reactor chamber.

(PATENT, CHEMICAL-REACTORS, HYDROGEN, PARABOLIC REFLECTORS, SOLAR FURNACES, THERMAL-POWER)

ST77 13171 POTENTIAL AND APPLICATIONS FOR ENERGY STORAGE

Sheldon, E.L., (JPL, Pasadena, CA), 1976, Oklahoma State University, Stillwater, OK, Frontiers of Power Technology Conference, EDB-77:067984

Energy storage has had limited use in the past because utilities have preferred to supply peak loads by building additional low-capital-cost generating facilities. Recently, however, concerns over fossil fuel shortages and sharply rising fuel costs have stimulated interest and studies of many methods for energy storage. Rapid growth of research, development and application of energy storage is predicted during the next 25 years. The large-scale use of solar energy for power production may depend on the availability of suitable and cost-effective storage systems. The potential benefits the role of energy storage and its impact on energy delivery systsms are discussed. Specific storage systems are not described extensively, but six that are discussed briefly are pumped hydro, superconducting magnetic, underground compressed air, batteries, hydrogen/fuel cell, and super flywheels.

(COMPARATIVE-EVALUATIONS, COMPRESSED-AIR, BATTERIES, FLYWHEELS, FUEL-CELLS, SUPERCONDUCTING MAGNETS, UNDERGROUND STORAGE)

ST77 13172 THE FUTURE OF SOLAR-THERMAL SMALL-SCALE POWER STATIONS

Simon, M., (Maschinenfabrik Augsburg-Nuernberg AG, Munich, West Germany), Essen, Arbeitsgemeinschaft Solarenergie, p. 28-30, 1977, In Solar Energy Applications, Systems, Experience; Lecture and Discussion Meeting, Essen, West Germany, Feb 4, 1977, Reports, DCAF A002631, A77-39976 18-44, A77-39981, In German

Electric power requirements in areas without a power distribution system can in many cases be only economically satisfied with the aid of decentralized small-scale solar energy systems. It is estimated that there is a worldwide demand of about one million units for solar power stations with a power output in the range from 15 to 500 kW. Such stations could provide power for air conditioning applications and the desalination of sea water. Such a desalination could become of vital importance for desert or semidesert areas. The development of suitable solar power stations in West Germany is discussed. The considered system makes use of a cylinder-parabolic mirror with a steel tube in the focal line. Steam which is to be heated flows through the steel tube. An assembly of modular units to systems which provide the required power output is possible. The steam is to be stored in an insulated energy storage unit. When needed, the steam can be used for the operation of a steam engine. Two types of steam engines are considered.

(FORECASTING, DESALINIZATION, STEAM ENGINES, DECENTRALIZED, GERMANY, THERMAL-POWER)

ST77 13173 A HIGH TEMPERATURE SOLAR ENERGY SYSTEM - STATUS REPORT

Skinrood, A.C., Brumleve, T.D., Schafer, C.T., Yokomizo, C.T., Leonard, C.M., Jr., (Sandia Labs., Albuquerque, NM), 170 p., SAND-74-8017, AT(29-1)-789, N77-76555

No abstract available

(DESIGN-ANALYSIS, THERMAL-POWER)

ST77 13174 THERMAL STORAGE FOR ELECTRIC UTILITIES

Swet, C.J., (ERDA, Washington, DC), Masica, W.J., (NASA, Lewis, Cleveland, OH), New York, American Institute of Aeronautics and Astronautics, Inc., p. 26-32, 1977, In New Options in Energy Technology; Proceedings of the Conference, San Francisco, CA, Aug 2-4, 1977, AIAA 77-1009, A77-41551 19-44, A77-41556

Applications of the Thermal Energy Storage (TES) principle (storage of sensible heat or latent heat, or heat storage in reversible chemical reactions) in power systems are evaluated. Load leveling behind the meter, load following at conventional thermal power plants, solar thermal power generation, and waste heat utilization are the principal TES applications considered. Specific TES examples discussed include: storage heaters for electric-resistance space heating, air conditioning TES in the form of chilled water or eutectic salt baths, hot water TES, and trans-seasonal storage in heated water in confined aquifers.

(TANKS, COMPARATIVE-EVALUATIONS)

ST77 13175 PRESSURIZED LIQUID CONCEPT FOR SOLAR-THERMAL ENERGY STORAGE FOR THE 24-HOUR CONTINUOUS OPERATION OF AN ENERGY CONVERSION SYSTEM

Talaat, M.E., (Univ of Maryland, College Park, MD), Am. Soc. Mech. Eng., (Pap.), V 76-WA:1-8, NHT-38, Dec 5, 1976, EDB-77:093294

Typical system arrangements of the pressurized liquid concept for solar thermal energy storage for 24-H operation are shown. In this concept, sufficient solar thermal energy would be collected during the sunny hours of the day (e.g., during 8 H in the

semitropical zones as in Egypt or the south western regions of the USA) and stored for providing an energy conversion system with a continuous thermal energy input for 24 H. The collected solar thermal energy of the day would be stored in a pressurized liquid (e.g., pressurized water) contained in a pressure vessel. Study results show the system is feasible. The thermal efficiencies shown may be further improved by reducing the thermal losses from the hot receiver tube of the collector to the ambient air, to a minimum.

(FEASIBILITY-STUDIES)

ST77 13176 A TERRESTRIAL SOLAR THERMAL ELECTRIC POWER SYSTEM - DEVELOPMENT OF BASIC MODEL SYSTEM

Tanaka, T., Sawata, S., Tani, T., Sakuta, K., Horigome, T., (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan), Solar Energy V 19: 335-341, N4, 1977, International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, CA, July 28-Aug 1, 1975, A77-44478

A model of a solar thermal electric power system consisting of a cylindrical parabolic concentrator, a heat transfer circuit, and a storage type heat exchanger is described. It features a selective surface on the absorber and a selective thin barrier on the glass envelope around the absorber and an automatic tracking system. The system was tested under clear-sky conditions and a range of direct insolation values, and heat losses in the collector, collector efficiency, temperature distribution in the heat storage reservoir, and the time variation of temperature in the reservoir were measured.

(STORAGE, CONTROL-SYSTEMS, CYLINDRICAL PARABOLIC CONCENTRATOR, TRACKING)

ST77 13177 INTEGRATION OF SOLAR GENERATION INTO ELECTRIC UTILITY SYSTEMS

Thierer, I., (Maine Univ., Orono, ME), 1976, Proceedings of the ERDA Semiannual Solar Photovoltaic Program Review Meeting, CONF-760837-P1, EDB-77:072977

The operation of solar power plants as a part of a large electric utility has been studied using Southern California Edison Company loss of load probability and production cost simulation computer programs. A solar generation model has been developed which includes effects of hourly solar input variation, cloud induced forced outages, use of energy storage, and peak shaving dispatch. The contribution of solar generation to the system's ability to serve forecast loads has been determined for varying amounts of installed solar capacity and for varying energy storage capabilities associated with the solar units. The effect of solar on the optimum mix of conventional resources has also been studied.

(ECONOMICS, STORAGE, PUBLIC UTILITIES)

ST77 13178 DEVELOPMENT AND TESTING OF SOLAR WATER-HEATING BOILERS MANUFACTURED BY DIFFUSION WELDING

Umarov, G.I., Soatov, F., Avezov, R.R., Sigalov, I.M., Koriagin, N.I., (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR), Geliotekhnika, p. 68-70, N2, 1977, A77-37773, In Russian

No abstract available

ST77 13179 SOLAR THERMAL POWER SYSTEM BASED ON OPTICAL TRANSMISSION

Vant-Hull, L.L., Hildebrandt, A.F., (University of Houston, Houston, TX), Sol. Energy, V 18:31-39, 1974, Hard Copy Avail., EDB-77:072982

A baseline deisgn, consisting of an array of heliostats that redirect beam radiation onto a receiver atop a 450 meter tower, was developed as part of a technical and economic feasibility study of a solar thermal electric power system based on optical transmission of direct solar energy to a central receiver. Reflector design was considered, along with guidance, tracking, and control subsystems, which include the sensors, electronics, motors, drive trains, and mounts required to support and orient the reflector assembly.

(CONTROL-SYSTEMS, FEASIBILITY-STUDIES, HELIOSTATS, TRACKING, TOWER-POWER)

ST77 13180 SUITABILITY OF CAST SODIUM SULFATE FOR THERMAL ENERGY STORAGE

Verma, A., Hu, Y.J., (Saskatchewan Power Corp., Regina), Can. J. Chem. Eng., V 55:105-108, N1, Feb 1977, EDB-77:080161

An "off-peak" electric furnace is a device which stores thermal energy in a storage material during the low power demand periods of generating plant operation and delivers thermal energy during periods of high power demand. Sodium sulfate is an attractive heat storage material due to its two solid-solid phase transitions of 171°C and 241°C,

respectively. The development of sodium sulfate with an aim of forming large high density solid blocks for use in an "off-peak" electric heat storage furnace cycling between 25°C and 700°C is discussed.

(RESEARCH-PROGRAMS, THERMAL-CYCLING, THERMAL-POWER)

ST77 13181 HELIOS: A COMPUTER PROGRAM FOR MODELING THE SOLAR THERMAL TEST FACILITY, A USERS GUIDE

Vittitoe, C.N., Biggs, F., Lighthill, R.E., (Sandia Labs., Albuquerque, NM), Mar 1977, SAND-76-0346, EDB-77:098505

Helios is a flexible computer code for evaluations of proposed designs for central tower solar energy collector systems, for safety calculations on the threat to personnel and to the facility itself, for determination of how various input parameters alter the power collected, and for design trade-offs. Input variables include atmospheric transmission effects, reflector shape and surface errors, suntracking errors, focusing and alignment strategies, receiver design, placement positions of the tower and mirrors, time-of-day, and day-of-year for the calculation. Plotting and editing computer codes are available. Complete input instructions, code-structure details, and output explanation are given. The code is in use on CDC 6600 and CDC 7600 computers.

(SUNTRACKING, COMPUTER-CALCULATIONS, MATHEMATICAL MODELS, TOWER-POWER)

ST77 13182 A SOLAR FLUX DENSITY CALCULATION FOR A SOLAR TOWER CONCENTRATOR USING A TWO-DIMENSIONAL HERMITE FUNCTION EXPANSION

Walzel, M.D., Lipps, F.W., Vant-Hull, L.L., (Houston, University, Houston, TX), NSF GI-39456, Solar Energy, V 19:239-253, N3, 1977, International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, CA, July 28-Aug 1, 1975, A77-41578

The calculation of flux density on the central receiver due to a large number of flat polygonal reflectors having various orientations is a basic part of the system simulation problem for the tower concept of solar energy collection. A two-dimensional Hermite function expansion is adapted to the simulation problem, and numerical results are contrasted with an analytic integration of the solar flux density at specific nodes on an image plane. Various measures of error in the flux density calculation are monitored vs distance to the image plant and orientation of the reflector. The flux densities predicted by the statistical method compare favorably with those of the analytic model and require approximately one-tenth the computer time.

(HERMITIAN-POLYNOMIAL, FLUX-DENSITY, COMPUTER PROGRAMS, NUMERICAL INTEGRATION, STATISTICAL-ANALYSIS)

ST77 13183 STEAM-ACTUATED PISTONLESS PUMP

Yissar, L.F., Nov 19, 1956, Israeli Patent 9990, EDB-77:087234

No abstract available

(PATENT, STORAGE)

ST77 13184 POWER FROM THE SUN. UTILIZING SOLAR ENERGY FOR LARGE-SCALE POWER GENERATION

Zoschak, R.J., (Foster Wheeler Energy Corp, Livingston, NJ), Certif. Eng., V 49:47-49, N2, Feb 1976, Central Receiver Steam Generator Supplements Fossil-Fueled Power Plant, EDB-77:092607

One promising method of collecting solar energy to generate steam is the central receiver concept currently being evaluated in a number of parallel studies funded by the National Science Foundation. Coupling the central receiver steam generator directly to a steam turbine cycle introduces difficult problems. Not only would the plant have to shut down every evening, it would also be subject to sudden loss and resumption of steam generation whenever clouds passed over the site. An alternative scheme which circumvents the problem of energy storage is one in which solar energy would be used as a supplemental source of thermal input to a conventional fossil-fueled power plant. During periods of sunshine, the firing rate could be substantially lowered, thereby saving fuel and reducing stack emissions. At night and during periods of cloud cover, the full station load would be carried solely on fossil fuel.

(HELIOSTATS, RESEARCH-PROGRAMS, TOWER-POWER, THERMAL-POWER)

# 14,000 THERMIONIC/THERMOELECTRIC

ST77 14011 SURVEY OF DIRECT ENERGY CONVERSION

Backus, C.E., (Arizona State Univ., Tempe, AZ), 1971, Institute of Gas Technology, Chicago, IL, Proceedings of the Conference on Natural Gas Research and Technology, EDB-77:068107

Brief description of processes, emphasizing space program developments and effects of availability of suitable solid state devices.

(BOTTOMING CYCLES, FUEL-CELLS, THERMIONIC, THERMOELECTRIC, TOPPING CYCLES)

ST77 14012 SOME QUESTIONS CONCERNING THE CREATION OF A SOLAR THERMIONIC CONVERTER SYSTEM

Grigorev, E.I., Zaitsev, V.M., Melnikov, M.V., Nevezhin, O.A., Ovchinnikov, V.S., Poluektov, V.P., Riabikov, S.V., Rubanovich, I.M., Khudiakov, S.A., Iurin, E.M., (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR), Geliotekhnika, p. 9-16, N2, 1977, A77-37765, In Russian

Apparatus is described for testing thermionic converters in laboratories or in the presence of solar radiation. Experiments involving high-temperature steady-state systems are explained. Volt-ampere characteristics, the effect of cathode temperature, the relation between incident and converted energy, and the effect of the reflection coefficient of the mirror were studied.

(VOLT-AMPERE CHARACTERISTICS, HEAT-FLUX, TEMPERATURE-EFFECTS, MIRROR)

ST77 14013 THERMIONICS (A BIBLIOGRAPHY WITH ABSTRACTS)

Grooms, D.W., (NTIS, Springfield, VA), 301 p., June 1977, NTIS/PS-77/0527/0WE

Research on thermionic power generation, power plant design, converter design, and basic research on thermionic materials are cited in the bibliography. Spacecraft applications are included. (This updated bibliography contains 296 abstracts, 61 of which are new entries to the previous edition.)

ST77 14014 SOME RESULTS OF FULL-SCALE TESTS AND A METHOD FOR CALCULATING THE CAPACITY OF SOLAR THERMOELECTRIC GENERATORS (STEG'S)

Khandovletov, S., Agabaev, C., Malevskii, Y.N., Annaev, O., (Physical-Technical Inst., Ashkhabad, USSR), Int. Chem. Eng., V 17:105-108, N1, Jan 1977, EDB-77:080021

A report is presented of full-scale tests on the use of solar thermoelectric generators for driving electric pumps for water lifting and calculation of the capacity of water-lifting installations based upon solar energy at geographical points in the Turkmen SSR.

(WATER-LIFTING, PUMPS)

ST77 14015 THE NASA THERMIONIC-CONVERSION (TEC-ART) PROGRAM

Morris, J.F., (NASA, Lewis, Cleveland, OH), NASA-TM-X-73610, 19 p., 1977, E-9093, N77-23604/0WE

The current emphasis is on out-of-core thermionic conversion (TEC). The additional degrees of freedom offer new potentialities, but high-temperature material effects determine the level and lifetime of TEC performance: New electrodes not only raise power outputs but also maintain them regardless of emitter-vapor deposition on collectors. In addition, effective electrodes serve compatibly with hot-shell alloys. Space TEC withstands external and internal high-temperature vaporization problems, and terrestrial TEC tolerates hot corrosive atmospheres outside and near-vacuum inside. Finally, reduction of losses between converter electrodes is essential even though rather demanding geometries appear to be required for some modes of enhanced operation.

(OUT-OF-CORE, VAPORIZATION, GEOMETRIES, LOSS-REDUCTIONS)

ST77 14016 THERMIONIC CONVERTER

Rasor, N.S., Britt, E.J., (ERDA), 8 p., Filed Jan 9, 1975, Patented Sept 28, 1976, This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing, PATENT-3 983 423, PAT-APPL-539 746
Avail:Commissioner of Patents, Washington, DC, PC$0.50

A gas-filled thermionic converter is provided with a collector and an emitter having a main emitter region and an auxiliary emitter region in electrical contact with the main emitter region. The main emitter region is so positioned with respect to the collector that a main gap is formed therebetween and the auxiliary emitter region

is so positioned with respect to the collector that an auxiliary gap if formed therebetween partially separated from the main gap with access allowed between the gaps to allow ionizable gas in each gap to migrate therebetween. With heat applied to the emitter the work function of the auxiliary emitter region is sufficiently greater than the work function of the collector so that an ignited discharge occurs in the auxiliary gap and work function of the main emitter region is so related to the work function of the collector that an unignited discharge occurs in the main gap sustained by the ions generated in the auxiliary gap. A current flows through a load coupled across the emitter and collector due to the unignited discharge in the main gap.

(PATENT, IONIZABLE-GAS, WORK-FUNCTION, UNIGNITED DISCHARGE)

ST77 14017 THERMIONIC CONVERSION

Thring, M.W., (Int Flame Res Found), Chart. Mech. Eng., V 22:75-77, N7, 2 refs, July 1975, EDB-77:093598

The principles of thermionic conversion which, like a thermopile, enables heat flowing from a high-temperature source to a heat sink to be converted into DC electric power are discussed. Less than theoretical quantities of electricity are obtained due to factors analogous to the internal resistance of an electric cell. This can be minimized by having electrodes very close together - in the order of 10 Mu. Very accurate alignment under high-current output is to create positive ions within the space to neutralise the charge. Examples are proposed for the use of thermionic conversion power sources for space modules in which heat is provided by the focused rays of the sun, and in nuclear reactors. In this latter application it is proposed that thermionic converters should surround the fuel element so that some of the heat energy is converted directly into electricity.

(HEAT-SOURCES, PRINCIPLES)

## 15,000 OCEAN THERMAL DIFFERENTIAL

ST77 15056 HYDROTHERMAL ELECTRIC POWER PLANTS AND THEIR CHARACTERISTICS

Astaf'ev, A.N., Marochek, V.I., (Far East Polytech Inst Im. V.V. Kuibyshev, USSR), Izv. Vyssh. Uchebn. Zaved., Energ., V 9:129-132, Sept 1976, EDB-77:087222, In Russian

Data are presented on the characteristics of the equipment and of the entire complex of hydrothermal power plants that could be built on shore or on floating platforms and could use freon-11, freon-21, ammonia or steam as their working medium. It is concluded that a thermal gradient of the order of 23-25°C is required for setting up adequately efficient hydrothermal power plants. Metal consumption would be fairly high but it can be reduced by using polyethylene. Other conditions being equal, power plants using ammonia as their working medium appear to be the most efficient.

(METAL-CONSUMPTION, CORROSION, OCEAN-ΔT, ECONOMICS, WORKING FLUIDS)

ST77 15057 AN OPTIMIZATION STUDY OF A LOW THERMAL POTENTIAL POWER SYSTEM. Final Report

Buckingham, J.R., Raike, W.M., Kelleher, M.D., (Naval Postgraduate School, Monterey, CA), Sept 1976, AD-A-031709, EDB-77:080032

A power generating system using the low thermal potential available from the vertical temperature distribution of the ocean is analyzed as a combined engineering and economic mathematical model. The model is optimized for minimum capital cost employing a sequential unconstrained minimization algorithm. Examples of the kinds of engineering and cost information available from the model are presented.

(ALGORITHMS, ECONOMICS, MATHEMATICAL MODELS, OCEAN-ΔT)

ST77 15058 DESIGN OF AN OCEAN THERMAL ENERGY PLANT SHIP TO PRODUCE AMMONIA VIA HYDROGEN

Dugger, G.L., Francis, E.J., (Johns Hopkins University, Laurel, MD), In World Hydrogen Energy Conference, 1st, Miami Beach, FL, Mar 1-3, 1976, Proceedings, Coral Gables, FL, University of Miami; New York, Pergamon Press, V 1:3A-31-3A-68, 1976, Research Supported by the Maritime Administration,(A77-33326 14-44), A77-33335

The 24°C temperature difference that exists between surface water and deep water at selected sites in tropical oceans can be used to drive a heat engine to produce electric power, electrolyze water, and produce ammonia from the resulting hydrogen plus nitrogen from the air. A baseline design has been developed for a 100-mWe ocean thermal energy conversion (OTEC) plant-ship that would produce 313 tons per day of ammonia. The cost estimates for this design have been extrapolated to 500-mWe plants to produce

ammonia (for fertilizers and chemicals) or liquid hydrogen for shipment to the U.S. It is judged that ammonia will be producible at competitive cost ($90/ton in 1975 dollars) by 1982-85 with reasonable financing arrangements.

(HYDROGEN, SYSTEMS-ENGINEERING, WORKING-FLUIDS, OCEAN-ΔT, ECONOMICS)

ST77 15059 MARITIME ASPECTS OF PRODUCING PRODUCTS AT OTEC PLANTS AT SEA AND DELIVERING THEM TO THE UNITED STATES

Dugger, G.L., Francis, E.J., (North Carolina State Univ., Raleigh, NC), (Johns Hopkins Univ., Laurel, MD), Energy From the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:072993

The conceptual design of a 100-mW(E), 313-ton/day, ocean thermal energy conversion (OTEC)/ammonia plant-ship has been developed in sufficient detail to assure that it can be built in and launched from existing U.S. shipyard facilities for deployment to tropical ocean sites. This design provided the basis for a first-of-a-kind cost estimate from which extrapolations were made for $N^{th}$ plant cost of a 500-mW(E), 1697-ton/day commercial-size OTEC/ammonia plant-ship. With a reasonable level of government cost sharing in the early years of operation of such a commercial-size vessel, it is estimated that ammonia can be produced and delivered to U.S. ports at a cost of $90/ton (1975 dollars) compared to recent sales prices near $180/ton, yielding a 50 percent return on sales and a cash flow that would equal the plant investment in approximately $5\frac{1}{2}$ years. Ammonia, produced via water electrolysis for the $H_2$ and air liquefaction or combustion for the $N_2$, appears most attractive as the product for early (1982-1985) plant-ships, because it is needed for fertilizers and other chemicals, it is presently made from natural gas (in short supply), no raw materials are required for its manufacture by OTEC at sea, and the economics appear to be attractive in the near term. Alternative uses of OTEC for the energy-intensive process of reducing alumina to aluminum (7-8 kWh/lb Al) and for making liquid hydrogen ($LH_2$) are also sufficiently attractive to warrant further study in depth. It appears possible to achieve a commercially competitive position for electrolytically produced $LH_2$ in large quantities in the 1990s. This $LH_2$ could serve as a fuel for heating and transportation, a chemical for industrial uses, and a source of electricity via fuel cells on shore. Other possible OTEC plant-ship products are magnesium and a variety of fuels and chemicals (e.g., methanol).

(ALUMINUM, AMMONIA, FEASIBILITY-STUDIES, HEAT-EXCHANGERS, HYDROGEN, PILOT-PLANTS, PRODUCT-MANUFACTURE, ECONOMICS, OCEAN-ΔT)

ST77 15060 OPTIMIZATION OF AN OCEAN THERMAL ENERGY CONVERSION SYSTEM

Dunn, H.S., (Swarthmore Coll, PA), Ocean Eng, V 4:23-39, N1, 5 refs, Mar 1977

A Rankine cycle ocean thermal energy conversion plant is investigated analytically. The ratio of maximum net power output to heat exchanger surface area varies as: (1) the overall heat transfer properties of the evaporator and condenser, (2) the temperature difference between the warm and cold sea water supplies, and (3) the pressure drops across the warm and cold sea water pumping systems. The model is relatively insensitive to the choice of working fluid. Ammonia is used as the example.

(MATHEMATICAL MODELS, HEAT-EXCHANGERS, RANKINE CYCLE, OCEAN-ΔT)

ST77 15061 TRANSIENT BEHAVIOR OF A SOLAR SEA POWER PLANT

Dykstra, L.J., Zener, C., (Carnegie-Mellon Univ., Pittsburgh, PA), July 1976, COO/2895-4, EDB-77:072985

Most studies of OTEC power plants have been concerned with the design of a minimum cost system. These studies employ essentially steady state models. However, the design of a working system must take into account the transient behavior caused by sudden or slow changes in the environment, component characteristics, and load. The start-up of an OTEC plant falls also in this category. Here, a first attempt at developing analytical models in the form of ordinary differential and auxiliary algebraic equations which describe the transient behavior of each component is detailed. These equations can be simulated on a digital computer to study the behavior of a complete OTEC plant so that the design of the plant accounts for the transient requirements. Later, these models can be used directly or indirectly to design controllers for the plant and to develop the instrumentation requirements to implement closed-loop system control.

