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Solar Thermal Power Generation

Quarterly Update April-June 1978

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THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO 87131

NASA

SOLAR THERMAL POWER GENERATION

A BIBLIOGRAPHY WITH ABSTRACTS

QUARTERLY UPDATE APRIL-JUNE 1978

PREPARED BY THE

ENERGY INFORMATION PROGRAM

of the

TECHNOLOGY APPLICATION CENTER

SEPTEMBER 1978

THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO

A DIVISION OF THE INSTITUTE FOR APPLIED RESEARCH SERVICES (IARS)

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INTRODUCTION

This volume on Power Generation for the 2nd Quarter Solar Energy Utilization series contains a large number of citations in all categories. The overviews on energy and solar power were especially noteworthy in this case, with government interest in impacts of alternate energies being the continued focus of study.

Feasibility studies (ST 78 13112) and solar rights (ST 78 13101) were heavily investigated in our section, Economics and Law, while various workshops and large-scale research on thermal power equipment built unusually large sections for this quarter. Computer simulations, economic analysis, and social impacts of ocean power, wind power, and biomass energy were also large in this quarter, in part reflecting our improved strategies for these terms.

Although the formal topic of photovoltaics is so large that it deserves a bibliography of its own, we have examined the research on larger systems as they apply to power generation. Facilities with the USA and European communities with large funding programs again generated a large number of technical reports this quarter.

The editor apologizes to those inconvenienced by delays in our production of this second quarter components bibliography. We have streamlined and accelerated our working process to bring future editions up to schedule.

John R. Peck
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 identifier 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 periodical's title, volume number, page number and date. If for a report, 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 TITLES/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.

-- A LIST OF ABBREVIATIONS used in describing frequently occuring titles or corporate sources.

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10,000 ENERGY OVERVIEWS

ST78 10058 An Evaluation of the National Energy Plan

GAO, Washington, D.C.
Avail:NTIS, N78-12548 186 p.

An analysis and comment on the President's National Energy Plan is presented. The report is intended to assist the Congress in considering the legislation that the Administration has proposed to implement the plan.

ST78 10059 Comparative Table of Various Energy Sources

Jrnl: Kohle Heizoel, V 17:45-57, N8, Aug. 1976, In Japanese

This table provides wide informations on the technological facets of various sources of primary energy. One of the outstanding features of this table is that it exposes and compares various technological problems involved in the energy conversion processes. The primary energy sources treated here are the solar energy (heat and light are treated separately), the geothermal energy, coal (gasification and liquefaction are treated separately), oil, natural gas, oceano-energy (tidal energy, temperature difference, and wave energy are treated separately), organic wastes, oil shale, tar sand, hydraulic power, wind power, biomass, uranium, thorium, and deuterium and lithium. On the other hand, the comparisons are made in three major items, i.e., characteristics as natural resources, conversion or refinement to secondary energy sources, and economical characteristics. The first item includes the estimated and recognized amount of deposits, easiness of mining, storage, and transportation, and cleanliness and safety. As for conversion characteristics, the easiness, controlability, efficiency, cleanliness, and safety of various conversion processes are compared. Finally, as for economical problems, cost comparisons are made for gathering or mining those resources, including required energy input, man power, required facilities, and site conditions.

ST78 10060 Danish Energy Policy 1976

Handelsministeriet, Copenhagen, Denmark
Avail:NTIS, INIS-MF-3373 April 1976 In Danish

A plan for energy supplies in Denmark up to 1995 was prepared by the Ministry for Commerce and Energy and presented to the Danish Parliament. Plans aim at achieving least possible dependence on oil through savings in energy consumption and changing from oil to other forms of energy. The main elements in the energy plans are the introduction of two new energy sources in Denmark, atomic power and natural gas, as well as the setting up of a "heating plan" to ensure optimal utilization of the available energy sources. Furthermore, weight is laid on carrying through savings in private consumption, in public agencies, and in industry, and implementing a program of expanding energy research and development.

ST78 10061 Energy: A Continuing Bibliography With Indexes, Issue 14

NASA, Washington, D.C.
Avail:NTIS, N78-16424 410 p.

This bibliography lists 1000 reports, articles, and other documents introduced into the NASA Scientific and Technical Information System from April 1, 1977 to June 30, 1977.

ST78 10062 Energy and Virginia's Future: A Report of the Virginia Energy Resource Advisory Commission

Virginia ERAC, Richmond, VA
Avail:NTIS, NP-21880 Oct. 26, 1976

In order to present the seriousness of the energy situation, an overview of the national energy situation is reviewed in Part I. Such areas as historical aspects, use patterns, resource base, production, prices, demand factors, public issues, and outlook for petroleum, natural gas, coal, hydroelectric power, electric power from primary thermal energy sources, and nuclear energy are examined. In Part II, Energy in Virginia, demand and supply data are summarized for petroleum, natural gas, coal, and electricity. Solar energy as an emerging energy technology is discussed, followed by a discussion on energy conservation as practiced and planned in Virginia.

ST78 10063 Energy Awareness

ORNL, Oak Ridge, TN
Avail:NTIS, CONF-770207 1977

The objective of the Symposium for Public Awareness on Energy was to provide an information exchange among the members of the technical community and the public, civic, fraternal, service, and labor organizations on timely energy-related issues. The 1977 symposium was oriented toward state and local governmental officials in the southeastern states. Since it is these officials who have the responsibility for the development and actualization of local energy strategies, the program was directed toward providing information which would be of help to them in considering energy plans. The symposium presentations featured speakers who are recognized in many facets of the energy field. A variety of views were expressed and a number of policy alternatives were suggested. It is hoped that the presentations provided the motivation for the audience to return to their respective communities with a new and expanded perspective regarding energy issues and policies. The private and public organizations represented at the symposium can continue to provide pertinent information to those who are interested. A separate abstract was prepared for each of the nine presentations.

ST78 10064 Energy Development Center: A Concept for Orderly Energy Development and Community Growth

Systems Consultants, Inc., Washington, D.C.
1977

Conceived and prepared by Systems Consultants, Inc., this report specifies the need for a series of energy development centers or communities to be located in areas of the United States that are now or will soon undergo rapid growth as domestic energy resources, in particular coal, as well as solar, geothermal, and wind power are developed. The concept presents a rational alternative to the rapid and unplanned growth that is taking place around such small energy-oriented towns as Gilette, Wyoming; Page, Arizona; and Port Valdez, Alaska. This concept for an energy development center is directed at the critical issues of conservation, supply development, environment and intergovernmental relations, as specified in the public notice from the President's Energy Policy Planning Office.

ST78 10065 Energy Development II - Book

ISES, Inc., New York, NY
Avail:AIAA, A78-10729 196. p., 1976

Attention is given to solar-electrical systems, hydrogen transmission, Soviet MHD power plants, fuel cell power generation, wind-driven generators, geothermal power, energy from solid waste and coal liquefaction. Also considered are solar thermal electric power, the NASA-Lewis Center Wind Energy Project, ocean-sited natural energy systems, and different types of energy storage systems.

ST78 10066 Energy For Industry, 1977

CIRSL, BSFM, Cambridge, England
Book: Survey of Developments in British Fuel Markets, 1975-1976

This is the second edition of The Annual Survey of Developments in the British Fuel Markets and their implications for industrial and commercial customers. This new edition employs a simple chapter scheme. Chapter 1 summarizes principal findings from the survey. Chapters 2 and 3 deal with the underlying trends and recent developments in energy supply and demand, firstly from an international standpoint and secondly from a UK viewpoint. With North Sea oil coming on stream in increasing quantities, there still seems little prospect that pricing levels will differ from those prevailing on the international market. Chapter 4 addresses the key question of energy conservation. Recently released fuel consumption figures suggest that while substantial and on-going economies are being made in the domestic sector, insufficient progress has been forthcoming from the industrial and commercial markets. It is a matter of particular importance to the industrial market that is now hopefully on the point of output recovery. It is vital in the long-term energy balance to avoid a return to fuel-consumption growth commensurate with output expansion. The following four chapters provide standardized profiles on the fuel supply industries. Each contains a review of developments in 1975 and 1976 and goes on to examine the questions of structure and supply base, conservation and customer liaison, and sales and market penetration. Chapter 9 contains results of the pricing survey. A review of recent developments is followed by portraits of the pricing characteristics of each fuel. The final chapter attempts to take a forward view and includes a summary of the pricing characteristics of each fuel. The final chapter attempts to take a forward view and includes a summary of estimates on supply and demand until 1990. Additional information is included in four appendices.

ST78 10067 Energy Management Guide for Light Industry and Commerce

Kelnhofer, W.J.; Wood, L.A.
NBS, Washington, D.C.
Avail:GPO, NBS HANDBOOK-120 Dec. 1976

The Energy Management Guide for Light Industry and Commerce is a training tool to assist small industrial and commercial organizations in an energy conservation program. It is part of a planned series of guides and training aids to assist industry in making the most efficient use of the energy supply. While much of the information in the light industry guide has been published in the NBS Handbook 115 (Energy Conservation Program Guide for Industry and Commerce), the material has been edited and re-written in shortened form for use by the large number of small organizations with a limited supply of technical manpower. The energy conservation case studies (cost saving opportunities) have been written with this target audience in mind.

ST78 10068 Energy Options: Challenge for the Future

Jrnl: Science, V 177:875-876, N4052, Sept. 8, 1972

A discussion covers the alternative methods of energy production that should be available by 1985 with increased federal spending and leadership, including the commercial use of solar energy, commercial geothermal energy, coal gasification, shale oil, a fluidized-bed combustion chamber for burning coal without emitting pollutants, combined-cycle gas and steam turbines, dry cooling towers for power plants, and commercial fuel cells; the amount of energy used in the US; the sources of US energy, including 43 percent from petroleum and 33 percent from natural gas; US uses of energy, e.g., for electricity generation, transportation, and industry; the amount federal funding for energy systems, which is highest for nuclear fission; and the need for a major reordering of funding patterns for energy research to develop solar energy, improve fossil fuel technology, etc.

ST78 10069 Energy Technologies for the West: Workshop, Solar; Direct and Indirect Technologies

ERDA, Washington, D.C.
Avail:NTIS, TID-27476 Sept. 21, 1976

ERDA's role in solar technology was discussed by the participants in the workshop. Various aspects of the ERDA programs, budget, and emphasis are discussed. The feasibility of different solar power plants and solar heating and cooling concepts are presented. Recommendations are made for things ERDA can do in the areas of public relations and energy priorities.

ST78 10070 ERDA-48: Creating Energy Choices for the Future

Jrnl: Prof. Engng., Washington, D.C., V 45:20-22, N8, Aug. 1976

A national plan for energy research, development, and demonstration (ERDA-48), newly released by the Energy Research and Development Administration (ERDA) indicates that three key resources which will play a significant role in determining America's future energy posture are: solar, geothermal, and fusion energy. For the near-term (now to 1985) and mid-term (1985-2000), ERDA will develop the technology needed to increase the use of geothermal energy, solar energy for heating and cooling, and extraction of more usable energy from waste materials. For the long term (past 2000), ERDA will pursue vigorously the technologies which will permit the use of essentially inexhaustible resources, namely fusion, which burns deuterium available virtually without limit from the oceans. Solar electric energy from a variety of technological options, including wind power, thermal and photovoltaic approaches, and use of ocean thermal gradients. Fuel from biomass, plants grown on the land or in the sea, or processes that utilize agricultural wastes. Taking each technology in turn, the author states the objective and suggests an approach to its attainment.

ST78 10071 Facing Up to the Hard Facts of the Energy Picture

4th Energy Tech. Conf.
Jrnl: Commer. Am, Review of Conf., V 2:4-7, N8, April 11, 1977

Participants in the Fourth Energy Technology Conference concluded that reality dictates (1) the development of all energy sources, with coal as a primary source; (2) deregulation of antural gas; (3) development of nuclear power; (4) a major conservation

program; (5)a balance in regulation between energy needs and environmental goals; and (6)a less wasteful public attitude. The high price of secure energy and conservation will have to be faced in order for investment decisions to be made. Public attitudes will have to change from simplistic fault-finding to an understanding of what the consequences will be if all energy options are not pursued. Representatives of ERDA, the American Gas Association, the Electric Power Research Institute, and the National Coal Association met to review their common goals and options. Highlights of the meeting are given, and the observation is made that those involved in energy development must participate in the process of educating the public.

ST78 10072 Federal Look at the Needs for Energy-Related Materials Research and Development, Volume 1, Near-Term Energy Program

FCST, Washington, D.C., Energy Task Group
Avail:NTIS, ERDA-76-28V1 1976

The objectives of this volume are to specify materials requirements and to provide guidance for those making decisions on government-sponsored materials work in support of the near-term National Energy Program. The report is the culmination of a study requested by the committee on materials of the Federal Council for Science and Technology. Panels charged with the following areas reported: fossil energy; nuclear energy; solar and geothermal energy; energy conversion, storage, and transmission; conservation and recovery of materials and energy; materials supply and management; and multi-impact basic research and exploratory development. Comments on common technology needs, near-term benefits, and budgetary allocations are included.

ST78 10073 Industrial Report: Future Energy Problems

Jrnl: Engng. Process Econ., V 2:165-167, N3, Sept. 1977

A review of energy-supply projections concludes that a responsible energy policy emphasizing conservation of oil and gas is vital for all countries, but particularly for the US. World energy consumption statistics indicate that, while alternate energy sources for the 21st century, and in the meantime, to reduce consumption through mandatory standards and regulations, realistic pricing, and serious monitoring.

ST78 10074 International Energy Agency (IEA), Cooperative Research, Development and Demonstration Program

Jrnl: Technol. Nachr. Programm-Inf., V 152:1-16, Dec. 1976, In German

On January 10th, 1976, The International Energy Agency (IEA), a subsidiary of OECD, adopted a long-term cooperation program by its governing board which came into effect on the 8th of March, 1976. The program has four key points: (1)saving energy, (2) expeditions development of alternative sources of energy, (3)energy research and development, (4)legislative and administrative obstacles and discriminating practices. In the following, only the Cooperative Research, Development, and Demonstration Program is dealt with; 13 task groups make preparations. It concerns the following areas: (1)conversion of biomass, (2)coal technology, (3)energy saving, (4)fusion energy, (5)geothermal energy, (6)HTR for process heat, (7)generation of hydrogen, (8)nuclear safety, (9)oceanic energy systems, (10)radioactive waste, (11)small solar energy systems, (12)solar energy, and (13)wind energy. In these 13 working areas whose definition is given on the following pages, task groups of the IEA Member Division of Work, Division of Costs, or Information.

ST78 10075 Inventory of Energy Research and Development: 1973-1975, Volume 1, Serial U, Part II

ORNL, Oak Ridge, TN
Avail:NTIS, PB-265125 Jan. 1976

This inventory provides an overview of the R and D being performed in every aspect of energy exploration, production, distribution, use, and conservation. Volume 1, Part II is divoted to bibliographic entries (including abstracts) concerning oil shales, tar sands, nuclear fuels, solar energy, geothermal energy, hydroelectric power sources, and synthetic fuels. This inventory expands and updates two earlier inventories of on-going energy research published in March 1972 and January 1974.

ST78 10076 National Energy Plan

Exec. Office of Pres., Energy Policy and Planning, Washington, D.C.
Avail:GPO, NP-21948 1977

Following an overview and summary of the National Energy Plan, Chapter 1 traces the origin of the US energy problem. The US energy demand, oil, natural gas, and implications for the USA and the international community are discussed in Chapter 2. The ten principles of the plan are given in Chapter 3. Conservation and energy efficiency dealing with transportation systems, buildings, appliances, industrial fuels, cogeneration and district heating, utilities, and conservation savings are discussed in Chapter 4. All aspects of policy pertaining to oil and natural gas in the National Energy Plan are discussed in Chapter 5, while Chapter 6 deals with coal, nuclear, and hydroelectric power. Chapter 7 deals with the government's role in development of nonconventional sources. The overall roles of government at all levels and of the American public are discussed in Chapter 8. Chapter 9, the National Energy Plan and the Future, concludes the document.

ST78 10077 Net Energy Analysis: An Energy Balance Study of Fossil Fuel Resources, Summary Report, Analysis Study

CERI, Golden, CO
Avail:NTIS, PB-259159 April 1976

This report examines industrial energy production in fossil fuels, emphasizing those of the western United States. It accounts for the complete direct and indirect energies which must be used to produce energy from fossil fuels. These include the direct and indirect energies which drive or subsidize the production. It includes those energies sequestered in materials needed to build and operate the industrial production and transportation facilities which either directly or indirectly are necessary for energy production. The study includes all steps in bringing fossil fuels from reserves in the ground to the point of end use (exploration, extraction, conversion, and transportation).

ST78 10078 Proceedings of the National Solar Energy Workshop of the ERDA Division of Solar Energy and the State Energy Offices

Univ. of Alabama, Center for Environ. and Energy Studies, Huntsville, AL
Avail:NTIS, ORO/5278-2 Jrnl: Proc. of Workshop 1976

Proceedings are presented of a workshop to bring together members of the ERDA Division of Solar Energy and energy officials of the various states to help improve the exchange of information and stimulate more direct participation in the planning of National Solar Energy Research, Development, Demonstration, and Commercialization Programs. The workshop was organized into six sessions with participants attending seven workshops involving meteorological and solar heating and cooling demonstration programs. Also, "mini-regional" meetings were held, as well as review and detailed presentation sessions. Topics ranged from measurement and construction standards to commercialization prospects for solar energy, and from the National Data Collection, Evaluation, and Dissemination Program to states participating in the design and collection of solar radiation data networks. The seven working groups were organized to allow each participant to attend sessions on three different topics of their choice. The subject areas were: (1)State Participation in Meteorological Net work Design, Data Collection; (2)Radiation Instrumentation Measurements and Calibration; (3)Meteorological Data Management (standards and format); (4)State Participation in Solar Heating and Cooling Demonstration; (5)Heating and Cooling Standards and Criteria, (6)Solar Heating and Cooling Data Management System; and (7)Solar Heating and Cooling Systems Analysis. The edited and consolidated results of all workshop sessions, handouts, and summaries are presented.

ST78 10079 Proceedings of the Public Meeting to Review the Status of the Inexhaustible Energy Resources Study

ERDA, Washington, D.C.
Avail:NTIS, CONF-770560 May 18, 1977

The Inexhaustible Energy Resources Study was requested by ERDA Acting Administrator, Robert Fri, to examine inexhaustibles as a class. The purpose of the study was to determine how soon inexhaustibles are needed, to formulate strategies for their development and deployment, to identify alternative paths to the utilization of the inexhaustible resources, to serve as a guide in formulating ERDA budget requests, and to project funding profiles associated with each strategy. Dr. James Kane, coordinator of this public meeting, after speaking briefly, introduced Robert Fri, who opened the meeting. Speakers who followed Dr. Fri included Mr. Donald A. Beattie, Acting Assistant Administrator for Solar, Geothermal, and Advanced Energy Systems; Mr. Robert Thorne, Acting Assistant Administrator for Nuclear Energy; Dr. James Leverman, Assistant Administrator for Environment and Safety; and Dr. Bennett Miller, Executive Director, Inexhaustible Energy Resources Study. A question and answer period followed the presentations.

ST78 10080 Quarterly Report of Foreign and Domestic Developments Affecting Energy

Engng. Foundation, New York, NY
Avail:NTIS, ERDA-77-3/2 Aug. 1977

This sixth quarterly report includes current statistical data on selected economic and energy indicators, along with background trends. In sum, recovery from the worldwide recession of 197 -1975 is continuing and United States economic growth is expected to slow during the last half of 1977. Near-term prospects for world oil and gas supplies are improving as the first Alaskan deliveries are made and new field discoveries rise in Mexico and the North Sea. Mexico is planning a new large pipeline for the delivery of gas to the US. The final choice of a route for delivering Alaskan gas to the lower 48 states appears to be near. Several Middle Eastern countries expect to bring liquefied natural gas to the capacity on streams within the next few years. Long-term prospects for energy supplies, particularly for the US have not improved. Expectations are that US coal production in 1977 will correspond to 1976's 665-million ton level. For the first four months of the year, nuclear power plants supplied a record 11.8 percent of US electricity. Divergent views on the prospects for US uranium reserves and production during the rest of this century are presented. There are a variety of reports of diverse and significant energy conservation in industrial and commercial facilities and processes. The production of medium-temperature solar collectors, the type used for space and water heaters, more than doubled between the first and second halves of 1976.

ST78 10081 Review of the Current US Energy Situation

Engng. Soc. of Cincinnatti, Energy Committee, Cincinnatti, OH
Avail:NTIS, NP-22421 Oct. 1, 1975

The goals of the Energy Committee of the Engineering Society of Cincinnatti, newly formed this year, are to promote the conservation of energy and the effectiveness of fuel utilization, to study and investigate the development of technologies that will improve efficiency in the finding, developing, production, transportation, conversion, and use of all domestic energy sources, including fossil fuels, nuclear power, and other conventional and nonconventional sources of energy; and to disseminate information and reports for the benefit of the public. Information in these areas is discussed in this review.

ST78 10082 Summary of Accidents Related to Non-nuclear Energy

EPA, Washington, D.C.
Avail:NTIS, EPA-600/9-77-012 May 1977

The first step in the assessment of the hazards of non-nuclear systems is a compilation of existing accident data. A report entitled accidents and unscheduled events associated with non-nuclear energy resources and technology has been prepared in an effort to summarize available information on this subject. This paper summarizes the findings of that report. Accidents or unscheduled events, whether natural or human-made, are considered. However, emphasis is placed on major accidents or minor accidents that have a cumulative major effect. Energy systems considered are coal, crude oil, natural gas, liquified natural gas, hydroelectric, oil shale, geothermal, and solar. Accidents in each energy cycle element (exploration, extraction, processing, transportation including transmission and distribution, and end-use technologies) are considered. Excluded from consideration in this report are environmental effects or threats to human health, safety, or property resulting from normal operations. Impacts of normal operations, such as instances of black lung disease in the coal mining industry, must of course be considered in choosing among available energy development options.

ST78 10083 Summary of International Energy Research and Development Activities, 1974-1976

SSIE, Inc., Washington, D.C.
Avail:NTIS, HCP/U2639-1 Nov. 1977

This directory includes information covering 3017 ongoing and recently completed energy research projects conducted in Canada, Italy, the Federal Republic of Germany, France, the Netherlands, the United Kingdom, Denmark, Sweden, Israel, and 18 other countries. This information was registered with the Smithsonian Science Information Exchange (SSIE) by supporting organizations in the nine countries listed and by international organizations such as the International Atomic Energy Agency. All narrative information presented in the directory, and in some cases, organization names were translated into English. In addition to the title and text of project summaries, the directory contains the following indexes: subject index, investigator index, performing organization index, and supporting organization index. To reflect particular facets of energy research, the subject index is cross-referenced. The subject index is based upon the SSIE classification system, which organizes index terms in hierarchies to relate groups of narrow subject areas within broad areas. The following types of energy

information are included: organic sources of energy (gas and oil-coal-peat, hydrocarbons, and nonfossil organic sources); thermonuclear energy and plasma physics; fission sources and energy production (reactor fuels assemblies and fuel management; reactor materials; reactor components; reactor thermodynamics, thermohydraulics, and mechanics; reactor safety and control; reactor testing, operations, and analysis; reactor and nuclear physics; uranium exploration and mining; reactors-general); geophysical energy sources (geothermal, hydro, solar, wave, and wind); conversion technology; environmental aspects of energy conversion and use; transport and transmission of energy; energy utilization and conservation; and energy systems and other energy research.

ST78 10084 Update on Alternative Energy Sources: Technology and Applications for Minnesota, Conference Summary

Minnesota Energy Agency, Minneapolis, MN
Avail:NTIS, 78C0004070 1976

Following the opening presentation by John P. Millhone examining Minnesota's energy future, 19 papers are presented on possible alternative energy source: solar and wind energy, peat, animal wastes and agricultural residues, forest products, and solid wastes. Nine papers on conservation of energy, using waste heat, side effects of new energy sources, and nuclear energy and energy from space complete the presentations. Additional remarks by William Sheppard, William Munger, Winston Borden, and Donald E. Anderson on Minnesota's energy future and concluding remarks by Perry L. Blackshear, Jr. close the conference.

ST78 10085 Using Net Energy Methodology for Energy Planning: Tradeoffs of Supply vs. End-Use Technologies, Volume II, Final Report

Dev. Sciences, Inc., East Sandwich, MA
Avail:NTIS, FE-2443-2 April 15, 1977

This volume contains Chapters 3, 4, and 5 of the study. Chapter 3 contains an overview of methodology. An attempt is made to present a concise review of the basics of net energy analysis developed previously and to demonstrate how an analysis can be structured to be easily reproduceable. The data and characteristics are those of New England, concerned specifically with New England space and water heating; also discussed in the chapter are energy supply trajectories and energy supply-demand options. Information contained in Chapter 4 provides the basis for the results and conclusions reported in Chapter 2. The chapter is divided into four parts: Section 4.1, an outline of the options for New England space and water heating; Section 4.2, the trajectories used to represent energy supply systems; Section 4.3, descriptions of the supply modules from which trajectories in Section 4.2 were built; and Section 4.4, the modules that determine energy demand for space and water heating. Chapter 5 consists of the following appendices: New England Energy Balance, New England Building Mix and Projected New Construction, Residential Buildings in New England, Commercial Buildings, Sample Module Calculation (Module 4.3.25, coal liquefaction by catalytic hydrogenation), Nuclear-Electric Power, Comparison of Transportation Modes, and Conversion Factors.

ST78 10086 Weather, Gas, and Solar Heating: Crisis and Resolution

SIPI, New York, NY
Avail:NTIS, 78C0027149 1977

The seminar was conducted to expose the urgency and need for an energy policy. Alan McGowan, President of Scientists' Institute for Public Information, expressed a view that due to the lack of an energy policy, persons suffered in the winter of 1977, particularly due to natural gas shortages. Then the solar aspect of the built environment and of heating systems was addressed. Panelists correlating these views were Roberta Hornig, Scott Bush, Dr. J. Murray Mitchell, Dr. Gerald E. Bennington, Joseph C. Dawson, and William Clark. Questions posed by the audience were answered.

ST78 10087 Methodological Aspects of Estimating the Efficiency of Utilization of Fuel and Energy Resources

Akhmedov, R.B.
Avail:NTIS, DOE-TR-25 Trans. of USSR Report, 1977

The economy of the Soviet Union is developing on the basis of utilization of its own fuel and energy resources (FER). This is an important advantage of the Soviet economy and one of the prerequisites for its stable growth. However, in order to make full use of this advantage, it is necessary to utilize the available FER as efficiently as possible. This means that the actual demand for various types of fuel and energy in all the branches

of the national economy must be satisfied with minimum total national-economic expenditures on the prospecting, extraction, processing, conversion, distribution, and utilization of the energy resources. A methodological basis for planning measures aimed at raising the efficiency of FER utilization and conservation includes the identification and study of existing reserves of FER economy, and technical economic justification of the sequence, periods, scales, and branch and territorial structure of their realization. Depending on the planning period of a measure, various methods of study are used. Some specific data are used to show calculation methods.

ST78 10088 United States Energy Model Economically Driven by a Global Growth Simulation

Alexander, J.F.Jr.; Sipe, N.G.; Odum, H.T.
Univ. of Florida, Gainesville, FL
Avail:NTIS, 78C0003696 Jrnl: Modeling and Simulation, V 7, Pt. 2, 1976, ISA, Pittsburgh, PA

Dual dynamic mini-models of the world and the United States were developed to simulate United States growth trends. The models were developed using energy language diagrams and concepts developed by H.T. Odum. The models were simulated from 1954 through 2054 using Dynamo II simulation language. Equations, symbols, and systems diagrams are presented and explained.

ST78 10089 Putting Alternative Sources of Energy into Perspective

Budenholzer, R.A.; Lavan, Z.
Illinois Inst. of Tech., Chicago, IL
Jrnl: IEEE Trans. Power Appar. Syst., V PAS-96:1190-1195, N4, 1977, 11 refs

The present United States energy consumption pattern is discussed, and a realistic evaluation of the various energy options for the next 10 to 30 years is presented. In this period, oil and natural gas will essentially be exhausted and the emphasis will most likely shift to coal, nuclear energy, solar energy, and synthetic fuels. Other alternative energy sources should also be developed since they may offer excellent solutions to specific regions. Energy conservation is essential and must be continuously implemented in all sectors of the economy.

ST78 10090 Down to the Abyssal Plane and Other Dark Places

Byford, A.N.
Inst. of Chem. Engng., Rugby, England
Avail:NTIS, 78C0005213 1977

Current and future energy trends are discussed in the light of the two-year lag in production platform orders. Several current technology solutions to the energy gap are then proposed, as follows: (1)a totally submerged pipe lay barge, (2)a sub-sea platform design, (3)a new design concept for harnessing wave power, (4)geothermal heat from semi-active volcanoes, (5)the in-situ gasification of coal, and (6)deep sea mining, based on a similar vessel to Item 1.

ST78 10091 Energy Guide: A Directory of Information Resources

Bemis, V.
Garland Publishing, Inc., New York, NY, 1977

This annotated volume is designed as a basic reference tool on the social science aspects of energy and energy alternatives. Included are chapters on governmental agencies, businesses, energy programs, alternative energy sources, non-governmental agencies, and energy self-sufficiency. There are also sections on instructional aids, texts, periodicals, reference materials, research projects, and a special section on energy materials for the visually handicapped. A chapter of detailed annotations on the major social science studies undertaken during the 1973-1974 energy crisis is included as well. Materials cited in this guide were written for all levels of interest, from primary schoolchildren to post-graduate researchers. This book may be used either independently or as a companion volume to Energy II, another Garland Publication.

ST78 10092 SPURR: System for Projecting Utilization of Renewable Resources

Bennington, G.E.; Rebibo, K.K.
Mitre Corp., McLean, VA
1977 Annual Mtg. of ASISES
Avail:NTIS, 78C0035985 Jrnl: Proc. of Mtg., V 1, Secs. 26-38, ISES, Cape Canaveral, FL

SPURR, a System for Projection of the Utilization of Renewable Resources, is an annual simulation model used to study the market penetration of new energy technologies, such as distributed and centralized solar energy conversion systems. This model is intended to fill the gap between the aggregate national energy models and the uncoordinated analyses of individual applications, e.g., solar hot water heating. The level of detail and modeling structure has been selected to permit analysis of the critical issues involved: the dynamic nature of new technology growth, the techno-economic description of a wide range of conventional and new systems, cost reduction from mass production and accumulated experience, the interface between the utility and the energy consumer, and market behavior. The purpose of the SPURR model is to assist government program directors in planning their RD and D Programs. By modeling the dynamic growth characteristics of emerging energy technologies and the interactions among the distributed and utility sectors, the effects of government programs in research, demonstrations, tax incentives, and subsidies can be incorporated in RD and D planning decisions.

ST78 10093 Energy Development and Related UNESCO Activities

Berkovsky, B.M.
UNESCO, Paris, France
Academic Press, New York, NY 1976

Energy is one of the crucial keys to socio-economic development. An analysis of past trends and future perspectives of energy consumption shows a significant increase in energy demand in the foreseeable future. The question as to whether the current method of energy production, combustion of fossil fuels, will cover future energy demand is examined. Although there is no immediate danger of the current method of energy production being unable to cover energy demand, the stock of fossil fuels will be exhausted within the foreseeable future and significant attention should be paid to the development of alternative sources of energy. The principal clean and renewable energy sources are discussed briefly along with ongoing research in these areas. The coordination and promotion of research in the field of fundamental scientific and technological energy problems is in the domain of UNESCO. UNESCO's activities in this field are described.

ST78 10094 Energy Department Will Help Focus Our Efforts

Chapman, W.
Johnson Controls, Milwaukee, WI
Jrnl: Energy User News, V 2:22, N30, Aug. 1, 1977

Creation of a Department of Energy is viewed as a positive step toward a better use of energy and relief from the energy crisis through more efficient planning and management. A need is seen for having a single agency responsible for setting energy standards that apply to both new and existing buildings. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) closely monitored the drafting of the legislation because of its potential for ending confusion and overlapping authority in the energy field. ASHRAE preferred S.826 to S.591, which would have created a Department of Energy supply and natural resources, because they felt the former had a better administrative structure. Other recommendations included special task forces to settle tradeoffs between conflicting agencies and the retention of teapot dome Naval reserves.

ST78 10095 Distributed Technologies in California's Energy Future, Volume 1

Univ. of California, Berkeley, CA, Lawrence Berkeley Lab.
Avail:NTIS, LBL-6831 Sept. 1977

This interim report contains eight of the eighteen chapters included in the complete report. In Chapter I, pertinent data, facts, and observations are made following an initial summary. Chapter II is an introduction, citing especially the writings of Amory Lovins. The criteria used in defining distributed systems, suggested by Lovins, are that the technologies be renewable, environmentally benign, local, subject to graceful failure, foolproof, flexible, comprehensible, and matched in energy quality. The following chapters are: The Energy Predicament; The California Setting; Energy Resources for California's Future; Alternative Energy Futures for California; Issues and Problems; and Directions for Future Work. Six appendices deal with residential heating loads and air conditioning, allocations, co-generation, population projections, and the California Wind Energy Resource.

ST78 10096 Status Report on the Alternative Energy Sources

Clarke, F.J.P.
UK Atomic Energy Authority, Harwell, Berks., England
BAAS Annual Mtg., Aug. 31-Sept. 7, 1977, University of Aston, Birmingham, England
Avail:AIAA, A78-11489 Jrnl: Atom, p. 268-280, Oct. 1977

The considered alternatives to oil and gas as sources of energy are sun, wind, waves, tides, and geothermal heating. With respect to solar energy, the UK in connection with its climatic conditions is mainly studying an employment of blackened flat-plate collectors for water and space heating. Problems are mainly related to the economy of the heating and heat storage systems in comparison to the costs of conventional systems. Investigations designed to reduce the costs and improve the efficiency of solar systems are planned. The employment of aerogenerators for the utilization of wind power is basically feasible. The major unknown about wind power lies in its economics. Studies are being conducted concerning the design of an aerogenerator optimized for UK hilltop sites and an aerogenerator which can provide electricity to the national grid from offshore locations. In the case of wave power, current programs are concerned with an examination of technological practicability at an economic cost. It is estimated that it will take about 20 years to complete a tidal energy project.

ST78 10097 Report to the Secretary of the Interior of the Advisory Committee

Comm, R.
Jrnl: Energy Commun., V 1:57-103, N1, 1975

The report is the product of a full-year effort, employing an interdisciplinary approach to study the situation and problems of the nation's energy economy. Subjects include elemental and new technology energy sources, such as wind, sun, and tides; petroleum liquid fuels; natural gas; water; coal; nuclear energy; synthetic oils; and synthetic gas. Recommendations are given for each.

ST78 10098 Energy, Jobs, and the Cost of Living

Commoner, B.
Washington Univ., St. Louis, MO
Keynote Address before LACFL Conf., Jan. 15, 1977
Avail:NTIS, 78C0027000

The energy crisis is still here, but is has "gone underground," Barry Commoner says. In fact, it is worse, he concludes, and is the driving force of inflation, a stumbling block to industrial development, a threatening portent of massive unemployment. The effects of the energy crisis are far-reaching, particularly in California. A review of that situation in California shows that environmental risks must be weighed in relation to energy supplies. Dr. Commoner says that when all facts are examined, it is not necessary to choose between jobs and environmental quality. He reviews a report prepared by TRW, Inc. concerning the strategy that industrial management is planning in Southern California to substitute alternate fuels for natural gas: the precautions necessary for the application of alternate fuels are summarized. The financial aspects and the reasons some sources have not been developed are cited. Dr. Commoner believes the development of solar energy conversion, particularly for California, is "not only technically and economically sound, it is also politically realistic."

ST78 10099 Letter From Greece

Crull, A.
Jrnl: Energy, Stamford, CT, V 2:7-8, N3, Summer 1977

Greece, a country that imports all of its petroleum, must develop an energy program that will allow the country to continue its economic development and insure reliable energy supplies. The National Energy Council (NEC) and Public Petroleum Corporation (OEP) are the government agencies most directly involved in making a policy that emphasizes export development and import substitution. A shift to lignite for power generation will not lower the consumption of petroleum by the growing transportation sector. Some steps the government is taking include revision of refinery contracts, exploration at offshore oil and geothermal sites, and applications of solar energy. Unlike Americans, the Greeks appreciate the seriousness of the energy crisis and are attempting to join the government and private sectors to attack the problem.

ST78 10100 Energy and Development: An Ecological Approach

Da Silva, J.V.; Souchon, C.
Univ. of Paris, Paris, France
Avail:NTIS, 78C0037245 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Elmsford, NY

Development in ecology is tantamount to increase in diversity. Energy is necessary for the development of human societies and for increase in diversity of human activities that improves the efficiency of energy utilization. Some examples of energy flow analysis of rural systems in Africa are given.

ST78 10101 Engineering, Ecology, Environment, and Buildings

Dubin, F.S.
Dubin-Mindell-Bloome and Assoc., New York City, NY
Cary Arboretum of the New York Botanical Garden, Millbrook, NY, 1976

Construction principles discussed in the conference that are being applied to various projects are examined and particularly those being applied at the Cary Arboretum. The construction mandate requires that the building not impose upon the land and the environment, but contribute something to it. The energy budget for the arboretum building is discussed, and the architecture required to satisfy this budget with its seven-ridged roof, tiny windows, and outside wall insulation is described. Problems with the solar collectors are noted. Other projects underway by the construction firm are cited briefly.

ST78 10102 Energy Sources for the Future

North Texas State Univ., Denton, TX
ESF Symp., July 5-23, 1976, Oak Ridge Assoc. Univ., Oak Ridge, TN
Avail:NTIS, CONF-760744 Jrnl: Proc. of Symp., 425 p.,

This conference contains eighteen papers which present a variety of technical problems of the future. Particular emphasis is placed on nuclear reactor technology, safety, environmental impacts, and economics. The prospects for solar energy, coal, and thermonuclear reactors are also discussed. Socio-political, as well as socio-economic aspects of future energy sources are considered on both a domestic and a global scale. Selected papers are indexed separately.

ST78 10103 Contribution to the Analysis of the Development of Unconventional Energy Sources in Latin America

Escobar, I.; Ibacache, M.E.
Inter-Am. Dev. Bank, Washington, D.C.
Avail:NTIS, ERDA-TR-298 April 1977

The energy demand for Latin America will be satisfied by the end of the present century mainly through utilization of its conventional hydraulic and fossil resources. Nuclear energy will experience a great development in Argentina, Brazil, and Mexico in the coming 20 years. The electronuclear alternative in other Latin American countries will be considerable, depending on the degree of industrialization, geographical location, and the possibilities for interconnecting networks for transmission and distribution of electrical energy in the country considered and depending on reduction in design scale and savings made in nuclear reactors presently in use (dropping down to capacities of about 150 MW per plant). The development of wind energy and tidal power as energy sources is discussed.

ST78 10104 New Energy Sources

Euler, K.J.
Gesamthochschule Kassel, De
Jrnl: Elektrotech. Z., A., V 96:45-52, N1, 1975, In German

Processes for the direct conversion of various energy sources to electrical power, such as thermoelectrical devices, thermionic converters, radionucleide batteries, magnetohydrodynamics, and electrochemical fuel cells are discussed. It is believed that solar, tidal, and geothermal energy conversion are the only techniques which are likely to provide significant amounts of energy in the coming decades. It is estimated that intensive research and development programs over the next 50-year period can result in solar energy relieving 30 percent of the natural gas demand and 10 percent of the fuel oil demand in the USA. Other systems currently under development, such as ocean thermal and artificial hydrodynamics, are described.

ST78 10105 Non-Conventional Energy-Sources and Methods

Euler, K.J.
Gesamthochschule Kassel, Germany, F.R.
Jrnl: Thiemig/Muenchen, Germany, F.R., 1977, In German

Fossil fuels, especially petroleum, become more and more short and expensive. If the present economy growth continues, the heat balance of the earth will be disturbed at latest in 150 years. Therefore, new energy sources and new more efficient methods with lower waste heat have to be developed soon. Direct energy conversion probably will play only a very small role in this regard. The other new sources - solar, geothermal, tidal power, etc. - do promise only minor relief. Today beneath coal, long-term energy policy depends strongly upon nuclear energy. The growth of energy consumption probably has to be limited.

ST78 10106 Energy Future of West Germany

Fells, I.
Univ. of Newcastle-Upon-Tyne, England
Jrnl: Energy Policy, V 5:341-344, N4, Dec. 1977

West Germany has had the strongest economy in Europe, but presently it is faltering. Environmentalists have halted construction of nuclear and fossil-fuel power plants. All this activity will affect the Autumn 1977 Energy Policy Programmes. Projected nuclear capacity will be greatly curtailed, but pressure is also being put on the relatively limited supplies of other indigenous fuels. Without a growing nuclear program, possibly based on the fast breeder or on the high-temperature thorium cycle system, the only way the country can maintain its economic growth through the next 20 years will be on imported oil and coal, with the associated vulnerability to cutback and ultimately rapid depletion of reserves, so compromise is essential and there is time to achieve balance.

ST78 10107 Development in an Arid Region: The Energy Picture

Ferguson, N.
Univ. of Arizona, Tucson, AZ
Avail:NTIS, 78C0037299 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Elmsford, NY

The energy inputs, transfers, and outputs are calculated and displayed for the year 1973 in Pinal County, Arizona. "Energy language" is used to depict the functional relationships between the major divisions of the county for 1890 and 1973. Energy monitored includes insolation, animal feeds, and human foods, as well as natural gas, gasoline, diesel fuel, and electricity. Energy flows are shown as they relate to the natural vegetation, agriculture, copper industry, ranching, feedlots, and the human sector. Estimates are made of the fossil-fuel equivalents for each energy flow and summed for the total county energy balance. The future of Pinal County is discussed in relation to the energy situation.

ST78 10108 Energy War is Generating Jobs

Fiester, K.
Jrnl: Worklife, V 2:14-20, N10, Oct. 1977

The fact that a permanent return from an energy-intensive to a labor-intensive society will create many new jobs has been overshadowed by fears of sacrifice and discomfort. Although the first visible jobs to be created by conservation programs were for low-skill short-term weatherization. Much of this work was also done by homeowners. Long-term employment opportunities will develop from solar energy and wind system projects, increased coal production, and new rail service. Each of these will involve public and private investment that will effectively reduce unemployment to a minimal level, while improving the environment. Projections and illustrations of the impact of existing and planned programs are given to show how conservation goals can be met and permanent skilled jobs can be created.

ST78 10109 Wisconsin Regional Energy Model: A Dynamic Approach to Regional Energy Analysis

Foell, W.K.; Mitchell, J.W.; Pappas, J.L.
Univ. of Wisconsin, Madison, WI
Avail:NTIS, 78C0003650 Jrnl: Springer-Verlag, New York, NY, 1976

A multidisciplinary approach to the study of energy systems and policies, undertaken to improve the analytical tools needed to understand policy alternatives, resulted in a regional simulation model. The Wisconsin Regional Energy Models (WISE) is designed to consider technology and economics as well as all sectors of energy use. The information sought included the need for new energy facilities, feasible environmental tradeoffs, the role of conservation, and the effect of primary fuel diversions. An overview is given of the WISE structure and components. Applications include long-range forecasts of state energy demand and the impacts of changing consumption patterns. The model was used, for example, to analyze the effects of improved air conditioner efficiency, smaller passenger cars, and higher building insulation standards. The effects of natural gas diversion indicate a relatively easy shift to coal with power plants able to withstand up to a seven percent cut and the commercial and industrial sectors able, with energy conservation, to absorb a 10 percent diversion without serious disruptions.

ST78 10110 Effect of Environmental Factors on Performance of the ERDA/LERC Systems Test Facility

Forestieri, A.F.
Univ. of California, San Diego, CA/LRC, Cleveland, OH
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

Some of the environmental factors which may affect the ERDA/LERC System Test Facility (STF) solar cell array are wind ambient temperature, snow, and partial shadowing of the array. These factors and others are being investigated and preliminary results are presented. Dirt, a factor which is dependent on the location of the array, has also been studied and typical effects are shown. Although the effect of environmental factors on STF are of primary interest, it is also necessary to investigate the effect of the STF on the environment. For example, radiated electromagnetic interference, which could affect communication, is being investigated as a function of array size and system components operating. Some preliminary results are presented.

ST78 10111 Utility Retrofit Programs and the Role of the Product Manufacturer

Gallager, K.J.
Owens-Corning Fiberglass Corp., Newark, OH
Jrnl: Public Util. Fortn., V 100:38-40, N6, Sept. 15, 1977

Public utilities, if they are to advocate and participate in energy conversion retrofit programs, must have some control over the standards and reliability of the manufactured retrofit products and materials they promote. Reliable performance is difficult to achieve when products like blown insulation are expected to meet a set R-value. Batt insulation, however, has been found to meet insulating efficiency standards more consistently and has been rated by the National Association of Home Builders Research Foundation, Inc. (NAHB) as an assured product. Utilities should also require manufacturers to supply on-site technical support, distribution to the consumer, and a commitment to achieve specific conservation goals.

ST78 10112 Energy Sources of the Future for the United States

Gaucher, L.P.
Oklahoma State Univ., Stillwater, OK
3rd Annual ECS Conf., 1965
Avail:NTIS, CONF-651077 Jrnl: Proc. of Conf., 48 refs

A study of energy sources for the future seemed appropriate at this time because of the many developments that had occurred in the field: the large number of new forecasts which had been published; the recent establishment of the Office of Coal Research; continuation of promotion of nuclear power by the AEC; renewed interest in oil shale and tar sands; recent reductions in coal transportation costs; development of extra-high voltage power transmission systems and power interties; and the phenomenal increase in the demand for electric power. All of these and related developments are taken into consideration in order to develop a sense of proportion regarding energy sources and energy requirements of the future in the US. The projections are extended through the year 2200, whereas most prognosticators content themselves to stop at the year 1980, or at the most, at the year 2000. The author takes a broader view because his is a "working model," not a one-shot forecast for posterity. This broader scope enables placing the past, present, and future in better perspective, and gives more room to maneuver and a wider window for viewing.

ST78 10113 Energy Analysis: A Tool for Evaluating the Impact of End Use Management Strategies on Economic Growth

Gilliland, M.W.
Univ. of Oklahoma, Norman, OK
Avail:NTIS, 78C0037197 Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Inc., Elmsford, NY

This conference session on energy analysis had two objectives. First, it was aimed at building a bridge of communications between economists and energy analysts, a bridge to allow discussion of semantic, as well as real theoretical differences. Second, research on what energy analysis has to say about the potential of end-use management strategies was reviewed. This paper focuses on the first objective. It examines the differences between the manner in which economic theory views the production and consumption of goods and services and the manner in which the theory which underpins energy analysis views production and consumption. The focus is at the macro level of planning rather than at the micro level of process analysis. Energy analysis is viewed as a powerful tool for examining energy flows within and between individual technologies that both produce and consume energy, a tool that is indispensable in analyzing end-use management technologies; the quantitative data is at the aggregated level only.

ST78 10114 Energy Crisis and You

Gilson, P.D.
FEA, Reg. V, Chicago, IL
Jrnl: IEEE Trans. Ind. Appl., V IA-13:195-199, N3, 1977

The national energy industry, and in particular, the electric utility industry is experiencing a serious financial crisis resulting from rising costs of generator fuels and deteriorating load factors. New market possibilities are related, utility problems and pricing are described, and current and future trends in electric generating fuels and national energy conservation legislation are summarized.

ST78 10115 Useful Energy Consumption: The Determination of Relative Fuel Efficiencies

Girod, J.
Institut Economique et Juridique de L'Energie, Grenoble, France
Avail:NTIS, 78C0037548 Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Inc., Elmsford, NY

The methodology for defining the total energy consumption of an economic sector or a whole country is discussed. Specifically, the relative fuel efficiencies are considered. Section 1 focuses on the substitutability of coal, gas, and oil for thermal use. Section 2 discusses the complementarity of electric power and the other fossil fuels. Some data on relative efficiencies of various fuels in France, Germany, Italy, Netherlands, USUK, Canada, Japan, and Sweden are tabulated.

ST78 10116 Cost of Hauling Firewood

Grimmer, D.P.
Appropriate Tech. Res., Santa Fe, NM
Jrnl: Alternative Sources Energy, V 27:4-6, Aug. 1977

An energy-balance analysis is made of the use of firewood for home space heating. It is shown that under certain circumstances burning firewood may not have a significant energy advantage over simply burning the petroleum used in hauling the firewood.

ST78 10117 Sources, Availability, and Cost of Future Energy

Hart, R.G.
AECL, Whiteshell Nucl. Res. Establ., Pinawa, Manitoba, Canada
Jrnl: At. Energy Can. Ltd., 33 p., Aug. 1977, 22 refs

This report attemps to put the future energy scene in perspective by quantitatively examining energy resources, their utilization, and energy costs. Available data on these resources show that conventional oil and gas are in short supply and that alternative energy sources are going to have to replace them in the not-too-distant future. While hydro, nuclear, and coal are all practical alternatives for space heating, coal appears to be the most practical alternative for meeting much of the industrial energy need. Solar energy shows promise of meeting some of the space heating load in Canada if economical energy storage systems can be developed. The general conclusion is that the basic energy problem is energy conversion.

ST78 10118 Corporate Research and Development in Alternate Energy

Herman, S.W.; Cannon, J.S.
Inform, New York, NY
Avail:AIAA, A78-11072 Jrnl: Energy Development III, 1977, p. 20-24, ISES, New York, NY

The current status of the corporate role in the development of alternate energy sources is reviewed. The role of different government agencies is surveyed and four stages toward the commercialization of alternate energy are examined: (1)exploratory research, (2)the pilot plant stage, (3)the demonstration plant stage, and (4)the commercial plant stage. Depletion resources - coal gasification and liquefaction, oil shale processing, and geothermal energy - are discussed along with man-made renewable resources - trash-to-energy systems, and inexhaustible resources - solar heating and cooling, solar photovoltaic conversion, solar thermal, ocean thermal and wind conversion and fusion.

ST78 10119 Residential Energy Use to the Year 2000: A Regional Analysis

Hirst, E.; Kurish, J.P.
ORNL, Oak Ridge, TN
Avail;NTIS, ORNL/CON-17 Nov. 1977 19 refs

A previous ORNL report (ORNL/CON-13) evaluates the national energy and direct economic effects of implementing various residential energy conservation programs. This report evaluates the effects of these programs in each of the ten federal regions. The programs considered are those proposed in the National Energy Plan: appliance efficiency targets, thermal standards for construction of new residences, and weatherization of existing housing units. Implementation of these programs might cut cumulative (1977-2000) national residential energy use by 41 QBtu Relative energy savings are highest in Regions Seven and Eight (11 and 10 percent, respectively, of their baselines) and smallest in Region Nine (seven percent). The net economic benefit to the nation's households of these three federal programs is $21 billion. Benefits exceed costs in each region. The benefit/cost ratio ranges from a low of 1.4 in Region 10 to a high of 2.0 in Region Six.

ST78 10120 Net Energy Analysis: Theoretical and Methodological Considerations

Huettner, D.A.
Univ. of Oklahoma, Norman, OK
3rd Annual UMR-MEC Conf., 1977
Avail:NTIS, 78C0037187 Jrnl: Proc. of Conf., Western Periodicals Co., N. Hollywood, CA

This paper takes a critical look at net energy analysis beginning with a summary of its major assumptions and objectives and an examination of the important theoretical and methodological difficulties encountered in this new discipline. An economic rationale is developed for placing a positive value on environmental services provided man by nature even when the supply of these services exceeds demand. The author concludes that the value weights developed by net energy analysis contain little information of use to decision makers and that the vitally needed insights of environmentalists, ecologists, energy analysts, and others can and should be integrated into traditional economic analysis.

ST78 10121 Applied Research on Energy Storage and Conversion for Photovoltaic and Wind Energy Systems

Johnson, A.W.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The overall purpose of the program, as originally conceived, was to obtain system-oriented evaluations of selected candidate energy storage concepts for use in conjunction with photovoltaic and wind energy conversion systems. Included are: (1)review of additional candidate energy storage concepts (11 total); (2)evaluation of the influence of selected parameters such as generating system output, storage capacity, location and efficiency on energy storage cost goals; (3)evaluation of the effect of multiple-source storage system charging on the worth of photovoltaic and wind energy systems; and (4) determination of the value of transient photovoltaic and wind energy system output smoothing using energy and storage techniques.

ST78 10122 Unconventional Energy Sources, Study Module (Final)

Johnson, L.R.; Simmons, G.; Peterson, J.
Northwest Energy Policy Project, Portland, OR
Avail:NTIS, PB-268301 1977

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.

ST78 10123 Trends in the Development of Heat and Power Production

Jurisch, J.
Jrnl: Energie, V 26:291-296, N10, 1974, In German

A survey is made of the present state of energy consumption and estimates are made of future demand. Both conventional and new energy sources are discussed. It is predicted that no major shortage of energy will occur within the next century. The total reserves of petroleum and natural gas are estimated to be 3.46×10^{11} and 2.33×10^{11} tons (coal equivalent), respectively. The western hemisphere is believed to be essentially independent of the eastern hemisphere with regard to natural gas. New sources of coal, ranging from anthracite to lignite, are continuously discovered in previously unsurveyed countries. Production of coal, however, continues to decline. New energy sources which may be considered to be essentially renewable and environmentally clean are hydrodynamic power, tidal energy, ocean thermal gradients, geopressured energy, solar energy, and geothermal energy. The potential output of geothermal energy is estimated to be 2.0×10^{13} tons (coal equivalent). The geothermal energy potential of the USA as of 1985 is predicted to be about 400 GW.

ST78 10124 Energy Storage: Applications, Benefits, and Candidate Technologies

Kalhammer, F.R.
EPRI, Palo Alto, CA
Energy Storage Symp., 1976
78C0032189 Jrnl: Proc. of Symp., The Electrochemical Soc., Inc., Princeton, NJ

A number of major energy-using functions in modern industrial societies could be served more flexibly and with important socio-economic benefits if new ways of storing energy were to become available. Consideration of current uses of energy storage and its potential for favorable impacts on conservation, energy economics, and environmental quality point to electric utility systems, transportation, the residential-commercial sector, and utilization of solar energy as major new opportunities for energy storage. The use of energy storage in these areas is discussed and some of the possible benefits are identified. Economic prospects are examined for utility energy storage, an application amenable to simplified economic analysis. The broad range of possible uses is not likely to be satisfied by a single energy storage method. In addressing existing and future opportunities, technologies for storage of mechanical, chemical, thermal, and electromagnetic energy are being developed. The most promising technologies are reviewed briefly and their prospects for practical applications are examined.

ST78 10125 Constraining the Energy Gobbler

Kaplan, G.
Jrnl: IEEE Spectrum, V 14:26-32, N12, Dec. 1977

Industry, responsible for 40 percent of the nation's annual energy consumption, has been targeted by the Department of Energy to use innovative technologies that will cut fuel use by 20 percent and lower fuel costs. Key elements in the program are better control of combustion, recovery of waste heat, co-generation of electric power and process heat, improved motor and induction-heating equipment efficiency, and on-site fuel cells. A summary of the present status and future potential is given for each of these areas of energy management. Four energy-management schemes ranging from personal surveillance to total energy control are summarized to indicate the equipment required, programs changes, vendors, and the advantages and limitations of the scheme.

ST78 10126 Energy Planning in Developing Countries

Kashkari, C.
Univ. of Akron, Akron, OH
Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

The energy crisis has hit the developing countries the hardest. The spiralling world-wide inflation, caused by the hike in oil prices, has put a strain on the meager resources available to them. These countries spend almost their entire foreign exchange earnings on oil imports and barely manage their present industrial activity. The rural-electrification programs have been dealt a severe blow by the sudden depletion of funds. There does not seem to be any hope of social transformation of one and a half billion people living in rural areas in the developing countries. The only way to approach the problem is to plan rural development based on renewable energy resources such that dependence on imports would be eliminated. It is suggested that rural energy cooperatives be set up that will undertake and coordinate energy work in villages. Under the auspices of the United Nations, model energy villages should be established. These villages would be energy-efficient units, utilizing indigenous energy reserves to the maximum possible extent.

ST78 10127 Energy Research and Development Program Prepared by the Government of the Federal Republic of Germany

Avail:NTIS, NP-22613 Jrnl: Kernforschungsanlage Juelich GMBH, Germany, F.R. 1976

The status report on research and development projects in the field of non-nuclear energy includes a review of sponsored projects and a description of the individual sponsored projects. A breakdown of the programs shows the specifications, objectives, funding data, project leaders, and much more information on the five sections: coal conversion and other thermochemical processes; mining technology and coal preparation; exploration and development of oil and gas deposits; energy conversion, transmission, and storage; and efficient utilization of energy.

ST78 10128 Facts and Possibilities for the Energy Problem

Koch, E.
Kernforschungszentrum Karlsruhe, Germany, F.R., Abt. Bauwesen
Jrnl: Keram. Z., V 29:116-117, N3, 1977, In German

After the oil crisis, all countries have become more aware of the energy problem. The economic dictate of OPEC countries must be counteracted by at least a partial self-supply with energy. The article deals with a few selected realistic developments on the energy sector. Among others, the following facts are discussed: petroleum reserves in the FRG, coal liquefaction, efficiency of thermal power plants, alternative projects for nuclear energy, reprocessing of nuclear waste, and problems of nuclear waste storage.

ST78 10129 Unconventional Energy Sources, A Select Bibliography

Lapeysen, E.H.
NCSTD, Brussels, Belgium
Avail:NTIS, N78-14626 64 p.

A total of 680 references to articles covering economics, statistics, and prospects; geothermal energy; prospects towards new policies; solar energy; and tidal energy and wind power are listed. There are no subject or author indexes.

ST78 10130 Possibilities of Developing New Non-Nuclear and Non-Fossil Energy Sources

Lehner, G.
Stuttgart Univ., Stuttgart, Germany, F.R.
Avail:NTIS, AED-CONF-77-002-007 1977 In German

As possible non-nuclear and non-fossil new energy sources one can discuss three essentially different options - tidal energy, geothermal energy, and solar energy. The word solar energy is used here in a broad sense, including the direct use of solar radiation and the indirect use of secondary energies derived from solar radiation. A discussion of the natural energy resources of the earth leads to an evaluation of the future possibilities for the different options. The potential of tidal energy is very small. Geothermal energy has a much larger potential, but only if one considers the heat stored in "hot dry rocks." The technology for its use is not yet available. It may meet economic and environmental difficulties. Thus, the future importance of geothermal energy is not clear now. Solar energy finally has an extremely large potential. Technologies

for several methods of its more or less direct use are available. The main problems are economic ones. In the long run, solar energy should be able to contribute significantly to the solution of the energy problem if the economic problems can be solved; in the short run, an appreciable contribution is, however, not to be expected.

ST78 10131 New Initiatives in Energy Policy

Linden, H.R.
IGT, Chicago, IL
Avail:NTIS, 78C0032443 March 1977

Dilemmas encountered in the establishment of a viable energy policy for the United States are considered. Reasons for the shift in thinking from a goal of energy self-sufficiency by the Nixon and Ford administrations to a more realistic approach are discussed. The need to determine parameters of the role of low-technology (including solar and biomass versus high-technology options in the future energy picture is emphasized.

ST78 10132 Review of World Energy Supplies

Linden, H.R.
IGT, Chicago, IL
12th World Gas Conf., 1973, Int. Gas Union, London, England
Avail:NTIS, 78C0003760 Jrnl: Proc. of Conf.

The projected increase in world energy requirements is related to the reserves and resources of fossil and fissile fuels. On the basis of currently definable technology and economics, world energy resources are insufficient to support historical rates of growth much beyond the middle of the 21st century. Further, conventional energy supply systems appear to be inadequate to support these growth rates under the expected limitations of the use of investment capital, raw materials, and air, water, and land resources. New energy supply systems are discussed, including those for conversion of the lower grades of fossil fuels to non-polluting fluid fuels and those employing hydrogen as the energy form. The state of technological development of the most promising fossil fuel conversion processes, and their thermal efficiencies, operating characteristics, investment costs, prospects for industrial use are reviewed. Particular reference is made to the major commercialization effort already under way in the United States. The advantages of a hydrogen-based economy over complete electrification are discussed in detail. Although major emphasis is placed on the adequacy of fossil fuel and uranium resources in meeting future requirements and on delivery systems for these energy sources which are compatible with investment cost and environmental limitations, the major renewable energy resources are also reviewed briefly.

ST78 10133 Facilitating the Use of Solar Building Technologies: A Report on Work in Progress

Masterson, C.
AIA Res. Corp., Washington, D.C.
Jrnl: IF, V 7:95-102, N2-3, 1976

Too much emphasis has been placed on technological innovation. It is necessary to consider the processes that are necessary to produce and distribute new products, and also to develop the accompanying knowledge base and motivations. The innovation process is non-linear when seen in human terms. A study has been made of the ways in which public and private institutions can facilitate the widespread use of solar technologies for building. A survey of early users reveals a number of problems including surviving false starts, involving key participants, overcoming lack of knowledge, resolving difficulties with bidding and quality assurance, etc. The use of solar technologies involves changes in the indistry and the adoption of a knowledge-based approach.

ST78 10134 World Energy: The Resource Picture

McKelvey, V.E.
USGS, Reston, VA
Avail:NTIS, 78C0037296 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

The era of abundant low-cost fossil fuels which has supported large increases in world population and material wealth over the past two centuries is approaching an end as exponential growth in demand proceeds to deplete remaining readily recoverable resources. Other fossil resources, neither cheap nor readily recoverable, may help smooth the transition to other energy sources. The resource position of nuclear power is clouded by

unresolved technical, economic, and political problems, while low-cost recovery systems have yet to be devised for capturing the abundant energy of the sun. The time available for producing alternative energy systems is short, but it can be stretched by prudent use of the fossil resources that remain.