(HEAT-EXCHANGERS, MATHEMATICAL MODELS, PUMPS, WORKING FLUIDS, OCEAN-ΔT - DYNAMICS)

ST77 15062 EFFECTS OF OCEANIC FLOW PATTERNS ON THE THERMAL EFFICIENCY OF OCEAN THERMAL ENERGY CONVERSION (OTEC)

Fry, D.J., (Carnegie-Mellon Univ., Pittsburgh, PA), Apr 1976, COO/2895-3, EDB-77:092611

This analysis examines the flow patterns produced by the intake of both warm and cold water into a OTEC power plant. It also examines the mixing and possible

recirculation of waters discharged from the OTEC plant back to the ocean. Since no OTEC power plant now exists in large or small size, it is important to forecast and identify possible problem areas for future work. A specific case study is made of a plant nominally designed to produce 200 mW of power. A parameterized description is developed to aid in the mathematical analysis of the principal features of the oceanic flow patterns for the OTEC power plant. From this analysis, it is shown, for the 200 mW plant, that recirculation of ocean water, as large as 40 percent of the evaporator discharge flow reduces power output by less than 10 percent. Some pattern of evaporator recirculation is likely to occur. It is an important result of this study to show that such recirculation is neither critical to plant operation nor an expected cause of instability, that is, the plant does not shut itself off by evaporator recirculation. Condenser (cold) water recirculation into the evaporator (warm) water intake is much more critical than a recirculation between evaporator discharge and intake. Fortunately, discharge flow patterns appear to provide a simple basis to assure that this kind of recirculation can be wholly avoided. A simple, but useful, analysis of the heat budget for the Caribbean Sea is examined in order to address some questions on the impact of large numbers of OTEC facilities in the tropical ocean. The analysis presents a relationship between net power withdrawal and reduction in ocean mixed layer (surface) temperature for several possible ocean flow conditions.

(BINARY-FLUID, FLOW MODELS, SITE-SELECTION, ENVIRONMENTAL-IMPACT, OCEAN-ΔT)

ST77 15063 THE NATURE OF PRIMARY ORGANIC FILMS IN THE MARINE ENVIRONMENT AND THEIR SIGNIFICANCE FOR OCEAN THERMAL ENERGY CONVERSION (OTEC) HEAT EXCHANGE SURFACES

Haderlie, E.C., (Naval Postgraduate School, Monterey, CA), 47 p., Feb 1977, NPS-68Hc 77021, AD-A038 752/2WE

The development of bacterial slime films on the heat exchanger surfaces of OTEC power plants is likely to be of critical importance in determining if OTEC closed cycle systems are technically and economically viable. This report surveys our present state of knowledge as to the nature and behavior of primary films in the marine environment. Areas where further research is needed are indicated. The report contains an extensive bibliography.

(HEAT-EXCHANGER, BIBLIOGRAPHY, OCEAN-ΔT)

ST77 15064 GULF STREAM BASED OCEAN THERMAL DIFFERENCES POWER PLANT

Heronemus, W.E., (North Carolina State Univ., Raleigh, NC), (Univ. of Massachusetts, Amherst, MA), Energy From the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:072996

The significance of the Gulf Stream thermal difference power plant to the energy market of the contiguous 48 states is discussed. The controlling characteristics of the site are enumerated and a macro examination of the size and quality of the resource is made. Then an examination of daily fluctuations in the resource is made, and the significance of the U. Mass Off-Design power plant studies is demonstrated. The general features of U. Mass power plant configurations proposed for the Gulf Stream site are enumerated together with a more specific examination of site controlled design characteristics. The general features and certain specific details of the more recent U. Mass power plant are then illustrated in a series of figures. The essentiality of a total systems approach by a large enough team of experts whose efforts are orchestrated and controlled by a bonafide ocean engineer is woven throughout the paper.

(ENERGY-DEMAND, FEASIBILITY-STUDIES, MAPS, PUMPS, ECONOMICS, OCEAN-ΔT)

ST77 15065 PERSPECTIVES ON IMPLEMENTING OTEC POWER - OCEAN THERMAL ENERGY CONVERSION

Jopling, D.G., (Florida Power and Light Co., Miami, FL), New York, American Institute of Aeronautics and Astronautics, Inc., p. 90-96, 1977, In New Options in Energy Technology; Proceedings of the Conference, San Francisco, CA, Aug 2-4, 1977, AIAA 77-1024, A77-41551 19-44, A77-41564

Major problems confronting the development and commercialization of Ocean Thermal Energy Conversion (OTEC) are discussed, along with OTEC feasibility. The need for large extended heat exhcangers and the high cost of such exchangers is focused on as a major problem, along with problems of corrosion and marine microbiofouling of the heat exchanger and other system equipment. Open or closed cycles, anchoring or sea surface grazing, component construction and assembly on the high seas, mooring during setup, and mechanical stresses at anchorage or en route to location are discussed. Advanced turbine and pump designs, bottoming cycles, new construction materials and techniques, and new heat transfer fluids and heat exchangers designs are envisaged as likely technological spinoffs from OTEC.

(FEASIBILITY-ANALYSIS, HEAT-EXCHANGERS, FORECASTING, ANCHORS, CORROSION, MARINE MICROBIOFOULING, ECONOMICS, OCEAN-ΔT)

ST77 15066 HYDRODYNAMICS OF GULF STREAM OCEAN THERMAL POWER PLANTS

Kirchhoff, R.H., Mangarella, P.A., McGowan, J.G., (Univ. of Massachusetts, Amherst, MA), American Society of Mechanical Engineers, NY, Ocean Engineering Mechanics, Monney, N.T., ed., 1975, EDB-77:087220

This paper considers the external hydrodynamic aspects of Gulf Stream sited Ocean Thermal Power Plants. Specific details of the ocean resource including flow, temperature, and density profiles are examined for suitability at selected sites. In the light of the most current system design, a semi-submersible 400-mWe net power plant, the fluid mechanical details of the interaction of the hot and cold ocean water systems with the total system are studied. The hydrodynamic studies include determination of the characteristics of the inlet and exit of the hot water system for both natural pumped evaporators (unsing kinetic energy of the Gulf Stream) and forced pumping systems. The hydraulic investigation of the cold water flow includes a determination of the withdrawal layer and effect on the site water stratification. Also, the characteristics of the condenser exhaust plume are examined to determine salinity concentration and flow pattern in the wake of the plant.

(PLUME, GULF-OF-MEXICO, PUMPS, RANKINE CYCLE, SITE-SELECTION, OCEAN-ΔT)

ST77 15067 MARINE CORROSION AND FOULING

Kirk, W.W., (National Oceanic and Atmospheric Administration, Miami, FL), (International Nickel Corp., Wrightsville Beach, NC), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Useable Energy From the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105386

The performance of materials in marine environments has been studied extensively and the results widely published. Despite this wealth of information available, material failures still are encountered with startling frequency. The basic concepts of corrosion as it may occur with any metal or alloy system in seawater are described. Many of the factors which can alter the basic and natural course of corrosion are found in seawater applications, and each of these is enumerated. The materials engineer also has several alternatives from which to choose an economical method of minimizing or preventing corrosion. The biofouling organisms in seawater also affect the performance of materials in several ways. These effects cannot be divorced from the corrosion evaluation and, therefore, necessitate the addition of biological research to those of electrochemistry and metallurgy. Important new materials and engineering concepts have emerged from marine corrosion research / and these same organizations and facilities should be capable of solving the materials performance problems of the future.

(BIOLOGICAL FOULING, CURRENT-POWER, OCEAN-ΔT)

ST77 15068 UTILIZING THE OCEAN'S HEAT AND CURRENT

Knoernschild, E., (Deutsche Forschungs- Und Versuchsanstalt Fuer Luft- Und Raumfahrt E.V., Stuttgart, Germany, F.R., Inst. Fuer Energiewandlung Und Elektrische Antriebe), Umschau Verl., Frankfurt Am Main, Germany, F.R., 1976, Energiequellen Fuer Morgen. Nichtnukleare-Nichtfossile Primaerenergiequellen, T, 4, Nutzung Der Meeresenergien, Meliss, M., (Kernforschungsanlage Juelich G.M.B.H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung), EDB-77:087221, In German

The study gives an introduction on kinetic energy and the potential of ocean currents as well as heat energy distribution in the ocean and the potential of ocean heat. The weight of the following considerations lies on oceanic thermal power stations. The following is discussed: 1) the open and closed Rankine process / the choice of working agents and heat transition, 2) choice of site and anchorage, 3) suggestions made up to now, project drafts, and projects already put into practice. An analysis of the costs for a 100-mW-system is carried out. The technical and economical potential of such oceanic thermal power stations is evaluated for countries bordering tropical oceans and for the Federal Republic of Germany. Finally, the importance of German research and development study is referred to.

(GERMANY, RANKINE CYCLE, RESEARCH-PROGRAMS, SITE-SELECTION, WORKING FLUIDS, OCEAN-ΔT)

ST77 15069 OCEAN THERMAL ENERGY DELIVERY SYSTEMS BASED ON CHEMICAL ENERGY CARRIERS

Konopka, A., Talib, A., Biederman, N., Yudow, B., (ITT Institute of Gas Technology, Chicago, IL), NSF C-1008 NSF AER-75-00033, In World Hydrogen Energy Conference, 1st, Miami Beach, FL, Mar 1-3, 1976, Proceedings, Coral Gables, FL, University of Miami; New York, Pergamon Press, p. 1B-19-1B-37, 1976, ERDA-Supported Research, A77-33375

Application of chemical energy carriers to deliver ocean thermal energy is reviewed. The technoeconomic requirements to convert thermal-gradient-produced shaft power into hydrogen and ammonia are discussed. Subsequent offshore chemical energy transmission and onshore terminal costs and technical requirements are also discussed.

A preliminary comparison of hydrogen and ammonia, as ocean thermal energy carriers, is made.

(HYDROGEN, AMMONIA, OCEAN-ΔT, COMPARATIVE-EVALUATIONS)

ST77 15070 OCEAN THERMAL ENERGY CONVERSION: A VIABLE ALTERNATIVE

Lavi, A., (North Carolina State Univ., Raleigh, NC), (Carnegie-Mellon Univ., Pittsburgh, PA), Energy from the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:072990

Contrary to the claims of nuclear power enthusiasts, the United States has an alternative to fission energy. Solar sea power plants based on the conversion of the thermal energy stored in the tropical oceans can begin feeding power into the national grid of the U.S. mainland as early as 1985. The cost of this source of energy is shown to fall below that of nuclear energy. The desired goal of 10,000 mW installed by 1990 can be realized only if work begins soon on a small power plant not larger than 2-5 mW, to become operational before 1980.

(COMPARATIVE-EVALUATIONS, FEASIBILITY-STUDIES, OCEAN-ΔT)

ST77 15071 SOLAR SEA POWER PLANTS

Lavi, A., Neuman, C.P., (Carnegie-Mellon Univ., Pittsburgh, PA), Sol. Age, V 1:24-29, 33, N10, Oct 1976, EDB-77:072997

The Ocean Thermal Energy Conversion concept is discussed in terms of the following topics: operation of conventional power plants / operation of SSPP / cycle efficiency / historical background / the economics of SSPP / U.S. sites for SSPP / deployment growth / and impact of SSPP.

(UNITED-STATES, SITES, ECONOMICS, FEASIBILITY-STUDIES, OCEAN-ΔT)

ST77 15072 COMPARISON OF THREE DIFFUSION MODELS OF THE UPPER MIXED LAYER OF THE OCEAN

Martin, P.J., (Naval Research Lab., Washington, DC), 56 p., 1976, NRL-GFD/OTEC-4-76, DSE/1005-4, EDB-77:087218

The Munk-Anderson, Vager-Zilitinkevich, and Mellor-Yamada turbulent diffusion models were used to model the upper mixed layer of the ocean and were compared to determine differences in predicted mixed layer depths for simple cases of mixed layer deepening. The mixed layer depths predicted by the models were found to be very strongly dependent upon the value of the Richardson number above which the generation of turbulence by the mean velocity shear was stabilized by the stratification. The larger this critical value of the Richardson number, the further the mixed layer deepened before the stratification at the base of the mixed layer was able to suppress the turbulent mixing and stop further erosion of the thermocline.

(OCEAN-ΔT, THERMOCLINE)

ST77 15073 OCEAN THERMAL ENERGY CONVERSION: AN APPRAISAL OF ITS POTENTIAL

Naef, F.E., (North Carolina State Univ., Raleigh, NC), (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA), Energy from the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:072989

Ocean Thermal Energy Conversion (OTEC) could have a significant impact on the economy and quality of life of the southeastern United States. The results of a nine month study indicate that the solar energy stored in the surface layers of the ocean can be tapped with state-of-the practice technology and, with design and fabrication improvements, can be made economically competitive with fossil and nuclear fueled plants. The concept presented consists of a Spar geometry concrete structure with a telescopic concrete cold-water pipe that extends to a depth of 1,500 feet. Four detachable power modules using aluminum heat exchangers generate a total net power output of 186.5 mW(E). The modular design permits lease-financing arrangements that make the finance requirements of OTEC plants equivalent to those of conventional plants. In the southeastern United States, established shipbuilding and offshore construction industries are located near the ocean thermal resource of the Caribbean Sea and Gulf Stream. The development of this resource offers a unique opportunity for the industrial assets of the southeastern United States.

(ECONOMICS, FEASIBILITY-STUDIES, SOUTHEASTERN UNITED-STATES, OCEAN-ΔT)

ST77 15074 DYNAMIC POSITIONING SYSTEM FOR A VESSEL CONTAINING AN OCEAN THERMAL ENERGY CONVERSION SYSTEM

Pearson, R.O., Mar 29, 1977, US Patent 4,014,279, EDB-77:105481

A dynamic positioning system for a sea-going vessel containing an Ocean Thermal Energy Conversion (OTEC) system utilizes the thrust produced by the sea water effluents resulting from the energy conversion process to position the vessel against wind and ocean current forces. In one preferred embodiment applicable to both cylindrical surface and Spar buoy types of vessels, both the warm water and cold water discharges are collected in a common annular plenum and then discharged through nozzles spaced angularly around the periphery of the plenum. Each nozzle is rotatable through a 90°arc in a vertical plane to alter the direction of the discharge water jet and thereby to alter the horizontal component of the thrust or the driving force acting upon the vessel. The nozzles may be selected as to location and angular orientation to attain the net resultant force vector necessary to provide station-keeping or propulsion to the vessel under most any combination of wind and ocean current conditions.

(PATENT, STABILIZATION, OCEAN-ΔT)

ST77 15075 RECIRCULATION AND THERMOCLINE PERTURBATIONS FROM OCEAN THERMAL POWER PLANTS

Piacsek, S.A., (Naval Research Lab., Washington, DC), Martin, P.J., Roberts, G.O., (North Carolina State Univ., Raleigh, NC), Energy from the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, DSE/1005-2, EDB-77:072994, EDB-77:087216

Numerical experiments were performed on the fluid motions resulting from the pumping action of ocean thermal power plants. In particular, the resulting thermocline distortions, sea surface temperature lowering and corresponding heat flow change were investigated. The object was to find engine discharge configurations and pumping rates that would minimize any alterations. This would accomplish both a minimal environmental impact and preservation of the temperature gradient across the engine, i.e., the energy resource. The results obtained to date, using 2-D turbulent flow calculations, indicate that near the engine (200 m less than or equal to x less than or equal to 500 m) the sea surface temperature perturbations will range from 0.01°F less than or equal to DT less than or equal to 3.0°F, depending on flow rates, season and geography. The results of the surface heat calculations showed that a depression of the sea surface temperature by 0.1°C leads to an increased heat flow from air to sea of 9.6 cal/cm$^2$/day in the Puerto Rico area. Accepting this as a permissible environmental perturbation, the area requirement for a 100 mW plant is 2500 km$^2$, with a radius of 29 km. The corresponding figures for Hawaii are 4 cal/cm$^2$/day, an area of 6000 km, and a radius of 44 km.

(ENVIRONMENTAL-EFFECTS, OCEAN-ΔT)

ST77 15076 INVESTIGATION OF COMPETITIVE ARRANGEMENTS, 400-MW OCEAN THERMAL DIFFERENCES POWER PLANT, FOR THE UNITED STATES' SOUTHEAST COAST DEVELOPMENT SITE

Poole, T.A.L., Heronemus, W.E., (Massachusetts Univ., Amherst, MA, Energy Alternatives Program), June 1975, PB-246752, EDB-77:066091
Avail:NTIS PC$6.00

This report is a chronicle of 2½ years of evolution of baseline configurations for the ocean thermal differences power plants first proposed by the University of Massachusetts in 1971. It is the work of ocean systems engineers who have dealt more with the spatial interaction and integration of subsystems and components into practical arrangements than with technological details.

(ECONOMICS, FEASIBILITY-STUDIES, RANKINE CYCLE, OCEAN-ΔT)

ST77 15077 TWO-DIMENSIONAL NUMERICAL MODEL OF THE NEAR-FIELD FLOW FOR AN OCEAN THERMAL POWER PLANT. II. SIMULATION OF THE LOCKHEED BASELINE DESIGN. FINAL REPORT APR-NOV 1976

Roberts, G.O., Piacsek, S.A., Toomre, J., (Science Applications, Inc., McLean, VA), Dec 1976, AD-A-035462, EDB-77:105476

A computation of the stratified turbulent flow-field near the Lockheed Baseline Ocean Thermal Power Plant (OTPP) design, with zero ambient current, is described. The calculation uses a two-dimensional near-field computer code NRFL02, and approximates the flow associated with one of the four power modules by assuming a rectangular domain of depth 500 ft, with horizontal slots at one end to represent the warm inflow and the two outflows. Flow is assumed to be statistically uniform across the width of this domain. Widths of 50 ft, 100 ft, 200 ft, and 400 ft are separately assumed / the 100-ft and 200-ft computations essentially bracket the results for the prototype flow. Numerical results for the average warm inflow temperatures, in the 4 cases, are 75.7°F, 77.2°F, 77.9°F, and 78.6°F. This is with a surface temperature of 80°F. The warm outflow is defined to be 3°F cooler / the cold outflow temperature is set to 45°F.

Numerical results for the OTPP-generated turbulent diffusivity indicate that it is effectively confined to the neighborhood of the plant. Its value is very small outside such a neighborhood.

(COMPUTER-CALCULATIONS, SIMULATION, OCEAN-ΔT)

ST77 15078 TWO-DIMENSIONAL NUMERICAL MODEL OF THE NEAR-FIELD FLOW FOR AN OCEAN THERMAL POWER PLANT. PART III. MANUAL FOR THE COMPUTER CODE NRFL02

Roberts, G.O., Piacsek, S.A., Toomre, J., (Science Applications, Inc., La Jolla, CA), (Naval Research Lab., Washington, DC), 1976, DSE/1005-7, EDB-77:087219
Avail:NTIS PC$4.50

This report is a user's manual for the computer code NRFL02 which has been developed to calculate the near-field stratified turbulent flow driven by the intakes and outflows of an ocean thermal power plant. The code uses a two-dimensional geometry and a four-parameter first-order turbulence closure model. Sophisticated numerical methods enable convergent and accurate solutions to be obtained rapidly and economically. A large and feasible printer output package provides for the display and interpretation of the results.

(COMPUTER CODES, MANUALS, MATHEMATICAL MODELS, OCEAN-ΔT)

ST77 15079 NUMERICAL OCEAN MODEL OF THE GULF OF MEXICO FOR EVALUATION OF THE ENVIRONMENTAL IMPACT OF OCEAN THERMAL POWER PLANTS

Thompson, J.D., Hurlburt, H.E., Lin, L.B., (JAYCOR, Del Mar, CA), 42 p., 1976, NRL-GFD/OTEC-3-76, DSE/1005-3, EDB-77:087217

Studies of OTPP effects on the far-field thermal gradient resource require a knowledge of the dynamics and thermodynamics of the time-dependent ocean. Short of actual OTPP operations, one can only assess the impact of OTPP's on the environment via long-term integrations of numerical ocean models. The best strategy for OTPP far-field modeling appears to be the selection of a single, well-observed ocean basin with well defined boundary conditions and surface input data. Conditions within the basin should be as representative as those to be encountered by OTPP's in the tropical and subtropical oceans. The basin should be large enough to represent open ocean conditions but small enough for economical computer modelling. It is suggested that the Gulf of Mexico satisfies the above requirements for OTPP evaluation. Further, it is believed that a numerical model superior to previous Gulf of Mexico models in (1) resolution, (2) physical processes included, and (3) numerical efficiency can be developed to a level useful for OTPP environmental impact studies. The ocean model must reproduce observed features of the actual ocean before it is useful for assessment of OTPP environmental modification. A strategy for development of a hierarchy of models is presented, and basic requirements for a useful ocean model are outlined.

(COMPUTER MODELLING, OCEAN-ΔT)

ST77 15080 INCENTIVES FOR THE COMMERCIALIZATION OF OCEAN THERMAL ENERGY CONVERSION TECHNOLOGY (OTEC)

Washom, B.J., Nilles, J.M., Lutz, R.E., Nachtigal, D., Schmidhauser, J.R., (University of Southern California, Los Angeles, Office of Interdisciplinary Program Development), NSF/RA-770087, 57 p., Jan 1977, PB-268 096/5WE

This research program is concerned with the identification of legal, jurisdictional, environmental, institutional, and other nontechnological barriers to the development of solar energy technologies in general, and OTEC in particular. The report concentrates on assessing the economic competitiveness with time of OTEC relative to conventional energy plants, both under existing institutional and regulatory conditions, and as they might appear if the institutional and regulatory conditions and constraints were altered in various ways.

(LEGAL, ENVIRONMENTAL, INSTITUTIONAL, ECONOMIC, SUMMARY, OCEAN-ΔT)

ST77 15081 INCENTIVES FOR THE COMMERCIALIZATION OF OCEAN THERMAL ENERGY CONVERSION TECHNOLOGY (OTEC)

Washom, B.J., Nilles, J.M., Lutz, R.E., Nachtigal, D., Schmidhauser, J.R., (University of Southern California, Los Angeles, Office of Interdisciplinary Program Development), NSF/RA-770088, 354 p., Jan 1977, PB-268 097/3WE

This research program is concerned with the identification of legal, jurisdictional, environmental, institutional, and other nontechnological barriers to the development of solar energy technologies in general, and OTEC in particular, and with the formulation of recommendations for strategies designed to diminish these barriers. The report concentrates on assessing the economic competitiveness with the time of OTEC relative to conventional energy plants, both under existing institutional and regulatory

conditions, and as they might appear if the institutional and regulatory conditions and constraints were altered in various ways.

(LEGAL, ENVIRONMENTAL, INSTITUTIONAL, ECONOMIC, OCEAN-ΔT)

ST77 15082 THE OTEC ANSWER TO OPEC - SOLAR SEA POWER

Zener, C., (Carnegie-Mellon, University, Pittsburgh, PA), Mechanical Engineering, V 99: 26-29, June 1977, A77-36409

It has been estimated that the top isothermal layer of the Tropical Ocean has an 'effective head' of 960 ft. Current research projects involving Ocean Thermal Energy Conversion systems making use of this work potential are briefly described. A new type of OTEC system in which all warm water input serves as a working medium and is discarded at the same temperature as the discard of the cold water input is outlined. The sea-water is foamed using a biodegradable surfactant; the tight mechanical coupling between the water vapor in a single foam cell and the liquid in its surrounding walls forms the basis of the system. The vapor and its share of the enclosing liquid move isen-tropically from the saturation vapor pressure for 25°C to the saturation vapor pressure for 5°C water, liberating a work potential of 2.87 j/g.

(ENERGY-TECHNOLOGY, RESEARCH-PROJECTS, OCEAN-ΔT)

## 16,000 WIND POWER CONVERSION

ST77 16073 HEAT THROUGH WIND

Gesund.-Ing., V 96:314, N11, 1975, EDB-77:073096, In German

A brief survey is presented of the projects on the utilization of wind power currently in progress in the FRG and USA.

(SURVEY, RESEARCH-PROGRAMS, GERMANY, UNITED-STATES)

ST77 16074 NEW MEXICO UTILITY WILL TEST 200-KW WIND TURBINE UNIT: EXPERIMENTAL POWER WINDMILL WILL BE BUILT ON CLAYTON MUNICIPAL SYSTEM

Public Power, V 35:23, N1, 1977, EDB-77:082166

A 200-kilowatt wind turbine unit will be tested at Clayton, New Mexico, as an ERDA demonstration program of a dual-fuel unit for power generation. Between 5 and 15 percent of local power is expected to be supplied on a windy day. Modifications were made in the Sandusky, Ohio, prototype to make it stronger and the blade design more efficient. A maximum of 200 kW will be produced, enough to serve 60 families. New features in the design will allow the unit to respond to changing wind speeds and direc-tion. Twin aluminum blades will maintain a constant rotor speed of 40 revolutions per minute. After tests at the Clayton site, four more sites will be selected for similar and larger installations. Possible locations are listed along with the name of the administering utility.

(DEMONSTRATION-PROGRAMS, PUBLIC UTILITIES, SITE-SELECTION)

ST77 16075 SHORT PULSE RADAR USED TO MEASURE SEA SURFACE WIND SPEED AND SWH (SIG-NIFICANT WAVE HEIGHT)

Hammond, D.L., Mennella, R.A., Walsh, E.J., (Naval Res. Lab., Washington, DC), IEEE Trans. Antennas and Propag., V AP-25:61-67, N1, A77-17234

A joint airborne measurement program is being pursued by NRL and NASA Wallops Flight Center to determine the extent to which wind-speed and sea-surface significant wave height (SWH) can be measured quantitatively and remotely with a short pulse (2 NS), wide-beam (60 degrees), Nadir-looking 3-cm radar. The concept involves rela-tive power measurements only and does not need a scanning antenna, Dopple filters, or absolute power calibration. The slopes of the leading and trailing edges of the averaged received power for the pulse limited altimeter are used to infer SWH and surface wind speed. The interpretation is based on theoretical models of the effects of SWH on the leading edge shape and RMS sea-surface slope on the trailing-edge shape. The models include the radar system parameters of antenna beam width and pulsewidth. Pre-liminary experimental results look promising and indicate that it may be possible to design a relatively compact airborne radar to infer, in real-time, the sea surface SWH and surface wind speed.

(RADAR-APPLICATIONS, REMOTE-SENSING)

ST77 16076 WIND ENERGY SYSTEM UTILIZING HIGH PRESSURE ELECTROLYSIS AS A STORAGE MECHANISM

Allison, H.J., (Oklahoma State Univ, Sch of Electr Eng, Stillwater, OK), World Hydrogen Energy Conf, 1st, Proc, Miami Beach, FL, Mar 1-3, 1976, Publ by Univ of Miami, Coral Gables, FL, V 2:3-14, 7 refs, 1976, Sess 2B

Energy storage which utilizes electrolysis cells to disassociate water into its component gases is then stored as hydrogen as a high pressure gas, or liquid, or hydride. This paper describes the OSU (Oklahoma State University) system, its performance parameters, its basic problems and economics which must be satisfied before such a system can become practical on a large scale.

(HYDROGEN)

ST77 16077 POSSIBILITIES OF UTILIZING WIND POWER

Armbrust, S., Kussmann, A., Molly, J.P., (Deutsche Forschungs- Und Versuchsanstalt Fuer Luft- Und Raumfahrt E.V., Stuttgart, Germany, F.R., Inst. Fuer Bauweisen- Und Konstructionsforschung), Dtsch. Forsch. Versuchsanst. Luft- Raumfahrt Nachr., V 19:765-770, Nov 1976, EDB-77:098562, In German

An outline on the technical possibilities of building wind power plants and a report on completed and planned plants are given. The economic utilization of wind power is discussed. Small plants of 10 to 50 kW and large plants integrated in a supply network are distinguished between as regards the megawatt performance.

(ECONOMICS, PLANNING, GERMANY, SMALL-SCALE, LARGE-SCALE)

ST77 16078 AN IMPROVED COMPUTER PROGRAM FOR CALCULATING THE THEORETICAL PERFORMANCE PARAMETERS OF A PROPELLER TYPE WIND TURBINE

Barieau, R.E., (West Texas State University, Canyon, TX), (Governor's Energy Advisory Council, Forecasting and Policy Analysis Division, Austin, TX), Mar 1977, (Contract IAC-76-77(1143)
Avail:Hard copy

The PROP Program of Wilson and Lissaman has been modified by adding the Newton-Raphson Method and a Step Wise Search Method, as options for the method of solution. In addition, an optimization method is included. Twist angles, tip speed ratio and the pitch angle may be varied to produce maximum power coefficient. The computer program listing is presented along with sample input and output data. Further improvements to the program are discussed.

ST77 16079 WIND POWERED FLUID COMPRESSOR

Bea, K.J., Feb 15, 1977, US Patent 4,008,006, EDB-77:105754

A wind machine comprising a fixed or controlled pitch blade assembly drives a variable displacement or variable clearance fluid compressor. Means which may be mechanical, hydraulic, pneumatic or electrical interconnect the blade assembly and the compressor to vary the fluid displacement or clearance volume of the compressor as a function of the drag or lift forces of the wind on the blade assembly.

(PATENT, CONFIGURATION, PUMPS)

ST77 16080 ENERGY FROM THE WIND - ANNOTATED BIBLIOGRAPHY

Burke, B.L., Meroney, R.N., (Colorado State University, Fort Collins, CO), Basic Volume, Aug 1975, First Supplement, Apr 1977, CER74-75BLB-RNM-44
Avail:Publications Department, Engineering Research Center, Colorado State University, Fort Collins, CO,
Avail:Hard copy

No abstract available

ST77 16081 SELF-REGULATING COMPOSITE BEARINGLESS WIND TURBINE. EXECUTIVE SUMMARY, JUNE 3, 1975-JUNE 2, 1976

Cheney, M.C., Spierings, P.A.M., (United Technologies Research Center, East Hartford, CT), Sept 1976, COO/2614-76/2, EDB-77:105746

An investigation was conducted into the feasibility of applying the Composite Bearingless Rotor (CBR) concept to wind turbines. The CBR blade is comprised of a conventional blade construction over the outboard span, but inboard is made up simply from a finite length (about 15 percent of the radius) of unidirectional composite material. This member, called the flexbeam, replaces the hinges and bearings normally located at the blade root and provides the necessary flatwise and edgewise stiffness, but due to the unidirectional fiber alignment, has low torsional stiffness. Blade pitch control is achieved by applying a moment at the outboard end of the flexbeam and

elastically twisting it. The work described in the final report was conducted under contract with ERDA and consisted of the design and fabrication of a dynamically scaled wind turbine model, the wind tunnel testing of this model, and the evaluation of several control concepts in an attempt to achieve a self-regulating system. Such a system was achieved and experimentally demonstrated in the wind tunnel. Operating characteristics at wind speeds exceeding 30 mph were investigated and simulated start ups and wind direction changes were successfully executed.

(WIND-TUNNEL TESTING, AERODYNAMICS, CONTROL-SYSTEM, BLADES)

ST77 16082 SELF-REGULATING COMPOSITE BEARINGLESS WIND TURBINE. FINAL REPORT, JUNE 3, 1975-JUNE 2, 1976

Cheney, M.C., Spierings, P.A.M., (United Technologies Research Center, East Hartford, CT), Sept 1976, COO/2614-76/1, EDB-77:105745

The Composite Bearingless Rotor (CBR) concept has been shown to have characteristics ideally suited for wind turbine applications. This rotor concept provides a fully self-regulating and self-aligning wind turbine. Such a system was achieved without the need for auxiliary controls or sensors. These features allow self-starting for wind initiating from any direction and automatic pitch and yaw variations to optimize performance under all normal wind conditions. The work described in this report consists of the design of a 4.5 ft dynamically scaled wind turbine model and the testing of this model in the United Technologies low speed wind tunnel. Several concepts were investigated which were designed to achieve self-regulation. Of these, a system which consisted of a hub supported pendulum integrated with the CBR blade provided the features desired. Testing of this configuration consisted of startups from any wind direction with wind speeds up to 30 mph. Stress and stability characteristics were investigated during the test program and the CBR wind turbine demonstrated low stress levels and highly stable response characteristics under all conditions tested.

(AERODYNAMICS, PERFORMANCE TESTING, BLADES, CONTROL-SYSTEM)

ST77 16083 STOCHASTIC MODELLING OF SITE WIND CHARACTERISTICS. Final Report

Corotis, R.B., (Northwestern Univ., Evanston, IL), Nov 1976, ERDA/NSF/00357-76/1, EDB-77:105759
Avail:NTIS PC$9.75

The economic feasibility of installing a wind energy conversion system at a given site depends on an accurate assessment of the wind characteristics at that site. To accomplish this, data records must be analyzed effectively. This report utilizes statistical methods and probability models to determine optimal evaluation procedures for survey data. Several years of hourly records from five typical midwest sites, one high tower midwest site, and one Rocky Mountain site provide a data base to develop the models and procedures. The minimum duration of survey is analyzed as a function of desired confidence level and acceptable tolerance range. Alternate survey procedures are discussed in terms of total survey duration and number of recorded values. Single year velocity records appear acceptable for velocity statistics, but are marginal for wind power estimates unless additional information is available.

(ECONOMIC, MONITORING, SITE-SELECTION, VELOCITY STATISTICS)

ST77 16084 EVALUATING A COMBINED WIND POWER/ENERGY STORAGE SYSTEM

Coste, W.H., (Massachusetts Audubon Society, MA), Lotker, M., (Northeast Utilities Service Co., Hartford, CT), Power Engineering, V 81:48-51, May 1977, A77-33596

A methodology for analyzing the economic costs and benefits of a system which combines energy storage with wind-driven power generators is presented. The advantages of such a system are that, with sufficient storage, energy could be delivered on demand with minimal environmental impact and without depleting the source of energy. A computer model has been developed to optimize the amount of storage and generating capacity for a particular location, and has been applied to the study of a site at Waterford, CT. In general, the model suggests that combined wind power and storage systems are capable of producing reliable, albeit costly, power at all capacity factors with a reasonable availability. Sites with average wind speed in excess of 15 mph might be required for economic viability.

(ECONOMIC, ENVIRONMENTAL-IMPACT, COMPUTER MODEL)

ST77 16085 IMPLEMENTATION ISSUES OF WIND ENERGY - COST ANALYSIS

Coty, U., Vaughn, L., (Lockheed-California Co., Burbank, CA), New York, American Institute of Aeronautics and Astronautics, Inc., p. 97-105. 1977, In New Options in

Energy Technology; Proceedings of the Conference, San Francisco, CA, Aug 2-4, 1977, AIAA 77-1025,(A77-41551 19-44), A77-41565

Initial production quantities required by users (including developing nations), competitive energy cost criteria, and energy cost fractions are tabulated and compared. Availability of alternative energy sources, availability of incentives (financing by government or foreign loans), and availability of suitable high-wind sites are taken into account. Minimum investments and commitments to purchases of wind turbine generators to implement a wind power development program on a commercial are estimated.

(DEVELOPING-NATIONS, INCENTIVES, ECONOMICS, SITES, INVESTMENTS)

ST77 16086 EFFECTS OF WIND FLUCTUATIONS ON WINDMILL BEHAVIOUR

Der Kinderen, W.J.G.J., Van Meel, J.J.E.A., Smulders, P.T., (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands), Wind Engineering, V 1:126-140, N2, 1977, A77-42073

A system-analytical approach is proposed to describe the output, i.e., power and forces, of a wind machine for the stochastic input signal, the wind. A simple model is presented to describe the fluctuations of wind speed and direction by means of average wind speed and wind direction, their variances and time constants. These input signals are used to calculate the influence of wind fluctuations on windmill performance, including the effects on nonuniformity of the flow in the rotor plane, rotor inertia and yawing of the rotor heat. Experimental results for a small 2-bladed windgenerator (diameter about 4 m) are reported.

(ROTOR AERODYNAMICS, MATHEMATICAL MODELS)

ST77 16087 PRINCIPLES OF A SYSTEM COMBINING WATER POWER AND WIND POWER IN SWITZERLAND

De Witt, H., Bull. Schweiz. Elektrotech. Ver., V 66:252-256, N5, Mar 8, 1975, EDB-77:066154, In German

Problems associated with the generation of wind energy are discussed. If the idea of direct conversion of wind into electric energy is abandoned and the wind energy is stored in available installations of hydroelectric plants, interesting possibilities arise for the interaction of both energy forms. Several versions for the construction of wind motors are proposed as alternatives for conventional realizations.

(FEASIBILITY-STUDIES, PUMPED STORAGE)

ST77 16088 WIND MACHINES

Eldridge, F.R., (MITRE Corp., McLean, VA), Oct 1975, PB-249936, EDB-77:092700
Avail:NTIS PC$5.00

This report provides a brief survey of the viability, history, taxonomy, and future potential of various types and sizes of wind machines that might be used to help meet future U.S. energy demands. It also discusses various applications of wind machines, as well as siting problems, performance characteristics, and system designs. A glossary of commonly used words and phrases, a list of suppliers, and a selected bibliography are included.

(HISTORY, GLOSSARY, ECONOMICS, FEASIBILITY-STUDIES, SITE-SELECTION)

ST77 16089 PROPOSED ALLOCATION MODEL OF WIND POWER SYSTEMS TO GEOGRAPHICAL REGIONS

Frair, L.C., (Virginia Polytechnic Institute and State Univ., Blacksburg, VA), 16 refs, 1975, EDB-77:092697

An allocation model is presented that may be used to generate plans for the implementation of wind power systems in suitable geographic regions. The proposed allocation model consists of four main steps. In step one, the energy requirements that are to be furnished by wind power are determined. Secondly, the number and type of wind power systems needed to satisfy the wind energy requirements specified in step one are determined. The third step consists of the application of a screening mechanism which evaluates the feasibility of the allocation from step two in regard to technological capabilities, gross economic considerations, social and political considerations, and environmental guidelines. Step four consists of a detailed benefit-cost analysis.

(COST-BENEFIT-ANALYSIS, ECONOMICS, ENVIRONMENTAL-EFFECTS, MATHEMATICAL MODELS, REGIONAL-ANALYSIS)

ST77 16090 WINDMILLS

Fricke, J., Phys. Unserer Zeit, V 7:129-130, N5, Sept 1976, EDB-77:105743, In German

A new plan of a wind energy converter is introduced. The principle is the production of tornado-like whirlwinds using wind power. The pressure difference between the inner side of the 'tornado' and its environs is to be used to drive a turbine. According to the calculations the new construction provides for a better energy yield than was possible with conventional wind mills of the same size. Furthermore, this system is less sensitive to storms. The turbine runs with higher R.P.M., thus making a power transmission unnecessary / it is near to the ground and this makes servicing easy. The production of 1 mW should be possible using a turbine with a diameter of 2 m in a 60 m high tower with a diameter of 20 m.

(WHIRLWINDS, PRESSURE GRADIENTS, TORNADO - TURBINES, COMPARATIVE-EVALUATIONS)

ST77 16091 UTILIZATION OF WIND ENERGY FOR ELECTRICAL POWER SUPPLIES TO ESSOR STATIONARY PLATFORMS - TROPOSPHERIC TETHERED BALLOON EXPERIMENT

Goas, J., (Meteorologie Nationale, Paris, France), La Meteorologie, p. 85-88, Mar 1977, A77-45610, In French

Model tests and full-scale tests of the performance of a horizontal-axis wind-powered generator are described. Technical data, weight optimization, and output optimization are discussed. Overall efficiency of 30-35 percent, corresponding to 37-44 percent energy conversion efficiency, is envisaged.

(TESTS, HORIZONTAL-AXIS, WEIGHT-OPTIMIZATION)

ST77 16092 WIND POWER STUDIES: REGIONAL WIND ENERGY MEASUREMENTS. PROGRESS REPORT, JULY-SEPTEMBER 1976

Hardy, D.M., (California Univ., Livermore, CA), 12 p., Nov 1976, UCRL-50034-76-4

This report discusses the wind power field measurement program which is being conducted in conjunction with numerical analyses of regional wind energy. Early examples of data collected in the program are given, including data confirming the existence of a broad area of high wind speeds which were predicted in previous numerical analyses. The measurement program is described, and plans for further numerical analysis and the continuation of the measurement program are discussed.

(NUMERICAL-ANALYSIS)

ST77 16093 SOME ASPECTS OF WIND POWER STATISTICS

Hennessey, J.P., Jr., (Department of Atmospheric Sciences, Oregon State University, Corvallis, OR), J. Appl. Meteorol., V 16:119-128, N2, Feb 1977, EDB-77:073094

Some of the problems of wind power statistics are examined. The exact relationship between the mean wind speed and the mean of the cube of the wind speed is discussed. The Weibull probability density function, a good model for wind speed distributions, leads to a Weibull model for the distribution of the cube of the wind speed. This model facilitates the computation of the mean and the standard deviation of the total wind power density, the usable wind power density, and the wind power density during the hours when an aerogenerator is operating. The Weibull model is applied to data from three Oregon wind power sites located in rugged terrain. It is concluded that the mean and standard deviation of the wind speed are the minimum statistics necessary for wind power estimates, that the Weibull model for the wind power density has many computational advantages, and that the existing wind power studies based solely on the total mean wind power density omit much valuable information about the wind power potential of a site.

(WEIBULL MODEL, OREGON, POWER-DENSITY, MATHEMATICAL-MODELS)

ST77 16094 OCEANIC WINDPOWER

Heronemus, W.E., (North Carolina State Univ., Raleigh, NC), (Univ. of Massachusetts, Amherst, MA), Energy From the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:073093

The oceanic windpower resource is examined macroscopically. One region in which that resource is known to be rich is then examined in greater detail. Six different products associated with the U.S. Energy Industry are then proposed as products that could be provided from windpower systems. A closer look at the possible size of that Atlantic coast resource is taken and an estimated total annual productivity is weighed against the last year's 73 quad U.S. energy budget: a 12 percent impact from this one solar replenished resource alone is predicted. Statements as the system energy budget and environmental impact are made. Conclusions suggest that windpower systems, including oceanic windpower systems, should be advanced rapidly by the United States.

(PRODUCTS, ATLANTIC-COAST, ENVIRONMENTAL-IMPACT, UNITED-STATES, STORAGE, FEASIBILITY-STUDIES, HYDROGEN, OFF-SHORE SITES, ECONOMICS)

ST77 16095 ENERGY FROM THE WIND

Hewson, E.W., (Department of Atmospheric Sciences, Oregon State University, Corvallis, OR), Bull. Am. Meteorol. Soc., V 58:33-38, N1, Jan 1977, EDB-77:087269
Testimony is given before U.S. Senate Subcommittee on Energy Research and Water Resources concerning the availability, environmental impact, and technological needs of using the wind for the generation of electric power.

(SENATE-SUBCOMMITTEE, ENVIRONMENTAL-IMPACT, STORAGE, ECONOMICS)

ST77 16096 COUPLED DYNAMICS ANALYSIS OF WIND ENERGY SYSTEMS

Hoffman, J.A., (Paragon Pacific, Inc., El Segundo, CA), NASA-CR-135152, 86 p., Feb 1977, PPI-1014-11, N77-20558/1WE
A qualitative description of all key elements of a complete wind energy system computer analysis code is presented. The analysis system addresses the coupled dynamics characteristics of wind energy systems, including the interactions of the rotor, tower, nacelle, power train, control system, and electrical network. The coupled dynamics are analyzed in both the frequency and time domain to provide the basic motions and loads data required for design, performance verification and operations analysis activities. Elements of the coupled analysis code were used to design and analyze candidate rotor articulation concepts. Fundamental results and conclusions derived from these studies are presented.

(COMPUTER-ANALYSIS, PERFORMANCE-VERIFICATION, OPERATIONS-ANALYSIS)

ST77 16097 PROJECTILE POWER GENERATOR

Hopkins, W.J., (Department of the Navy Washington, DC), 5 p., Filed Apr 12, 1976, Patented Jan 25, 1977, This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing, AD-D004 018/8, PAT-APPL-676 018, PATENT-4 004 519
Avail:Commissioner of Patents, Washington, DC, PC$0.50
The patent relates to a system for generating electrical power, comprising a stator in combination with an air driven turbine type rotor of annular shape, and supported for rotation on an outer surface of the unit to which power is to be supplied. Aerodynamically responsive fins on the annulus ring, when exposed to the air flow, rotate the annulus. Magnets in the annulus are separated from stationary stator coils embedded in the unit to generate alternating current.

(FINS, ANNULUS-RING, WIND)

ST77 16098 WIND POWER (CITATIONS FROM THE ENGINEERING INDEX DATA BASE)

Hundemann, A.S., (NTIS, Springfield, VA), 157 p., June 1977, NTIS/PS-77/0400/0WE
Windmill and wind power feasibility, use, and engineering are discussed in these citations of worldwide research. Abstracts primarily cover the use of wind power for electric power generation and wind turbine design and performance. General studies dealing with the use of wind power in developing countries and comparative analyses of wind power and alternative energy sources are included, as are studies on energy storage systems.

(ABSTRACTS, BIBLIOGRAPHY)

ST77 16099 WIND POWER (CITATIONS FROM THE NTIS DATA BASE)

Hundemann, A.S., (NTIS, Springfield, VA), 258 p., June 1977, NTIS/PS-77/0399/4WE
The feasibility, use, and engineering aspects of wind power and windmills are discussed in these citations of Federally-funded research reports. Abstracts primarily cover the use of wind power for electric power generation and wind turbine design and performance. General studies dealing with comparative analyses of wind power and alternative energy sources are included, as are energy storage devices which can be used in these systems.

(ABSTRACTS, BIBLIOGRAPHY)

ST77 16100 SHROUDS FOR AEROGENERATORS

Igra, O., (Ben-Gurion Univ of the Negev, Beer Sheva, ISR), AIAA (Am. Inst. Aeronaut. Astronaut.) J., V 14:1481-1483, N10, 10 refs, Oct 1976, EDB-77:098564
To use wind power efficiently, reduce the size of rotors, and to increase the rotational speeds, various combinations of turbines operating inside specially designed shrouds composed of a bell-shaped intake, a cylindrical section, and a diffuser have

been recently investigated. This article presents a vew approach to shroud design, such that good aerodynamic performance is retained, while the shroud is made more attractive economically.

(DIFFUSER, SHROUD-DESIGN, AERODYNAMIC-PERFORMANCE, MATHEMATICAL MODELS, TURBINE BLADES, VORTEX-AUGMENTED)

ST77 16101 COMPACT SHROUDS FOR WIND TURBINES

Igra, O., Energy Conversion, V 16:149-157, N4, 1977, Research Supported by the U.S.-Israel Binational Science Foundation, A77-42891

As part of a large project aimed at finding the optimal configuration for an aerogenerator to exploit wind power, an investigation was launched to find the most compact shroud possible. The dominant contributor to the shroud length is the structure downstream of the turbine (the diffuser). This component has an ever increasing cross-section as one progresses downstream, however, fast rate of area divergence will cause flow separation and the significant reduction in output power associated with it. It is the purpose of the present paper to demonstrate ways to overcome this difficulty. This can be achieved either by proper diversion and introduction of the shroud's external flow into the diffuser's inner boundary layer or alternatively, by the usage of a ring-flap.

(AERODYNAMIC-CHARACTERISTICS, DIFFUSER, RING-FLAP)

ST77 16102 GENERATION SCHEMES FOR WIND POWER PLANTS

Jaya Devaiah, T.S., Smith, R.T., (Univ of Wisconsin, Milwaukee, WI), IEEE Trans. Aerosp. Electron. Syst., V AES-11:543-550, N4, 14 refs, July 1975, EDB-77:092703

Various electric generation schemes for wind energy conversion suitable for interconnection with a power grid are reviewed. The schemes can be generally classified as constant speed constant frequency (CSCF) and variable speed constant frequency (VSCF) systems. Historically, only CSCF systems have been used for large power generation in wind power plants. However, with the advent of power electronics and the availability of solid state devices capable of handling large amounts of power, VSCF systems are becoming competitive. Various schemes under each classification are discussed and compared. It is stressed, however, that the optimum choice of the generating scheme is not decided by considering the generator alone. The optimum choice is one which minimizes the cost of energy generated by the wind power plant.

(INTERCONNECTION, CONSTANT-SPEED, VARIABLE-SPEED, COMPARATIVE-EVALUATIONS, ECONOMICS)

ST77 16103 SEGMENTED AND SELF-ADJUSTING WIND TURBINE ROTORS. Final Report

Jordan, P.F., Goldman, R.L., (Martin Marietta Labs., Baltimore, MD), Apr 1976, COO/2613-2, EDB-77:105744

An investigation was carried out to examine the use of blade aeroelastic properties for providing rotational speed control for a wind turbine generator (WTG). The study was specifically directed at obtaining a rotor configuration that has the capability for maintaining nearly constant torque at constant rpm in the presence of varying wind conditions and is aimed at eliminating the current requirement for mechanical pitch change devices. The approach considered is one in which rotor twist due to aerodynamic loading is used to adjust the blade's pitch as the wind speed changes. The preliminary design concept that has evolved is a flexible rotor blade formed from a series of individual, light, rigid segments that are arranged along the blade spar. Each segment can rotate around the spar but is restricted in pitch by a nonlinear mechanical spring. The results of performance calculations as well as vibration and flutter analyses are presented. Based on these results, the concept appears to provide an attractive solution to the problem of WTG operation in a varying wind field.

(AERODYNAMIC-LOADING, SPEED-REGULATORS, BLADE-TWIST, BLADE-DESIGN)

ST77 16104 DESIGN, ECONOMIC AND SYSTEM CONSIDERATIONS OF LARGE WIND-DRIVEN GENERATORS

Jorgensen, G., Elsoe, L.M., Meier, R.C., Brierley, D., (Northeast Util Serv Co, Hartford, CT), IEEE Trans Power Appar Syst, V PAS-95:870-878, N3, May-June

This paper reviews the selection of wind-driven generators, system optimization, control system design, safety aspects, economics to electric utility systems and potential electric system interfacing problems.

(CONTROL-SYSTEM, SAFETY, UTILITY-SYSTEMS)

ST77 16105 REFERENCE WIND SPEED DISTRIBUTIONS AND HEIGHT PROFILES FOR WIND TURBINE DESIGN AND PERFORMANCE EVALUATION APPLICATIONS

Justus, C.G., Hargraves, W.R., Mikhail, A., (Georgia Inst. of Tech., Atlanta, GA), Aug 1976, ORO/5108-76/4, EDB-77:098560

The purpose of this report is to provide a set of reference or standard values of wind profiles, wind speed distributions and their effects on wind turbine performance for engineering design applications. Based on measured Weibull distribution parameters, representative average, low, and high variance data are given for height profiles of mean, 25 percentile, and 75 percentile wind speeds / and for wind speed probability density (velocity frequency) functions and cumulative probability (velocity duration) functions at selected heights. Results of a sensitivity analysis of the dependence of wind turbine performance parameters on cut-in speed, and rated speed for various mean wind and wind variance regimes are also presented. Wind turbine performance is expressed in terms of capacity factor (ratio of mean power output to rated power) and recovery factor (ratio of mean energy output to energy theoretically available in the wind). The representative high, mean, and low variance cases were determined from calculated Weibull distributions at 140 sites across the continental U.S., and all of the representative functions are evaluated at mean wind speeds of 4, 5, 6, 7, and 8 m/s at standard 10 m level.