ST78 10135 Energy Savings and Peak Power Reduction Through the Utilization of Natural Ventilation

Milbank, N.O.
British Res. Station, Garston, England
Jrnl: Energy Build., V 1:85-88, N1, May 1977

This paper is concerned with the factors involved in utilizing natural ventilation to the maximum extent possible in order to reduce the need for air conditioning and mechanical ventilation. It is noted that predicting a building's cyclic response is a difficult procedure, but that simple methods such as the admittance procedure have been developed. Thermal comfort studies have indicated the acceptability of the larger daily temperature variations associated with natural ventilation. The characteristics of possible new control systems are discussed. Characteristics and data on non-structural external solar products are listed.

ST78 10136 ASHRAE Interim Recommendation Relative to a National Energy Policy

Morabito, B.P.
Jrnl: ASHRAE J., V 19:23-24, N8, Aug. 1977

Prior to the release of its policy statement, the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) submitted interim recommendations for a national energy policy based on efficient use of energy resources. The report stresses a prompt reduction of the energy gap through simultaneous energy development and energy conservation. Public education and commitment are needed to direct funding if this goal is to be realized. The recommendations cover economics, trade, exploration, incentives, consumer involvement, and energy conservation standards arrived at by consensus. ASHRAE pledges its cooperation with all sectors in providing reliable information.

ST78 10137 Solar Energy in Australia

Morse, R.N.
CSIRO, Solar Energy Stud., Victoria, Australia
Jrnl: Ambio, V 6:290-215, N4, 1977 10 refs

A sun-rich country with a wide variety of solar research programs and with manufacturers who have the technical and marketing skills to implement research results, Australia is one of the most interesting countries on the solar energy scene. In the context of a proposed national goal of energy independence by the year 2000, the article discusses exciting possibilities for the large-scale utilization of energy from the sun. Among the points covered are present and future energy usage, large-scale utilization of solar energy, the state-of-the-art within the country, and future prospects.

ST78 10138 Energy Conversion Efficiency Versus Energy Utilization Effectiveness

Omurtag, Y., Cline, D.A.
Univ. of Missouri, Rolla, MO
3rd Annual UMR-MEC Conf., 1977
Avail:NTIS, 78C0037590 Jrnl: Proc. of Conf., Western Periodicals Co., N. Hollywood, CA

A brief outline is provided of the thermodynamics of energy conversion and efficiency concepts to establish a basis for the argument that energy conversion is essentially a technical problem to be solved within the constraints of available technological knowhow, whereas energy-use effectiveness is largely a management problem that requires a somewhat different approach. An attempt is made to show that significant economic contributions can be made by improved management of energy use within the existing technological boundaries.

ST78 10139 Energy: Prospects for the Rest of the Century

Othmer, D.F.
Polytechnic Inst., New York, NY
Jrnl: Mech. Engng., V 96:18-25, N8, Aug. 1974

A discussion covers historical aspects of US energy use; the present overall picture; the tradeoff between energy and environmental protection; the need for better use of coal, oil shale, and tar sands, and improved fossil fuel combustion systems; the exploitation of various forms of direct solar energy, of the heat of the tropical seas, of oceanic food resources, and of geothermal energy; the cost advantages of the use, shipping, and distribution of methanol as opposed to LNG; the production, transport, and storage of hydrogen fuel; and the need for energy conservation until nuclear energy becomes more available; and includes a prediction that world energy needs will quadruple by the year 2000.

ST78 10140 Energy: Fluid Fuels From Solids

Othmer, D.F.
NY Polytechnic Inst., Brooklyn, NY
Avail:AIAA, A78-13625 Jrnl: Mech. Engng., V 99:29-35, Nov. 1977

A survey of processes that produce gas or liquid fuels from solid fuels is presented. Approaches considered include gasification of coal, liquid fuels from coal, and oil and gas from oil shales. Additional sources considered include tar sands and bio-solids or biomass. The costs of various processes are examined. Overall, it is thought that more than $1 trillion will be required to build energy plants in the US alone in the near future.

ST78 10141 National Energy Policy: Strategy and Implications

Ottaviano, V.B.
Ottaviano Tech. Serv., Melville, NY
Jrnl: ASHRAE J., V 19:60-63, N6, June 1977

The cornerstone of the President's energy program is to reduce demand through conservation. Mr. Ottaviano points out that conservation is the only way we can buy a barrel of oil for about $3., that it costs $13 or $14/Bbl to waste it, and the US wastes far more than any other nation. There are no easy solutions to the energy problems, but President Carter has proposed some energy goals to be achieved between now and 1985: reduce annual growth of US energy demand to less than two percent; reduce oil imports from a potential level of 16 million barrels a day to less than six million barrels, about one-eighth of the total energy consumed; achieve a 10 percent reduction in gasoline consumption; insulate 90 percent of all residences and other buildings; increase coal production on an annual basis by at least 400 million tons; and utilize solar energy in more than 2.5 million homes. Tax incentives, mandatory standards, reserves of conventional and non-conventional sources, and the cost of the program are discussed.

ST78 10142 Energy Use for Subsistence and Prospects for Development

Parikh, J.K.
IIASA, Laxenburg, Austria
Avail:NTIS, 78C0037384 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

The paper focuses on the present use of energy in the developing countries in order to first estimate the energy required for subsistence-level activities and to see how much surplus is available for economically productive activities taking into account both the commercial and non-commercial (firewood, farm waste) energy. Relationships are derived for explaining the uses of both of these energy forms in terms of economic and demographic variables from the sample of 82 countries. These relationships are then used to show that the dependence on non-commercial energy is likely to continue up to 2000 A.D. and beyond. During the transitional phase of development, it will be essential to use intermediate technology to make the currently inefficient use of non-commercial energy more efficient by converting them into more versatile forms such as methane and other synthetic fuels, and employing renewable resources such as solar and hydro potential.

ST78 10143 New Energy Sources: Are They a Substitute or a Supplement?

Peyches, I.
Avail:AIAA, A78-10131 Jrnl: Sciences et Techniques, Sept.-Oct. 1977, p. 67-71, In French

The future roles of several energy sources are considered. The discussed energy sources include nuclear energy, hydroelectricity, tidal power, and geothermal heat. In comparison with the use of constructed absorbers for solar energy, the use of large natural absorbers, such as the sea or areas of vegetation, is felt to be more advantageous. Wind power, which results from insolation, is also considered. The prospects of solar and nuclear energy in the near and distant future are compared.

ST78 10144 Food and Energy: Their Interdependence

Price, D.R.
Jrnl: Engng., Cornell Q., V 12:8-13, N1, Spring 1977

Agriculture, which accounts for nearly a fourth of US energy consumption, will benefit from research into new conservation and new energy sources that will enable food production to be nearly independent of the fossil-fuel industry. Direct changes will involve new ways to fertilize, control pests and weeds, and operate machinery, while indirect changes will involve food handling and preservation changes. Fuel requirements at spring-planting and fall-harvesting times make food production particularly vulnerable to energy shortages and emphasize the need to develop world cooperation in the exchange of food and fuel. Changes in diet away from meat consumption and a slowing of the birth rate will help, but new agricultural practices themselves are needed. Cornell's researchers are looking into ways to lower hot water demand on dairy farms, to produce methane gas from manures and agricultural wastes, and to influence plant production through changes in the genetic and biological makeup of plants and animals. Efforts to take advantage of solar energy aim at maximizing photosynthesis.

ST78 10145 Heat and Mass Transfer Problems with Alternative Energy Production

Ramachandran, A.
Dept. Sci. and Tech., New Delhi, India
Jrnl: Future Energy Production Systems, V 2, 1976, Hemisphere Publ. Corp., Washington, D.C.

The heat and mass transfer problems that may be encountered in various forms of alternative energy sources are briefly discussed. Problems in direct solar radiation utilization, ocean thermal gradient energy conversion, photosynthesis, geothermal energy, and energy from inorganic wastes including hydrogenation, hydrogasification, pyrolysis, and bio-conversion are considered.

ST78 10146 Perspectives on Energy in India

Ramachandran, A.; Gururaja, J.
Technology Bhavan, New Delhi, India
Jrnl: Annual Rev. Energy, V 2:365-386, 1977, 9 refs

The authors attempt to place India's energy problems in the perspective of the country's geographic location and its technological base. They are concerned primarily with patterns of energy consumption, the fuels or other sources required to produce this energy, and the effect that energy use will have on India's economic development. The overall situation is examined, and both the short-term problems and the long-term outlook are discussed. Considerable attention is devoted to questions of conventional energy supplies and new energy technologies that will fit into the Indian scene. A great deal must be done to translate energy plans into concrete and specific programs of action. The basic necessities such as food, clothing, and shelter for India's population, estimated to reach 950 million by the year 2000, can only be achieved with increased production requiring substantial growth of per capita energy consumption from present levels. In the context of India's needs, this undoubtedly is an immense task and one has to view energy resources, development, utilization, and conservation as part of a total system comprising urban and rural life styles: agricultural, industrial, transportation, housing and domestic needs of the society. New techniques will have to be developed and utilized optimally at several levels in various sectors of the nation. Energy conservation and efficient use of existing energy sources must be more vigorously pursued. Fusion energy and solar energy are twin challenges for meeting future energy demands. The outlook for new energy sources is quite bright, but they must be developed with the aim of supplementing the conventional sources, rather than displacing them. The challenges are very great, as are the rewards.

ST78 10147 Energy Status in Puerto Rico: An Assessment of the Petroleum Situation

Rigau, J.J.
OPFA, Santurce, Puerto Rico
3rd Annual UMR-MEC Conf., 1977
Avail:NTIS, 78C0037444 Jrnl: Proc. of Conf., Western Periodicals Co., N. Hollywood, CA

This paper covers selected aspects of the energy status in Puerto Rico, with particular consideration to the relation between energy and economic development. A historical perspective of the development of the petroleum-petrochemical sector is given with consideration of policy aspects and current efforts to reinstate past comparative advantages with the Gulf Coast.

ST78 10148 Thermodynamics and Energy Policy

Rotty, R.M.; Vanartsdalen, E.R.
IEA, Oak Ridge, TN
Avail:NTIS, ORAU/IEA(M)-77-18 July 1977

Of all the fundamental physical considerations that enter into the determination of personal and collective energy policy, only one can be quantitatively addressed through thermodynamics; this is the minimal use of energy resources to achieve conservation of scarce energy supplies. Thermal efficiency (redefined in this work as effectiveness coefficient) has been widely used in evaluating energy exchanges, but this procedure gives no consideration to "quality" of energy being used. Thermodynamics indicates that different energy quantities also can have different energy quality and efficient use of energy requires a matching of the energy quality supplied to that required for the given task. Thermodynamic efficiency as a "figure of merit" in evaluating energy exchanges has the advantage of considering energy quality. It does not, however, give information to assist in the trade-offs between energy resources and the other considerations that must be made in the formulation of an energy policy.

ST78 10149 Idea For an International Decade of Energy Alternatives

Ruzic, N.P.
NSI
Jrnl: Ind. Res., V 19:111-116, N9, Sept. 1977

Economic and environmental aspects of energy resource developments are discussed. Low-BTU coal gasification, the light-water nuclear reactor, ground-based solar thermal plants, as well as synchronous solar satellite stations, and low-orbit solar satellites are comparatively evaluated.

ST78 10150 The Energy Problem of the North: Power Requirements, Resources, and Technological Evolution

Stepanov, I.R.
Avail:AIAA, A78-13989 Jrnl: Leningrad, Izdatel'stvo Nauka, 132 p., 1976, In Russian

The influence of the specific climatic, economic, and geographic features on power generation and engineering in northern regions of the globe is examined. The natural energy resources of Siberia, Alaska, Northern Canada, and Scandinavia are reviewed. Particular attention is given to the northern regions of the USSR, their industrialization, technological evolution, and the associated changes in heat and power requirements. A survey of power plants particularly well-suited for use in northern regions includes mobile diesel power plants, mobile gas turbine power plants, underground nuclear power plants, and power plants employing the combined gas turbine-steam cycle. Some aspects of the development of wind-driven and tidal power plants are discussed.

ST78 10151 New Zealand's Energy Supplies; Past, Present, and Future

Stott, J.B.
Univ. of Canterbury, Canterbury, New Zealand
Jrnl: J. Inst. Fuel, V 50:139-146, N404, Sept. 1977

The aims of this paper are first, to present the facts about the history, present position, and the likely future changes in New Zealand's energy supplies and patterns of use. Second, these facts are analyzed and their social and political implications discussed. New Zealand's strong dependence on oil is apparent, and it is extremely important to notice that the supply of transport fuels is the largest single flow (apart from energy losses).

ST78 10152 Place and Role of Various Energy Resources in Energetics of the Future

Styrikovich, M.A.
Nat'l Comm. for Heat and Mass Transfer, Moscow, USSR
Jrnl: Alternative Energy Sources, 1976, Academic Press, New York, NY

After reviewing the various energy sources and estimating future supplies, subject to numerous qualifications, future prospects are considered. In the long term, the author proposes that thermonuclear fusion and breeder reactors can supply the needed energy for a long time. In the short term, major adjustments will be required and the nature of these are suggested for developing and developed countries and especially for the USA, Japan, France, and the USSR. The USA presently uses large quantities of oil for transportation and domestic heating. The only obvious solutions are increasing domestic oil production

or the production of liquid fuels from oil sands, oil shales, or coal, combined with economical compact cars and more public transportation. Domestic liquid fuels can only be replaced by electricity (at considerable additional expense due to low overall efficiency unless heat pumps are used). The overall cost will be high due to capital cost, environmental, and safety problems. Japan and France will undoubtedly convert from oil-fired power plants to nuclear energy. The USSR is in the best situation to meet the future with few cars and mostly public transportation, and large apartments with district heating from central power stations supplying heat and electricity in a combined cycle. The specific energy consumption of developing countries will lag behind that of developed countries due to lack of capital and skilled specialists.

ST78 10153 Computer-Aided Design of a Continuous Duty Energy System, Using Both Solar and Wind Energy

Swift, A.H.P.Jr.
Univ. of Washington, St. Louis, MO
3rd Annual UMR-MEC Conf. on Energy, Rolla, MO, Oct. 12-14, 1976
Avail:AIAA, A78-11093 Jrnl: Proc. of Conf., p. 81-90, Western Periodicals Co., N. Hollywood, CA

In many areas of the United States, the average monthly solar and wind energy density profiles complement each other, which suggests utilization of a power system that employs both solar and wind energy. This paper addresses the problem of identifying these areas from weather data, developing a computer-aided method for the design of such combined solar and wind systems, and examines the economics of combined systems as compared to solar or wind only systems.

ST78 10154 Energy Use Management: Building Materials and Design

Tamboise, M.
Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Elmsford, NY, In French

Better architectural design, especially for better air and heat movement, and utilization of more energy-efficient materials are emphasized.

ST78 10155 Fuels and Energy From Renewable Resources; Proceedings of the Symposium, Chicago, IL, Aug. 29-Sept. 2, 1977

Tillman, D.A.; Sarkanen, K.V.; Anderson, L.L.
Materials Assoc., Inc., Washington, D.C.
Avail:AIAA, A78-20524 Symp. spons. by ACS, Academic Press, Inc., New York, NY, 352 p., 1977

Quantitative estimates of energy requirements for the longer term are considered, taking into account the rationale for estimating energy requirements, the approaches used for obtaining energy targets, and the relation of conservation to employment. Attention is given to the present contribution of renewable resources, the anticipated competition for available wood fuels in the US, a thermal analysis of forest fuels, the conversion of stagnated timber stands to productive sites and use of non-commercial material for fuel, industrial wood energy conversion, and the pyrolysis-gasification-combustion process. Prospects for cogeneration of steam and power in the forest products industry are discussed, along with the feasibility of utilizing crop and forestry residues to produce energy, the use of wood oil from pyrolysis of pine bark-sawdust mixture, the logistics of energy resources and residues, bagasse as a renewable energy source, the use of ginning waste as an energy source, the design of a large-scale manure-methane facility, and energy recovery from municipal wastes.

ST78 10156 Development of World Energy Requirements and Ways of Meeting the Demand

Valvoda, Z.
Jrnl: Jad. Energ., V 23:30-36, N1, Jan. 1977, In Czech.

Past and future energy demand and the possibility is of using fossil and non-fossil energy sources in meeting the needs of population are discussed. The use of alternative energy sources is recommended to reduce the fossil-fuel demand, e.g., solar energy, water energy, geothermal energy, tidal energy, wind energy, sea wave energy, ocean temperature gradients, photosynthesis, glacier energy, and nuclear fission energy. The comparison of the possible use of the respective types of energy sources shows that only geothermal energy, tidal energy, and nuclear energy produced by thermal reactors have undergone the whole developmental stage and are industrially applicable.

ST78 10157 Overview of Energy Supply and Demand

Waterman, W.W.
IGT, Chicago, IL
Avail:NTIS, 78C0032384, March 1977

Available data on present and future energy sources are reviewed. It appears inescapable that while world reserves of fossil fuels are still large, such high levels and growth rates in energy use have been reached that continuation of the present trend threatens to exhaust our resources within a comparatively short time. The United States prospect is similar to the world picture. In addition, it has special problems stemming from (1)the high level of industrialization attained with consequent high gross national product and an apparent dependency on both high levels and growth in GNP for our economic prosperity, (2)the fact that the relative amounts of remaining natural gas, petroleum, and coal reserves are grossly at variance with the proportions in which these resources are being consumed. Over the next fifteen years substantial progress should be made in applying both developed and emerging technologies to establish economic processes for producing synthetic gas and liquid fuels from coal and oil shale. In general, our remaining fossil fuel reserves should be considered as providing lead time for development of non-fossil sources of energy. Conservation of energy, by preserving fossil fuel resources, will extend this lead time and alleviate transitional problems. Recycling of metals, glass, etc. and the efficient utilization of carbonaceous wastes to produce fuels represent important and technically feasible methods of conserving energy. Production of biomass with conversion to combustible gasand liquids represents a natural method of carbon fixation, and an important source of fuels based on solar energy. It offers a route to synthesis gas, methane, higher hydrocarbons, and organic chemicals that can be utilized long after fossil sources have been depleted.

ST78 10158 Alternative Long-Range Energy Strategies

Weinberg, A.M.; Rotty, R.M.
Oak Ridge Assoc. Univ., Oak Ridge, TN
Avail:NTIS, 78C0016454 Jrnl: Abakon Verlagsgesellschaft, Berlin, W. Germany, 1977

Each of the energy modes is beset with limitations that become apparent when viewed in the long run. Fossil fuels may be limited by CO_2. Geothermal is probably a small source. Fusion may not be feasible. Fission, in the long run, may pose unacceptable risk. Solar may be extremely expensive. With world energy demand increasing, possible tenfold, it seems prudent to pursue all alternatives. Though some argue that centralized energy poses a threat to human freedom, the authors point out that there may be no credible alternative to such modes of production unless population stabilizes at a relatively low value.

ST78 10159 Yet Another Constraint: Are We Altering the Earth's Climate

Williams, J.
Jrnl: Options, IIASA, p. 4-5, Summer 1977

The impact of man's energy conversion activities on the earth's climate will put a constraint on how energy options are chosen. It is vital to project the effects of present and future technologies in order to select those causing the least changes in temperature, composition of the atmosphere, or character of the land surface. The nuclear fossil fuel, and solar options are examined in this context. Computer simulation studies of nuclear power parks indicate atmospheric effects will extend beyond the vicinity of the parks. Carbon dioxide (CO_2) studies show that continued burning of fossil fuels will double the CO_2 content and cause a one to three degree rise in temperature. Solar energy will involve the use of vast amounts of land, with a subsequent impact on local climates as surface reflectivity, texture, and hydrology are altered.

ST78 10160 World Energy Prospects to the Year 2000

Wilson, C.L.
MIT, Cambridge, MA
Royal Soc., London, England, Jan. 6, 1978
Avail:AIAA, A78-22545 Jrnl: Soc. Proc., Series A, Math. and Phys. Sci., V 358: 121-139, N1693

Projections for energy consumption in 15 major industrial or oil-producing nations during the period 1985 to 2000 are presented; the study focuses on the transition from petroleum-dominated energy economies to economies relying on nuclear fuels or coal. The projections, stated in terms of a standard unit of measure, are based on various growth rates and national energy policies. Particular attention is given to nuclear fuel reprocessing and the introduction of fast breeder reactors, the possibility of trebling US coal produciton, and the contributions of hydroelectric power, oil shale, and solar power to the world energy budget.

ST78 10161 Solar Energy in Theory and Practice, Volume 1, Basic Principles

Winkler, J.P.; Gygax, P.
Book: Mueller/Karlsruhe, Germany, F.R., 1976

With this presentation of the basic principles of solar energy utilization, an attempt is made to give easily comprehensible information related to practice on application in domestic building heating and hot water supply. This volume, after an elementary introduction, deals with the principles for building with a view to heat economy.

ST78 10162 Solar Energy in Theory and Practice, V 2, Application

Winkler, J.P.; Gygax, P.
Book: Mueller/Karksruhe, Germany, F.R., 1976

With this presentation of the principles of solar energy utilization, an attempt is made to give easily comprehensible hints, related to practice, for the application in heating and hot water supply of residential dwellings. This second volume is concerned with the components of the system for solar energy utilization, describes the most economical fields of application: water heating, outdoor and indoor swimming pools, and by the example of existing plants, illustrates the present state of technology. The booklet concludes by pointing out some remarkable aspects concerning structural physics.

ST78 10163 Navajo Nation Energy Conference

Young, F.
LASL, Los Alamos, NM
Avail:NTIS, LA-6927-C Oct. 1977

The Navajo Energy Conference was conducted for individuals who are interested in problems associated with energy conservation and utilization, and social costs problems related to the process of energy exploitation. Current technology and possibilities for new science to show the way toward improving energy utilization technology was examined. Critical issues associated with the process of energy exploitation such as policies on taxation, water utilization, environment, and development financing were discussed. The conference was designed to point planners in the Navajo community toward both immediate applied research and more long-range exploratory research problems. The objectives were to be realistic and critical and to give the attendee an increased and genuine understanding of the basic concepts and principles associated with the total process of energy exploitation. The conference provided an opportunity for economic development planners from the Navajo community such as the Navajo Tribal Council and the Navajo Tribal Administration to meet with a selected group of economic development researchers from both the scientific and university communities who conducted specific studies on Navajo energy and energy-related issues.

ST78 10164 Comparison of the Fossil Fuel Energy Requirements for Solar, Natural Gas, and Electrical Water Heating Systems

Zucchetto, J.; Brown, S.
Stockholms Universitet, Stockholm, Sweden
Avail:AIAA, A78-20244 Jrnl: Resource Recovery and Conserv., V 2:283-300, Nov. 1977, FEA

A comparison between solar and fossil fuel heating is presented with primary attention given to cost factors. In most areas of the United States, solar heating is found to be several times more cost-efficient than comparable electric water heating, and about half as efficient as natural gas water heating per joule of energy produced. An input-output flow model is devised, with all costs, including those of raw materials for solar heater construction, installation, energy consumption rates, and heat loss from inefficiencies in the heater system taken into account. Over the projected lifetime of solar heaters (10-25 years), the savings are said to be substantial in comparison with fossil fuel heaters, and solar heaters do not damage the environment.

11,000 SOLAR OVERVIEWS

ST78 11071 A Guide to Solar Info

Jrnl: Mechanix Illustrated, V 73:126, Nov. 1977

No abstract available.

ST78 11072 A New Promise of Cheap Solar Energy, (With Amorphous Semiconductor Devices)

Ovshinsky, S.R.
Jrnl: Business Week, p. 20, July 18, 1977

No abstract available.

ST78 11073 Annual Report to the Legislature, 1975-1976

Florida State Energy Office, Dept. of Admin., Tallahassee, FL
Avail:NTIS, NP-21862 Feb. 1976

This report is submitted to the legislature in fulfillment of Chapter 75-256, Laws of Florida. After summarizing the history and purposes of the State Energy Office, the report discusses the office's current and proposed programs and recommends policy alternatives for a comprehensive energy conservation program. Data and publications are included in four appendices: State Energy Publications and Studies, Energy Conservation Action Plan for Florida, the Federal Energy Policy and Conservation Act of 1975, and Energy Proposals for State Action. In a supplement, forecasts of future supply and demand of energy in Florida, the following are presented: a world energy outlook, production of energy in Florida, and consumption of energy in Florida by type and sector.

ST78 11074 Applied Solar Energy: A Book Review on Introduction

Meinel, A.B.; Meinel, M.P.
Jrnl: Physics Today, V 30:66, Jan 1977

No abstract available.

ST78 11075 Australian Inventors Plan Solar-Powered Car

Jrnl: Electr. Veh., London, England, V 62:18-19, N2, June 1976

A solar-powered electric commuter car was designed. The vehicle is powered by four individual printed armature servo motors fitted into the hub of each wheel and driven by a bank of 16 conventional car batteries. Solar energizers, molded to form the roof of the car, would boost the performance of the batteries. An optional power boost could be obtained from conventional combustion-driven generators which would provide up to 60 percent of the average power load during a trip. A prototype planned at a cost of about $120,000 would seat four people and would be about 2 m (7 ft) long by 1.8 m (6 ft) wide. The prototype would be capable of speeds of up to 100 km per hour (60 mph). Depending on speed, the car would have a range varying from 80 to 300 km (50 to 200 mi). It is estimated that for every five hours that a car was parked, it would recharge the batteries sufficiently through solar energy to provide one hour's driving at 40 km per hour (25 mph), the speed said to be the average for commuter vehicles in Australian cities.

ST78 11076 Conference on Establishing the Solar Energy Regional Network

Midwest Res. Inst., Kansas City, MO
Avail:NTIS, CONF-770404 1977

A premise of the conference was that a regionally diversified effort is the most effective way to encourage widespread use of solar energy. ERDA and the Solar Energy Research Institute (SERI) have been working in that direction. In the first paper, Regionalization and the SERI Network, Don Kornreich reviews the plan to establish four regions, the west, the north central, New England, and the southeast. Next, Walter Jenkins, ERDA, presented a discussion, Regional Planning Grants. Dr. Henry Marvin, ERDA, discussed SERI as it relates to the National Solar Energy Program. The meeting concluded

with the following papers: The Solar Energy Research Institute - Its Mission and Plans, by Dr. Paul Rappaport, Director, SERI; and Regional Considerations in Solar Energy Research, by Dr. Michael Noland, Deputy Director, SERI. Extensive discussions followed each presentation.

ST78 11077 Does Solar Heating Really Work? What Owners say

Jrnl: US News and World Report, V 82:70, April 4, 1977

No abstract available.

ST78 11078 Early Use of Solar Energy in Buildings, A Study of Barriers and Incentives to the Widespread Use of Solar Heating and Cooling Systems

AIA Res. Corp, Washington, D.C.
Avail:NTIS, N77-31663 195 p.

The use of the technology and implementation of the knowledge in the building process is analyzed. A summary structure of incentives is also presented. The results of life-cycle cost analyses of fifteen selected solar heating projects, as well as a general overview of the various economic factors relating to the commercialization of solar technology are evaluated. A regulatory analysis of sun rights and land use, building codes, warranties of performance, rights to energy, and the implications of these rights are discussed.

ST78 11079 Energy Gap Can be Closed by the Sun: Statement Issued for the Press Conference on the Occasion of the Meeting "Heating With Sun"

Jrnl: Mitteilungsbl. Dtsch. Ges. Sonnenenergie, V 2:35-37, N2, March 1977, In German

On the occasion of the meeting "Heating With Sun," held in Munich in March 1977, the Deutsche Gesellschaft Fuer Sonnenenergie E.V. commented on the problems of solar energy utilization. It is expected that in 1977 some 5000 solar plants will be produced, the technological break-through having taken place in 1976. In the eighties, an annual production of 250,000 solar plants is expected, which corresponds with about 7.5 billion dm. A production volume in this region will require some 100,000 places of work. Financial backing by the state is expected in the future.

ST78 11080 Federal Procurement Plan to Accelerate Use of Solar Energy: Federal Energy Administration Solar Energy Government Buildings Program

Sowle (Don) Assoc., Inc., Arlington, VA
Avail:NTIS, NP-22219 FEA, Washington, D.C. Dec. 1976

The Solar Energy Government Buildings Program (SEGBP) is a major commercialization project being developed by the Federal Energy Administration in conjunction with other agencies. This project will utilize a portion of the vast inventory of federal buildings to provide an early and significant market for solar heating and hot water equipment and thus assist the early development of a solar heating and cooling industry infrastructure. The report analyzes several aspects of the federal procurement process that can be used in pursuing the goals of the SEGBP to (1)encourage use of solar energy systems in new and existing structures, (2)stimulate industry towards increasing investment in facilities designed to expand production and reduce costs, (3)stimulate marketing activities in the private sector, and (4)enhance equipment quality with improvement in performance-to-cost ratios. The procurement procedures, methods, and tools described for use in the report are designed to remove or minimize current major constraints in achieving rapid and widespread use of solar systems. These constraints include: (1)the high initial cost of solar systems, (2)present high costs of systems compared with lower costs which should result from volume production, and (3)potential inability of producers to obtain capital, or unwillingness to risk available capital for creation and expansion of production facilities. Key features of government procurement as part of an overall implementation plan for the SEGBP are addressed. The report reviews trends and techniques in government procurement, discusses alternative strategies, and sets forth a procurement plan to achieve SEGBP goals and objectives.

ST78 11081 Interview With George O.G. Loef

Jrnl: Solar Age, V 1:28-30, N12, Dec. 1976

Questions and answers from a veteran of over 30 years in solar energy and a pioneer in flat-plate air collectors are presented. The emphasis is on air-cooled collectors with pebble bed heat storage which is considered to be durable and maintenance-free. Some questions are aimed at overall trends in the field.

ST78 11082 NEES Finds the Jury is Still Out on Solar

Jrnl: Electr. Light Power, Boston, MA, V 55:39, N7, July 1977

Preliminary findings of the New England Electric System (NEED) indicate that solar water heating for the residential sector is not yet competitive, but may become so as installation costs are lowered. NEES feels the biggest threat to solar energy development may be overrated public expectation. The water heater test involved 100 customers using four types of systems: Direct water draindown, a closed-loop with freezable collector, an antifreeze loop, and air to water. The units were retrofitted to existing homes at a cost of $200 to the customer and $375,000 total cost to NEES. Information on water and power usage was collected and processed weekly. Design problems and equipment failure kept energy savings below the anticipated 50 percent, ranging instead from less than 5 to 37 percent and averaging 17 percent. Most of the design problems, such as drainage, freeze-up, leakage, and noise are felt to be correctable. Payback periods have been extended upward to 20 years, but the time is expected to shorten as installation problems are resolved. The study recommends emphasizing energy conservation, strong supply and service, training programs for installers, a system of standards, regulations and guarantees, and consumer caution.

ST78 11083 New Energies: Solar Energy

Service D'Information et de Diffusion, Paris, France, 1976, In French

A brochure is presented whose objective is to disseminate as clearly and simply as possible the present status of information on solar energy. The topics discussed are the characteristics of solar energy and the meteorological factors affecting it, use of solar energy for heating, the solar motor, thermodynamic and photovoltaic methods of producing electricity, biological conversion, photochemistry and solar thermochemistry, and wind energy.

ST78 11084 Proposed Objectives for a Solar Energy Development Program in Illinois

Illinois Dept. of Business and Economic Dev., Springfield, IL, Div. of Energy
Avail:NTIS, NP-22131 March 1975

The purpose of the Illinois Solar Energy Program is to develop the state's maximum capability for solar energy technology as soon as possible, thereby diversifying their energy base consistent with economic reasonableness and technological feasibility. The program will provide coordination of the state's efforts with those of the federal government and the private sector. This will be done to maximize productivity and minimize duplication of research and development effort. This document outlines the general areas of activities proposed under the Illinois Solar Energy Development Program and invites response from all interested parties within the state of Illinois. The input from all sectors will be evaluated and developed into a comprehensive solar energy implementation plan for the state. Public hearings will be held prior to finalizing this program.

ST78 11085 Prospects For Solar Energy Use in Dealing With the Critical Energy

Jrnl: Environ. Sci. Tech., V 7:581, N7, July 1973

Present technology can apparently furnish solar heating for less cost than electric heating throughout most of the US by 2000, enough solar energy should be produced to supply 35 percent of the energy needed for the heating and cooling of buildings and the equivalent of 30 percent of the US gas fuel needs, 10 percent of its liquid fuel needs, and 20 percent of its electrical energy requirement.

ST78 11086 Public Service of New Mexico: Solar Energy is Coming up Strong

Jrnl: Business Week, P. 134, March 20, 1978

No abstract available.

ST78 11087 Solar Energy Prospects Grow for US Southwest

Jrnl: Energy Int., V 14:17-21, 32, N6, June 1977

A combination of large energy load centers located in the American Southwest, the technical resources for developing solar energy, a new awareness of the sun as a renewable energy source, and dwindling supplies of oil and gas makes mass application of solar power increasingly attractive for that portion of the country. Three possible development routes are direct application, power generation, and indirect use through biomass. Direct applications for space and water heating and air conditioning in residences and public buildings are under study. Trinity University in Texas, with the help of an ERDA grant, is developing viable solar air conditioning systems. Solar demonstration houses using flat-plate collectors have been shown to benefit both the homeowner and the utility, which is spared peak domestic loads. Solar power generation projects favor the tower concept of generating steam by concentrating heat at a central tower by the use of tracking mirrors. A reverse concept, the distributed collector system with movable receivers, offers another alternative. Incorporating solar plants and storage facilities into conventional utility networks is also under study. Siting of solar power stations is most practical in the lightly populated southwest. Financial incentives are expected to act as a catalyst in the development of solar energy.

ST78 11088 Solar Energy, Report Bibliography, Jan. 1955-Dec. 1976

Defense Documentation Center, Alexandria, VA
Avail:NTIS, AD-A-038600 April 1977

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.

ST78 11089 Solar Engineering: Activities in the Field of New Technologies

Jrnl: Dornier-Post, Engl. Ed., V 1:5, 1977, In German

A brief survey is presented of activities by the firm of Dornier System GMBH in the field of solar engineering. Fields of work are solar water and space heating, solar sea water desalination, solar cooling, solar electricity generation, solar pump, and solar air conditioning.

ST78 11090 Solar Program Assessment: Environmental Factors

ERDA, Div. of Energy, Washington, D.C.
Avail:NTIS, N78-14681 75 p.

The major environmental issues associated with the further development of solar thermal electric (STE) systems are presented. The basic concepts of the technology are reviewed, as are its economic and resource requirements. The potential effects of this new technology on the full range of environmental concerns (i.e., 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 STE 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 problems unique to the solar portion of the technology are discussed in depth. Finally, an environmental work plan is presented, listing research and development proposals and a National Environmental Policy Act (NEPA) work plan which might help clarify and/or alleviate specific environmental problems.

ST78 11091 Solar Total Energy Lectures

Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-76-9225 1976

The lectures presented describe some of the calculations and experiments under way in the US to determine the feasibility of various types of solar systems. Economic studies continue to say systems are not economical. Other studies reveal a series of tax policies and incentives which favor consumption of fuels over capital investments in any form of capital intensive fuel substitutes. The true cost after taxes of fuels is the most powerful leverage to make solar power either economical or noneconomical.

ST78 11092 Successfull Second Conference of DGS

DGS' GSSEU Conf., Oct. 1976, Stuttgart, Germany
Jrnl: Mitteilungsbl. Dtsch. Ges. Sonnenenergie, V 1:18-23, N6, Nov. 1976, Brief Survey of Conf.

The article presents a brief survey of the second meeting of the "Deutsche Gesellschaft Fuer Sonnenenergie E.V. (DGS)," held in Stuttgart in October 1976. The main lectures were concerned with the following subject groups: solar-thermal collectors, selective layers, corrosion problems with collectors, the use of plastic for collectors, photovoltaic conversion, latent heat accumulators.

ST78 11093 Survey and Analysis of Small Business and Minority Business Enterprise Participation in Solar Energy Procurement Activity

ERDA, Washington, D.C., Div. of Solar Energy
Avail:NTIS, DSE/4033-1 Feb. 1977

The findings of a survey of small business and minority business enterprise participation in solar energy programs as a result of procurement actions by the Energy Research and Development Administration, Division of Solar Energy, and subcontract actions by solar energy prime contractors for Fiscal Year 1976 and the transition quarter (FY76 and TQ) are presented. Also, information about awards made to Small Business-Minority Business Enterprise (SB/MBE) by other federal agencies during the same period is provided. The primary findings of this survey indicate that $6.7 million of a total $94.3 million solar energy outlay, for FY76 and the TQ, was allocated to small business in the form of prime contracts. Another $16.6 million was subcontracted to Small Business/ Minority Business Enterprise (SB/MBE) by solar energy prime contractors during this period. This represents a total of $23.3 million solar energy dollars contracted and subcontracted to SB/MBE's or 24.7 percent of the $94.3 million solar energy outlay during FY76 and the TQ.

ST78 11094 The Selling of the Sun: Doodads or Commodity?

Jrnl: Audobon, V 80:224, Jan. 1978

No abstract available.

ST78 11095 The Sunny Side of Energy: Solar Energy Conversion

Avail:AIAA, A78-13800 Jrnl: Energy Developments, V 1:7-10, Oct. 1977

A description is presented of developments related to a conversion of solar heat to mechanical and electrical power. A 10-kw solar generator (electric) system developed by a German company is based on the operation of a cold vapor turbine with the low-temperature heat (90 to 140 C) of solar collectors. The generator has been installed in Cairo, Egypt, for a study under realistic conditions. Other developments reported make use of parabolic cylindrical collectors for concentrating the incident solar radiation onto a focus line containing an abosrber tube. It is believed that in countries with suitable meteorological conditions solar energy plants will be able in 10 to 20 years to generate electrical power at competitive prices, if appropriate series-production techniques are developed.

ST78 11096 US, Israel Agree on Solar Exchanges

Jrnl: Electrical World, V 189:26, Feb. 15, 1978

No abstract available.

ST78 11097 Use of Solar Energy 1977: State-of-the-Art, Experiences, and Aspects

Ante, B.
Batelle-Institut E.V., Frankfurt Am Main, Germany, F.R.
Avail:NTIS, AED-CONF-77-027-007 1977, In German

Starting from a general survey of questions of energy policy and availability of energy, the author discusses energy sources that are likely to play an important part in energy supplies, especially converters for solar energy. The level of development and the future prospects of solar systems are reported on. The situation on the market for solar systems is also discussed.

ST78 11098 Solar Energy: Perspective and Prospects

Bos, P.B.
EPRI, Palo Alto, CA
Am. Power Conf., 1976
Avail;NTIS, 78C0032442 Jrnl: Proc. of Conf., V 38:447-457

With solar energy promising to supplement the nation's energy resources, its prospects are reviewed. The federal government through NSF and subsequently through ERDA, has been supporting solar research. Also, the utility industry has been supporting research through EPRI. The program at EPRI is summarized briefly. Technology reviews and assessments of solar heating and cooling, solar electric power generation, wind energy conversion, ocean thermal energy conversion, photosynthesis of biomass, and environmental impacts are included. It is concluded that large-scale utilization of solar applications for electric power production is not anticipated before the year 2000. Competitive energy costs must be demonstrated, requiring major cost reductions in collectors, reflectors, or photovoltaic arrays, as well as long system life-times of 15 to 30 years. Solar energy systems must be assessed under the same conditions of reliability as conventional power systems.

ST78 11099 Relative Cost-Performance of Various Solar-Based Power Supply Packages

Begemann, S.H.A.; Jansen, P.
Philips' Gloeilampenfabrieken, Philips Res. Labs., Eindhoven, Netherlands
Avail:AIAA, A78-10557 Jrnl: Acta Electronica, V 20:197-204, N2, 1977

A computer simulation technique was used to compare several solar-based power supply systems for applications requiring daily availability of fixed, limited number of kilowatts. In addition to storage batteries, the power supply systems evaluated involved one or more of the following components: photovoltaic cells, wind generators, or conventional electric generators. The simulations were conducted for climates having various levels of insolation and wind availability. The costs of the systems were compared; it was concluded that in areas with much sun and medium levels of wind, solar cell systems could become competitive with wind and conventional systems if photocell costs decrease somewhat.

ST78 11100 Solar Option

Bell, C.R.; Jager, F.
Jrnl: Options (IIASA), p. 1-4, Summer 1977

The International Institute for applied systems analysis reviews the costs and benefits of the solar energy options to see where they can realistically be applied. Climate is basic to the efficiency and cost of solar energy, with direct radiation more useful than indirect radiation. An outline of solar technology includes the use of heliostats, photovoltaic arrays, and solar-thermal-electric concepts (STEC) and their market feasibility. The report concludes that high capital costs and the vast amount of land needed to collect solar radiation will make it non-competitive as fuel prices rise. In regions requiring large amounts of low-grade heat, a solar economy could result in disruptive shifts of materials and manpower. Market sensitivity analyses indicate that a faster breakeven point, lower capital requirements, improved system efficiency, and a program of government subsidy are needed to take the solar option beyond test programs to widespread implementation.

ST78 11101 Solar Energy Task Progress Report for 1975/76: Evaluation of Solar Energy Options

Bell, C.R.
IIASA, Laxenburg, Austria
Avail:NTIS, IIASA-RM-77-20 May 1977

Solar options are evaluated as a potential source for meeting future energy-supply requirements. Emphasis is on contemporary concepts in the solar-thermal and photovoltaic systems and their space, as well as economic constraints. The range of uncertainties during this formative stage of solar technology is shown in typical examples of performance and cost estimates. The broad spectrum of assessed information is synthesized and condensed for general information as an interim report. The fundamental trends of the continuing efforts in the subject field are identified.

ST78 11102 Solar Energy as an Alternate Energy Source to Mixed Oxide Fuels in Light Water Cooled Reactors

Bertini, H.W.
ORNL, Oak Ridge, TN
Avail;NTIS, ORNL/NUREG/TM-131 June 30, 1977

Supplemental information pertaining to the generic environmental impact statement on the PU recycling process for mixed oxide light water-cooled reactors (GESMO) was requested from several sources. In particular, the role of alternate sources of energy was to be explored and the implications of these alternate sources to the question of PU recycle in LWRS were to be investigated. In this vein, solar energy as an alternate source is the main subject of this report, along with other information related to solar energy. The general conclusion is that solar energy should have little effect on the decisions concerning GESMO.

ST78 11103 Building Regulations, Planning of Building Constructions and Housing Development Areas Taking into Account the Utilization of Solar Energy

Bierhals, R.; Schaffer, G.; Weigert, D.
Fraunhofer-Gesellschaft Zur Foerderung der Angewandten Forschung E.V., Karlsruhe, Germany, F.R., Inst. Fuer Systemtechnik und Innovationsforschung
Avail:NTIS, AED-CONF-77-027-003 1977 In German

Complete systems for utilizing solar energy both for hot water preparation and for space heating are available in the FRG today. However, solar technology is unlikely to prevail without governmental support since the plants are still too expensive, although there is a principal positive attitude towards solar energy. More knowledge of the process of solar energy utilization is necessary both in the field of building laws, and for building enterprises, architects and planners, if this new form of energy is to succeed.

ST78 11104 Materials and Energy From the Sun

Calvin, M.
Univ. of California, Berkeley, CA
Avail:AIAA, A78-14025 Jrnl: Sunworld, p. 2-6, Aug. 1977

Attention is given to using the green plant as a solar energy collector device noting various types of plants having such potential. A Brazilian project producing ethanol from sugar cane is discussed along with the hydrocarbon storage capacities of such rubber-producing plants as Hevea Brasiliensis and Guayule. Latex-producing plants (including Euphorbia Tirucalli, Asclepias, and Euphorbia Trigona) are described in terms of their possible cultivation under arid or semiarid conditions. Methods for latex hydrocarbon analysis are presented along with the preliminary results of an experimental planting project. Practical approaches for the use of hydrocarbon as a crude oil are identified, including refining processes and the utilization of the plants as both collectors of sunlight and producers of compounds.

ST78 11105 Solar Energy Utilization and its Effect Upon Land Use and Urban Planning

Carella, V.A.
Univ. of California, Irvine, CA
Avail;NTIS, 78C0035992 Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Inc., Elmsford, NY

Solar energy utilization will have an effect upon land use and urban planning. The implications and effects of large and small-scale solar energy development on legislation, comprehensive plans, zoning, local codes, and personal and community attitudes towards building designs, siting, and aesthetics are considered. Regional impacts are also considered. The large land areas required for the large-scale power plants are discussed. Also considered are the growth-inducing aspects of such systems along with the environmental effects. Solar energy on a smaller scale is also discussed. The small-

scale development is viewed from the building of new communities with Solar Energy, Incorporated from the beginning to the retrofitting of older communities. Sun rights and solar easements are considered along with other controls to aid a landowner in gaining access to sunlight, such as local regulations of building codes, height regulations, setback and landscape provisions, and general zoning. A consideration of land-use planning of larger areas and their interrelationships is included.

ST78 11106 Advancing Solar Energy in the Southeast Through Education and Training

Clarke, F.J.; Fausett, J.G.; Tate, R.C.
Georgia Inst. of Tech., Atlanta, GA
1977 Annual Mtg. of ASISES
Avail:NTIS, 78C0035969 Jrnl: Proc. of Mtg., V 1, Secs. 26-38, ISES, Cape Canaveral, FL

The demand for trained personnel to work in energy is expected to grow rapidly as the national energy plan is implemented. Educational and training resources to meet this demand exist but better delineation of roles and coordination of the use of facilities is necessary. Georgia has developed a pilot program for the southeast utilizing a technical university, a technical institute, and a vocational technical school. Program emphasizes energy conservation and solar energy while providing entries to careers at several levels of competence. Provision is made for interaction between members of ISES and the program.

ST78 11107 New Danger: Solar Ripoffs, Beware of Fly-By-Nighters

Coffee, F.
Jrnl: Mechanix Illustrated, V 74:70, Feb. 1978

No abstract available.

ST78 11108 Solar Energy Research in Iran

Dabiri, A.E.
Arya-Mehr Univ., Tehran, Iran
Avail:NTIS, 78C0001454 Jrnl: Heliotechnique and Dev., V 2:1976, Dev. Analysis Assoc., Inc. Cambridge, MA

This paper presents the current status of solar energy research and development in Iran as well as the programs envisaged for the future. The following major areas are being pursued: (1)thermal processes for domestic applications, including development of flat-plate and concentrating collectors, solar water heating, space heating, and air conditioning systems; (2)solar cells development for use as the prime energy source in remote telecommunication transmission stations; and (3)water desalination and hydrogen production with solar energy.

ST78 11109 Some Recent Domestic Solar Energy Systems in Europe

De Comelli, G.
Universita de Trieste, Trieste, Italy
17th ISTS Conf., March 25,26, 1977, Rome, Italy
Avail:AIAA, A78-12909 Jrnl: Proc. of Conf., p. 443-453, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, Rome, Italy

Solar space heating, air conditioning, and domestic hot water systems in a dozen experimental domestic solar energy facilities constructed in Europe since 1970 are discussed. Solar collection type, the heat transfer fluid employed, heat pumps, and the accumulation systems for the facilities are compared.

ST78 11110 A Fluidized Bed Solar Reactor: A Thermochemical Application

Flamant, G.; Bonet, C.; Hernandez, D.; Traverse, J.P.
CNRS, Laboratoire des Ultra-Refractaires, Odeillo, Pyrenees-Orientales, France
Avail:AIAA, A78-20623 Jrnl: Cooperation Mediterraneenne Pour L'Energie Solaire, Revue Internationale D'Heliotechnique, 2nd Quarter, p. 39-43, 1977, In French

The design of a fluidized bed thermochemical reactor powered by a two-kw solar furnace is described; the reactor may provide a means for storing solar energy through application of solar power to such processes as the generation of hydrogen from the thermochemical decomposition of water. The projected reactor employs fluidized silica particles. As a sample process, the thermochemical decomposition of $CaCO_3$ is considered.

ST78 11111 Proposed Standard for AM1 Sunlight

Hadley, H.Jr.
NASA, Lewis, Cleveland, OH
Avail:NTIS, NASA-TM-X-71802 1975

It is proposed that for evaluating solar simulators the characteristics of terrestrial sunlight be as defined by a curve of global radiation calculated in the manner used by gates from a well-defined AMP spectral distribution and a "standard atmospheric" containing specified amounts of the scattering and absorbing materials. The AM1.0 global curve for these conditions is shown and has an integrated flux of 91.7 milliwats/cm^2. The tabulated energy distribution is given.

ST78 11112 Program to Develop Low-Cost Solar Energy Utilization in New Mexico

Haggard, K.W.
NMSEA, Santa Fe, NM
NM ERDA

The NMSEA has arisen as one of New Mexico's primary media by which low and intermediate solar technology has been disseminated to the general public. This proposed program is designed to expand the scope and increase the reach and frequency of the activities conducted by the NMSEA. The primary areas of this program are (1)general administrative and informational operations, (2)practical demonstration and outreach efforts, and (3) advisory service to state administrators. The emphasis of this program is on the dissemination of information on low-cost solar applications and energy-conserving practices at the people level. This program will substantially aid New Mexico in the development of the widespread use of this renewable energy source.

ST78 11113 Solar Energy Research: Making Solar After the Nuclear Model?

Hammond, A.L.; Metz, W.D.
Jrnl: Prof. Engng., Washington, D.C., V 47:24-30, N9, Sept. 1977

After five years of rapid but uneven development, solar energy is in need of reassessment. The present federal program has been as much the product of institutional happenstance and various technical predilections as it has been the product of coherent planning. Many solar technologies already work, even though the best designs have not yet been found, and they are already facing the economic challenges that other long-range energy options have yet to confront. It is arguably time to reconsider solar priorities and ask whether the distribution of research resources among nuclear, fossil, and solar options reflects a rational policy.

ST78 11114 Aurinko Suomen Energialahteena: Sun as a Source of Energy in Finland

Hassi, O.
Tempere Tek. Korkeakoulu, Tampere, Finland
Jrnl: Sahko, V 50:219-222, N7-8, July-Aug. 1977, In Finnish, 9 refs

The article demonstrates how the power density of insolation on the earth's surface depends on the degree of latitude, season, and the time of day. The variation in diurnal energy density as a function of season is examined at the equator, in Tampere, Finland, and at the North Pole. The energy absorption capacity of photosynthesis and solar batteries in Finnish conditions is also examined.

ST78 11115 Sun as an Alternative Resource

Hauer, C.R.
NSF, Washington, D.C.
Avail:NSF Cary Arboretum of the New York Botanical Garden, Millbrook, NY, 1976

The paper emphasizes that we must start using solar energy, that conservation measures will only help us to remain economically viable over the next few years. However, in the final analysis, we must use fuels or techniques that capture sunlight so that we can use it efficiently in our economy. The first step is to allow the sunlight to warm a black surface, and to use the heat through a working fluid, either air or water of mixtures of air and water and ethylene glycol, and to have this perform useful work. It is apparent, though, that first solar energy utilization measures must become cost competitive. The author then sums up the necessary conditions and constraints that have to be overcome to accomplish this.

ST78 11116 Review of Overseas Solar Technologies Relative to International Cooperation

Herwig, L.O.
ERDA, Div. of Solar Energy, Washington, D.C.
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11367 Jrnl: Proc. of Mtg., Secs. 26-38, p. 30-6--30-11, ISES, Cape Canaveral, FL

A brief review is presented of the overseas interests and activities in solar technology and cooperative programs and of the increasing cooperative relationships between the US and various other countries. A more detailed review of overseas interests and cooperation in small solar thermal power systems is presented to illustrate the broadening interest in some technologies. In particular, technologies as developing in Japan, the USSR, France, Germany, and other countries are summarized. Those technologies with greatest international interest include water and air heating for varied uses, heating and cooling of space for residential, commercial, and industrial use; pumping of water for general uses and for irrigation; and production of electricity by smaller power systems including solar thermal, photovoltaic, and wind systems.

ST78 11117 Solar Energy Implementation Centers

Hirshberg, A.S.
Booz, Allen, and Hamilton, Bethesda, MD
1977 Annual Mtg. of ASISES
Avail;NTIS, 78C0035971 Jrnl: Proc. of Mtg., Secs. 26-38, V 1, ISES, Cape Canaveral, FL

Solar space and water heating are currently technically feasible and nearly economically competitive (with conventional fuels). However, widespread use will not automatically occur when the economics becomes competitive, in part because of the characteristics of the building industry. An implementation center designed to interact with consumers and the building industry will speed the use of solar heating and cooling. To be effective, the centers should be regional and provide communication both to the building industry and to solar researchers and manufacturers. The centers should also provide information to potential users and evaluate solar projects. Two implementation centers could be funded at about $2 million each for a state the size of California through a small tax on natural gas and electricity sales.

ST78 11118 Design Options in Solar Total Energy Systems

Hoffman, A.A.J.; Rapp, D.
Texas Christian Univ., Fort Worth, TX
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11346 Jrnl: Proc. of Mtg., Secs. 14-25, p. 24-16--24-19, ISES, Cape Canaveral, FL

A solar total energy system consists of a collector field which converts solar radiation to thermal energy in a working fluid which in turn drives a heat engine. Shaft power from this engine drives a mechanical electrical generator, while exhaust from the heat engine is used for such applications as space heating, domestic hot water, and process heat. Cooling can be accomplished by electrically driven compression chillers or thermally driven absorption chillers. This paper discusses a multitude of subsystem options and their effects on the overall system. Such options include choices of type of concentrator, reflecting surfaces, tracking method, alignment (i.e., EW vs. NS), working fluid, temperature, receiver, field size, storage (arrangement, type, capacity), heat engine capacity and type (steam or organic rankine), heat exchangers controls, and methods of cooling (compression and absorption). Based on the experience of the authors, this paper discusses the implications of these options on the efficiency, economy, and safety of the system.

ST78 11119 Environmental and Safety Implications of Solar Technologies

Holmes, J.G.; Baluss, J.E.; Mihlmester, P.E.; Miller, S.G.; Super, T.L.; Thomasian, J.B.
Energy and Environmental Analysis, Inc., Arlington, VA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11360 Jrnl: Proc. of Mtg., Secs. 26-38, p. 28-5--28-9, ISES, Cape Canaveral, FL

A series of environmental reviews prepared for ERDA's Division of solar energy and environmental analysis is summarized. A survey is presented of the environmental impacts of the following ERDA-funded solar technologies: heating and cooling, solar thermal electric, total energy systems, industrial-agricultural applications, photovoltaic conversion, wind, ocean thermal, and biomass energy conversion.

ST78 11120 Impact of Solar Energy on Electric Utility Generation System Reliability and Operations

Jordan, G.A.; Moisan, R.W.; O'Brien, G.P.
GE Co., Schenectady, NY
Avail:NTIS, CONF-770403-3 1977

Generation system reliability and operations with photovoltaic electric power systems on the electric utility system were discussed. Over the years, the utility industry has developed a methodology to evaluate conventional thermal generation consisting of system reliability and production cost calculations. Although these methods might have to be modified slightly, it is important that new forms of generation be evaluated in a consistent manner. How these modifications can be accomplished to handle an intermittent power source such as solar photovoltaic power plants was shown. Results were presented which illustrate the usage of this approach. Applications of this method, when coupled with assessments of capital cost requirements will yield estimates of photovoltaic electric power system value in actual utility systems.

ST78 11121 Solar Technology and the Developing Countries

Kara, K.M.; Tabet-Aoul, M.
Institut Hydrometeorologique de Formation et de Recherches, Oran, Algeria
Avail:NTIS, 78C0001452 Jrnl: Heliotechnique and Dev., V 2, 1976, Dev. Analysis. Assoc., Cambridge, MA, In French

The promotion of solar technology in a developing country proceeds by taking into consideration three essential factors which are: the pressure of the proprietary needs of the country in the base sectors of the economy such as agriculture, industry, energy, environmental protection, and evaluation of arid and semi-arid zones; the degree of sensitivity of the national authorities to the consideration of the economic role of solar technology; and the setting up of appropriate structures and organization for solar technology in the country and ways of organizing a professional corps with all categories.

ST78 11122 Fusion and Solar Energy: Potential Alternative Energy Sources

Kemeny, L.G.
Avail:NTIS, CONF-7605161 Jrnl: Engineering, 1976-2001, 1976

The present status and future prospects of fusion and solar energy sources are critically reviewed in terms of technology and economic prospects. In the case of thermonuclear fusion, the technology of magnetically and inertially confined fusion systems is discussed and future prospects for successful power generation are assessed. Consideration is given to the possible hybrid combination of fusion and fission systems. While conclusions concerning economic power generation are bound to be somewhat speculative, it is estimated that fusion techniques are unlikely to be competitive with fast breeder reactor systems before the end of the century unless the cost of superconducting magnets can be reduced by a factor of twenty to thirty. For inertial confinement systems, this "break even" figure with fission technology will come when laser light is at least 30. The potential utilization of the solar energy source through biological and photochemical conversion is reviewed. Despite the many appealing aspects of solar energy conversion cycles, it is projected that by the year 2000 it will be providing the world with less than 10 percent of its solid, liquid, and gaseous fuel requirements.

ST78 11123 Hydel and Solar Power for Pakistan

Khan, M.I.
Univ. of Engng. and Tech., Lahore, Pakistan
Avail:NTIS, 78C0001667 Jrnl: Heliotechnique and Dev., V 2, 1976, Dev. Analysis Assoc., Inc., Cambridge, MA

This paper reviews the energy resources of Pakistan, and makes projection for future needs. If Pakistan is to implement its development plans and increase energy self-sufficiency, it should develop its two principal energy resources: hydel and solar.

ST78 11124 National Solar Heating and Cooling Information Center

Lifsey, J.A.
NSHCIC, Philadelphia, PA
1977 Annual Mtg. of ASISES
Avail:NTIS, 78C0035968 Jrnl: Proc. of Mtg., Secs. 26-38, V 1, ISES, Cape Canaveral, FL

Under the provisions of the Solar Heating and Cooling Demonstration Act of 1974, a National Solar Heating and Cooling Information Center was established in 1976 by the Department of Housing and Urban Development, in corporation with the Energy Research and Development Administration. The mission of the center is to disseminate information about the practical feasibility of using solar energy regarding solar heating, hot water, and cooling systems in homes and buildings, and to accelerate the development of the building market. The means by which the center aims to achieve these goals and what has been done to date are described.

ST78 11125 Solar Energy Source Book

Solar Energy Inst. of Am., Washington, D.C.
Jrnl: Cat. of Products and Services, 1977

An organized compilation of solar energy related products and services is provided for the building owner and solar building industry. The categories, products, and services are each subdivided into three sections: (1) the catalog, (2) a listing by state, and (3) a listing by title. There is a section on taxes and tax breaks related to a solar system in various parts of the country, a glossary to explain new terms, and descriptive passages to answer questions about facets of the solar energy field. The material presented was either supplied by or abstracted from information received from the companies and service organizations.

ST78 11126 Solar Energy Development

Marvin, H.
ERDA, Washington, D.C.
Nat'l Energy Forum, 1976
Avail:NTIS, 78C0035976 Jrnl: Proc. of Forum, Univ. of Akron, Akron, OH

The US ERDA Solar Energy Research, Development, and Demonstration Program is described. Direct thermal applications, fuels from biomass, and solar electric conversion (including wind energy, photovoltaic, solar thermal electric, and ocean thermal energy) are discussed.

ST78 11127 Solar Energy on the Road to Practical Use: "Domestic Use" may be Possible in Five Years

Matthoefer, H.
Bundesministerium Fuer Forschung und Technologie, Bonn, Germany, F.R.
Jrnl: Beratende Ing., V 1:16-20, N2, 1976, In German

The state of development in the FRG is described in a general manner and explained by means of three complete test systems (Experimental House Aachen, Solar House Essen, Open-Air Bath Wiehl).

ST78 11128 Some Chemical Aspects of Solar Energy Utilization

Mattox, D.M.
Sandia Labs., Albuquerque, NM
Jrnl: J. Solid State Chem., V 22:31-39, N1, Sept. 1977, 32 refs

This paper asserts that for solar energy to have significant impact on the energy economy of the United States, hundreds of square miles of solar collectors will have to be constructed. The chemistry of materials fabrication and stability will have an important role in the economics of collector fabrication and service life. A review is presented for some of the material aspects of the materials involved and the environments to which they are exposed. In many cases, few data are available on the applicability of materials to solar applications.

ST78 11129 Hydro-Sol: A Forward Looking Energy Model for Currently Hydro-Sufficient Provinces and States

McKee, J.S.C.
Univ. of Manitoba, Winnipeg, Canada
Jrnl: J. Environ. Sci. Health, Part A, V 12:393-400, N8, 1977

Hydro-Sol, an integrated and solar power system, offers a model for using water power and solar conversion to augment local energy self-sufficiency while more research is conducted to make nuclear energy safer. The model takes advantage of the current

capability for efficiently converting solar energy to electrical energy and allowing hydro power to be stored. Examples are drawn of how systems can benefit by using solar power to supply electricity to the power grid during periods of high demand, while the continued storage of water in reservoirs and lakes adds no cost to the system. States and provinces that already have energy self-sufficiency can benefit most from this kind of power-augmentation system.

ST78 11130 An Overview of Where Solar Energy Stands: Seven Percent of Our Energy by the Year 2000

McKelvey, J.
Jrnl: Vital Speeches, V 44:165, Jan 1, 1978

No abstract available.

ST78 11131 Sun Power: An Introduction to the Applications of Solar Energy

McVeigh, J.C.
Book, Pergamon Press, Inc., New York, NY, 1977

The following chapters are included: Historical Background; Solar Radiation; Water and Air Heating Applications; Space Heating Applications; Thermal Power and Other Thermal Applications; Methods of Economic Analysis; Photovoltaic Cells, Biological Conversion Systems, and Photochemistry; Wind Power; and Some Practical Heating Applications. A glossary is also included.

ST78 11132 Solar Energy in Switzerland

Mueller, R.E.
Office Federal de L'Economie Energetique, Berne, Switzerland
Avail:NTIS, 78C0001458 Jrnl: Heliotechnique and Dev., V 2, 1976, Dev. Analysis Assoc., Inc., Cambridge, MA, In French

This paper describes the research and development efforts in the area of heat production by solar energy undertaken on both the government level and on the private enterprise level. The most recent Swiss projects on the production of mechanical or electrical energy are also included.

ST78 11133 Lifestyle Implications of Decentralized Solar Energy

Okagaki, A.
Center for Sci. in Public Interest, Washington, D.C.
Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Inc., Elmsford, NY

Decentralized applications of solar technologies can be integrated into community structures and life-styles that are radically different than the conventional American life-style. It is argued that for environmental and sociological reasons, it would be wise to explore alternative communities and life-styles based on "appropriate" or "intermediate" technologies such as decentralized solar power. A federal program to support this kind of exploration is proposed.

ST78 11134 Methodology for Assessment of Need for Solar Trained Skilled Workers

Orsak, C.G.; Morehouse, J.H.; Gibson, H.J.; Barnstone, R.
Navarro College, Corsicana, TX
1977 Annual Mtg. of ASISES
Jrnl: Proc. of Mtg., Secs. 26-38, V 1, ISES, Cape Canaveral, FL

A methodology is presented for assessing the qualitative and quantitative need for trained manpower in the solar energy industry. The assessment procedure described is presently being used in the Navarro College (Corsicana, Texas) study to determine the need for technician training in solar equipment maintenance and installation. The methodology consists of a coordinated initial effort by three separate working groups: an equipment group, a market penetration group, and a skills analysis group. The final solar manpower needs assessment is to be formulated from the combination of the results from the three initial working groups. Additional information on the specific objectives of each of the working groups, and their operational procedure, is presented.

ST78 11135 Technical and Socio-Economic Aspects of Solar Energy and Rural Development in Developing Countries

Ramakumar, R.
Oklahoma State Univ., Stillwater, OK
Avail:AIAA, A78-16829 Jrnl: Solar Energy, V 19:643-649, N6, 1977

No abstract available.

ST78 11136 Solar Energy and Congress: Program Budget Appropriations

Rice, W.L.R.
ERDA, Office of Congr. Relations, Washington, D.C.
Avail:AIAA, A78-16828 Jrnl: Solar Energy, V 19:631-641, N6, 1977

The background of the US Solar Energy Program is examined. It is pointed out that during the period from 1950 to 1970, federal support of solar energy research and development averaged about $100,000 per year. In Fiscal Year 1971, $1 million were allocated to research project grants for solar energy terrestrial applications. Federal funding of solar energy has subsequently risen to an annual rate of $115 million for 1976. Aspects of program planning and budgeting are considered and questions related to the Congressional funding of solar research are examined, taking into account the budget process, 1977 solar budget, budget projections, and a program assessment. Attention is also given to Congressional oversight hearings, legislative proposals, the value of internal budget data, and Congressional actions.

ST78 11137 Solar Power Stations

Rodot, M.; Etievant, J.-C.; DeFlandre, J.; Peube, J.-L.
CNRS, Paris France
Avail:A78-17673 Jrnl: La Recherche, V 8:1038-1048, Dec. 1977, In French

The use of solar energy is considered with reference to existing and planned large-scale solar energy systems. The technology of optical systems is studied, and the Odeillo Project is examined as an example of an optical system. The Sofretes Power Stations, which use a less common thermal approach, are also described. It is noted that present stations are less than 20 percent efficient. The development of new technologies to utilize solar energy is discussed.

ST78 11138 Fundamentals of Solar Energy Survey Development

Salieva, R.B.
Electrotechnical Inst. for Communications, Tashkent, USSR
Jrnl: Appl. Solar Energy, Engl. Trans., V 12:45-57, N6, 1976

The principles involved in developing a solar-energy survey are considered. The survey is based on construction of a mathematical model whose parameters, with certain natural-availability standards, might be used to determine the useful output of a solar energy plant of any design and to validate the effectiveness and desirability of plant utilization for a particular local topography. Here the mathematical model is considered from the viewpoint of the theory of random processes. Modelling algorithms are given, together with their digital-computer realization. The final result is represented in the form of computational tables that may be used to determine the useful output and installed capacity utilization coefficient for plants of any design.

ST78 11139 Solar Electric Energy Market Penetration

Sarin, R.K.; Nair, K.
Woodward-Clyde Consultants, San Francisco, CA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11362 Jrnl: Proc. of Mtg., Secs. 26-38, p. 28-13--28-17, ISES, Cape Canaveral, FL

A Bayesian approach was employed to forecast the solar electric market penetration by the years 1990 and 2000. The study identified a multitude of factors, including relative cost of competitive energy systems, government incentives, future environmental regulations, and new technologies, that would affect the solar market share. The judgments of several experts from utility companies, government agencies, and research laboratories were utilized in a systematic manner to quantify the probability distributions of future solar market share as a function of the various factors. The likelihood of the occurrence of these factors was also assessed, and the solar market share was forecasted for the most-likely future scenarios.

ST78 11140 Preliminary Environmental Assessment of Solar Energy Systems, Final Report

Sears, D.R.; McCormick, P.O.
Lockheed Missiles and Space Co., Huntsville, AL
Avail:NTIS, N78-16465 134 p.

The environmental consequences of three kinds of solar energy utilization photovoltaic concentrator (steam electric) and flat-plate are addressed. The application of solar energy toward central power generating stations was emphasized. Discussions of combined modes and of the geosynchronous satellite generating stations are included.

ST78 11141 Solar Energy Research in European Communities

Strub, A.
CEC, Brussels, Belgium
Avail:NTIS, AED-CONF-77-027-005 1977 In German

The article gives a survey of a four-year program of the commission of the European community which covers several plans to improve the utilization of solar energy. The amounts used in the countries of the community for solar energy research are shown. The following central points are supported from the technical point of view: (1)flat-plate collectors and their use in buildings, (2)thermal solar power plants, (3)photoelectric conversion, (4)photochemical and photobiological processes, (5)bioconversion, and (6) collection of data on solar radiation. Finally, organization and management of the EC solar research program are reported.

ST78 11142 Solar Energy Utilization in Tropical and Subtropical Areas

Suttor, K.H.
Kraftanlagen A.G., Heidelberg, Germany, F.R.
Avail:NTIS, 78C0030336 Jrnl: Elektrowaerme Int., Ed. A, V 35:212-216, N4, July 1977, In German

The author describes the climatic conditions in tropical and subtropical areas and the prospects for utilization of solar energy which, as thermal energy, can only partially be transformed in mechanical and electrical energy except when using the photovoltaic principle. Basic utilization possibilities and economic aspects dominating in these countries are discussed and export chances of the German industry are outlined.

ST78 11143 Organization Chart for the Accelerated Development of Industrial Applications of Solar Energy

Touchais, M.
Comples, Marseille, France
Avail:NTIS, 78C0001836 Jrnl: Heliotechnique and Dev., V 2, 1976, Dev. Analysis Assoc., Cambridge, MA, In French

If one refers to the history of technology, it is possible to identify organization elements which would favor innovation in the area of solar technology. The solution of the energy problems is becoming pressing and it cannot be abandoned to an evolution governed by chance. An applied research structure and commercialization structure acting by feedback on research itself are proposed. Such structures should have the effect of causing a spectacular acceleration of technological process.

ST78 11144 Two Enemies of Industrial Development of Solar Energy: Simplicity and Economy

Touchais, M.
Comples, Marseille, France
Avail:NTIS, 78C0001745 Jrnl: Heliotechnique and Dev., V 2, 1976, Dev. Analysis Assoc., Inc., Cambridge, MA In French

Solar energy installations are necessarily expensive. This has led to extravagant research for simplicity and economy, but the true problem of the industrial utilization of solar energy is not posed in these terms. The most adaptable solutions are not generally simple and are independent of the proprietary research on the best investment return. These considerations are developed on the example of solar heating of homes. The necessity for the technician to be occupied first with solar techniques before preoccupying himself with commercialization is stressed.

ST78 11145 Role of Solar Energy in the Developing Countries: Prospects in Mali

Traore, C.
Laboratoire De L'Energie Solaire, Bamako, Mali
Avail:NTIS, 78C0001453 Jrnl: Heliotechnique and Dev., V2, 1976, Dev. Analysis Assoc., Inc., Cambridge, MA In French

This paper describes the studies made or underway in the Laboratoire National De L'Energie Solair of Mali. These projects include water heaters, stills, drying apparatus, solar stoves, and solar pumps as well as studies on climatization and activities for the popularization of solar processes. These projects illustrate the role and the importance that this energy can play in the group of developing countries.

ST78 11146 Possibilities of Exploiting Solar And Terrestrial Radiation in Certain Areas of the World

Trombe, F.
Jrnl: Chauffage-Vent.-Cond., V 51:9-24, N1, 1975

Capture of solar radiation with and without concentration of the radiation, and capture of terrestrial radiation are discussed with illustrative examples. Various solutions for air conditioning of buildings using solar radiation, water heating, water distillation, and ice making are discussed.

ST78 11147 Solar Energy Installations in Germany

Urbanek, A.
Avail;AIAA, A78-13455 Jrnl: Elektrowaerme International, Edition A, Elektrowaerme Im Technischen Ausbau, V 35:A297-A301, Sept. 1977, In German

About 250 solar systems for providing hot water and for heating swimming pools and buildings have been installed in West Germany during 1976. The number of installed solar systems in Germany at the end of 1977 will be about 5000. Solar heating procedures used in the case of large public swimming pools are discussed, along with the approaches employed for providing hot water. Attention is given to a use of combined systems, the employment of heat pumps, the use of low-temperature solar systems for floor heating applications, and a house in which about 80 percent of the heat requirements are provided by solar energy.

ST78 11148 Toward a Solar Civilization

Von Hippel, F.; Williams, R.H.
Jrnl: Bulletin of the Atomic Scientists, V 33:12, Oct. 1977

No abstract available.

ST78 11149 Can the Sun Replace Uranium?

Weinberg, A.M.
Institute for Energy Analysis, Oak Ridge, TN
Avail:NTIS, ORAU/IEA(M)-77-21 July 1977

Two asymptotic worlds, one based on solar energy, the other based on nuclear energy, are compared. The total energy demand in each case is 2000 quads. Although the sun can in principal supply this energy, it probably will be very expensive. If the energy were supplied entirely by breeders, the nuclear energy system would pose formidable systems problems, particularly safety and proliferation. It is suggested that in view of these possible difficulties, all options must be kept open.

ST78 11150 Florida Solar Energy Industry

Yarosh, M.M.; Beaty, K.D.; Talwar, R.
Florida Solar Energy Center, Cape Canaveral, FL
1977 Annual Mtg. of ASISES
Jrnl: Proc. of Mtg., Secs. 26-38, V 1, ISES, Cape Canaveral, FL

In 1974, the Florida Legislature established the Florida Solar Energy Center to carry out activities which would further the application and utilization of solar energy in Florida and in the nation. It was recognized that to carry out the specific mandates of the legislation, an in-depth understanding of the status of solar energy in Florida and in

particular of the fledgling solar energy industry was essential. Accordingly, a study was conducted of business and industrial activities in solar energy within Florida, and because it was recognized that such information would be of use in furthering the application of solar products, the decision was made to publish a directory of solar energy equipment and services available in the state. The study has now been completed, and the directory published and widely distributed.

ST78 11151 Solar Energy: A Current Overview

Yellott, J.I.
Arizona State Univ., Tempe, AZ
Jrnl: Heat., Piping Air Cond., V 48:50-56, N7, July 1976

A comprehensive look at the solar events of 1976 is presented. The article summarizes events in solar energy use in the generation of heat at moderate temperatures for space and service water heating.

12,000 CONSERVATION

ST78 12035 Comprehensive Community Planning For Energy Management and Conservation, First Interim Report, Volume I, Technical Report

Hittman Assoc., Inc., Columbia, MD
Avail:NTIS, HIT-693, April 1977

The objective of the project is to develop a methodology which will enable community planners and/or energy analysts to evaluate the impact of proposed planning measures on the energy use and supply patterns existing in the community. To do this, the project team is developing an overall methodology, and two major analytical tools that are used within that community, defining community energy goals, and identifying action alternatives capable of achieving those goals. Once action alternatives are identified, the two analytical tools are used to evaluate the alternatives. The first analytical tool, the community characterization procedure (CCP), enables the user to estimate the likely impact of proposed alternatives on the physical makeup of the community. The second analytical tool, the energy analysis procedure (EAP), enables the user to quantitatively analyze the impact that anticipated physical changes will have on the energy usage and supply patterns existing. When the physical and energy impacts of proposed alternatives are determined. The methodology then provides the user with guidelines for assessing the implementability of alternatives, ranking and comparing them, and making a final selection of action items.

ST78 12036 Energy Conservation, Employment, and the Economy

SIPI, New York, NY
Energy Seminar, Washington, D.C., Oct. 20, 1975

The panel discussion on energy conservation, employment, and the economy was moderated by Dan W. Lufkin, who stated that the specific objective of the discussion was to search for or contribute to an energy policy for the nation. Dr. Barry Commoner, the first panel speaker, spoke on capital implications of unconstrained energy demand. Other panel discussions were a view from labor on energy conservation policy, Irving Bluestone, UAW; energy management systems and job conservation, Fred Dubin and Richard Aspenson, Dubin-Mindell-Bloom Assoc. and 3-M Corp., respectively; the potential for growth in secondary metals recovery, Alan Amper, Steelmet; and the energy problem of New York City.

ST78 12037 Energy Efficiency Program For Appliances

Midwest Research Inst., Kansas City, MO
Avail;NTIS, PB-26571 Feb. 1977

The main objective of this study is to identify candidate consumer products to be covered by the 14th category of household consumer products outlined by P.L. 94-163 (Part B, Title V), the Energy Policy and Conservation Act of 1975. Alternative definitions for household are reviewed. The potential consequences of alternative definitions for households are examined. Tables within the report itemize published annual energy consumption estimates from seven prior surveys and summarize consumer use patterns (hour/year) and power ratings (wattage) derived from MRI research.

ST78 12038 Mixed Strategies for Energy Conservation and Alternative Energy Utilization (Solar) in Buildings, Final Report, Volume II, Detailed Results

Honeywell, Inc., Minneapolis, MN
Avail:NTIS, SAN/1234-1/2 June 1977

The mixed-strategy analysis was a tradeoff analysis between energy-conservation methods and an alternative energy source (solar), considering technical and economic benefits. The objective of the analysis was to develop guidelines for reducing energy requirements, reducing conventional fuel use, and identifying economic alternatives for building owners. The analysis was done with a solar system in place. This makes the study unique in that it is determining the interaction of energy conservation with a solar system. The study, therefore, established guidelines as to how to minimize capital investment, while reducing the conventional fuel consumption through either a larger solar system or an energy-conserving technique. To focus the scope of energy-conservation techniques and alternative energy sources considered, five building types (house, apartment buildings, commercial buildings, schools, and office buildings) were selected. Finally, the lists of energy-conservation techniques and alternative energy sources were reduced to lists of manageable size by using technical attributes to select the best

candidates for further study. The resultant energy-conservation techniques were described in detail and installed costs determined. The alternative energy source reduced to solar. Building construction characteristics were defined for each building for each of four geographic regions of the country. A mixed strategy consisting of an energy-conservation technique and solar heating/hot water/cooling system was analyzed, using computer simulation to determine the interaction between energy conservation and the solar system. Finally, using FEA fuel-price scenarios and installed costs for the solar system and energy conservation techniques, an economic analysis was performed to determine the cost effectiveness of the combination.

ST78 12039 Mixed Strategies for Energy Conservation and Alternative Energy Utilization (Solar) in Buildings, Final Report, Volume III, Appendixes

Honeywell, Inc., Minneapolis, MN
Avail:NTIS, SAN/1234-1/3 June 1977 10 appendices

This appendix summarizes building characteristics used to determine heating and cooling loads for each of the five building types in each of the four regions. For the selected five buildings, the following data are attached: new and existing construction characteristics, new and existing construction thermal resistance, floor plan and elevation, people load schedule, lighting load schedule, appliance load schedule, ventilation schedule, and hot water use schedule. For the five building types (single family, apartment buildings, commercial buildings, office buildings, and schools), data are compiled in 10 appendices. These are building characteristics; alternate energy sources and energy conservation techniques description, costs, fuel price scenarios; life-cycle cost model; simulation models; solar heating; cooling system; condensed weather; single and multi-family dwelling characteristics and energy conservation techniques; mixed strategies for energy conservation; and alternative energy utilization in buildings. An extensive bibliography is given in the final appendix.

ST78 12040 Prime Contractors For Resource Recovery Systems: Who Will Be The Leaders of the 1980's, Who Will Fall By the Wayside

Jrnl: Resource Recovery Energy Revue, V 4:12, 14-21, N2, 1977

A portrait of prime contractors for resource recovery systems was made in an effort to determine how these companies are approaching the new field and which are most likely to become industry giants. Small companies are at a disadvantage in a capital-intensive industry, with the result that most of the companies are primarily involved in other areas. Responses to a questionnaire by 26 companies are reprinted. The companies were asked to provide information on (1)what the resource system is designed to do, (2)the major components and names of their manufacturers, (3)what, if any, fuel is produced, (4)whether any installations are in existence, (5)names of contracts awarded and work under construction, (6)who was involved in the engineering and organization, and (7)whether the company has been involved in the solid waste business.

ST78 12041 Replacement Cost of Energy

Jrnl: Resources, V 56:1,3, 1977

Congressman Joseph L. Fisher asked Resources for the Future's Milton Russel the following questions: What is the implication of basing the "replacement cost" of energy on the price of imported oil; Does the basis of the import price matter; and Does the potential for price manipulation matter? Mr. Russel's answers are given, and the following conclusions are provided. There is no reason on narrow economic grounds for the United States to adopt a policy that holds domestic energy prices below the equilibrium level based on the replacement cost of energy, the landed cost of imported oil plus some insecurity premium. Similarly, there is no reason that action should be taken ahead of time to prevent those prices from adjusting even to fluctuations in imported oil prices, even deliberately manipulative fluctiations. But, there do exist equity problems (relating to the distribution of income), adjustment problems (relating to a speedy transition to replacement-cost pricing of energy), and inflation and unemployment problems (associated with rising energy costs and changes in the distribution of income) that demand attention.

ST78 12042 State of Georgia Energy Conservation Plan

Georgia Office of Energy Resources, Atlanta, GA
1977

Georgia's energy conservation plan entails measures that are cost-effective, practical, and supportive of existing state programs. Particularly those that conserve energy. The plan is also designed to meet the minimum requirements for funding under both the Energy Policy and Conservation Act of 1975 and the Energy Conservation and Production Act of 1976. In that it includes all necessary mandatory measures and projects at least a five percent reduction in 1980 energy consumption. This report contains formal application for EPCA funds only. The programs and their management plans, with specifics in each sector, are described.

ST78 12043 Technological Techniques for the Conservation of Energy, Summary of the Results of a Study on Behalf of the Ministry for Research and Technology

Jrnl: Kohle Heizoel, V 29:19-22, N8, Aug. 1976, In German

A brief summary of the findings of a study covering the technology of saving energy is presented. The study covers five major points: energy consumption and energy saving in (1)households, small users; (2)industry; (3)environmental protection measures; (4) energy gain; and (5)transportation and traffic. The last section is dedicated to the effects of energy-saving measures on the general overall future energy use in the Federal Republic of Germany.

ST78 12044 Third Annual Energy Conservation Management Conference

Bonneville Power Administration, Portland, OR, 1976; Dept. of the Interior, Washington, D.C.

Eleven papers were presented at the conference, with titles and authors as follows: Northwest Energy Situation, Don Hodel, Bonneville Power Administration; Energy Management in Buildings, Carl Fullman, Energy Management Services; Automobile Energy Conservation, Bob Allen, McDonnell Douglas Corp.; Northwest Energy Policy Project, Myron Katz; Heat Recover Techniques and Applications, Elric Saaski, Sigma Research, Inc.; Electric Utility Rate Design Study: A Progress Report, Robert Uhler, EPRI; Electric Heat Pumps in TVA's Service Area, J.W. Ward, Tennessee Valley Authority; Energy Conservation Research and Development for the Naval Short Establishment, John M. Slaminski, Naval Construction Battalion Center; The Cupertino Story and Electric Vehicles Used in the US Postal Service, T.W. Martin, US Postal Services, Western Region; Solar Energy and its Relation to Other Energy Systems, J.H. Zettel, Johns-Mansville Sales Corp.; and Electric Utility Industry and Conservation, Jack B. Robertson, Federal Energy Administration, Region X.

ST78 12045 UCAN Technical Implementation Manual, Final Report

Gordian Assoc., Inc., New York, NY
Avail:NTIS, PB-261094 Aug. 1976

The manual focuses on the methods available to utility companies, public service commissions, and public interest organizations to ensure the successful implementation of utility rate reform, load management, insulation programs, energy efficiency promotion, interior environment consultation services, building code revisions, energy audit programs, and elimination of master metering. In doing so, it highlights the differences in implementation strategies for gas and electric utilities.

ST78 12046 Winona: Towards an Energy Conserving Community

Univ. of Minnesota, Minneapolis, MN
1975

The utilization of solar energy, wind energy, bio-fuels, and aqua-agriculture is discussed. Bibliographies are presented and other pertinent information is included on these subjects preceeding the presentation on Winona, Minnesota. The application of energy-conserving technology to a total existing community is then examined in depth, using Winona as the sample city. Its population is 27,000 persons with three institutions of higher learning.

ST78 12047 Salt River Power Saver Service Sells, Finances Home Insulation

Athmer, L.
Salt River Project, Phoenix, AZ
Jrnl: Public Power, V 35:12-14, N4, 1977

The Salt River Power Saver Service in Phoenix developed the philosophy that demonstrable service including inspection of homes and the sale and financing of home insulation must accompany programs in which a utility offers energy saving advice. The Salt River Project, after studies and public surveys, began a free inspection and recommendation service. Costs from installing and financing insulation are recovered by involving local contractors and a bank. Response from local industry and business has been good because the increase in business allowed lower prices and because the public appreciates action more than propaganda. The utilities have developed performance and safety specifications for insulating materials and monitored contracts. Some areas with short supplies of materials may have to use questionable cellulose materials and insure the integrity of the program with extra monitoring. Financing is handled as an installment loan through a bank rather than as an addition to utility bills. The utility provides capital and the bank, the accounting, while the property owner puts up collateral. Since the loans are smaller than conventionally available home improvement financing, the project expands the homeowner's financing options. After an hour and a half inspection using a time-motion approach, recommendations are made that emphasize changes with both an immediate and a long-range effect on utility bills.

ST78 12048 Design Guidelines for Energy-Conserving Systems

Baker, M.Jr.
New York, Inc., Consulting Engrs., New York, NY, 1977
Veteran's Admin., Washington, D.C.

Guidelines for the design of new Veteran Administration facilities are presented. The information given is applicable in whole or in part to the following: solar energy systems, total energy systems, continuous-duty standby systems, engine-driven chillers, heat pump systems, and solid-waste boiler systems. The guidelines provide uniformity of design for new VA facilities and supplement established VA standards and policy.

ST78 12049 Opportunities in Electrical Load Management

Bauer, D.C.
Research Triangle Inst., Research Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212 Jrnl: Proc. of Symp., FEA, Washington, D.C.

The importance of reliable and sufficient supplies of electricity in our economy, coupled with the substantial and increasing economic, energy, and environmental costs associated with its production, make it essential to insure that its development incorporates maximum practicable efficiencies. High among the underexploited opportunities for efficiency is load management and its complement, structural rate reform on the basis of long run marginal costs. The deterioration of load factors (average load/peak load) has aggravated financial stresses on the electric utility industry already burdened by inflationary pressures that have caused marginal costs to consumers to increase in constant dollars. Initial FEA modeling work projects that load management could have the effect of decreasing oil consumption by about 1.3 million barrels per day while maintaining a kilowatt-hour sales growth rate of about five percent/year. Capital savings in plant expansion would be about $48 billion. From a fuels management point of view, increased reliance upon nuclear fuel and coal instead of oil and gas could be accomplished. Successive sections of the paper discuss the importance of structural rate changes, including peak usage pricing, load management opportunities in space conditioning, heat storage, "cool storage," load deferrals, and load control options. The FEA utility program goals and features are described; these include a synopsis of demonstration projects in seven states (recently expanded to another 12), the UCAN voluntary commitment program with the largest utilities, and invited regulatory interventions before local public service commissions.

ST78 12050 Energy Resources Recovery, Improvement of Recovery Methods

Beck, K.
Kraftanlagen Ag, Heidelburg, DE
Jrnl: Brennst.-Waerme-Kraft, V 27:100-102, N3, 1975, In German

An outline is provided of several reports presented at the IX World Energy Conference (Detroit). The geographical distribution of geothermal energy resources throughout the world is described and information on completed geothermal power plants is detailed in tables, including efficiency and borehole data. The utilization of solar energy is described, with particular reference to applications in the US and the USSR. Also discussed are uranium mining and processing, and hydroelectric plants in Japan. Energy research and development programs in the US are described.

ST78 12051 Overview of the Potential for Energy Conservation for Intercity Truck and Rail Operations

Bevilacqua, O.M.
Purdue Univ., West Lafayette, IN
Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

The characteristics of intercity truck and rail-freight modal operations were investigated to evaluate the potential for achieving energy savings. Intercity truck and rail-freight operations were analyzed to determine the relationships between energy consumption and the delivery of transport service. The energy consumption impact of alternative conservation measures was calculated and, in turn, evaluated in light of a series of institutional constraints. As such, this study goes beyond the characteristics cataloging of alternative energy conservation measures by conducting a disaggregated assessment of the effectiveness and feasibility of implementing such measures. It is concluded that the potential for achieving energy conservation in the movement of intercity freight by truck and rail systems is limited, as well as shrouded by the complexity of the nature of the commodity itself, the commodity flow characteristics, and the market and institutional structure.

ST78 12052 Potential Role of Solar Energy in Conservation for Building, Heating, and Cooling

Biancardi, F.R.; Meader, M.D.
Res. Triangle Inst., Res. Triangle Part, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212 Jrnl: Proc. of Symp.

A number of solar collector configurations and air conditioning subsystems are being investigated for use in solar-powered building, heating, and cooling applications. The pertinent characteristics and operating features of representative flat-plate and focusing-type collectors, as well as typical rankine-cycle, absorption, and desiccant air conditioning systems are briefly described. Estimates of the energy savings possible for the remainder of this century, with widespread utilization of solar-powered systems, are also presented. A rankine-cycle turbocompressor air conditioning and heating system has been designed, fabricated, and tested. The design features of the system are described and results obtained during the performance testing of the system are presented. The test results provide a convincing demonstration of the feasibility of operating a rankine-cycle turbocompressor air conditioning and heating system at system temperature levels consistent with present-day flat-plate solar collectors. During the testing of the demonstration system, more than four tons of cooling and in excess of 60 hours of safe reliable operation were obtained. Most significant was the operation of the system over a range of turbine inlet temperatures from approximately 165 F to more than 215 F, during which the system performance goals were met or exceeded.

ST78 12053 Energy Conservation in Chemical Reactions: Some Thermodynamical Aspects

Bidard, R.A.
CEN, Paris, France
Jrnl: Energy Use Management, V 2, Pergamon Press, Inc., Elmsford, NY, 1977

The energy crisis has resulted in emphasis being placed on energy conservation. When dealing with energy, it is not sufficient to consider only heat, but the temperature level of the heat must be considered in a process. The author feels that, in the usual considerations of chemical reactions, all of the implications are not emphasized completely. In this view, he examines endothermic and exothermic processes, some equations, and some practical applications. He concludes, "actual practice is to accept very low energetical efficiencies (thermal ones are not considered here) in chemical processes...we have described the general lines of some solutions...but when one is forced with a sudden increase in fuel cost, one must anyhow work a new economical balance between consumptions and investments, in which consumptions have to be reduced substantially, and investments increased sufficiently, so as to reach a new minimum overall cost."

ST78 12054 Economic Feasibility of Heating Maryland Broiler Houses With Solar Energy

Cain, J.L.; Van Dyne, D.L.
Univ. of Maryland, College Park, MD, Agricultural Experiment Station
Avail:NTIS, MP-898, Feb. 1977

The economic feasibility of heating Maryland broiler houses with solar energy was examined, utilizing simulation and present value cost effectiveness. Simulation was used to analyze (1)weather data, (2)building heat requirements, and (3)the portion of total

heating needs to be supplied by each solar collection, storage, and distribution system. Present-value cost effectiveness was applied to the simulation results to determine when the optimum combination of solar collection, storage, and distribution units (solar system) would become less expensive than conventional fuels over a 20-year period. The simulation analysis, utilizing some 150 different combinations of size and quality of solar collection and storagesystems, yielded the following results (on an annual basis): (1) the test solar systems provided from 24.31 to 85.85 percent of total building heat requirements, (2) solar system efficiency ranged from 15.32 to 4.52 percent, and (3) solar heat overflow was 0.17 to 27.49 percent of total heat available to the collection. Other results are presented and discussed.

ST78 12055 Energy Conservation and State Legislatures, Based on the Energy Conversion Workshop for Region Eight State Legislators

Carpenter, S.
Rocky Mountain Center on Environment, Denver, CO
Energy Conservation Workshop, Dec. 10-11, 1976, Denver, CO
Avail:NTIS, N78-12550 Jrnl: Proc. of Workshop

The purpose of the workshop was to increase the participants' awareness of the general need for energy conservation, to interest legislators in promoting energy conservation, and to provide information about specific practices which can further conservation efforts.

ST78 12056 Montana Renewable Energy Study

Cochran, K., Nybo, J.H.
Alternative Energy Resources Organization, Billings, MT

The purpose of this project was to prepare a very basic guide to renewable energy resources in Montana. Information was collected on energy conservation practices, solar energy, wind power, biogas, wood, water, and architecture and design. A list of references on each of these topics was completed.

ST78 12057 Illuminating Engineer in a Changing World

Collins, J.B.
Build. Res. Establ., Garston, Watford, England
Jrnl: Light Res. Tech., V 9:1-11, N1, 1977, 21 refs

The history of the Britain Illuminating Engineering Society is recalled and the effects of the energy situation on the lighting practice in Britain at present and in the future are considered.

ST78 12058 Proposed ASHRAE Standards Hit

Dell, A.
Jrnl: Energy User News, V 2:1,24, N29, July 25, 1977

Critics of the energy conservation standards proposed by the American Society of Heating, Refrigeration, and Air Conditioning (ASHRAE) for existing industrial buildings have responded with a flood of objections and recommendations. The main objection to ASHRAE's proposal pertains to how an industrial building is defined. Critics claim the standards were set as if the buildings were used for commercial purposes. They object to ASHRAE's not identifying energy-intensive processes and point out areas of the draft that need further clarification and analysis. Recommendations include omitting the whole section on electrical distribution systems and defining an energy audit that will break down energy use in more useful detail.

ST78 12059 California Model for Energy Extension Services in the United States

Dorf, R.C.; Hunter, Y.L.
Univ. of California, Davis, CA
Jrnl: IEEE Trans. Educ., V E-20:130-133, N3, Aug. 1977, 4 refs

One method for instilling the conservation ethic into American lifestyles is an energy extension service. A model for such a service, based upon contributions from existing agricultural extension and university extension models, is presented, and the role of university extension is stressed. Some of the areas in which electrical engineers can make contributions are indicated.

ST78 12060 Writing an Energy-Efficiency Construction Code

Duke, M.M.
World Trade Center, New York City, NY
Cary Arboretum of the New York Botanical Garden, Millbrook, NY, 1976

The author, representing Mrs. Lee Goodwin, New York State Commissioner of Housing and Community Renewal, stated their views on the proposed "energy efficiency construction code," the need for such a code, and on the writing of such a code. New York state was aware of the impending energy shortages and high utility costs well before the energy crisis. A report was prepared there in March 1973 for guideline recommendations in the three areas of design, construction, and maintenance and operation. Formulation of ensuing construction codes and conservation standards and implementation of the New York State construction code are described.

ST78 12061 Energy Consumption in the Transportation Sector

Dupree, W.G.
Bureau of Mines, Washington, D.C.
Avail:NTIS, CONF-760895 May 1977

Energy consumption in the transportation sector accounted for 30 percent of the total gross energy input to the US economy in 1975. In mid-1976, petroleum accounted for more than 95 percent of the energy input to the transportation sector, and this dominance by petroleum is also expected to continue well into the future. The consumption of petroleum products by the transportation sector has shown some variation over time. There are six major products: liquefied gases, jet fuel, lubes and waxes, gasoline, distillate fuel, and residual fuel. Their percentage distribution over time is also documented in tabular form. Regional variations in transportation energy consumption are also documented.

ST78 12062 Energy-Efficiency Improvements in Residential Gas and Electric Ovens

Erickson, R.C.
Science Applications, Inc., La Jolla, CA
Avail:NTIS, 78C0037640 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

Residential energy consumption accounts for approximately one-third of total national US energy consumption with the energy required in the preparation of foods being one of the top four residential energy end uses. Also, the efficiency of the household over is rather low, providing a large potential for improvements. Results are presented of an investigation to define methods of measuring energy consumption, to determine where energy goes, and to evaluate means of reducing energy required by ovens to produce the same useful output. Design changes evaluated include input power, vent flow rate, door configuration, element surface area, insulation conductance, over thermal mass, forced convection, and automatic ignition devices. These design improvements were evaluated with a combination of appliance testing and computer modeling. The results show that, for a gas oven, elimination of the standing pilot light and the use of forced convection would improve the energy efficiency by almost eight percent and would result in saving 4.8 billion ft^3 of natural gas per year in the US for electric oven, redesigning new units to have the thermal insulation and door seals now required of self-cleaning ovens, and reducing oven size by two inches in each dimension would save 143 million kW-Hr annually in the US or the equivalent of 272,000 barrels of oil annually of the power plants.

ST78 12063 Energy Use, Efficiency, and Conservation in Industry

Essenhigh, R.H.
Res. Triangle Inst., Res. Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA0600/2-76-212

Energy conservation can reduce pollutant emissions, reduce pressure on energy sources, and possibly reduce manufacturing costs. The basis for energy savings campaigns must be, first, knowing current consumption and efficiencies of use; and second, having targets of consumption and of use efficiencies for comparison. Current use is determined by energy audits. Target use is determined on the basis of several factors, including thermodynamic considerations. Furnace analysis also provides a basis for identifying the principal factors controlling efficiency of furnaces. Factors include output, excess air, processing temperature, etc. In evaluating and comparing systems and tasks, four efficiencies and three efficiency ratios are involved: the operating efficiency of the system (ε), its intrinsic efficiency (α), its maximum efficiency (ε_{max}), and the figure of the merit for the efficiency of the system at its optimum efficiency (ε_{max}') of the

optimum system for the task; the efficiency ratio of the system ($\varepsilon_s'\eta\eta_{max}$), the efficiency ratio for the task ($\varepsilon_t'\eta\eta_{max}'$), and the figure of the merit for the efficiency of the system at its optimum efficiency ($\varepsilon_{st}'\varepsilon_{max}\varepsilon_{max}'$). The task efficiency ratio (ε_t) is shown to be identical, or nearly identical to the so-called "second law" efficiency. Evaluation of the material deployed in terms of efficiencies and the furnace analysis performance equations provide a basis for developing a systematic energy savings procedure. However, in spite of low overall efficiencies (25 to 35 percent) in the industrial sector of the energy market, where potential for savings exists, it is nevertheless concluded that the chief barrier to more rapid progress in energy is out-of-date or invalid cost accounting procedures.

ST78 12064 Energy Conservation by Adaptive Control for a Solar Heated Building

Farris, D.R.; Melsa, J.L.; Murray, H.S.; McDonald, T.E.; Springer, T.E.
LASL, Los Alamos, NM
Avail:NTIS, LA-UR-77-1517, 1977

Identification and optimal control techniques are combined to form an adaptive optimal control strategy which is used to minimize the auxiliary energy consumption for a solar heated building. The adaptive optimal control strategy is described and application of the adaptive optimal controller to the heating, ventilating, and air conditioning (HVAC) system in an appropriate building is modeled. The building used is the newly completed National Security and Resources Study Center (NSRSC) at the Los Alamos Scientific Laboratory (LASL). The NSRSC uses an 8000-ft^2 solar collector to provide energy for heating and cooling the building. A cost functional to define optimal performance of the HVAC system and an identification process to produce a linearized building model are combined to yield an adaptive linear regulator solution. Although solar energy is used for both heating and cooling the NSRSC, only the results from the heating simulation are available for presentation here. Energy savings predicted by the model when compared to a conventional control system are described and an alternate system configuration is briefly discussed. Plans for actual implementation of the adaptive optimal controller are discussed.

ST78 12065 Environmental Implications on Non-Technological Methods to Conserve Energy

Gibbons, J.H.
Res. Triangle Inst., Res. Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212 Jrnl: Proc. of Symp.

US policy to improve health, safety, and environment has resulted in higher energy prices, reflecting more adequately its true cost. The OPEC Cartel price shift raised prices further. In response to higher prices, energy users are shifting to less energy-intensive consumption patterns and higher efficiency of use. The environmental implications of these altered consumption patterns are generally salubrious, because the actions taken to save energy are much less polluting than using the energy. Most other policies to induce additional conservation will not only save consumer's money, but will further reduce environmental insults. There are some proposed actions to save energy by relaxing environmental controls. While a small amount of energy could be saved in this way, it seems far more productive to save energy through increased efficiency of use, rather than a retreat from environmental goals.

ST78 12066 Preliminary Assessment of the Role of Energy Storage and Implicated Technologies for Energy Conservation in Industry

Glenn, D.R.
Res. Triangle Inst., Res. Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212 Jrnl: Proc. of Symp.

Energy storage is but one possible means for reducing the consumption of fuel and/or electricity within the industrial plant. A twofold approach is underway to identify candidate industries where heat storage can measurably improve energy efficiency and produce a concomitant improvement in operating economics. The methodologies selected to identify candidate industries and processes, the nature of available information, and how additional needed data on energy utilization dynamics are being accomplished are discussed. FEA and ERDA have recognized a needed focus on current energy-related factors describing the industrial sector and programs to explore applicable conservation techniques. In one such program, the role of energy storage, particularly thermal energy, is synthesized into process designs for a first approximation of cost-benefit and energy conservation impacts afforded by inclusion of this function. Examples of near-term planned or feasible energy storage schemes are shown. With some 40 percent of the total energy demand related to

industrial requirements, including space heat, process and direct heat, and boiler heat for steam, the full spectrum of temperature and energy levels are represented. Matching in-plant available excess or reject energy to other compatible needs separated by a time and/or magnitude function, can represent a real opportunity for an energy storage application. Significant design challenges for accomplishing requisite heat/energy exchange and storage in operational industrial energy systems are recognized and discussed.

ST78 12067 Advanced Energy Conservation Technology Program

AIAA, New York, NY
Avail:NTIS, CONF-7603106, July 15, 1976

Effective energy conservation is an essential element in national policy. This conference was assembled to consider the processes by which advanced energy conservation engineering knowledge and methods are introduced into practical end-product manufacture and use, and to examine the possibilities for accelerating these processes. The specific conference goals were (a)to identify those energy conservation technical disciplines which offer the best promise for early integration into end products, (b)to project the value and effectiveness of a program designed to accelerate their implementation, and (c)to suggest an organizational approach for implementing and assessing such a program. Ten major technologies were identified that affect energy conservation and which utilize advanced engineering methods: waste heat recovery; instruments and controls; energy conversion, including combustion and heat transfer; energy transmission and storage; materials, including recycling; analytical methods and modeling, including new computer techniques; manufacturing processes; basic component design; systems integration; and alternative energy sources. The application of these techniques may be in transportation, heating and cooling, electric power generation, end-product manufacture, and process industries. Sections of this report provide a detailed review of the degree to which each of these applications requires advanced knowledge in the various technologies listed above. Conclusions and recommendations common to the implementation of this advanced engineering information in all the listed technologies are listed.

ST78 12068 Energy Conservation Policy for the US: Five Years in Formulation

Grundy, R.D.
Senate Committee on Energy and Natural Resources, Washington, D.C.
Jrnl: Prof. Engng., V 47:16-19, N9, Sept. 1977

Energy conservation policy, which has evolved after five years of legislation deliberation over questions of efficiency, self-sufficiency, and the appropriate role of government, focuses on the cost analysis of lifetime energy use. Inefficiency characterizes the US energy problems because demand growth was designed into consumer products and rate structures. A re-evaluation of consumption pattern concludes that we must shift to technologies that allow us to accomplish comparable economic activities with less energy. Legislation setting both mandatory and voluntary efficiency standards for industry, buildings, and automobiles will challenge engineers. The discussion covers the purposes and impacts of the Energy Policy and Conservation Act, the Energy Supply and Environmental Coordination Act, the Energy Conservation and Production Act, and the Natural Energy Plan.

ST78 12069 Solar Energy and Energy Conservation Information Service

Haggard, K.W.
NMSEA, Santa Fe, NM
NM ERDA

This program is primarily an information service to accelerate understanding, acceptance, and adoption of available technology which is manageably priced. It is responsive to the growing interest elicited by the first year's program and includes (a)an expanded resource center in Santa Fe, (b)the creation of a sister office in Las Cruces,(c)a (c)a demonstration-outreach program. Activities will include (1)a solar energy toll-free phone line; (2)maintenance and expansion of reference libraries including slide collections; (3)response to written queries and those from walk-in visitors; (4)edit and publish monthly newsletter and quarterly journal; (5)coordinate conferences, workshops, seminars, and classes; (6)prepare how-to manuals; (7)distribute pamphlets, books, and manuals; (8)conduct tours. Demonstration-outreach activities will include scheduling and conducting hands-on workshops throughout the state. Items to be constructed include (1)movable insulation, (2)Trombe walls, (3) solar water heaters, (4)air collection systems, (5)crop dryers, (6)greenhouses, and (7)cookers.

ST78 12070 Thermodynamic Analysis of Industrial Energy Conservation Opportunities

Hall, E.H.
Res. Triangle Inst., Res. Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212 Jrnl: Proc. of Symp.

Thermodynamic analyses were conducted of the processes employed in the steel, copper, aluminum, glass, synthetic rubber, selected plastics, and paper industries. Results of the calculations for these seven industries include the minimum theoretical energy, the efficiency of selected unit processes, and the effect of certain process changes on the energy use. A computer model was developed to perform the necessary calculations. The model performs the customary energy balances based on the First Law of Thermodynamics. More importantly, availability losses are calculated according to the Second Law of Thermodynamics. The model is general and can be applied to an entire industrial process or to any of the unit operations which are employed within the process. The results identify where large energy or availability losses occur. The model is a powerful tool for identifying those operations in which significant fuel savings can be realized through straightforward modifications. On the other hand, the model will also show where the potential for energy conservation is limited by the irreversibilities inherent in the basic processes employed. Such a definition of the nature of the various availability losses is invaluable in directing the attention of process engineers to those operations which offer the greatest potential for overall fuel savings.

ST78 12071 Energy, Labor, and the Conserver Society

Hannon, B.
Univ. of Illinois, Urbana, IL
Jrnl: Tech. Revue, V 79:47-51, 53, N5, 1977, 17 refs

The tenets of energy conservers are seen as promoting a more-rational, less-complex world in which economic stability and equity can be maintained in spite of declining energy consumption. The relationships of capital, labor, and energy are examined in the context of prices, cost, taxes, regulation, and free-market forces. Centralization of production, for example, is energy-inefficient but capital and labor-efficient, so that rising energy prices should result in a trend toward decentralization. A society choosing to conserve will stress efficiencies based on the Second Law of Thermodynamics and net energy. Change in a conserver society will be slow, with modifications made to existing systems to reduce total energy and keep employment stable. Consumer decisions to make substitutions that are less energy-intensive are calculated for their impact on employment in terms of new jobs created and jobs lost. Tables for the 1950-1973 period show a substitution of energy for labor as wages increased with a result that capital and employment were kept high by low-energy costs. Increases in electricity are found to result in lost jobs in the short term because of the diversion of money. Various activities, such as a switch to vegetable protein diet, are analyzed to illustrate how conservers can set priorities for energy options. Responses can also be prompted by energy taxes and rationing to compensate for individuals who do not take the initiative.

ST78 12072 Improved Use of Energy

Hatami, R.
Arya-Mehr Univ. of Tech., Tehran, Iran
Avail:NTIS, 78C0001748 Jrnl: Heliotechnique and Development, V 2, 1976, DAA, Inc., Cambridge, MA

The world energy economy has been de-established by the sudden increase in fossil fuel price. This had the beneficial effect of revising the methods of energy consumption and of investigating new energy sources. This paper surveys briefly the different possibilities of energy conservation in buildings and of recuperation of waste from nuclear plants. It also discusses the multi-aspect power plant concept, where heat is used throughout a wide range of temperatures for various processes. This concept combines the use of solar energy with nuclear energy.

ST78 12073 Daylighting of Buildings, A Compendium and Study of its Introduction and Control, Final Report

Holton, J.K.
NBS, Center for Building Tech., Washington, D.C.
Avail:NTIS, PB-259523 Oct. 1976

Planners must no longer ignore daylight as a valuable natural resource for building illumination. Significant reductions in the energy consumption of buildings are possible

by decreasing the dependence on artificial illumination and decreasing air conditioning loads by employing methods which bring in cool light. In order to design buildings utilizing daylight effectively, there must be an understanding of the design principles of daylighting. This requires a knowledge of illumination to meet the needs of the building users, an understanding of the characteristics of daylight at the location of the building, and imagination in developing ways to introduce and control daylight. Innovative techniques for the introduction and control of daylight are discussed.

ST78 12074 Residential Refrigerators: Energy Conservation and Economics

Hoskins, R.A.; Hirst, E.
Oak Ridge Nat'l Lab., Oak Ridge, TN
Avail:NTIS, 78C0037641 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

A detailed computer model is developed to calculate energy flows and electricity uses for residential refrigerators. The model is used to evaluate the energy and associated initial cost impacts of alternative designs to reduce refrigerator energy use. Implementing all the changes considered, except for elimination of the frost-free feature, would cut electricity use 52 percent and increase purchase price only 19 percent.

ST78 12075 Energy Accounting and Analysis: The Carborundum System

Howell, E.D.
Carborundum Co., Niagara Falls, NY
Avail:NTIS, 78C0037189 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

The Carborundum Company has developed an energy accounting and analysis system which is a simple coherent method of gathering common information from a variety of operations that reveals how energy is being used. The system compares one measured time period with another and compensates for environmental variables. The system is as applicable to a home, an office building, a hospital, or a hotel as it is to a factory, powerhouse, or refinery. The description is broken down into input, output logic, and analysis.

ST78 12076 Toward a Methodology for the Implementation of Energy Saving Technologies

Howland, M.; House, P.W.; Bruck, H.W.
Univ. of California, Berkeley, CA
Avail:NTIS, 78J0003836 Jrnl: Water, Air, Soil Pollut., V 7:221-224, N2, Feb. 1977

ERDA (The Energy Research and Development Administration) was given the mandate to perform or cause to be performed the research and development of alternative energy sources and energy-conserving technologies and strategies. However, answers to the energy dilemma not only depend upon the proof that a technology or strategies exist, but that they reach the end user and actually conserve energy. At the same time, there is an indication that R and D projects carried out by or supported by the federal government are seldom utilized. This lack of utilization can be partially blamed on a lack of concern and knowledge surrounding the implementation process. To avoid this pitfall in the case of energy research, the study outlined here is a beginning to understanding the implementation process, and specifically, the implementation of energy-saving technologies.

ST78 12077 Why Not Triples

Hutton, T.D.Jr.
Avail:NTIS, CONF-760895 May 1977

The size and weight of commercial motor vehicles have been effectively frozen since the adoption of the Federal Aid Highway Act of 1956. The author feels that removal of political barriers for liberalization of these restrictions will help stem the tide of inflation, while at the same time making potential fuel savings of as much as 21 percent for intercity freight trucks a reality. With transportation a recurrent cost in every phase of production, distribution, and service, fuel becoming more expensive, and the security of supply more tenuous, the significant increase in transportation efficiency provided by the triple trailer combination must not be withheld from the nation's economy, he states. Millions of operational miles have clearly demonstrated that out nation's highways have been built to the point where they can safely handle this equipment, he continues, with triples having established the best safety record of any vehicle ever used on our highways. Finally, he adds, triples make it possible to move freight with fewer vehicles, thereby reducing highway congestion, conserving energy, and consequently, reducing pollution.

ST78 12078 Efficiency of Obtaining and Delivering Energy

Loberg, T.J.; Cuccinelli, K.T.
AGA, Arlington, VA
Conf. on Improving Efficiency in HECFRSCB, 1976, Purdue Res. Foundation, W. Lafayette, IN
Avail:NTIS, 78C0008945 Jrnl: Proc. of Conf., V 2

The Second Law of Thermodynamics generally deals with thermal efficiency of a heat engine which depends only on the absolute temperatures of the source and the sink. Second Law efficiencies are significant in identifying energy utilization efficiency. The efficiencies of the various fuels and energy distribution systems in use in the United States are discussed. After discussing natural gas, coal, petroleum, nuclear fuels, hydroelectric power, and solar energy, it is concluded that the highest efficiencies are realized by utilizing fuels as directly as possible.

ST78 12079 Energy Conservation and Economic Growth

Males, R.H.
EPRI, Palo Alto, CA
Avail:NTIS, 78C0037355 Jrnl: Energy Use Management, V 1, 1977, Pergamon Press, Inc., Elmsford, NY

There is a need for a greater understanding of the qualitative concept of conservation and of the quantitative evaluation of actual energy savings, as well as more specific knowledge of the effects on the economy of policy initiatives to implement more energy-conserving life-styles. This paper lays a foundation for this understanding by defining "conservation" by listing the mechanisms that motivate conservation actions, and by describing the possible effects of conservation actions. By the use of economic models and econometric estimations, it has been determined that the efficient use of energy can, in the long run, reduce energy consumption in the US by substantial amounts without severe effect on the economy. Beyond this, additional life-style changes and technology shifts begin to reduce measurably the size of the nation's economic activity. The effects of energy price increases in the short run, and especially on the low-income consumer and the producer whose options for change are limited, will contribute to serious inflationary pressures. The incorporation of energy efficiency (or "conservation") into our economy and managing the income redistributive effects of higher energy prices will require delicate balance and great political wisdom for dealing fairly with all sectors of the economy.

ST78 12080 Italy Mulls Shift to Low-Energy Industries

Massai, E.
Jrnl: Energy User News, V 2:21, N 29, July 25, 1977

The Italian Parliament is debating a controversial conversion plan that will reverse the push to develop energy-intensive industries and will, as France and Germany have done, promote electronics, refined chemicals, and other industries with a lower energy demand. In the ten years since 1963, Italy's energy use per dollar of product rose from 1.51 to 1.87 kilograms, while France and Germany were able to lower their energy use. Electricity-dependent steel mills were largely responsible for Italy's increase in energy use, along with an expanding petrochemical industry that has produced a market surplus. With several years needed to make the sweeping change that is contemplated, interim efforts will concentrate on industrial conservation projects that emphasize efficient equipment and processes.

ST78 12081 Appropriate Technology and Energy Conservation: A Canadian Experience

McCloskey, E.
Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia
Avail:NTIS, 78C0037357 Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Elmsford, NY

Many developing societies still have, yet are rapidly losing, environmental attitudes and "technologies" that are appropriate to their context. Inherent in such attitudes, and particularly manifest in the siting and construction of indigenous habitats, is a strong feeling for energy conservation. The project described is an attempt, in part, to identify indigenous technologies and energy-conserving building methods so as to develop, with modifications and additions, a form of housing appropriate to Indian reserves in Northern Quebec.

ST78 12082 Capital-Short Small Firms Find Ways to Save Energy

McCue, A.
Jrnl: Energy User News, V 2:7, N 31, Aug. 8, 1977

International Rectifier and Avery Label, both small companies with capital constraints, have been able to reduce energy costs with modest investments. International Rectifier spent only $2000 on air conditioning timer controls and individual oven and heater on-off switches at 17 plants in order to reduce electricity consumption 25 percent. A system for placing red tags on equipment that was incorrectly left running requires an accounting by the department manager responsible. The company has decided against centralized management of power demand by computer. Changes at Avery Label emphasize reducing gas consumption by a redesign of coating ovens to recirculate air and concentrate pollutants, a plan that reduced consumption by half at an investment cost of $25,000.

ST78 12083 Department of Commerce Voluntary Labeling Program for Household Appliances and Equipment to Effect Energy Conservation

Meyerson, M.R.
NBS, Washington, D.C.
Conf. on Improving Efficiency in HECFRSCB, 1974, Purdue Res. Foundation, W Lafayette, IN

The appliance labeling program of the US Dept. of Commerce is aimed at encouraging manufacturers to provide consumers, at the point of sale, with information on the energy consumption and energy efficiency of household appliances, including air conditioners, space heaters, refrigerators, freezers, water heaters, dishwashers, clothes washers, clothes dryers, stoves, and ovens. The implementation of the program and its contribution in influencing consumers to buy energy-efficient equipment are discussed.

ST78 12084 Four-School Project Aids Smaller Firms' Efforts to Save

Minarcin, D.
78J0004221, Jrnl: Energy User News, V 2:8, N30, Aug. 1, 1977

Energy conservation projects at 50 small and medium-sized firms were assisted by four universities working with a federal grant of $250,000 from the Department of Commerce. Energy analysis and diagnostic centers (EADC) were set up by the University of Pittsburgh, University of Tennessee, Georgia Tech., and Case-Western Reserve to make energy audits, monitor consumption, and encourage companies to develop a system for gathering information on energy and energy use. Many of the companies, their attention focused on production, would not have known where to get the kind of help provided by the centers. Many others were not even aware that they needed help in eliminating wasteful energy consumption. The EACD conducts a one-day engineering audit of major equipment and makes tests for efficiency. Information on the energy use for production and energy consumption for the previous two years is gathered and analyzed. The team submits recommendations, with options, and has follow-up meetings with the management. The companies are generally favorable toward the centers and appreciative of the information and suggestions they receive.

ST78 12085 Energy Conservation Programs for Consumer Products

Owens, W.
FEA, Washington, D.C.
Conf. on Improving Efficiency of HECFRSCB, 1976, Purdue Res. Foundation, W. Lafayette, IN
Avail:NTIS, 78C0009025 Jrnl: Proc. of Conf.

The responsibilities of the Federal Energy Administration on the legislation (PL 94-163) to develop appropriate test procedures and develop energy efficiency improvement targets, specifically for HVAC systems and home appliances are discussed. Congress did not dictate any specific variables with which to deal, so FEA and the National Bureau of Standards are working closely with members of the industry to specifically set energy efficiency standards.

ST78 12086 Tradeoffs Between Energy Conversion Stages, Environmental Effects, and Technical Efficiency

Pagoulatos, A.
Univ. of Kentucky, Lexington, KY
3rd Annual UMR-MEC Conf., 1977
Avail:NTIS, 78C0037376 Jrnl: Proc. of Conf., Western Periodicals Co., N. Hollywood, CA

From analyzing the physical constraints in managing exhaustible and nonrenewable energy resources, it follows that decisions concerning how far to convert a given energy resource should be made within an economic framework. The tradeoffs between conversion stages, environmental effects, technical efficiency, and uses satisfied by energy resources are then determined. In light of the direct and opportunity costs stemming from increased conversion stages, the intertemporal allocative decisions for exhaustible and nonrenewable energy resources are derived.

ST78 12087 Research on Energy Conservation in Building at the National Bureau of Standards

Powell, F.J.
NBS, Washington, D.C.
Carey Arboretum of the New York Botanical Garden, Millbrook, NY, 1976

The Energy Conservation Program at the National Bureau of Standards consists of three main parts. The first part deals with individual buildings of all types, the second part treats industrial processes that occur within buildings, and the third part is concerned with urban complexes of buildings. This paper will concentrate mainly on the first part, topics applicable to individual buildings. Selected topics of the National Bureau of Standards Energy Conservation Program related to buildings are discussed. Those included are the National Bureau of Standards Load Determination Computer Program (NBSLD) for estimating building energy consumption, the experimental results of tests on a masonry and a wood-frame house, the status of an experiment on a mobile home, the study to retrofit an existing house on the NBS grounds to save energy, the experiment to retrofit a townhouse with solar collectors and storage systems to supply 75 percent of the annual energy needs of the townhouse, the Energy Conservation Demonstration Office Building at Manchester, New Hampshire, and a new Energy Conservation School in New York City. Other energy conservation efforts are named by title only.

ST78 12088 Energy Conservation and Solar Heating in Poultry Production

Reece, F.N.
Dept. of Agriculture, Mississippi State, MS
Avail:NTIS, 78C0036107 Jrnl: Energy Use Management, V 1, 1977, Permgamon Press, Inc., Elmsford, NY

Energy conservation methods in poultry production are discussed including the use of adequate insulation in poultry houses, precision control of ventilation systems to prevent loss of heat through excessive ventilation,and use of limited-area or partial-house brooding. A system for collection and application of solar energy for poultry brooding was developed for a research house in which energy conservation research was under way.

ST78 12089 Federal Initiatives to Save Energy in Lighting and Appliances

Riegel, K.W.
Res. Triangle Inst., Res. Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212 Jrnl: Proc. of Symp.

Energy savings to the nation and to individual consumers can accrue from the following approaches: research and development on new technologies that will lead to more efficient appliances, lighting systems, and control systems that govern their use; improving the energy efficiency of new appliances and lighting equipment by better incorporating presently available technology; and motivating purchasers of appliances and lighting equipment to make selections based on energy efficiency and life-cycle cost, thus creating market pressures for more efficient manufactured products. The federal government is engaged in programs that follow all of the above approaches. ERDA has programs for research, development, and demonstration of energy-efficient technology in appliances and lighting. The FEA and the Department of Commerce conduct a voluntary Appliance Efficiency Improvement Program, the purpose of which is to encourage implementation of presently available technology in new and more energy-efficient appliances. The FEA encourages wise use of energy in lighting to conserve energy through two programs: The Federal Energy Management Program and the Lighting and Thermal Operations Program. Both federal operations and the private sector are the targets of these efforts. Finally, consumer awareness and motivational issues relating to efficient energy utilization are being addressed in such programs as Commerce's Voluntary Appliance Labeling Program, FEA and ERDA research projects, and by legislation calling for stronger programs in all of the mentioned subject areas.

ST78 12090 Customer Services' Role in the Conservation of Energy

Robb, R.F.
S. California Gas Co., Los Angeles, CA
AGA Op. Sect., 1976
Avail:NTIS, 78C0007414 Jrnl: Proc. of Sect., V 76-D-20

The efficient use of natural gas and the practice of adjusting gas appliances for maximum efficiency and advising customers of their proper use are discussed. Fields of possible energy savings in industry, homes, and public places are mapped out.

ST78 12091 Energy Conservation in the Long Term

Roberts, F.; Harris, P.S.
Inst. of Chem. Engrs., Rugby, England, 1977, 11 refs

Review of energy conservation possibilities for the industrial sector of the UK over the long term. Opportunities for achieving considerable savings by the application of improved technology to processes are discussed, and reference is made to some energy-intensive industries such as iron and steel, cement, and chemicals. More generic ways of saving energy in the long term are also discussed and these opportunities are stated to be most relevant to the less energy-intensive sectors. Some of the barriers to achieving desirable energy savings are identified.

ST78 12092 Energy Conservation

Sant, R.W.
FEA, Washington, D.C.
NEF, 1976, Univ. of Akron, Akron, OH
Avail:NTIS, 78C0037341 Jrnl: Proc. of Forum, V 2

Mr. Sant, former assistant administrator for Energy Conservation, FEA, points out that conservation is by far the largest and most attractive energy source that we have. This is not the conservation of belt-tightening, curtailing, or reducing consumption, but that of investing in improved productivity of energy use, so that we can find a way to get more usable work for BTU burned. For example, translated into figures: (1)home ceiling insulation works out to about $7./barrel oil, (2)electronic ignitors on gas furnaces to $1.60/1000 ft^3, (3)storm windows to about $10./barrel oil, and (4)cogeneration using waste steam in industrial plants to about 20 to 25 mills/kWH. Mr. Sant advocates a much simplified national energy policy: "that we should choose additional or marginal BTU's of energy that are required on the basis of the lowest cost to our society, whether that energy is saved or produced, as long as it meets the federal and state environmental requirements which are probably inadequate as yet." He sees an ultimate of 14 million Bbl. oil/day by this means, and feels, with what's happened since the 1973 embargo, we will get seven of those 14 million by 1985 in any case. The problem is to somehow get the other seven, and he sees three things that would be required to accomplish this: (1) consumer groups must get behind the effort, (2)Congress must provide meaningful incentives for making the investment, and (3)all the present fragmented interests for improved efficiency must be consolidated.

ST78 12093 Electrical System Hems in Effort to Save

Schmidt, D.A.
Jrnl: Energy User News, V 2:1,8, N33, Aug. 22, 1977

In spite of an outdated electrical system that cannot use advanced conservation technology, the Sawbrook Steel Co. in Ohio used 34 percent less natural gas than in 1972 by replacing boilers, burners, and preheaters. The cost of installing a new electrical system to take advantage of energy-saving equipment is prohibitive for the small company. The addition of a new burner in the annealer furnace was responsible for reducing gas consumption 20 percent. A dual-fuel system in new ladle preheaters burns either gas, oil, propane, or no. 2 fuel oil. The efforts so far have enabled the company to continue with new burners having 80 percent efficiency.

ST78 12094 Seagram Spends $10M, Cuts Energy 12 Percent

Schmidt, D.A.
Jrnl: Energy User News, V 2:9, N30, Aug. 1, 1977

A combination of new equipment, rescheduling of operations, and housekeeping changes cost the Joseph E. Seagram and Sons, Inc. $10 million and has allowed a 12 percent of the targeted 14 percent energy reduction over 1972 consumption levels that were set by the Federal Energy Administration. Capital expenditures included the replacement of old gas and oil-fired boilers with new coal-fired units and a front-end compression evaporator and heat exchanger for heat recovery. Under consideration are a wood-burning unit and the collection of heat from blowdown lines. Seagram is investing in projects with a maximum payback period of two years.