(MONITORING, SITE-EVALUATIONS)

ST77 16106 WIND-POWER PLANT

Kling, A., Aug 26, 1976, German (FRG) Patent 2,506,160/A//, EDB-77:073097, In German

The invention is concerned with a wind-power plant whose rotor axis is pivoted in the supporting structure and swingable around an axis of tilt, forming an angle with the rotor axis and the vertical axis, and allowing precession of the rotor. On changes of wind direction an electric positioning device is moving the rotor axis into the new direction in such a way that no precession forces are exerted on the supporting structure and this one may very easily be held. Instead of one rotor, also a type with two coaxial, co-planar countercurrent rotors may be used. Each of the two countercurrent rotors is carrying a number of magnetic poles, distributed all over the circumference, acting together with the magnetic poles of the other rotor. At least the poles, of one rotor have electric line windings being connected by lead with a collector so that the two rotors form the two parts of a power generator being each rotatable with respect to the other ('stator' and 'rotor').

(PATENT, CONSTRUCTION, DESIGN-REVIEW)

ST77 16107 VARIABLE SPEED WIND TURBINES FOR HIGH WIND ENERGY CONVERSIONS

Kling, A., (Luftfahrzeug System, Berg, West Germany), Wind Engineering, V 1:141-149, N2, 1977, A77-42074

This study compares variable speed and constant speed rotor generator systems, and shows that under certain conditions the former may extract more than twice as much useful energy as the latter. Also suggested are a rotor configuration having less vibrational problems than the propeller and a high frequency generator specially adaptable to variable speed systems.

(VARIABLE-SPEED, CONSTANT-SPEED, ROTOR-CONFIGURATION, COMPARATIVE-EVALUATIONS)

ST77 16108 THEORY AND EXPERIMENTAL INVESTIGATION OF DUCTED WIND TURBINES

Lewis, R.I., Williams, J.E., Abdelghaffar, M.A., (Newcastle-Upon-Tyne, University, Newcastle-Upon-Tyne, England), Wind Engineering, V 1:104-125, N2, 1977, A77-42072

Practical wind turbine designs are examined and compared, with the object of selecting the one best suited to domestic use in low-level technology. Attention is focused in this paper on ducted (open) wind turbines. Wind turbine (WT) ideal efficiency (ducted or unshrouded), total wind thrust on the system, design of a theoretical WT duct, diffuse design, and turbine design (blading and impeller) are described. Experiments conducted on small and large ducts are described. Results show that a gain in power output can be obtained from a WT of specified diameter by using a suitably shaped duct. The optimum diffuser area ratio is found to be roughly 10% larger than the theoretically predicted value. Power output is maximized when some stall exists at the diffuser outlet.

(DUCTED-FLOW, DOMESTIC-ENERGY, DIFFUSER, DUCT-DESIGN)

ST77 16109 WIND ENERGY FOR THE DEVELOPING COUNTRIES

Lysen, F.H., (Rijksuniv. Groningen, Groningen, Netherlands), Ingenieur, (Netherlands), V 89:233-239, N12

The economic progress of many third world countries depends on their agricultural development, now hit by the oil crisis. Wind energy is thus of great potential importance. Applications can be divided into two groups: power + 1 kW, water pumping and small scale lighting; and power 1-10 kW, driving machinery, generating electricity and grinding grain. The Dutch R and D programme, 'Wind Energy in the Developing Countries', embraces R and D into wind energy systems up to the prototype stage; the handing over of information; and the establishment and guidance of national projects.

(ECONOMICS)

ST77 16110 MEASUREMENT OF OCEANIC WIND SPEED FROM HF SEA SCATTER BY SKYWAVE RADAR

Maresca, J.W., Jr., Barnum, J.R., (Remote Measurements Lab., Stanford Res. Inst., Menlo Park, CA), IEEE Trans. Antennas and Propag., V AP-25:132-136, N1, A77-17160

Remote measurements of the spatial mean ocean wind speeds were obtained using Doppler spectra resolved to 0.08 Hz from high-resolution HF skywave-radar backscatter measurements of the ocean surface. A standard deviation of 2.4 m/s resulted from the correlation of observed winds over the ocean and the broadening of the Doppler spectra in the vicinity of the higher first-order Bragg line. This broadening, for Doppler spectra unperturbed by the ionospheric propagation, is proportional to the increase in power caused by higher order hydrodynamic and electromagnetic effects in the vicinity of the bragg line and inversely proportional to the square root of the radio frequency. A lower bound on the measure of wind speed was established at 5 m/s by the low resolution spectral processing and low second-order power. An upper limit is suggested by the steep slope in the region of the sea backscatter spectrum outside the square root of two times the first-order Bragg line Doppler.

(REMOTE-SENSING, RADAR-MEASUREMENT, OCEANIC WIND-SPEED)

ST77 16111 WIND-POWER GENERATORS FOR THE ILES-DE-LA MADELEINE

McConnell, R.D., Van Sant, J.H., Fortin, M., Piche, B., (Inst. De Recherche De L'Hydro-Quebec, Montreal, Canada), Eng. J., Canada, V 60:20-22, N1

On account of the high cost of fuel in isolated regions, Hydro-Quebec has become interested in high-power wind-driven generators. Such a generation of 200 kW output based on a vertical rotor of unusual design would be introduced into the production network of the Iles-De-La Madeleine, in which the installed power provided by diese groups is 26 mW. Wind-power studies and cost-benefit figures show that such an installation would be commercially viable.

(200-KW, ISOLATED-REGIONS, ISLAND)

ST77 16112 THE 'WIND-WALL' - AN INTEGRATED WIND/SOLAR SYSTEM

McVeigh, J.C., (Brighton Polytechnic, Brighton, Sussex, England), Pontin, G.W.W., (Wind Energy Supply Co., Peacehaven, Sussex, England), Wind Engineering, V 1:150-158, N2, 1977, A77-42075

Design of an integrated system combining a windmill system and solar panels is discussed. The system is intended for power supply to residential areas. A bank of fixed ducted windmills and batteries of solar collectors sharing a common overall site are considered in an arrangement providing hot water and space heating. A water reservoir heat storage system, basic electrical system, and the pattern of energy supply and demand are outlined.

(HOUSES, HEATING, RESIDENTIAL, ELECTRICAL-SYSTEM)

ST77 16113 SITES FOR WIND POWER INSTALLATIONS: WIND TUNNEL SIMULATION OF THE INFLUENCE OF TWO-DIMENSIONAL RIDGES ON WIND SPEED AND TURBULENCE. ANNUAL REPORT, FIRST YEAR

Meroney, R.N., Sandborn, V.A., Bouwmeester, R.J.B., Rider, M.A., (Colorado State Univ., Fort Collins, CO), ERDA/NSF/00702-75/1, July 1976, EDB-77:092705
Avail:NTIS PC$5.00

The objective of this research was to increase technical capacity to locate favorable wind system sites, reduce uncertainty in the prediction or validation of the characteristics of sites, and thus assist in the sizing and performance prediction of wind systems. The research included evaluation of low speed aerodynamics over terrain and boundary flow conditions over ridges by means of wind tunnel modeling. Measurements have been completed over triangular and sinusoidal shape hills of wind speed, static pressure variation, turbulence intensity, wall shear, and wind deflection. Hill aspect ratios studied range from $1_2$ to $1_6$ with some data available at $1_{20}$. Measurements of wind overspeed, streamline patterns, and turbulence changes over the topography are compared with results from Boundary Layer theory. Large overspeed effects over the hills are found for the shear layers investigated.

(BOUNDARY-LAYER, SITE-SELECTION, TOPOGRAPHY, AERODYNAMICS)

ST77 16114 WIND ENERGY FOR HUMAN NEEDS

Merriam, M.F., (Univ. of California, Berkeley, CA), Technol. Rev., V 79:29-39, N3, 8 refs, Jan 1977, EDB-77:068105

ERDA-commissioned studies have determined that, contrary to popular opinion, large-scale wind power could contribute a significant amount of power to meet human needs. Windmills have been in use over 2000 years, and have been vital to such endeavors as western irrigation. Failures of past large-scale projects are under study and new designs are sought to overcome problems of stress, erratic wind, energy storage, and esthetics. Since the wind is free, inexhaustible, and non-polluting, a national effort to overcome technological and economic problems is justified. Windmills, which are rated on output per unit capital cost rather than efficiency, can be improved by extracting more power from the wind or by making the machines less costly. A two-blade propeller can deliver 3000 to 3500 megawatt-hours a year, with 100,000 wind generators capable of supplying 15 percent of the U.S. electricity. Near-future applications for wind energy are small- and large-volume water pumping, battery chargers in remote locations, and supplementary sources for power grids. The search for suitable windmill sites could be alleviated with better instruments to integrate wind speed. An incentive program similar to that used for uranium prospecting could locate new sites overlooked by bureaucratic surveys. A subsidy to windmill users might be a better government approach than the construction of expensive prototypes.

(ECONOMICS, ENERGY POLICY, STORAGE, ENVIRONMENTAL-EFFECTS, FINANCIAL INCENTIVES, RESEARCH-PROGRAMS, SITE-SELECTION, UNITED-STATES, ERDA)

ST77 16115 WIND ENERGY CONVERSION. PROGRESS REPORT, JULY 15, 1975-FEBRUARY 15, 1976

Humes, T., Miller, R.H., Martinez-Sanchez, M., Dugundji, J., Larrabee, E., (MIT, Cambridge, MA), ERDA/NSF/00826-75/2, 181 p., Feb 15, 1976, ASRL-TR-184-2

Information is presented concerning control strategies for maximum power; loading in the presence of wind shear and gusts; aeroelastic stability margins; performance comparison between constant rpm and constant velocity ratio operation; synchronous alternators for wind energy conversion; experimental vibration behavior of windmill; experimental wind turbine model description; development of solution for finite number of blades; aerodynamic design and performance of windmills; linear aeroelastic analysis of blade; and nonlinear analysis of a feathering-flapping-lagging rigid rotor blade without aerodynamics.

(WIND-SHEAR, AEROELASTIC-STABILITY, PERFORMANCE-COMPARISON, SYNCHRONOUS ALTERNATORS, AEROELASTIC-ANALYSIS)

ST77 16116 WIND ENERGY CONVERSION

Miller, R.H., Martinez-Sanchez, M., Dugundji, J., Larrabee, E.E., Chopra, I., (MIT, Cambridge, MA), NSF/RA-760569, ERDA/NSF-00826/75-3, 431 p., Oct 1976, ASRL-TR-184-3, PB-268 718/4WE

An investigation is made of various problems associated with the design of horizontal axis, low solidity, high performance wind turbines. The report deals with the following topics: (a) Wind turbine performance as determined from various elementary and more refined momentum theories; (b) Performance trade-offs between constant RPM and constant velocity ratio operation; (c) Aerodynamic vortex theories for blade loadings including unsteady effects and wind shear velocity gradients; (d) Control dynamics of a synchronous alternator-wind turbine system; (e) Linear aeroelastic stability studies of rotor blades in the presence of moderate initial coning angles; (f) Nonlinear dynamic response of rotor blades including gravity and wind shear excitation; (g) An experimental investigation of a .914 m (3 ft) diameter, 2 bladed wind turbine placed in a wind tunnel.

(HORIZONTAL-AXIS, MOMENTUM-THEORIES, BLADE-LOADINGS, CONTROL-DYNAMICS, STABILITY-STUDIES, WIND-SHEAR, WIND-TUNNEL)

ST77 16117 STEPHAN SIERADZKI: WINDMILL ON A BOOM

Moran, E., Pop. Sci., V 210:22-23, N2, Feb 1977, EDB-77:080118

The design of a small wind turbine which develops approximately 200 watts at 12 volts in a 15 mph wind is presented. In high winds the entire wind turbine and counterweighted tower assembly gradually pivot until a horizontal position is reached.

(200-WATTS, 12-VOLTS, DESIGN-PERFORMANCE)

ST77 16118 FUNDAMENTALS OF AERODYNAMIC DESIGN PROPELLERS / 2ND ENLARGED EDITION - SERBO-CROATIAN BOOK

Nenadovic, M., (Belgrade, Univerzitet U Beogradu), 671 p., 1976, A77-37949, In Serbo-Croatian

Basics of the mechanical and aerodynamic design of propellers, for piston engines, turboprop engines, wind-tunnel propeller groups, hovercraft, windmills, and wind-powered generators are presented, with extensive graphical and numerical data on various types of propellers and propeller systems, wind-tunnel studies, airfoil aerodynamic design, and similarity studies. Many numerical examples are discussed and worked out for existing aircraft and propeller system designs. Interaction between propellers and other aircraft parts, tractor propellers and pusher propellers, variable-pitch and fixed-pitch propellers, ducted propellers, and tandem propellers are discussed, along with propeller dynamics at supersonic speeds. Detailed attention is given to devices for varying propeller pitch in flight.

(NUMERICAL-ANALYSIS, WIND-TUNNEL TESTS, WIND)

ST77 16119 THE SPACING OF WIND TURBINES IN LARGE ARRAYS

Newman, B.G., (McGill University, Montreal, Canada), Energy Conversion, V 16:169-171, N4, 1977, A77-42893

The effect of spacing on the power output of wind turbines in large arrays has been determined theoretically. Following Templin, the effect is assessed by determining the increase in roughness of the earth's boundary layer due to the drag of the turbines. The thickness of the boundary layer is assumed to change in proportion to the square root of the skin friction, which is appropriate for a turbulent Ekman layer, and differs from the assumptions made by Templin. The loss of power for both flat-open country and rough-wooded country is determined as a function of the area density of the turbines, and it is found that quite large spacings are required to avoid a significant loss of power.

(GROUND-EFFECT, SITING)

ST77 16120 APPLICATION OF WIND POWER TO THE ELECTRIC POWER SYSTEM

Pantalone, D.K., Potter, A.G., (Iowa State Univ., Ames, IA), 1976, Oklahoma State University, Stillwater, OK, Frontiers of Power Technology Conference, EDB-77:068104

A wind generator system consists of a wind turbine, an electric generator, and a link to the electric power line. The dynamics of a WGS are exhibited by block diagrams and a frequency and time response, and the resulting eigenvalues of the system for different conditions are calculated. Positive damping characteristics are shown that indicate stability for small disturbances.

(FREQUENCY, POSITIVE-DAMPING)

ST77 16121 WIND ENERGY CONVERSION SYSTEMS MANUFACTURING AND SALES ACTIVITY, 1975 AND 1976

Parker, N., Walton, H., (FEA, Washington, DC), 11 p., Apr 1977, FEA/B-77/121, PB-265 823/5WE

This report contains the results of an annual survey of private firms engaged in the manufacturing and distribution of wind energy conversion systems in the United States during the years 1975 and 1976. Imports of systems manufactured abroad for distribution in the United States are also included.

(UNITED-STATES, IMPORTS, ECONOMICS)

ST77 16122 CONTRIBUTIONS TO THE DEVELOPMENT OF WIND ENERGY CONVERSION SCHEMES

Rajagopalan, V., Lescarbeau, A., Veilette, D., (Universite du Quebec a Trois-Rivieres), Rao, S.K., (Concordia University), Paper presented at the International Electrical, Electronics Conference and Exposition, Sept 26-28, 1977, Toronto, Session 31: Energy Sources and System operation

Taking into consideration the renewed interest in wind power conversion schemes for electric power generation feeding a utility grid, we have undertaken this research project, supported by the National Research Council and the Department of Energy, Mines and Resources, with a view to building experimental power conversion schemes incorporating static power thyristor converters suitable for a variable speed prime mover. This paper presents experimental results obtained for four different methods of generating electric power from a variable speed prime mover feeding into constant frequency constant voltage electric utility grid. Four different schemes have been considered for this paper: A common feature of all these schemes is the use of power electronic converters similar to a d.c. transmission configuration consisting of a three phase diode bridge, a d.c. link and a three phase line-commutated inverter. The diversity of these schemes lies in the use of either an alternator or a slip ring induction machine or two slip ring induction machines connected in cascade - cumulatively or differentially for power generation. The prime mover is supposedly a wind mill, where energy input from the wind is essentially a variable one resulting in variable speed of the prime mover; it is this variable speed prime mover feature is obtained from the use of

a separately excited d.c. motor. This paper contributes towards the comparative study of four different schemes with a view to identifying the merits and demerits of each one of them.

(STATIC-POWER THYRISTOR, ELECTRONIC CONVERTERS, VARIABLE-SPEED)

ST77 16123 DEVELOPMENT AND ADAPTATION OF FIELD MODULATED GENERATOR SYSTEMS FOR WIND ENERGY APPLICATIONS. PROGRESS REPORT

Ramakumar, R., Hughes, W.L., Allison, H.J., Yarlagadda, R.K., Smith, G.G., (Oklahoma State Univ., Stillwater, OK), Oct 17, 1975, PB-263604, EDB-77:105758

Two Ward-Leonard variable-speed drive systems were set up for use as motoring dynamometers for testing field modulated generators. All the parts required for the dynamometer cradle arrangement were designed and fabricated. A specially designed test machine has been fabricated for the experimental investigation. The stator and rotor are being wound. The solid state inverter required for this system is being assembled in a conveniently transportable rack for testing. Parallel-bridge rectifier system studies were extended to include bridge-input capacitors for the case of resistive loads. Fourier analysis of source current and load current waveforms has been completed, and the results are presented in graphical form for different values of $(X_L/R_L)$ and $(X_L/X_C)$ ratios. Preliminary literature surveys have been completed in the study of: (1) the Variable Load Band Pass filter required at the output of the field modulated generator system / and (2) the Snubber and Voltage Transient divided circuitry associated with the electronics subsystem. The results are summarized in this report.

(SOLID-STATE INVERTER, FOURIER-ANALYSIS, LOAD CURRENT-WAVEFORMS, PERFORMANCE TESTING)

ST77 16124 MATERIALS AND PROCESSING APPROACHES TO COST COMPETITIVE WIND TURBINE ROTOR BLADES

Rothman, E.A., (United Technologies Corp., South Windsor, CT), Deabler, H.E., Sampe Q., V 8:13-21, N2, Jan 1977, EDB-77:087272

A study was made of materials and processes using metallics and composites or combination of both for the fabrication of low cost wind turbine blades. As a result of these studies the filament winding process was selected as offering the potential for low cost fabrication while requiring the minimum compromises in aerodynamic shape, optimum structure, and weight. The process is described which is compatible with existing winding facilities and equipment and which results in near optimum structural fiber orientation. Fiberglass material is used with a resin system appropriate for the process and requiring minimum curing time and equipment.

(AERODYNAMICS, COMPARATIVE-EVALUATIONS, FABRICATION, FLEXURAL-STRENGTH, TURBINE BLADES)

ST77 16125 MODELING ALGORITHMS AND THEIR IMPLEMENTATION ON A DIGITAL COMPUTER FOR CALCULATING THE CAPACITY OF STORAGE CELLS AT WIND-POWER AND SOLAR ENERGY INSTALLATIONS

Salieva, R.B., (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR), Geliotekhnika, p. 75-83, N2, 1977, A77-37775, In Russian

No abstract available

(DIGITAL-TECHNIQUES, STOCHASTIC-PROCESSES)

ST77 16126 WIND-POWERED ENGINE, PARTICULARLY FOR PRODUCING ELECTRICAL ENERGY

Schroeder, K., July 29, 1976, German (FRG) Patent 2,502,783/A//, EDB-77:098563, In German

The wind-powered engine has 2 wind-operated propellers which are situated one behind the other, bearing-mounted, independent of one another and rotating in opposite directions, which convert their energy of rotation in an electric generator. The rotor and stator of the generator are each connected to one propeller, so that they rotate in opposite directions. Speed regulation takes place due to stresses in the propellers. The pitch of the blade ends changes at high wind speeds. Braking surfaces are created there which stop the machine.

(PATENT, CONSTRUCTION, SPEED-REGULATORS, TURBINE BLADES)

ST77 16127 WHAT PRICE WIND POWER - WIND TURBINE EFFICIENCIES

Shepherd, D.G., (Cornell University, Ithaca, NY), Aware, p. 11-15, May 1977, Eng., Cornell Q., V 11:2-11, N3, Autumn 1976, EDB-77:068103, A77-37248

Basic considerations in adapting wind power systems for different uses and locations are discussed. The role of such factors as average wind velocity and wind variation

in the selection of a wind system design is examined. The advantages and disadvantages of different types of wind power systems, including lift or drag types and horizontal or vertical axis types, are discussed and compared. Wind concentration devices are briefly described. Applications of small wind energy systems are discussed, and proposals for large-scale wind-based power systems are considered.

(VERTICAL-AXIS, CONCENTRATION-DEVICES, LARGE-SCALE, HORIZONTAL-AXIS, SMALL-SCALE)

ST77 16128 DUAL OPTIMUM AERODYNAMIC DESIGN FOR A CONVENTIONAL WINDMILL

Steward, H.J., (Calif. Inst. of Technol., Pasadena, CA), AIAA (Am. Inst. Aeronaut. Astronaut.) J., V 14:1524-1527, N11, Nov 1976, EDB-77:098565

The theoretical possibility of designing the blading of a conventional windmill so as to match the optimum loading for maximum output at two different operating conditions (i.e., at two different values of the ratio of tip speed to wind speed) is investigated using the vortex blade element theory. The theory of optimum loading is developed, including the effect of profile drag. For the range of parameters considered, it is shown that the effect of profile drag on blade loading is quite small, although the effect on efficiency is significant. The simpler theory, neglecting profile drag, and first presented by Glauert, then is used to design three sets of blading which match the Glauert loading conditions at two conditions, tip speed ratios of 4 and 5.

(NUMERICAL-ANALYSIS, TURBINE BLADES)

ST77 16129 RURAL ELECTRIFICATION AND WIND POWER

Tewari, S.K., (National Aeronautical Lab., Bangalore, India), Indian East. Eng., V 118:455,457-459, N10, Oct 1976, EDB-77:080115

The economic aspects of using wind generated electricity in rural villages of India are studied.

(ECONOMICS, INDIA)

ST77 16130 FARM ENERGY SYSTEM EMPLOYING HYDROGEN STORAGE

Tison, R.R., Biederman, N.P., (Inst. of Gas Technol., Chicago, IL), World Hydrogen Energy Conf., 1st, Proc., Miami Beach, FL, Mar 1-3, 1976, Publ by Univ of Miami, Coral Gables, FL, V 2:3-28, Sess 4B, 3 refs, 1976

Wind energy systems that supply up to 100% of a farm's energy requirements are feasible with existing technology. Mobile fuel applications and loads requiring long-term, large volume storage are not currently viable. Short-range, small-volume storage to allow for wind availability and load requirements, appears feasible. Nonoptimized costs for power supplied to a 100-head dairy farm discussed in this paper are in the range of $0.27 to $0.57/KWHR. Optimized costs are anticipated, however, to be as low as $0.10/KWHR.

(HYDROGEN, STORAGE, WIND)

ST77 16131 WIND POWER PLANTS FOR PEAK DEMANDS

Upmalis, A., Energie, V 28:262-265, N9, 5 refs, Sept 1976, EDB-77:098561, In German

A survey of the current development of wind turbines and control systems for storage and peaking requirements is given. The prospects of using wind power plants mounted on roofs of high buildings are evaluated.

(ROOF-MOUNT, CONTROL-SYSTEMS, LOAD-MANAGEMENT, STORAGE)

ST77 16132 CLOSING ENERGY GAPS WITH THE AID OF WIND POWER

Upmalis, A., Energie, V 28:262-265, N9, Sept 1976, EDB-77:087268, In German

The exhaustion of fossil and nuclear fuel reserves predicted is the starting point for considerations concerning the utilization of the non-exhaustive wind power. The dependences of the efficiency of utilization are sketched, and experimental wind power plants already in use with outputs of between 100 and 200 KW are described in some detail. At, the same time planning, as well as current research into the utilization of wind energy is taking place.

(MECHANICAL-EFFICIENCY, PLANNING, RESEARCH-PROGRAMS)

ST77 16133 WIND ENERGY IN PRACTICAL USE WHEELS, ROTORS, MILLS, WIND POWER PLANTS - GERMAN BOOK

Von Koenig, F., Munich, Udo Pfriemer Verlag Gmbh, 182 p., 1976, EDB-77:080116, A77-33114, In German

A descriptive survey of the use of wind power and equipment for harnessing wind energy. Slightly less than half the text deals with the history of wind-power equipment, windmills in particular, and covers equipment for wind measurements, anemographs, wind wheels, and prayer wheels. More recent developments are described; savonius rotor and other rotors, farmstead wind turbines, aeolian motors, new wind motors for generating electric power, large-scale wind tower projects, and wind engine parks. A separate chapter is devoted to the wind as an energy vehicle, and another chapter to economical exploitation of wind power. The text is generously illustrated throughout.

(ROTOR AERODYNAMICS, ROTOR BLADES, MEASUREMENT, ANEMOGRAPHS)

ST77 16134 STUDY OF ALASKAN WIND POWER AND ITS POSSIBLE APPLICATIONS. ANNUAL PROGRESS REPORT - MAY 1 - DEC 31, 1974

Wentink, T., Jr., (Alaska Univ., College, AK), Jan 31, 1975, PB-254822, EDB-77:080114
Avail:NTIS$4.50

This report examines the potential and possible applications of wind power in the Alaskan area. The relative potential for alterntive applications and users of wind power systems is examined and the wind potential of related sites and the problems associated with wind systems in the severe Alaskan environment are discussed.