ST78 12095 Dual Mode Internal Window Management Device for Energy Conservation

Silverstein, S.D.
GE Co., Schenectady, NY
Jrnl: Energy Build., V 1:51-56, N1, May 1977

This paper reports on the design of a simple energy-conserving window management system and its calculated heat transfer characteristics. The device serves as a quasi-active solar collector during winter daytime, providing added insulation comparable with that of vented storm windows during winter nighttime, and rejecting insolation during summer. The problem of avoiding the intensity of direct sun through windows while obtaining essentially all the associated heat is effectively solved with a window system of this type.

ST78 12096 Coming Age of Conservation

Socolow, R.H.
Univ. of Princeton, Princeton, NJ
Jrnl: Annual Revue of Energy, V 2:239-289, 1977, 78 refs

The energy dilemma for the most industrialized societies is usually perceived in terms of creation of an energy supply sufficient to permit expansion of consumption. The author, and many others, have been arguing that the energy dilemma would be as well formulated with inverted emphasis. Technology plays a dominant role in finding ways to make an industrialized society dynamic and high-spirited under the constraint of putting ever fewer demands on natural resources. Several themes emerge in this review: (1) in every sector of the economy, dramatic reductions in energy consumed to provide a given product or amenity are technically feasible; (2) however savings are computed, no single sector and no single strategy dominates the sum; and (3) the structures of the economies of the industrialized countries, viewed from the standpoint of energy consumption, are remarkably similar, such that when one of these countries identifies significant areas for energy conservation and promising tactics, these are almost always applicable in nearly every other country. This review suggests many of the characteristics of a society preoccupied with conservation; it is not a boring place. There is a lot of currently unfamiliar engineering: machines are more complicated, but built to be serviced and to last. There are large "extension" services, helping and industries use resources more carefully. There are many jobs associated with the extension services and with doing repairs generally. Everywhere there is evidence of "systems" thinking: fewer energy-costly traffic jams, more thermally integrated industries, and a lot of tricks to match loads to requirements over time.

ST78 12097 Conservation: The Centerpiece

Sparks, W.D.
Air-Conditioning and Refrig. Inst., Arlington, VA
Jrnl: ASHRAE J., V 19:22-24, N 5, May 1977

The Carter administration's energy policy involves convincing people that conservation means giving up extravagance, rather than comfort, and that financial incentives to develop greater energy efficiency can produce savings that offset rising energy costs. The policy is geared to economics, with emphasis on encouraging voluntary cuts in consumption. Consumer choice will largely determine whether this will work or whether higher prices are needed as a deterrent. Changes in the country's growth pattern are needed before any real conservation can take place, particularly in the efficiency of new buildings. New federal performance and building standards are being developed to concentrate first on the uninsulated housing that makes up one-third of the nation's dwellings. Incentive proposals include utility participation in home insulation projects, automatic thermostats, modifications for furnaces, retrofit programs for improving appliances, and demonstrations of solar equipment.

ST78 12098 Potential for More Efficient Energy Use in Building

Stein, R.G.
Richard G. Stein and Assoc., New York City, NY
Cary Arboretum of the New York Botanical Garden, Millbrook, NY, 1976

The context for reexamining energy use in all buildings is the severity and chronic nature of the energy situation. The consequences of continuing past policies on a national scale and globally are well known. The extent of future world demand has only been hinted at in most policy discussions. Since all these bear on our attitudes and on our options in building decisions, the author stresses the relationship between growing world needs for oil or other energy sources and our own expectations. Buildings are responsible for about 40 percent of all energy used in the United States. Of this 40 percent, about six percent is used in the manufacture and assembly of buildings, 13 percent in the built-in electric uses, and 20 percent in direct fossil fuel usage for heat, for hot water and for absorption cooling. Detailed investigations of energy use by schools in New York City and two office building complexes in Albany, NY, are described along with some general data on church buildings, etc.

ST78 12099 Process Design With Energy and Environmental Constraints

Timmerhaus, K.D.; Reusch, C.F.
Univ. of Colorado, Boulder, CO
Jrnl: Chem. Ing. Tech., V 49:30-38, N1, Jan. 1977, 18 refs

It is evident that the philosophy of process design has changed dramatically with the advent of higher energy prices and stricter environmental regulations. It is only with careful design and well-practiced operation that maximum recovery of energy in the form of steam, electricity, and refrigeration can be successfully achieved. Initial capital costs will generally be higher, but operating costs are lower, particularly in this era of high fuel costs. The major problems that are usually associated with these "tighter" designs are more difficult maintenance and more complex startup problems. The latter are due to the energy integration which is built into an energy efficient plant. On the other hand, maximizing energy recovery and increasing yields of feedstocks not only lowers operating costs, but often can have environmental advantages because exhaust gases and liquids are either consumed in the plant or contaminants are recovered as by products.

ST78 12100 Urban Planning as an Impediment to Energy Conservation: An Examination of Potential Conflicts Between Existing Planning Regulations and Energy-Conserving Site-Planning Alternatives

Tschanz, J.
Argonne Nat'l Lab., Argonne, IL
Avail:NTIS, 78C0037248 Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Inc. Elmsford, NY

Energy inefficiencies in urban areas are, in part, a legacy of the layout of streets and buildings during land development. It seems almost inevitable that this process must be more systematically carried out if the energy performance of cities is to be improved in the future. Systematic analyses of the performance of cities and suggestions for achieving public objectives, such as energy conservation, are within the realm of urban planning. Implementation of energy-conserving ideas at the site-planning level should be particularly effective. As the concepts for energy-conserving site planning become more widespread, a situation that might frequently occur is the public review of energy-conserving site plant for private-development projects. This paper is a report of an examination of conflicts that might arise if existing planning regulations were applied in such reviews.

ST78 12101 Evaluation of Energy Utilization Analysis Methods for Industrial Processes

Urdaneta, A.; Schmidt, P.S.
Univ. of Texas, Austin, TX
Avail:NTIS, 78C0037542 Jrnl: Energy Use Management, V 2, 1977, Pergamon Press, Elmsford, NY

Various methods for analyzing energy utilization in industrial processes are reviewed. These methods are categorized as noneconomically versus economically based, and as analytical versus synthesis-oriented. It is shown that most analytical formulations based on thermodynamic availability are not well-suited as design tools, whereas, enthalpy-based design methods do not clearly delineate sources of energy dissipation. Integration of availability-based methods with economic considerations to produce a more general design approach is discussed.

ST78 12102 Steam Trapping

Webb, T.
Yarway Ltd., Pertshire, Scotland
Avail:NTIS, 78C0004244 Jrnl: Int. J. Energy Res., V 1:179-185, N2, 1977

Faults in steam trapping are wasting money and high-grade energy in industrial installations. A steam trap survey in facilities with more than 500 traps will probably locate some significant steam losses. Steam loss may occur through trap failure or through the installation of wrongly sized traps. The flow capability method used for estimating steam loss is described. The technique using visual and aural observation and temperature measurement for surveying steam traps is also described. Finally, a list of application errors is presented.

ST78 12103 Commercial Space: Policy Analysis of Profitability of Retrofit for Energy Conservation, Final Report

Williams, J.; Eisen, D.; Beverly, A.; Murray, R.
Metrostudy Corp., Washington, D.C.
Avail:NTIS, N78-10591

The formulation of policy alternatives to promote the retrofit of commercial buildings for energy conservation was investigated. The study design called for (1)the collection of detailed financial data and building characteristics; (2)the identification of rational retrofit measures individually developed for selected buildings with an estimate of cost and energy saving; (3)a detailed analysis of the financial projection for each building over its expected life, for each retrofit option, and for three selected policy alternatives; (4)the description of commercial space in 12 cities as derived from existing studies; and (5)the preparation of detailed inventories of the commercial space in two cities.

13,000 ECONOMICS, LAW

ST78 13087 Economic Evaluation of Small Decentralized Energy Projects

Jrnl: URJA, V 1:25-28, N6, June 1977

In the developing countries of the world, traditional sources of energy have been animal and human effort and crudely utilized forms of animal and vegetable matter. Water and wind power and recently rural electrification schemes have become important. With increased petroleum prices, the development of decentralized technologies to use traditional energy sources has progressed. Biogas, solar energy, wind power, and mini-hydroplants have become alternative new energy sources. Some of the critical factors concerning the economic evaluation of alternative sources are discussed with emphasis on biogas technology. Characteristics and cost benefits are summarized for biogas but may be applied to all alternative energy sources.

ST78 13088 Economic Pre-Feasibility Study: Large-Scale Methanol Fuel Production From Surplus Canadian Forest Biomass, Part I, Summary Report

Intergroup Consulting Economists Ltd., Winnipeg, Manitoba, Canada
Avail:NTIS, NP-22159/1

The practicability of using methanol produced from surplus renewable Canadian Forest Roundwood as a substitute for non-renewable hydrocarbons in meeting Canadian energy requirements was studied. The discussion is presented under the following subject headings: methanol demand as substitute for non-renewable hydrocarbons; surplus roundwood availability and opportunity costs; methanol plant technologies, characteristics and costs; wood procurement technologies and costs; financial analysis and appraisal; and economic impacts and institutional implications.

ST78 13089 Government Money Fuels Solar Heating

Jrnl: Business Week, V 2:29, May 23, 1977

No abstract available.

ST78 13090 Guide to Federal Programs of Possible Assistance to the Solar Energy Community

Comm. on Science and Tech., US House of Reps., 94th Congress, Second Session
Library of Congress, Washington, D.C., GPO, 1976

This report is a guide to existing federal programs that may in some way assist individuals and organizations interested in applications or advancement of solar conversion technology. It identifies a variety of informational and financial assistance programs available through 21 agencies of the federal government. Thus far no financial assistance program has been established specifically for solar interests, but some programs may be applied to solar programs even though they were established for some other purpose. Of the 21 agencies identified, six offer some form of financial assistance: The Farmers' Home Administration, The Rural Electrification Administration, The Economic Development Administration, The Office of Minority Business Enterprise, The Farm Credit Administration, and The Small Business Administration. The agencies offering information, addresses, and informational brochures on solar interests are identified.

ST78 13091 Here Comes The Sun, Easy and Economic to Harness

Jrnl: Newsweek, V 89:94, May 16, 1977

In this abstract, some economic aspects of solar energy are discussed.

ST78 13092 Legal-Institutional Implications of Wind Energy Conversion Systems (WECS), Executive Summary

George Washington Univ., Washington, D.C.
Avail:NTIS, N78-16472

The legal issues presented by wind energy conversion systems (WECS) utilization are related to its structural and technological features, as well as to its economic and social implications. Some information about wind systems, their likely applications and

problems, are briefly stated. The features of the existing legal structure which may facilitate the implementation of such systems are noted. The ways in which the legal situation varies with particular applications and which applications pose the greatest legal difficulties are summarized. The complex subject of offshore wind systems is discussed.

ST78 13093 Solar Heating Impact on Revenue Should be Small

Jrnl: Electrical Light. Power, Boston, MA, V 55:22-23, N2, Feb. 1977

At a recent Pennsylvania Electric Association meeting, Harold Lorsch (Franklin Institute) said solar-assisted residential space heating probably will not disrupt revenues of public utilities in this century. The Franklin Institute study concentrated on the effect of solar heat and hot water systems with electrical backups in single-family homes. Two locations were modeled: one in Allentown and the other in Philadelphia, PA. In General, the study conclusions show that the solar-assisted alternatives have an adverse impact on utility revenue, but due to the sluggish growth of solar systems predicted, the overall effect is expected to be minimal. The study assumes that solar-assisted heating systems will account for only five to ten percent of the electrical heat market (for single-family homes) by the year 2000. A key reason for this slow growth, the study shows, is the extra cost of solar energy to the homeowner who must borrow capital needed over 20 years at an eight percent interest rate.

ST78 13094 Solar Heating Your House - Would it Pay?

Jrnl: Changing Times, V 32:6, April 1978

No abstract available.

ST78 13095 Solar Heat Lights up a New Industry

Jrnl: Business Week, p. 142, May 16, 1977

No abstract available.

ST78 13096 Economic and Commercial Assessment of Solar Energy Conversion

ISES
Proc. of the ECASEC Conf., London, England, July 5, 1977, 96 p.
Avail:AIAA, A78-10614

The economics and commercial prospects of solar energy systems, including space heating, domestic hot water heating, and absorption cooling systems, as well as photovoltaic cells and hybrid wind-solar systems, are evaluated. The papers consider such topics as a discounted cashflow analysis of solar space heating; an examination of the long-range effects of inflation and interest rates on domestic solar energy systems; energy cost studies for a utility; the cost-effectiveness of photovoltaic and thermal conversion research programs, the use of heat pumps in domestic, industrial, and commercial heating; a simple mathematical model for evaluating photovoltaic energy conversion efficiency; comparative rating of commercial solar water systems; a heat recovery system for a housing project; and a computer program for assessing the US market for domestic and commercial solar energy systems.

ST78 13097 Survey and Analysis of Small Business and Minority Business Enterprise Participation in Solar Energy Procurement Activity

ERDA, Washington, D.C.; TechMatics Corp., Falls Church, VA
Avail:NTIS, DSE/4033-1 29 p. Feb. 1977

This report discusses survey results of Small Business and Minority Business Enterprise participation in the Solar Energy Programs resulting from procurement actions by ERDA, Division of Solar Energy, and subcontract actions by Solar Energy prime contractors for Fiscal Year 1976 and the Transition Quarter. Information about Small Business/Minority Business Enterprise (SB/MBE) Awards made by other federal agencies during the same period is also provided. The findings of this survey indicate that $6.7 million of a total $94.3 million Solar Energy outlay was allocated to Small Business in the form of prime contracts, and another $16.6 million was subcontracted to Small Business/Minority Business Enterprise (SB/MBE) by Solar Energy Prime contractors. This represents a total of $23.3 million Solar Energy dollars contracted and subcontracted to SB/MBE's or 24.7 percent of the $94.3 million Solar Energy outlay during FY76 and the TQ.

ST78 13098 Survey of the Emerging Solar Energy Industry

Justin, A.
Jrnl: Bulletin of the Atomic Scientists, V 34:64, Feb. 1978

No abstract available.

ST78 13099 The Effectiveness of Solar Energy Incentives at the State and Local Level

Booz, Allen, and Hamilton, Inc., Washington, D.C.
Avail:NTIS, PB-263371 March 1976

The Federal Energy Administration (FEA) is currently developing policies and programs to accelerate the utilization and widespread commercialization of solar energy technologies. As part of this program, FEA contracted this study to provide an overview of existing, proposed, and possible state and local actions to encourage or stimulate the use of solar energy heating and cooling systems. This report is directed primarily to state and local legislatures and administrations and has two principal objectives: (1) to explore the state and local issues surrounding widespread solar energy development, and (2) to indicate areas for assessment and evaluation, both in the design of state and local incentive programs and in the development of federal support of those efforts.

ST78 13100 US Energy and Economic Growth, 1975-2010

Allen, E.L.; Cooper, C.L.; Edmonds, F.C.; Edmonds, J.A.; Reister, D.B.; Weinberg, A.M.
Inst. for Energy Analysis, Oak Ridge, TN
Avail:NTIS, ORAU/IEA-76-7, Sept. 1976 136 refs

This study projects economic growth (GNP) and energy demand for the US to the year 2010. The main finding is that both GNP and total energy demand are likely to grow significantly more slowly than has been assumed in most analyses of energy policy. Projections of energy, GNP, and electricity (total and per capita) are summarized, with electricity demand expected to grow more rapidly then total energy demand. Two scenarios designated "high" and "low" were developed in this study. However, even the "high" scenario, 126 quads (q/1 1 = 10^{15}/BTU) in 2000, is much lower than most previous estimates. It is felt that this raises serious questions about fundamental energy and energy R and D policies which, generally, have been based on perceptions of more lavish energy futures. Although the aggregate demands and GNP are projected to increase rather modestly, the energy demands per capita and GNP per capita increase at rates comparable to or even higher than historic rates. The authors believe that the projections developed in this study represent a logical culmination of many trends toward lower growth. These trends have not yet been factored into the older energy projections upon which so much energy policy is based.

ST78 13101 The Formal Implication of Solar Rights

Arumi, F.N.; Dodge, R.L.
Univ. of Texas, Austin, TX
Avail:AIAA, A78-20497 Jrnl:Energy and Buildings, V 1:183-191, Oct. 1977

A hand method to determine the vertical limits of construction when solar rights criteria are specified for neighboring structures is demonstrated and compared with a computer-based method. The emphasis is placed on the methodology and it includes an appendix showing the logic and the listing of the computer programs.

ST78 13102 Impact of the National Energy Plan on Solar Economics

Ben-David, S.; Noll, S.; Roach, F.; Schulze, W.
LASL, Los Alamos, NM
Avail:NTIS, LA-UR-77-2694 1977

The National Energy Plan (NEP) sets as a goal the use of solar energy in two and a half million homes in 1985. A key provision of the NEP (as well as Congressional alternatives) provides for the subsidization of solar equipment. The extent to which these subsidies (income tax credits) might offset the impact of continued energy price control is examined. Regional prices and availability of conventional energy sources (oil, gas, and electricity) were compiled to obtain a current and consistent set of energy prices by state and energy type. These prices are converted into equivalent terms ($/$10^6$ BTU) which account for combustion and heat generation efficiencies. Projections of conventional fuel price increases (or decreases) are made under both the NEP scenario and a projected scenario where all wellhead price controls are removed on natural gas and crude

oil production. The economic feasibility (life-cycle cost basis) of solar energy for residential space heating and domestic hot water is examined on a state-by-state basis. Solar system costs are developed for each state by fraction of BTU heating load provided. The total number of homes, projected energy savings, and sensitivity to heating loads, alternative energy costs and prices are included in the analysis.

ST78 13103 Near-Term Prospects for Solar Energy: An Economic Analysis

Ben-David, S.; Schulze, W.D.; Balcomb, J.D.; Katson, R.; Noll, S.; Roach, F.; Thayer, M.
Univ. of New Mexico, Albuquerque, NM
Jrnl: Nat. Resources J., V 17:169-207, N2, April 1977

Current projections, retaining a high capital cost of $10/ft^2 for installed solar collectors, find that residential solar water and space-heating systems should be economically feasible by 1990. Earlier economic projections were poor because they were based on pre-1973 cheap energy supplies and are no longer valid. Regional scenarios are developed to show future energy prices, including price controls and curtailments, and consumer costs for both current and life-cycle use. Areas with decontrolled energy prices or natural gas shortages are shown to encourage widespread use of solar energy. Other areas may also shift because of high fuel costs or because of a combination of favorable sun and interest rates. Available capital is crucial to the expansion of solar energy use because, unlike other energy sources, there are no fuel costs. Low-income groups will suffer and present energy resource owners will enjoy windfall profits unless decontrol of prices is accompanied by taxes designed to distribute income equitably. Loan guarantees and low interest rates for investment in solar equipment could be an appropriate alternative strategy to price decontrol.

ST78 13104 Assessment of Incentives to Accelerate Market Penetration of Solar Heating and Cooling Systems

Bezdek, R.H.; Ezra, A.A.
ERDA, Div. of Solar Energy, Washington, D.C.
ISES Annual Mtg., 1977
Avail:AIAA, A78 11363 Jrnl: ISES Proc., Secs. 26-38, Cape Canaveral, FL, p. 29-1--29-5

A modified version of the mitre/metrek solar heating and cooling market penetration model was used to analyze five different tax incentives in addition to the base case of no incentives. The solar market share is plotted as a function of the relative price of solar energy and the effects of different tax incentives on the production of solar heating and air conditioning systems are compared.

ST78 13105 An Attitudinal Study of the Home Market for Solar Devices, Progress Report, March-Sept. 1977

Campbell, V.N.; Brown, R.V.; Rhees, T.R.; Repici, D.J.
Decisions and Designs, Inc., McLean, VA
Avail:NTIS, N-7812535 73 p.

This study estimates that 1.1 million American residences would have home and hot water heated with solar energy by 1985 if the total cost averaged $20 a month more than the cost of heating with fossil fuels, and initial costs were no barrier. An additional 7.2 million homes would have hot water alone heated with solar energy by 1985 if the total cost was $5 a month more. These are fairly favorable cost assumptions under current conditions. Almost half (44 percent) of potential homeowners surveyed would prefer to have their living spaces and hot water heated with solar energy if the total cost averaged $20 per month more than conventional heating and initial costs were no barrier. Although interest runs high, for various economic and technical reasons only about one in 75 American families may have both their home and water heated with solar energy by 1985. Any development that makes solar energy cost-competitive with fossil fuels for home heating will increase the level of market penetration. Another key to how quickly Americans will have solar homes is how fast builders and developers use solar energy in new homes and can assure good performance.

ST78 13106 The Economic Evaluation of Solar Energy Schemes

Chapman, P.F.
Milton Keynes Open Univ., Bucks., England
Econ. and Commercial Assess. of SEC Conf., July 5, 1977
Avail:AIAA, A78-10615 Jrnl: Proc. of Conf., London, England, 9 p.

Standard methods of discounted cashflow analysis, which take into account capital costs and savings in annual fuel consumption, are used in evaluating the cost-effectiveness

of solar energy systems for heating buildings. Uncertainties affecting the evaluation, such as the cost of solar energy system components, the future of fuel prices, government tax credits, and future fuel price structures, which may involve seasonal tariffs to compensate for the cost of supplying peak demand, are also considered. Comparisons are made with the economics of natural gas, electricity, and coal heating systems. In addition, the effects of insulation costs and interest rates for house mortgages on the selection of a heating system are mentioned.

ST78 13107 Engineering Cost Estimates for Solar Technologies

Curto, P.; Cherdak, A.; Miller, G.; Spewak, P.
Mitre Corp., Metrek Div., McLean, VA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11365 Jrnl: ISES Proc., Secs. 26-38, Cape Canaveral, FL, p. 29-14--29-18

In support of solar energy technology analysis and market development studies, a study was performed to estimate engineering costs for each of several designs for solar technologies. These technologies include wind energy conversion systems, solar thermal electric and total energy systems, photovoltaic systems, ocean thermal energy conversion systems, biomass-derived fuels and energy conversion systems, agricultural and industrial process heat systems, and solar heating and cooling of building systems. All costs are presented in mid-year 1976 dollars. The applications of these data are widespread, and may include market penetration studies, regional and national impacts, environmental assessment, resource management (manpower, materials, and financial), and scenario studies.

ST78 13108 Economic Methodology for Solar-Assisted Industrial Process Heat Systems: The Effect of Government Incentives

Dickinson, W.C.; Freeman, H.J.
Univ. of California, Livermore, CA, Lawrence Livermore Lab.
Avail:NTIS, UCRL-52254 June 6, 1977

Standard life-cycle costing techniques are used to establish an economic methodology and determine the economic attractiveness of solar thermal systems for industrial process heat and the effect of government-sponsored economic incentives. One particularly attractive incentive is to reward those who save fossil fuel as a result of installing a solar thermal system with an income tax rebate, a "fuel-savings incentive." Another appealing incentive is to provide low-interest, government-backed loans for the construction of these systems. It is concluded that such incentives will be needed to open a mass industrial market for solar thermal systems in the near future.

ST78 13109 Economic Viability of Solar-Assisted Industrial Process Heat Systems: The Need for Government Economic Incentives

Dickinson, W.C.; Freeman, H.J.
Univ. of California, Livermore, CA
1977 Annual Mtg. of ASISES, Cape Canaveral, FL
Avail:ISES, 78C0035988 Jrnl: ISES Proc., Secs. 26-38

Standard industrial life-cycle-costing techniques were employed to determine the economic attractiveness of solar thermal systems for industrial process heat and the effect of possible government economic incentives. It was concluded that incentives will be needed to open up a mass market for such systems in the near future.

ST78 13110 Solar Energy and US Public Utilities: The Impact on Rate Structure and Utilization

Dickson, C.; Eichen, M.; Feldman, S.
Clark Univ., Worcester, MA
Jrnl: Energy Policy, V 5:195-210, N3, Sept. 1977 18 refs

The possible effects of widespread adoption of solar power are examined in the context of utility rate structures. Solar space heating and cooling systems normally require some form of backup to take account of protracted periods of cloudy weather. With relatively low utilization, capital costs are likely to be the most crucial aspect in choosing such backup systems, and the tendency will be to choose systems running on electricity or natural gas. Widespread adoption of solar power could have a profound effect on utility demand patterns. The cost-effectiveness of solar power can be crucially dependent on the rate structure chosen and on whether the system is considered from the point of view of the customer or the utility. In the appendix, the authors provide details of current research and development on solar space heating in the United States.

ST78 13111 Growing Energy Gap Threatens Major Disruptions

Dix, S.M.
Dix Associates, Grand Rapids, MI
Jrnl: Energy User News, V 2:22-23, N42, Oct. 24, 1977

Members of the Michigan Legislature were advised that an economic solution to the problem of future fuel supplies is not consistent with physical facts. The impact of energy attrition on the relationships of business, industry, and individuals to each other and to the energy market is outlined in a scenario for Michigan. Industry is expected to operate in the present free market until energy attrition prompts it to demand government control over supply, a move that will not leave energy available for expansion. Remaining supplies will require strict rationing and will promote intensive competition and serious employment disruptions. The economic and political breakdown that will accompany this process can be avoided if politicians will adopt long-range planning for a more efficient transportation system and lifestyle, and for the development of synthetic and alternate fuels.

ST78 13112 The Feasibility of an Energy-Related Loan Program for Low-Income Homeowners

Eccli, E.
Design Alternatives, Inc., CSA, Washington, D.C.
Avail:NTIS, PB-273 403/6ST 94 p. Oct. 1977

This paper concerns a study to explore the opportunities to create an interest-subsidized residential retrofit loan program which would assist low-income homeowners to substantially reduce their utility bills. Cost-effective energy conservation techniques were identified and the methodology used included a literature search to locate savings for areas of energy use and supply. Among these were retrofits, water heating, appliances, lights, the effects of natural and mechanical ventilation, and the use of renewable energy sources such as solar space and water heating. An engineering/economic analysis of the options available through a 20-year loan program and at interest rates of one, three, and six percent, was performed. It was found that substantial reductions in utility bills can be obtained with such a loan program. The information in the study would be useful to other income groups besides the poor. References and a list of information sources are also included.

ST78 13113 On the Right to Sunshine: Homeowner Access to Solar Energy

Eisenstadt, M.M.; Utton, A.E.
Soltrax, Inc., Albuquerque, NM
Avail:AIAA, A78-19836 Jrnl: Solar Energy, V 20:87-88, N1, 1978

Problems associated with operating a residentially located solar energy system are discussed. Historical cases dealing with legal rights to the free flow of light and air are reviewed. Methods for creating solar rights are suggested, including easements and zoning.

ST78 13114 Economics of SNG Production by Anaerobic Digestion of Specially Grown Plant Matter

Fraser, M.D.
Intertechnology Corp., Warrenton, VA
Avail:NTIS, 78C0030373 IGT, Chicago, IL, March 1977

An energy plantation is a means for producing fuels by collecting and storing solar radiation in plants purposely for their fuel value. The plant material can be used as a solid fuel, or alternatively, it can be converted into synthetic natural gas (SNG) by anaerobic digestion. Appropriate selection of plant species and plantation cultural practices is the key of producing raw material for SNG production at attractive cost. To be suitable as feedstock, the plant material should have a high potential SNG yield and not be resistant to biological attack. These requirements suggest that suitable woody material is sapwood from Deciduous species. The SNG production process is anaerobic digestion of the plant material, which produces a mixture of methane and carbon dioxide, and biological cell matter. The proposed SNG production process will involve three major steps: pretreatment of the plant material involving comminuting the plant material to possiby as fine as forty mesh and slurrying it in hot water; digestion of the slurry anaerobically for about fifteen days; and removal of the carbon dioxide and water vapor from the digester gas. Operation and design of the anaerobic digester are examined from an estimated material balance. It is estimated that about 4.5 standard ft^3 (ScF), or a little more, of methane can be produced per dry pound of Deciduous plant material 0.28 m^3/Kg. The major unknown parameters in the proposed process are identified. Capital and operating costs are estimated for this proposed process. Total plant

investment cost is estimated to be between $2.00 and $3.00 per daily Scf ($71 to $106 per daily m^3) of SNG production capacity. The estimated revenue required for producing SNG from Deciduous material is between $3.75 and $5.00 per thousand Scf ($132 to $177 per thousand m^3) and most probably nearer the lower limit than the higher limit of this range, depending upon the unknown influential parameters.

ST78 13115 Will a Solar Home Save You Money?

Frutkin, R.
Jrnl: Science Digest, V 82:70, Nov. 1977

No abstract available.

ST78 13116 Projection of Distributed-Collector Solar-Thermal Electric Power Plant Economics to Years 1990-2000

Fujita, T.; Elgabalawi, N.; Herrera, G.; Turner, R.H.
JPL, Caltech, Pasadena, CA
Avail:NTIS, N78-15568 90 p.

A preliminary comparative evaluation of distributed-collector solar thermal power plants was undertaken by projecting power plant economics of selected systems to the 1990 to 2000 time frame. The selected systems include: (1)fixed orientation collectors with concentrating reflectors and vacuum tube absorbers, (2)one-axis tracking linear concentrator including parabolic trough and variable slat designs, and (3)two-axis tracking parabolic dish systems, including concepts with small heat engine-electric generator assemblies at each focal point as well as approaches having steam generators at the focal point with pipeline collection to a central power conversion unit. Comparisons are presented primarily in terms of energy cost and capital cost over a wide range of operating load factors. Sensitivity of energy costs for a range of efficiency and cost of major subsystems/components is presented to delineate critical technological development needs.

ST78 13117 Proper Evaluation and Pricing of "Energy"

Gaggioli, R.A.
Marquette Univ., Milwaukee, WI
Avail:NTIS, 78C0037192 Jrnl: Energy Use Management, V 2, 1977, 28 refs
Pergamon Press, Inc., Elmsford, NY

It is the available-work content of a substance, not its energy content, that truly represents the potential of the substance to accomplish work. Available work is what is called "energy" in lay terminology, and is the real commodity of value. Thus, an "energy" converter is supplied available work in one form. The converter literally consumes (irreversibly destroys) part of it, using that part to drive the conversion processes. The remaining part is delivered in one or more converted forms. The inefficiencies, then, lie in the consumptions and in any effluent losses of available work; only by evaluating these can proper assessments of "energy" utilization and of prospective savings be made. Available work is the only rational basis for evaluating (1)fuels and resources; (2) process, device, and system efficiencies; (3)dissipations and their costs; (4)the value and cost of system outputs. This paper (1)develops the methodology of such second law analyses, which can not be made much more comprehensible as a result of recent progress in thermodynamics; (2)surveys the results of efficiency analyses of a variety of processes, devices, systems, and economic sectors; and (3)illustrates the application of available-work methods for costing ("thermoeconomics").

ST78 13118 Solar Shade Control: Legislation to Assure Direct Solar Radiation Availability

Kraemer, S.F.
Kraemer and Kendall, Colorado Springs, CO
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11358 Jrnl: ISES Proc., Secs. 26-38, Cape Canaveral, FL, p. 26-28--26-30

In the United States there is no legal right to direct sunlight. Therefore, new laws will have to be developed to assure the availability of direct solar radiation to solar energy systems. Aerial photos of urban development in residentially zoned areas at the winter solstice indicate 60-70 percent of the potential shading problems occur from trees. A solar shade control law defining a shadow of a tree on a solar collector as a public nuisance should be a valid exercise of police power. Therefore, the adoption at the state or local level of a solar shade control law declaring a shadow a public nuisance under certain circumstances is proposed. Such a law creates no bureaucratic proceedings, commissions, or government costs, and is preventive in nature.

ST78 13119 How Much Investment in Conversion Devices, For Terrestrial Solar Energy Utilization

Landsberg, P.T.
Univ. of Southampton, Southampton, England
Econ. and Commercial Assess. of SEC Conf., July 5, 1977
Avail:AIAA, A78-10617 Jrnl: Proc. of Conf., London, England, ISES, p. 20-27

An economic analysis which takes into account the effects of inflation and interest rate variations is used in evaluating the feasibility of installing solar energy conversion systems. In addition, the analysis can be adapted to research and development programs and to the energy cost studies for a utility. Sample calculations are given for the minimum conversion efficiencies of economically viable domestic thermal collectors or solar cell panels; the cost-effectiveness of thermal conversion and photovoltaic conversion research programs is also discussed.

ST78 13120 Economic Considerations in the Energy Supply of Autarkic Dwellings

Littler, J.G.F.; Thomas, R.B.
Cambridge Univ., Cambridge, England
Econ. and Commercial Assess. of SEC Conf., July 5, 1977
Avail:AIAA, A78-10621 Jrnl: Proc. of Conf., London, England, ISES, p. 64-77

The design of a housing project for Cambridge, UK, which would rely on solar and wind energy for space and hot water heating is discussed. The project uses internal shutters, heavy insulation, and heat recovery from both ventilation and the hot water supply to increase the efficiency of the energy system. In addition, a short-term heat store lengthens the amount of time the internal shutters may be kept open during days in cooler seasons. A computer simulation program based on a ten-year meteorological record is employed to determine the water storage capacity and the amount of collector area necessary to maintain a specified level of heating. The associated wind generator system using resistance heating is also mentioned.

ST78 13121 The Application of Solar Energy to Boiler Feedwater Heating in Steam-Electric Power Plants

Lorsch, H.G.
Franklin Inst. Res. Labs., Philadelphia, PA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11320 Jrnl: ISES Proc., Secs. 14-25, Cape Canaveral, FL, p. 20-1--20-5

The technical and economic feasibility of augmenting the heating of boiler feedwater in steam-electric power plants by solar energy was investigated. It was found that this 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 US 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 US consumption of these fuels.

ST78 13122 FEA Plans for Federal Incentives and Market Evaluation

Lutkefeder, N.
First ERDA SemiAnnual SPCP Conf., 1975
Avail:NTIS, JPL-5040-13 Jrnl: Proc. of Conf.

The federal laws covering solar energy are listed. The role of the Federal Energy Administration, its commercialization effort, its program areas, and the projects currently being addressed are outlined. The solar energy bills proposed in 1975 are listed according to introduction in the House or the Senate.

ST78 13123 Rising Energy Prices and Regional Economic Development

Miernyk, W.H.
West Virginia Univ., Morgantown, WV
Jrnl: Growth and Change, V 8:2-7, N3, July 1977

Traditionally, development planners and policymakers have based their activities and programs on the export base theory embedded in a Clark-Fisher development model. The propulsive force of economic development in the model is technological progress and the gains in productivity that new technology engenders. A review of the model shows that it stands up well when used to explain the pattern of regional development in the United

States between the Civil War and the beginning of World War II. The most immediate impact of the energy crisis (on the fiscal positions of various states) is discussed first; then the impact on the location of industry is analyzed briefly. The author points out that two major regional development programs started in the 1960's, The Appalachian Regional Commission and The Economic Development Administration, have not been outstandingly successful in reducing interregional disparities. He concludes that "neither conventional regional development policies nor reliance on market forces will permit the nation to cope with the difficulties that will be faced by the energy-poor highly industrialized regions. New policies will have to be devised to help these regions adjust to the structural changes which further increases in energy prices are almost certain to engender."

ST78 13124 Legal Barriers to Solar Heating and Cooling of Buildings

Miller, A.S.; Thompson, G.P.
Environmental Law Inst., Washington, D.C.
Avail:NTIS, DSE/2528-1 March 1977

Ways solar energy will probably be used and legal problems its would-be users may encounter are considered. The barriers are reviewed under the following subjects: solar access and land-use issues; building codes; home financing; utilities; mandatory installation; ERDA patent policy; antitrust and fostering competition; labor union resistance and conflicts; property taxes; mobile homes; and tort liability, insurance, and warranties. A bibliography is included.

ST78 13125 Solar Energy and Economic Considerations

Miller, J.F.
Singer Co., Auburn, NY
Avail:AIAA, A78-15407 Jrnl: ASHRAE J., V 19:40-42, Nov. 1977

The article discusses the economic considerations surrounding various solar energy projects, and notes that solar supplements for closed-loop heat pump systems are often necessary. Attention is given to (1)geographical factors important in a solar energy project's success, (2)the possibility of a night set-back system to reduce annual energy consumption, and (3)the selection of an optimum solar array.

ST78 13126 Solar Housing

Page, J.K.
Univ. of Sheffield, Sheffield, England
Avail:NTIS, 78C0030409 Jrnl: Energy and Housing, Pergamon Press, Oxford, England, 1975

The bare bones of a systematic approach to estimating solar gain are presented. It is concluded that the economic design of solar housing in the high latitude of the UK is very difficult. Long range research could, however, radically alter this situation.

ST78 13127 Status of Legislation Related to Energy Conservation

Ratchford, J.T.
Purdue Research Foundation, Lafayette, IN
Conf. on Improving Efficiency in HECFRSCB, 1975
Avail:NTIS, 78C0004128 Jrnl: Addendum to Proc. of Conf.

The objectives and status of US federal legislation related to energy conservation are discussed briefly. These Congressional bills deal with subjects such as daylight savings time, highway speeds, creation of the FEA and ERDA, solar heating, and non-nuclear energy research.

ST78 13128 Effect of Tax-Credits on the Economics of Solar Heating for Homeowners

Reid, R.L.; Hendricks, R.C.
Cleveland State Univ., Cleveland, OH
1977 Annual Mtg. of ASISES
Avail:NTIS, 78C0035984 Jrnl: ISES Proc., Secs. 26-38, V 1

A hypothetical 114 m^2 (1231 ft^2) house in Hampton, Virginia was selected for study since hourly insolation values and weather data were available on computer tape for 1962 (2263 C or 4073°F heating days). The house was assumed to have a 38 m^2 (409 ft^2) of collector facing south at 32° from the horizontal. Heating and domestic hot water were

supplied by the solar system with the house kept at 21 C (69.8°F) and a domestic usage of 300 KG (660 lbm) per day of water at 60 C (140°F) evenly distributed between 7:00 a.m. and 9:00 p.m. The overall space heating required by the residence was 63.5 GJ (60.2 MBtu) which corresponds to 245 kJ (m^2-C-day), 12.0 Btu (ft^2°F-day) heat loss. The TRNSYS computer simulation program was used to model the system after being modified to include an economics subroutine. The design above resulted in the solar energy providing 82 percent of the total requirements where the domestic hot water load was 50 percent of the space-heating. The effect of the proposed tax credit on the break-even point and incremental present worth of a solar heating system is studied.

ST78 13129 Economics of Solar Heating with Homeowner-Type Financing

Reid, R.L.; Lumsdaine, E.; Albrecht, L.
Cleveland State Univ., Cleveland, OH
Jrnl: Solar Energy, V 19:513-517, N5, 1977, 7 refs

A feasibility study of the present-day economics of solar space and hot water heating is presented for a region with Tennessee's climate and geographic latitude. The economics of solar systems are considered for typical cities across the state representing different weather conditions. Financing is considered for conditions likely to be encountered by a homeowner. These costs are compared to current fossil fuels and electric power systems, with graphs presented to aid in economic decisions.

ST78 13130 New Development for Economical Use of Solar Energy

Scherber, W.
Jrnl: Dornier-Post, V 1:12-14, 1977, In German

The development of novel alpha/epsilon layers for photothermal energy conversion are reported on. With these layers, the efficiency of the solar collectors can be increased by 10 percent up to 100 percent, depending on the working temperature. In addition, a more simple frame construction can be chosen as there is no need for a cover plate. Within the framework of a test programme, the new collectors were subjected to a long-term trial. The results up to date are very satisfactory.

ST78 13131 Sun Wars, (Development Rights)

Singular, S.
Jrnl: New Times, V 9:34, Sept. 30, 1977

No abstract available.

ST78 13132 Economics of Solar Home Heating Systems for the Southwest Region

Stevens, T.H.
New Mexico State Univ., Las Cruces, NM
Jrnl: J. Energy Dev., V 2:279-291, N2, Spring 1977

A cost analysis is made to compare initial cost of installing a residential solar space heating and hot water system with the estimated fuel savings over a 20-year period. A conventional backup system provides supplementary heating. Analysis is made for five geographic areas in the South and Southwest. Tables are used to summarize data on capital investment, energy prices, heat demand, and the value of fuel savings. Indications are that, with mass-production of collectors, solar energy is competitive with electricity and liquefied petroleum in three locations. Increases in electric rates will make it competitive in all areas. If natural gas systems are deregulated, solar systems will be able to compete. A comprehensive program to encourage solar systems will require policy changes that eliminate block pricing and property taxing, expand tax incentive programs to include loans and information programs, and deregulate natural gas.

ST78 13133 Economic Assessment of Research and Development

Tolley, G.; Townsend, S.
Avail:NTIS, COO/4128-1 Sept. 1977

Research has provided new processes and ideas that can be utilized in new technologies for the production and conservation of energy; many technologies are not yet profitable. Rising fuel prices, improved efficiencies, and reduced production costs will increase profitability until many of the more exotic technologies will, at some time,

become economically feasible. Research and development projects can accelerate this process and can be analyzed as investment activities. After a discussion on the rationale for government support in research, a method is developed for the systematic comparison of energy storage research and development projects that are competing for federal funding. The government attempts to use criteria in deciding on which project to fund so as to obtain the most return from public investment in energy-conserving technologies.

14,000 THERMAL POWER

ST78 14006 Expression of Interest in Solar Thermal Power Generation by the Westinghouse Electric Corporation

Westinghouse Electric Corp., Pittsburgh, PA, Astronuclear Lab.
Avail:NTIS, WANL-BK-503701 April 1975

The reasons Westinghouse Electric Corporation reached a no-bid decision on the ERDA RFP 75-124 (Central Receiver Solar Thermal Power System, Phase 1) are discussed. Potentially troublesome design and development areas in the Central Receiver Solar Thermal Power System Program are pointed out. Also, the education and experience of key Westinghouse personnel who might participate in a corporate effort for the Central Receiver Solar Program is summarized.

ST78 14007 Integration of Solar Thermal Power Plants into Electric Utility Systems

S. California Edison Co., Rosebud, CA
Avail:NTIS, N78-14667 135 p.

The operation of solar power plants as a part of a large electric utility system was studied using the Southern California Edison Company loss of load probability and production cost simulation computer programs. Solar generation was evaluated in the context of an electric system having high percentages of baseload-type generation, represented by nuclear. A solar generation model was developed which included effects of hourly solar input variations, 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 was determined for varying amounts of installed solar capacity and for varying thermal energy storage capabilities associated with the solar units. Breakeven costs for solar generation were calculated based on financial assumptions consistent with those Edison presently uses in generation resource planning.

ST78 14008 Proceedings of the ERDA Workshop on Fluid Waste Heat Recovery and Utilization, 1977

Washington Sci. Mark., Inc., Washington, D.C.
ERDA FWHRU Workshop, Nov. 17-19, 1976, Washington, D.C.
Avail:NTIS, CONF-761157 Jrnl: Proc. of Workshop, 127 p., Washington Sci. Mark., Inc.

This report discusses the objective of a workshop to develop specific ideas for research, development, and demonstration of fluid waste streams in the temperature range of 100° to 200° F, generated by various industrial processes. Industrial engineers, executives, and researchers knowledgeable of the thermodynamic processes participated within their various sectors. Joining them were technologists studying concepts which could be utilized for fluid waste heat augmentation. These areas of expertise included heat exchangers, heat pumps, heat pipes, and solar utilization techniques. Each project was evaluated by the groups in terms of energy conservation potential, time and money required for RD and D, and probability of implementation. A description of the recommendations generated during the workshop is contained in the final appendix.

ST78 14009 Recommendations for the Conceptual Design of the Barstow, California, Solar Central Receiver Pilot Plant, Executive Summary

Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-77-8035 Oct. 1977

As technical manager of the ERDA Division of Solar Energy's Central Receiver Progra, Sandia Laboratories has recommended subsystem designs that should be incorporated into the 10-Mw_e pilot plant to be built at Barstow, California. Those recommendations, along with a summary of technical information used in making the selections, are presented. These recommendations are relative to the design concept only; they are not intended to represent a rating of the contractors.

ST78 14010 Research Applied to Solar-Thermal Power Systems

Minnesota Univ., Minneapolis, MN
Avail:NTIS, NP-22688 1974

Photographs, diagrams, tables, and graphs are presented on various aspects of solar collectors, reflector life tests, heat pipes, solar absorber coatings, cost analysis of transfer loop systems, cooldown of absorber tubes, thermal conductivity of insulation, and thermal storage.

ST78 14011 Solar Thermal Conversion to Electricity Utilizing a Central Receiver, Open-Cycle Gas Turbine Design, Summary Report

Black and Veatch Consulting Engnrs., Kansas City, MO
Avail:NTIS, EPRI-ER-387-SY March 1977

A completed conceptual design of a solar-electric power plant intended for intermediate load range utility applications is reported. The conceptual design effort encompassed all principal aspects of the plant system, with particular attention directed toward the crucial heliosatt field, high temperature solar receiver, and turbine-receiver interface elements. The plant design incorporates a conventional and commercially available open-cycle, regenerative gas turbine as the prime mover. A high-temperature ceramic heat exchanger is used to capture concentrated solar radiation and to heat air to the high temperatures, 980 to 1065 C (1800°to 1950°F), required for efficient turbine operation. The gas turbine generator unit and the solar receiver-heat exchanger are both located atop a tall steel-reinforced-concrete tower that is surrounded by an array of sun-tracking reflecting surfaces (heliostats). The capital costs, in 1976 dollars, of the conceptually designed plant are estimated to be in the $1250 to $1660 per kw range, depending upon the cost of heliostat subsystems. The estimated costs are lower than, and the efficiency of this system is superior to, that of a water-steam solar-electric system.

ST78 14012 Three Companies Compete in Designing 10-MW Pilot Plant

Mach. Design, V 49:30-32, N3, Feb. 10, 1977

Competing designs are being considered for a 10-Mw solar-electric pilot plant to be constructed in the California Desert. The principal differences among the contractors' proposals are their heat storage systems. Two propose the use of sensible-heat systems and a third proposes a latent-heat storage system. As a cost-cutting step, all contractors will use a heliostat constructed of silvered float glass rather than exotic mirrors.

ST78 14013 Utilization of Solar Radiation at Large Solar Power Plants With Pumped Storage

Aparisi, R.R.; Teplyakov, D.I.
Avail:NTIS, 78C0030386 Jrnl: Appl. Solar Energy, USSR, Trans. to Engl., V 13:1-7, N1, 1977

The specific solar-radiation influx regimes are responsible for the problem of storing the energy developed at a solar power plant. To solve this problem, it is necessary to provide not only for daily storage, but also for seasonal and even yearly volumes of storage. Of the various alternatives so-called pumped-storage systems stand out. In principle, these contain the main elements of a system ensuring the development of production and favorable human living conditions (energy, water). In association with fairly ramified and extensive power systems, solar electric power plants do not necessarily have to be constructed in direct proximity to the dams of hydroelectric power plants. It is sufficient that they operate in a common electric network or from a common network.

ST78 14014 Use of Solar Energy For Direct and Two-Step Water Decomposition Cycles

Bilgen, E.; Ducarroir, M.; Foex, M.; Sibieude, F.; Trombe, F.
Ec. Polytech. de Montreal, Montreal, Quebec
Jrnl: Int. J. Hydrogen Energy, V 2:251-257, N3, 3 refs, 1977

This report describes a study of the feasibility of using concentrated solar energy at high temperatures to decompose water. The preliminary studies show that direct decomposition of water at 2000-2500 C is possible and the main development should be directed to reactor design and the separation of product gases. It is also shown that two-step thermochemical cycles for hydrogen production are feasible when the reactions are carried out at appropriate high temperatures in a solar furnace. The thermal decomposition of zinc oxide, suitable for such a two-step cycle, is studied in detail.

ST78 14015 Central Receiver Solar Thermal Power

Blake, F.A.
Symp. on 5-MWT STTF, 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Proc. of Symp.

An extensive overview is given of the conceptual baseline configuration for a 10-Mw_e central receiver solar thermal power pilot plant. The field layout, overall system schematic, and detail diagrams of all subsystems are presented. A design point chart shows power required at each significant point in the system where performance can be audited. Efficiency tables and a day performance profile chart are included. The thermal storage research experiment, features of a one-Mw_{th} cavity receiver steam generator, the electric power generation subsystem, and the heliostat research experiment and test calorimeter are all discussed. An economic summary of all pilot plant subsystems is included.

ST78 14016 Integration of Solar Thermal Power Plants into Electric Utility Systems

Braun, G.W.; Ballance, J.W.
S. California Edison Co., Rosebud, CA
Avail:NTIS, N78-14666

The findings of a study designed to fill the need for an electric utility to evaluate solar thermal power plants are summarized. Calculations are described which were used to compute the economic value of solar power plants to an electric utility under assumptions that are valid today. Topics covered are reliability evaluation, economic evaluation, storage, system operation, and cost and design considerations.

ST78 14017 Eye Hazard and Glint Evaluation for the 5-MW_t Solar Thermal Test Facility

Brumleve, T.D.
Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-76-8022 May 1977

Potential eye hazards associated with concentrated reflected light are evaluated for the ERDA five-Mw_t solar thermal test facility to be constructed at Sandia Laboratories, Albuquerque, New Mexico. Light intensities and hazardous ranges of single and multiple-coincident heliostat beams are evaluated at ground level and in the air space above the facility. Possible long-range and short-range effects of distractive effects of reflected beams are discussed. Also described are certain beam control modifications which were incorporated to minimize the altitudes at which overflying aircraft could encounter unsafe levels. Recommendations are made for further evaluation of intensity excursions during fail-safe shutdown situations, and for experiments to verify analytical models and to asses distractive glint effects.

ST78 14018 High-Temperature Solar Energy System

Brumleve, T.D.
Sandia Labs., Livermore, CA
Avail:NTIS, CONF-741197 1974

A system for collecting large amounts of solar energy at high temperature and high efficiency has been under investigation since late 1972 at Sandia Laboratories, Livermore, for applications which benefit from temperatures greater than 673 K (752°F). The system consists of a large array of individually controlled, nearly flat mirrors which direct solar energy into a cavity-type absorber at the top of a centrally located tower. The concentrated solar flux enters the insulated cavity from the bottom through a windowless aperture and is absorbed directly in a film of molten eutectic salt flowing down the interior walls. It appears that over 95 percent of the solar energy entering the aperture can be absorbed and delivered to an electrical power plant at a temperature of about 768 K (923°F). Current economic studies indicate that in the southwestern US, at a mirror module cost of $20 to $40 per m^2, the system becomes competitive with new fossil power plants at a fuel cost of $1.50 to $2.50 per million BTU depending upon the mode of operation. For certain types of solar systems, Busbar energy costs are only about 10 to 20 percent higher at $1.00 per million BTU. Continuing analytical, design, and experimental efforts are aimed at demonstrating component and system feasibility, optimizing system performance, and evaluating key economic questions. The system is described briefly and the current status of these investigations is summarized.

ST78 14019 Status of Photoelectrochemical Production of Hydrogen and Electrical Energy

Byvik, C.F.; Walker, G.H.
NASA, Hampton, VA
3rd UP Symp., Sept. 1976
Avail:NTIS, CONF-760646 Jrnl: Proc. of Symp.

The efficiency for conversion of electromagnetic energy to chemical and electrical energy utilizing semiconductor single crystals as photoanodes in electrochemical cells has been investigated. Efficiencies as high as 20 percent have been achieved for the conversion of 330 nm radiation to chemical energy in the form of hydrogen by the photoelectrolysis of water in a $SrTiO_3$-based cell. The $SrTiO_3$ photoanodes have been shown to be stable in 9.5 M NaOH solutions for periods up to 48 hours. Efficiencies of nine percent have been measured for the conversion of broadband visible radiation to hydrogen using N-type GaAs crystals as photoanodes. Crystals of GaAs coated with 500 nm of gold, silver, or tin for surface passivation showed no significant change in efficiency. By suppressing the production of hydrogen in a CdS-based photogalvanic cell, an efficiency of nine percent has been obtained in conversion of 633 nm light to electrical energy. A CdS-based photogalvanic cell produced a conversion efficiency of five percent for 500 nm radiation.

ST78 14020 Balance-of-Plant Power Requirements for Advanced Power Systems

Chait, I.L.
Res. Triangle Inst., Res. Triangle Park, NC
EEC Symp., Aug. 1976
Avail:NTIS, EPA-600/2-76-212

The growth in unit size of central station steam power plants in the last 20 years has been accompanied by a parallel and even more rapid growth in the auxiliary power required to operate the unit. From a nominal four to six percent of rating, onsite auxiliary power has steadily increased, and today, often takes 10 to 12 percent of the plant's output. The increases have resulted from a combination of environmental regulations and more severe operating conditions. Many proposed advanced power-conversion plants include, in addition to the usual auxiliaries, process equipment not found in today's plants. The power demand of all these auxiliaries may exceed the totals of present-day plants and must be included in determining the overall performance of advanced power systems, particularly when comparisons are made among such systems. To achieve the efficiencies and environmental acceptance desired, power plants using advanced power conversion systems, such as MHD generation, fuel cells, advanced steam and gas turbines in various combinations, fusion reactors, and solar collectors, are combined with topping and bottoming plants, which look very much like present-day plants. For equally cogent reasons, they are integrated with coal gasification and fuel-conditioning processes, cryogenic refrigeration, magnets, oxygen plants, scrubbing systems, seed recovery, and similar energy-consuming auxiliaries. The power load imposed by these additional processes may significantly reduce the overall plant thermal efficiency. From the viewpoint of energy and environment conservation, considerable benefit can be achieved by optimizing the balance-of-plant systems. Efforts for such improvements should proceed on parallel paths with, and at the same pace as, the efforts being made in developing the main advanced power-conversion systems.

ST78 14021 Central Receiver Solar Thermal Power Program Overview

Coleman, G.C.
Symp. on 5-MWT STTP, 1976
Avail:NTIS, ALO/3701-76/1

A brief overview is presented of the conceptual design of a 10-MW_e solar thermal power plant. Design concepts for the collector, thermal storage, heat rejection, electrical power generation, tower and receiver assembly, and master control system are discussed and diagrammatically shown. The project flow and project milestone charts are included.

ST78 14022 Central Receiver Power Plant: An Environmental, Ecological, and Socioeconomic Analysis

Davison, M.; Grether, D.
Univ. of California, Berkeley, CA
Avail:NTIS, LBL-6329 June 1977

The technical details of the central receiver design are reviewed. Socioeconomic questions are considered including market penetration, air industrial sector model, demands on industry, employment, effluents associated with manufacture of components, strains due to intensive construction, water requirements, and land requirements. The

ecological effects in the vicinity of the central receiver plant site are dealt with, with emphasis on effects on land surface, mammals, and reptiles and amphibians. Climatological considerations are reviewed including desert types, effects of surface albedo modification, effects of aerosols, effects on evaporation rates, the heliostat canopy, effects on turbulent transfer rates, effects on the wind profile, a model of convection about a central receiver plant, and a global scenario. Drawings of heliostat and plant design are included in appendices.

ST78 14023 Solar Thermal Electric Power Systems: Comparison of Line Focus Collectors

Duff, W.S.; Shaner, W.W.
Colorado State Univ., Fort Collins, CO
"Sharing the Sun," 1976
Jrnl: STS Proc., ASISES, Cape Canaveral, FL

Three different line focus collectors, the parabolic trough, the circular array of fixed slats with a movable absorber, and the linear array of movable curved slats with a fixed absorber, are evaluated using minimum cost per kw hour of electricity generated as the measure of performance. The minimum cost of electricity is found using a sequential optimization approach that considers variations in rim angle, reflectance, aperture width, length, orientation, tracking, contour error, slat width, slat curvature, tangent slat angle, slope, design, installation methods, materials, fabrication methods, absorptance, emittance, cover transmittance, field shape, layout, pipe sizes, insulation thickness, and turbine-generator cooling-tower efficiencies and designs. This approach provides a uniform treatment of both cost and performance for the solar thermal electric power system. This uniform treatment of solar thermal electric power systems for all collector types insures that valid comparisons can be made.

ST78 14024 White Sands Solar Furnace

Dysart, R.Q.
White Sands Missile Range
Avail:NTIS, CONF-741197 1974

The heliostat and concentrator are described and their alignment is discussed. Other topics mentioned are the attenuator, the test chamber, and weathering.

ST78 14025 Large-Scale Central Receiver Solar Test Facilities

Francia, G.
Univ. of Genoa, Genoa, Italy
Avail:NTIS, CONF-741197 1974

The solar plants described all have in common anti-radiating structures either like honeycombs or parallel planes made of a material which is transparent to solar rays and black to thermic rays (glass, quartz, plastic materials) perpendicular to the surface to be protected. The solar rays meeting the walls of the structure go partly through it and partly are reflected but all their energy reaches the absorber. The plants described are the solar boiler of Casana Torinese, the linear solar boiler of Marseilles, and the three point-shaped solar boilers at St. Ilario of Nervi, Genoa. The design, performance testing, and operation of each is discussed briefly.

ST78 14026 5-MW Solar Thermal Test Facility

Grosskreutz, C.
Symp. on 5-MW STTF, 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Proc. of Symp.

An extensive description of objectives, features, and capabilities of the five-MW solar thermal test facility at Albuquerque is presented. Praparations for initial bench model receiver tests at one-mw and five-mw are reviewed. Curves are presented for power as a function of heliostat field area, with time of day and day of year as parameters. A table is presented of flux concentrations at different tower elevation levels to be used for subsystem research experiments. Numerous diagrams are included that show the test site plan, heliostat layout, receiver tower and associated test facilities, heat rejection system, and power distribution system. Data acquisition facilities are discussed. A milestone chart for test facility completion is included.

ST78 14027 A Novel Gas Adsorption Cycle for Solar Thermal Power Generation

Hartman, T.L.Jr.; Hartman, T.L.III; Williams, J.R.
Georgia Inst. of Tech., Atlanta, GA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11323 Jrnl: Proc. of Mtg., Secs. 14-25, p.20-16--20-19, ISES, Cape Canaveral, FL

The present configuration for solar thermal power towers are severely restricted by the low thermal efficiency which results from the temperature and pressure restriction under which they must operate. This paper presents a new thermodynamic cycle which, while operating under the same pressure and temperature restrictions, offer significantly increased performance. It should be noted that this cycle is not restricted to solar power applications, but may also be of utility in nuclear and fossil fuel applications. This paper presents a summary of previous research, a detailed heat balance of the cycle, and the scope and initial results of on-going research.

ST78 14028 White Sands Solar Furnace Test Facility

Hays, R.A.
Symp. on 5-MWT STTF, 1976
Avail;NTIS, ALO/3701-76/1 Jrnl: Proc: of Symp.

A very brief description is given of the system and test performance capabilities of the White Sands Solar Furnace Test Facility. Total usable thermal power of 40 kw is quoted. Thermal pulse lengths as short as 0.1 sec with 30 msec rise times are obtainable. In addition to defense testing, the facility is used for solar energy investigations. These include synthetic production of calcium carbide, non-uniform heating of pressurized tubes, reactor heat exchanger materials tests, surface materials coatings, and hot air receiver tests. A plot of the facility irradiance profile at the focal plane is included.

ST78 14029 Potential Role of Solar Thermal Electric Power in the US

Hoover, D.Q.; Watt, A.D.
Westinghouse Electric Corp., East Pittsburgh, PA
Avail:AIAA, A78-10743 Jrnl: Energy Development II, p. 130-140, 1976, IEEE, New York, NY

The paper considers the potential for the production of electrical energy by means of conversion of the incoming electromagnetic energy to thermal energy and then its subsequent conversion via some type of heat engine to the generation of electrical energy. Insolation in the United States is discussed with emphasis on atmospheric effects, insolation observed at the earth surface, and energy available to various collectors. Consideration is also given to collectors and their performance, the transport and storage of energy, heat engines, and system performance and costs.

ST78 14030 Optical Analysis of Solar Facility Heliostats

Igel, F.; Hughes, R.L.
Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-77-0582 May 1977

An experimentally verified simple analytical model, based on classical optical aberrations, is derived and predicts the power reception of a central receiver solar facility. A laboratory simulation was made of a typical heliostat, and its images were photographed and measured at several angles of incidence. The analytically predicted image size is in agreement with experiment to within less than 10 percent over an incident angle range of 60 degrees. Image size for several of the heliostats in the Sandia-ERDA Solar Thermal Test Facility Array were calculated throughout a day and compared with ideal images and the size of the receiver. The optical parameters of the system and the motion of the sun were found to severely affect the design and optimization of any solar thermal facility. This analysis shows that it is the aberration astigmatism which governs the solar image size at the receiver. Image growth is minimal when heliostats are used at small angles of incidence, which usually corresponds to a limited operating time of two to three hours. However, image size is markedly increased at large angles of incidence. The principal result is that the predominant sources of image enlargement are identified and measures for minimizing these enlargements are presented. This analysis considers only the idealized optical problem and does not consider the pragmatic errors associated with implementation and operation of a heliostat array.

ST78 14031 Piping Design Considerations in a Solar-Rankine Power Plant: Pipe Size

Lansing, F.L.
JPL, Caltech, Pasadena, CA
Avail:NTIS, N78-15085 Jrnl: Its the Deep Space Network, V 39:168-176

Two of the main parameters in sizing the piping of a solar power plant are the working pressure of the vapor leaving the solar collectors, and the type of working fluid used. Numerical examples for each case are given using the graphical moody friction charts and the analytical Darcy-Weisbach equation. Different working pressures of steam vapor in the solar collector-turbine pipe connection indicate their major role in the design. The size variation was found not to be in linear proportion to vapor density variations. On the other hand, high molecular weight organic fluids such as R-11 and R-113, when compared with water, show insignificant changes in piping sizes.

ST78 14032 Cellwise Method For the Optimization of Large Central Receiver Systems

Lipps, F.W.; Vant-Hull, L.L.
Univ. of Houston, Houston, TX
1977 Annual Mtg. of ASISES, 1977
Avail:NTIS, 78C0001705 Jrnl: Proc. of Mtg., Secs. 14-25, V 1, ASISES, Cape Canaveral, FL

The total number of heliostats in the collector field determines the approach to the optical simulation problem. For large central receiver systems, it is desirable to introduce a cell model which establishes an array of representative heliostats. There is now an arsenal of computer programs which allows one to optimize the arrangement of heliostats in the collector field subject to the approximations of the cell model. Each cell contains an arbitrary regular two-dimensional array of heliostats.

ST78 14033 Plans and Programs of the Division of Solar Energy

Marvin, H.
Symp. on 5-MWT STTF, 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Proc. of Symp.

The areas of solar energy research, development, and demonstration emphasized in the Division of Solar Energy budget in FY76, FY77 are spelled out. Expectations of increased funding allocated to the high priority for research and development in the Central Receiver Program are voiced. The intention that the Solar Thermal Electric Test Facility will be accessible to user groups in other research areas is stated.

ST78 14034 Use of Solar Energy in Large Solar Power Plants

Meinhardt, H.
Jrnl: Elektr. Energie-Tech., V 21:375-380, N18, Sept. 1976, In German

The article first gives a survey of the energy sources on the earth: fossil fuels, nuclear energy, and non-conventional energy sources. Solar energy has a special position among the energy sources. Characteristic values for solar radiation are given. Finally, large solar power plants, air heat power plants, and sea heat power plants are discussed with regard to their profitability and applicability.

ST78 14035 Solar Tower: Thermal Collection Energy Component 10-MWe Pilot Plant

Meyers, A.C.III; Hildebrandt, A.F.
Univ. of Houston, Houston, TX
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11322 Jrnl: Proc. of Mtg., Secs. 14-25, p. 20-11--20-15, 1977, ISES, Cape Canaveral, FL

Net energy analysis is characterized and key terms are defined. The analysis is applied to the thermal collection segment of the 10-Mwe Solar Tower Central Receiver Pilot Plant to determine the amount of energy this subsystem component represents with respect to the construction and operation of the facility. The first step in net energy analysis is to determine the material make-up of the various components. The process energy consumption for production of raw steel and of concrete are calculated, as are the capital energy required and the time required to recover capital energy.

ST78 14036 The Impact of Solar Central Electric Technology on the Regulated Utility

Murray, D.A.
Univ. of Oklahoma, Norman, OK
3rd Annual UMR-MEC Conf., Oct. 12-14, 1976, Rolla, MO
Avail:AIAA, A78-11119 Jrnl: Proc. of Conf., p. 768-776, 1977, Western Periodicals Co., N. Hollywood, CA

Scale-up of the generation of electric power from solar energy to pilot-plant level is discussed. The "framework in which the solar central electric technology will likely be developed" is outlined, admittedly without any "detailed engineering cost estimates of specific plans." The pro forma impact of pilot plant designs for a proposed (Hobbs, NM) solar central on the local utility is discussed. Regulatory or other provisions likely to encourage economically optimal integration of solar energy facilities into the public utility grid are examined.

ST78 14037 Use of Sandia Facility

Otts, J.
Sandia Labs., Albuquerque, NM
Symp. on 5-MWT STTF, 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Proc. of Symp.

The objectives and proposed operational use of the five-MW_{th} solar thermal test facility are reviewed. Open discussions of users' questions are included. Scheduling, data acquisition services, test planning, and dissemination of information on facility capabilities are discussed.

ST78 14038 System Test Facility Power Conditioning Hardware Testing

Pickrell, R.L.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

Inverters are required to convert the DC power available at the solar array output terminals to the AC power form required to drive most electric devices in this country. Tests on three type designs for single-phase line voltages are planned for the STF. The first two are off-the-shelf designs and are already installed in the STF. The third is in the procurement process and will be custom tailored to better match the PV application requirements. Performance data from the first unit under test, a line commutated eight-kW inverter, are presented together with a discussion of its operating characteristics. The second unit, a five-kva unit for stand-alone system operations, has just been installed and data is not available yet, except for manufacturers specifications. The 10-kva new design unit performance goals and a discussion of the special requirements for photovoltaic applications are presented. In addition, block diagrams showing parameter measurements and specialized measurement equipment are presented. Test conducted to date have demonstrated that inverters can be operated to extract energy from a solar array and transfer that energy to a commercial power system in a controlled manner to optimize the amount of energy output from the solar array. Plans are underway to design, build, and deliver a custom designed self-commutated 10-kva inverter by September 1977 for photovoltaic applications.

ST78 14039 10-MWe Pilot Plant: Design for Solar Thermal Test Facility

Powell, J.C.
Symp. on 5-MWT STTF, 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Proc. of Symp.

An overview is given of the design of the 10-MW_e Solar Thermal Central Receiver Pilot Plant. Design parameters for the plant are presented. Conceptual designs for the heliostats, thermal storage subsystem, central receiver, and steam generator are presented and diagrammed. A description of the test instrumentation is included. A computer map of the incident flux on receiver cavity walls is discussed. A flow schematic of the solar steam generator and a pictorial drawing of the thermal storage tank design are presented.

ST78 14040 Central Receiver Collector Subsystem Design

Ratcheson, W.I.; Gillette, R.B.
Sandia Labs., Albuquerque, NM
STCPCP Proj., March 1977
Avail:NTIS, SAND-77-8011 Jrnl: Highlights Rept. of Proj.

Boeing is developing a preliminary design for the collector (heliostat) subsystem for a 10-Mw_e solar pilot plant. The collector subsystem concept, operating with a central receiver installation, is shown. Several heliostat field geometries have been investigated with the aid of a heliostat array simulation computer model. Three heliostats and a drive and control assembly are being tested at a Boeing Desert Test Site in northeast Oregon to provide design data and verification of the preliminary design. An extensive evaluation program is being conducted on the key plastic materials used for the protective enclosure and reflector.

ST78 14041 Construction of a Large Solar Furnace, VI, Protection of Aluminized Mirror Surfaces

Sakurai, T.; Sudo, Y.
Tohoku Univ., Sendai
Avail:NTIS, CONF-741197 1974

Spectral transmission at wavelengths of 0.2 mu through 0.5 mu for window glass, white glass, acrylic, and vinyl plate were measured. The vinyl plate was chosen as the material for the protective film. The mirror was dipped in polyvinyl (vinylose) dissolved in lacquer-thinner and pulled up to dry in air. It was considered that the stripes on the film obtained by this method should not interfere with the reflected image. Following experiments proving that a protective film was a practicality, a large solar furnace was constructed. The surfaces of the first mirrors coated were inspected and no corrosion or water damage were found.

ST78 14042 Study on the Solar-Furnace Instrumentation in Tohoku University

Sakurai, T.
Tohoku Univ., Sendai
Avail:NTIS, CONF-741197 1974

In 1964, a 70-kw solar furnace of the heliostat type was constructed at Tohoku University. A paraboloidal concentrator 10 m in aperture and 3.2 m in focal length is a mosaic composed of 180 segments that have been ground and polished accurately into portions of a paraboloid and aluminized to form front-surface mirrors. Using the furnace, various oxides were fused and their physical properties were investigated. Recently, a novel infrared pyrometry to measure the target temperature and a microwave ellipsometry to measure the electrical conductivity at high temperatures have been developed. Study on solar concentrators is being continued. Various methods of fabrication mirror segments of a concentrator are presented.

ST78 14043 Solar Thermal Power Generation

Teagan, W.P.; Atallah, S.; Glaser, P.E.
Arthur D. Little, Inc., Cambridge, MA
Avail:NTIS, 78C0001666 Jrnl: Heliotechnique and Development, V 1, 1976, Dev. Analysis Assoc., Inc., Cambridge, MA

This paper discusses the preliminary design and feasibility analysis of a 100-kw electric generation station utilizing solar energy. The primary components of the system are an advanced flat-plate solar collector array and a rankine-cycle engine which utilizes an organic fluid. Preliminary estimates for the cost of power generated by the proposed facility lies between 3.9 and 6.8 cents/kwhr. A marked improvement in collection efficiency can be realized by the addition of a simple reflector system, which in turn, would reduce the cost of power generation by 15 to 30 percent.

ST78 14044 Tower-Type Solar Power Plant: Configuration and Thermal-Regime Stability of Receivers and Steam Generators

Teplyakov, D.I.; Aparisi, R.R.
Krzhizhanovski State Sci-Res. Energy Inst, USSR
Jrnl: Appl. Solar Energy, V 13:31-39, N2, 9 refs, 1977

This report describes a graph-analytic method with results obtained for calculating the irradiances of cylindrical receiver steam generators formed by flat fields of reflectors in tower-type solar power plants. The "thermal bias" appearing at the ray-collecting surfaces of the receivers in the course of the working day is demonstrated; it results from changes in geometry and in the amount of direct solar radiation.

ST78 14045 Results of Experiments With Heliostats for Central Receiver Power Plants

Thornton, J.P.; Waddington, D.
Martin Marietta Corp., Denver, CO
1977 Annual Mtg. of ASISES,
Avail:NTIS, 78C0001701 Jrnl: Proc. of Mtg., Secs. 14-25, V 1, ASISES, Cape Canaveral, FL

Two new applications of standard techniques are providing more accurate measurements of heliostat performance over longer ranges than have ever before been achieved. Four experimental heliostats have been fabricated and installed in the solar thermal test facility at Martin Marietta, Denver. Performance testing of these heliostats has been completed, and the resulting data are being used in support of the design of commercial central receiver solar power plants. Both the design of the experimental heliostats and the results of the performance testing are described.

ST78 14046 One-MWTH Solar Cavity Steam Generator Solar Test Program

Tracey, T.R.; Blake, F.A.; Royere, C.; Brown, C.T.
Martin Marietta Aerospace, Denver, CO
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11329 Jrnl: Proc. of Mtg., Secs. 14-25, p. 21-15--21-20, ISES, Cape Canaveral, FL

The solar test program for a one-mwth solar cavity steam generator is described. In this system, the parabolic concentrating mirror receives the redirected beam of solar radiation from the heliostat field and focuses it to a point in the focal building; the experimental equipment placed at this point is irradiated by the concentrated solar radiation. It is concluded that the thermal performance of the generator has demonstrated the potential of the cavity receiver concept. Both the cavity efficiency and the boiler efficiency exceeded 90 percent, with potential further improvements indicated. High solar utilization factors were realized during long test runs, with rated pressures maintained over 91 percent, and rated superheat over 78 percent of available daily insolation. No excessive thermal stresses were detected.

ST78 14047 French CNRS 1000-KW Solar Furnace: Description, Performance Characteristics, Present Utilizations, and Perspectives

Trombe, F.; Le Phat Vinh, A.; Royere, C.
CNRS Solar Energy Lab., Odeillo, France
Avail:NTIS, CONF-741197 1974

The predecessors of this solar furnace are discussed briefly. The facility is described with emphasis on the tracking systems. The energetic performance characteristics of the Odeillo furnace are discussed and shown graphically. Other topics covered are methods for measuring heat flux density, use of solar furnace for thermal shock studies, automatic control of thermal flux, and use for processing refractory materials in cavity centrifugal furnace and fixed cavity furnace.

ST78 14048 French CNRS 1000-KW Solar Furnace: Description, Performance Characteristics, Present Utilization, and Perspectives

Trombe, F., Le Phat Vinh, A., Royere, C.
CNRS Solar Energy Lab., Font Romeu, France
Jrnl: Alternative Energy Sources, Academic Press, New York, NY, 1976

The history, facility description, energetic performance characteristics, and methods for measuring heat flux density are discussed. The utilization of the solar furnace for thermal shock studies and processing refractory materials is described. Processing in a cavity centrifugal furnace, apparatus for processing piled materials, and processing a fixed-cavity furnace are discussed.

ST78 14049 Liquid Sodium Cooled Solar Tower System

Vant-Hull, L.L.
Univ. of Houston, Houston, TX
1977 Annual Mtg. of ASISES
Avail:NTIS, 78C0001700 Jrnl: Proc. of Mtg., Secs. 14-25, V 1, ASISES, Cape Canaveral, FL

A low-pressure liquid sodium cooled central receiver system is described. The high thermal conductivity of liquid metals leads to a more compact and efficient receiver while the generation of turbine steam from hot stored sodium decouples the turbine from the receiver and leads to very efficient trouble-free operation. Safety and economics of the sodium system are comparable to a water steam system with hot oil and rocks thermal storage.

ST78 14050 Liquid Metal Cooled Solar Central Receiver Feasibility Study and Heliostat Field Analysis

Vant-Hull, L.L.; Raetz, J.
Sandia Labs., Albuquerque, NM
STCPCP Proj., March 1977
Avail:NTIS, SAND-77-8011 Jrnl: Highlights Rept. of Proj.

A 100-Mw_e sodium-cooled, solar central receiver system is being analyzed to defing the conceptual design and determine the technical feasibility of the system. Additional work on slope and latitude studies for a water steam receiver, net energy balance, and insolation are described.

ST78 14051 Solar Thermal Developments in Foreign Countries

Vant-Hull, L.L.
Univ. of Houston, Houston, TX
Symp. on 5-MWT STTF, 1976
Avail:NTIS, ALO-3701-76/1 Jrnl: Rept. on Symp.

Programs for development and demonstration of solar furnaces and solar thermal power generation systems in several foreign countries are briefly scanned. An over-all evaluation of the goals of projects in France, Italy, Japan, and Switzerland is made. The efforts in these countries are classed as aimed at systems for markets in remote areas and developing countries. Russian efforts are regarded as confined to an academic level. No Chinese effort is seen as evident.

ST78 14052 A Liquid Sodium-Cooled Solar Tower System

Vant-Hull, L.L.
Univ. of Houston, Houston, TX
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11325 Jrnl: Proc. of Mtg., Secs. 14-25, p. 20-25--20-29, ISES, Cape Canaveral, FL

A low-pressure liquid sodium-cooled central receiver system is described. The high thermal conductivity of liquid metals leads to a more compact and efficient receiver while the generation of turbine steam from hot stored sodium decouples the turbine from the receiver and leads to very efficient trouble-free operation. Safety and economics of the sodium system are comparable to a water steam system with hot oil and rocks thermal storage.

ST78 14053 Georgia Tech. Solar Thermal Test Facility

Walton, J.D.
Symp. on 5-MWT Solar Thermal Test Facility, 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Rept. on Symp.

The site plan, mirror and drive mechanism design, thermal test capabilities, areas of application, and construction schedule for the Georgia Tech. solar thermal test facility are briefly discussed. Flat mirrors are employed in focused and non-focused operation. Design of a kinematic motion drive mechanism for solar tracking at the latitude of Atlanta is briefly discussed. Solar energy is focused into a steam boiler and superheater. A performance curve is presented that shows available heat flux and concentration ratio vs. equilibrium temperature at the test facility for flat and focused mirrors. Indicated testing applications are receivers, materials, coatings, thermal energy storage, other system studies. A construction schedule is given. Facility operation is slated to begin in July 1977.

15,000 THERMIONIC, THERMOELECTRIC

ST78 15033 Closed-Cycle High-Temperature Central Receiver Concept for Solar Electric Power

Boeing, Seattle, WA
Avail:NTIS,EPRI-ER-403-SU Aug. 1976

The Electric Power Research Institute (EPRI) awarded Boeing a contract to examine the technical feasibility of a high-temperature gas-cooled central receiver for producing electric power from solar energy using a closed Brayton helium cycle. Feasibility was examined in terms of system life, efficiency, cost, and technology requirements. These considerations have been implemented into the conceptual design of a receiver for utilization in a 100-MW output solar plant. The rationale is provided which supports the configuration, equipment arrangement, and material choices. Thermal cycling tests simulating a 30-year lifetime of the receiver's heat exchangers at operational temperatures to 816 C (1500°F) were performed to select materials. Preliminary design considerations were made for a one-MW bench model receiver to verify the full-scale receiver. Preliminary planning was developed for a 10-MW electrical pilot plant to follow the receiver verification. The scope of the study also included system/subsystem definition for employing the central receiver design in a solar plant and predicting plant performance. Conceptual designs of several thermal energy storage devices were defined, integrated into plant performance and operational models, and evaluated with energy cost as the criteria. The information developed during the study is highlighted in this final summary report.

ST78 15034 Closed-Cycle High-Temperature Central Receiver Concept for Solar Electric Power

Atlas Corp., Santa Clara, CA; Boeing, Seattle, WA
EPRI Procs., Feb. 1977
Avail:NTIS, EPRI-ER-371-SR, 78C0001675

The concept definition of a closed-cycle high-temperature central receiver plant capable of producing 100 MW_e of electrical power is presented. The design and fabrication of a one-MW_{th} receiver which simulates the 100-MW receiver and plans for testing the materials and concepts selected in an operational environment are described. The test period and data evaluation of the one-MW_{th} receiver design are outlined.

ST78 15035 Open-Cycle Gas Turbine Solar Electric System, Conceptual Design of High-Temperature Receiver and Turbine Interfaces

Atlas Corp., Santa Clara, CA; Black, Veatch Engng., Kansas City, MO
EPRI Procs., Feb. 1977
Avail:NTIS, EPRI-ER-371-SR, 78C0001676

The completed conceptual design of a solar-electric power plant intended for intermediate load range utility applications is reported. The conceptual design effort encompassed all principal aspects of the plant system, with particular attention directed toward the crucial heliostat field, high-temperature solar receiver, and turbine-receiver interface elements. The plant employs a conventional and commercially available open-cycle regenerative gas turbine as the prime mover. A high-temperature ceramic heat exchanger is used to capture concentrated solar radiation and to heat air to the high temperatures (app. 982 C, app. 1800°F) required for efficient turbine operation. The gas turbine generator unit and the solar receiver-heat exchanger are both located atop a tall, steel-reinforced concrete tower that is surrounded by an array of sun tracking reflector surfaces (heliostats).

ST78 15036 Closed-Cycle High-Temperature Central Receiver Concept for Solar Electric Power

Atlas Corp., Santa Clara, CA
EPRI Procs., Feb. 1977
Avail:NTIS, EPRI-ER-283-SR Jrnl: Solar Electrical Power, V 2

The initial phase of the program described concentrated on the conceptual design of the receiver. To establish performance requirements for the receiver, a solar plant concept developed earlier by Boeing was base-lined. This early work used a closed-cycle concept with helium as a working fluid. The system was assumed to have an operational mode that allowed the plant to produce electrical power, limited only by the solar insolation available up to a 100-MW_e maximum capacity. The design goal was the conceptualdesign of a receiver with a 30-year lifetime using state-of-the-art technology,

materials, and fabrication techniques. The work under the second phase of the program expands the Phase I receiver concept into a more complete system definition. The impact energy storage on system operations has been added in this phase. Alternate working fluids have been considered (e.g., air and other gas mixtures) and qualitative performance and cost comparisons of closed-cycle systems with open-cycle and steam rankine systems are in progress.

ST78 15037 Open-Cycle Gas Turbine Solar Electric System

Atlas Corp., Santa Clara, CA
EPRI Procs.
Avail:NTIS, EPRI-ER-283-SR, 78U0001674

The general objective of the project described is to develop a conceptual design of a central receiver-type solar electric system, which utilizes an open-cycle gas turbine as the prime mover. The two specific objectives are to develop a conceptual design of a high-temperature receiver capable of producing 1800-2000 F air, and to select the turbine and interface ducting which will allow hybrid operation from either the solar receiver or a fossil fuel combustor. The project also is addressing the design of the heliostat field best suited to this type application. Non-uniform ground cover and a non-symmetric field-tower configuration are being pursued. The high-temperature receiver, or heat exchanger, design utilizes silicon carbide ceramic tubes. A conceptual design has been developed which permits the operation of a utility-type gas turbine from either solar or fossil fuel heat, or from both sources simultaneously. The central receiver tower has been designed to support both the high-temperature cavities, one for each field quadrant, and the gas turbine-generator set at the top. For a 60-MWe system. The tower is 700 feet tall.

ST78 15038 Experimental Study of Temperature Fields in Liquids in the Steady State Regime For Solar Thermoelectric Generator Cooling

Annamukhammedov, E.; Agabaev, C.
Akademiia Nauk Turkmenskoi SSR
A78-21030, Jrnl: Fiziko-Tekhnicheskikh, Khimicheskikh I Geologicheskikh Nauk, N4:32-36,1977
In Russian

Cooling liquids are used to equalize heat flux distribution on the hot surfaces of solar thermoelectric generators. This paper describes the testing of two such liquids, water and glycerin, performed for the case of heat flux energies of 0.25 x 10^6 w/m^2 fed to a heat-absorption surface with a Gaussian distribution. Temperature distribution on the heat-absorption and heat-removal surfaces was measured radially at points distributed every two centimeters by thermocouples. At optimal film thicknesses (150 mm for water and 100 mm for glycerin), the hot-surface temperature was reduced by 3-5 percent from maximum temperature.

ST78 15039 The Evening Out of Hot Junction Temperatures in Solar Thermoelectric Generators by a Disk Method

Annamukhamedov, E.
Turkmenskii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR
A78-20423, Jrnl: Fiziko-Tekhnicheskikh, Khimicheskikh I Geologicheskikh Nauk, N5:26-31, 1977, In Russian

The paper analyzes a disk method of maintaining an identical temperature in all the thermoelements of solar thermoelectric generators. (Non-uniformity of temperatures results in a loss of efficiency.) The method of determining the optimum thickness of the high-thermoconductance disk relies on a solution for the disk temperature field. By separation of variables the temperature field is analyzed for a uniform compact disk, and a procedure for calculating the temperature field is explained.

ST78 15040 Solar Radiation Collector and System for Converting and Storing Collected Solar Energy

Arthur, D.M.
US Patent no. 4,010,614; March 8, 1977

A system is disclosed for converting solar radiation into electricity and for storing energy generated in excess of demand. The system includes a large circular collector fabricated from modular elements. The collector is combined with a concentrator and boiler for producing steam. The steam produced is used to drive an electrical generator and a hydraulic pump. When system demand is less than the capacity of the generator, the excess energy is used to drive the pump. The pump transports water from a low-level

reservoir to an elevated reservoir, thereby storing potential energy. Later, when demand increases, water from the elevated reservoir is used to drive a second electrical generator. The circular collector is mounted on tracking apparatus which automatically aims the collector to focus on the sun and receive maximum solar radiation on its surface.

ST78 15041 Solar-Electrical Systems: Theory and Applications

Braunstein, A., Biran, D.
Tel Aviv Univ., Tel Aviv, Israel
Avail:IEEE, A78-10731 Jrnl: In Energy Development II, p. 33-39, 1976

A general description is given of a solar-electrical energy system, and the solar array and its output as a function of different radiation intensities are discussed. The energy balance concept of a solar-electrical system is developed for constant and varying loads, and criteria for the design of the energy systems are presented. The cost and reliability of solar-electrical systems are examined.

ST78 15042 Solar To Electrical Energy Converting System

Brinjevec, H.J.
US Patent no. 4,047,385; Sept. 13, 1977

This energy system comprises a metal sphere equipped on the outside thereof with two centrally located arc-shaped and pivoted arms which meet on the top of the sphere and are joined by means of a spring loaded connection. Each of said arms consists of a bank of spaced convex lenses which focus the rays of the sun into intensely hot focal points on the surface of the sphere. Inside the sphere are coils of pipe containing water which is converted to steam by means of a heating liquid in which these pipes are immersed, so that the heating liquid which is heated by the surface of the sphere in turn heats the coiled pipe changing the contained water to steam. The steam is fed to an engine or turbine, which in turn powers a dynamo which supplies electrical power. The heating fluid inside the sphere also circulates through a furnace which takes over the heating of the liquid during the absence of the sun's rays. Heat sensing devices spread the arms from the sphere when it becomes overheated beyond a predetermined temperature. In addition, the system is provided with the usual control valves, thermostats, and a heat exchanger.

ST78 15043 Promises and Problems in ERDA's Push For Solar-Electric Power

Connolly, R.
Jrnl: Electronics, V 50:58, Sept. 29, 1977

No abstract available.

ST78 15044 Some Problems Involved in the Development of a Solar Thermionic Power Plant

Grigor'ev, E.I.; Zaitsev, V.M.; Mel'nikov, M.V.; Nevezhin, O.A.
All-Union Sci-Res Inst. of Current Sources, USSR
Jrnl: Applied Solar Energy, V 13:6-10, N2, 1977

This report considers a thermionic energy converter for development of a solar power plant, used to operate under conditions of high equilibrium ambient temperatures. The experimental data is reported and analyzed for laboratory and solar tests of the converter.

ST78 15045 Open-Cycle Gas Turbine Solar Electric System

Grosskreutz, C.
Symp. on 5-MW STTF, 1976
Avail:NTIS, ALO/3701-76/1 78C0036055

A conceptual design overview for a gas-cooled central receiver driving an open Brayton cycle is given. Inherent problems are discussed, along with advantages of an open Brayton cycle approach. Overall advantages include high thermodynamic efficiencies, small water requirements, lack of a cooling tower requirement, and use of fossil fuel combustion, rather than thermal energy storage. Problems affecting feasibility include the need for a high-temperature receiver design, very high pressure and temperature materials requirements, and compressor-turbine design parameters. Results of computer analyses of receiver heat transfer surface geometry are described. Design and testing of a tube-type cavity receiver heat exchanger are discussed. Comparison is made between analytic and experimental results in heat exchanger design.

ST78 15046 Solar Energy Systems for Electricity Production

Herwig, L.O.
NSF, Washington, D.C.
Avail:IEEE, A78-10738 Jrnl: In Energy Development II, P. 92-95, 1976

A brief description is given of three system concepts of electricity generation from solar energy: (1)solar thermal, (2)photovoltaic, and (3)ocean thermal. Progress in improving the performance and reducing the costs of solar thermal systems is reviewed in more detail, with emphasis on the collector subsystem, energy transport, and thermal storage.

ST78 15047 General Method for the Evaluation of Possible Systems for Electric Generation With Solar Energy

Pollard, W.G.
Electrical Power Res. Inst., Oak Ridge, TN
"IEEE Power Engng. Soc., Summer Mtg," Mexico City, Mexico, July 17-22, 1977
Avail:IEEE, New York, NY, Paper F 77 757-8, 8 p., 5 refs

The paper consists of, first, a brief description of various possible solar-electric systems, two being presently developed by ERDA and the others briefly indicated. Secondly, the quantities employed in analysis of sites for a solar-electric plant are defined and their measured values given for ten representative sites in the United States. The third section is devoted to specifying characteristics of a planned solar-electric system on a chosen site and any auxiliary energy-storage systems planned for operation with it. The fourth section combines general specifications of site system characteristics to obtain generally applicable expressions for the cost per kilowatt hour of electricity as delivered by the system. The final section describes a variety of possible applications of solar electricity and modes of operation of both very small and very large plants, evaluating their performance.

ST78 15048 Selectivity in Photochlorination Using Solar Energy

Parchamazad, I.; Guillemonat, A.
Tehran Univ., Tehran, Iran
78C0001256 Jrnl: Heliotechnique and Dev., V 1; Dev. Analysis Assoc., Inc., Cambridge, MA

Results are presented of experiments on the effect of light intensity on the production of chain-chlorinated isomers of NPB.

ST78 15049 Prospects For Solar Electricity

Pollard, W.G.
191 Outer Drive, Oak Ridge, TN, 37830
Jrnl: Phys. Teach., V 15:391-395, N7, Oct. 1977

Simple calculations are performed on the cost and the efficiency of the production of electricity from solar radiation using the solar-thermal method and the photovoltaic method.

ST78 15050 Solar Central Electric Power Generation: A Baseline Design

Powell, J.C.
Honeywell, Inc., Minneapolis, MN
Avail:IEEE, A78-10742 Jrnl: In Energy Development II, P. 125-129, 1976

The paper presents the conceptual technical baseline design of a solar electric power plant using the central receiver concept, and derives credible cost estimates from the baseline design. The major components of the plant - heliostats, tower, receiver, tower piping, and thermal storage - are discussed in terms of technical and cost information. The assumed peak plant output is 215 MW_e, over 4000 daylight hours. The contribution of total capital investment to energy cost is estimated to be about 55 mills/KWH in mid-1974 dollars.

ST78 15051 Dynamic Conversion of Solar-Generated Heat to Electricity

Powell, J.; Grosskreutz, J.C.
Honeywell Systems and Res. Center, Minneapolis, MN
Avail:NTIS, CONF-741197, 78C0001670 1974

Four types of systems were considered and the central receiver concept was considered superior. The specifications for the commercial plant baseline are shown. A site plan reference for a 200-MW solar thermal-electric plant is shown. An architect's perspective of the generating plant and tower is sketched. The floor plan of the generating station is shown. Other topics considered bench model receiver design, receiver test requirements, heliostat baseline, and heliostat test requirements.

ST78 15052 Limits on the Yield of Photochemical Solar Energy Conversion

Ross, R.T.; Hsiao, T.-L.
Ohio State Univ., Columbus, OH
Avail:AIAA, A78-15847 Jrnl: J. of Applied Physics, V 48:4783-4785, Nov. 1977

Entropy and unavoidable irreversibility place a limit on the efficiency of photochemical solar energy conversion, which is substantially lower than that placed by the First Law of Thermodynamics alone. Shockley and Queisser's (1961) "detailed balance limit" on the efficiency of p-n-junction photovoltaic devices is a special case of this general thermodynamic limit on the efficiency of all quantum-utilizing solar energy converters. For a single photochemical system operating at 20 C in sunlight not attenuated by the atmosphere, this efficiency cannot exceed 29 percent. Under the same conditions, the efficiency of a solar converter composed of two photochemical systems can reach 41 percent.

ST78 15053 Solar Photolysis of Water

Ryason, P.R.
NASA, Pasadena, CA
US Patent no. 4,045,315; Aug. 30, 1977, Filed Feb. 13, 1976

Hydrogen gas can be produced by the solar photolysis of water in a photooxidation vessel with transparent walls in the presence of a water soluble photooxidizable reagent and an insoluble hydrogen recombination catalyst. Oxygen can also be produced in a second photoreduction reactor with transparent walls in the presence of an insoluble photoreduction reagent catalyst. When spent, the solution from the first reactor is fed into the second reactor. A reaction occurs in the dark in which the redox reagents are regenerated, and the regenerated photooxidation reagent solution is recycled to the first reactor. The photoreduction-catalyst is a bifunctional reagent catalyst including a transition metal salt together with a hydroxyl or chlorohydroxyl decomposition catalyst of high area.

ST78 15054 Solar Energy Thermionic Electricity Generating Plants for Spacecraft

Sahin, S.
EGE Universitesi, Izmir, Turkey
Jrnl: Kerntechnik, V 19:233-236, N5, May 1977

We have presented fundamentals of the construction of an electricity generating plant with the help of thermionic conversion of the solar energy for spacecraft. In the course of the study it appeared that inside of the trajectory of Mars Solar Energy Plants will be more suitable than thermionic reactors, mainly due to technical robustness and light construction. The fabrication costs of the solar energy converters seem to be lower because they have simpler construction and seem more suitable for mass production than nuclear converters.

ST78 15055 Solar Stirling Power Generation: Systems Analysis and Preliminary Tests

Selcuk, M.K.; Wu, Y.C.; Moynihan, P.I.; Day, F.D.III
JPL, Pasadena, CA
Proc. of 1977 Annual Mtg. of ASISES, V 1, Sect. 14-25
Avail:ISES, 78C0001660

The feasibility of an electric power generation system utilizing a sun-tracking, parabolic concentrator, and a stirling engine-linear alternator is being evaluated. Performance predictions and cost analysis of a proposed large distributed system are discussed. Design details and preliminary test results are presented for a 9.5-ft. diam. parabolic dish at the Jet Propulsion Laboratory (Caltech) Table Mountain Test Facility. Low temperature calorimetric measurements were conducted to evaluate the concentrator performance, and a helium flow system is being used to test the solar receiver at anticipated working fluid temperatures (up to 650 or 1200 C) to evaluate the receiver thermal performance. The receiver body is designed to adapt to a free-piston stirling engine, which powers a linear alternator assembly for direct electric power generation. During the next phase of the program, experiments with an engine and receiver integrated into the concentrator assembly are planned.

ST78 15056 Present Status of Thermionic Energy Conversion

Shimada, K.
JPL, Pasadena, CA
Symp. on 5-MW STTF, 1976
Avail:NTIS, ALO/3701-76-1

Typical performance of thermionic converters in space applications is reviewed. Overall efficiencies at 2000 K of 10 percent are quoted. For terrestrial use, at 1400 K operating temperatures, efficiencies of 20 percent are projected, assuming solution of materials and oxidation problems. The establishment of cost in terrestrial applications is needed.

ST78 15057 Silicon Photovoltaic Cells in Thermophotovoltaic Conversion Progress Report

Swanson, R.M.; Bracewell, R.N.
Stanford Univ., Stanford, CA
Avail:NTIS, N78-16460

A preliminary assessment of the feasibility of a solar-electric thermophotovoltaic (TPV) system was performed. The proposed system uses concentrating mirrors focused on a TPV converter that operates at high power density and potentially high efficiency. Within the TPV converter, the concentrated sunlight heats a refractory radiator. A photovoltaic cell faces the radiator, receives incandescent radiation from it, and converts the radiation to electricity. A numerical model of TPV conversion was developed to assess TPV conversion and to facilitate an initial design of TPV photocells. Also, a facility for experimentally evaluating TPV photocells was designed and built.

ST78 15058 Thermophotovoltaic Systems for Electrical Energy Conversion

Yeargan, J.R.; Cook, R.G.; Sexton, F.W.
Arkansas Univ., Fayetteville, AR
"12th Photovoltaic Specialists Conf.," Baton Rouge, LA, Nov. 15-18, p. 807-813, 1976
Avail:IEEE, A78-11031

Thermophotovoltaic cells are discussed where the energy not absorbed by the bandgap semiconductor is reflected to the radiating material and used to maintain its temperature. Equations are presented for a blackbody radiator which predicts maximum efficiencies in terms of the radiator temperature and parameters of the cell. Design curves, which estimate output power densities and overall efficiency as a function of source temperature, are also presented. Maximum efficiencies of 56 percent for silicon TPV cells at radiator temperatures of 2000 K and 63 percent for GaAS cells with a 2400 K source are predicted. Efficiencies as high as 40 percent for silicon cells are expected with existing technology. Use of the TPV cells as a topping cycle for a conventional steam generator is also discussed.

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ST78 16073 Analytical and Experimental Studies of OTEC Heat Transfer Problems at Oak Ridge National Laboratory

Oak Ridge Nat'l Lab., Oak Ridge, TN
4th OTEC Conf., March 22, 1977, New Orleans, LA
Avail:NTIS, N78-14661 Jrnl: OTEC Proc., 27 p.

The analysis, planning, and implementation of a program to develop advanced heat exchangers for ocean thermal energy conversion (OTEC) are described. An analysis of the NH_3 binary cycle and the current state of commercial heat exchanger technology indicated that the goals of this program should be to improve the seawater heat transfer coefficients by a factor of two, the ammonia heat transfer coefficients by a factor of two to four, and to be able to control fouling factors at a value of 0.0003 or below. These improvements coupled with qualifying aluminum for this seawater-ammonia service would go far toward assuring the economic viability of the OTEC concept. A single-tube ammonia heat transfer loop has been built and operated to evaluate the heat transfer characteristics of fluted tubes. Preliminary ammonia condensation results are presented.

ST78 16074 Energy From the Oceans

Jrnl: S. Africa J. Anim. Sci., p. 4-5, June 1976

Since the world reserves of conventional primary sources, such as coal, oil, and gas are not unlimited and may be exhausted before the century is out, alternative means of power generation have been sought. The exploitation of the mechanical energy of the sea has received almost universal approval. The tidal power station is employed for exploiting the potential energy of the sea, which takes three basic forms: dynamic energy, through the motion of waves, tides, and currents; heat energy in the various layers between the sea surface and deep water; and the substances contained in the seawater itself.

ST78 16075 Energy Winning System From Water or Ocean Waves

German (FRG) Patent no. 2,512, 946/A, Oct. 7, 1976, In German

Arrangement according to invention specifications consists of round or angular steel pipes of about one m^2 cross-section, vertically arranged, and welded together to form a honey comb formation, which is open at the bottom and closed at the top. When the water level in a pipe is raised by an ocean wave, the air present above the water is forced through a pressure valve into upper half of the pipe honey comb pressure space. When the water level in a pipe falls, air from the suction space above the pressure space is sucked out through a suction valve and afterwards through pipe line. The pressure equalization between the pressure and suction spaces is accomplished by air turbines, that are coupled with electrogenerators. The complete floating honey comb is kept at optimal wave energy use level by floats. The honey comb diameter should be approximately 2.5 to 3 times the maximum wave length.

ST78 16076 Ocean Thermal Energy Conversion (OTEC) Test Facilities Study Program, Volume I

Lockheed Missiles and Space Co., Sunnyvale, CA
Avail:NTIS, N78-11507 496 p.

Alternative non-site specific OTEC test facilities-platform requirements for an integrated OTEC test program including both land and floating test facilities were studied. A progression of tests were established in which OTEC power cycle component designs proceeded through advanced research and technology, component, and systems test phases. This progression leads to the first OTEC pilot plant and provides support for following developments which potentially reduce the cost of OTEC energy. It also includes provisions for feedback of results from all test phases to enhance modifications to existing designs or development of new concepts. Emphasis is placed on defining the test facility which is capable of supporting the spectrum of tests envisioned. All test support facilities and equipment were identified and included in terms of space, utilities, cost, schedule, and constraints or risks.

ST78 16077 Ocean Thermal Energy Conversion (OTEC) Test Facilities Study Program, Final Report, Volume II, Part A

Lockheed Missiles and Space Co., Sunnyvale, CA
Avail:NTIS, SAN/1156-77/1 Jan. 17, 1977

Results are presented of an eight-month study to develop alternative non-site-specific OTEC facilities, platform requirements for an integrated OTEC test program which may include land and floating test facilities. The document, Volume II-appendixes is bound in three parts (A, B, and C) which together comprise a compendium of the most significant detailed data developed during the study. Part A contains definitions, baseline revisions, test plans, and energy utilization sections.

ST78 16078 Ocean Thermal Energy Conversion (OTEC) Test Facilities Study Program, Final Report, Volume II, Part B

Lockheed Missiles and Space Co., Inc., Sunnyvale, CA
Avail:NTIS, SAN-1156/77/1 Jan. 17, 1977

Results are presented of an eight-month study to develop alternative non-site-specific OTEC facilities, platform requirements for an integrated OTEC test program which may include land and floating test facilities. Volume II-appendixes is bound in three parts (A, B, and C) which together comprise a compendium of the most significant detailed data developed during the study. Part B provides an annotated test list and describes component tests and system tests.

ST78 16079 Ocean Thermal Energy Conversion (OTEC) Test Facilities Study Program, Final Report, Volume II, Part C

Lockheed Missiles and Space Co., Inc., Sunnyvale, CA
Avail:NTIS, SAN-1156-77/1 Jan. 17, 1977

Results are presented of an eight-month study to develop alternative non-site-specific OTEC facilities, platform requirements for an integrated OTEC test program which may include land and floating test facilities. Volume II-appendixes is bound in three parts (A, B, and C) which together comprise a compendium of the most significant detailed data developed during the study. Part C describes test facility support, data acquisition and control system design, cost data, energy self-sufficiency, and test facility applications.

ST78 16080 Ocean Thermal Plant Would Be Costly But Fuel Would Be Free and Limitless

Jrnl: Energy Res. Rep., V 3:2-4, N16, Sept. 5, 1977

Commercialization of ocean thermal power plants is hampered more by capital costs then by a lack of technology. At twice the cost of a nuclear plant, ocean thermal-energy conversion (OTEC) developers must choose a standard design for power plants, design appropriately sized heat exchangers, and solve corrosion problems. OTEC's potential to utilize an inexhaustible free fuel supply with little environmental impact at a low operating cost will encourage a solution to the problem of capital costs. Based on concepts known since 1881, several companies are pursuing research programs and making feasibility studies with government support. ERDA, for example, is funding an ammonia-drive turbine concept. The diffuse energy in warm water will require efficiencies as low as 2.5 to 3 percent, but this will help to minimize environmental effects. Offshore plants could transmit electricity directly to land, while mid-ocean plants could be used to synthesize ammonia for fuel or fertilizer.

ST78 16081 Solar Program Assessment, Environmental Factors: Ocean Thermal Energy Conversion

ERDA, Washington, D.C., Div. of Solar Energy
Avail:NTIS, N78-14683 55 p.

The environmental problems which may arise with the further development of ocean thermal energy conversion (OTEC), are presented. To provide a background for this environmental analysis, the history and basic concepts of the technology are reviewed, as are its economic and resource requirements. The potential effects of this new technology on the full range of environmental concerns (i.e., air, etc.) are then discussed in terms of both their relative significance and possible solutions. Although the emerging solar technologies will contribute to environmental problems common to any construction project or energy-producing technology (e.g., air pollutants from steel production), only those impacts unique to the solar aspects of the technology are discussed in depth. Finally, an environmental work plan is presented listing research and development proposals and a work plan which might help clarify and/or mitigate specific environmental concerns.

ST78 16082 Tidal Power Study for the United States ERDA, Final Report, Volume 2

Stone and Webster Engineering Corp., Boston, MA
Avail:NTIS, DGE/2293-3 March 1977

Appendices to a comprehensive tidal power study (DGE/2293-3 V 1) are presented. They include a bibliography, maps, various tabulated data, and results of ancillary studies.

ST78 16083 Wave and Salinity Gradient Energy Conversion

Delaware Univ., Newark, DE
Avail:NTIS, COO-2946-1 1976

Separate abstracts were prepared for each of the 13 papers included.

ST78 16084 Wave Power at Work

Jrnl: Energy Dig., London, England, V 6:15-16, N2, April 1977

This article illustrates the principle of a wave-activated electric generator for buoys. A central tail tube or skirt-keel to which the ballast is attached is fitted to the buoy. As the buoy rises and falls, air trapped within this tube is compressed and sucked through a turbine. This turbine drives a three-phase AC motor and produces up to 60 W at 12 volts according to conditions. This is then used to charge a low self-discharge battery, which in turn, supplies the lighting apparatus, fog signal, racon, radio beacon, and/or any other devices which might be located aboard the buoy. The amount of current provided has been much higher than has normally been required aboard buoys, but the widely accepted need to produce greater vertical divergence from the lighting apparatus, together with the more expensive character-ratios demanded by the incoming new marking systems, make the use of wave generation look a logical choice, particularly as the need for financing replaceable cells and the need to bring batteries ashore for recharging are avoided.

ST78 16085 Keynote Address: Ocean Thermal Energy

Anderson, J.H.
Sea Solar Power, Inc., York, PA
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: Workshop Proc.

The potential benefits of sea solar power are discussed. The basic principles and economics of an ocean thermal gradient power plant are described.

ST78 16086 Pump Starting System for Sea Thermal Power Plant

Anderson, J.H.
US Patent no. 4,030,301; June 21, 1977

In a turbine-driven power-generating plant of the type using, for example, a hydrocarbon or halocarbon as the working fluid operating on or near the surface of an ocean, warm surface water is used as a source of heat for a boiler and cold water pumped from substantial depths is used to condense the working fluid after it has been expanded through the turbine. An auxiliary power source for starting the water pumps of the main system includes a prime mover driving a compressor, which in turn supplies a high-energy working fluid to a turbine, coupled to drive the water pumps. The turbine exhaust, after being cooled in a heat exchanger by the cold water pumped from the ocean depths, is returned to the suction side of the compressor.

ST78 16087 Ocean Thermal Energy Conversion: Resource Assessment and Environmental Impact For Proposed Puerto Rico Site, Final Report

Atwood, D.; Duncan, P.; Stalcup, M.C.; Barcelona, M.J.
Puerto Rico Univ., Mayaguez, Puerto Rico
Avail:NTIS, PB-259303 Aug. 1976

This report centers on the possibility of extracting thermal energy stored in the tropical sea surface by ocean thermal energy conversion (OTEC) at a site near the town of Yabucoa, on the southeast coast of Puerto Rico. The report consists of two parts. Part I is a survey of existing oceanographic and meteorological data at and near the site and for other possible sites near Puerto Rico. Part II is a survey of the specific site to confirm the oceanographic conditions prevalent there.

ST78 16088 Wave-Powered Pneumatic System For Power Generation

Bolding, R.D.
US Patent no. 4,013,379 March 22, 1977

A wave-powered pneumatic system for producing compressed air to be used for energy storage or power generation is described, which comprises an elongated seawall, extending parallel to the shore and at a distance out from the shore, upon which an air-accumulating structure is built. The air-accumulating structure is divided by partitions into a plurality of modules, each consisting of a plurality of stacked air chambers arranged one above the other. Each of the chambers is relatively shallow in the vertical dimension, and each chamber is closed on all sides, except the end facing out to sea. A plenum chamber is connected to each of the air chambers by separate ducts having check valves which allow air to flow into the plenum chamber when pressure within the duct exceeds the pressure in the plenum chamber. The plenum chamber is connected to the air storage or power generating means. Depending upon the wave height, one or more of the chambers will be filled with a solid mass of water from each wave as the latter moves toward shore. This mass of shoreward-moving water acts as a piston, driving the air trapped in the chamber toward the rear end thereof, and compressing it, the compressed air being forced out through the duct to the plenum chamber, and finally to the air-driven power generating means.

ST78 16089 Concurrent Studies of Enhanced Heat Transfer and Materials for Ocean Thermal Exchangers, Progress Report

Bonewitz, R.A.
Aluminum Co. of America, ALCOA Center, PA
Avail:NTIS, N78-14659 75 p.

Aluminum alloys 1100, 3003, 5052, and 6063 were examined for their compatibility with the proposed working fluids for ocean thermal energy conversion, anhydrous ammonia, freon 22 and propane, and mixtures of these with sea water. Such mixtures would occur if leaks develop in evaporator or condenser heat exchangers. These aluminum alloys are compatible with the anhydrous working fluids. In ammonia sea water solutions only limited general corrosion is found in 0 to 30 percent ammonia, no corrosion in 30 to 90 percent ammonia, and "self-limiting" pits in 90 to 100 percent ammonia so rapid deterioration of the exchangers would not occur. No corrosion was observed in sea water saturated with Freon 22 or propane. No differences in alloy performance were evident in any of these tests so selection can be made on the basis of compatibility with sea water. A review of the available literature indicated that 5052 shows the best performance in surface sea water followed by 1100, 3003, and then 6063 alloy.

ST78 16090 Wave Motion Offers The Way to Gain Power Without Limit

Bott, A.N.W.
Jrnl: Engineer, V 240:32-33, N6211, March 27, 1975

Work in Mauritius on the storage of wave power as potential energy in landward lagoons and its conversion to electricity is described. Work could lead to field trials for a 5000-KW installation.

ST78 16091 The Wave Pump; Conversion of Wave Energy to Current Energy

Bruun, P.; Viggosson, G.
Norwegian Inst. of Tech., Trondheim, Norway
Avail:AIAA, A78-16222 Jrnl: ASCE Waterway, Port, Coastal, and Ocean Div. J., V 103:449-469, Nov. 1977

The considered device utilizes the momentum of waves close to or at breaking to create a current. The effectiveness of the wave pump can be improved for the utilization of even smaller waves by concentrating wave heights in a funnel. The sections of the pump include a funnel-shaped entrance, a "breaker section" with an almost buoyant slab, and a "discharge-canal" which receives its supply of water from the compressed waves. The original theory upon which the operation of the wave pump is based is considered and a description is provided of the flushing of basins on sea coasts where tidal currents are weak while wave action is always present. In a possible future application, the wave pump might also become a tool for the production of energy. Attention is given to funnel geometry, hydraulic model experiments, an attempt to explain results theoretically, a preliminary field test, and comparisons between theoretical, laboratory, and field investigation.

ST78 16092 Theoretical Evaluation of The Seakeeping Performance of Five Candidate OTEC Platforms; Ocean Thermal Energy Conversion

Barr, R.A.; Odea, J.F.
Hydronautics, Inc., Laurel, MD
2nd STAR Symp., San Francisco, CA, May 25-27, 1977
Avail:AIAA, A78-10727 Jrnl: STAR Proc., SNAME, New York, NY, p. 233-255

This paper describes a theoretical study of the seakeeping performance of five types of platforms, which may be appropriate for use with ocean thermal energy conversion (OTEC) plants. The platforms are assumed to be unmoored. The platform types can be described as a ship, a submarine, a vertical column stabilized semisubmersible, a disk, and an axisummetric spar. In all cases a cold water pipe, required for OTEC plant operation, is attached to these platforms. The calculated motions and accelerations of the platform and cold water pipe bending moments in regular waves and irregular, long-crested waves are discussed and compared. Variations of motions, accelerations, and bending moments with platform size and cold water pipe size and attachment restraints are discussed. It is concluded that motions and accelerations, except perhaps for heave of the ship and disk, should not be serious design problems, but that cold water pipe bending moments may be a serious design problem. Of the platforms considered, the semisubmersible appears to be most attractive from the standpoint of overall seakeeping performance.

ST78 16093 Shadows' Effect in a Large Scale Solar Power Plant

Barra, O.; Conti, M.; Santamata, E.; Scarmozzino, R.; Visentin, R.
Calabria Universita, Cosenza, Italy
Avail:AIAA, A78-16843 Jrnl: Solar Energy, V 19:759-762, N6, 1977

An investigation is conducted concerning the effect of shadows which are projected on the surface of a collector in a concentrating cylindrical-parabolic collector system. The investigation makes use of an analytical-numerical method. The optimum cutting angle for different geometries of the solar plant is numerically evaluated. Values of the optimum cut angle of cylindrical-parabolic tracking collectors as a function of the ratio between spacing and height are presented in a function of the ratio between spacing and height are presented in a graph. It is concluded that the ratio between the spacing and the height of the collectors at intermediate latitudes should be larger than 2.5 to avoid excessive shadowing effects in a large-scale solar plant.

ST78 16094 Nearshore Application For an Ocean Thermal Energy Conversion Pilot Plant in Hawaii

Bathen, K.H.
Univ. of Hawaii, Manda, HI
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: Workshop Proc.

The objective of the project is to assess potential sites for nearshore ocean thermal proof-of-concept experiments off Keahole Point on the island of Hawaii. The main efforts are an oceanographic evaluation of the Keahole area and a socioeconomic profile of the neighboring Kailua-Kona coast. The oceanographic effort is divided into three phases: a historical data survey, an effort to provide data where existing data were insufficient, and an attempt to estimate potential impact of the pilot plant. The data taken include bathymetric surveys, current meter data, and local water quality to at least the 1500-foot depth. Some early results of temperature, salinity, and nutrient profile are shown.

ST78 16095 National Ocean Thermal Energy Conversion Program

Cohen, R.
ERDA, Washington, D.C.
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: Workshop Proc.

A status report on the National Thermal Energy Conversion Program is presented. The objectives are listed and the level of funding is mentioned. The proposals received in the two basic categories are touched on briefly. A summary of awards is tabulated. Two concepts are sketched.

ST78 16096 Ocean Tide and Wave Energy Converter

Conn, J.L.; Spector, G.
US Patent no. 4,034,231 July 5, 1977

A machine is described for harnessing the motion of ocean waves in order to convert the motion energy into useful electrical power, the machine consisting of a large V-shaped frame, submerged near a beach, having its apex pointed away from the beach, and the frame supporting a series of water turbines connected to an electric generator so that incoming waves toward a beach move along the outer side of the frame while turning the turbine rotors, and outgoing waves moving along the inner side of the frame so to likewise influence turning the turbine rotors.

ST78 16097 Wave Power Apparatus Supported and Operated by Floats in Water

Diggs, R.E.
US Patent no. 4,013,382 March 22, 1977

An apparatus for converting water wave movement into power is described. A float is located in a body of water, and the apparatus converts the up and down movement of that float caused by waves in the water to operate a pump to displace hydraulic fluid through a hydraulic pumping station which actuates fluid motors, or the like to produce power. The force of the float movement is multiplied by a mechanical advantage so that the pump displaces the hydraulic fluid on both the upward and downward movement of the float even in calm water. A plurality of modules are interconnected to take advantage of as much of a wave front as desired.

ST78 16098 Water and Energy

Ellis, F.
Bureau of Reclamation, Washington, D.C.
3rd Annual UMR-MEC Energy Conf., 1977
Avail:NTIS, 78C0037293 Jrnl: Proc. of Conf., Western Periodicals Co., N. Hollywood, CA

Energy self-sufficiency or independence from foreign oil imports depends critically on the yet-undeveloped domestic fossil fuel resources, particularly for the production of heat, which can be utilized in the conventional and technically feasible thermal energy cycles of steam-electric generators and prime movers which can easily be replicated. An integral facet of the complex domestic energy development undertaking is the availability of water that may be required to convert the vast domestic coal and oil shale resources into usable energy forms. An orderly utilization of water resources muse receive attention if sufficient development of fossil fuel-conversion energy systems is to materialize. Also, the water requirements of alternative energy sources, such as nuclear fast-breeder reactors and solar energy, which have not yet been demonstrated to be commercially viable, must be reviewed critically.

ST78 16099 Feasibility of Integrated Ocean Thermal Gradient-Nuclear Plants for the Production of Electrical Power

Ferrer, F.; Sasscer, D.
Univ. of Puerto Rico, Mayaguez, Puerto Rico
3rd Annual UMR-MEC Energy Conf., 1977
Avail:NTIS, 78C0030392 Jrnl: Proc. of Conf., Western Periodicals Co., N. Hollywood, CA

A study was made of the feasibility of integrating an ocean thermal energy conversion (OTEC) electrical power plant with a nuclear power plant. The integration was such that the waste heat of the nuclear plant was used to augment the thermal efficiency of the OTEC plant. The study was performed for three shore line sites of Puerto Rico where deep water is found between two and 10 miles from shore.

ST78 16100 Studies of Biofouling in OTEC Plants; Ocean Thermal Energy Conversion

Fetkovich, J.G.; Grannemann, G.N.; Mahalingam, L.M.; Meier, D.L.
Carnegie-Mellon Univ., Pittsburgh, PA
2nd STAR Symp., May 25-27, 1977, San Francisco, CA
Avail:AIAA, A78-10728 Jrnl: STAR Proc., p. 257-268, SNAME, New York, NY

It is feared that biofouling of sea water may seriously impede heat transfer in OTEC heat exchangers. The present work presents preliminary results of a research program designed to investigate the biofouling of these heat exchangers. In a simulation study, heat exchange tubes made of copper-nickel, aluminum, and titanium alloy were used and the effect of fouling on the heat transfer coefficient was investigated as a function of the material used and water velocity.

ST78 16101 Forecast Markets, Economics and Shipbuilding Program for OTEC/Industrial Plant Ships in Tropical Oceans; Ocean Thermal Energy Conversion

Francis, E.J.; Seelinger, J.
Johns Hopkins Univ., Laurel, MD
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11349 Jrnl: ISES Proc., Secs. 14-25, p. 24-28--24-32, Cape Canaveral, FL

The unique applied physics laboratory concept for ocean thermal energy conversion (OTEC) ammonia-producing plant-ships "grazing" the tropical oceans is presented. A tropical Atlantic Ocean grazing pattern provides 43 F (24 C) temperature differential 11 of 12 months, reducing costs through an optimized power cycle. Ammonia produced is shown to be commercially competitive at $96-$99 per short ton delivered to US ports. Twenty-four to thirty-one plant-ships are needed for US market share prior to 1990; seven additional for South Atlantic market. Special needs are highlighted for Brazil and India. The article concludes that it would be imprudent for US and tropical countries not to initiate an OTEC-ammonia program as soon as possible.

ST78 16102 Power From the Oceans' Thermal Gradients

Griffin, O.M.
US Navy, Naval Res. Lab., Washington, D.C.
OERT Conf., Sept. 18-23, 1977, Houston, TX
Avail:AIAA, A78-10652 Jrnl: Proc. of Conf., p. 1-20, ASME, New York, NY

The concept of extracting useful power in tropical regions from the temperature differences between the oceans' warm surface water and cold deep currents dates from the late 19th century. Since that time, several attempts have been made to design and operate such a power plant, and these early ventures, and more recent 20th century undertakings, have culminated in a US Government-sponsored R and D program aimed at operating a prototype plant driven by ocean thermal gradients during the 1980's. In this paper, the history of the so-called ocean thermal energy conversion (OTEC) concept is outlined and its R and D funding history is traced through 1977. The present technological status of open and closed rankine cycle plant concepts is discussed in terms of potential OTEC applications, and the state-of-the-art is reviewed in terms of baseline plant designs and other promising plant configurations. Several key areas remain to be addressed successfully before ocean thermal difference power plants become an economically and technically viable option; these include the development and successful operation of a new generation of efficient low temperature-difference heat exchangers; prevention of biofouling and corrosion problems; environmental and resource potential assessments; and platform, mooring, and stationkeeping design problems.

ST78 16103 Wind-Forced Equatorial Waves in the Atlantic Ocean, PhD Thesis

Hallock, Z.R.
Miami Univ., Coral Gables, FL
Avail:Univ. Microfilms No. 77-28935

During the Garp Atlantic Tropical Experiment, north-south fluctuations in the equatorial current system were observed. Observations of current profiles during phase two suggest that the fluctuations had a period of about 16 days and were propagating westward with a phase speed of 130 to 190 cm/sec. Evidence of fluctuations in the tradewinds at similar frequencies was also found. Analysis of profiling current meter data reveals that latitudinal shear in the zonal equatorial currents is important, and that meridional and vertical motions are highly time-dependent and have small means. Theoretical analysis of a linear, two-layer system shows that the characteristics of the observed fluctuations are consistent with the theory of linear, equatorially trapped waves, particularly the Yanai Wave.

ST78 16104 Conceptual Design of OTEC Platforms; Ocean Thermal Energy Conversion

Harlow, E.H.; Cohen, R.; Skowbo, H.
Frederic R. Harris, Inc., New York, NY
2nd STAR Symp., May 25-27, 1977, San Francisco, CA
Avail:AIAA, A78-10724 Jrnl: STAR Proc., p. 195-201, ASME, New York, NY

ERDA is developing a technology for converting ocean thermal energy into electrical energy. Such power plants in themselves will be enormous floating vessels. The configuration of these vessels is the subject of this paper, which summarizes the status of conceptual design for such plants that might be suitable for operation in various areas of the tropical and sub-tropical oceans. All designs have one common characteristic unusual for marine structures, namely a cold-water pipe, which will extend down into the

down into the cooler layers of the deep ocean several thousand feet below the surface, and circulate quantities of cool water through the condensers. The possible types of ocean thermal conversion platforms (OTEC) are reviewed and analyzed with respect to cost, mooring requirements, response to wave and current action, and viability as living quarters for crew.

ST78 16105 Second Ocean Thermal Energy Conversion Workshop: Workshop Proceedings

NSF, Washington, D.C.
Avail:NTIS, CONF-7409169 April 1975

Separate abstracts were prepared for eighteen papers. The proceedings also include the reports of the five working groups: biofouling; economics; power technology; resource, oceanographic, and environmental aspects of ocean thermal plants; and marine technology, waves, forces, and positioning.

ST78 16106 Some Technology Limitations on Practical Ocean Δ-T Power Plants

Heronemus, W.E.; McGowan, J.G.
Univ. of Massachusetts, Amherst, MA
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: OTEC Proc.

The two main problem areas confronting ocean thermal energy conversion are corrosion and biofouling. The controlling technology problems are summarized. The Mark I and Mark II designs and modifications are described.

ST78 16107 Three Ocean-Sited Natural Energy Systems

Heronemus, W.E.; Mangarella, P.-A.; McGowan, J.G.
Univ. of Massachusetts, Amherst, MA
Avail:AIAA, A78-10735 Jrnl: Energy Development II, p. 70-78, 1976, IEEE, New York, NY

A general description of the ocean current kinetic energy resource, the ocean thermal differences resource and of the energy resource in the winds over them, and the related energy transmission systems for exploitation of each of those natural energy flows, is given. Relative resource size, relative economics are compared. Comparative environmental, social geo-political, political characteristics of the oceanic power systems are mentioned. The possible uses of these ocean-sited power plants to provide either raw energy or an energy product, or to provide electrical power on demand are treated. The conclusion suggests that the typical power engineer and the majority of the population might lead a fuller life the sooner we break free from consumption of owned fuel resources.

ST78 16108 Ocean Food and Energy Farm Project, Subtask No. 6: Systems Analysis, Volume 4 Processing Subsystem, Final Report

Hoffman, G.A.; Budhraja, V.
Integrated Sciences Corp., Santa Monica, CA
Avail:NTIS, ERDA/USN/1027-76/1 July 1976

The processing subsystem of the Ocean Food and Energy Farm (OFEF) performs the functions related to conversion of the kelp harvest into synthetic natural gas and valuable by-products. It consists of seven major processes: pretreatment to wash and chop harvest; pressing to separate volatile solids from salts; filtration to recover soluble carbohydrates from salt (brine) solution; brine processing to recover fertilizer salts and water from brine solution; anaerobic digestion to convert volatile material into gases and sludges; sludge processing to convert sludges into fertilizer or feed for mariculture; gas compression and scrubbing to remove carbon dioxide and enter synthetic natural gas into gas transmission pipelines. The systems and economic analysis, based on a review of the state-of-the-art, discussions with program management, and consultation with advisors and experts in the field. The resulting design is by no means an optimized or recommended design, but a representative one suitable for estimating overall costs and productivity, and for identifying opportunities for design trade-off studies and areas of cost sensitivity.