(ENVIRONMENT)

ST77 16135 WIND POWER POTENTIAL OF ALASKA, PART II. WIND DURATION CURVE FITS AND OUTPUT POWER ESTIMATES FOR TYPICAL WINDMILLS

Wentink, T., Jr., (Alaska Univ., Fairbanks, AK), Aug 1976, RLO / 2229 / T12-76/1, EDB-77:092698
Avail:NTIS$5.00

An empirical analytical function (F1) and the Weibull function (F3) were compared for use in casting measured long-term wind speed frequency data in the form of the wind speed duration curves. Data from 18 Alaskan locations were used in the 248 cases treated. The fitted duration curves were coupled with the instantaneous power vs. wind speed characteristics for three wind energy conversion systems (WECS) to predict the probable monthly and annual mean energy productivity and power levels of the WECS. The latter, as used here, were rated at 6 KW (elektro), 15 KW (grumman), and 100 KW (NASA-mod 0). In the absence of reliable test data for average energy or average power (anti P) at known average wind speeds no choice between F1 and F 3 is obvious, but statistical tests favor F1. Both seem equally useful for wind power estimation. The validity of use of the long-term average wind speed as a key parameter in wind work is demonstrated. The main text contains seven figures, 15 tables and 11 references. An appendix dealing with the effect of furling on anti P contains six additional figures and two references.

(FREQUENCY-DATA)

ST77 16136 WIND ENERGY - BOUNTY IN THE BREEZE

Wise, C.E., Machine Design, V 49:20-22, 24-26, Aug 11, 1977, A77-43123

Wind-generated power is discussed, and development programs for several generator systems are reviewed. Limitations on the wide-scale use of wind-generated power, including the variable availability of the energy source and the inherently low power-conversion coefficient of wind-energy systems, are considered estimates of the role of wind-energy in future U.S. energy consumption are given. A number of wind-operated electrical generators having power ratings of 100 KW to 2.5 MW are described. It is noted that the high capital costs of large systems may restrict their development

(CONVERSION-EFFICIENCY, ROTOR BLADES, DEVELOPMENT-PROGRAMS)

ST77 16137 BENEFIT-COST METHODOLOGY STUDY WITH EXAMPLE APPLICATION OF THE USE OF WIND GENERATORS - Final Report

Zimmer, R.P., Justus, C.G., Mason, R.M., Robinette, S.L., Sassone, P.G., (Georgia Inst. of Tech., Atlanta, GA), July 1975, EDB-77:092699, N-75-31571
Avail:NTIS$10.50

An example application for cost-benefit methodology is presented for the use of wind generators. The approach adopted for the example application consisted of the following activities: (1) surveying of the available wind data and wind power system information, (2) developing models which quantitatively described wind distributions, wind power systems, and cost-benefit differences between conventional systems and wind power systems, and (3) applying the cost-benefit methodology to compare a conventional electrical energy generation system with systems which included wind power generators. Wind speed distribution data were obtained from sites throughout the contiguous United States and were used to compute plant factor contours shown on an annual and seasonal

basis. Plant factor values (ratio of average output power to rated power) are found to be as high as 0.5 (on an annual average basis) in portions of the Central U.S. and in sections of the New England coastal area. Two types of wind power systems were selected for the application of the cost-benefit methodology. A cost-benefit model was designed and implemented on a computer to establish a practical tool for studying the relative costs and benefits of wind power systems under a variety of conditions and to efficiently and effectively perform associated sensitivity analyses.

(NEW-ENGLAND, CENTRAL UNITED STATES, COMPARATIVE EVALUATIONS, COST-BENEFIT-ANALYSIS, WIND, ECONOMICS)

ST77 16138 TRANSFORMER OF ENERGY DIRECTION FOR USE IN AERODYNAMIC AND HYDRODYNAMIC FLOW

Zimmermann, G., German (Frg) Patent 2,507,295/A, Sept 2, 1976, EDB-77:073092, In German
The invention refers to a flow power engine where the power wings, picking up the thrust and being arranged around the axis of the engine by means of wing carries, are brought into the position required for power pick-up by the flow itself. Until the next power pick-up phase the flow puts them into a position in which they do not put up any resistance to the flow. If the flow direction is changed, e.g., on transition from high tide to low tide, the sense of rotation does not change. The mass of the power wings is equal to that of the amount of water displaced, e.g., by means of air-filled cavities, in order that they do not change their position by buoyancy or gravity. The power wings fold on the carriers turning around the wing axis until a prolongated straight line is formed. By means of the brake arm or brake rod they are prevented from folding any further.

(CONSTRUCTION, CONTROL-SYSTEMS, WAVE-ENERGY, WIND, PATENT)

## 17,000 BIOMASS

ST77 17056 BIOMASS CONVERSION: ECONOMICS INHIBIT PROGRESS

Chem. Eng. News, V 55:21-22, N9, Feb 28, 1977, EDB-77:082168
Unfavorable economics are the major deterrent to biomass conversion as a source of energy, although numerous small-scale processes have demonstrated the potential for hydrocarbon fuels and chemical feedstocks. Most efforts to date have focused on recycling wastes. Biomass conversion has the advantage of drawing on an unlimited renewable resource, much of which, however, is located in undeveloped tropical areas. Conversion technology, while available on a small scale, is so far used mostly by wood-based industries. Competition with the food industry for land still leaves the United States with adequate land to develop biomass as an energy source, but the price will include income lost from food exports. Recent increases in agricultural land reflect the growth of the food export industry. Forest acreage has remained stable, although production has increased because of improved technology and management. The energy potential from wood comes from recycling wastes rather than direct burning, which is inefficient, although there is increasing competition from the plant researchers investigating relative photosynthesis production and carbon dioxide limiting characteristics of different plants.

(BIOMASS, PLANTATIONS, COMMERCIALIZATION, ECONOMICS, FORESTS, TECHNOLOGY-ASSESSMENT)

ST77 17057 CLEAN FUELS FROM BIOMASS, SEWAGE, URBAN REFUSE, AGRICULTURAL WASTES; PROCEEDINGS OF THE SYMPOSIUM, ORLANDO, FLORIDA, JANUARY 27-30, 1976

Symposium sponsored by the Institute of Gas Technology, Chicago, Institute of Gas Technology, 1976, 465 p., (For individual items see A77-37653 to A77-37671), A77-37652
Papers dealing with production of biomass for conversion to synthetic fuels with concomitant savings in materials and energy are presented. Major topics covered include fundamentals of photosynthesis, scaled-up production of biomass, biomass-to-fuels conversion processes, characteristics and compositions of municipal and agricultural wastes, separation techniques, microbiological and anaerobic processes for production of gas from sewage effluents and other wastes, and economics of energy and materials recovery processes. Recovery of methane from landfill wastes, gas production from ocean kelp, microalgae, and water hyacinths, and reprocessing of cellulose to produce sugars and eventually alcohols are discussed.

(SYMPOSIUM, CONFERENCES, ECONOMICS, ENVIRONMENT-EFFECTS, PHOTOSYNTHESIS, PROCEEDINGS)

ST77 17058 FUELS FROM BIOMASS PROGRAM: PROGRAM AND PROJECT STATUS

(ERDA, Washington, DC), Nov 1976, ERDA-76-137, EDB-77:066025
Avail:NTIS$4.00

The fuels from biomass program, part of the division of solar energy, Energy Research and Development Administration (ERDA), supports projects dealing with the production of biomass and its conversion to clean fuels. Systems studies are underway to inventory biomass resources, estimate production costs, and identify and evaluate conversion processes. These studies will also assess impacts on food production, the new environment, and society. Research contracts to develop processes for converting biomass to fuel have been awarded and the best sources of biomass and best conversion technologies for intensive development will be identified in the coming year. An experimental facility in Albany, Oregon is nearly completed. Its mission is scale-up of the Bureau of Mines process for converting wood wastes to fuel oil.

(PLANTATIONS, ETHANOL, HYDROGEN, METHANE, RESEARCH-PROGRAMS)

ST77 17059 PHOTOSYNTHETIC PRODUCTIVITY

(National Academy of Sciences - National Research Council, Washington, DC), In Its World Food and Nutr. Study, Enhancement of Food Production for the United States, p.119-123 (see N77-77830 12-43), N77-77843

No abstract available

(CONVERSION-EFFICIENCY, FORECASTING, BIOMASS)

ST77 17060 SYNTHETIC LEAF MAY BE BUDDING ENERGY SOURCE

Chemical Week, V 120:41-42, N6, Feb 9, 1977

Argonne National Laboratory researcher Joseph Katz views the leaves of green plants as solar cells, converting the energy of sunlight into useful chemical energy. He has created a synthetic leaf to prove his point. The device generates an electrical potential when sunlight or other light energy shines on it, and future versions may be able to electrolyze water to obtain hydrogen. Katz's research is funded by ERDA, and the synthetic leaf has the potential of being more efficient than traditional solar thermal devices. The mechanism operates when light shines on a chlorophyll coated membrane between two electrodes. While green plants convert about 2 percent of the solar energy falling on them, thus far the Katz conversion is only 0.0024 percent,but he is working toward higher efficiency. The scientific background on the device is discussed.

(ELECTROLYZE WATER, HYDROGEN)

ST77 17061 BIOSOLAR SYNFUELD FOR TRANSPORTATION

Anderson, C.J., (California Univ., Livermore, CA), Biosolar Synfuels for Transportation, 17 p., UCRL-52208, W-7405-ENG-48

This paper presents a short review of biosolar sources of synthetic liquid fuels (synfuels) for transportation. There are a variety of ways to convert potentially large energy crops into fuels suitable for transportation use; e.g., liquid fuels such as methanol, ethanol, and pyrolytic oils. In addition, organic wastes are widely produced and although they are still generally not considered a resource, there is little doubt that they will increasingly be recycled for their material and energy value. Major technical, social, economic, environmental, and political questions remain, and although the potential for biosolar transportation synfuels is large, it is still small compared to transportation energy demand. Because of their costs, early implementation of biosolar conversion schemes will likely not be in the area of transportation synfuels.

(BIOMASS, ETHANOL, METHANE, AUTOMOTIVE-FUELS, FEASIBILITY-STUDIES, ENERGY-CROPS, ENVIRONMENTAL, POLITICAL)

ST77 17062 METHOD FOR PRODUCING SYNTHETIC FUELS FROM SOLID WASTE

Antal, M.J., Jr., (ERDA, Washington, DC), Filed Mar 28, 1975, patented Nov 23, 1976, 8 p., PATENT-3 993 458, PAT-APPL-563 274. This government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC, $0.50, PATENT-3 993 458, EDB-77:079910, EDB-77:087077

Organic solid wastes represented by the general chemical formula $C_xH_yO_z$ are reacted with steam at elevated temperatures to produce $H_2$ and $CO_2$ in an endothermic reaction. This heat is supplied by a tower top solar furnace; alterntively, some of the solid wastes can be used as a fuel or a chemical feedstock. Alterntively, methanol can be produced by the commercial process. Since the reaction is endothermic, the system represents a method for storing heat energy from an external source in a chemical fuel produced from solid wastes. 6 claims, 1 drawing figure

(ENDOTHERMIC-REACTION, SOLAR FURNACE, HYDROGEN, BIOMASS)

ST77 17063 ENERGY PRODUCTION BY MICROBIAL PHOTOSYNTHESIS

Benemann, J.R., Weissman, J.C., Koopman, B.L., Oswald, W.J., (California,University, Berkeley, CA), Nature, V 268:19-23, July 7, 1977, A77-40471

Scientific and practical aspects of fuel and fertilizer production from microalgae and photosynthetic bacteria are reviewed, with emphasis given to large-scale culture of microscopic algae in waste treatment ponds. Harvesting microalgae requires low-cost filtration and sedimentation techniques that are not available for use in ponds of present dimensions. However, once methods are developed for selective cultivation of filamentous or colonial microalgae, harvesting becomes a simpler and cheaper operation. Accordingly, selective straining and limitation of nutrients are suggested as means of promoting growth of desired species. Modifying algal pond systems to increase solar energy conversion rates is discussed, and other possibilities for obtaining energy sources from microbial photosynthesis, such as production of hydrogen gas from water, are also indicated.

(BIOMASS, PHOTOSYNTHESIS, BACTERIA, CONVERSION-EFFICIENCY, HYDROGEN, METHANE)

ST77 17064 INSEPARABLE LINKAGE: CONSERVATION OF NATURAL ECOSYSTEMS AND THE CONSERVATION OF FOSSIL ENERGY

Bormann, F.H., (Yale Univ., New Haven, CT), Bioscience, V 26:754-760, N12, Dec 1976, EDB-77:088548

Natural forest ecosystems, which by virtue of photosynthesis and transpiration are solar-powered, provide a stable predictable environment. Stresses aiding in degradation and destruction of these ecosystems also cause increased use of fossile fuels, thus furthering the destruction of the ecosystem. In addition to supplying wood products and recreational areas, the temperate forest ecosystem plays a role in controlling climate, hydrology, circulation of nutrients, erosion, cleansing of air and water, and status of streams, lakes, and underground water supplies. Stresses which can ultimately destroy forest ecosystems are related to man's technology and economic growth and must be controlled.

(ECONOMICS, FORESTS, PHOTOSYNTHESIS, UNITED-STATES)

ST77 17065 PHOTOSYNTHESIS AND SOLAR ENERGY CONVERSION

Clayton, R.K., (Brookhaven National Lab., Upton, NY), (Cornell Univ., Ithaca, NY), Chlorophyll-Proteins, Reaction Centers, and Photosynthetic Membranes, Olson, J.M., Hind, G., eds., 1976, BNL-50530, EDB-77:108550

The following topics are discussed: wind-powered electric generators, ocean thermal gradients, direct solar heating, variations of agriculture, photosynthetic hydrogen production, and photoelectric devices. It is concluded that sunlight provides the best long-term hope for an inexhaustible supply of pollution-free energy.

(HYDROGEN, PHOTOELECTRIC-CELLS, PHOTOSYNTHESIS, WIND, OCEAN-ΔT)

ST77 17066 DESIGN, OPERATION AND ECONOMICS OF THE ENERGY PLANTATION

Fraser, M.D., Henry, J.F., Vail, C.W., (Intertechnology Corp., Warrenton, VA), In Clean Fuels from Biomass, Sewage, Urban Refuse, Agricultural Wastes; Proceedings of the Symposium, Orlando, FL, January 27-30, 1976, Chicago, Institute of Gas Technology, p. 371-395, 1976, DACA23-74-C-0009, A77-37652 17-44, A77-37667

The energy plantation concept considered represents an innovative, systematic approach for producing a practical and economic fuel from plant matter on a large scale. Ultimately, the fuel derives from solar energy, which is collected and stored in plants grown for their fuel value. The advantages of energy plantations are examined and questions regarding the plant resources are investigated. Attention is given to natural stands versus managed plantings, annual plants versus perennials, deciduous plants versus conifers, preferred deciduous species, and preferred perennial grasses. Suitable land resources are considered along with plant-matter production rates, plantation design and operation, and the economics of energy plantation.

(BIOMASS, ENERGY-TECHNOLOGY, LAND-USE)

ST77 17067 PHOTOSYNTHETIC SOLAR ENERGY - REDISCOVERING BIOMASS FUELS

Hammond, A.L., Science, V 197:745,746, Aug 19, 1977, A77-44396

Possibilities for using biomass as an energy source are considered, noting that biomass is potentially a renewable source of a full range of liquid and gaseous fuels for which domestic sources of their fossil counterparts are increasingly in short supply. Biomass fuels discussed include wood products, gas derived from walnut shells, manure, crop residues, biomass ethanol, forest wastes, and aquatic plants. Some research projects are described which involve the development of biomass gasifiers,

ethanol fermentation from sugarcane and sweet sorghum, cultivation of blue-green algae and kelp as methane sources, and a proposal for a biomass refinery in which hydrogen would be produced from organic wastes with steam generated by solar heat concentrated on a boiler. The extent of biomass resources in the United States and the economics of biomass energy systems are assessed.

(BIOMASS, ECONOMICS, HYDROGEN, METHANE, WOOD, UNITED-STATES)

ST77 17068 HYDROCARBON FUELS FROM SOLAR ENERGY VIA THE ALGA BOTRYOCOCCUS BRAUNI

Hillen, L.W., Warren, D.R., (Aeronautical Research Labs, Melbourne, Australia), 47 p., ARL/MECH. ENG.-148, DCAF F090834, N77-28576

The production of liquid hydrocarbon fuels from a non-depleting source such as solar energy and algae is investigated. The alga botryococcus braunii, which grows widely in nature, can produce hydrocarbons in amounts up to 75% of its dry mass. There is considerable contemporary and geological evidence, especially in Australia, that it is capable of prolific growth under appropriate conditions. Harvesting and processing is relatively simple compared with other energy crops. Problems involved in producing solar oil in this way on a large scale are assessed.

(BIOMASS, SOLAR-OIL)

ST77 17069 A MODEL FOR OXYGEN AND BIOMASS PRODUCTION IN A MASS ALGAL CULTURE

Incropera, F.P., Thomas, J.F., (Purdue Univ., Lafayette, IN), 87 p., PB-264 100/9SL, W77-04998, OWRT-A-042-IND(1)

The primary purpose was to develop a model for a reliable method of predicting the yield of a mass culture of unicellular algae in wastewater treatment ponds. Such algal cultures are capable of producing a high protein food supplement. The model developed determines both oxygen and algal biomass production and is based upon the use of available insolation data. It accounts for spectral effects in the photosynthetically active region, as well as directional effects through delineation of the diffuse and collimated components of the radiation. The effects of the air-water interface are treated, and predictions of the radiation field within the water are used with a representative photosynthesis model to predict the hourly yield. Calculations have been performed for the Indianapolis, Indiana region, and comparisons with field data for similar latitudes reveal that the model is well suited for predicting the maximum yield of mass cultures.

(AQUACULTURE, MATHEMATICAL-MODELS, PHOTOSYNTHESIS, BIOLOGICAL-PRODUCTIVITY, INDIANA)

ST77 17070 BIOSOLAR PRODUCTION OF FUELS FROM ALGAE

Jeffries, T.W., Moulthrop, P.H., Timourian, H., Ward, R.L., Berger, B.J., (California Univ., Livermore, CA), 41 p., UCRL-52177, W-7405-ENG-48, N77-28323

A design concept is described for the production of methane, hydrogen, and ammonia using solar energy. Filamentous, nitrogen fixing blue-green algae are employed as a source of biomass for methane and ammonia generation by anaerobic digestion and as a biological catalyst for the photoproduction of hydrogen from water. The resources needed, biomass production and harvest, anaerobic digester, the process of biophotolysis, and product separation are discussed. The environmental and genetic modifications possible to increase biomass production are indicated. Preliminary cost estimates are made for methane and hydrogen production. It is concluded that biosynthetic methane is not economically competitive with that derived from coal gasification, but that hydrogen production offers a viable long-range prospect.

(HYDROGEN, METHANE, ECONOMICS, BIOMASS)

ST77 17071 LONG-RANGE APPROACH TO THE NATURAL GAS SHORTAGE UTILIZING NONFOSSIL RENEWABLE CARBON

Klass, D.L., (Inst. of Gas Tech., Chicago, IL), Energy Sources, V 3:177-195, N2, 1977, EDB-77:072802

Based on our present knowledge, the only long-term practical solution to sustaining a national economy on natural gas is to convert a major source of continuously renewable nonfossil carbon to substitute natural gas that is interchangeable with, or can be substituted for, natural gas. The most promising source of this carbon is land- and water-based biomass produced from solar energy by photosynthesis. An assessment of this concept is presented, and the major problems encountered in the development of the technology are reviewed. The technology for biomass production and conversion is sufficiently advanced so that break-throughs and discoveries of a fundamental nature are not required. Special emphasis is given to the importance of system design, biomass production, biomass conversion to SNG, economics, and energetics. A concept for the net energy production ratio of fully integrated systems is also presented. After suitable

development, the commercialization of an SNG industry using low-cash-value, high-fuel-value biomass raw materials will probably be economically attractive. It is essential to start a full-scale development program now so that the technology is ready for use before fossil fuel depletion causes even greater energy supply problems.

(BIOMASS, ECONOMICS, NET-ENERGY, ORGANIC WASTES, PHOTOSYNTHESIS, SYSTEMS-ANALYSIS)

ST77 17072 BIOLOGICAL SOLAR ENERGY CONVERSION: APPROACHES TO OVERCOME YIELD, STABILITY AND PRODUCT LIMITATIONS

Kok, B., Fowler, C.F., Hardt, H.H., Radmer, R.J., (Martin Marietta Labs, Baltimore, MD), NSF/RA-770063, 27 p., Mar 1977, MML-TR-77-27c, PB-267 937/1WE

This report continues the study of chloroplast aging and rate limitations in the photosynthetic electron transport system. It was confirmed that the photosystem II acceptor, phenylenediamine, accepts electrons from two sites in the electron transport chain, one of which is uncoupler insensitive. These two sites have approximately equal rate constants and contribute about equally when photochemistry operates with maximum rates. Therefore, it was concluded that when uncoupler is present, the primary rate limitation precedes the uncoupler-insensitive transport to phenylenediamine. Fluorescence measurements have confirmed the results showing that chloroplast storage at high pH inhibits only the oxygen evolution system and not the functioning of the trap. Intact bundle sheath and mesophyll chloroplasts were isolated from corn (Zea mays) and compared to spinach chloroplasts in terms of their 02 evolution activity and Mn content. The relatively high activity high Mn content in the bundle sheath chloroplasts (which are about equal to those measured with the mesophyll chloroplasts) are not consistent with the idea of a deficiency in the system II in the bundle sheath cells of the highly efficient C4 plants, such as corn. Mass spectrometer studies have indicated that NO3 reduction suppresses the 02 cycle by competing with 02 for photosystem I-generated reducing equivalents.

ST77 17073 MARINE PASTURES: A BY-PRODUCT OF LARGE (100 MEGAWATT OR LARGER) FLOATING OCEAN-THERMAL POWER PLANTS - Final Report

Laurence, S., Roels, O.A., (Columbia Univ., Palisades, NY), 225 p., Aug 31, 1976, COO/2581-3, EDB-77:080033

The potential biological productivity of an open-sea mariculture system utilizing the deep-sea water discharged from an ocean-thermal energy conversion (OTEC) plant was investigated. In a series of land-based studies, surface water was used to inoculate deep water and the primary production of the resultant blooms was investigated. Each cubic meter of deep water can produce approximately 2.34 g of phytoplankton protein, and that an OTEC plant discharging deep water at a rate of $4.5 \times 10^4$ $M^3$ $MIN^{-1}$ could produce $5.3 \times 10^7$ KG of phytoplankton protein per 350-day year. A series of land-based shellfish studies indicated that, when fed at a constant rate of $1.83 \times 10^{-3}$ G of protein per second per 70-140 G of whole wet weight, the clam, Tapes japonica, could convert the phytoplankton protein-nitrogen into shellfish meat protein-nitrogen with an efficiency of about 33 percent. Total potential wet meat weight production from an OTEC plant pumping $4.5 \times 10^4$ $M^3$ $MIN^{-1}$ is approximately $4.14 \times 10^8$ KG for a 350-day year. Various factors affecting the feasibility of open-sea mariculture are discussed. It is recommended that future work concentrate on a technical and economic analysis.

(SHELLFISH, MARICULTURE, BIOMASS, OCEAN-ΔT)

ST77 17074 AN ECONOMIC ASSESSMENT OF FUELGAS FROM WATER HYACINTHS

Lecuyer, R.P., (United Technologies Florida Research and Development Center, West Palm Beach, FL), Marten, J.H., (Davy Powergas, Inc.), In Clean Fuels from Biomass, Sewage, Urban Refuse, Agricultural Wastes; Proceedings of the Symposium, Orlando, FL, January 27-30, 1976, Chicago, Institute of Gas Technology, p. 267-286, 1976, A77-37652 17-44, A77-37663

An economic study is presented to produce 200 million SCF/DAY of methane using water hyacinths as a feedstock. The water hyacinths are grown in a controlled area, harvested by a unique process and converted to a 600 BTU/SCF biogas through an anaerobic digestion process. The approximate 1,000 BTU/SCF pipiline quality gas (PQG) is then compressed to pipeline pressure and sold to a gas pipeline company or large industrial user(s). Water hyacinths were selected as a feedstock because of their prolific growth rate (60 dry TONS/ACRE/YEAR), absence of a current economic value and ease of harvesting since they are floating plants. The results of the analysis indicate that the process is ecologically sound, technically feasible, and economically near-viable in an increasing natural gas cost economy, but possibly questionable from a public acceptance standpoint because of the large land area required.

(BIOMASS, ECONOMIC, BIODEGRADATION, ENVIRONMENTAL-IMPACT, LAND-USE)

ST77 17075 FUELS FROM BIOMASS - ENERGY OUTLAY VERSUS ENERGY RETURNS. A CRITICAL APPRAISAL

Lewis, C.W., (Strathclyde, University, Glasgow, Scotland), Energy (UK), V 2:241-248, Sept 1977, A77-38673

The concept of fuel production by the microbial conversion of biomass is discussed with particular emphasis upon the energy implications involved. Both the energy requirements and energy returns for a number of selected systems are assessed in the light of current technology, while areas for future improvements are also mentioned. The general trend of such biological energy systems is that energy gains made via plant photosynthesis using intensive systems are subsequently more than lost in the conversion of biomass energy content into storable, high-energy fuels such as ethanol and methane. Of the operations under investigation, the growth of sugarcane and its fermentation to ethanol is considered to be the most favorable as a marginal net energy production process.