ST78 16109 Ocean Food and Energy Farm Project, Subtask 4: Preliminary Design Studies of Substrate and Upwelling Systems, Volume 2, Artificial Upwelling in Support of the OFEF Project, Project Report

Hoffman, R.T.; Strickland, A.T.; Harvey, P.J.
Naval Undersea Center, Kailua, HI
Avail:NTIS, ERDA/USN/1027-3/2 July 1976

Engineering studies on the upwelling of deep, nutrient-rich ocean water to the surface for kelp nutrifaction are reported. A conceptual design analysis was performed on methods of upwelling deep ocean water and powering the upwelling system. Both computer analysis and a dye experiment were used to examine the dispersion of upwelled water. Results of analysis of the following candidate systems are given: Isaacs buoy/ propeller pump, wave turbine/ propeller pump, windmill/propeller pump, wave vane/propeller pump, modified Isaacs pump, and bellows pump. It is concluded that the wave turbine/propeller pump and bellows pump (pipe upwelling system) offer the greatest simplicity of design and are expected to induce the lowest forces into the substrate structure.

ST78 16110 Wave and Wind Storage Station

Hoppe, H.
German (FRG) Patent 2,514,447/A, Oct. 14, 1976, In German

The specification concerns an arrangement which is to use the energy of sea waves. It is to be situated outside the breakers in waters of great depth. Pistons are moved to and fro by the sea waves in cylinders which are open below and which reach into the water. In the upper air-filled part of such a cylinder, there is alternate high and low pressure due to the piston movement, and a so-called excess pressure store is filled via non-return valves, while a low-pressure store is emptied. Using these two stores, water is pumped pneumatically from a lower fresh water container into an upper container floating on it. The water drives a turbine, when flowing back from the upper to the lower container, which is coupled to a generator for power generation.

ST78 16111 System Analysis and Engineering Studies for Ocean Thermal Energy Conversion, Final Report, January 1, 1976-September 30, 1976

Lavi, A.
Carnegie-Mellon Univ., Pittsburgh, PA
Avail:NTIS, COO/2895-7 Nov. 15, 1976

The question of tube layout in an OTEC heat exchanger is studied so as to meet a desired performance at a minimum cost. A number of layouts employing vapor lanes (tributaries and main channels) have been evaluated for a large 25 MW_e heat exchanger module. There appear to be a number of practical arrangements which result in a low-pressure loss without increasing the shell diameter. An attempt is made to develop an analytical model for predicting the transient response of a complete OTEC power cycle. A system of ordinary differential equations and a number of algebraic relationships have been derived which allow the modeling of a variety of transient processes of the system and also lay the foundation for the control strategies necessary to achieve a desired performance. A conceptual design is presented of two OTEC power plants employing vertical fluted tubes in the heat exchangers. One cycle plant is nominally designed to produce one MWe and the other is a self-sustaining system capable of producing all its pumping and parasitic power requirements at the least available seasonal Δ-T. A procedure for the design of such small plants is developed which, if desired, can be readily computerized.

ST78 16112 Progress Report on Solar Sea Power Plants

Lavi, A.
Carnegie-Mellon Univ., Pittsburgh, PA
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: OTEC Proc.

A general discussion is presented on problems in ocean thermal power plant design with emphasis on pumps and cold water intake. Some possible component layouts are sketched.

ST78 16113 Environmental Considerations

Levanthal, E.L.
TRW, Inc., Redondo Beach, CA
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: OTEC Proc.

The impact of an ocean thermal energy conversion system on the environment is discussed briefly in the areas of physical, chemical, and biological phenomena.

ST78 16114 Deep Water Pipe, Pump, and Mooring Study: Ocean Thermal Energy Conversion Program, Final Report

Little, T.F.; Marks, J.D.; Wellman, K.H.
Westinghouse Electric Corp., Annapolis, MD
Avail:NTIS, COO/2642-76/3 June 1976

The ocean engineering issues affecting the design, construction, deployment, and operation of ocean thermal energy conversion (OTEC) power plants were studied. The problems associated with the conceptual design of the deep-water pipe, cold-water pumping, and platform mooring arrangements were addressed. These subsystems fall into a natural grouping since the parameters affecting their design are closely related to each other and to the ocean environment. Analysis and evaluations are provided with a view toward judging the impact of the various subsystems on the overall plant concept and to provide an estimate of material and construction cost. Parametric data is provided that describes mooring line configurations, mooring line loads, cold-water pipe configurations, and cold water pumping schemes. Selected parameters, issues, and evaluation criteria are used to judge the merits of candidate concepts over a range of OTEC plant size from 100 MW_e to 1000 MWe net output power.

ST78 16115 How Hot is Solar Energy

Marvin, H.H.
Jrnl: Environ. Sci. Tech., V 11:651-654, N7, July 1977

OTEC (ocean thermal energy conversion), one of six solar energy technology options that constituted the original United States Solar Energy Plan is described. OTEC uses the oceans, an intermediate media, as its direct source of energy. The real advantage of OTEC, which is not shared with the other forms of solar energy, is that it can operate 24 hours a day without the use of an auxiliary storage medium. OTEC is now moving into the hardware development phase. Its plants operate on the temperature difference (Δ-T) between warm surface water and cold deep water. The Δ-T runs a heat engine. The warm ocean surface water vaporizes a working fluid; the vapor drives a turbine, and is subsequently condensed by the cold ocean water brought up from the depths of a half mile below the surface. The cycle is continuous, and the turbines produce electricity. Worldwide, there are 40 sites with sufficient thermal gradients. Since the OTEC plant efficiency increases with approximately the square of the Δ-T available, the best sites are in the tropical oceans within eight to 10 latitude of the equator. The appeal of OTEC is considerable, realizing that certain resource-poor and less-developed nations with such gradients have an untapped energy resource that could be used when OTEC plants are built. There are no major technical mysteries to OTEC. It's all economics. Like other new energy technologies, it is capital-intensive, but less so than others. It is said to offer production costs for electricity, ammonia, aluminum, and other energy-intensive products that will be competitive in six to eight years (or as soon as these OTEC plants can be developed and built) with plants using fossil or nuclear power. Another point is that the thermal gradient is almost two orders of magnitude smaller than that used in conventional energy plants.

ST78 16116 Ocean-Wave-Operated Engine for the Driving of an Electric Generator

Masuda, Y.
German (FRG) Patent no. 1,488,997/C Jan. 13, 1977 In German

The invention concerns an arrangement for converting the mechanical energy of ocean waves into electrical energy. It is meant primarily to serve for electricity production in buoys. An open cylinder, whose inner room is accessible to the sea water from below, is half-submerged in water. From oscillating up and down in the sea, air is pumped out or sucked in through an air line in the upper part of the cylinder. Thereby, the air runs through a turbine, which in turn, drives an electric generator. Four air valves insure that the air always flows through the turbine only in one direction. A float is arranged and firmly joined to the cylinder from underneath; it carries a weight below to keep the buoy in vertical position. The cylinder cross-section and the buoy mass is so measured that the period of vertical oscillation of the buoy equals the average oscillation period of the ocean wave.

ST78 16117 Progress Report of OTEC Research at the University of Massachusetts

McGowan, J.G.; Heronemus, W.F.
Univ. of Massachusetts, Amherst, MA
2nd OTEC Workshop, April 1975
Avail:NTIS, CONF-7409169 Jrnl: OTEC Proc.

Diagrams of power plant components are shown. A preliminary cost estimate for a 400-MW ocean thermal power plant design is given. Other results are mentioned briefly and conclusions for ocean thermal power systems are presented.

ST78 16118 Ocean Energy Resources: Proceedings of the Energy Technology Conference, Houston, TX, September 18-23, 1977

Monney, N.T.
US Naval Academy, Annapolis, MD
OERT Conf.
Avail:AIAA, A78-10651 Jrnl: OESS Conf. Proc., V 4:108, ASME

The papers deal with the principal aspects of the formidable problem of both harnessing the solar energy stored in the oceans and tapping the geothermal energy at the bottom of ocean basins. The topics covered provide a broad overview of ocean energy resources, noting resource potential and the technical problems involved in harnessing each form of ocean energy. One paper uses a specific engineering problem to place in proper perspective the technical difficulties encountered in the actual development of a system that will operate effectively in an ocean environment.

ST78 16119 Economic Considerations in the Case of Sea Solar Power Plants

Naef, F.
Lockheed, Inc., Washington, D.C.
2nd OTEC Workshop
Avail:NTIS, CONF-7409169 Jrnl: Workshop Proc.

The following topics are considered: the resource allocation process, capital costs, operating costs, cost considerations, and the indirect economic factors: political, social, environmental, and technical.

ST78 16120 Ocean Thermal Plant

Owens, L.J.
NASA, Cocoa Beach, FL, John F. Kennedy Space Center
Avail:NTIS, N77-21666 March 29, 1977

An ocean thermal plant consisting of a floating energy converter utilizing large volumes of sea water to produce electrical power is described. In this plant, a fluid working medium is pumped to an evaporator where it is heated by a flow of warm surface sea water. The fluid in liquid form boils to a pressurized gas vapor which is routed to drive a turbine that, in turn, drives a generator for producing electricity. The gas vapor then enters a condenser immersed in cold sea water pumped from lower depths. The gas vapor condenses to its original liquid form and is then pumped to the evaporator to repeat the cycle. Modular components can be readily interchanged on the ocean thermal unit, and inlet pipes for the sea water are provided with means for maintaining the pipes in alignment with the oncoming current. The modular construction allows for the testing of various components to provide a more rapid optimization of a standardized plant.

ST78 16121 Energy From Ocean Surface Waves

Panicker, N.N.
Mobil Res. and Development Corp., Dallas, TX
OERT Conf., Sept. 18-23, 1977, Houston, TX
Avail:AIAA, A78-10655 Jrnl: OERT Proc., p. 43-67, ASME, New York, NY

A quantitative estimation of the energy present in ocean waves, and a review of the techniques for utilizing wave energy are presented. Computations based on climatological data for the northern hemisphere show that wave energy is maximum at mid-latitudes and at longitudes towards the eastern end of the Atlantic and Pacific Ocean basins. The total wave energy present in the world oceans at 12 noon GMT on Oct. 2, 1975 is found to be 800 x 10^{15} J. Wave energy is estimated to be renewed at the rate of 10^{12} to 10^{13} watts, about the present level of world power consumption. The techniques for converting wave energy for use vary widely in scope. The proposed schemes include propulsion schemes, buoy power supply devices, offshore power plants, and shore-based power stations. The technical and economic feasibility of utilizing wave energy is discussed.

ST78 16122 On the Hysteresis of the Sea Surface and its Applicability to Wave Height Predictions

Parsons, C.L.
NASA, Wallops Flight Center, Wallops Island, VA
SAMT Conf., Nov. 15-17, 1977, New Orleans, LA
Avail:AIAA, A78-13669 Jrnl: Collection of SAMT Tech. Papers, p. 174-181, AIAA, Inc., New York, NY

Because of the low dissipation rate of wave energy on the ocean's surface, the wave height at some location and time must be dependent upon wind fields in existence there at previous times and upon swell propagated there from other regions. To study these relationships, significant wave height (SWH) measurements from the Geos-3 radar altimeter are used in conjunction with anemometer windspeed measurements from weather ships, L, C, and R. During the passage of large cyclonic disturbances near the fixed locations of these vessels in the North Atlantic in February 1976, distinct hysteresis profiles that characterize the sea's memory during generation and dissipation conditions are observed. Examples are given that demonstrate the influences of cyclone intensity, movement, velocity, and shape on the configuration of these profiles.

ST78 16123 Energy From the Waves of the Sea

Salters, S.H.
Univ. of Edinburgh, Edinburgh, Scotland
Jrnl: Meerestechnik, V 6:131-134, N4, Aug. 1975, In German

A novel method for generation of power from the sea waves is described. A spline pump is designed with a vane that resembles a camshaft. Water waves are exerting force on the vane, which in turn, transmits torsional force on the pump shaft. Experimental results in a test tank are described.

ST78 16124 The Energy of Near-Surface Internal Waves in the Strait of Georgia

Samuels, G.; LeBlond, P.H.
Univ. of British Columbia, Vancouver, Canada
Avail:AIAA, A78-17948 Jrnl: Atmosphere, V 15:151-159, N3, 1977

An estimate of the energy content of near-surface internal waves in the Strait of Georgia is obtained from a combination of aerial photographs and in-situ measurements. The role of these waves in the tidal energy budget and in the mixing processes in the strait is discussed.

ST78 16125 OTEC: A Survey of the State-Of-The-Art; Ocean Thermal Energy Conversion

Sheets, H.E.
Univ. of Rhode Island, Kingston, RI
2nd STAR Symp., May 25-27, 1977, San Francisco, CA
Avail:AIAA, A78-10723 Jrnl: STAR Proc., p. 183-194, SNAME, New York, NY

Research on ocean thermal energy conversion is reviewed together with the availability of energy from this source. OTEC power plants can be built within existing technology. However, for optimum cost, certain component improvements will be necessary. Of particular interest are heat exchangers, as present practice would result in extremely large units, and in high costs. The pumps and cold water pipe require some development due to the large amounts of water which must be transported. The platform structure and mooring arrangements need special attention and for the entire unit, corrosion and biofouling are critical factors for the intended long life and expected high reliability. The parasitic power of the auxiliary systems is critical to maintain the high efficiency of the power plant over its expected life. Energy use and transmission are dependent on the location of the OTEC plant.

ST78 16126 State Variable Analysis, Control, and Feasibility of Design of an Ocean Thermal Power Plant

Sigg, J.S.; Heydt, G.T.
Purdue Univ., Lafayette, IN
Avail,NTIS, TR-EE-76-45 Dec. 1976

One of the most attractive energy conversion techniques is ocean thermal energy conversion. This process uses the existing temperature difference between the upper and lower layers of the ocean to cause phase changes in a working fluid and thus extract net

work. Details of the design of a 24-MWe ocean thermal energy converter are presented. In particular, the following design aspects are emphasized: economic analysis, siting considerations, heat cycle description, heat exchanger design, electrical system design, and control of the power plant. A brief summary of the biological impact of the ocean thermal energy converter is also given. The design parameters for this power plant are taken from the island of Tutuila, American Samoa.

ST78 16127 Prospects for OTEC Energy Utilization: Ocean Thermal Energy Conversion Coupled with Ammonia and Aluminum Production

Snyder, J.E.III; Douglass, R.H.Jr.
TRW, Inc., Redondo Beach, CA
2nd STAR Symp., May 25-27, 1977, San Francisco, CA
Avail:AIAA, A78-10725 Jrnl: STAR Proc., p. 203-214, SNAME, New York, NY

Floating ocean thermal energy conversion (OTEC) power plants are favorably sited in tropical ocean waters. Several methods for utilization of OTEC power by onshore users have been proposed, including direct electrical transmission by undersea cable, chemical energy carriers, and manufacture of energy-intensive products onboard the OTEC platform. In this paper, direct electrical transmission is compared with two energy-intensive manufacturing processes: aluminum smelting and ammonia production. Conceptual designs for both aluminum and ammonia plants are developed as an integral part of a 100-MWe baseline OTEC power plant. The designs include consideration of sea transport of raw materials and products, effect of plant space and weight requirements on the baseline OTEC configuration, sea state-induced plant motions, safety hazards, and environmental impact.

ST78 16128 Wave Energy Converter

Toernkvist, R.
German (FRG) Patent no. 2,504,330/A Aug. 7, 1975 In German

A device is described for winning energy from sea and/or lake-water waves. By this method, the energy of waves should be converted into pressure energy. For this, elements of variable shape connected to pump cylinders are used, which pump water into a pipe system due to a deformation of the elements caused by the waves. These variable-shape elements are filled with water in or below the water surface and flexibly connected. Further claims are concerned with variations of the arrangement of the elements, their shape and dimension, and with the supporting structures. The water pressure produced is used, preferably, to drive water turbines. Besides, the invention has the aim of erecting a wave breaker.

ST78 16129 Process and Device for Harnessing Wave Energy

Tornabene, M.G.
US Patent no. 4,048,801 Sept. 20, 1977

This report describes an invention which utilizes several floats to convert wave energy into mechanical energy. A collection of cams and offset floats allow it to utilize several orthogonal forces of wave energy.

ST78 16130 Engineering Aspects of OTEC Systems; Ocean Thermal Energy Conversion

Trimble, L.C.
Lockheed Missiles and Space Co., Inc., Sunnyvale, CA
2nd STAR Symp., May 25-27, 1977, San Francisco, CA
Avail:AIAA, A78-10726 Jrnl: STAR Proc., p. 215-232, SNAME, New York, NY

The paper considers the Naval architectural and engineering aspects of a baseline OTEC plant, including a central core and platform structure, four peripherally mounted power modules and their auxiliary equipment, heat exchangers, safety provisions, ammonia turbines, sea water pumps, cathodic protection, the cold-water pipe, the mooring system, and methods of deployment and construction. Performance and economic analyses show that with a single design iteration on only the power-cycle components, the projected performance and resulting cost of energy were greatly improved.

ST78 16131 Tidal Power Generation in India

Vaidyaraman, P.P.; Brahme, S.B.
Central Water and Power Research Station, Pune, India
Jrnl: J. Inst. Engng., Electrical Engng. Div., India, V 57:200-206, Feb. 1977

Tidal energy forms one of the important sources of energy. The first attempt to utilize tidal power in India was in the form of tide mills, which made use of the kinetic energy of tides. Extensive studies were made to understand the phenomenon of tides and harness it for power production. Although the first tidal power plant was commissioned in 1967 in France, due to economic factors, tidal power generation is yet to make sufficient headway. Unpredictability of the output of the conventional hydroelectric plants due to vagaries of nature, problems of transportation of coal to thermal power projects and economical and pollution problems connected with the nuclear projects have led to a beginning in harnessing of tides in India by constructing a pilot plant which, it is hoped, would help solve some of the problems connected with such schemes and also help develop technical know-how of the scheme indigenously.

ST78 16132 Tidal Power Study for the United States Energy Research and Development Administration, Final Report, Volume 1

Wayne, W.W.Jr.
Stone and Webster Engineering Corp., Boston, MA
Avail:NTIS, DGE/2293-3 March 1977

The results of a study of the feasibility of tidal power utilization in the United States are presented. The study covered the following areas: (1)the current status of tidal power in the world today, (2)the potential for the use of tidal power, (3)potential sites in the US, and (4)environmental, societal, and legal consequences of a major tidal power project.

ST78 16133 Ocean Energy and Food Farm Project

Wilcox, H.A.
Naval Undersea Center, San Diego, CA
7th SPG Symp., 1976
Avail:NTIS, CONF-7510149 Jrnl: SPG Proc.

The solar energy naturally received by the oceans can be used to manufacture synthetic natural gas (SNG), thus alleviating the supply shortages now facing the American gas industry. This paper describes the Ocean Energy and Food Farm Project, which promises by 1985 to 1990 to be able to yield 160,000 standard ft^3 of methane (SNG) per year per acre of cultivated ocean. On this basis, the 23 trillion standard ft^3 of methane presently being consumed by the USA each year could be produced from a square of ocean approximately 470 miles on a side, a distance reaching roughly from San Francisco to San Diego, California. The Ocean Farm Project is presently funded by the federal government and the American Gas Association in roughly equal shares. Current planning and accomplishments of the project are given in the paper. The project is on schedule at this time.

ST78 16134 Preliminary Drag Model for the Ocean Food and Energy Farm

Wilcox, H.A.
Integrated Sciences Corp., Santa Monica, CA/Naval Undersea Center, San Diego, CA
Avail:NTIS, ERDA/USN/1027-76/1 OFEFPSA, V 7, Final Report

This study of an important aspect of the Ocean Farm concept provides tentative and preliminary answers to important questions regarding the forces which will be exerted on farm structures under various oceanic current conditions. No data concerning current-induced forces on actual farm structures yet exist. A preliminary drag model for the ocean farm was developed.

ST78 16135 Electricity From the Thermal Power of the Sea

Winter, S.D.
Centre National Pour L'Exploitation Des Oceans, Paris, France
Jrnl: Future Energy Production Systems, V 2, 1976, Hemisphere Publ. Corp., Washington, D.C.

Major problems associated with solar energy conversion using the thermal gradient of the sea are briefly reviewed. Technological aspects are mentioned in connection with the choice of location of the plant and of the working medium.

ST78 16136 System For Generating Power From Wave Motions of the Sea

Wood, E.
US Patent no. 4,048,512; Sept. 13, 1977

A power generating system for the generation of energy from the wave motions of the sea is buoyantly supported by the sea. The system comprises spine elements defining a spine on which ducks are rockably mounted, the system further including tension cable means pressing the spine elements towards each other, thereby to define a spine, and energy conversion means for converting the rocking motion into electrical power.

ST78 16137 Investigation of Wind Energy: Technical Concepts and Research Problems

Ziegler, A.
Bundesministerium Fuer Forschung Und Technologie, Bonn, West Germany
Avail:AIAA, A78-14102 Jrnl: Sonnenenergie, V 2:8-10, 12, May-June 1977, In German

Technical concepts for wind energy production, including the Honnef, Darrieus, Mantle Turbine, and Huetter, are compared, and their potential contribution to energy production is estimated. Research problems in the development of wind energy utilization are identified, and West German research projects are surveyed. Some goals for future projects are suggested. Data on the prevalence of wind velocities at different heights are presented, and the need for more meteorological data is noted.

17,000 WIND POWER

ST78 17034 Design Study of Wind Turbines 50 KW to 3000 KW for Electric Utility Applications, Volume 1, Summary Report

GE Co., Philadelphia, PA
Avail:NTIS, ERDA/NASA/9403-76, Sept. 1976

This study was one of two parallel efforts conducted to define the wind turbine configuration that would lead to generation of electrical power in a cost-effective manner. All possible overall system configurations, operating modes, and subsystem concepts were evaluated for both technical feasibility and compatibility with utility networks, as well as for economic attractiveness. A design optimization computer code was developed to determine the cost sensitivity of the various design features, and thus establish the configuration and design conditions that would minimize the generated energy costs. The preliminary designs of both a 500-kw unit and a 1600-kw unit operating in a 12-mph and an 18-mph median wind speed, respectively, were developed. This report summarizes both the rationale employed in this study and the key findings of this study, but does not present an in-depth detail discussion of all design considerations.

ST78 17035 Design Study of Wind Turbines 50 KW to 3000 KW for Electric Utility Applications, Volume 1, Summary Report, Final Report

GE Co., Philadelphia, PA
Avail:NTIS, N78-12529, 65 p.

Wind turbine configurations that would lead to generation of electrical power in a cost-effective manner were considered. All possible overall system configurations, operating modes, and subsystem concepts were evaluated for both technical feasibility and compatibility with utility networks, as well as for economic attractiveness. A design optimization computer code was developed to determine the cost sensitivity of the various design features, and thus establish the configuration and design conditions that would minimize the generated energy costs. The preliminary designs of both 500-kw unit and a 1500-k2 unit operating in a 12-mph and 18-mph median wind speed, respectively, were developed. The rationale employed and the key findings are summarized.

ST78 17036 Project Combines Solar Energy and Wind Power

Jrnl: Design News, V 33, Nov. 21, 1977

No abstract available.

ST78 17037 Solar Program Assessment: Environmental Factors, Wind Energy Conversion

ERDA, Washington, D.C., Div. of Solar Energy
Avail:NTIS, N78-14682, 42 p.

The major environmental issues associated with the further development of wind electric conversion (WEC) systems are presented and prioritized. To provide a background for this environmental analysis, the basic concepts of the technology are reviewed, as are its resource requirements. The potential effects of this technology on the full range of environmental concerns are then discussed in terms of both their relative significance and possible solutions. Although the development of WEC will in some ways contribute to environmental problems common to any construction project or energy producing technology, only those impacts unique to the solar-wind portion of the technology are discussed in depth.

ST78 17038 Some Answers to Power Generation Lie Blowing in the Wind

Jrnl: Engineer, V 241:30-31, N6237, Oct. 2, 1975

An assessment of wind power generation schemes by the Energy Technology Support Unit is reported. The capital cost of large efficient windmills should be around 100-200 pounds per installed kW and an optimum size for a single wind rotor would 1 MW.

ST78 17039 Summary of Current Cost Estimates of Large Wind Energy Systems

JBF Scientific Corp., Washington, D.C.
Avail:NTIS, N78-14650 64 p.

The Federal Wind Energy Program, over the past two years, has substantially extended the state of knowledge about the costs and performance of large wind energy conversion systems (WECS). Much of this progress was achieved as a result of a series of ERDA-sponsored studies dealing with the system design, mission analysis, and regional applicability of WECS. This report reviews these studies, summarizes the most pertinent results, and provides a view of the current status and uncertainties surrounding the economics of generating energy from the wind for electric utility applications.

ST78 17040 Utilization of Wind Energy

AEO of Iran, Centre for Res. and Application of Radioisotopes, Teheran, Iran
Avail:NTIS, AEOI-63, Oct. 1976, In Iranian

The statistics of the wind energy in the three aerology stations in the Shahbanu Farah Dam Region, over a period of eight years, were evaluated and analyzed. The average of maximal velocity calculations indicates a speed of 15 m/s. The yearly physical conversion value of this energy is 150,000 kWH, which is quite sufficient for a family of five persons. On a larger scale, this power can be used to supply the energy required for the sediment dredging activities of the Shahbanu Farah Dam.

ST78 17041 Wind Energy Mission Analysis, Appendices A-J, Final Report

GE Co., Philadelphia, PA
Avail:NTIS, N78-14647 504 p.

Information is presented concerning meteorological data and supporting analyses, gross energy consumption patterns and end-use analysis, as well as analysis for industrial applications of wind energy conversion systems (WECS). Also presented is an analysis for residential applications of WECS, an analysis for application of WECS to communities remote from utility grids, an analysis for agricultural applications of WECS, a regional evaluation of the economics of wind turbine generation to the US Electric Utility District, impact of storage on WECS, financial analysis techniques, and system spacing.

ST78 17042 Wind Energy Mission Analysis, Executive Summary

GE Co., Philadelphia, PA
Avail:NTIS, N78-14645 28 p.

High-potential applications, functional, performance, operational, and cost goals for wind energy conversion systems and the impact of the wide-scale deployment of such systems on energy users were evaluated. The institutional and nontechnical problems associated with the acceptance of wind energy were also studied. Emphasis was placed on identifying and exploring high-aggregate energy users who have significant potential to utilize wind energy in place of other alternatives.

ST78 17043 Wind Energy Mission Analysis, Final Report

GE Co., Philadelphia, PA
Avail:NTIS, N78-14646 252 p.

The development of wind energy systems in the US is discussed under the following headings: baseline power systems, assessment of wind potential, identification of high potential applications, electric utilities, residential application, paper industry application, agriculture application, and remote community applications.

ST78 17044 Wind Energy Mission Analysis, Appendix

Lockheed-California Co., Burbank, CA
Avail:NTIS, SAN/1075-1/2 April 1976

Appendices include information on the average power density of the wind for the US and its territories, characteristics of the vertical axis machine, structural analysis details, aerodynamic analysis, cost factors for WTG cost model, evaluation of utility applications, industrial cost of electricity, national impact of WECS, public acceptance, and environmental issues.

ST78 17045 Wind Energy Utilization: A Bibliography With Abstracts, Cumulative Volume, 1944-1974

Univ. of New Mexico, Albuquerque, NM, TAC
Avail:NTIS, TAC-W-75-700 1975

To compile this bibliography, the Technology Application Center utilized a combination of computerized data bases and manual searching techniques to retrieve and evaluate wind information from throughout the world. Among the more significant sources searched were: Scientific and Technical Aerospace Reports (1963-74), Engineering Index (1962-74), Government Report Announcements (1964-74), Energy Abstracts (1973-74), International Aerospace Abstracts (1962-74), The Oklahoma State University Synopsis of Energy Research, plus a number of published documents on the subject of wind. In addition, valuable input was provided by Brace Research Institute of Canada's McGill University, The Alternative Sources of Energy in Mukwonago, Wisconsin, and The Electrical Research Association of Leatherhead, England. Citations are grouped under the following headings: general, utilization, wind power plants, wind power generators, wind machines, wind data and properties, energy storage, and related topics.

ST78 17046 100-KW Wind Turbine Blade: Dynamics Analysis, Weight-Balance, and Structural Test Results, Final Report

Anderson, W.D.
Lockheed-California Co., Burbank, CA
Avail:NTIS, N77-21468 June 1975

The results of dynamic analyses, weight and balance tests, static stiffness tests, and structural vibration tests on the 60-ft-long metal baldes for the ERDA-NASA 100-kw wind turbine are presented. The metal blades are shown to be free from structural or dynamic resonance at the wind turbine design speed. Aerolastic instabilities are unlikely to occur within the normal operating range of the wind turbine.

ST78 17047 Analysis of the Potential for Wind Energy Production in Northwestern Ontario

Brown, C.K.; Warne, D.F.
Ontario Res. Foundation, Sheridan Park, Canada
Avail:NTIS, NP-22490 Nov. 1975

A study of the feasibility of generating electric power from wind generators at remote sites in Northwestern Ontario has been carried out on behalf of the Ontario Ministry of Energy, with project management from Ontario Hydro. The work included (1) a survey of commercially available wind-driven electric plant, both currently available and planned for production; (2)an analysis of existing wind data and preparation of an isovent map for Ontario showing annual mean wind speeds; (3)the selection of suitable sites for a demonstration unit and a prototype system; (4)the matching of available plant to the wind regimes to predict annual energy production; and (5)a systems analysis of pure diesel, hybrid wind/diesel, and pure wind electric plants to determine the cost of power from the various alternatives.

ST78 17048 Computer-Aided Aerogenerator Analysis and Performance

Base, T.E.; Brussel, L.J.
Univ. of Western Ontario, London, Canada
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22229 Jrnl: Proc. of Symp., 26 p.

The general theory of windmills is examined, taking into account slow-running and fast-running windmills and the importance of inflow factors, which represent a modification to the flow field about rotating objects. Horizontal shaft windmills are considered, giving attention to linear and angular momentum changes considered in the Rankine-Froude Momentum Theory, the employment of the Newton-Raphson Method of solving nonlinear differentiable equations, a computer program for the determination of torque coefficients, the distribution of the inflow factors, and the response of the windmill to turbulence. It is pointed out that much of today's wind energy research is being devoted to vertical axis machines. A logical approach to their theoretical analysis appears to follow that derived by Glauert for propellers. Computer programs for the study of vertical shaft windmill performance and their results are discussed along with inflow factors and experimentation.

ST78 17049 A Low-Cost Windmill Rotor

Baxter, A.C.
Univ. of Leicester, Leicester, England
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22242 Jrnl: Proc. of Symp. 10 p.

The economic feasibility of a use of windmills to obtain power for the generation of electricity depends primarily on the capital cost of the required installation. It appears that this capital cost is still too high. In this connection, a vertical axis, high-speed rotor design has been proposed by Rangi, et al. (1974), who estimate that the cost of their device would be about one-sixth of that of a conventional windmill. In the new windmill, the expensive airfoil section blades, which form a main component of most windmills, are replaced with a simple steel framework around which a tensioned fabric cover is placed. A description is given of experiments in which models of the new airfoils are employed. Static aerodynamic tests of a vertical-axis windmill rotor using flexible blades predict that the design appears promising.

ST78 17050 Closed Wind Turbine With a Conically Adjustable Wind Tunnel for the Generation of Current and Direct Energy

Bertelsmeier, G.
German (FRG) Patent no. 2,539,058/A, March 10, 1977, In German

The invention refers to a closed wind turbine with a conically adjustable wind tunnel for the generation of electric and/or mechanical power. The device is characterized by a wind wheel, equipped with covers and a wind-catching device, which is installed within the frame construction in a revolving position in a closed case.

ST78 17051 Wind Energy: A Supplement to Hydro-Electric Energy Using the Columbia River Valley as an Example

Chen, P.I.; Garg, V.K.
Portland State Univ., Portland, OR
1977 Annual Mtg. of ASISES, 1977,
Avail:NTIS, 78C0002130 Jrnl: Proc. of Mtg., V 1, Secs. 15-25, ASISES, Cape Canaveral, FL

A conceptual wind energy conversion system (WECS) is described which consists of a wind power conversion unit that pumps water from the tail water level to the reservoir level in order to store it there in a form of potential energy that can be converted to electrical energy through existing hydro-electric power plants. Site selections for using this WECS are constrained, therefore, not only by the availability of wind power, but also the existence of hydro-power facilities. Examples of the total wind energy potential at Cascade Locks, the Dalles, John Day and McNary sites were analyzed based on available data. Economic assessments of the wind power systems are presented.

ST78 17052 The Use of Built Form to Enhance the Output of Wind Collectors

Coonley, D.R.
Avail:AIAA, A78-20478 Jrnl: Wind Tech. J., V 1:24-30, Summer 1977

Consideration is given to using a built form to increase the output of wind collectors. The application of wind energy conservation systems (WECS) to buildings is discussed, and the advantages and disadvantage encountered are noted. Attention is given to various wind system design considerations, including social and economic aspects, adaptation to existing structures, and community design for the use of wind energy. Potential methods integrating several energy sources into a single comportable system are reviewed.

ST78 17053 United States Wind Speed and Wind Power Duration Tables, By Months, Cumulative Distributions, Scientific Report No. 1

Coty, U.A.; Court, A.; Reed, J.W.
Lockheed-California Co., Burbank, CA
SAN/1075-2, Oct. 1975

Cumulative distribution of wind speed (meters per second), adjusted to a standard height of 10 meters (33 feet) above ground at 478 places in the United States, for each month and season, and for the year as a whole, are presented. In addition, cumulative distributions of wind power (watts per m^2), by seasons, and for the year, at heights of 10, 50, and 100 meters above ground are given.

ST78 17054 A Computer Model for Large-Scale Offshore Wind-Power Systems

Dambolena, I.G.; Rikkers, R.F.; Kaminsky, F.C.
Bucknell Univ., Lewisburg, PA
Avail:AIAA, A78-18089 Jrnl: Wing Engng., V 1:163-168, N3, 1977

A computer-based planning model has been developed to evaluate the cost and simulate the performance of offshore wind-power systems. In these systems, the electricity produced by wind generators either satisfies directly demand or produces hydrogen by water electrolysis. The hydrogen is stored and later used to produce electricity in fuel cells. Using as inputs basic characteristics of the system and historical or computer-generated time series for wind speed and electricity demand, the model simulates system performance over time. A history of the energy produced and the discounted annual cost of the system are used to evaluate alternatives. The output also contains information which is useful in pointing towards more favorable design alternatives. Use of the model to analyze a specific wind-power system for New England indicates that electric energy could perhaps be generated at a competitive cost.

ST78 17055 Analytical Performance and Economic Evaluation of Residential Wind or Wind and Solar Heating Systems

Darkazalli, G.; McGowan, J.G.
Univ. of Texas, Arlington, TX
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11347 Jrnl: Proc. of Mtg., Secs. 14-25, ISES, Cape Canaveral, FL

A performance and cost model for a variety of wind space and water heating systems for single-family residences is presented. In addition to wind-powered systems, combined wind and solar systems are modeled and compared to conventional and solar only heating systems. Analytical results are presented for a site in Amhert, Massachusetts. System capital economic details include an itemized cost breakdown of the wind heating system components. The results demonstrate that wind-powered systems are presently competitive with electric-based heating systems, and will be competitive oil or gas systems in the future.

ST78 17056 Approximate Method for Calculating Free Vibrations of a Large Wind Turbine Tower Structure

Das, S.C.; Linscott, B.S.
NASA, Lewis, Cleveland, OH
Avail:NTIS, N78-16434 46 p.

A set of ordinary differential equations were derived for a simplified structural dynamic lumped-mass model of a typical large wind-turbine tower structure. Dunkerley's equation was used to arrive at a solution for the fundamental natural frequencies of the tower in bending and torsion. The ERDA-NASA 100-kW wind turbine tower structure was modeled, and the fundamental frequencies were determined by the simplified method described. The approximate fundamental natural frequencies for the tower agree within 18 percent with test data and predictions analyzed.

ST78 17057 Wind Fabric Diagrams and Their Application to Wind Energy Analysis

Davis, B.L.; Ekern, M.W.
S. Dakota School of Mines and Tech., Rapid City, SD
Jrnl: J. Applied Meteorol., V 16:522-531, N5, May 1977, 5 refs

By means of the Lambert Projection, wind vector data may be plotted onto a frequency map. The resulting diagram portrays the "wind fabric" for the data sample of a single station or for groups of stations. The area-true distribution of wind vectors is thus given in great detail and allows several standard tests for homogeneity and anomaly significance. By using a "swinging plate" device, the wind energy density and wind power can be calculated for any velocity-compass heading sector of the diagram desired and allows for a universal scaling of the velocity variable of the diagram.

ST78 17058 The Use of Wind Power by Electric Utilities

Davitian, H.
BNL, Upton, NY
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11311 Jrnl: Proc. of Mtg., Secs. 14-25, ISES, Cape Canaveral, FL
p. 19-1--19-5

The maximum power that can be practically extracted from the wind is roughly one to three times 10^{12} kWH year, which is in the range of current US electricity consumption. Wind machines used by utilities are likely to be characterized by two blades, a horizontal-axis rotor, heights over 200 feet, and a synchronous generator with power ratings in the one Mw range. One such machine could produce about 7 x 10^6 kWH/year in an 18-mph mean wind. Currently available estimates for the costs of producing and installing machines are in the range of $500-$700/kW for the 100th machine produced. The value of wind machines to utilities will be in this range in some parts of the US, given expected increases in fuel costs. This preliminary analysis of the economics of wind power indicates a promising potential for regions of the US with high wind power availability and high fuel costs.

ST78 17059 Down-Wind Coning-Type Generator

Dew, J.
Jrnl: Alternative Sources Energy, V 24:11-14, Feb. 1977

Specifications, materials, and construction procedures for a three-bladed, downwind, coning-type wind turbine are presented.

ST78 17060 A Self-Contained 5000-KW Capacity Wind Energy Conversion System With Storage

Fekete, G.I.
McGill Univ., Montreal, Canada
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22246 Jrnl: Proc. of Symp., 18 p.

A wind energy conversion system intended to provide a minimum continuous output of 5000 kw even during the calmest month of the year is designed for the Magdalen Islands in the Gulf of St. Lawrence, one of the windiest areas in North America. In addition to 34.5-m diameter horizontal-axis wind turbines with 300-kW generators, the system includes extensive storage capacity responsible for almost half the total cost of the power plant. A capital cost of about 65 million 1974 dollars is projected for the entire system; the minimum cost of the electricity is put at about 20 cents per kWH.

ST78 17061 Experiment and Analytical Studies of the Aerodynamic Performance of Windmills

Figard, R.L.; Schetz, J.A.
Virginia Polytech. Inst. and State Univ., Blacksburg, VA
AIAA 16th ASM, Jan. 16-18, 1978, Huntsville, AL
Avail:AIAA, A78-22612 Jrnl: ASM Proc., 8 p.

The aerodynamic performance of a modern high tip speed, three-bladed windmill rated at 10 kw at 30 mph was studied by three methods. First, the results of field tests of the actual device with both a resistive and a battery-charging electric load are reported. Second, the predictions of a simple blade-element analysis are presented and compared with the field data. Aerodynamic blade section coefficients of an actual blade section were measured in a wind tunnel and used as input in the analysis. Third, wind tunnel test results for a one-fifth scale model are given. Reynolds number simulation from model to prototype is considered in detail. Finally, the results of all three efforts are compared.

ST78 17062 Mathematical Modeling of Topographic Effects on Wind Energy Systems

Freeman, B.E.; Taft, J.R.
Science Applications, Inc., La Jolla, CA
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22228 Jrnl: Proc. of Symp., 13 p., BHRA, Cranfield Beds, England

The reported investigation is concerned with the development of a methodology which employs theoretical-numerical methods to select wind energy sites on the basis of climatological data. The use of mathematical model-based meteorological prediction tools makes it possible to relate climatological data at National Weather Services and aviation weather stations in the region to corresponding data at the unmeasured locations within the region. Attention is given to a mesoscale meteorological computer code design and development, aspects of mathematical formulation, calculations of terrain effects, terrain coordinate transformation, relations between atmospheric pressure and wind speed, and horizontal wind vectors at various altitudes.

ST78 17063 Economics of a Vertical-Axis Wind Turbine

Fritzsche, A.A.
Dornier-System GMBH, Friedrichshafen, West Germany
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22243 Jrnl: Proc. of Symp, 8 p., BHRA, Cranfield Beds, England

Consideration is given to the energy conversion system and the operating characteristics of vertical-axis wind turbine configurations. Design features for several components of the turbine (including rotor blades, rotors, tower, blade and rotor bearings, and energy transmitting elements) are described and cost estimates are presented. It is found that (1)based on current technology, vertical-axis wind turbines can cover a power range to 100 kw; (2)low manufacturing methods for small rotor blades may not be applied to large ones; (3)assuming identical generators for both turbines, the lower tip speed ratio requires a larger transmission ratio; and (4)the advantage of wind direction independence decreases for large power plants.

ST78 17064 Land Contouring to Optimize Wind Power

Fuhs, S.E.; Fuhs, A.E.; Vanderplaats, G.N.
US Naval Postgraduate School, Monterey, CA
AIAA 16th ASM, Jan. 16-18, 1978, Huntsville, AL
Avail:AIAA, A78-20786 Jrnl: ASM Proc., 8 p.

Certain locations on a hill have higher local wind velocity than the freestream value. The augmentation of wind power depends on the shape of the hill. Using numerical optimization techniques, the optimum shape has been determined for several different constraints. Knowledge of the optimum shape is valuable for two reasons: first, the site selection is aided if the best contour is known; near-optimum shapes may occur naturally. Second, for a given site, the excavation and fill necessary to achieve optimum shape can be determined. Four cases are discussed. Each case had different constraints and yielded different values of wind power augmentation as follows: Case 1, 226 percent; Case 2, 311 percent; Case 3, 210 percent; and Case 4, 156 percent.

ST78 17065 Generation of Electricity by Wind Power

Golding, E.W.
E. and F.N. Spon. Ltd., London, England, 1976
Book, $19.00

Information on wind power is presented concerning the history of windmills, estimation of the energy obtainable from the wind, wind characteristics and distribution, wind power sites, wind surveys, wind flow over hills, measurement of wind velocity, wind structure and its determination, wind data and energy estimation, testing of wind-driven AC generators, wind-driven machines, propeller-type windmills, plants for isolated premises and small communities, economy of wind power generation, construction costs for large wind-driven generators, relationship of wind power to other power sources, research and development, and international cooperation.

ST78 17066 Homebuilt Wind-Generated Electricity Handbook

Hackleman, M.A.
Peace Press, Culver City, CA, 1975, Earthmind, Mariposa, CA
Book, $8.00

Information on wind generator systems for home electric power is presented in the following chapters: Search For Pre-REA Wind Machines, Wind Machine Restoration, Towers, Installing Wind Machines, Controls, Auxiliary Electricity-Generating Equipment, and Wind Machine Design Notes.

ST78 17067 Specific Output of Windmills, A Discovery

Harder, E.L.
IEEE Mtg., Nov. 1977
Avail:AIAA, A78-15783 Jrnl: Proc. of Mtg., V 65:1623-1625

Because the wind varies widely from point to point on the earth, it has generally been assumed that the specific output of a wind turbine generator, the kw-hrs generated in a year per kw of rating, could only be determined from the particular wind pattern involved. However, it was discovered empirically that the specific output of windmills is practically

independent of their location on the earth, or of the means annual wind velocity. It depends instead on the ratio of the rated speed, the wind speed at which full rating is realized, to the mean annual wind velocity. This is demonstrated by data from many designs and wind-power sites. The resulting curve of specific output versus rated speed/ means annual wind velocity, together with the fundamental formula for power extracted from the wind by a windmill constitutes a useful approximate design and optimizing method.

ST78 17068 Cross-Flow Wind Turbine

Holgate, M.J.
Univ. of Durham, Durham, England
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22233 Jrnl: Proc. of Symp., 13 p., BHRA, Cranfield Beds, England

A theoretical analysis is presented of the operation of a type of crossflow turbine that depends for its action on angular momentum conversion rather than aerodynamic lift. Experimental results confirm the theoretical predictions to a satisfactory degree. These are, that while the turbine does develop a starting torque and has a stable torque-speed characteristic, it runs at low velocity ratio and has a low efficiency of energy conversion.

ST78 17069 The Outlook For Wind Energy

Huetter, U.
Avail:AIAA, A78-14101 Jrnl: Sonnenenergie, V 2:3-8, May-June 1977, In German

The prospects of using wind energy in West Germany are examined. Winds are most favorable in coastal regions and in a few mountainous areas. Windmill blade characteristics and their relation to energy output are considered. It is noted that 5500 three-mw units would have supplied 16 percent of West Germany's energy requirements in 1973, or all the energy used in the northern part of the country. The performance of different windmill designs are described, and costs associated with a windmill energy system are estimated. The problem of uneven delivery of energy is examined with attention to the possible desirability of trading off performance for dependability.

ST78 17070 The Shrouded Aerogenerator, Wind Turbines

Igra, O.
Univ. of Negev, Beersheba, Israel
Avail:AIAA, A78-13344 Jrnl: Energy, Uk, V 2:429-439, Dec. 1977

Experimental studies have been performed on a shrouded aerogenerator. The device tested will produce about twice the output power obtainable from an ideal wind turbine working under the same freestream conditions but without a duct. The aerogenerator does not require a driving mechanism that will keep it parallel to the free-stream direction. A simple, two-stage turbine with fixed-blade geometry will provide the expected power output over a fairly wide range of free-stream velocities and rotational speeds.

ST78 17071 Survey of Wind Power Development in the United States and Europe

Johnson, C.; Smith, R.T., Swanson, R.K.
Southwest Res. Inst., San Antonio, TX
IV IAMT Conf., 1975
Avail:NTIS, CONF-750677-P1 Jrnl: Proc. of Conf.

Windpower use for electrical power generation is reviewed in terms of past and current development, both in the USA and Europe. Technical data and operating experience are presented for a number of important windpower generation systems (WGS) in Denmark, Germany, and particularly, the Putnam 1000-kw plant at Grandpa's Knob, Vermont. Recent programs initiated by the National Science Foundation are described, as well as the USA windpower R and D program proposed for the next five to ten-year period. Consideration is given to the maximum available power from the wind and how much of this power can actually be extracted and utilized. A recent study by SWRI of wind prediction for specific candidate WGS sites is described. This study was carried out for the Texas Panhandle region, which is shown to have outstanding potential for windpower development. Various systems for processing the variable-speed mechanical power of wind turbines are discussed in terms of complexity, cost, availability, and specific application. Systems evaluated include synchronous, induction, commutator, and solid-state power conversion techniques.

ST78 17072 Economic Analysis of Wind Generation and Energy Storage for Electric Utility Systems

Jones, B.W.; Moretti, P.M.
Oklahoma State Univ., Stillwater, OK
3rd Annual UMR-MEC Conf., 1977
Avail:NTIS, 78C0030546 Jrnl: Proc. of Conf., Western Periodical Co., N. Hollywood, CA

If wind generators are being evaluated as part of a larger electric utility generation system, the economic analysis should consider all of their effects upon the make-up and operation of the rest of the system. The introduction of wind generators changes the characteristics of the effective load seen by the rest of the system and consequently, shifts the optimal mix of base, swinging, and peaking capacity and their operation. Storage systems used in conjunction with wind generators must also be evaluated. The storage can also be evaluated by determining its effect upon load characteristics. It is shown that the storage evaluation and wind-generation evaluation can be separated in most cases.

ST78 17073 Evaluation of Wind Generator Economics in a Load Duration Context

Jones, B.W.; Moretti, P.M.
Oklahoma State Univ., Stillwater, OK
Avail:AIAA, A78-11073 Jrnl: Energy Development III, IEEE, New York, NY, 1977, p. 25-29

Wind generators used without energy storage are usually considered to compete with other generation facilities on the basis of the average incremental cost of generation. This approach can significantly underestimate the actual competitiveness of the wind generators. By analyzing the effect of the wind generators on the remaining load characteristics for an electric utility's generation system, they are shown to affect the required investment in other generation facilities considerably more than they affect operating costs.

ST78 17074 Reference Wind Speed Statistics for Wind Turbine Design

Justus, C.G.; Hargraves, W.R.; Mikhail, A.
Georgia Inst. of Tech., Atlanta, GA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11313 Jrnl: Proc. of Mtg., Secs. 14-25, p. 19-11--19-15, ISES, Cape Canaveral, FL

No abstract available.

ST78 17075 The Potential for Power Production by Large Dispersed Arrays of Wind Turbines

Justus, C.G.
Georgia Inst. of Tech., Atlanta, GA
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22227 Jrnl: Proc. of Symp., p. A2-23--A2-38, BHRA, Cranfield Beds, England

An evaluation is conducted of wind energy output statistics of simulated arrays of wind turbines in the New England and Middle Atlantic Federal Power Commission regions of the US annual average capacity factors (fraction of rated power) of about 40 to 50 percent are obtained for 500 kW, about 15 to 25 percent for 1500 kW, and about 30 to 40 percent for 1000-kw machines. The investigation shows that the reliability of power outputs of 100 kW to 200 kW per generator can be significantly improved by dispersing the wind turbines in large arrays. Much better reliability can be achieved by the addition of 24 to 48 hours of storage capacity. Under conditions of reasonably steady high wind power in winter and high afternoon peak wind power in summer (corresponding to afternoon air conditioning loads), it might, however, be possible to achieve significant load displacement without use of storage.

ST78 17076 Four Probability Densities (Log-Normal, Gamma, Weibull, and Rayleigh) and Their Application to Modeling Average Hourly Wind Speed

Kaminsky, F.C.
Univ. of Massachusetts, Amherst, MA
1977 Annual Mtg. of ASISES, 1977
Avail:NTIS, 78C0002107 Jrnl: Proc. of Mtg., Secs. 14-25, V 1, ASISES, Cape Canaveral, FL

Four probability density functions (the log-normal, the gamma, the Weibull, and the Rayleigh) and procedures for estimating the parameters of each density function are described. The models are then used to describe average hourly wind speed for selected months at Mt. Tom, Holyoke, Massachusetts. χ^2 goodness of fit tests are then conducted to determine the appropriateness of each model. The results indicate that the gamma and the Weibull density functions are more appropriate models for the description of average hourly wind speed.

ST78 17077 Preliminary Survey of the Aerial Wind Energy Resources in Sweden

Karlstrom, C.; Krieg, R.; Kvick, T.; Olsson, L.E.; Ljungstrom, O.
Styrelsen Foer Teknisk Utveckling, Stockholm, Sweden
Avail:NTIS, VES-1975-28 Jan. 1976, In Swedish

Wind velocity data for different heights are reviewed for several meteorological stations in Sweden. Wind energy resources are estimated for the different countries. It is shown that it is possible to produce wind energy in Sweden. Up to 30 twh/year could be produced. It is desirable ot produce this energy in big plants; otherwise, it will not be an economic way of producing energy.

ST78 17078 Evaluation of Offshore Site for Wind Energy Generation

Kirschbaum, H.S.; Somers, E.V.; Sulzberger, V.T.
Westinghouse Electric Corp., Pittsburgh, PA
Avail:AIAA, A78-11080 Jrnl: Energy Development III, p. 108-114, 1977, IEEE, Inc., New York, NY

An analysis of the potential for wind generation at an offshore site indicates a potential in excess of 5700 kWH for a one-MW windmill rated at 20 mi/h and a hub height of 235 ft. The preliminary economics of the application of wind power, as a limited supplement to base-loaded nuclear and other forms of generation, appears to offer enough promise such that a more serious study is warranted to determine the overall economic, technical, and environmental feasibility of such an application. In addition, some of the statistical properties of the wind at the offshore site have been analyzed.

ST78 17079 Wind Power Plant

Kling, A.
German (FRG) Patent no. 2,524,360/A Jan. 13, 1977 In German

The wind power plant described has at least one rotor which is coupled to an electricity generator. The systems are fixed to a suspended body so that it is possible to set up the wind power plant at greater height where one can expect stronger and more uniform winds. The anchoring on the ground or on a floating body is done by mooring cables, which can simultaneously have the function of an electric cable. The whole system can be steered by fins. The rotor system itself consists of at least one pair of contrarotating, momentum-balanced rotors.

ST78 17080 Optimal Design Methodology For a Wind Power System

Langham, R.W.; Frair, L.
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA
ORSA and IMS Jt. Nat'l Mtg., May 9-11, 1977, San Francisco, CA
Avail:AIAA, A78-13847 Jrnl: Proc. of Mtg. Paper, 27 p.

Design criteria for a wind generator system located in an arbitrary wind regime are developed, and a mathematical model for optimal design is tested. Costs associated with the rotor blade, tower, and generator are included in the design criteria. An empirical relationship connecting wind speed to altitude, and a discrete approximation of wind energy are discussed in evolving a solution technique for the mathematical design model. Computational results are presented for a 2500-kW generator system located in Oklahoma City.

ST78 17081 Wind Power Systems, A Select Bibliography

Lapeysen, E.H.
Nat'l Center for Sci. and Tech. Documentation, Brussels, Belgium
Avail:NTIS, N78-14627

The list includes 331 reports, articles, conference papers, and other documents concerning wind energy policy, conversion technology, and transfer. A subject index is included.

ST78 17082 Economic Competitiveness of Windmills

Lapin, E.E.
Aerospace Corp, Los Angeles, CA
Jrnl: Energy Conversion, V 16:213-220, N4, 1977

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.

ST78 17083 General Performance Theory for Crosswind Axis Turbines

Lissaman, P.B.S.
Aerovironment, Inc., Pasadena, CA
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22236 Jrnl: Proc. of Symp., p. C 2-21--C2-38, BHRA, Cranfield Beds, England

An analytical theory is presented for the determination of the performance characteristics of rotary crosswind axis machines. The considered approach can be used for the preliminary design of wind turbine geometry and the selection of blade sections. It is found that for high chordal ratio (c) devices, the crosswind force has a significant adverse effect on power extraction, as well as on aerodynamic loads. The theory considers wake induction and unsteady aerodynamics in the simplest way consistent with the objective of developing realistic engineering results. For low-c devices, this appears to be adequate for a first order analysis, but further refinement is desirable to predict aerolastic behavior. For high-c devices, more data is required to validate the proposed viscuous corrections.

ST78 17084 Large-Scale Wind Energy Conversion System (WECS) Design and Installation as Affected by Site Wind Energy Characteristics, Grouping Arrangement, and Social Acceptance

Ljungstrom, O.
Avail:NTIS, 78C0030545 Jrnl: Wind Engng., Sweden, V 1:36-56, N1, 1977

The Swedish Wind Energy Prospecting Program includes special features of determining site wind characteristics and design of WECS group stations, which are described briefly, such as applications of normalized WDP-wind duration profiles, WHP-wind height profiles, and how these are affected by site location and terrain roughness. A set of WEC-wind energy classes (one to four) is introduced as an aid in territorial wind energy surveys. A survey of Sweden's WEPA-wind energy producing areas, with associated distribution over WEC-two to four, is presented. In order to determine the corresponding wind energy production capacity, the problem of optimizing WECS group station design for cost-effective energy production per land usage must be solved. Here, the effects of WECS unit size and spacing on specific annual energy production, twh/km^2/year, are analyzed with the use of specific group station models in the 40 to 100 mw capacity range, applying WECS unit sizes 50 kW, one MW, and five MW, studying the energy balance for typical group stations. By applying the specific productivity data for one to five mw systems, a survey of the WEPA-associated wind energy production capacity in Sweden is presented.

ST78 17085 Betz-Type Limitation of Vortex Wind Machines

Loth, J.L.
West Virginia Univ., Morgantown, WV
Avail:AIAA, A78-18090 Jrnl: Wind Engng., V 1:169-185, N3, 1977

Various vortex wind machines, which use a vortex generator in the form of a low-aspect ratio wing or vanes in a tower, are evaluated to determine theoretical power limitations. The maximum possible power output is represented by a Betz-type dimensionless power coefficient.

ST78 17086 Wind Power Limitations Associated With Vortices

Loth, J.L.
West Virginia Univ., Morgantown, WV
AIAA 16th ASM Mtg., Jan. 16-18, 1978, Huntsville, AL
Avail:AIAA, A78-20785 Jrnl: Proc. of Mtg., 9 p.

The total pressure dissipation inside vortices, due to viscuous shear, has been analyzed. The reduced level of the total pressure flux of the flow inside a vortex has an adverse effect on all vortex ingesting wind machines. The Betz limit of wind turbines ingesting the vortex generated by an airfoil has been computed and is nondimensionalized using the area of the vortex generator. The vacuum pumping ability of vortices is also limited. The Betz-type limit for wind turbines exhausting into the core of a vortex has been computed for both wing tip and tornado tower-type vortex generators. The energy required to eliminate a tornado has been computed.

ST78 17087 Locating Areas of High Wind-Energy Potential by Remote Observation of Eolian Geomorphology and Topography

Marrs, R.W.; Marwitz, J.
Univ. of Wyoming, Laramie, WY
Avail:NTIS, 78C0036281 1977

The purpose of research under ERDA contract EY-76-S-06-2343 is to develop an efficient procedure for inferring wind characteristics through interpretation of Eolian landforms. An areas in Central Wyoming was chosen as the test site. The site contains many well-developed Eolian landforms and is noted for its high winds. While some members of the research team interpreted satellite imagery and aerial photos and gathered field data in regions of dunes and blowouts, others compiled all available climatic information and collected additional data via low-altitude flights with a specially instrumented aircraft. Observed characteristics of Eolian features were then correlated with the wind data. Cause-and-effect interrelationships were identified and theoretical models were tested as possible explanations to the observed relationships. Relationships which proved useful in the Wyoming test area were then applied over a broader region and in other areas of the country to test for regional applicability of each predictor.

ST78 17088 Wind-Wall: An Integrated Wind-Solar System

McVeigh, J.C.; Pontin, G.W.W.
Brighton Polytechnic, Engng.
Jrnl: Wind Engng., V 1:150-158, N2, 1977

An approach is described to the problem of providing space and water heating to a group of local authority houses in the south of England, where there is moderate annual mean wind speed, 6.0 m/s^{-1}, and an annual solar insolation of about 1000 kWH/m^2 on a south-facing inclined slope. The windmill system is grouped in a "wind-wall," a new concept with fixed ducted horizontal-axis, bi-directional windmills based on a two-mc cube.

ST78 17089 An Asynchronous AC/DC/AC Link for Wind Power Application, PhD Thesis

Merritt, B.T.
Univ. of Wisconsin, Madison, WI
Avail:Univ. Microfilms no. 77-17842

It is proven that an asynchronous AC/DC/AC electric link is a practical way of converting the kinetic energy in the wind to electrical energy. The AC/DC/AC link termed a wind energy conversion system (WECS) consists of a wind driven polyphase alternator, rectifier, inductor, and an inverter tied to the existing utility grid. The laboratory investigations studied various alternator types, types of inverters, and types of inverter control. Based on these laboratory tests, a WECS consisting of a modified commercial aerogenerator, a three-phase six-pulse bridge rectifier, a bus stabilizer, and a single-phase four-pulse bridge inverter was designed, built, and installed.

ST78 17090 Wind Energy: Large and Small Systems Competing

Metz, W.D.
Jrnl: Science, V 197:971-973, N4307, Sept. 2, 1977

Wind turbine development and application programs in the US are described. Potential environmental impacts of large wind power plants are discussed. Small wind turbine generators are also described.

ST78 17091 Rotor-Generator Isolation for Wind Turbines

Mirandy, L.
Boeing Vertol Co., Philadelphia, PA
Jrnl: J. Energy, V 1:180-188, N3, 1977

The interface dynamics between the rotor and electrical generator are analyzed for horizontal-axis constant-RPM wind turbine systems. Coupled equations of motion for the rotor, drive shaft, and generator are developed and solved to obtain the system natural frequency and forced response characteristics. It is concluded that isolation via a soft drive shaft should be used to keep vibratory torque inputs to the generator within acceptable levels. It is also shown that this isolation can be accomplished with realistic designs. Sample calculations are carried through for a two-bladed 265-ft-diameter 1000-kw system.

ST78 17092 Balancing Power Supply From Wind Energy Converting Systems

Molly, J.P.
Deutsche Forschungs und Versuchsanstalt Fuer Lift und Taumfahrt E.V., Stuttgart, Germany
Avail:NTIS, 78C0030561 Jrnl: Wind Engng., V 1:57-66, N1, 1977

The random power-fluctuation of a wind energy converter can be decreased by the electrical connection of several WECS located at large dispersed sites. It is shown that such a combination reduces the zero output time per year and leads to smaller mean power fluctuations than those of a single WEC with an equivalent storage system. In addition, the way in which mean power fluctuation varies if momentary demand is chosen for reference is investigated.

ST78 17093 Systems Development and Test Center Activities in the Wind Systems Program at Rocky Flats

Moment, R.L.
Atomics Internat'l Div., Rocky Flats Plant, Golden, CO
Avail:NTIS, RFP-2698 1976

A test center has been established with 12 machine towers of varying descriptions and eight WTGS erected to date. Additionally, two large and three small meteorological towers have been installed, as well as a small irrigation system, typical of the type commonly used throughout the country. Experience with these machines has revealed a number of operational problems, but has resulted in hardware modifications by manufacturers. The other main area of effort has been to solicit and evaluate proposals for development of eight kw, 40 kw, and high reliability SWECs.

ST78 17094 Wind-Powered Drive Aggregate

Murphy, J.M.; Baumgartner, F.W.
German (FRG) Patent no. 2,639,886/A March 10, 1977 In German

The patent application concerns a wind drive aggregate with vertical rotation axis. The drum-shaped rotor carries a number of vertically positioned parts on its circumference, which have a wing-shaped profile in their horizontal cross-section, the chord of which forms an angle of attack with the tangent on the periphery. The rotor is surrounded by an equally cylindrical stator like a cage which has several vertical rod-shaped parts of suitable cross-section. By these means, the speed of the radially entering wind current is increased on contact with the rotor wing and moves it diagonally to the air current, so that the rotor is set in motion. In another design, the rotor and the stator are of spherical design, also with vertical axis.

ST78 17095 How To Maximize Your Wind Generator's Output

Nightingale, D.; Ramsey, R.; Rowe, L.
State Univ. College, New Paltz, NY
Jrnl: Alternative Sources Energy, V 24:15-17, Feb. 1977

An electronic control circuit is described for a varying RPM wind turbine using a 12-volt DC automobile alternator.

ST78 17096 Noble Wind Generator

Noble, H.
Jrnl: Alternative Sources Energy, V 24:4-10, Feb. 1977

A homebuilt wind turbine is described that was built from plans appearing in the July 1976 issue of "Popular Science" magazine. Critical design details and some dimensions are presented, but all dimensions are not included.

ST78 17097 Wind Structure in Strong Winds Below 150 M

Panofsky, H.A.
Pennsylvania State Univ., University Park, PA
Jrnl: Wind Engng., V 1:91-103, N2, 1977

Information on wind structure in winds below 150 meters is presented concerning wind fluctuations, distribution of mean wind over homogeneous terrain in strong winds, effect of stability on wind profiles, effect of terrain change on wind speed, wind variability, spectra of wind speed, and cross-spectra of wind speed.

ST78 17098 A Practical Approach to Vortex Augmentation of Wind Turbines

Pederson, N.F.
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11315 Jrnl: Proc. of Mtg., Secs. 14-25, ISES, Cape Canaveral, FL p. 19-20--19-24

The case for vortex augmentation is built by reviewing the limitations imposed on the extraction of energy from the wind by means of a conventional impulse turbine. The vortex augmented reaction wind turbine is analyzed by means of the ideal gas laws and conventional empirical flow coefficients. The results are plotted to show the relations between turbine size and turbine output as a function of wind velocity. Costs of construction are estimated and the relation to turbine output shown.

ST78 17099 A Wind Energy Conversion System Based on the Tracked Vehicle Airfoil Concept

Powe, R.E.
Mississippi State University, Mississippi State, MS
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22234 Jrnl: Proc. of Symp., 18 p., BHRA, Cranfield Beds, England

It is pointed out that current investigations regarding wind-energy devices are either concerned with the conventional horizontal axis wind generator or with vertical axis devices. Little thoughtful effort has been devoted to the development of alternate types of devices for extraction of energy from the wind. The considered investigation was conducted to determine the technical feasibility of such an alternate wind energy conversion system. The investigated system is a novel momentum interchange device based on the tracked-vehicle airfoil concept. The system consists of airfoils mounted vertically on carriages which move around a horizontal, closed-track system. It is shown that this system may possess certain significant advantages over the horizontal axis device for specific applications.

ST78 17100 Behavior of Wind-Driven Synchronour Generators Under Wind Gusts

Qazi, A.Q.; Ramakumar, R.
Oklahoma State Univ., Stillwater, OK
1977 CPS Conf.
Avail:NTIS, 78C0036279 Jrnl: Proc. of Conf., IEEE, New York, NY

The results are presented of a computer simulation conducted for an aeroturbine-driven synchronous generator operating in parallel with a large utility grid. Coupled nonlinear differential equations describing the dynamic behavior of such a system are solved numerically by employing fourth order Runge-Kutta technique. Influence of parameters such as system inertia, damping coefficient, external reactance, machine reactance, and generator excitation is examined under conditions of short and long duration wind gusts by simulating generator torque angle Δ as a function of time.

ST78 17101 Wind Shear Downwind of Large Surface Roughness Elements, For Wind Energy Conversion System Design

Ramsdell, J.V.
BPNL, Richland, WA
7th AAM Conf. and RSS Symp., Nov. 16-19, 1976, Melbourne, FL
Avail:AIAA, A78-14957 Jrnl: Proc. of Conf. and Symp. Reprints, p. 22-27, 1977, AMA, Boston, MA

Data on fluctuations of the vertical and lateral shears of the longitudinal wind component near the central business district of Seattle, Washington, have been analyzed to determine shear characteristics downwind of large surface roughness elements. The frequency distribution and time scales of the shear fluctuations have been evaluated, and when possible, the results have been compared with results from Cape Kennedy. It is found that vertical and lateral shear fluctuations downstream of large roughness elements can be described by a Pearson type IV distribution. Parameters of the distribution can be predicted by simple relationships involving the mean wind speed and several easily determined physical variables.

ST78 17102 Annual Report of the Wind Characteristics Program Element, April 1976-June 1977

Ramsdell, J.V.
BPNL, Richland, WA
Avail:NTIS, BNWL/WIND-10 July 1977

Battelle, Pacific Northwest Laboratories (PNL), has been providing technical and management support for the wind characteristics program element (WCPE) of the Wind Energy Conversion Program since April 1976. This first annual report to the Wind Systems Branch (WSB) of ERDA's Division of Solar Energy describes the technical progress within the program element from April 1976 through June 1977. Within the Wind Energy Conversion Program, the WCPE is a service element to provide information on wind characteristics to those involved in energy program planning, design and evaluation of performance of wind energy conversion systems (WECS), selection of sites for installation of WECS, and operation of WECS. To identify pertinent wind characteristics and collect and present that information in formats that are usable, the WCPE has been divided into four technical areas: design and performance evaluation, site selection, presiting evaluation, and planning and operation.

ST78 17103 Evaluation of Wind Energy Conversion Systems for Israel

Rudman, P.S.
Tech-Isr. Inst. of Tech., Haifa, Israel
Jrnl: Adrikhalut, V 34:78-59, N4-5, 1975, 25 refs

Wind energy conversion (WEC) has not been competitive with fossil fuels with the promise of essentially unlimited and cheap nuclear energy. "Modern electric" turbine with a high-speed aerodynamically profiled rotor does not leave much room for improvement in efficiency. While all of the machines of less than or equal to 200 kw have been operated successfully for tens of years without serious breakdown, all of the mw-range machines have broken disastrously. Efficient, trouble-free, lifetime = 20 years, less than or equal to 200-kw wind turbines can be built with the present state-of-the-art. Data are tabulated and appended in graphical form.

ST78 17104 Performance Characteristics of Concentrator-Augmented Savonius Wind Rotors

Sabzevari, A.
Pahlavi Univ., Shiraz, Iran
Avail:AIAA, A78-18092 Jrnl: Wind Engineering, V 1:198-206, N3, 1977

This paper describes the performance characteristics of seven S-rotor configurations tested in the wind tunnel to study the effect of wind concentrator, diffuser, and ducting on the tip speed ratio and power output. The configurations tested included both continuous and split S-sections.

ST78 17105 Potential of Wind as an Energy Source in Iran

Sabzevari, A.
Pahlavi Univ., Shiraz, Iran
Avail:AIAA, A78-18223 Jrnl: Iranian J. of Sci. and Tech., V 6:51-62, N2, 1977

Wind energy is a clean abundant resource in Iran. It can be captured by large-group wind turbine generators to supplement the electricity provided by thermal power plants. It can also be captured by medium-scale local wind turbogenerators to supply the energy needs of so many thousands of scattered rural centers in the windy regions, in particular in the eastern provinces of the country.

ST78 17106 Wind-Powered Aeration for Remote Locations, Progress Report, March 15, 1975-March 15, 1976

Schierholz, P.M.; Somervell, W.L.Jr.; Babcock, W.; Hartel, R.; Watson, K.
Colorado State Univ., Fort Collins, CO
Avail:NTIS, PB-259304 April 1976

This report concerns the use of wind power directly to compress air to increase oxygen levels in polluted rivers and lakes subject to winter-kill. A prime advantage may be using the water for storage of oxygen eliminating requirements for energy storage such as batteries. Three sites are proposed for the installation of wind-powered systems. One is a lake chosen on the high plains for ease of access, another is a high mountain lake subject to winter-kill, and the third is a high plains river with pollution problems.

ST78 17107 Wind-Powered Aeration for Remote Locations, Final Report, March 15, 1975-Aug. 31, 1976

Schierholz, P.M., Somervell, W.L.Jr.; Bobcock, W.; Hartel, R.; Timbre, K.
Colorado Div. of Wildlife, Fort Collins, CO
Avail:NTIS, ERDA/NSF/00833-75/1 Oct. 1976

Wind-powered aerators were installed and operated at three fish winter-kill lakes and at a sewage lagoon. A wind-powered aerator is a system that converts the energy in the wind directly into compressed air, which can be used in an aeration process. No auxiliary energy storage is required in that the lake acts as a storage device for the oxygen. None of the lakes where wind-powered aerators were installed experienced fish winter-kill during the 1975-1976 winter. Wind-powered aeration shows promise for increasing sewage lagoon capacity only under severe weather conditions. The most desirable wind-powered aerator would be an American wind turbine driving a rotary blower mounted on a single pole tower. The winds are of sufficient strength and frequency for wind-powered aeration in northeastern Colorado and southeastern Wyoming, between the front range and the continental divide.

ST78 17108 TV and FM Interference by Windmills, Final Report, January 1, 1976-December 21, 1976

Senior, T.B.A.; Sengupta, D.L.; Ferris, J.E.
Michigan Univ., Ann Arbor, MI
Avail:NTIS, COO/2846-76/1 Feb. 1977

A preliminary but wide-ranging investigation of the effects of a horizontal axis windmill on the reception of TV and FM signals in its vicinity is described. It is shown that the rotating blades produce a time varying amplitude modulation of the total signal received, and that for an antenna so located as to pick up the specular or forward scattering off the blades, the modulation can produce severe distortion of the video portion of a TV signal reproduction. The distortion is worst at the higher frequencies, and therefore poses more of a problem at UHF than at VHF. No interference to the audio signal nor to any FM transmission has been observed. Based on laboratory studies as well as field tests, a modulation level has been established at which the video interference is judged "severe" (or objectionable), and this threshold of interference is substantially independent of the primary field strength. A theory has been developed to compute the interference zone about a windmill for any given TV transmitter, and the results are in good agreement with those obtained from field tests using the operational windmill at the NASA Plum Brook Facility.

ST78 17109 Vortex Augmentation of Wind Energy: Aerodynamic Surface Design for Energy Conversion Efficiency

Sforza, P.M.
New York Polytechnic Inst., Farmingdale, NY
Avail:AIAA, A78-18091 Jrnl: Wind Engng., V 1:186-197, N3, 1977

Aerodynamic devices which can concentrate and augment natural winds are discussed. The keynotes element is the generation and control of discrete vortices of high power

density by the appropriate interaction of suitably designed aerodynamic surfaces with natural winds of relatively low power density. Properly designed turbines are utilized to transform the energy in this compacted vortex field to useful shaft work. This idea is termed the vortex augmentor concept (VAC). The basis for the concept is described and experimental studies of the vortex flow field are discussed. Turbine rotor requirements and advantages are outlined and a test facility for such rotors is illustrated. A prototype wind energy conversion system incorporating the VAC is described. The field test program for the prototype is discussed.

ST78 17110 An Aerodynamic Performance Theory For the Darrieus Wind Turbine

Sharp, D.J.
Kingston Polytechnic, Kingston-on-Thames, Surrey, England
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22250 Jrnl: Proc. of Symp., p. X46-X53, 1977, BHRA, Cranfield Beds, England

Blade element and momentum theories are used to predict the induced velocity distribution over the vertical height of the Darrieus wind turbine. The effect of local Reynolds number values on airfoil data is also taken into account. The airfoil for the turbine blades is the NaCa 0012 profile; a blade shape of the Troposkien type is adopted for the analysis. Results of the performance study indicate the marked influence of the wind speed Reynolds number and the need for correct airfoil data.

ST78 17111 Control and Dynamic Analysis of a Wind Energy Conversion and Storage System Operating at Constant Velocity Ratio

Simkovits, H.R.; Kassakian, J.G.
MIT, Cambridge, MA
Avail:AIAA, A78-11076 Jrnl: Energy Development III, p. 48-55, 1977, IEEE, Inc., New York, NY

A wind energy conversion and storage system operating at constant velocity ratio is proposed and analyzed. Lead-acid batteries are used for energy storage and consideration is given to the number of battery sections required to produce efficient operation of the windmill. A charge control algorithm is developed and the system energy extraction efficiency calculated. System dynamics caused by both windspeed transients and battery switching are investigated. Optimum values of field time constants are determined.

ST78 17112 Practical Method for Determining Wind Frequency Distributions for the Lowest 200 Meters From Routine Meteorological Data

Smedman-Hoegstroem, A.S.; Hoegstroem, U.
Uppsala Univ., Meteorologiska Institutionen, Uppsala, Sweden
Avail:NTIS, UUIM-47 1977

A method is described for determining wind speed frequency distributions at any height up to Ca.200 m above ground for a meteorological station where wind speed and direction are measured at a low reference level (usually 10 m) and which reports routine meteorological data at least once every three D hour. The roughness characteristics of the terrain surrounding the station must be known in detail, because the model calculates the rate of growth of internal boundary layers resulting from discontinuities in roughness as well as the shape of the wind profile in the various layers. The rate of growth of the internal boundary layers has been determined from a work by Pasquill (1972). The shape characteristics of the profile are determined as a function of roughness length and of stability by the aid of measurements from three Swedish 100-m high masts. The method is successfully tested against an independent set of data from a 100-m mast. Also given are some results from application of the method to Swedish data. The method has been developed for rural conditions and is not valid for urban conditions.

ST78 17113 Lift on a Rotating Porous Cylinder: With Application to Wind Power Generation

So, R.M.C.
GE Co., Schenectady, NY
Avail:AIAA, A78-21633 Jrnl: ASME Transactions, Series I, J. of Fluids Engng., V 99:753-757 Dec. 1977

Two-dimensional flow past a rotating circular cylinder with uniform suction at the surface is considered. The method of solution follows closely that used by Glauer and the problem is solved for the case in which there is no viscuous flow separation from the

cylinder surface. Expressions in terms of the ratio of the cylinder peripheral velocity and a suction parameter are obtained for the lift and torque. The results show that uniform suction has a limited effect on the lift; however, the torque increases with suction. Possible application of these results to wind power generation is briefly discussed.

ST78 17114 Direct and Indirect Economics of Wind Energy Systems Relative to Fuel-Based Systems

Sorensen, B.
Jrnl: Wind Engng., V 1:15-22, N1, 1977

It is shown that the addition of an energy-storage system of modest capacity, to a wind energy generator, provides a total wind-energy electricity-generating system as dependable as current alternative means of producing electricity. It is further shown, based on projections of the mass-production costs of wind-energy generators and energy-storage systems, that such combined systems, as well as fuel-saving generators without storage, appear economically competitive to the alternatives, provided the comparison is made over the entire life-cycle of the systems.

ST78 17115 Effects of Rotor Location, Coning, and Tilt on Critical Loads in Large Wind Turbines

Spera, D.A.; Janetzke, D.C.
NASA, Lewis, Cleveland, OH
Avail: AIAA, A78-20476 Jrnl: Wind Tech. J., V 1:5-10, Summer 1977

Three large (1500 kw) horizontal rotor configurations were analyzed to determine the effects on dynamic loads of upwind and downwind rotor locations, coned and radial blade positions, and tilted and horizontal rotor axis positions. Loads were calculated for a range of wind velocities at three locations in the structure: the blade shank, the hub shaft, and the yaw drive. Blade axis coning and rotor axis tilt were found to have little effect on loads. However, locating the rotor upwind of the tower significantly reduced loads at all locations analyzed.

ST78 17116 Wind Energy Techniques of the Past and Present: Windmill Design

Stampa, U.
Avail:AIAA, A78-14103 Jrnl: Sonnenenergie, V 2:12-15, May-June 1977, In German

The characteristics of several types of windmills used in the past are surveyed with attention to some facets of the history of research on windmill design. Analogies with aircraft construction are considered, and procedures for generating current are examined. Requirements for and approaches to economic and reliable power generation are summarized.

ST78 17117 International Symposium on Wind Energy Systems, St. John's College, Cambridge, England, September 7-9, 1976, Proceedings

Stephens, H.S.; Patel, M.P.; Coles, N.G.
Avail:AIAA, A78-22226 Jrnl: Proc. of Symp., 482 p., 1977, BHRA, Cranfield Beds, England

Aspects of large-scale wind energy conversion system design and installation as affected by site wind energy characteristics, grouping arrangement, and social acceptance are considered along with the potential for power production by large dispersed arrays of wind turbines, the mathematical modeling of topographic effects on wind energy systems, computer-aided aerogenerator analysis and performance, a study on the use of windmills in Singapore, wind tunnel simulation of the influence of two-dimensional ridges on wind speed and turbulence, and performance-optimized horizontal-axis wind turbines. Attention is also given to a crossflow wind turbine, a wind energy conversion system based on the tracked vehicle airfoil concept, design aspects of high-speed vertical-axis wind turbines, a performance prediction model for the Darrieus turbine, aerodynamic studies on a vertical-axis wind turbine, a variable geometry vertical axis windmill, a low-cost windmill rotor, windmills with diffuser effect induced by small tipvanes, a self-contained 5000-kw capacity wind energy conversion system with storage, and underground gas storage in the US and its potential application to wind-powered systems.

ST78 17118 A Performance Prediction Model for the Darrieus Turbine: For Wind Energy Conversion

Strickland, J.H.
Texas Tech. Univ., Lubbock, TX
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22237 Jrnl: Proc. of Symp., p. C3-39--C3-54, 1977, BHRA, Cranfield Beds, England

An analytical performance prediction model for the Darrieus turbine is described. Such a model is needed in connection with the recent interest in the Darrieux turbine as a wind energy conversion device. In an approach recently used by Templin (1974) the rotor is visualized as being enclosed in a single streamtube. In a more sophisticated model, a series of streamtubes (actually stream filaments) are assumed to pas through the rotor. The development and utilization of such a multiple streamtube model is discussed. The basic aerodynamic model is first developed along with a description of a suitable iterative solution technique. A computer model is employed to predict the overall rotor power output and the distribution of aerodynamic forces along the rotor blades. The effects of rotor geometry variations can also be studied.

ST78 17119 Aerodynamic Studies on Vertical-Axis Wind Turbine

Swamy, N.V.C.; Fritzsche, A.A.
Indian Inst. of Tech., Madras, India
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22239 Jrnl: Proc. of Symp., p. C5-73--C5-80, BHRA, 1977, Cranfield Beds, England

A description is presented of investigations which were conducted in West Germany and in India with the objective to improve the Darrieus type of motor. The conventional cross-section of the blade for the Darrieus motor is that of a symmetrical airfoil section. Mathematical relations describing the blade geometry are presented and the behavior of the blade in a centrifugal force field is investigated, taking into account a comparison of the actual shape of the rotor blades with a quadratic parabola and a catenary for different rotor height-diameter ratios. The contribution to the torque provided by the various segments of the rotor is determined. There appears to be a distinct advantage in using a straight cylindrical section instead of curved blades. This hypothesis is to be investigated with the aid of a small model.

ST78 17120 Some Design Aspects of High-Speed Vertical-Axis Wind Turbines

Templin, R.J.; South, P.
NRC, Ottawa, Canada
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22235 Jrnl: Proc. of Symp., P C1-1--C1-20, BHRA, 1977, Cranfield Beds, England

The paper discusses the aerodynamic, mechanical, and economic reasons for the choice of the various design parameters (rotor height to diameter ratio, solidity, number of blades, etc.) for high-speed vertical-axis wind turbines from kilowatt to megawatt sizes and shows that very large turbines are theoretically feasible. The paper also describes various methods to prevent overspeeding, to improve the starting characteristics, and to alleviate the effects of cyclic torque and drag loads. The operation of the turbine at constant efficiency is compared with operation at constant speed to show that as long as the rotor speed is properly selected the constant speed mode produces nearly as much average power as the constant efficiency mode. Finally, the economics of a large turbine feeding electrical energy into an existing thermal system are considered to show that under the right circumstances the use of wind energy makes considerable financial savings possible.

ST78 17121 ERDA/NASA 100-Kilowatt Mod-O Wind Turbine Operations and Performance; at the NASA Plum Brook Station, Ohio

Thomas, R.L.; Richards, T.R.
NASA, Lewis, Cleveland, OH
WECS Conf., Sept. 19-21, 1977, Washington, D.C.
Avail:NTIS, N78-15563 Jrnl: Proc. of Conf., 18 p.

The ERDA/NASA 100-kw mod-O wind turbine is operating at the NASA Plum Brook Station near Sandusky, Ohio. The operation of the wind turbine has been fully demonstrated and includes start-up, synchronization to the utility network, blade pitch control for control of power and speed, and shut-down. Also, fully automatic operation has been demonstrated

by use of a remote control panel, 50 miles from the site, similar to what a utility dispatcher might use. The operation systems and experience with the wind turbine loads, electrical power, and aerodynamic performance obtained from testing are described.

ST78 17122 Cost-Effective Electrical Power Generation From the Wind

Todd, C.J.; Eddy, R.L.; James, R.C.; Howell, W.E.
Bureau of Reclamation, Denver, CO
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11316 Jrnl: Proc. of Mtg., p. 19-25--19-29, ISES, Cape Canaveral, FL Secs. 14-25

Wind energy conversion systems (WECS) now being developed are expected to be able to provide large amounts of electrical energy at selected windy sites at costs competitive with energy from new coal and nuclear power plants. WECS and hydroelectric facilities for storage connected to the same large-scale transmission grids are expected to put large energy resources within reach of load centers up to 2000 km from the wind sites. Diversity of wind sites reduces the cost of storage required to smooth fluctuations in wind energy. Transmission from the best sites to load centers is expected to be preferable to local generation from the wind and sun at inferior sites. All elements of the integrated system are within the present state-of-the-art.

ST78 17123 Aerodynamic Design of a Conventional Windmill Using Numerical Optimization

Vanderplaats, G., Fuhs, A.E.
Naval Postgraduate School, Monterey, CA
Jrnl: J. Energy, V 1:132-134, N2, 1977

Numerical optimization techniques are identified as an effective tool for automated synthesis of windmill design. Several simple design examples are presented to show the efficiency and generality of these methods. The extension to more sophisticated design problems is discussed, and the advantages and limitations of these techniques are identified.

ST78 17124 Innovative Wind Turbines

Walters, R.E.; Fanucci, J.B.; Loth, J.L.; Squire, W.; Migliore, P.G.; Huq, R.
West Virginia Univ., Morgantown, WV
3rd Annual UMR-MEC Conf., Oct. 12-14, 1976, Rolla, MO
Avail:AIAA, A78-11101 Jrnl: Proc. of Conf., p. 268-275, 1977, Western Periodicals Co., N. Hollywood, CA

Two types of wind energy turbines are described. The vortex concentrator is a device which creates a strong vortex in the ambient wind. The energy per unit area in the vortex region is much higher than for the undisturbed wind. The vertical axis wind turbine uses straight blades composed of airfoil shapes having high efficiency. High efficiency is attained by using circulation-controlled airfoils for the blades; these airfoils contain slots near the rounded trailing edges through which a small amount of compressed air is blown to obtain high lift forces. Theoretical and experimental studies of the two systems are reported.

ST78 17125 Generation of Electricity From the Wind

Warne, D.F.; Calnan, P.G.
Electrical Res. Assoc., Ltd., Leatherhead, Surrey, England
Avail:AIAA, A78-16053 Jrnl: IEE Reviews, V 124:963-985, Nov. 1977

The paper outlines the present status of wind power, its technology, and potential in various applications with special emphasis on electricity generation. Topics reviewed include the availability of wind energy, fundamental wind-turbine theory, design options, practical plant achievements, major projects in progress in various countries, and wind-power economics. Wind turbine performance prediction is discussed relative to simple momentum theory, types of wind turbine, lift and drag in airfoil sections, and operation of high-speed vertical-axis turbines. Possible applications of wind-driven plants are assessed, and potential contributions to future energy needs are projected.

ST78 17126 Cylindrical Arrays of Vertical-Axis Wind Turbines

Willem, R.A.
New Mexico State Univ., Las Cruces, NM
Avail:AIAA, A78-20477 Jrnl: Wind Tech. J., V 1:11-16, Summer 1977

This paper presents the concept of wind energy conversion using tall cylindrical arrays of vertical-axis turbines. This concept provides an alternative to the large single-turbine approach for economical wind power conversion. Various aspects of the concepts are considered and a comparison is made with respect to ground-mounted turbine systems.

ST78 17127 Performance-Optimized Horizontal-Axis Wind Turbines

Wilson, R.E.; Walker, S.N.
Oregon State Univ., Corvallis, OR
IWES Symp., Sept. 7-9, 1976, Cambridge, England
Avail:AIAA, A78-22232 Jrnl: Proc. of Symp., p. B1-1--B1-28, 1977, BHRA, Cranfield Beds, England

Design procedures for optimum wind turbines is shown to be different from that used for propellers. An optimum design generation approach for wind turbines is developed from a modified strip theory that includes tip-loss. The approach entails a local optimization of blade element parameters to maximize power output. Examples are presented that illustrate the optimum design generation procedure and off-design performance.

ST78 17128 Wind Operated Generator

Winderl, W.R.
US Patent no. 4,039,848, Aug. 2, 1977

A wind-operated generator is described which has counterrotating propellers with an alternating current generator positioned between the blades of the propellers and spacing the same. The propellers and generator parts are mounted on concentric shafts supported in a positive drive structure in which the shafts are tied together through gearing to insure positive starting and counterrotation of the propellers in a positive equal-drive system. A governor associated with one of the shafts governs the operational speed of rotation of both propellers to protect the propellers and generator.

18,000 BIOMASS

ST78 18005 Bioconversion: Harvest Time For Energy Crops

Jrnl: Mach. Des., V 49:20-22, 24-25, N24, Oct. 20, 1977

This article addresses bioconversion as it is rapidly gaining support in the energy scenario. Millions of tons of unused farm, forest, and marine products can be converted to efficient fuels, and prototype processing plants are already in operation. Huge commercial facilities are being designed.

ST78 18006 Bioconversion of Plant Biomass to Ethanol, First Bimonthly and Quarterly Report

GE Co., Schenectady, NY, Res. and Development Center
Avail:NTIS, COO/4147-1 1977

Research progress is reported in the development of an all-biological two-stage process for converting plant biomass into ethanol. The first stage will consist of a high-solids biomass pretreatment with thermo-tolerant mold to remove sufficient lignin to make the cellulose available for saccharification. The second stage consists of a mixed culture fermentation and ethanol production using a thermo-tolerant anaerobic sporoctophaga to hydrolyze cellulose and a compatible thermo-tolerant bacillus to convert the soluble sugars formed during saccharification into ethanol. Initial studies on nutritional requirements of various thermophilic organisms and ethanol production are reported.

ST78 18007 Clean Fuels From Biomass and Wastes; Proceedings of the Second Symposium, Orlando, FL, January 25-28, 1977, $40

Avail:AIAA, A78-11120 IGT, Chicago, IL, 1977, 528 p.

The use of biomass and wastes as a source of fuel is studied, with attention given to land requirements of biomass plantations, the application of forest biomass to energy production, hydrogen production through photolysis, ethanol-gasoline automotive fuels, the conversion of solid-waste cellulose to glucose, genetic engineering to improve plant photosynthesis rates, and the operation of a 100,000-gallon anaerobic digester to treat municipal solid wastes. Other topics discussed include the design of a compact reactor to produce methane from solid wastes, the efficiency of several pyrolytic processes, the gasification of biomass and wastes with a rotary kiln, the production of methane through fermentation of microalgae in waste water treatment ponds, and the culture and processing of water hyacinths.

ST78 18008 European Seminar on Biological Solar Energy Conversion Systems, Grenoble, France, May 9-12, 1977

Avail:AIAA, A78-10624 CNRS, COMES, CEA, DGRST, INRA, ISES, London, 1977, 164 p.

Agriculture and plant biochemistry topics relevant to biological solar energy conversion systems are discussed. Besides several studies of photosynthesis, research investigations on plant protein, nitrogenase, glycerol production, hydrogen production, methane fermentation, lignocellulose degradation, and electron transfer are reported. Other research deals with plant selection, silvicultural biomass plantations, the use of plant residues to produce energy, and algae characteristics. Also reported are the design of a solar greenhouse, an analysis of post-agricultural energy, a study of village and farm energy systems, and a study of an ocean food and energy farm project.

ST78 18009 Photosynthetic Solar Energy: Rediscovering Biomass Fuels

Jrnl: Science, V 197:745, Aug. 19, 1977

No abstract available.

ST78 18010 Solar Program Assessment: Environmental Factors, Fuel From Biomass, Environmental Impact

ERDA, Washington, D.C., Div. of Solar Energy
Avail:NTIS, N78-11506 144 p.

The major environmental issues associated with the further development of biomass production and biomass conversion systems are presented and evaluated with respect to priority. The basic concepts of the technology are reviewed, as are resource requirements. The potential effects of this technology on the full range of environmental concerns (i.e., air and water quality, biosystems, safety, social/institutional structures, etc.) are then discussed in terms of both their relative significance and possible solutions. Only those impacts unique to the solar portion of the technology are discussed in depth. An environmental work plan is presented, listing research and development proposals and a NEPA work plan, which might help clarify and/or alleviate specific environmental problems.

ST78 18011 Steam Gasification of Biomass

Wright-Malta Corp., Ballston Spa, NY
Avail:NTIS, COO/4124-2 April 29, 1977

Progress is reported in the construction of the biogasifier to be used in experiments on basic parameters involved in the steam gasification of biomass. Photographs illustrating various stages in the construction are included.

ST78 18012 Steam Gasification of Biomass

Wright-Malta, Inc., Ballston Spa, NY
Avail:NTIS, COO/4124-3 July 20, 1977

Construction of experimental equipment for research on basic parameters involved in the steam gasification of biomass was completed. Modifications were made on the equipment to improve performance. Information obtained from preliminary runs indicated that intermediate liquids and tars are converted to fuel gas within the time/temperature profile of the biogasifier. Another significant finding is that pressure has little effect on gas composition.

ST78 18013 Steam Gasification of Biomass, Progress Report

Wright-Malta, Inc., Ballston Spa, NY
Avail:NTIS, COO/4124-1 March 11, 1977

Changes in the design of the research gasifier are described. A sketch of the equipment and a flowsheet of the process to be used for experiments on parameters of feed rate, particle size, pressure, temperature, type of biomass, and catalysts are included.

ST78 18014 Biomass Potential From Underexploited Species

Allen, A.D.
Avail:AIAA, CONF-770368 1977

Factors affecting the establishment of a new crop, such as genetic adjustments, crop design and growth pattern, cultural requirements, etc., are considered. Possible advantages and disadvantages associated with an increase in cultivation of a few underutilized plants, i.e., Kenef, Roselle, Giant Reed, and Guayule are discussed.

ST78 18015 Ocean Food and Energy Farm (OFEF): Development of the Kelp Growth Model

Anderson, B.N.
Integrated Sciences Corp., Santa Monica, CA
Avail:NTIS, ERDA/USN/1027-76/1 Jrnl: OFEFPSA, V 7, Final Report

A mathematical model which simulates the growth of single fronds of kelp (macrocystis pyrifera) was published (Anderson, 1974). Further development of the model was undertaken to extend its simulation to the growth of a kelp population as opposed to single fronds (North and Anderson, 1975). Following this, effort was directed toward developing the model for use in the Ocean Food and Energy Farm Project. This entailed generalizing the model so that it was not restricted to the Southern California coastal region. The modifications which were made and the results of preliminary exercises are reported. Limits of the model and experimentation and research necessary for its further development and application are described.

ST78 18016 Fuel Gas Production From Animal Residue, Dynatech Report No. 1551

Ashare, E.; Wise, D.L.; Wentworth, R.L.
Dynatech R/D Co., Cambridge, MA
Avail:NTIS, COO/2991-10 Jan. 14, 1977

A comprehensive mathematical model description of anaerobic digestion of animal residues was developed, taking into account material and energy balances, kinetics, and economics of the process. The model has the flexibility to be applicable to residues from any size or type of animal husbandry operation. A computer program was written for this model and includes a routine for optimization to minimum unit gas cost, with the optimization variables being digester temperature, retention time, and influent volatile solids concentration. The computer program was used to determine the optimum base-line process conditions and economics for fuel gas production via anaerobic digestion of residues from a 10,000-head environmental beef feedlot. This feedlot at the conditions for minimum unit gas cost will produce 300 McF/day of methane at a cost of $5.17/McF ($CH_4$), with a total capital requirement of $1,165,000, a total capital investment of $694,000, and an annual average net operating cost of $370,000. The major contributions to this unit gas cost are due to labor (37 percent), raw manure (11 percent), power for gas compression (10 percent), and digester cost (13 percent). A conceptual design of an anaerobic digestion process for the baseline conditions is presented. A sensitivity analysis of the unit gas cost to changes in the major contributions to unit gas cost was performed, and the results of this analysis indicate areas in the anaerobic digestion system design where reasonable improvements could be expected so as to produce gas at an economically feasible cost. This sensitivity analysis includes the effects on unit gas cost of feedlot size and type, digester type, digester operating conditions, and economic input data.

ST78 18017 Fuel Gas Production From Animal Waste, Report of Quarterly Review Meeting, Palo Alto, California, December 13-14, 1976, Dynatech Report No. 1573

Ashare, E.; Wentworth, R.L.; Wise, D.L.
Dynatech R/D Co., Cambridge, MA
Avail:NTIS, COO/2991-11 Feb. 1, 1977

A quarterly review coordination meeting was held with all the contractors on the ERDA Fuel Gas From Animal Waste Program. Included in this report are a meeting schedule and reports from the various contractors giving a description of their work during the reporting period. Progress in the following studies is reported: Monfort waste conversion demonstration, engineering report on fuel gas production from animal residue, biological conversion of biomass to methane, anaerobic fermentation of animal and crop residues, heat treatment of organics for increasing anaerobic biodegradability, and anaerobic fermentation of agricultural wastes-potential for improvement and implementation.

ST78 18018 Alternative Organizational and Marketing Arrangements For Marketing Biomass

Black, W.E.
Avail:NTIS, CONF-770368 1977

Alternatives of business organizations and marketing arrangements that might be developed to transfer biomass from production to conversion plants are identified. Requirements for feasible marketing systems and organizational alternatives are discussed. It is concluded that the most feasible marketing system may well center on the shortage and high cost of fuel to farmers.

ST78 18019 Biological Conversion of Solar Energy: An Assessment of its Potential Contribution to Our Energy Requirements

Boardman, N.K.
CSIRO, Canberra, Australia
Avail:NTIS, CONF-7605161 Jrnl: Engineering, 1976-2001, 1976

The global annual productivity of terrestrial and marine plants is equivalent to stored solar energy of 3×10^{21}J, which is 10-fold higher than present world consumption of energy. Solar energy incident on the earth's surface is 2×10^{24}J per annum. Total marine photosynthetic productivity is lower than that of the land. Maximum short-term growth rates of high yielding crops represent solar energy conversion efficiencies of 2.7 to 4.6 percent. Annual productivities are considerably lower (0.16 to 1.6 percent). Average forest productivities in the Northern Hemisphere represent solar energy conversion efficiencies of 0.2 to 0.3 percent. Indigenous forests in Australia have much lower productivities (0.02 to 0.03 percent). At the global level, it seems unlikely that photosynthesis can provide more than a relatively small percentage of the world's energy requirements. In Australia, large areas of good agricultural land or productive forest would be required to produce a substantial fraction of our energy requirements.

ST78 18020 A Systems Analysis of Bioconversion With Microalgae: Combined Sewage Treatment and Methane Production

Benemann, J.R.; Koopman, B.L.; Baker, D.C.; Weissman, J.C.; Oswald, W.J.
Univ. of California, Berkeley, CA
CFFBW 2nd Symp., Jan. 25-28, 19i7, Orlando, FL
Avail:AIAA, A78-11124 Jrnl: Proc. of Symp., p. 101-126, IGT, Chicago, IL

The production of methane through fermentation of microalgal biomass in waste water treatment ponds is discussed. Problems in harvesting the microalgae, related to straining and sedimentation techniques and the selective cultivation of larger, filamentous or colonial algae through mechanical enrichment (size-specific recycling) or nutrient limitation (nitrogen fixation), are considered. In particular, the use of a large-scale microstrainer to achieve algal species selection is mentioned. Biophotolysis, the production by algae of hydrogen and oxygen from water, is also described. It is suggested that by employing all available liquid wastes and enriching ponds with carbon dioxide, a combined waste treatment-algal biomass conversion system could supply 10 percent of a locality's methane requirements.

ST78 18021 Solar Energy Conversion With Microalgal Sewage Treatment Ponds

Benemann, J.R.; Koopman, B.L.; Weissman, J.C.; Oswald, W.J.
Univ. of California, Berkeley, CA
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11351 Jrnl: Proc. of Mtg., Secs. 14-25, Cape Canaveral, FL, p. 25-6--25-10

Algal species control in sewage treatment ponds is discussed, and the problems associated with microalgal bioconversion are reviewed. Microstraining and recycling of filamentous or large colonial algae, as well as the selective cultivation of nitrogen-fixing blue-green algae, are considered; the adjustment of pond depth, detention times, loadings, pH and carbon dioxide levels to control algas growth is also mentioned. It is suggested that combined sewage treatment-algas biomass production facilities could provide tertiary waste water treatment and also yield substantial amounts of methane and fertilizer.

ST78 18022 Systems Analysis of Bioconversion with Microalgae

Benemann, J.R.; Koopman, B.L.; Baker, D.C.; Weissman, J.C., Oswald, W.J.
Univ. of California, Berkeley, CA
IGT, Chicago, IL, March 1977, 57 refs

Methane can be produced through fermentation of microalgae biomass. Large quantities of freshwater algal biomass could be produced as by-products of liquid waste treatment in ponds. In these large shallow ponds algae are grown on the nutrients present in sewage to provide the oxygen required for waste treatment. Present technologies of algae harvesting from such ponds (particularly chemical flocculation) are too expensive for methane production. The most economical methods of algae harvesting are straining ("microstraining") and sedimentation ("autoflocculation"). The minute size of most pond algae makes application of these harvesting methods difficult. Selective cultivation of larger, more harvestable, filamentous or colonial algae could be achieved by a number of methods, including mechanical enrichment (size specific recycle), nutrient limitations (nitrogen fixation), pond operations, etc. Data are presented which indicate that mechanical enrichment does, indeed, achieve a degree of algal species selection. Assuming inexpensive harvesting technology, algal biomass produced during secondary waste treatment (oxidation of organics) of municipal sewage could supply about two percent of per capita residential methane requirements. By utilizing all available liquid wastes and enriching ponds with CO_2 for tertiary treatment (removal of N and P nutrients) algal biomass could supply 10 percent of local methane usage. Combined algal waste treatment-bioconversion systems would be very economical in the climatically favored regions of the US by optimizing sewage transportation distances and land costs, these systems would be applicable to a wide range of treatment capacities. Algae bioconversion systems designed exclusively for gaseous fuel (CH_4 or H_2) production are possible only if favorable assumptions about economics, cultivation technology and photosynthetic efficiencies are made.

ST78 18023 Biomass Potential From Agricultural Production

Benson, W.R.
Avail:NTIS, CONF-770368 1977

Estimates of the potential quantity of biomass from agricultural production of grain and grass crops were developed from the analysis of a specially constructed data base. The four types of crops provided for in the analysis are food, forage, grass, and new crops. Various land use scenarios favoring biomass production are presented for consideration.

ST78 18024 Environmental Critique of Solar Power by Bioconversion Methods

Calef, C.E.
Brookhaven Nat'l Lab., Upton, NY
Avail:NTIS, BNL-21955 1975

Idealistic approaches to the resolution of the energy crisis by increased usage of bioconversion methods are discussed. It is pointed out that shortcomings of the technology make such a goal unrealistic. Lack of land, water, and nutrients make a significant contribution to world energy needs impossible. Even modest application of bioconversion processes may damage valuable biotic communities and other natural resources, especially soils. Data on minimum projected land, water, and nutrient requirements are presented; obvious generic impacts are discussed.

ST78 18025 Biomass as an Energy Mechanism

Clausen, E.C.; Sitton, O.C.; Park, E.L.; Gaddy, J.L.
Univ. of Missouri, Rolla, MO
3rd Annual UMR-MEC Conf., 1977
Jrnl: Proc. of Conf., Western Periodicals Co., North Hollywood, CA

Laboratory studies demonstrated the feasibility of producing methane by anaerobic digestion of various crop materials, such as grasses and corn stalks. These studies indicate that about 6.0 SCF of methane are produced per pound of the crop material destroyed. Preliminary design and economic studies of a large methane plant show that the reactors represent the largest cost item, and that efforts should be concentrated on defining reaction kinetics and reactor design. Various approaches to reactor design are discussed. A process to produce 50 MSCFD of methane is described, and the design and economics are analyzed.

ST78 18026 Potential and Economics of Energy Production by Bioconversion

Clausen, E.C.; Sitton, O.C.; Gaddy, J.L.
Univ. of Missouri, Rolla, MO
2nd PaChEC, Aug. 28-31, 1977, Denver, CO
Jrnl: Proc. of Conf., V 1:183-186, 16 refs, AIChE, New York, N Y

Insolation can be collected by photosynthesis, with biomass serving as an energy mechanism. The US has 250 million acres of idle range and forest land, some suitable for growing energy crops. There are presently about 400 million tons of crop residues produced each year. Together, these sources represent a potential energy source of about 20×10^{15}BTU/year, or more than our present energy deficit. Crop material is an inconvenient form of energy. However, methane can be produced from crop matter by anaerobic digestion. This paper analyzes the design and economics of methane production from energy crops or crop residues.

ST78 18027 Water Hyacinth Biomass Yield Potentials

Del Fosse, E.S.
Lee County Hyacinth Control District, Fort Myers, FL
Avail:NTIS, 78C0030367 IGT, Chicago, IL March 1977 176 refs

Most emphasis on Water Hyacinth research has dealt with control of the plant (chemical, biological, cultural, and integrated) or with aspects of Water Hyacinth biology and distribution. Several countries have recently begun to investigate seriously using Water Hyacinth as animal food, silage, soil additives, as a source for alcohol, protein, methane and paper, and for various other purposes. If an economic usage can be found for Water Hyacinth, plant abundance and cost of cultivation and harvesting will be of prime importance. Growth solutions in which Water Hyacinth has been successfully grown are reviewed, as are effects of water quality on the plant. Optimum growth conditions are reviewed and summarized, including both chemical and physical parameters. Mean mineral and carbohydrate content of Water Hyacinth are summarized from data collected over the entire world. Theoretical considerations for maximizing Water Hyacinth growth potential are discussed. Over 60 metric tons of Water Hyacinth per acre may be harvested under ideal conditions.

ST78 18028 Future Competitive Demand on Land For Biomass Production

Doering, O.C.III
Purdue Univ., Lafayette, IN
Avail:NTIS, 78C0030365 IGT, Chicago, IL March 1977

The land resource base as it is currently used in the production of food and fiber in the United States is examined. Changes in land use are documented for the past two decades. Alternatives of intensive and extensive agricultural systems are evaluated for their potential impact upon land use. Suggestions for biomass production are evaluated in the context of the relatively fixed land resources and in the context of both intensive and extensive alternatives for agricultural production. The importance of land quality and the matching of a crop with the appropriate land quality to prevent land degradation is stressed as essential to preserving a land base that might be able to support large-scale biomass production.

ST78 18029 Use of Crop Residue to Support a Municipal Electric Utility

Eckhoff, N.D.
Avail:NTIS, CONF-770368 1977

Various options were considered in a study on supplying the energy needs of Pratt, Kansas. It is concluded that biomass in the form of wheat straw and other agricultural residue and wastes, such as cattle manure, sewage sludge, and municipal refuse, can be used as replacement for steam systems. The cost of wheat straw, which is readily available, is estimated to be competitive with low-sulfur, high-BTU coal delivered to Pratt.

ST78 18030 Synthetic Fuel Production From Solid Wastes, Final Report

Feber, R.C.; Antal, M.J.
Princeton Univ., Princeton, NJ
Avail:NTIS, N78-14182 LASL, Los Alamos, NM

Potential catalysts for the commercial practice of the gasification of chars produced by the pyrolysis of municipal or industrial wastes are evaluated. The potential for synthetic fuel production from solid wastes and the feasibility of providing the heat required for the gasification reactions by coupling a chemical reactor to a solar collector are also examined. A small-scale fixed-bed flow-through reactor was assembled, and a number of potential catalysts were tested on chars from a number of sources. Several possible schemes for coupling a solar collector and a gasification reactor are suggested, and economic analyses of the systems are attempted. It is concluded that feasible, economically attractive systems are possible.

ST78 18031 The Energy Plantation as an Alternative Source of Fuels

Fraser, M.D.; Henry, J.F.; Vail, C.W.
Intertechnology Corp., Warrenton, VA
Avail:AIAA, A78-11088 Jrnl: Energy Development III, p. 166-174, IEEE, Inc., New York, NY

A proprietary "energy plantation" concept for collecting and storing solar radiation energy in plants suited to the purpose is outlined. Plant resources, species best adaptable to the requirements of the project, plant-matter production rates, land resources, and economics of energy plantation management are discussed. Disadvantages of wild plants and annual plants (in terms of consistency and storage requirements) are indicated, along with advantages of Deciduous over Conifer species, and particularly preferred Deciduous stocks (hybrid Poplars, Cottonwoods), and grasses. Capital and operating costs, plantation area requirements, and expected energy yields are discussed.

ST78 18032 Hydrogen From Sunlight, The Biological Answer; Development of a Low-Cost Biological Solar Panel

Friedland, J.
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11350 Jrnl: Proc. of Mtg., p. 25-1--25-5, Secs. 14-25, Cape Canaveral, FL

Development of a hydrogen-producing apparatus which relies on a blue-green marine algal species is discussed. The species studied is capable of yielding as much as one milliliter of hydrogen per milliliter of algae during a 24-hour period. In addition, several selectively permeable polymer membranes are reviewed for use in separating the hydrogen gas from the anaerobic atmosphere under which the algae are cultured. A thin

film of poly (vinylidene chloride) is found to allow transmission of more than 90 percent of the available hydrogen, while permitting less than one percent of the argon or nitrogen to pass. The adaptation of the experimental hydrogen-generating system to large-scale fuel production is also mentioned.

ST78 18033 Environmental Impact of Solid Waste and Biomass Conversion-to-Energy Processes

Gage, S.J.; Chapman, R.A.
IGT, Chicago, IL
Avail:NTIS, 78C0030375 March 1977

A brief summary of the supply and demand outlook for solid waste and biomass-derived fuels through the year 2020 is presented. The potential air, solid, and liquid emissions of environmental consequence from selected systems that are currently commercially available or in the final development stages for the production of useful energy from solid waste are discussed. Collectively, these systems are capable of producing steam, electricity, oil, and gas from solid waste or biomass. EPA's program in the "waste-as-fuel" technology development and environment assessment area is also discussed.

ST78 18034 Thermal Processing of Biomass Materials, Overview

Garrett, D.E.
Garrett Energy Res. and Engng. Co., Inc., Claremont, CA
3rd Annual UMR-MEC Conf., Oct. 12-14, 1976, Rolla, MO
Avail:AIAA, A78-11117 Jrnl: Proc. of Conf., p. 679-683, Western Periodicals, Co., North Hollywood, CA

A cursory overview is presented of research on biomass utilization in energy recovery. Wood pyrolysis, suitable chemical reactors, processing of cellulose and pump, and treatment of municipal solid wastes and sewage sludge and the literature on them are discussed briefly. Required preprocessing of the process feedstock, presence of a drying/evaporating step in the process, and absence of workable solutions on extraction of heat/energy from off-gas streams are pointed out as crucial problems. Attention is given to cost and profitability.

ST78 18035 Comprehensive Gasification Process For Energy Recovery From Cellulosic Wastes

Ghosh, S.; Klass, D.L.; Conrad, J.R.; Henry, M.P.; Griswold, K.; Sedzielarz, F.
IGT, Chicago, IL
Avail:NTIS, CONF-770222 Feb. 1977

A comprehensive, energy and materials-resource recovery system (the biogas process) capable of processing organic wastes and land and water-based plant biomass to yield intermediate or high-BTU gas (SNG), combustible solid fuels, recyclable by-products, and stabilized residues that can be returned to the environment without adverse impact on the biosphere is described. Biological gasification by anaerobic digestion forms the heart of this process. Laboratory, small pilot, and field work needed for the development of unit operations and processes involved in feed preparation and pretreatment, biological gasification, enhancing biodegradability of fermenter residues and recycling, gas cleanup, and effluent dewatering and ultimate disposal is summarized. Data on the effects of temperature, mixing, substrate particle size, detention time, loading, and C/N ratio on anaerobic digestion are presented. Laboratory digester kinetics covering the rate-limiting step, maximum specific growth rate, saturation constant, and cell yield constants in the overall process of anaerobic digestion of cellulose-sludge mixtures are detailed. In-depth process evaluation in terms of technical feasibility, material and energy balances, capital and operating costs, and environmental impact assessment is included. It is concluded that the next logical step in this program is to demonstrate the technology in a 100-ton/day plant to confirm our findings, and to justify full-scale operations. Highlights of the proposed demonstration plant are presented.

ST78 18036 Photosynthetic Solar Energy: Rediscovering Biomass Fuels

Hammond, A.L.
Jrnl: Science, V 197:745-746, N4305, Aug. 19, 1977

Recent research efforts in the production and use of biomass as a fuel source are reviewed. These include a gasifier for the conversion of dry agricultural or wood waste to a low or medium-BTU gas, inventory of agricultural residues in the US, production of ethanol from sugar cane and sweet sorghum, evaluation of energy recoverable from forestry wastes, cultivation of trees, algae, and giant kelp, and improvement of the photosynthetic efficiency of plants. The uncertainty of the economics of biomass energy systems is examined briefly.

ST78 18037 Rotary Kiln Gasification of Biomass and Municipal Wastes

Hooverman, R.H.; Coffman, J.A.
Wright-Malta Corp., Ballston Spa, NY
Avail:NTIS, 78C0030288 IGT, Chicago, IL March 1977

A rotary kiln gasifier-gas turbine generator system for the clean, efficient recovery of energy from biomass and wastes is reported. Solids and liquids combined are dried, pyrolyzed, and steam-gasified during slow passage through a continuous-feed externally heated rotary kiln. The low-BTU product gas fuels a gas turbine generator, and the turbine exhaust provides process heat for the gasifier. Neither shredding, classifying, nor preliminary drying of the charge is necessary, and in principle, the efficiency of the system can be as high as that of a combined cycle plant burning conventional fuels. The steam-gasification chemistry was demonstrated in a bench-scale, batch-feed "mini-kiln." In this equipment, paper, wood, and municipal solid and sewage wastes have been gasified under various conditions of steam flow, temperature, pressure, and heating rate. This work has established the feasibility of low-temperature steam gasification and indicated the optimum process conditions.

ST78 18038 Silvicultural Biomass Farms, Volume II, The Biomass Potential of Short-Rotation Farms

Howlett, K.; Gamache, A.
Mitre Corp., McLean, VA, Metrek Div.
Avail:NTIS, MTR-7347 V 2, May 1977

The management of Silvicultural Biomass Farms was compared with that of Timber Strands. Suitability criteria were developed and used to identify potential crops for biomass farms. Biomass productivity was evaluated, management practices were identified, and management costs were estimated.

ST78 18039 Silvicultural Biomass Farms, Volume VI, Forest and Mill Residues as Potential Sources of Biomass

Howlett, K.; Gamache, A.
Mitre Corp., McLean, VA, Metrek Div.
Avail:NTIS, MTR-7347 V 6, May 1977

A study was conducted on the utility of using mill and forest residues as an energy feedstock. A system was developed to determine the quantities of residues that are currently available, and to estimate the quantities that might be available in the future. Current selling prices of mill residues were surveyed by residue type and the costs of collecting, reducing, and transporting forest residues were analyzed. Two site-specific situations were examined to determine the competitiveness of residues with conventional fuels within the forest industry.

ST78 18040 Silvicultural Biomass Farms, Volume I, Summary

Inman, R.E.
Mitre Corp., McLean, VA, Metrek Div.
Avail:NTIS, MTR-7347 V 1, May 1977

Results of a study to assess the potential of wood biomass as a feedstock for producing energy products are summarized in this first volume of the six-volume report. Section titles include biomass supply, including sub-sections on the Silvicultural Energy Farm, biomass species and productivity, land suitability and availability, site characteristics for site-specific production analyses, energy farm design, biomass production costs, and energy budget for biomass production, and the utility of forestry residues: mill residues and forest residues; biomass conversion, indluding sub-sections on the future demand for energy products, conversion technologies, prices of wood-derived energy products, and commercial feasibility of wood-derived energy products; needed research on biomass production; procurement and biomass conversion.

ST78 18041 Silvicultural Biomass Farms, Volume IV, Site-Specific Production Studies and Cost Analyses

Inman, R.E.; Salo, D.J.; McGurk, B.J.
Mitre Corp., McLean, VA, Metrek Div.
Avail:NTIS, MTR-7347 V 4, May 1977

ST78 18042 Trees as a Renewable Energy Resource

Jamison, R.L.
Weyerhaeuser Co., Tacoma, WA
2nd CFFBW Symp., Jan. 25-28, 1977, Orlando, FL
Avail:AIAA, A78-11127 Jrnl: Proc. of Symp., p. 169-183, IGT, Chicago, IL

Sources of forest biomass for energy conversion, including manufacturing wastes, post-consumer paper and wood wastes, forest residuals, and energy plantations are discussed. At present, wood products industries obtain about 45 percent of their energy from manufacturing wastes. Technical and economic barriers may limit the amount by which this percentage can be increased. In the area of post-consumer waste processing, the choice between recycling or burning paper and wood products is considered. The use of forest residuals for energy is shown to be economic under certain circumstances. Forest energy plantations, however, are not presently economic and may become even less so due to rising demand for wood products and shortages of timber.

ST78 18043 Bioconversion of Solar Energy to Methane

Keenan, J.D.
Univ. of Pennsylvania, Philadelphia, PA
Avail:AIAA, A78-13342 Jrnl: Energy, UK, V 2:365-373, Dec. 1977

The purpose of this paper is to report the results of an investigation of the energy conversion efficiency of an aquatic-based fuel-from-biomass system. The bases of the system are the biochemical conversions of solar energy to algal biomass to methane, which is, in turn, used an auxiliary fuel for a fossil-fuel-fired steam-electric power plant. The alga used in the research was anabaena flos-aque, a blue-green algae possessing many of the characteristics desired in an energy crop. The results of the research indicate that renewable methane can significantly reduce the imported fossil fuel requirement of the power station, that an overall efficiency of the conversion of solar energy to methane of one percent is attainable, and that energy inputs account for 12 percent of the methane fuel value.

ST78 18044 The Anaerobic Digestion of Macrocystis Pyrifera Under Mesophilic Conditions For Synthetic Fuel Recovery

Klass, D.L.; Ghosh, S.
IGT, Chicago, IL
2nd BFFBW Symp., Jan. 25-28, 1977, Orlando, FL
Avail:AIAA, A78-11135 Jrnl: Proc. of Symp., IGT, Chicago, IL, p. 323-351

The results of work done to study the anaerobic digestion of the giant brown kelp, macrocystis pyrifera, in laboratory digesters at mesophilic temperatures are described. The primary objective of this work was to determine whether kelp could be digested over long periods of time under conventional conditions without the addition of external nutrients. It was concluded that kelp alone will sustain an enriched anaerobic culture under mesophilic conditions over extended periods without adding any external nutrients. The nutrients contained within the kelp are sufficient to promote the digestion process. A linear relationship was found to exist between volatile solids destruction in the feed and energy recovery as methane in the product gas up to about 50 percent volatile solids destruction levels. It is expected that at higher destruction levels, energy recovery in the gas will begin to plateau since, at about 80 percent destruction levels, the experimental data indicate maximum energy recoveries. Kelp digestion is estimated from thermodynamic analysis to be slightly exothermic at mesophilic temperatures. The heat of reaction was projected to be about 249 BTU/lb of kelp reacted.

ST78 18045 Biomass and Waste Production as Energy Resources, Update

Klass, D.L.
Jrnl: Energy, V 2:23-27, N4, Fall 1977, Stamford, CT, 11 refs

A review of the status of biomass and waste utilization as energy sources agrees that concentration on waste disposal systems is appropriate in the near term, while biomass offers a long-term renewable resource. The large-scale use of land for fuel farming competes directly with food production, although new technologies and the use of marginal lands and water for biomass may offset this argument. Comparisons are drawn between the compositions, heating values, thermal and biological gasification processes, and thermodynamic comparisons of methane production of biomass and wastes. Various research programs are aimed at finding a practical conversion process that is competitive with natural gas and petroleum. Some field tests of solid-waste conversion have progressed to full-scale plants for municipal waste treatment and co-generation systems, anaerobic digestion systems, and some small-scale biomass pilot plants.

ST78 18046 Biomass and Wastes as Energy Resources, Update

Klass, D.L.
IGT, Chicago, IL
Avail:NTIS, 78C0030363 IGT, Chicago, IL March, 1977

For the past year, work has continued on processes and systems for the production of synfuels and energy-intensive products from renewable biomass and wastes. An update of the subject is presented, and selected recent research and commercial developments are summarized. Combined waste disposal-energy recovery processes are currently receiving the most attention. Biomass production directed specifically to energy applications has not yet been optimized for large-scale systems, and is in the initial development stages. In the long term, wastes offer a small but continuing supply of energy products and synfuels, and biomass can ultimately serve as a major source of supply. Synfuel plantations are discussed from the standpoint of net energy production and economics. Various processes for the conversion of biomass and wastes are considered, with particular emphasis placed on the use of wood.

ST78 18047 A Long-Term Solution to Fossil Fuel Depletion: Biomass Energy Conversion Technology Assessment

Klass, D.L.
IGT, Chicago, IL
Avail:AIAA, A78-10739 Jrnl: In Energy Development II, p. 96-106, IEEE, Inc., New York, NY

It is argued that the only long-term practical alternative to sustaining a national economy on organic fuels is to convert a major source of continuously renewable non-fossil carbon to synfuels that are interchangeable with fossil fuels. The most promising source of this carbon is land and water-based biomass, produced from solar energy by photosynthesis. This paper presents an assessment of the biomass energy conversion concept, with emphasis on system design, economics, and energetics.

ST78 18048 Biological Solar Energy Conversion: Approaches to Overcome Yield, Stability, and Product Limitations, Progress Report No. 2, October 1, 1975-March 31, 1976

Kok, B.
Martin Marietta Labs., Baltimore, MD
Avail:NTIS, PB-258850 March 1976

Simultaneous measurements were made of the exchange of O_2, CO_2, H_2, and their isotopes in illuminated algae. A direct competition for the photosynthetic reducing power was observed between CO_2 uptake, O_2 uptake, and H_2 evolution, with H_2 evolution being third in line. H_2 evolution and H-D scrambling occurred in presence of Ca one percent O_2H_2 uptake was less sensitive to O_2. Further studies were made of the stability of the photosynthetic electron transport chain in dark at O . The two most sensitive sites were located between system II and the O_2 evolution system and between plastocyanin and plastoquinone. The second site was protected in intact chloroplasts. The two effects of glutaraldehyde, rate inhibition and stabilization, proved to have a similar dose requirement. The inhibition by this agent might be due to inactivation of plastocyanin.

ST78 18049 Potentials of Hydrogen Production Through Biophotolysis

Krampitz, L.O.
Case-Western-Reserve Univ., Cleveland, OH
2nd CFFBW Symp., Jan. 25-28, 1977, Orlando, FL
Avail:AIAA, A78-11125 Jrnl: Proc. of Symp., p. 141-151, IGT, Chicago, IL

A two-stage biophotolysis system for the production of hydrogen and oxygen by algae is described. Working in series, the two stages of the photosynthetic apparatus cleave water to form oxygen and electrons, then produce hydrogen through catalysis. In the system considered, a species of blue-green algae is employed to cleave water, placing the electrons at a favorable potential for the reduction of protons. The coupling of the photosynthetically reduce electron receptor triphosphopyridine nucleotide with a bacterial hydrogenase system produces the hydrogen. The hydrogenase system of a non-sulfur bacterium is used to overcome the thermodynamic barrier to hydrogen production. It is suggested that the two-stage system has advantages in terms of ease of gas collection.

ST78 18050 Peat and Biomass Will Save Sweden From Oil and Nuclear Power

Lindstroem, O.
Kungliga Tekniska Hoegskolan, Stockholm, Sweden
Jrnl: Tek. Tidskr., V 107:53-55, N10, May 20, 1977, In Swedish

Three sources of energy can meet global needs after the year 2000: coal, biomass conversion, and breeder reactors. Peat can provide a significant contribution as a bridge to the development of renewable energy sources.

ST78 18051 Systems Study of Fuels From Sugarcane, Sweet Sorghum, and Sugar Beets, Volume II, Agricultural Considerations, Task 77, Final Report

Lipinsky, E.S.; McClure, T.A.; Nathan, R.A.; Anderson, T.L.; Sheppard, W.J.; Lawhon, W.T.
Battelle Columbus Labs., Columbus, OH
Avail:NTIS, BMI-1957 Dec. 31, 1976

The principal findings of the agricultural aspects of the Sugar Crops Research Program are summarized. Sugarcane, sugar beets, and sweet sorghum were studied as to their their respective production methods, geographical areas in which the crops can be grown, yields, composition, costs, and energy budgets. Sugarcane culture practices in Florida, Louisiana, Texas, Hawaii, and Puerto Rico are compared. Salient factors in production of sugar beets are summarized. The state-of-the-art for sweet sorghum is also presented. The yields of sugarcane with respect to fresh material, dry matter, fermentable solids, and combustible organic products are summarized. The sugar beet product yields and total production by states is presented. Estimates of the yields of sweet sorghum are also included. The present commercial yields of the sugar crops in each agricultural region are far below those obtained under experimental conditions. Comparisons of current estimated costs of sugarcane, sugar beets, and sweet sorghum products with prices that would balance between the energy content of the biomass production of fuels and chemical feedstocks is presented. The energy balance between the energy content of the biomass and the fuels required to manufacture this biomass is presented. Speculative forecasts of sugarcane and sweet sorghum production in the years 1985 and 2000, under alternative scenarios, are shown. Potential production of selected chemicals from sugarcane crop products in the year 2000, in a "critical need" scenario is shown. Speculative forecasts of the cost of fermentable solids and combustible organic material derived from sugarcane and sweet sorghum are shown.