(BIOMASS, ENERGY-TECHNOLOGY, PHOTOSYNTHESIS, FERMENTATION, NET-ENERGY)

ST77 17076 ENERGY FROM WASTES

Miller, I.J., (Department of Scientific and Industrial Research, Chemistry Div., Petone, New Zealand), New Zealand Energy Journal, V 50:31-33, Mar 25, 1977, A77-33280

The overall production of refuse in New Zealand is estimated to be about 3,200 tons per day with a calorific value of approximately 11.6 GJ/T. Technical aspects of energy recovery and procedures for increasing the use of energy recovery systems are discussed. Consideration is given to the recycling of energy-intensive materials, the production of fuels, and the direct production of energy (usually in the form of heat).

(BIOMASS, ENERGY POLICY, NEW-ZEALAND, ORGANIC WASTES)

ST77 17077 OCEAN FOOD AND ENERGY FARM PROJECT. SUBTASK NO. 1 AND 2: BIOLOGICAL STUDIES OF M. PYRIFERA GROWTH IN UPWELLED OCEANIC WATER

North, W.J., (California Inst. of Tech., Pasadena, CA), Nov 1976, ERDA/USN/1027-76/4, EDB-77:092598

The primary objective of the research activities during 1975-1976 was to assess the capacity of artificially upwelled water to stimulate growth in giant kelp, macrocystis. Although deep oceanic water is known to be rich in a number of plant nutrients, there was little assurance that all required elements would be present in the necessary amounts or as forms that could easily be assimilated. There was also a possibility that concentrations of the free forms of potentially harmful trace substances such as copper, might occur in deep water above the toxic thresholds. Original plans for 1975-1976 called for considerable experimentation with adult macrocystis plants. Adults often attain lengths greater than 30 meters, may weigh hundreds of kilograms, and display massive foliage. Huge containments and large quantities of water and other materials are needed for performing nutritional studies on adult macrocystis plants. One study was attempted involving maintenance of an adult plant in artificially upwelled water for eleven days. Although some useful results were obtained, the considerable outlay of effort and money did not appear to be justified. Much of the desired information could undoubtedly be gathered more efficiently by laboratory experimentation. Accordingly emphasis was switched from a few large-scale field studied to a variety of modest-sized activities under reasonably controlled conditions in our laboratory. The testing apparatus, experimental methodology, and results are presented and discussed in detail.

(BIOMASS, PLANTATIONS, PHOTOSYNTHESIS)

ST77 17078 ENERGY FROM BIO-CONVERSION FOR DEVELOPING COUNTRIES

Parikh, J.K., (International Institute for Applied Systems Analysis, Laxenburg, Austria), Revue De L'Energie, V 28:239-251, Apr 1977, A77-32592, In English and French

Large- and small-scale organic waste anaerobic fermentation systems used in developing countries are described. These systems generate a gas which is 60% methane. The leftover sludge, which retains nitrogen compounds, is used as fertilizer. A bio-gas plant used in India has two main parts, a digester and a gas holder. Data concerning the amount of dung consumed and the amount and the quality of gas produced are provided. Characteristics of Indian communities are described and the economic impact of single-family bio-gas plants is analyzed.

(BIOMASS, DEVELOPING-NATIONS, ENERGY-TECHNOLOGY, ANAEROBIC FERMENTATION, DOMESTIC)

ST77 17079 COST OF PRODUCING ENERGY FROM WOOD IN INTENSIVE CULTURES

Rose, D.W., (Univ. of Minnesota, St. Paul, MN), J. Environ. Manage., V 5:23-35, N1, Jan 1977, EDB-77:082167

The production of energy in intensively managed "fuel plantations" of woody species

has been proposed as an alternative to help meet increasing energy needs. To date no vigorous cost studies of such a proposed fuel production system have been completed. Utilizing an economic model developed for investigating intensive cultures, likely ranges of fuel production costs for a number of production alternatives and intensities were determined. Given today's technology and costs, energy can be produced from wood competitively with other energy sources in certain production situations. The use of the fiber produced in intensive cultures for pulp and paper processing appears to be the better alternative at current market prices. The pulp and paper industry has, however, a great potential for using wood fiber also in the production of energy.

(BIOMASS, PLANTATIONS, COMPARATIVE-EVALUATIONS, ECONOMICS, FORESTS, MATHEMATICAL-MODEL)

ST77 17080 CHINA CLAIMS LEAD IN BIOGAS ENERGY SUPPLY

Smil, V., (Manitoba, University, Winnipeg, Canada), Energy International, V 14:25-27, June 1977, A77-36050

First attempts to produce biogas in China were made during the time from 1958 to 1960. A successful adoption of biogasification methods occurred more than a decade later. Peasants in the Szechwan basin built the first few hundred digesters with local rocks and lime during the period from 1970 to 1972. It has now been reported that more than 1.3 million digesters were built in Szechwan during the first six months of 1976. The primary use of biogas throughout the country is for household cooking and lighting. Biogas is also employed for fueling water pumps, farm processing machinery, and generating sets. Details of digester design and operation are discussed.

(BIOMASS, GAS GENERATORS, DOMESTIC-ENERGY)

ST77 17081 FEASIBILITY OF MEETING THE ENERGY NEEDS OF ARMY BASES WITH SELF-GENERATED FUELS DERIVED FROM SOLAR ENERGY PLANTATIONS (APPENDICES D, E, F, G, AND H) Final Report

Szego, G.C., (Intertechnology Corp., Warrenton, VA), July 1976, AD-A-031211, EDB-77: 092597
Avail:NTIS$9.75

The study investigated the merit of producing fuel at energy plantations at or near the bases. The fuel would be used for directly fired steam generators, hot water heaters, space heaters, and cooking. The research examined the major characteristics of energy plantations, analyzed plant-matter production rates from deciduous plants, and examined fuel consumption in stationary facilities at major troop training centers. The possibilities and requirements of energy plantations at Fort Benning, Fort Leonard Wood, and at army bases in general are detailed.

(FEASIBILITY-STUDIES, MILITARY, BIOMASS)

ST77 17082 ENERGY FORESTS AND FUEL PLANTATIONS

Szego, G.C., Kemp, C.C., (Intertechnology Corp., Warrenton, VA), Chem. Technol., V 3:275-284, N5, 23 refs, May 1973, EDB-77:098479

A discussion of the use of specially grown forests to fuel a steam electric power plant covers the advantages of such a system over the use of fossil fuels, including the absence of sulfur dioxide and other types of pollution, advantages over nuclear fuels, including the absence of thermal pollution, the safety, and more advanced technology, advantages over other means for harnessing solar energy, including lower capital cost requirements, land requirements for energy plantations, which are approximately equivalent to the land bases that support Kraft Pulp Mills in the Southern U.S., economics, yield of fuel, the effect of moisture, estimated insulation rate (the rate of delivery of direct solar energy), fuel production costs and prices, including the fuel cost of pulp wood, corn, and perennials, and price competitiveness with fossil fuels.

(BIOMASS, ECONOMICS, FEASIBILITY-STUDIES)

ST77 17083 SYNTHETIC FUELS FROM SOLID WASTES AND SOLAR ENERGY

Tinkle, M.O., Feber, R.O., Antal, M.J., Jr., (Princeton Univ., Dept of Aerospace and Mechanical Sciences, Princeton, NJ), First World Hydrogen Energy Conference: Vol 1 edited by T.N. Veziroglu, Coral Gables, FL, University of Miami, School of Continuing Studies, p. 3A-69-3A-88, 1967

No abstract available

(BIOMASS, HYDROGEN, ECONOMICS)

ST77 17084 WASTEWATER RECLAMATION SYSTEM UPS PRODUCTIVITY, CUTS WATER USE

Warnke, J.E., Thomas, K.G., Creason, S.C., (Beckman Instrum, Inc., Porterville, CA), Chem Eng (NY), V 84:75-77, N7, Mar 28, 1977

Combining reverse osmosis and solar evaporation, the system reclaims plating wastewater, reducing water consumption, minimizing product waste, and meeting the 1983 EPA goal of zero discharge. Details of the system and its operation are given.

ST77 18012 CONCEPTUAL DESIGN AND SYSTEMS ANALYSIS OF PHOTOVOLTAIC POWER SYSTEMS

Kirpich, A., (Maine Univ., Orono, ME), (General Electric Space Div., Valley Forge, PA), Proceedings of the ERDA Semiannual Solar Photovoltaic Program Review Meeting, 1976, CONF-760837-P1, EDB-77:072974

Conceptual designs, performance analyses, economic analyses, and design problems for photovoltaic converters for single residences, central power plants, and intermediate sized systems are outlined.

(HOUSES, CONCENTRATORS, RESEARCH-PROGRAMS, SCHOOL BUILDINGS)

ST77 18013 ON-SITE ENERGY SYSTEMS STAGE A COMEBACK

Meckler, M., (Meckler Assoc., Los Angeles, CA), Electr. Consult. V 91:20-23, N3, Mar 1975, EDB-77:093629

This country is experiencing a significant resurgence of interest in on-site systems because such systems reuse "waste" heat. They about double the efficiency of energy recovery from the fuel source, from typically 35 percent at a conventional electric utility, to about 70 percent for an on-site system. Also, in spite of the high initial cost, a properly designed, installed and operated system can be paid off quite quickly. Air pollution is reduced, as is water pollution, and the danger of brown-outs and black-outs is eliminated.

(ECONOMIC, ENVIRONMENTAL-EFFECTS, RESIDENTIAL)

ST77 18014 HIGH LEVEL CONCENTRATION OF SUNLIGHT ON SILICON SOLAR CELLS

Napoli, L.S., Swartz, G.A., Liu, S.G., Klein, N., Fairbanks, D., Tamutus, D., (RCA Laboratories, Princeton, NJ), RCA Review, V 38:76-108, Mar 1977, ERDA 02-7996, A77-32208

Silicon solar cells have achieved 15.5% conversion efficiency at 330 SUNS concentration level. Design rules regarding the fabrication and use of these solar cells at high concentration levels are derived. Finally, a system consisting of lens arrays and solar cells designed to generate 100 watts is described in detail. Preliminary data shows that the system efficiency is 8.3% during conditions of 74 MW/SQ CM insolation level.

(CONVERSION-EFFICIENCY, LENS-DESIGN, FABRICATION, RESIDENTIAL)

ST77 18015 WIND/SOLAR ENERGY INVESTIGATION: A FEASIBILITY STUDY

Stickney, G.H., (Univ. of Kansas, Lawrence, KS), University Microfilms Order No. 76-1311, 1975, EDB-77:080046

This project is concerned with obtaining from the wind and sun the principal energy required by an average home. This involves the lower class of energy used for space heating, space air-conditioning, and household hot water supply rather than the higher class needed for electric clocks, radio, television, etc. The procedure described illustrates a quantification of the requirement rate compared with the daily availability of wind and solar energy and the consequent storage needed to reconcile the two. Preliminary design procedures are shown for wind and solar energy collection systems and for storage. Initial design procedures are also shown for an accompanying heating and cooling system.

(HOUSES, HEATING, WATER-HEATERS, WIND, RESIDENTIAL-POWER)

ST77 18016 RURAL DOMESTIC ENERGY SELF-SUFFICIENCY: A COOPERATIVE STUDENT RESEARCH PROJECT

Wyatt, A., Masin, L., Eng., Cornell Q., V 11:19-26, N3, Aug 1976, EDB-77:067929

A student-organized case study of reliance on renewable energy resources and small-scale technology used a 127-acre site in New York State. The land contained 52 acres of fields and 75 acres of woodland. Five steps were followed for each of two scenarios for a non-farming family of five: (1) a preliminary audit of energy consumption, both direct and indirect (as in processed foods), (2) a list of needs and conservation steps, (3) a list of options for on-site renewable resources, (4) an evaluation of these options relating the family's heating and food needs with economics, time, and labor involved, and (5) a household strategy incorporating these options with considerations of environmental effects, lifestyle, and economics. The project developed familiarity with the plant and animal life, climate, and soil characteristics in order to select the options most compatible with good farm and woodlot management. A solar hot water system was constructed and information gathered on other alternative sources. The two

scenarios followed applied to a family willing to spend moderate sums of money but little time or labor and a family changing its lifestyle to include home-built equipment and organic gardening.

(ECONOMICS, ENVIRONMENTAL-EFFECTS, SOCIO-ECONOMIC-FACTORS, WIND)

## 19,000 LARGE SCALE PHOTOVOLTAIC, HYDROGEN PRODUCTION, AND OTHER

ST77 19052 HYDROGEN AS ENERGY CARRIER. FUTURE POSSIBILITIES IN THE NETHERLANDS

(Unidynamics, Phoenix, AZ), Sept 1975, EDB-77:092482, N76-24723
Avail:NTIS$9.25

The application of hydrogen as carrier for thermal energy, produced by new energy sources such as wind and solar energy generators, is discussed. Topics dealt with include production, storage, transport and distribution of hydrogen, aspects of location bound use, application in transport vehicles, environmental and safety aspects, and problems in introducing hydrogen. Conclusions and recommendations for each of these topics are given and, as a general conclusion, there are thought to be wide perspectives for the use of hydrogen as carrier in the energy supply in the Netherlands. The technological problems are considered surmountable.

(HYDROGEN, NETHERLANDS, PROCESS-HEAT, SAFETY, WIND)

ST77 19053 POWER PLUS PROTEINS FROM THE SEA

Energy Dig., (London), V 4:21-24, N3, June 1975, EDB-77:066153

An account is given of research work carried out in Mauritius and the United Kingdom into the feasibility of a sea-wave energy project. Reefs fringing the island were to provide a foundation for concrete ramps up which the waves would run and spill over into the landward lagoon. The lagoon would be formed into a water-impounding basin by means of cross-bonds between the sea-wall and the shore. However, the crest height of the seawall (2.3 M), and a small storage capacity of the lagoon basin made the cost of the hydroelectric plant uneconomical if it had to be operated at so low a head. At the time (1966), the cost of oil was actually falling and the project was officially abandoned. However, it is suggested that a rotary version of the hydraulic ram, capable of accepting large quantities of seawater at low pressure (1.5-2 M) and delivering a much reduced quantity of high-pressure water to a reservoir at a high "head" (say above 10 M) may be a practicable way of converting low-grade seawave energy into high-grade, high-pressure hydro-power energy. The concept then looks viable, being from the sea pumps onward, a normal hydroelectric plant, except that it would use seawater and the turbines would discharge directly into the sea. The potential of the scheme as a fish farm is also discussed.

(DAMS, HYDROELECTRIC, PUMPED STORAGE, WAVE-POWER)

ST77 19054 TIDE TABLES 1978. HIGH AND LOW WATER PREDICTIONS. EAST COAST OF NORTH AND SOUTH AMERICA INCLUDING GREENLAND

(National Ocean Survey, Rockville, MD), 294 p., PB-265 988/6SL, NOAA-77031502

This edition of the tide tables, east coast of North and South America, contains full daily predictions for 48 reference ports and differences and other constants for about 2,000 stations in North and South America. It contains also a table for obtaining the approximate height of the tide at any time, a table of local mean time of sunrise and sunset for every 5th day of the year for different latitudes, a table for the reduction of local mean time to standard time, a table of moonrise and moonset for 8 places, and a table of the Greenwich mean time of the moon's phases, apogee, perigee greatest north and south and zero declination, and the time of the solar equinoxes and solstices.

(OCEAN-TIDES, DIURNAL-VARIATIONS, MOONRISE, MOONSET)

ST77 19055 CONCEPTUAL DESIGN AND SYSTEMS ANALYSIS OF PHOTOVOLTAIC POWER SYSTEMS

Bartels, F.T.C., (Maine Univ., Orono, ME), (Spectrolab, Inc., Sylmar, CA), Proceedings of the ERDA Semiannual Solar Photovoltaic Program Review Meeting, 1976, CONF-760837-P1
EDB-77:072976

Development progress on conceptual designs for three terrestrial photovoltaic systems are outlined. Photovoltaic systems for a single family residential, a central power station, and a shopping center are studied.

(HOUSES, COMMERCIAL BUILDINGS, RESEARCH-PROGRAMS, RESIDENTIAL)

ST77 19056 WORKSHOP ON SOLAR ENERGY FOR NITROGEN FIXATION AND HYDROGEN PRODUCTION

Beck, R.W., (Tennessee Univ., Knoxville, TN), NSF/RA-760289, NSF APR-75-17596, Workshop held at Gatlinburg, TN, 60 p., Sept 18-20, 1975, PB-261959/1, N77-79427
Avail:TAC, hard copy
No abstract available

(CONFERENCES, HYDROGEN, BIOSYNTHESIS)

ST77 19057 UTILIZING THE ENERGY OF WATER WAVES

Behrendt, V., (Dornier-System G.M.B.H., Friedrichshafen, Germany), Energiequellen Fuer Morgen. Nichtnukleare-Nichtfossile Primaerenergiequellen. T. 4. Nutzung Der Meeresenergien/ Meliss, M. (Kernforschungsanlage Juelich G. M. B. H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung, 1976, EDB-77:087263, In German
The study examines the different kinds of waves, attempts an evaluation of energy and power potential and then enters into technical concepts and the position of technology in the utilization of wave energy. It discusses the environmental effects and infrastructural problems, makes assertions for the economy and weighs up application possibilities of wave energy converters, both within and without the Federal Republic of Germany. Global frequency of wave height = '1 M and ='5 M is described in tabular form. Finally, as regards research work and development, political consequences for the Federal Republic of Germany are shown.

(ECONOMICS, ENVIRONMENTAL-EFFECTS, GERMANY, GLOBAL-ASPECTS, KINETIC-ENERGY, WAVE-POWER, RESEARCH-PROGRAMS)

ST77 19058 UTILIZING TIDAL ENERGY

Behrendt, V., (Dornier-System G.M.B.H., Friedrichshafen, Germany), Energiequellen Fuer Morgen, Nichtnukleare-Nichtfossile Primaerenergiequellen. T. 4. Nutzung Der Meeresenergien, Meliss, M., Kernforschungsanlage Juelich G. M. B. H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung, 1976, EDB-77:087052, In German
The study deals first of all with the physical principles of the tidal phenomena, then evaluates the energy potential and enters into geo-physical suppositions, possible sites and the technical design of tidal power plants. The position of technology in French, Soviet, British, American and Australian projects is explained in more detail. Further project considerations are sketched out. The concept of a system of a large-scale tidal power plant combined with a pumped storage plant, serves as a basis for investigation concerning questions of economy. Further statements in the study are to do with: (1) newer considerations for the completion of tidal power plants, (2) ecological effects and infrastructural suppositions, (3) costs of a tidal power plant and current production costs, (a tabulated outline with this), (4) application possibilities for a tidal power plant. Finally, political consequences for the Federal Republic of Germany, as regards research work and development, are shown.

(POLITICAL-CONSEQUENCES, AUSTRALIA, ECONOMICS, FRANCE, GERMANY, RESEARCH-PROGRAMS, SITE-SELECTION, TIDAL-POWER, UNITED-KINGDOM, UNITED STATES, USSR, FABRICATION, ENVIRONMENTAL-IMPACT)

ST77 19059 HYDROGEN PRODUCTION USING HIGH TEMPERATURE SOLAR ENERGY

Bilgen, E., Ducarroir, M., Foex, M., Sibieude, F., Trombe, F., (Ec Polytech, Montreal, Quebec, Canada), World Hydrogen Energy Conf., 1st, Proc, Miami Beach, FL, Mar 1-3, 1976, Publ by University of Miami, Coral Gables, FL, V 1:15, Sess 3A, 1976
A direct and two-step thermochemical cycles for dissociation of water using concentrated solar energy at high temperature, 2,000 to 3,000°K are reviewed. A 2 KW solar furnace was used for research.

(WATER-DISSOCIATION)

ST77 19060 SOLAR ELECTRICITY FOR MILITARY APPLICATIONS

Blumenstock, T., Goold, M.A., (Solarex Corp., Rockville, MD), Signal, V 31:88-90,92,94, May-June 1977, A77-34113
Modular arrays of panels of photovoltaic solar cells for low-cost solar power are described. Reliability, mechanical design and mountings, temperature behavior, charging capability and overcharging protection, and reduction of costs from $500/W to $15/W are discussed. Panels feature 5 x 5 or 6 x 3 interconnected photovoltaic cells mounted on fiberglass board and encapsulated in transparent stabilized silicone, with no exposed metal terminals. Plexiglas, lexan, or glass covers are also available. Recommended military applications include mobile communications, radio/telephone repeaters, tactical radio battery charges, navigation aids, water purification and pumping, remote security

and surveillance (seismic, magnetic, acoustic, IR), data collection platforms (environmental, hydrological, geological), railroad signaling, and impressed current cathodic protection.

(RELIABILITY-ANALYSIS, ENERGY-TECHNOLOGY)

ST77 19061 OPTIMUM OPERATION OF IMPROVED WAVE-POWER CONVERTER

Budal, K., Falnes, J., (Norges Tekniske Hoegskole, Trondheim, Norway), Mar. Sci. Commun., V 3:133-150, N2, 1977, EDB-77:105738

An improved version of the previously proposed resonance-tuned absorber of ocean-wave power is presented. The absorber utilizes a machine to control its movement in an optimum way relative to the time evolvement of the incident wave. As a result, the improved absorber becomes theoretically as efficient in non-harmonic waves as the resonance-tuned absorber is in harmonic waves. Assuming waves and oscillations of small amplitudes, mathematical expressions are derived for the maximum obtainable absorbed power and for the corresponding optimum velocity function of the oscillating heaving absorber body. Provided the wave spectrum is reasonably narrow, the optimum velocity is approximately proportional to and in phase with the excitation force due to the incident wave.

(EFFICIENCY-OPTIMIZATION)

ST77 19062 PHOTOELECTROLYSIS WITH YFE03 ELECTRODES - WATER SPLITTING USING SOLAR ENERGY

Butler, M.A., Ginley, D.S., Eibschutz, M., (Sandia Laboratories, Albuquerque, NM), (Bell Telephone Laboratories, Inc., Murray Hill, NJ), Journal of Applied Physics, V 48:3070-3072, July 1977, AT(29-1)-789, A77-40553

The investigation is related to the possibility to use the photoelectrolysis of water with illuminated semiconducting electrodes as a means of solar energy conversion. Butler and Ginley (1977) have shown that a smaller electron affinity for the photo-anode results in improved zero bias operation. The considered model predicts that the rare-earth orthoferrites should have improved zero bias operation characteristics over FE203. A description is presented of studies which show that this is actually the case. The studies include the determination of the photoresponse of YFE03 anodes. The data indicate an indirect optical gap of 2.58 EV. It is found that the general behavior of YFE03 photoanodes is promising for the practical conversion of solar energy to chemical energy.

(IRON OXIDES, PHOTOLYSIS, YTTRIUM-COMPOUNDS, ENERGY-TECHNOLOGY, HYDROGEN, PHOTOANODES)

ST77 19063 OFFSHORE APPLICATIONS FOR SOLAR ENERGY CELLS

Crabtree, R., Offshore Technology Conference, Dallas, 1976, Eight Annual Offshore Technology Conference, V II, EDB-77:098493

This paper presents the results of two years operation of solar powered navigational aids in the Gulf of Mexico. The first phase of the project consisted of fourteen single light installations at high island 24-L and five single lights with horn installations in the high island area fields. Experience confirms that solar power is an excellent method of energizing navigational aids, providing a one to two year pay out. The project was expanded to provide solar power for lighting buoys in the Eugene Island block 175 field. Even in this demanding application, solar panels have performed satisfactorily. Now seven buoys are being powered by solar panels, requiring only routine maintenance for the past eighteen months. Expectations are that this record of low maintenance will continue for years.

(LIGHTING-SYSTEMS, MAINTENANCE, OPERATION)

ST77 19064 TAPPING TIDAL POWER

Dixit, D.K., (Visvesvaraya Regional Coll. of Engineering, Nagpur, India), Indian East. Eng., V 118:99,101,107, N3, Mar 1976, EDB-77:080113

Methods for harnessing tidal power are reviewed, and the advantages and scope of tidal power generation in India are surveyed.

(FEASIBILITY-STUDIES, INDIA)

ST77 19065 THE ROLE OF NONLINEAR INTERACTIONS IN THE FORMATION OF MEAN FIELDS - OCEAN WAVE GENERATION BY RANDOM WIND FIELD

Ermakov, S.A., Pelinovskii, E.N., (Nauchno-Issledovatel'Skii Radiofizicheskii Institut, Gorki, USSR), Akademiia Nauk SSR, Izvestiia, Fizika Atmosfery I Okeana, V 13:537-542, May 1977, A77-41060, In Russian

The propagation of a regular wave against a random background is studied using

equations which describe nonlinear wave interactions. It is shown that the damping of the mean field is expressed by the space-time spectrum of noise and nonlinear interaction coefficients for the values of wave numbers and frequencies satisfying the conditions of wave synchronism. The generation of an internal wave in an exponentially stratified ocean by a field of random wind waves is considered as an example.