ST78 18052 Process for Manufacturing Combustible Bricks From Plant Materials

Loas, D.
US Patent no. 4,043,764 Aug. 23, 1977

Combustible bricks are manufactured from plant materials by agglomeration under pressure of these materials after pulverization and drying. Prior to this, the plant materials are subjected to a fermentation, and in the course of fermentation, to a pulverization treatment while controlling this fermentation so as to obtain a destructuration of the cellulosic tissues of the plant materials without producing separation of the lignin. This process produces small bricks having a good strength and a low moisture content.

ST78 18053 Chemical Technology

Luberoff, B.J.
Avail:NTIS, CONF-770368 1977

A broad view of the technology involved in producing energy from biomass is presented. Suggestions for its development are given.

ST78 18054 Case Study of Biomass Farm Management

Mathews, R.C.
Avail:NTIS, CONF-770368 1977

The production of biomass is examined from the standpoint of a practical farm operation in order to determine the financial return and possibility of producing biomass in competition with other crops. An actual Iowa farm was used for the analysis. Although the use of refuse seems feasible, it is concluded that until the value of biomass exceeds the value of grain, biomass production is not feasible in a conventional farm operation.

ST78 18055 Efficient Processing of Photobiological Material

McCann, D.J.; Saddler, H.D.W.; Prince, R.G.H.
Univ. of Sydney, Sydney, Australia
Avail:NTIS, CONF-7605161 Jrnl: Engineering, 1976-2001, 1976

The possibility of harnessing solar energy utilizing the photosynthetic mechanisms of green plants to produce reduced carbon compounds for chemical processing to fuel has recently been advocated as one possible renewable energy source. Recent work is summarized; ways of utilizing this photobiological material are discussed and the technical and economic implications of utilizing this source of solar energy in the most efficient manner are examined.

ST78 18056 Value of Energy From Waste at the Production Interface

McCartney, J.K.
Occidental Research Corp., La Verne, CA
Avail:NTIS, 78C0030203 IGT, Chicago, IL, March 1977

It is pointed out that energy recovered from wastes will never have a fixed value. The net economics of its production are determined by the changing market conditions based on energy supply and demand. The production pattern of the energy produced from wastes will directly affect the value of the recovered energy. For example, steam produced by various methods must be put to use near the point of production or it can assume a negative value. Load factors of solid, liquid, and gaseous fuels produced from refuse are discussed.

ST78 18057 Corn Production Practices

McClure, T.A.
Avail:NTIS, CONF-770368 1977

The agricultural production and cost aspects of corn as a potential biomass crop are presented. The major topics of discussion include an overview of US corn production, presentation of agricultural aspects of various alternatives of using corn as an energy feedstock, and a rough assessment of the energy balance of theoretical energy output-input ratios associated with US corn production. Three alternatives for using corn as an energy or industrial feedstock are considered in detail. These include the use of silage to produce synthetic natural gas, using corn grain to produce ethanol, and using the crop residues to produce either fuel gas or ammonia.

ST78 18058 Photosynthetic and Water Efficiency of Salsola Pestifer; Tumbleweeds for Biomass Energy Production

Meinel, A.B.; Meinel, M.P.
Univ. of Arizona, Tucson, AZ
ISES Annual Mtg., June 6-10, 1977, Orlando, FL
Avail:AIAA, A78-11352 Jrnl: Proc. of Mtg., Secs. 14-25, ISES, Cape Canaveral, FL, p. 25-11--25-13

Salsola Pestifer (tumbleweed) has a photosynthetic efficiency of 0.5 percent, but is the most efficient plant for water use efficiency. The plant grows over a wide area of the western United States as a weed. Measured yields in metric tons per acre offer a crop requiring minimum care yielding $320/acre. Direct combustion of the pelletized plant is proposed.

ST78 18059 Solar Energy for Australia, The Role Of Biological Conversion

Morse, R.N.; Siemon, J.R.
Avail:NTIS, CONF-7605161 Jrnl: Engineering, 1976-2001, 1976

Solar energy by means of photosynthesis stores energy in trees and plants, which can be converted to liquid fuel suitable for internal combustion engines. Ethanol could be produced this way from cellulose on a scale sufficient to supply half Australia's estimated needs for transportation in 2000 from forest plantations totalling 13 million HA. The process has been used on a small scale, but is not fully developed. Rising energy costs will improve the prospects that research could make solar ethanol competitive with synthetic fuels such as oil from coal, and introduce a major renewable source of liquid fuel.

ST78 18060 Agronomist's View of Biomass Production

Moss, D.N.
Avail:NTIS, CONF-770368 1977

Biochemical reactions involved in the photosynthetic process are discussed. Differences in the photosynthetic processes of C_3 and C_4 plants are outlined. Means of counteracting limitations placed on energy production from biomass by natural limitations on the efficiency of the photosynthetic process are considered.

ST78 18061 Agronomic Potential for Biomass Production

Nelson, C.J.
Univ. of Missouri, Columbia, MO
3rd Annual UMR-MEC Conf., 1977
Avail:NTIS, 78C0036034 Jrnl: Proc. of Conf., Western Periodicals Co., North Hollywood, CA

Plant biomass may be an economic means of harvesting and storing solar energy. Present-day agricultural practices, however, do not allow maximum biomass production in the primary sense, or as crop residue. Biomass production is closely related to photosynthetic potential of single leaves in a complete canopy. New developments in crop selection and culture may allow more efficient canopies and photosynthetic rates. Genetic improvement in vegetative growth, as well as grain or economic product, would increase production potential for both fuel crops and crop residues. Long-range agronomic considerations on soil structure and land use would also need to be considered.

ST78 18062 Growth Factors in the Production of Giant Kelp

North, W.J.
CIT, Pasadena, CA
Avail:NTIS, 78C0030369 IGT, Chicago, IL March 1977

Problems of kelp production in the near-surface layers of the deep sea are being studied. The ultimate objective is bioconversion of solar energy. Experiments have established that kelp growth at offshore locations is strongly limited by availability of dissolved nutrients. Nutrient requirements of kelp are being studied to guide fertilizing programs for marine farms. Sea water is such a complex mixture that we are unable quantitatively to analyze direct availability of many micro-nutrients, particularly trace metals. A bioassay procedure, using juvenile kelp plants as test organisms, was developed. Eight micro-nutrients apparently required by kelp (N, P, I, Fe, Mn, No, Zn, Co, and possibly As) were identified. The list may not yet be complete. A comparison is being made of the availability of these micro-nutrients in sea water samples gathered at various times and locations. Differences were found between offshore surface water and deep water pumped up from 300 meters. Temporal differences have also been demonstrated.

ST78 18063 Energy From Biomass: Some General Reflections

Poole, A.D.
Oak Ridge Assoc. Univs., Oak Ridge, TN
Avail:NTIS, 78C0030374 IGT, Chicago, IL March 1977

It is pointed out that the use of biomass as an energy source is at a significant disadvantage both on a near or long-term basis in developed countries. It should continue to provide an increasing contribution to energy needs of underdeveloped countries, however. This is especially likely to be true in countries where yields of biomass are high (in tropical or subtropical climates), labor is cheap, and the domestic availability of fossil fuels is uncertain. It is concluded that with projected increases in populations of underdeveloped countries and the resulting growth in world energy demand, biomass could play a significant role in the energy metabolism of the longer-term future.

ST78 18064 Methane Production From Waste

Rasch, R.
1st IMEFR Symp., Oct. 21, 22, 1976, Antwerp, Belgium
Avail:AIAA, A78-11144 Jrnl: Proc. of Symp., p. 31-36, Leiden, Spruyt, Van Mantgem en de Does, In German

Techniques for the production of methane from organic wastes are reviewed with emphasis on biological degradation and a technique (called "geordnete deponie") involving the treatment of waste deposits. Special emphasis is put on thermal methods of methane production from organic refuse, including a method of degassing (i.e., pyrolysis) and a method of gasification (i.e., oxidative gas generation).

ST78 18065 Bioconversion Fuels from Biomass, Book

Robertson, E.E.
BEI, Inc., Winnipeg, Canada
Avail:AIAA, A78-21700 Franklin Inst. Press, Philadelphia, PA 72 p., 1977

Topics related to the use of biomass for energy generation are surveyed. Urban and agricultural wastes, as well as land and ocean farm products are common sources, while photosynthesis and anaerobic digestion are frequently used bioconversion processes. Subjects considered include the use of biomass to generate high temperatures, storing solar energy naturally, the biosphere's life support systems, the oxygen/carbon dioxide cycle, and self-reproducing machines and biomass.

ST78 18066 Energy and Materials From the Forest Biomass

Saeman, J.F.
Forest Products Lab., Madison, WI
Avail:NTIS, 78C0030370 IGT, Chicago, IL March 1977

Priorities and strategies are offered in optimizing the contribution of forest biomass to our materials and energy budget. The net photosynthetic productivity of the earth has been estimated at 155 x 10^9 tons per year. Forests account for 42 percent of this total, and croplands for six percent. The net productivity of forests, including tropical forests, is equivalent to more than the world consumption of fossil fuels. The most cost-effective energy contribution of US forests is an indirect one resulting from the use of conventional forest products, rather than more energy-intensive alternative products. Next in importance is the direct use of residues as a fuel, particularly in wood processing industries. Wood industries now use 1.1 Q (10^{15} BTU's) of residues and 1.5 Q of purchased fuel. There are over two Q of energy available from unused but accessible manufacturing and logging residues. Equipment is readily available for handling and burning wood residues in an environmentally acceptable manner. Achieving energy self-sufficiency would constitute a direct three percent contribution to the energy budget. Net timber growth in the United States, particularly of hardwoods, exceeds consumption. This can be used for forest products, chemicals, or fuel. An economic assessment of available technology for converting wood to ethanol, furfural, methanol, formaldehyde, and phenol with various assumed plant sizes and wood prices showed high capital costs and profits too low for the risks involved. Research opportunities for timber production and utilization offer the realistic hope of an energy self-sufficient industry with twice present output. This holds high economic potential in maintaining balance of trade and improving the relationship between gross national product and energy consumption.

ST78 18067 Silvicultural Biomass Farms, Volume III, Land Suitability and Availability

Salo, D.J.; Inman, R.E.; McGurk, B.J.; Verhoeff, J.
Mitre Corp., McClean, VA, Metrek Div.
Avail:NTIS, MTR-7347 May 1977

Land suitability criteria were developed and used to identify potentially available land for silvicultural biomass farms. Six land availability scenarios were chosen for analysis. The annual potential production of biomass energy was estimated on a regional basis assuming the use of 10 percent of the potentially available land in each of the six scenarios and estimated biomass yields. Ten hypothetical biomass farm sites were selected and described.

ST78 18068 Fuels From Biomass

Scheller, W.A.
Univ. of Nebraska, Dept. of Chem. Engng., Lincoln, NE

The utilization of solar energy in the production of plant materials as an intermediate to energy production today is the most economical means for utilizing solar energy. Although the efficiency in the photosynthesis process is low, land costs and production costs in the United States are such that biomass as an energy source is more attractive than the more exotic methods for converting solar energy, e.g., solar cells. A number of routes are available for the conversion of biomass to energy, including direct combustion, pyrolysis digestion, and fermentation. We have prepared a detailed net energy analysis of ethanol production by fermentation, including the farming associated with grain production. With appropriate utilization of a portion of the field wastes, this system is capable of introducing new energy into the economy. We have also prepared a preliminary process design and economic analysis of the enzymatic hydrolysis of cellulose to sugars. While not economically attractive under present state-of-the-art, the analysis has revealed that significant research in the area of enzyme production, recovery, and immobilization is needed to improve the process economics. With additonal funding, we plan further process studies.

ST78 18069 Approach to Modeling the Ocean Food and Energy Farm

Walsh, D.H.; Schneider, R.H.
ISC, Santa Monica, CA
Avail:NTIS, ERDA/USN/1027-76/1 Systems Analysis, V 7, 1976, Final Report

Models of the Ocean Food and Energy Farm (OFEF) economics, operations, and installation are being developed. System concept and farm site descriptions are inputs to each model. The economic model is a mathematical model, consisting of the following sub-models: kelp crop, kelp production, kelp harvesting, kelp processing, aquatic animal production, aquatic animal processing, land animal production, land animal processing, support, and system integration and executive sub-model. The general philosophy and specific approach to the economic modeling are discussed. The approach to operations and installation models is discussed briefly.

ST78 18070 Method For Calculating Ocean Food and Energy Farm Costs

Walsh, D.
ISC, Santa Monica, CA
Avail:NTIS, ERDA/USN/1027-76/1 Systems Analysis, V 7, 1976, Final Report

The "utility financing method" was used for calculating the cost of methane (per million BTU) produced by the Ocean Food and Energy Farm (OFEF). Guidelines to be used in carrying out the principles of the utility financing method for the cultivation, harvesting, processing, and support subsystems are given. The aquatic animal cultivation subsystem is treated as a profit center separate from the kelp operations that contribute to the production of methane. Steps for making a discounted cash flow analysis are given.

ST78 18071 Methane From Algae Grown in Desert Regions of California Using Available Ground Waters

Ward, R.L.; Jeffries, T.W.; Timourian, H.
Univ. of California, Lawrence Livermore Lab., Livermore, CA
Avail:NTIS, UCRL-79716 1977

The potential for growing thermophilic filamentous blue-green algae in the California Desert is discussed. Filamentous blue-green algae grow well at elevated temperatures under high solar radiation in water containing a wide range of dissolved solids. The physical characteristics of filamentous blue-greens makes them easier and less expensive to harvest than unicellular algae forms and once harvested, can be readily converted to methane gas by anaerobic digestion. An artist's concept of the proposal is presented. Various factors involved in such a project are considered. They include productivity, carbon dioxide sparging, high solar insolation, water, anaerobic digestion, suitability of desert resources, special requirements (including water, nutrients, and sunlight), shallow solar pond system, and cost estimates.

ST78 18072 Biomass as a Long-Range Source of Hydrocarbons

Waterman, W.W.; Klass, D.L.
IGT, Chicago, IL
Avail:NTIS, 78C0030364 March 1977

Possible sources of liquid and gaseous hydrocarbons over an extended period of time are examined in relation to the probable life of our fossil fuel resources. Biomass productivity, land requirements, conversion processes, and economics are discussed. It is concluded that available technologies applicable to both biomass and organic wastes offer the potential of supplying all or most of our current nonfuel needs for carbonaceous materials, and in addition, a large portion of our synthetic fuel requirements in the future.

ST78 18073 Plant Species for Biomass Production on Marginal Sites, I, Forage Grasses and Legumes

Wedin, W.F.; Helsel, Z.
Avail:NTIS, CONF-770368 1977

Since most grasses and legumes currently under extensive cultivation in the US are grown as a forage resource, with emphasis on nutrient value, a search for candidates with high and efficient yield for biomass production is necessary. Data relative to biomass production are examined for reed canary grass, switch grass, and a C_4 annual species, sorghum SPP. Climatic conditions suggest that rain-fed biomass production from grasses will be maximized when moving from west to east, more particularly from northwest to southeast, in the North Central states or corn belt.

ST78 18074 Artificial Oceanic Upwelling

Wilcox, H.A.
ISC, Santa Monica, CA
Avail:NTIS, ERDA/USN/1027-76/1 Systems Analysis, V 7, 1976, Final Report

This study of an important aspect of the Ocean Farm concept shows that a system of bellows, pipes, valves, and other wave energy extraction and pumping devices can probably upwell and distribute all required nutrient-rich ocean water from depths of a thousand feet or more to all parts of an ocean farm placed at almost any location of the world-wide oceans. In particular, such artificial oceanic upwelling and distribution was found to require extraction and use of only a few percent of the space and time-average wave energy, which is present on the oceans.

ST78 18075 The US Navy's Ocean Food and Energy Farm Project

Wilcox, H.A.
US Naval Ocean Systems Center, San Diego, CA
OERT Conf., Sept. 18-23, 1977, Houston, TX
Avail:AIAA, A78-10657 Jrnl: Proc. of Conf., p. 83-104, ASME, New York, NY

The aim of the project discussed is to learn how to raise giant seaweeds and other organisms in the vast sunlit surface waters of the tropical and temperate oceans. Wave powered pumps would be used to upwell cool nutrient-rich waters to plants attached to horizontal lines positioned at depths of 15 to 30 m. Accomplishments include experience gained with three small farms, a variety of engineering studies, successful stimulation of seaweed growth by upwelled waters in both the Atlantic and Pacific, production of human foods by feeding seaweeds to sheep and shellfish, and production of methane fuel gas from digesters fed with seaweeds. Economic studies indicate that methane costs may range from about $2 to as much as $7/GJ (per million BTU), depending on credit values assumed for foods and other products (1975 dollars).

ST78 19055 Hydrogen From Solar Energy

Jrnl: Umsch. Wiss. Tech., V 77:226-227, N8, April 1977, In German

The long-range options of energy sources are the breeding reactor, nuclear fusion, and solar energy. Concerning solar energy, three systems are being developed: first the photovoltaic cells which are almost ready for industrial production, but which are still too expensive, at least today; secondly, the thermal utilization of solar radiation. In comparison, thirdly, the photobiological and photochemical possibilities of solar energy utilization have been somewhat neglected so far. However, the photolysis of water by solar energy is a very promising option for future energy demands. This can be done by making use of the photo-synthetic splitting of water in technical facilities or with semi-conductors.

ST78 19056 Investigation of Terrestrial Photovoltaic Power Systems With Sunlight Concentration

Spectrolab, Inc., Sylmar, CA
Avail:NTIS, SAND-76-7006 Aug. 1977

A major Spectrolab task was to recommend a concentrator system that appears best-suited for development into a 10-KW prototype. This task resulted in the recommendation of a two-axis tracking concentrator system using passive cooling. The optics of this system consisted of reflective parabolic troughs, each operating in conjunction with a second stage compound elliptical secondary mirror. A review of the work leading to this recommendation is given. Other program tasks included continuation of experimental work in both the concentrator systems and device area. They included a two-axis tracking platform equipped with an on-axis Fresnel Lens System, a non-tracking low-concentration system, and a flat array. Solar insolation data, both total and direct, along with other important weather data, was monitored as necessary during this period. A review of these experiments and their results are given. In the device design area a low-level but effective effort was directed at upgrading concentrator cell efficiency. The results of this effort substantiated earlier predictions that Silicon solar cells could operate efficiently at 100 aml solar constants and higher. This work is also reviewed.

ST78 19057 Large-Scale Production Task of the Low-Cost Silicon Solar Array Project, Final Report

Spectrolab, Inc., ERDA, Sylmar, CA
Avail:NTIS, ERDA/JPL/649005-76/1 22 p. Dec. 29, 1976

Two thousand solar power modules capable of producing over 10 KW of peak power were delivered by Spectrolab, Inc., during the period of March to October 1976. These modules were comprised of 20 two-inch diameter silicon solar cells embedded in a silicon elastomeric potting compound on an aluminum T-beam extrusion with a glass cover-plate, and were typical of standard commercial products being manufactured during that time period. These modules have good structural and thermal dissipation characteristics, but difficulties were encountered with respect to delamination of the encapsulant material, low electrical breakdown resistance, and humidity sensitivity. The extensive environmental test program and subsequent analytical analysis of results has provided a great deal of new knowledge of the module design. It has shown there were many limitations with this particular commercial module which were not known at the start of the program, and should provide a good basis for developing an improved module in the future. Design modifications that have been recommended to improve reliability and reduce cost include the elimination of metal substrate, replacement of silicone with a more suitable encapsulant, larger module size, and use of series-parallel circuit configurations.

ST78 19058 Research Lowers Solar Cell Prices

Jrnl: Industrial Research, V 20:36, Feb. 1978

No abstract available.

ST78 19059 Economical Photovoltaic Power Generation With Heat Recovery

Ascher, G.
NASA, Goddard Space Flight Center, Greenbelt, MD
SOUTHEASTCON Reg. 3 Conf., April 4-6, 1977, Williamsburg, VA
Avail:IEEE, Cat. no. 77CHO 1233-6 Reg. 3, New York, NY, p. 277-280

Three designs for conversion of solar radiation into electricity and thermal energy are offered. The objective of these converters is to increase the electrical and thermal output for each photovoltaic array, so that the cell cost is lowered, relative to the amount of energy delivered by the device.

ST78 19060 Technoeconomic Aspects of Central Photovoltaic Power Plants

Bradley, J.D.; Costello, D.R.
Midwest Research Inst., Kansas City, MO
"Sharing the Sun," Aug. 15-20, 1976, Winnipeg, Canada
Avail:AIAA, A78-16835 Jrnl: Solar Energy, V 19:701-709, N6, 1977, ISES, SESC, Canada

The economic feasibility of central photovoltaic power plants is investigated from the perspective of an electric power utility company. The maximum acceptable price of the system is established, as a function of conventional fuel costs. Factors which would enhance the economic attractiveness of the system are analyzed. These factors include increases in conventional fuel costs, decreases in photovoltaic system costs, and subsidies to attract utility companies.

ST78 19061 Photovoltaic Energy Conversion Using Concentrated Sunlight

Burgess, E.L.
Sandia Lab., Albuquerque, NM
Jrnl: Optical Engng., V 16:305-312, N3, May-June 1977, 12 refs

This report discribes a development program in which sunlight concentration techniques are used to produce a reduction in cost-per-unit power for photovoltaic systems where solar cell cost dominates system cost. Current examples of concentrator solar cell technologies are single-crystal silicon and gallium arsenide. Implementation of cost reductions by the use of sunlight concentration is not dependent on the development of low-cost mass-production cell technologies but emphasizes high cell efficiency and low-cost concentrator systems.

ST78 19062 Concentrator Development Task of the ERDA Photovoltaic Systems Definition Project

Burgess, E.L.; Schueler, D.G.
Univ. of California, San Diego, CA,/Sandia Labs., Albuquerque, NM
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

An approach to photovoltaic-concentrator development is to investigate both basic performance of system components as well as system-level considerations. Solar cells which have high-power conversion efficiencies at high sunlight intensity and elevated temperature are being studied. Both single-crystal silicon and single-crystal gallium arsenide solar cell technologies are being developed and evaluated. The cost and performance of a variety of concentrator technologies is being studied, as well as solar cell cooling methods and the potential of combined electrical and thermal conversion total energy systems. Several prototype concentrator arrays having peak output in the 100 We to one KWe range are currently being constructed for performance evaluation.

ST78 19063 Terrestrial Photovoltaic Power Systems With Sunlight Concentration

Backus, C.E.;Jacobson, D.L.; Wood, B.D.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The objective of the program during the last three years was to generate and evaluate information on all aspects of photovoltaic concentration systems. During 1976, ASU has been experimentally testing cells and other components that were especially made for concentration systems. Several silicon cells especially designed for concentration by Spectrolab were tested in concentrated sunlight up to about 60 suns. For constant temperature operation all of these cells showed an increase in efficiency up to about 10 to 15 suns, and then a gradual decrease as the intensity continued to increase.

ST78 19064 Solar Photovoltaic Power Stations

Chowaniec, C.R.; Ferber, R.R.; Pittman, P.F.; Marshall, B.W.
Westinghouse Electric Corp., East Pittsburgh, PA
1977 Annual Mtg. of ASISES, Cape Canaveral, FL
Jrnl: Proc. of Mtg., V 1, Secs. 14-25

There are several major cost elements in addition to solar cells which must be included in the cost of a solar photovoltaic power station. The subsystems are identified and the cost of major components is estimated. From these, cost-performance tradeoffs can be made. The capital and energy costs for a solar photovoltaic power station are then determined.

ST78 19065 Reliability Assessment Technique for Generating Systems With Photovoltaic Power Plants

Chowaniee, C.R.; Pittman, P.F.; Marshall, B.W.
Westinghouse Electric Corp.
IEEE,PES Summer Mtg., July 17-22, 1977, Mexico City, Mexico
Avail:IEEE, Pap. A 77 655-4, 4 p., New York, NY

This paper reports on a method to assess the reliability of utility generation systems, which include solar photovoltaic capacity. The technique employs conventional probabilistic calculations conducted for hourly time intervals. The solar capacity is modeled by varying capacity rating and equivalent forced outage rate. As a result, the firm load-carrying capability of the photovoltaic installations can be determined.

ST78 19066 46-KW Module Performance

Curtis, H.B.; Weinberg, I.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Mtg. Proc.

During the past eight months, over 6000 modules have been delivered to NASA-Lewis from the 46-KW ERDA buy. These modules range in power from about five to 15 watts and in area from about 800 to 2300 cm^2. I-V measurements have been performed on several hundred modules chosen on a random basis throughout the delivery schedule. The purpose of the paper is to show the results of these I-V measurements in the form of distributions of short-circuit current, open-circuit voltage, and maximum power for each of the four manufacturers. All the I-V measurements were made using a xenon-pulsed solar simulator. Data were taken at room temperature and at an irradiance level near 100 MW/cm^2 and then converted to the standard conditions of 28 C and 100 MW/cm^2. For each manufacturer, a calibrated reference cell, matched in spectral response to the module being measured, was used to determine incident irradiance. The data are presented in the form of histograms for short-circuit current, open-circuit voltage, and maximum power for each manufacturer. On each histogram a normal distribution curve is plotted. In all cases, the data are normalized so that the average value is equal to one. A table showing standard deviations in percent for all distributions is included. There were no noticeable trends in any of the data throughout the delivery schedule.

ST78 19067 Solar Power Supply For Remote Rural Consumers

Darveniza, M.
Univ. of Queensland, St. Lucia, Australia
Avail:NTIS, CONF-7605161 Jrnl: Engineering, 1976-2001

Because of remoteness, a significant number of rural dwellings and properties in Queensland (and in other states) have little prospect of connection to public electricity supply. The most attractive alternative supply system is based on solar energy. Two systems of high reliability and low maintenance could be developed for this purpose, a combined thermal photovoltaic system or a small turbine-generator unit thermally powered by solar collectors. The requirements for the application of such systems to the supply of rural consumers are considered in this paper, and it is shown that a research and development program would cost about $30 to $60 per potential customer.

ST78 19068 Requirements Assessment of Photovoltaic Electric Power Systems

Atlas Corp., Santa Clara, CA
1st SemiAnnual EPRI SPR Mtg., 1976
Avail:NTIS, EPRI-ER-283-SR Jrnl: Proc. of Mtg., V 2

A brief outline of the project is presented. The major issues to be studied are (1) electric utility requirements and impact, (2) central station and load center, (3) active vs. passive units, (4) capacity and energy displacement, and (5) characteristics of photovoltaic electric power systems.

ST78 19069 Requirements Assessment of Photovoltaic Electric Power Systems

Atlas Corp., Santa Clara, CA
SemiAnnual EPRI SPR Mtg., Feb. 1977
Avail:NTIS, EPRI-ER-371-SR Jrnl: Proc. of Mtg.

Information concerning photovoltaic power plants is presented on site analyses, comparison of reference photovoltaic systems, and technical and economic analyses of the reference systems.

ST78 19070 Research on Low-Cost Silicon Solar Cell Structure for Large Electrical Power Systems

Fang, P.H.
Boston College, Chestnut Hill, Mass. Dept. of Physics, NSF, Washington, D.C.
Avail:NTIS, PB-273 039/8ST 48 p. Jan. 1973

This report is concerned with research attempts to develop a new solar cell structure for generation of electricity. The authors' approach is to use silicon solar cells, which have been rapidly developed and successfully applied in spacecraft. A fundamental aim of this work is to ameliorate the problem of the astronomical numbers of labor hours and enormous costs connected with this process. This report includes the following: Section II presents some factual data concerning solar cells; Section III discusses a new solar cell structure and production methodology; Section IV describes the laboratory program for this work, with some initial results; and Section V discusses the future program and the outlook.

ST78 19071 The ERDA/LERC Photovoltaic Systems Test Facility

Forestieri, A.F.
NASA, Lewis Res. Center, Cleveland, OH
1977 PVSEC, Sept. 27-30, 1977, Luxembourg,
Avail:NTIS, N78-15059 Jrnl: Proc. of Conf.

A test facility was designed, and built to provide a place where photovoltaic systems may be assembled and electrically configured to evaluate system performance and characteristics. The facility consists of a solar cell array of an initial 10-KW peak power rating, test hardware for several alternate methods of power conditioning, a variety of loads, an electrical energy storage system, and an instrumentation and data acquisition system.

ST78 19072 ERDA/Lewis Research Center Photovoltaic Systems Test Facility

Forestieri, A.E.; Johnson, J.A.; Knapp, W.D.; Rigo, H.; Stover, J.
NASA, Lewis, Cleveland, OH
Avail:NTIS, N77-22609 April 1977

A national photovoltaic power systems test facility (of initial 10-KW peak power rating) is described. It consists of a solar array to generate electrical power, test-hardware for several alternate methods of power conversion, electrical energy storage systems, and an instrumentation and data acquisition system.

ST78 19073 Assessment of Large-Scale Photovoltaic Materials Production, Final Report

Gandel, M.G.; Dillard, P.A.; Sears, D.R.; Ko, S.M.; Bourgeois, S.V.
Lockheed Missiles and Space Co., Huntsville, AL
Avail:NTIS, N78-15589

Solar cell production at rates needed to supply continuously one percent of projected US power requirements in the year 2000 is examined. Si and Cds are followed from raw material extraction to finished cell; GaAs is reviewed less thoroughly. Numerical data are developed for air, water, and solid wastes, and compared with corresponding effects of equivalent coal-electric power.

ST78 19074 Large Area Silicon Sheet Task Low-Cost Silicon Solar Array Project, Fifth Quarterly Progress Report, January 1, 1977-April 1, 1977

Garfinkel, M.; Hall, R.N.
GE Co., Schenectady, NY
Avail:NTIS, ERDA/JPL/954350-77/1 20 p. April 12, 1977

This report concerns the seeded growth furnace with slotted molybdenum susceptor operated during the past quarter. Flat sheets of sapphire were used as the tray and local cooling at the tin-silicon alloy surface was provided by a symmetric water-cooled jet. The silicon surface growth obtained during the past quarter has been consistently polycrystalline. This poor growth is attributed to impurities in the seeded growth furnace, caused by leakage into the system. Two sources have been identified: deteriorating neoprene O-rings and leaks of cooling water from the jet nozzle. The O-rings were replaced with indium gaskets, and the nozzle is being rebuilt. Weight loss measurements of the sapphire tray plates indicate that they suffer negligible attack by tin-silicon alloy melts at 1000 C to 1100 C. The growth habit of crystals nucleated spontaneously at the tin-silicon alloy melt surface has been studied. The crystal growth observed is consistent with dendritic and web growth from (111) singly twinned triangular nuclei. Examples of planar surface growth of small (less than 0.1 mm), thin crystals from these twinned surface seeds have been observed.

ST78 19075 Laser-Zone Growth in a Ribbon-to-Ribbon, RTR, Process Silicon Sheet Growth Development for the Large-Area Silicon Sheet Task of the Low-Cost Silicon Solar Array Project, Annual Report

Gurtler, R.W.; Baghdadi, A.
Motorola, Inc., Phoenix, AZ; JPL, Caltech, Pasadena, CA
Avail:NTIS, N78-16437

A ribbon-to-ribbon process was used for routine growth of samples for analysis and fabrication into solar cells. One lot of solar cells was completely evaluated; ribbon solar cell efficiencies averaged 9.23 percent with a highest efficiency of 11.7 percent. Spherical reflectors have demonstrated significant improvements in laser silicon coupling efficiencies. Material analyses were performed including silicon photovoltage and open circuit photovoltage diffusion length measurements, crystal morphology studies, modulus of rupture measurements, and annealing/gettering studies. An initial economic analysis was performed indicating that ribbon-to-ribbon add-on costs of $.10/watt might be expected in the early 1980's.

ST78 19076 Definition Study for Photovoltaic Residential Prototype System, Final Report

Immamura, M.S.; Hulstrom, R.; Cookson, C.; Waldman, B.H.; Lane, R.
Martin Marietta Corp., Denver, CO
Avail:NTIS, ERDA/NASA-19768 Sept. 1976

It is proposed to determine the information needed for implementing the residential photovoltaic Prototype System Test (PST) program and to define and configure an appropriate PST to provide that information. This included the definition of a test plan, test equipment required, and test procedures. The secondary objectives were to (1)select nine regions in the continental United States, rate them as potential residential PST sites, and identify three sites for each region; and (2)identify and examine institutional problems. The PST is an experiment intended to provide the necessary information so that more intelligent design selections can be made in subsequent tests and analyses. It is therefore not intended to be a demonstration system for the final residential photovoltaic power system, and not a verification of an optimum design. This study consisted of the following tasks: Task I - site selection study, Task II - parametric sensitivity analysis, Task III - conceptual design of residential PST, Task IV - test plan, Task V - test equipment requirements and test procedures, and Task VI - identification and examination of institutional problems. As a part of Task II, a computer program was required to be developed and used in generating the sensitivity data. The basic constraints and guidelines for this study are given.

ST78 19077 Definition Study for Photovoltaic Residential Prototype System

Imamura, M.S.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The objectives of the residential photovoltaic prototype system test (PST) are (1) determine information needed to implement PST; (2)define PST configuration, including test plan, test procedure, and test equipment. Secondary objectives are (1)select eight regions in continental US, rate these regions, and identify three potential PST sites per region; and (2)identify institutional problems.

ST78 19078 Change in Solar Cells May Speed up Timetable

Iwler, L.
Jrnl: Electrical World, V 189:23, Jan. 1, 1978

No abstract available.

ST78 19079 A Lightweight Solar Array Study

Josephs, R.H.
JPL, Pasadena, CA
Avail:NTIS, N77-22611 Feb. 15, 1977

A sample module was assembled to model a portion of a flexible extendable solar array, a type that promises to become the next generation of solar array design. The resulting study of this module is intended to provide technical support to the array designer for lightweight component selection, specifications, and tests. Selected from available lightweight components were 127-micron-thick wrap-around contacted solar cells, 34-micron-thick sputtered glass covers, and as a substrate, a 13-micron-thick polymide film clad with a copper printed circuit. Each component displayed weaknesses. The thin solar cells had excessive breakage losses. Sputtered glass cover adhesion was poor, and the covered cell was weaker than the cell uncovered. Thermal stresses caused some cell delamination from the model solar array substrate.

ST78 19080 NSF International Seminar on Large-Scale Solar Energy Test Facilities: Summary Meeting

Kaplan, G.
NSF, Washington, D.C.
Avail:NTIS, CONF-741197

The discussion was directed to such topics as the distinctions between solar furnaces and solar power plants; the best materials for reflectors; heliostat tracking; operation, maintenance, and safety; boiler design; and test facilities.

ST78 19081 A Tracking, High-Concentration Electrical and Thermal Solar Energy Collection System

Kaplow, R.; Frank, R.I.
MIT, Cambridge, MA
12th PSC, Nov. 15-18, 1976, Baton Rouge, LA
Avail:AIAA, A78-11032 Jrnl: Conf. Record, p. 814-819, IEEE, New York, NY

A solar energy converter, designed with the intent of providing cost-effective supplemental electricity and hot water for houses and institutions, has been constructed in a full-size working model form and is being tested. The model is being operated to obtain measurements of performance, to make improved cost calculations, and to optimize the system and its components. The system is designed to lend itself to inexpensive manufacturing techniques and its modular construction allows different capacity units to be assembled from standardized components.

ST78 19082 Research on Energy Storage for Photovoltaic Conversion

Kirschbaum, H.S.; Federmann, E.F.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The overall objective of the one-year program is to determine and define the nature, mode of operation, and usefulness and defining actions regarding any technical and/or implementation problems with battery-stored energy when applied to both single family residences and utility central station systems that would use photovoltaic-derived electricity, circa 1985-1995.

ST78 19083 Utility Interfacing

Kornrumpf, W.P.
GE Co., Schenectady, NY
PVPC Workshop, March 1977
Avail:NTIS, SAND-770393 Jrnl: Record of Workshop

ST78 19084 Status of Power Conditioning Technology

Kroeger, F.R.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The evaluation of power conditioning technology is in support of the ERDA/Sandia Laboratories Solar Photovoltaic Systems Definition Project. The primary objectives of this support effort, which began mid-FY76, are (1)evaluate power conditioning industry; (2)formulate design specifications for power conditioning hardware in photovoltaic system applications, including utility interfacing for the last three; (3)make recommendations for ERDA power conditioning hardware development program; and (4)contract for innovative hardware development. The first objective has received the most emphasis to date. Design specifications will be formulated in the near future. Hardware development recommendations and contracts (where appropriate) will follow.

ST78 19085 Mission Analysis of Photovoltaic Solar Energy System

Leonard, S.L.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The overall objective of the project described is to support the formulation, planning, and justification of the ERDA National Photovoltaic Plan through (a)analyses that lead to the identification of promising terrestrial applications for photovoltaic solar energy conversion, to the recognition of attractive demonstration possibilities, and to the identification and resolution of critical external issues influencing the widespread utilization of the technology; and (b)planning support to refine the overall program strategy. Previous activities and current efforts are summarized.

ST78 19086 Photovoltaic System Analysis Program: Solcel

Linn, J.K.
Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-77-1268 Aug. 1977

Program Solcel is a simulation program designed specifically for photovoltaic systems analysis and design optimization. Photovoltaic conversion is modeled, based upon cell parameters; concentrating, non-concentrating, tracking, and non-tracking systems are available for simulation. Other subsystem models included are power conditioning, energy storage, and either utility or diesel generator backup. Total subsystem performance may be evaluated using either life-cycle or levelized busbar energy-costing methods. A self-contained routine allows the system performance to be optimized, relative to subsystem or component sizing for a defined load and insolation data base.

ST78 19087 Price Goal Allocations

Macomber, H.L.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

Silicon solar cell array fabrication cost data are presented.

ST78 19088 Solar Photovoltaic Power Systems

Magid, L.M.; Marshall, B.W.; Schueler, D.G.
US ERDA, Washington, D.C.
IEEE PES Summer Mtg., July 17-22, 1977, Mexico City, Mexico
Avail:IEEE, Pap A 77 695-0, 5 p., 4 refs, New York, NY

This paper is concerned with analysis of a number of residential conceptual designs, indicating that substantial fractions of the annual electrical energy demand can be provided by on-site photovoltaic systems. These results also indicate, however, that a backup power source, such as a local utility connection or on-site motor/generator will be required to provide adequate system reliability. In the case of utility connection, issues relating to the customer/utility interface, such as rate structure, ownership, energy feedback to the utility, and safety and control require further definition. Conceptual designs for central station power plants ranging in size from 100 to 1700 MW

peak generating capacity have been developed and analyzed. A key feature of the analysis is that solar plant operation is not forced to a particular mode, such as peaking, intermediate, or base load operation, but rather, integrated into the overall grid generating capacity in the most effective and economic manner.

ST78 19089 Design and Construction of a One-Kilowatt Concentrator Photovoltaic System

Marchi, D.L.
Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-77-0909 Aug. 1977

The construction details of a system which uses Fresnel lenses to concentrate sunlight on silicon solar cells are described. The cells are cooled either passively by convection or actively using a pumped fluid coolant. Construction and operation of the array have disclosed several unique problems; future modifications and improved future designs are being considered.

ST78 19090 Systems Engineering and Analysis Task

Marshall, B.W.; Schueler, D.G.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The systems engineering and analysis task of the Photovoltaic Systems Definition Project at Sandia Laboratories is concerned with providing system analysis and definition for the ERDA National Solar Photovoltaic Program. The task has as its objectives providing conceptual design studies, conducting detailed analyses and design tradeoff studies, performing subsystem analysis and design requirements, providing systems definition support for tests and experiments, and conducting component and subsystem integration experiments. During the past six months, primary emphasis has been placed on concluding the existing conceptual design studies, providing an updated, thorough solar data base, and developing in-house system simulation and optimization models. During the next six months, these efforts will be continued. In particular, solar data tapes, maps, and tables will be available and a report presenting a comprehensive comparison of the final results of the conceptual design studies will be published, along with the final reports from each of the contractors. A substantial amount of new systems analysis and design studies is planned for the next six months. These studies will support the test and demonstration projects, will provide applications analysis and baseline design definition, and will provide subsystem performance requirements and technology status support. Examples of the studies planned are (1)assessment of the utility/customer interface for on-site systems, (2)conceptual design of photovoltaic/thermal electric systems, (3)reliability and capacity displacement for PV systems in a utility grid, (4) transient effects and reliability of photovoltaic array systems, and (5)power conditioning studies. Other areas of study are listed.

ST78 19091 Comparison of Photovoltaic Conceptual Design Studies

Marshall, B.W.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

In June 1975, the Photovoltaics Branch of the Division of Solar Energy, ERDA, initiated contracts with General Electric, Spectrolab, and Westinghouse for one-year conceptual design studies of photovoltaic systems. The contracts required studies for three concepts: an on-site residential system (RPS), a central power station (CPS), and an intermediate power system (IPS). Results of the studies were not interchanged between contractors during the contract period as encouragement for each to develop independent concepts. These studies, including three-month extensions, have been completed and the final reports are in preparation. Sandia Laboratories, as a part of their Photovoltaic System Analysis Project, undertook the technical direction for these studies in November 1975, and is presently preparing an evaluation and comparison of these studies. Although this effort is not totally complete, much of the information has been accumulated and is presented.

ST78 19092 MIT/LL Solar Photovoltaic Field Tests and Applications Project

Matlin, R.W.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

ST78 19093 Solar-Electric Residential System Tests

Miller, D.B.; Boer, K.W.
Purdue Univ., West Lafayette, IN
Avail:AIAA, A78-10741 Jrnl: Energy Development II, p. 116-124, 1976, IEEE, New York, NY

The test system consisted of an array of CdS/Cu_2S photovoltaic cells, augmented by a power amplifier, a parallel battery circuit, a normal residential lighting circuit, auxiliary rheostat loads, and a tie to the utility power line located in the Solar One house. All circuits were carefully instrumented. Through a series of day-long tests, during partially cloudy and overcast days, 13-49 percent of the normal residential load came from the amplified solar source. A battery "float" mode was shown to be useful for voltage regulation and maximum power tracking. The batteries were also "deep-discharged" to show their energy storage capability.

ST78 19094 Solar Cells Find Their Niche in Everyday Life on Earth

Morris, D.
Jrnl: Smithsonian, V 8:38, Oct. 1977

No abstract available.

ST78 19095 Problems in Adapting Photocells to Terrestrial Applications

Naaijer, G.-J.
Laboratoires D'Electronique et de Physique Appliquee, Limeil-Brevannes, Val-de-Marne, France
Avail:AIAA, A78-10555 Jrnl: Acta Electronica, V 20:165-185, N2, 1977, In French

The characteristics of a silicon photovoltaic cell are reviewed and a practical mathematical model for the device is established. A series of examples of low-power terrestrial utilizations are described. With a single cell, the following devices can be operated: solar motors and swings, distress micro-transmitters, power supplies for pocket calculators or clocks with liquid crystal display, and discharge tube blinker lights. With a series of 34 cells a 12-V battery can be kept charged, thus prolonging its lifetime. Between these two extremes, power supply of digital circuits, heliogyrators, electrolysis, refining, and cathodic protection against corrosion of metallic objects in contact with a net environment should be mentioned. Series-parallel association of cells with protection measures (by diodes), energy storage devices, adaptors/converters, adaptive associations, and simple solar tracking system without concentrators are discussed.

ST78 19096 Cost Factors in Photovoltaic Energy Conversion With Solar Concentration

Parrott, J.E.
Univ. of Wales, Inst. of Science and Tech., Cardiff, Wales
ECASEC Conf., July 5, 1977, London, England
Avail:AIAA, A78-10619 Jrnl: Proc. of Conf., p. 49-53, ISES, London

A simple mathematical model for evaluating the economics of photovoltaic energy conversion with solar concentration is developed, and the major components of a concentration system, including the concentrating lens or mirror, the tracking system, solar cells, and the means of heat dissipation are discussed. It is suggested that to be competitive, solar concentrators must have a lower cost per unit area than solar cells and must be very efficient at high levels of irradiance and under a variety of climate conditions. Three types of solar cell for use in concentration systems are considered: a conventional silicon cell with the p-n junction normal to incident radiation; a vertical junction cell, also of silicon; and a conventional cell with an $Al_{(1-x)}$ $Ga_{(x)}$ as window on a GaAs substrate containing the junction. Cost estimates are developed on the basis of these three designs.

ST78 19097 Photovoltaic Applications in the Southwest for the National Park Service

Peatfield, C.R.; Jarvinen, P.O.
Lincoln Lab., Mass. Inst. of Tech., Lexington, MA
Avail:NTIS, N78-15578

Nearly three megawatts of electrical power are produced annually by diesel-electric generator sets at National Park Service sites. To prove the economic viability of photovoltaic power generation systems to meet NPS electric power needs as well as to stimulate public acceptance and reliance on solar-generated electricity, NPS and MIT/LL are cooperating in a Field Tests and Applications Project sponsored by the US Energy Research and Development Administration. The power level for the applications will be in

the range from 10-100 kW. The most promising NPS sites were visited and evaluated. Based on 10 criteria, Natural Bridges National Monument in Utah was selected as the optimum first pick. The FTA project and evaluation details for 10 sites are described.

ST78 19098 Silicon Material Task, Part 3: Low-Cost Silicon Solar Array Project, Final Report

Roques, R.A.; Coldwell, D.M.
Texas Instruments, Inc., Dallas, TX
Avail:NTIS, N77-24584 Jan. 1977

The feasibility of a process for carbon reduction of low impurity silica in a plasma heat source was investigated to produce low-cost solar-grade silicon. Theoretical aspects of the reaction chemistry were studied with the aid of a computer program using iterative free energy minimization. These calculations indicate a threshold temperature exists at 2400 K below which no silicon is formed. The computer simulation technique of molecular dynamics was used to study the quenching of product species.

ST78 19099 MIT/LL Residential Program

Sacco, S.B.
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ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The objectives of the MIT/LL Residential Program are to develop and demonstrate the technology of photovoltaic power systems as utilized in residential applications, and to develop the institutional interfaces (i.e., financial, insurance, building codes) necessary to permit residential applications of photovoltaics to achieve market penetration as rapidly as possible after the attainment of economic viability in this market sector. To accomplish these objectives, a 7-year program has been proposed, which will field a total of 57 residential units in the classifications of mobile, single-family, and multi-family. These are spread in a pattern of increasing rate of construction over the 7-year period, and will be located in areas which have been determined to be probable areas of early economic viability for residential photovoltaics. For the FY77 segment of this plan, it is planned to design and construct three residences, all of which will be of single-family detached construction. Two of these will be of the "stand-alone" variety (i.e., no connection to utility grid) and will be sited in northeastern and southwestern locations in the US. The third residence will be a two-way interactive design which supplies power to the electric power grid during periods of high insolation and draws power from the grid whenever the load is greater than the output from the solar array. This residence will most likely be sited in Southeastern US.

ST78 19100 A Hypothetical 1000-MW(e) Photovoltaic Solar-Electric Plant, Final Environmental Impact Statement, April 1-July 31, 1976

Sears, D.R.; Merrifield, D.V.; Penny, M.M.; Bradley, W.G.
Environmental Consultants, Inc., Lockheed Missiles and Space Co., Huntsville, AL
Avail:NTIS, N78-16468

The hypothetical plant is 1000-MWe silicon photovoltaic, located on 52 km^2 of desert. The principal adverse environmental impacts expected relate to the destruction of soil and vegetation on 52 km^2 of desert terrain.

ST78 19101 The Conceptual Design and Analysis of a Photovoltaic-Powered Experimental Residence

Shepard, N.F.Jr.; Landes, R.
GE Co., Space Div., Philadelphia, PA
12th PSC, Nov. 15-18, 1976, Baton Rouge, LA
Avail:AIAA, A78-11015 Jrnl: Conf. Record, p. 705-714, IEEE, New York, NY

The paper deals with the results of a six-month definition study conducted to analyze the performance, plan the testing program, and specify the test equipment requirements for an experimental photovoltaic-powered residence. In a residence of the type proposed, the solar cell modules are mounted above the south-facing roof in such a way that the natural convective cooling from the rear side can be used to reduce the cell operating temperature. Other functional elements are a photovoltaic system components room and a room housing the data-acquisition and control systems required to monitor the experiment. A display panel is also provided as a visual aid to graphically represent the operation and performance of the system tested. Following a 12-month operational evaluation period, a lead-acid battery was added to the photovoltaic system. The results of a performance sensitivity analysis for four selected site locations are evaluated.

ST78 19102 Definition Study For Photovoltaic Residential Prototype System

Shepard, N.F.Jr.
Univ. of California, San Diego, CA
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112 Jrnl: Proc. of Mtg.

The residential prototype system test (RPST) is defined as a prototype experimental photovoltaic power system, which is integrated into a conventional single-family residential structure. The six-month definition study was intended to analyze the performance, conduct the conceptual design, plan the testing program, and specify the test equipment requirements for such an experimental residence. Since RPST installations are currently planned for several regional site locations, this program also included a site selection evaluation.

ST78 19103 DOD Photovoltaic Energy Conversion Systems Market Inventory and Analysis, Volume I

Terry, R.M.; Carter, C.P.; Israel, J.; Merrill, O.H.; Semmans, M.G.
BDM Corp., Vienna, VA
Avail:NTIS, N78-16469

The potential Department of Defense market for photovoltaic energy systems, and the potential role of the DOD in promoting industry and market development were estimated. The focus of the study is on delineating near term markets.

ST78 19104 DOD Photovoltaic Energy Conversion Systems Market Inventory and Analysis, Volume II

Terry, R.M.; Carter, C.P.; Israel, J.; Merrill, O.H.; Semmans, M.G.
BDM Corp., Vienna, VA
Avail:NTIS, N78-16470

Topics discussed include (1) statement of work; (2) near-term application of photovoltaic energy systems, detailed data and results; (3) long-term application of photovoltaic energy systems, detailed data and results; (4) combined energy systems, (5) market survey of technology transfer potential of the Department of Defense photovoltaic applications; and (6) technology transfer potentials for non-department of defense applications.

ST78 19105 DOD Photovoltaic Energy Conversion Systems Market Inventory and Analysis, Summary Volume

Terry, R.M.; Carter, C.P.; Israel, J.; Merrill, O.H.; Semmans, M.G.
BDM Corp., Vienna, VA
Avail:NTIS, N78-16471

Estimates of the potential Department of Defense market for photovoltaic energy systems, and the potential role of the DOD in promoting industry and market development were provided. The focus was on delineating near-term markets. It is hoped that rapid development of these markets will provide sufficient sales volume to promote industry automation and drive down the unit cost of photovoltaic energy systems to the point where large-scale DOD and civilian markets will develop.

ST78 19106 System Analysis and STF Interface

Watkins, J.L.; Forestieri, A.F.
Sandia Labs., Albuquerque, NM
ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112

Sandia Laboratories has responsibility for the systems definition project within the National Photovoltaic Conversion Program. As a part of this activity, Sandia is expected to provide conceptual systems designs and evolve preferred system configurations and preliminary design specifications for various applications. Many system performance characteristics can be determined by developing analytical models of the system components. However, there naturally arise many questions concerning the performance of terrestrial photovoltaic systems that can best be answered with the aid of actual test results. A variety of these system questions that have surfaced in the system analysis and design studies are presented, and approaches to determining the answers to these questions using the system test facility are discussed. In addition, consideration is given to future areas of systems studies that may become apparent in the course of experimental activity at the system test facility.

ST78 19107 Visual Defects in 46-KW Models

Weinberg, I.
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ERDA SemiAnnual SPPR Mtg., 1977
Avail:NTIS, CONF-770112

All of the modules scheduled for delivery to NASA-LERC, approximately 44 kw from the JPL 46-kw buy, have been delivered for inspection and processing into photovoltaic applications. Approximately 12 percent of the received modules have been processed through the Lewis pulsed xenon simulator where I-V curves were obtained under standard conditions (air mass one, 28 C). In addition, visual inspections were performed on the modules before assembly into arrays for use in applications. The major defects observed in the visula inspection include air bubbles in the encapsulant, pinholes, and protrusions through the encapsulant. A breakdown, by supplier, is given for these and additional types of defects. Most of the visual defects observed are of the type that do not impair module performance. The remainder are such that they are easily repairable. In addition, to inspection, before use, modules are visually inspected at NASA-LERC while in use in the ERDA/LERC systems test facility. The major types of defects observed in the STF are delamination, partial cell darkening, and dirt accumulation. The first two are irreversible defects while dirt accumulation can be removed by cleaning with detergent solution. I-V measurements were obtained for modules, both before and after cleaning, on removal from the facility. The results indicate that cleaning can effectively assist in maintaining the power output of modules of the type tested.

ST78 19108 Systems Aspects of Large-Scale Solar Energy Conversion

Weingart, J.M.
Internat'l Inst. for Applied Systems Analysis, Laxenburg, Austria
Avail:NTIS, IIASA-RM-77-23 May 1977

With a view to the potential role of solar energy as global energy option, the presently known solar energy technologies are employed to contribute to the world energy supply. Such a global solar energy supply system would evolve in stages of development, proceeding from local use of solar energy to regional and global systems. The initial stage would include local low-temperature applications for heating purposes, and the embedding of small amounts of solar electric generation capacity in the existing electric grids. Regional interconnections of solar electric power generation would be followed by increasing production of solar fuels in locations with favorable insolation, and by long-distance transport of these fuels. It turns out that much more needs to be known about the behavior of very large integrated solar energy conversion systems. Market penetration calculations indicate that it takes roughly five decades for a major source of energy to be developed and used on a truly significant scale. It therefore would be necessary to initiate large-scale deployment of solar energy perhaps 50 years or more before fossil resources are finally depleted.

ST78 19109 Automated Array Assembly, Annual Report

Williams, B.F.
RCA Labs., ERDA, Princeton, NJ
Avail:NTIS, ERDA/JPL/954352-77/1 88 p. May 1977

This report is concerned with the goal of ERDA/JPL LSSA's program of a $.50/W selling price for array modules in 1985. An extensive and detailed analysis of technologies which could be related to array module manufacturing was completed, and a minimum manufacturing cost in a highly automated line of $.30/W was found, assuming the silicon is free. The panels of double-glass construction are based on round wafers and screen-printed silver has been used as the metallization with a spray-coated AR layer. The least expensive junction formation technology appears to be ion implantation, but several other technologies also may be used with very little cost penalty. Based on the required investment, a profit of $.05/W appears reasonable. If silicon wafers are available at a price of $20 to $40/m^2, a selling price for these array modules of $.50 to $.66/W is projected. An analysis of the impact of factory size has been made. For a production level of 500 MW/yr, the price above is derived. For comparison, a factory processing 50 MW/yr using the same technology would sell modules for $.54 to $.70/W. An analysis of the impact of wafer size indicates that with traditional metallization and panel designs there is no advantage in increasing wafer size from three in. to five in., and in fact, there is some penalty (10 percent in $/W) due to increased metallization costs and reduced system performance. There is a premium placed on high efficiency due to its impact, not only on array module cost, but on system cost. For the near-term goals of this program, wafers cut from single-crystal material seem the most likely sheet configuration.

ST78 19110 Near-Term Commercial Uses for Terrestrial Photovoltaics

Winegarner, R.M.
Optical Coating Lab., Inc., Santa Rosa, CA
1977 Annual Mtg. of ASISES, 1977
Avail:ISES, Cape Canaveral, FL Jrnl: Proc. of Mtg., V 1

It has been estimated that terrestrial photovoltaics will not become competitive with central station-supplied electrical power until 1990 or beyond. At that time, photovoltaics may be used on a large scale for central plant power, on-site power for industrial use, and possible even on-site residential power. In the interim, however, there are several commercial markets in which terrestrial photovoltaics will compete. Six segments of the United States commercial market that have been evaluated are as follows: corrosion protection, communications, mobile vehicles, navigation, remote power, and certain novelty applications. This evaluation concludes that the near-term commercial market potential for terrestrial photovoltaics is on the order of 376 kw in 1977 and 18 Mw in 1983.

ST78 19111 The Near-Term Prospectives for Photovoltaic Solar Energy Conversion

Wolf, M.
Univ. of Pennsylvania, Philadelphia, PA
IEC +5, March 28-April 1, 1977, Paris, France
Avail:AIAA, A78-10558 Jrnl: Acta Electronica, V 20:205-215, N2, 1977

Changes in the price/demand curve for photovoltaic energy conversion devices during the next five years, as well as technological advances affecting the cost of photocells, are discussed. Innovations, such as the black or non-reflective silicon solar cell, or cells employing thin (50-100 micron) silicon layers and ceria-doped glass covers are described; GaAs cells are also mentioned. A mathematical model for evaluating the economic viability of solar systems with varying cost per unit of array is given. In addition, a price/demand curve for solar arrays sold in the US, including historical data as well as predictions through 1982, is developed. The forecast involves annual doubling of production, with a 25 percent price reduction for each doubling, and an increase of cell efficiency to 12 percent by 1982.

ST78 19112 10-MWe Pilot Plant Program

Yokomizo, C.
Sandia Labs., Livermore, CA
5-MWT STTF Symp., 1976
Avail:NTIS, ALO/3701-76/1 Jrnl: Report on Symp.

The major objectives of the 10-Mwe electric central receiver pilot plant program, the conceptual approaches of four contractor teams, and the organization of the program are discussed. McDonnel Douglas, Martin Marietta, and Honeywell are designing complete pilot plant systems. Boeing is working solely on the heliostat design. A description of the concepts of each team for heliostat, receiver, and thermal storage system design is given. Emphasis in the program will be on investigation of daily thermal cycling so that practical use of electric central receiver power plants by utilities can be established.

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LIST OF ABBREVIATIONS

7th AAM Conf. and RSS Symp.: 7th Aerospace and Aeronautical Meteorology Conf. and Remote Sensing from Satellites Symp.

AES: American Electroplaters' Society

AES CFSC Symp.: AES Coatings For Solar Collectors Symp.

16th AIAA ASM: 16th AIAA Aerospace Sciences Meeting

AIChE Symp. Series, 16th NHT Conf.: AIChE Symposium Series, 16th National Heat Transfer Conf.

AGA: American Gas Association

ASCE: American Society of Civil Engineers

BEI, Inc.: Biomass Energy Institute, Inc.

BHRA: British Hydromechanics Research Association

BNL: Brookhaven National Laboratory

BPNL: Battelle Pacific Northwest Laboratory

CEC: Commission of European Communities

2nd CFFBW Symp.: 2nd Clean Fuels From Biomass Wastes Symp.

CIRSL BSFM: Cambridge Information and Research Services, Ltd.; British Gas School of Fuel Management

CIT: California Institute of Technology

DAA: Development Analysis Associates

Proc. of ECASEC Conf.: Proc. of Economic and Commercial Assessment of Solar Energy Conversion Conf.

3rd Annual ECS Conf.: 3rd Annual Energy Conversion and Storage Conf.

EEC Symp.: Environmental and Energy Conversion Symp.

1st SemiAnnual EPRI SPR Mtg.: 1st SemiAnnual EPRI Solar Program Review Meeting

ERDA FWHRU Workshop: ERDA Fluid Waste Heat Recovery Utilization Workshop

ERDA SemiAnnual SPPR Mtg.: ERDA SemiAnnual Solar Photovoltaic Program Review Meeting

1st ERDA SemiAnnual SPCP Conf.: 1st ERDA SemiAnnual Solar Photovoltaic Conversion Program Conf.

FCST: Federal Council for Science and Technology

Conf. on Improving Efficiency in HECFRSCB: Conf. on Improving Efficiency in HVAC Equipment and Components for Residential and Small Commercial Buildings

IAMT Conf.: Inter-American Materials Technology Conf.

IEC: International Electronics Conference

12th IECE Conf.: 12th Intersociety Energy Conversion Engineering Conf.

IEEE PES Summer Mtg: IEEE Power Engineering Society Summer Mtg.

IF: Industrial Forum

IGT: Institute of Gas Technology

IIASA: International Institute for Applied Systems Analysis

1st IMEFR Symp.: 1st International Materials and Energy From Refuse Symp.

17th ISTS Conf.: 17th International Scientific-Technological Space Conf.

IWES Symp.: International Wind Energy Systems Symp.

JPL: Jet Propulsion Laboratories

Keynote Address before LACFL Conf.: Keynote Address before Los Angeles County Federation of Labor Conf.

NCSTD: National Center for Scientific and Technological Documentation

NEF: National Energy Forum

NRC: National Research Council

NSHCIC: National Solar Heating and Cooling Information Center

NSF: National Science Foundation

NSI: National Space Institute

OERT: Ocean Energy Research Technology

OESS Conf.: Ocean Engineering Symposium Series Conf.

OFEFPSA: Ocean Food and Energy Farm Project Systems Analysis

OPFA: Office of Petroleum Fuel Affairs

ORSA and IMS Jt. Nat'l Mtg.: Operations Research Society of America and Institute of Management Sciences Joint National Meeting

OSA: Optical Society of America

PASEWP Workshop: Practical Applications of Solar Energy to Wood Processing Workshop

12th PSC: 12th Photovoltaics Specialists Conference

PVPC Workshop: Photovoltaics Power Conditioning Workshop

1977 PVSEC: 1977 Photovoltaics Solar Energy Conference

SAMT Conf.: Satellite Applications to Marine Technology Conf.

SIPI: Scientists' Institute for Public Information

SNAME: Society of Naval Architects and Marine Engineers

7th SPG Symp.: 7th Synthetic Pipeline Gas Symp.

2nd STAR Symp.: 2nd Ship Technology And Research Symp.

STCPCP Proj.: Solar Thermal Conversion Program Central Power Proj.

Symp. on 5-MW STTF: Symp. on 5-MW Solar Thermal Test Facility

3rd UP Symp.: 3rd Uranium Plasmas Symp.