(AIR-WATER INTERACTIONS, NONLINEAR EQUATIONS, WIND-EFFECTS, WAVE-POWER)

ST77 19066 MILITARY APPLICATIONS OF PHOTOVOLTAIC SYSTEMS

Faehn, D.D., (Maine Univ., Orono, ME), (Army Mobility Equipment Research and Development Command, Fort Belvoir, VA), Proceedings of the ERDA Semiannual Solar Photovoltaic Program Review Meeting, 1976, CONF-760837-P2, EDB-77:072921

A demonstration program to investigate the applicability of solar cells to a wide variety of military power consuming equipment is outlined. The initial projects include: (1) a small battery charger, (2) rado relay station, (3) telephone communications station, (4) water purification system, and (5) remote radar.

(BATTERY-CHARGERS, COMMUNICATIONS, RADAR, RADIO-EQUIPMENT)

ST77 19067 HYDRAULIC POWER RODUND II OF THE VORARLBERGER ILLWERKE

Falger, A., Energiew Irtsch. Tagesfragen, V 26:645-652, N11, Nov 1976, EDB-77:073943

Since 1948, a water volume of 209 x $10^6$ $M^3$ per normal year is led via by-channels from the tyrol into the natural catchment area of the ill. So far, these quantities of water had to be processed by the Rodundwerk I, as the last stage. This meant an increase of more than 3,000 hours per year in operating time for these works, and its use, especially during the summer months, fell short of that of a top power station. For the reasons mentioned above, a second Rodundwerk was built as a parallel station to the existing one, and on March 10th, 1976, it was taken into operation. A general description is followed by aspects of the project with a view to hydro- and energy-economy, and the upper reservoir and the down-pipes are outlined. The article then deals with: (1) the hydroelectric generating set, the pumping turbine, the motor generator, the starting motor, the generator transformer, and auxiliary equipment and service buildings of the main power block, (2) the lower reservoir and (3) the transport of the electric power generated.

(AUSTRIA, HYDROELECTRIC-POWER, 100-1000-MW, STORAGE, SITE-SELECTION, CURRENT-POWER)

ST77 19068 HYDRODYNAMIC BASIS OF WAVE-ENERGY CONVERTERS OF CHANNEL FORM

French, M.J., (Lancaster, University, Lancaster, England), Journal of Mechanical Engineering Science, V 19:90-92, Apr 1977, A77-32211

The paper analyzes a problem of energy extraction from sea waves in which the vertical plane containing the motion is perpendicular to the wave direction and the surfaces are in facing pairs defining channels down which the waves travel, being attenuated as they go. The analysis concerns an ideal case in which the absorbing walls are of unlimited depth, whereas in the practical device they must be relatively shallow; the wall is the skin of a series of partially inflated air bags, formed by dividing a long tube by transverse septa. The very simple intuitive treatment in which the wave train is considered simply to be attenuated exponentially gives results which in practical cases are very good approximations. A numerical example is provided, and defects pertinent to the analysis are identified.

(HARMONIC-MOTION, TIDEPOWER, WAVE EQUATIONS, WAVEFORMS)

ST77 19069 SOLAR GENERATORS FOR TERRESTRIAL APPLICATIONS

Friedberg, H., Funkschau, V 47:43-46, N19, Sept 12, 1975, EDB-77:072942

Full details are given of the size, power, and efficiency of various cells. The methods of constructing solar generators for terrestrial use with details of their dimensions, their effective temperature range and power output under various weather conditions, and their cost are described. The application of solar batteries and generators is considered, as transmitter power supplies, for example, on tropical expeditions for meteorological stations, emergency lighting on motorways, and warning buoys at sea.

(FABRICATION, SOLAR-CELL)

ST77 19070 ELECTRIC POWER GENERATION ON NOMAD BUOYS

Gallagher, J., (National Oceanic and Atmospheric Administration, Miami, FL), (New London Lab., CT), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., EDB-77:105388, CONF-740252

Wind-driven, solar, nuclear and mechanical electrical power generating techniques have been explored since 1958 for use on the deep ocean nomad buoys. These devices have demonstrated that they can reliably supply low level, trickle-charge rates of electrical energy to lead-acid and ni-cad batteries to compensate for the intermittent demand of the electronics systems and navigational aids on the buoys. The wind and solar cell collector-generator systems were successfully tested at sea during the period 1959-1967, and were essentially operational since 1967. The solar cell generator appears to be a more reliable generator system than the wind generator. Nuclear generators were also tested in nomad buoys in the Gulf of Mexico since 1964 and performed successfully. A resonant pendulum generator design which utilizes wave motion and is housed inside the buoy hull was successfully tested in the laboratory, but has not been tested at sea. The high energy tidal current regime in Eastern Long Island Sound is viewed as a possible area for testing water-driven electrical energy collector-generators in concert with wind and solar sources of energy.

(COMPARATIVE-EVALUATIONS, PERFORMANCE TESTING, CURRENT-POWER, WAVE-POWER, WIND)

ST77 19071 FEASIBILITY OF UTILIZING SUBMERGED TURBINES FOR EXTRACTING POWER FROM THE FLORIDA CURRENT: CONSIDERATIONS FOR A FEASIBILITY STUDY AND A PILOT INSTALLATION

Gilman, B.C., (National Oceanic and Atmospheric Administration, Miami, FL), (Perry Oceanographics, Inc., Riviera Beach, FL), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105736

This paper attempts to outline and highlight some of the major considerations which should be addressed should the Palm Beach Shores Workshop on the Engineering and Economic Feasibility of Utilizing Submerged Turbines Seaward of South Florida as a Source for Electric Power result in a recommendation to proceed with obtaining funding for further work. The further work would consist of two phases, the first being a feasibility study leading to the second phase, which would be a pilot installation.

(FEASIBILITY-STUDIES, GULF-STREAM, RESEARCH-PROGRAMS, CURRENT-POWER)

ST77 19072 THE PHOTOELECTROLYSIS OF WATER USING IRON TITANATE ANODES

Ginley, D.S., Butler, M.A., (Sandia Laboratories, Albuquerque, NM), J. Appl. Phys., V 48:2019-2021, N5, May 1977, EDB-77:094553

Single-crystal and polycrystalline samples of the iron titanates $FeTiO_3$, $FeTiO_4$, $FeTiO_5$ have been studied as anodes for the photoelectrolysis of water. Band gaps and flatbands for the various compositions have been determined and aging studies have been conducted which indicate electrochemical leaching of iron atoms from the surface.

(HYDROGEN, WATER-SPLITTING)

ST77 19073 OCEAN ENERGY SYSTEMS

Harrenstien, H.P., (National Oceanic and Atmospheric Administration, Miami, FL), (Univ. of Miami, Coral Gables, FL), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105377

Prospects for the utilization of the Florida current as an energy source are discussed.

(FEASIBILITY-STUDIES, FLORIDA, GULF-STREAM, CURRENT-POWER)

ST77 19074 EXTRACTION OF KINETIC ENERGY FROM OCEANIC AND TIDAL RIVER CURRENTS

Heronemus, W.E., Mangarella, P.A., McPherson, R.A., Ewing, D.L., (National Oceanic and Atmospheric Administration, Miami, FL), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Useable Energy from the Florida Current, Steward, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105383

The technical feasibility of extracting power from oceanic and tidal river currents is examined.

(FEASIBILITY-STUDIES, TIDE-POWER, CURRENT-POWER)

ST77 19075 WAVE POWER - POTENTIALLY AVAILABLE IN NEW ZEALAND

Hulls, K., (New Zealand Electricity Department, Wellington, New Zealand), New Zealand Energy Journal, V 50:44-48, Apr 25, 1977, A77-43011

The amount of energy potentially available to New Zealand through the use of wave power systems is examined. It is estimated that the mean power level for New

Zealand is 35 KW per meter of wave front; the energy flow in 63 KM of wave front is equivalent to the electrical energy consumption in New Zealand at present. Assuming a conversion efficiency of 35% for wave-power devices, about 250 KM of coastline would receive an energy flow sufficient to meet present energy needs. Seven major problem areas requiring attention before large-scale wave-power devices can go into production are identified and discussed. These include conversion devices, generation mooring, structural loading, possible adverse environmental effects, the lack of sufficient wave data, and undersea power transmission. A chart of the average wave power in different locations around the world is provided.

(ENERGY-TECHNOLOGY, ENVIRONMENT-EFFECTS, TIDE-POWER, PROBLEM-AREAS, LARGE-SCALE)

ST77 19076 FEASIBILITY OF HYDROGEN PRODUCTION BY DIRECT WATER SPLITTING AT HIGH TEMPERATURE

Ihara, S., (Ministry of International Trade and Industry Electrotechnical Laboratory, Tonashi, Tokyo, Japan), In World Hydrogen Energy Conference, 1st, Miami Beach, FL, March 1-3,1976, Proceedings, V 2, A77-33326 14-44, Coral Gables, FL, University of Miami; New York, Pergamon Press, p. 5B-55 to 5B-70, 1976, A77-33372

Conceptual study on the process of hydrogen production by direct dissociation of water using high-temperature solar energy is described. Calculated result of equilibrium composition of water vapor, hydrogen, and oxygen suggests that the temperatures above 3,000 K are required for the dissociation of water. A solar furnace for supplying such high-temperature energy is considered. Basic ideas on the method for separating hydrogen and oxygen from high-temperature water vapor are suggested. Analysis of overall efficiency and target cost shows that the process will be justified for practical use if an effective separation method can be developed.

(ENERGY-TECHNOLOGY, THERMAL DISSOCIATION, SOLAR FURNACES)

ST77 19077 UTILIZATION OF THE ENERGY IN OCEAN WAVES

Isaacs, J.D., Castel, D., Wick, G.L., (Univ. of California, San Diego, La Jolla, CA), Ocean Eng., V 3:175-187, N4, Aug 1976, EDB-77:073090

The characteristics of ocean wind waves place certain constraints upon devices designed to convert their energy to a useful form. Here we consider the nature of these constraints and the theoretical analysis of a wave power generator that conforms to the design criteria. We also present the results of field tests with several models of the wave power generator. The experimental results support the theory and indicate that such a wave pump is suitable for power generation in a variety of circumstances.

(THEORETICAL-ANALYSIS, PERFORMANCE, WAVE-ENERGY)

ST77 19078 COMMENTS FOR THE WORKSHOP ON THE ENGINEERING AND ECONOMIC FEASIBILITY OF EXTRACTING POWER FROM THE FLORIDA CURRENT

Johnson, G.D., (National Oceanic and Atmospheric Administration, Miami, FL), (Allis-Chalmers Corp., York, PA), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105382

In addition to a few very general guidance comments, this presentation points out that Allis-Chalmers is the world's most experienced manufacturer of hydraulic turbine equipment, including the world's most powerful units for grand coulee. These runners are 32 feet in diameter, slightly larger than the world's largest kaplan runners, and there are many Allis-Chalmers propeller turbine runners and ship propellers in the 20 to 30 feet diameter size range, so that runner diameters of 50 to 100 feet or more, as contemplated for the Florida Current Project, do not represent excessive extrapolation over previous experience, especially when their low unit power output is taken into consideration.

(HYDRAULIC TURBINES, CURRENT-POWER)

ST77 19079 APPLICATION OF THEORETICAL HYDRODYNAMICS TO THE DESIGN OF WAVE POWER GENERATORS

Katory, M., Nav. Archit., V 3:91-92, May 1976, EDB-77:073089

The theoretical hydrodynamic analysis of the salter nodding duck wavepower device is discussed.

(SALTER NODDING-DUCK, MATHEMATICAL MODELS)

ST77 19080 LOW TEMPERATURE, THREE-STEP WATER SPLITTING PROCESS

Kittle, P.A., Mahoney, D.F., Schuler, J.E., (Rohm and Haas Co, Bristol, PA), World Hydrogen Energy Conf, 1st, Proc, Miami Beach, FL, Mar 1-3, 1976, Publ by Univ of Miami, Coral Gables, FL, V 1:3-6, 12 refs, Sess 5A, 1976

A three-step water splitting process is reviewed. The system is based on the chemistry of iodine. The generation of an intermediate solid phase to reverse the unfavorable equilibrium constant has been verified in recent laboratory work. The system is now in the process development stage. The chemistry leading to the clean generation of hydrogen and oxygen and process concepts are described.

(HYDROGEN)

ST77 19081 ENERGY FROM THE OCEANS: FACT OR FANTASY, REPORT NO. 76-1

Kohl, J., ed., (North Carolina State Univ., Raleigh, NC), UNC-SG-76-04, EDB-77:072987

Twelve papers are included. Separate abstracts were prepared for each paper.

(TIDAL-POWER, WAVE-POWER, WIND, OCEAN-ΔT)

ST77 19082 SEMICONDUCTING OXIDE ANODES IN PHOTOASSISTED ELECTROLYSIS OF WATER

Kung, H.H., Jarrett, H.S., Sleight, A.W., Ferretti, A., (E. I. DuPont DeNemours and Company, Wilmington, DE), J. Appl. Phys., V 48:2463-2469, N6, June 1977, EDB-77:087194

The electrochemical properties of semiconducting anodes of $TiO_2$, $SrTiO_3$, $BaTiO_3$, $Fe_2O_3$, CdO, $CdFe_2O_4$, $WO_3$, $PbFe_{12}O_{19}$, $Pb_2(TiO)_5(O_6)_5$, $Hg_2Ta_2O_7$, and $Hg_2Nb_2O_7$ in photoassisted electrolysis of water were determined. All of these oxides formed a rectifying junction with the electrolyte and anodic photocurrents were generated only with larger-than-band-gap illumination. For $Fe_2O_3$, the optical absorption spectrum was different fron the photoelectrochemical spectrum due to crystal field transitions. These oxides were found to be stable over certain range of pH. In a given electrolyte, the flatband potential $V_{fb}$ varied linearly with the band gap. A good correlation was obtained between $V_{fb}$ and the heat of formation of the oxide per metal atom per metal-oxygen bond, but not between $V_{fb}$ and the calculated fermi energy of the oxide. This suggests that a semiconductor-electrolyte intsrface may be approximated by a semiconductor-metal junction where the barrier height is determined by the heat of formation of the metal-semiconductor compound. The practical aspect of using a photoassisted electrolysis cell for solar energy conversion is discussed.

(HYDROGEN-PRODUCTION)

ST77 19083 PHOTOCHEMICAL CONVERSION OF SOLAR ENERGY - SEMIANNUAL PROGRESS REPORT, JAN 1 - JUNE 30, 1976

Lichtin, N.N., (Boston Univ., MA), NSF/RA-760354, NSF/RANN/SE/AER72-03579/A05-76, NSF AFR-72-03579-A05, PB-262450/0, N77-24628

The dependence of the composition and kinetics of decay of the photostationary state of acidic iron-TH(+) solutions on solvent anions and initial concentrations of solutes has been measured and correlated with rates of elementary reactions. Sensitization increases the photostationary concentration of leucothiazine.

ST77 19084 THE OCEANS AS A SOURCE OF ELECTRICITY

Littler, D.J., (Central Electricity Generating Board, London, England), Aware, p.12-15, July 1977, A77-42401

Several methods for extracting energy from the ocean are described. Floating installations to harness wave power include a cam-shaped rocking float that minimizes both reflection and transmission of energy; coupled rafts, the variations in whose surface profiles would operate pumps; and buoys that use wave-powered flap valves to displace air and drive air turbines. Large-scale devices employing any of these three designs could achieve practical efficiencies of 25 to 25% and provide an average of 10 megawatts of power. A voltaic cell that takes advantage of the differing levels of salinity in the ocean and fresh water, a heat engine using temperature differences between surface and deep water, and a generator powered by ocean currents are also mentioned. Tidal energy, though available for use at only a limited number of sites, may nevertheless provide the most economical and effective use of ocean energy. Development of the rance estuary power station in France, which has a generating capacity of 240 megawatts, is described, and other possible installations in England and France are also considered.

(WAVE-POWER, TIDEPOWER, OCEAN-ΔT)

ST77 19085 WAVE AND TIDE ACTUATED HYDRAULIC ELECTRICAL GENERATING APPARATUS

Long, C.S., Long, J., U.S. Patent 4,009,395, Feb 22, 1977, EDB-77:087265

A wave and tide actuated hydraulic electrical generating apparatus is described which includes a flotation chamber floatingly supported in a water containing basin area connected to a fluctuating water source, such as the tide and wave level of an ocean, the flotation chamber rising and falling with the changes in elevation of the water in the basin, such as caused by the movement of waves, with the chamber being linked by level arms through suitable gear mechanisms to a multitude of piston rods associated with a like number of hydraulic cylinders which are connected in hydraulic parallel relationship, the movement of the flotation chamber in an upward direction effecting movement of the piston rods in a first direction relative to the cylinders, the movement of the flotation chamber in a downward direction effecting movement of the piston rods in the opposite direction in their associated cylinders, this movement of the piston rods in their associated cylinders effecting a pumping of hydraulic fluid to a hydraulic turbine to power the same, the turbine in turn being drivingly connected to an electric generator such that movement of the water in the basin effecting movement of the flotation chamber effects the generation of electrical energy by means of the hydraulic turbine powered by the hydraulic fluid from the hydraulic cylinders which are, in turn, operated by the lever arms connected to the flotation chamber.

(PATENT, TIDE-POWER, WAVE-POWER)

ST77 19086 WAVE OPERATED POWER PLANT

Mattera, H.A., Pitts, P.F., Pitts, M.M., U.S. Patent 4,009,396, Feb 22, 1977, EDB-77:087266

A wave operated power plant is provided wherein a buoyant vessel is anchored on the ocean surface with the wave motion causing displacement of water carried in a chamber in the hull such that upon rocking motion the water is forced upwardly through pipes on one side of the vessel. The water contacts turbine blades which through shafts rotate electrical generators and generate electricity. The water is returned to the chamber when the vessel moves in the opposite direction and the cycle is repeated with water forced up through pipes in the other side of the vessel, used for electrical generation and then returned to the chamber. The water being forced up from the chamber can contact the blades directly or be stored in a tank on top of the vessel and released at a predetermined rate.

(PATENT, BUOYS, WAVE-ENERGY)

ST77 19087 OVERVIEW OF THE OCEANS AS ENERGY SOURCES

McCormick, M.E., (Naval Academy, Annapolis, MD), Cohen, R., (North Carolina State Univ., Raleigh, NC), Energy From the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:072988

An overview of renewable ocean energy resources is presented, including waves, tides, currents, salinity gradients and thermal gradients, along with the utilization of ocean coolness and the use of the ocean as "real estate" for the conversion of solar radiation and wind energy.

(TIDAL-POWER, CURRENT-POWER, WAVE-POWER, WIND, OCEAN-ΔT)

ST77 19088 SALINITY GRADIENTS, TIDES, AND WAVES AS ENERGY SOURCES

McCormick, M.E., (North Carolina State Univ., Raleigh, NC), (Naval Academy, Annapolis, MD), Energy From the Oceans: Fact or Fantasy, Kohl, J., ed., 1976, UNC-SG-76-04, EDB-77:073088

The alternate energy sources of wind-waves, tides and salinity gradients are discussed in terms of their resource potentials, required technologies, and environmental consequences. From the various aspects discussed, it is concluded that salinity gradient energy conversion will yield the most energy and, yet, is the most unfeasible in light of present technology. Tidal power conversion is very regional but requires no technological breakthroughs. Wave energy can be extracted both in deep waters and shoaling waters with existing technologies. Further, the environmental consequences appear to be minimum, thus making wind-wave energy conversion most feasible.

(WIND, ENVIRONMENTAL-EFFECTS, FEASIBILITY-STUDIES, TIDAL-POWER, WAVE-POWER)

ST77 19089 DOUBLE-ACTION TURBOGENERATOR

McCormick, M.E., Holt, R.L., Bosworth, C.E., (Environmental Protection Agency, Denver, CO), Patent, Nov 11, 1976, EDB-77:105735, AD-D-003484

A double-action turbogenerator for providing energy using sinusoidal energy produced by ocean waves is proposed. First and second turbines are mounted on a common

shaft and positioned in separate horizontal tubes. An air chamber, which is subjected to ocean waves, alternately applies pressure to one horizontal tube and then a vacuum to the other horizontal tube to drive the turbines. A pair of ratchet joints are provided to prevent the outputs of the two turbines from acting against one another.

(CONFIGURATION, PNEUMATICS, WAVE-ENERGY, PATENT)

ST77 19090 EVALUATION OF A PHOTOVOLTAIC CENTRAL POWER STATION

McCutchan, D.A., Pittman, P.F., Ferber, R.R., Ruschak, G.C., Jr., Chowaniec, C.R., (Westinghouse Electric Corp., East Pittsburgh, PA), 1977, CONF-770403-8, EDB-77:105466

The solar plant consists of an "array subsystem", which includes the cells and their supporting surface, a supporting structure and tracking equipment, and a "power conversion subsystem", principally composed of solid state inverters and transformers. Many design variations were examined for each of these components. Since solar cells are expensive, the array design effort explored the use of lenses and mirrors to concentrate the solar radiation on the cells. When either a flat, unconcentrated cell array or a concentrator device is not aimed directly at the sun, its output decreases, therefore, low-cost solar tracking arrays were designed to increase the daily energy yield. Because the conversion efficiency of photovoltaic cells decreases with temperature, forced air and water cooling were considered in addition to natural convection cooling. The annual energy output was calculated for each plant concept in Phoenix, using the solar cell technology expected to be available in about 1990: for the silicon single-crystal cell used in the space program, a 16 percent conversion efficiency and the 1985 ERDA cost goal of $500/KWP (peak) for this cell (1975) was postulated. At the peak solar radiation in Phoenix, about 1.1 $KW/M^2$, this implies a cell cost of $88/$M^2$. Photovoltaic power plants were also designed for an advanced concept cell, a thin polycrystalline film of $Cu_2S$-CdS with a projected efficiency of only 10 percent, but the potential for markedly reduced material and manufacturing costs. $100/KWP or $11/$M^2$ was assumed as a representative cost for this cell in the late 1990's consistent with the ERDA goal of $100/KWP cells by 2000 A.D.

(COST-BENEFIT ANALYSIS, ECONOMICS, PERFORMANCE-EVALUATION)

ST77 19091 INVESTIGATION OF HYDROGEN PRODUCTION FROM WATER AT HIGH TEMPERATURES

Nakamura, T., (Electrotech Lab, Tanashi-shi, Tokyo, Japan), World Hydrogen Energy Conf, 1st, Proc, Miami Beach, FL, Mar 1-3, 1976, Publ by Univ of Miami, Coral Gables, FL, V 2:71-96, 14 refs, Sess 5B, 1976

A two-step thermochemical decomposition process using iron oxide is investigated. The iron oxide process operates efficiently at relatively low temperatures attainable with solar heat and is also compatible with structural materials. The iron oxide process can utilize solar energy efficiently to produce hydrogen and oxygen from water.

(THERMODYNAMICS, IRON-OXIDE-PROCESS, WATER-DECOMPOSITION)

ST77 19092 SOLAR ENERGY COLLECTION AND RETRIEVAL EMPLOYING REVERSIBLE PHOTOCHEMICAL ISOMERIZATION

Nathan, R.A., Schwerzel, R.E., Adelman, A.H., Wyant, R.E., U.S. Patent 4,004,572, Jan 25, 1977, EDB-77:072971

A process for photochemical collection, storage, and retrieval of solar energy, including solar energy in the visible and near-infrared light spectrum is described comprising: exposing to solar radiation of a trans-isomer of particular geometrically isomerizable compounds, while dissolved in a predominantly (greater than 50 percent by volume) aqueous liquid medium, to isomerize the trans-isomer to a thermodynamically less stable, but kinetically stable, cis-isomer of higher energy content, heating the produced cis-isomer to an activation temperature triggering exothermal conversion (or return) of the cis-isomer to the trans-isomer with release of thermal energy, and continuing exothermal conversion of cis-isomer to trans-isomer through use of a portion of the exothermically released thermal energy and transferring of another portion of the released thermal energy from the region of exothermal conversion for availability of this other portion for useful thermal energy applications.

(PATENT, STORAGE, PHOTOCHEMISTRY)

ST77 19093 POWER, FRESH WATER, AND FOOD FROM THE SEA

Othmer, D.F., (Polytech Inst. of NY, Brooklyn, NY), Mech. Eng., V 98:27-34, N9, Sept 1976, EDB-77:087223

The oceans, particularly the tropic seas, are built-in collectors of the sun's heat. To extract this thermal energy, one condition is indispensable: two currents of water, one warm and one cold, in close proximity to each other - a condition that exists in

many places and within a few miles of land. A system has been devised to tap this thermal energy for power in conjunction with the production of fresh water, food fish, and seaweeds. As for the economic aspect, the payout time for a plant of the size designed might be in the range of a few years.

(BIOMASS, PLANTATIONS, FEASIBILITY-STUDIES, WORKING-FLUIDS, THERMAL-EFFICIENCY, OCEAN-ΔT)

ST77 19094 USE OF PROPELLER-TYPE TURBINES FOR EXTRACTION OF OCEAN ENERGY

Pepper, P.A., (National Oceanic and Atmospheric Administration, Miami, FL), (EDO Corp., College Point, NY), Proceeding of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105380

An attempt has been made to apply to previously developed semi-empirical method to the design of propeller-type water turbines for extraction of ocean energy. A principal design criterion was high power conversion efficiency. Difficulties were encountered which were caused partly by the approximate nature of the mathematical model and partly by physical limitations inherent in this type of turbine. It is pointed out that similar, if not worse, limitations must exist for other types of turbines, such as the savonius rotor. It is recommended that suitable analytic and experimental studies be made for closer definition of these limitations, preferably as one aspect of an integrated system feasibility analysis.

(COMPARATIVE-EVALUATIONS, MATHEMATICAL MODELS, CURRENT-POWER)

ST77 19095 PHOTOCHEMICAL UTILIZATION OF SOLAR ENERGY

Peschek, G.A., (Univ Wein, Austria), Elektrotech Maschinenbau, V 94:49-57, N1, 76 refs, Jan 1977, In German

Plant photosynthesis is considered for photochemical energy production. The author discusses photochemical production of hydrogen with biological and abiotic water photolysis and photogalvanic methods for the production of electricity.

ST77 19096 CONCEPTUAL DESIGN AND SYSTEMS ANALYSIS OF PHOTOVOLTAIC POWER SYSTEMS

Pittman, P.F., (Maine Univ., Orono, ME), (Westinghouse Research Labs, Pittsburgh, PA), Proceedings of the ERDA Semiannual Solar Photovoltaic Program Review Meeting, 1976, CONF-760837-P1, EDB-77:072975

The overall objective of this program is to study the systems required to generate electricity utilizing photovoltaic solar cells, and to determine their cost and performance when installed during the 1985 to 2000 time period. The conceptual design and systems analysis of three types of photovoltaic electric power systems are included. The systems analyzed are: (1) on-site residential power systems (1-10 KW), (2) intermediate power system (100 KW - 10 MW), and (3) central power system (50 - 1000 MW).

(ON-SITE RESIDENTIAL, HOUSES, RESEARCH-PROGRAMS)

ST77 19097 USE OF SOLAR GENERATORS IN AFRICA FOR BROADCASTING EQUIPMENT

Polgar, S., (Telediffusion de France, Montrouge, Hauts-de-Seine, France), International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, CA, July 28-Aug 1, 1975, Solar Energy, V 19:201-204, N2, 1977, A77-30320

A description is presented of the use of solar cells as a power supply for TV receivers in Niger. The required power for the operation of the TV receivers had, at the beginning, been provided by high-capacity alkaline electrolyte cells. Attention is given to solar irradiation characteristics in Africa, the silicon solar panels, the lead-acid storage batteries, questions of equipment maintenance, aspects of system reliability, and economic considerations.

(SOLAR-CELLS, ECONOMICS, MAINTENANCE, RELIABILITY)

ST77 19098 PHOTOVOLTAIC SYSTEMS - SOLAR ENERGY CONVERSION RESEARCH FOR MILITARY APPLICATIONS

Prince, M.B., (ERDA, Washington, DC), Signal, V 31:83-86, May-June 1977, ERDA-DOD-supported research, A77-34112

Goals, strategy, and plans of military research on photovoltaic solar energy systems (National Photovoltaic Program) are reviewed. Military applications are viewed as offering early cost-effective uses of solar photovoltaic energy conversion systems. Development of reliable low-cost photovoltaic systems, overcoming high initial cost at low array production levels, demonstration of the feasibility of thin-film technology, development of performance standards, and dealing with environment and legal problems are encompased in the program. Attention is given to development of large-area silicon

sheet technology, development of solar concentrators, marketing studies, sensors and monitors for remote military surveillance systems, and water energy storage subsystems.

(STORAGE, ENERGY-TECHNOLOGY)

ST77 19099 PHOTOVOLTAIC-POWERED REFRIGERATOR EXPERIMENT AT ISLE ROYALE NATIONAL PARK

Ratajczak, A.F., (NASA, Lewis Research Center, Cleveland, OH), NASA-TM-73703 E-9241, ERDA/NASA-1022/77/15, E(49-26)-1022, 32 p., N77-27497

The use of photovoltaic power system to operate an electric refrigerator at a trail construction camp at Isle Royale, Michigan is investigated. The use of P/V power for refrigeration in a remote installation is demonstrated. System design as well as predicted and measured system performance are presented.

(PERFORMANCE TESTS, REFRIGERATING)

ST77 19100 UTILIZING THE ENERGY OF RUNNING WATER

Rohde, F.G., Langer, M., Zoller, C., (Technische Hochschule Aachen, Germany), Energiequellen Fuer Morgen. Nichtnukleare-Nichtfossile Primaerenergiequellen. T. 6. Nutzung der Wasserenergien, Meliss, M., Kernforschungsanlage Juelich G. M. B. H., Germany, F.R., Programmgruppe Systemforschung Und Technologische Entwicklung, EDB-77:092556

An introduction is given to the physical properties and the theoretical potential of running water as a source of energy. The following are described: (1) the principles of utilization and energy conversion as well as different kinds of utilization, (2) a short outline on the classification of hydroelectric power stations, including elements of the system and their efficiency, (3) the technically useable energy potential is defined and temporary availability, political questions, security, environment, operational aspects, as well as the question of costs are discussed. The hydroelectric power potential of Europe, the USSR, North America, oceans, Africa, Asia, Latin America, and the Federal Republic of Germany are discussed. Worldwide hydroelectric power extension and developing tendencies, as well as the future role of hydroelectric power in the Federal Republic of Germany and the possible contribution of the Federal Republic of Germany to the utilization of hydroelectric power potential in the world is also discussed.

(GLOBAL-ASPECTS, ENVIRONMENTAL-EFFECTS, HYDROELECTRIC-POWER, LEGAL-ASPECTS, GERMANY, MATHEMATICAL MODELS)

ST77 19101 DEVELOPMENT OF THERMOCHEMICAL WATER SPLITTING FOR HYDROGEN PRODUCTION AT GENERAL ATOMIC COMPANY

Russell, J.L., Jr., McCorkle, K.H., Norman, J.H., Schuster, J.R, Trester, P.W., (General Atomic Co., San Diego, CA), 131 p., GA-A-14050, N77-30619

Prospects for future hydrogen consumption and the theoretical bases for water splitting are discussed. Other topics include chemical cycle development, process engineering, and materials investigations. Possible heat sources considered are gas-cooled and fusion reactors and solar energy concentrating-systems.

(CONCENTRATING-SYSTEMS)

ST77 19102 LABORATORY EVALUATION OF SOLAR POWER UNITS FOR MARINE ADIS TO NAVIGATION Interim Report

Ryba, J.S., Naus, D.A., (Coast Guard Research and Development Center, Groton, CT), 80 p., AD-A034987, CGR/DC-5/76, USCG-D-106-76, N77-25672

This report describes the Coast Guard evaluation of solar energy as a power source for lighted aids to navigation. Fifty-three solar powered aids, on test in a natural environment at Groton, CT, have been continuously monitored for two years. Solar arrays from two manufacturers were tested with neither being wholly satisfactory. One had major quality control problems while the other suffered from inadequate sealing. Three types of lead-acid batteries used for energy storage have all been satisfactory to date. The test has indicated the advantages of voltage regulation in reducing water use in batteries, but has not proved that regulation is in fact required for long battery life. The insolation measured has shown excellent agreement with that predicted using the averages from a surrogate area. Almost all of the original estimates that were made to predict system performance (battery capacity vs. time of year) proved to be very conservative and most of the systems performed better than expected.

(COAST-GUARD, PHOTOVOLTAIC, NAVIGATION-AIDS)

ST77 19103 WAVE POWER NODDING DUCK WAVE ENERGY EXTRACTORS

Salters, S.H., Jeffrey, D.C., Taylor, J.R.M., (Univ of Edinburgh, Scotland), Energy Dig., London, V 5:19-21, N4, Aug 1976, EDB-77:092696, UNC-SG-76-04, EDB-77:105737

Stating that North Atlantic waves on a 500 kilometer front could produce all the electricity now used in the United Kingdom, the authors describe an offshore mechanism proposed for generating electric energy by utilizing motion imparted by sea-water waves. It consists of a number of 'duck'-shaped segments rotating about a common backbone. The whole structure has a very low freeboard so that it could be easily submerged. The rear surface of each duck is a cylinder coaxial with the center of rotation so that no water is displaced behind and no rear wave created. The front curve is designed to match the displacements of water in approaching waves. The natural 'nodding' period is designed to coincide with the wave period where maximum efficiency is required and attempts are made to broaden the frequency response. Each duck runs on rollers which are the bodies of commercially available rotary hydraulic pumps. High pressure oil drives hydraulic swash plate motors coupled to electrical generators at sea. Each meter length of structure displaces just over one hundred tons. One string of ducks will be about 500 meters long.

(UNITED-KINGDOM, CONSTRUCTION, ENVIRONMENTAL-EFFECTS)

ST77 19104 TRANSITION METAL PHOTOASSISTED VALENCE ISOMERIZATION OF NORBORNADIENE. AN ATTRACTIVE ENERGY-STORAGE REACTION

Schwendiman, D.P., Kutal, C., (Univ. of Georgia, Athens, GA), Inorg. Chem., V 16:719-721, N3, Mar 1977, EDB-77:089317

The photoassisted valence isomerization of norbornadiene to quadricyclene in the presence of catalytic amounts of cuprous chloride in chloroform, ethanol, and in acetonitrile was described. Electron absorption spectral data indicate the preassembly of norbornadiene and copper chloride in a stoichiometric complex as a key feature of the reaction mechanism. The attractive features of the norbornadiene-quadricyclene interconversion as a solar energy storage system were discussed.

(STORAGE, CONVERSION)

ST77 19105 SOLAR HYDROGEN GENERATOR - PATENT

Sebacher, D.I., Sabol, A.P., (NASA, Pasadena Office, CA), NASA-CASE-LAR-11361-1, 5 p., US-PATENT-4,019,868, US-PATENT-APPL-SN-669928, US-PATENT-CLASS-23-281, US-PATENT-CLASS-23-277R, US-PATENT-CLASS-55-158, US-PATENT-CLASS-423-648R, N77-22607

An apparatus, using solar energy to manufacture hydrogen by dissociating water molecules into hydrogen and oxygen molecules is described. Solar energy is concentrated on a globe containing water thereby heating the water to its dissociation temperature. The globe is pervious to hydrogen molecules permitting them to pass through the globe while being essentially impervious to oxygen molecules. The hydrogen molecules are collected after passing through the globe and the oxygen molecules are removed from the globe.

ST77 19106 POLICY FOR TIDAL ENERGY

Shaw, T.L., (Univ. of Bristol, England), Mar. Policy, V 1:61-69, N1, Jan 1977, EDB-77:093581

The potential of tidal energy for the United Kingdom should be reassessed, it is argued, and some of its advantages are cited. The technology for its development is available and proven. Experience suggests that the capital works will have an indefinite life, with only the turbine blades needing to be replaced occasionally. It is a source of water power, and can be regulated to generate when required, on a flexible basis and only by day if so desired. This compared favorably with the relatively unpredictable nature of the other sources. It can be made to complement directly, and so to improve the performance of the coal and nuclear sources at a scale readily possible from a proportionately small installed capacity. The fuel is free, present indications unquestionably suggest that it will be timely to reassess this source as part of the present energy review, so that its potential may be realized when needed after 1990. It is especially significant that the environmental effects of the necessary works appear to be comparatively small whereas the industrial and social rewards, so far not financially quantified, could be appreciable. The disadvantages that have been expressed are cited, but the author counters the attack on them.

(ECONOMICS, ENERGY POLICY, ENVIRONMENTAL-EFFECTS, GLOBAL-ASPECTS, STORAGE, SOCIAL-IMPACT, TIDAL-POWER, UNITED-KINGDOM)

ST77 19107 ENERGY RECOVERY FROM FLUID MOTION

Sheets, H.E., (National Oceanic and Atmospheric Administration, Miami, FL), (Univ. of Rhode Island, Kingston, RI), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105381

Calculations are performed for the maximum energy recovery from a flowing fluid without affecting the extraction process.

(MATHEMATICAL MODELS, OPTIMIZATION, CURRENT-POWER)

ST77 19108 PHOTOVOLTAIC POWER IN LESS DEVELOPED COUNTRIES

Smith, D.V., (Massachusetts Inst. of Tech., Lexington, MA), Mar 24, 1977, COO-4094-1, EDB-77:105425

The potential of solar photovoltaic power in the Third World (less developed countries) is analyzed. Application of irrigation systems powered by photovoltaics in Bangledesh, Chad, India, and Pakistan, plus an economic analysis of a photovoltaic-powered village in Northern India indicate solar energy is competitive with the least-cost fossil-fuel alternatives. The most cost-effective method for specific geographical locations can be determined by field testing based on the case history data reported.

(DEMONSTRATION-PROGRAMS, DEVELOPING-COUNTRIES, ECONOMICS, FEASIBILITY-STUDIES, IRRIGATION)

ST77 19109 ELECTRIC POWER PRODUCTION FROM THE FLORIDA CURRENT

Somers, E.V., Shoupp, W.E., (National Oceanic and Atmospheric Administration, Miami, FL), (Westinghouse Research Labs., Pittsburgh, PA), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105385

The extraction of energy from the Florida current can be conceptually visualized using a close localized network of small water-mill-driven electric generators that feed electric power to a central platform. The hydrodynamic design of these units appears conceptually well-founded. Generator costs will predominate generator-to-platform transmission costs by at least an order of magnitude.

(GULF-STREAM, CURRENT-POWER, ECONOMICS)

ST77 19110 PROSPECTS FOR HYDROGEN PRODUCTION BY WATER ELECTROLYSIS TO BE COMPETITIVE WITH CONVENTIONAL METHODS

Sprinivasan, S., Salzano, F.J., (Brookhaven Natl Lab, Upton, NY), World Hydrogen Energy Conf, 1st, Proc, Miami Beach, FL, Mar 1-3, 1976, Publ by Univ of Miami, Coral Gables, FL, V 2:23-27, 14 refs, Sess 6B, 1976

The progress made and proposed studies on these topics are briefly dealt with in the paper. The General Electric Solid Polymer Water Electrolyzer and Teledyne Alkaline Water Electrolysis Cells, both operate at about 120-150 degrees C, look most promising in achieving the goals of low capital cost and high energy efficiency.

ST77 19111 INVENTION DESIGNED TO CONVERT OCEAN CURRENTS INTO USABLE POWER

Steelman, G.E., (National Oceanic and Atmospheric Administration, Miami, FL), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105387

A device for converting the energy in ocean currents into electric power is described. The device employs collapsible sails on a flexible loop which turns a generator.

(SPECIFICATIONS, CURRENT-POWER)

ST77 19112 CHEMICAL STORAGE OF SOLAR ENERGY AND PHOTOCHEMICAL FUEL FORMATION

Stein, G., (Hebrew Univ. of Jerusalem, Israel), Isr. J. Chem., V 14:213-225, 1975, EDB-77:072935

Recent advances in the quantum utilizarion of solar energy are surveyed. The efficiency of photovoltaic devices in combination with electrical storage is compared with photogalvanic and photochemical systems. Photochemical formation of fuel (including hydrogen) in homogeneous and heterogeneous devices is discussed in detail.

(STORAGE, HYDROGEN, PHOTOCHEMISTRY, PHOTOGALVANIC-CELLS, PHOTOVOLTAIC)

ST77 19113 PROCEEDINGS OF THE MACARTHUR WORKSHOP ON THE FEASIBILITY OF EXTRACTING USEABLE ENERGY FROM THE FLORIDA CURRENT

Stewart, H.B., Jr., ed., (National Oceanic and Atmospheric Administration, Miami, FL), 1974, CONF-740252, EDB-77:105372

A separate abstract was prepared for each of the 15 papers presented at the conference.

(CURRENT-POWER, GULF-STREAM)

ST77 19114 HYDROGEN PRODUCTION PROCESSES FOR ENERGY SUPPLY

Stuart, A.K., (Electrolyser Corp Ltd., Toronto, Ontario, Canada), Symp on Hydrogen Econ at Can Chem Eng Conf, 26th, Toronto, Ontario, Canada, Oct 3-6, 1976, Printed by Transcanada Pipelines Ltd., 27 p., 15 refs, 1976

The paper reviews various hydrogen production methods with the application of direct and indirect solar energy. The following subjects are discussed: hydrogen production by electrolysis of water; hydrogen from sewage, garbage and agricultural wastes; hydrogen production by photosynthesis; etc.

ST77 19115 MECHANISM FOR TAPPING THE SURF ENERGY

Tah-Sun, L., U.S. Patent 3,994,629, Nov 30, 1976, EDB-77:087264

A mechanism utilizing the energy of the surf including a gravitational bucket with a rack on the outside thereof is described. The rack engages a gear which drives a reciprocating water pump. The pump transports water to a tank for use later as a source of steady controllable energy.

(PATENT, STORAGE, WAVE-ENERGY)

ST77 19116 ANALYSIS OF THE SUN PUMPED LASER CONE OPTICS

Towles, P.M., (Air Force Inst. of Tech., Wright-Patterson AFB, OH), Sept 1976, AD-A-034284, EDB-77:089597

A meridional ray analysis is accomplished on the solar energy collector part of a sun pumped laser. A Gaussian approximation is completed and shows a solar image 0.57 inches in diameter is located 3.81 CM from the end of the laser rod. The image is inside the laser cavity. For 200 watts available at the primary mirror of the Cassegrainian system, it is found that only about 150 watts is furnished to the cone lens for through put. Only about 66 percent of the available 150 watts is collected by the cone lens and channelled to the laser rod by the condensing cone. The last is found by a skew ray analysis of some rays coming from the outer radial part of the primary mirror. These rays are traversing the system all the way to the cone lense, but are diverging before entering the lens and therefore not being collected by the condenser cone. An analysis is made of the exit angle of the power traversing the condenser cone. The analysis was made so that an AR coating of the appropriate material and thickness could be put on the laser rod for maximum collection of the solar energy wavelengths used in pumping the ND: YAG laser rod.

(BEAM OPTICS, MATHEMATICAL MODELS, LASERS)

ST77 19117 TIDAL POWER GENERATION IN INDIA

Vaidyaraman, P.P., Brahme, S.B., (Central Water and Power Research Station, Poona, India), Institution of Engineers (India), Journal, Electrical Engineering Division, V 57:200-205, Feb 1977; Discussion, p.205-206; Author's Reply, p.206, A77-36988

Estimates are presented of power output from a tidal energy source with reference to developing tidal power plants in India. Tidal power plants are classified into single-basin and double-basin plants, and the possibility of tidal power plants on the West Coast of India is examined. Some results of hydraulic model studies in reference to pilot plant development are discussed.

(HYDRAULIC MODEL)

ST77 19118 MODEL OF CONTINENTAL-SHELF RESONANCES

Webb, D.J., (Inst. of Oceanographic Science, Wormley, England), Deep-Sea Res. Oceanogr., Abstr., V 23:1-15, N1, 26 refs, Jan 1976, EDB-77:066152

Recent work has indicated that resonances of the water on the Continental Shelves may have an important effect on the flux of tidal energy in the ocean. In order to gain some understanding, this paper considers the simple model of a rectangular Continental Shelf at the end of a canal. A kelvin wave is propagated along the canel and is partly absorbed and partly reflected by the Continental Shelf. The canal has a depth typical

of the deep ocean and the parameters of the Shelf are chosen to be typical of the Patagonian Shelf off Argentina. It is found that usually much of the incident energy is reflected by the edge on the Shelf. But at the frequency of the dominant Shelf resonance, more than 95 percent of the incident energy is absorbed. The structure of the main resonances and the effect on tidal observations is also considered. The dominant resonance near 14 RAD $DAY^{-1}$ has a width of about 1 RAD $DAY^{-1}$. Even if shifted in frequency into one of the tidal bands, it has such a large width that at a single location it could not be positively identified as a resonance from tidal records. Instead a better indication of such a resonance is a geographically localized increase in the amplitude and age of the tide.

(MATHEMATICAL MODELS, TIDAL-POWER)

ST77 19119 SOME COMMENTS ON STRUCTURES

Wiegel, R.L., (National Oceanic and Atmospheric Administration, Miami, FL), (Univ. of CA, Berkeley, CA), Proceedings of the MacArthur Workshop on the Feasibility of Extracting Usable Energy from the Florida Current, Stewart, H.B., Jr., ed., 1974, CONF-740252, EDB-77:105384

Four factors of primary importance in the consideration of the types and costs of structures that would be required to house turbines to extract power from the Florida current are discussed. These factors are: (1) low kinetic energy density. The equivalent "head" of the Florida current is of the order of less than one foot, which is very small. Thus, very large diameter turbines are needed, with small power output per unit length of diameter (Sheets, 1974). (2) Need to have turbines near the water surface. The current speeds are much larger in the top 100 meters of the Florida current than they are below this region (Von Arx, Stewart and Appel, 1974). This, combined with the fact that the power (rate of energy) that can be extracted from the current is proportional to the cube of the current speed requires the turbines to be placed in the upper 100 meters. (3) The water depth is rather great, generally more than 250 meters. Thus, the structure will likely have to be some sort of a moored "semi-submersible". And, (4) the region is subject to hurricanes, with the very high winds and waves associated with them.

(MECHANICAL-STRUCTURES, CURRENT-POWER, DESIGN-ANALYSIS)

ST77 19120 ENERGY GENERATING SYSTEM

Wood, E., German (Frg) Patent 2,604,746, A, Aug 19, 1976, EDB-77:073091

The discovery deals with a device for converting the mechanical energy from sea waves into electrical energy. For this concrete cylinders of about 9 M diameter and 18 M in length are set together end to end and linked to a cylinder which is very pliant and about 1 KM in length and pressed together by cords which are inside these hollow cylinders. These cylinders are anchored and float on the sea surface. Several, or even all, of the cylinders carry floaters for generating energy. Each floater carries a blade which the incoming waves strike, along with two circular belt components at the back which give no resistance. Through the action of wave movement, the floaters roll backwards and forwards on the cylinder shell towards the periphery, and by these rolling movements, alternating current generators, which are between the floaters and the cylinders, are in the end powered. The electrical energy thus generated is taken away in the same direction in the form of high tension direct current and supplied to the coast by means of a cable.

(PATENT, WAVE-POWER)

ST77 19121 THE CHEMICAL CONVERSION OF SUNLIGHT

Wrighton, M.S., (MIT, Cambridge, MA), Technology Review, V 79:30-37, May 1977, A77-33598

Photochemical conversion is explored as a possible solution to the problem of storage of intermittently available solar energy. The advantages of photoelectrochemical cells utilizing semiconductor electrodes immersed in liquid electrolytes are examined, and cell efficiencies are discussed. Thermodynamic stability of photoinduced electrolysis, band bending as a barrier to charge recombination, charge separation, and the search for photoassistance agents to absorb sunlight by photoelectrochemical means are discussed. Controlling factors for interfacial electron transfer rates are seen as a major research target. Applications in large-scale power stations and transportation system power plants are envisaged.

(STORAGE, ENERGY-TECHNOLOGY, PHOTOELECTRICITY, ELECTROLYSIS, LARGE-SCALE)

ST77 19122 SOLAR ENERGY DEPOT - USING LIQUID HYDROGEN AS FUEL AND OXYGEN AS OXIDIZER

Zachmann, H.C., (Associated Enterprises, Ellicott City, MD), American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, NM, AIAA Paper 77-726, 7 p., June 27-29, 1977, A77-37251

A completely new energy system is described based on the use of liquid hydrogen as a fuel, along with liquid or gaseous oxygen as an oxidizer. The concept is made economically feasible by a solar concentrator in conjunction with a free piston engine, using developments of a similar engine by Exxon Corp. and General Electric Co., to generate electricity in a closed thermodynamic system, which in turn is separately converted to liquid hydrogen. The cost effectiveness and competitive analysis with other fuels, as well as the capital investment, and other important considerations, was based on Australia as a location. Over 20 years of weather data along with a geographical analysis was used in the various options of power generation, fuel liquefaction, and cryogenic power transmission.

(ECONOMICS, FEASIBILITY-ANALYSIS)

ST77 19123 MICROBIAL HYDROGEN PRODUCTION

Zajic, J.E., Brosseau, J., In World Hydrogen Energy Conference, 1st, Miami Beach, FL, Mar 1-3, 1976, Proceedings, V 2, Coral Gables, FL, University of Miami; Pergamon Press, New York, p. 4B-29 to 4B-68, 1976, A77-33326 14-44, A77-33367

A comparison of fuel properties of nonfossil and other fuels reveals that hydrogen is an ideal fuel not only as an alterntive primary energy source but also as a highly efficient energy carrier. The four basic processes available for hydrogen production from nonfossil primary energy sources are electrolytic, thermomechanical, radiolytic, and microbial. The paper is a brief review of microbial production of hydrogen. Primary environmental factors determining the outcome of enrichment procedures for some chemoautotrophic and chemoheterotrophic bacteria are identified. The biochemistry of hydrogen gas production by microorganisms is discussed for 'clostridal' and 'coli-type' reactions. Also discussed are the nitrogenase relationship to hydrogen synthesis and the use of photosynthetic bacteria.

(BIOMASS, FERMENTATION, PHOTOSYNTHESIS)

ST77 19124 SEA WATER - THE ENERGY ELIXIR - OCEAN THERMAL, TIDE AND WAVE ENERGY CONVERSION

Zimmerman, M.D., Machine Design, V 49:20-22, 24-26, July 7, 1977, A77-38446

Approaches for utilizing the energy stored in the oceans are considered. One approach is based on the utilization of the difference between the temperature of the water at the ocean surface and the temperature of deep-ocean waters. The approach is to employ a working fluid that boils and condenses at small temperature differences, like ammonia, to establish a closed power-conversion cycle. Other approaches considered are to make use of the moon-driven tides, the power of wind-swept waves, or the energy which can be released from the mixing of freshwater with saltwater. Attention is also given to a number of unresolved issues concerning ocean-energy systems.

(ENERGY-TECHNOLOGY, TIDEPOWER, WAVES, OCEAN-ΔT)

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