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ENERGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

APRIL 1976

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ENERGY

A Continuing Bibliography

With Indexes

Issue 9

44
A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from January 1 through March 31, 1976 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(09)) lists 345 reports, journal articles, and other documents announced between January 1, 1976 and March 31, 1976 in *Scientific and Technical Aerospace Reports* (*STAR*) or in *International Aerospace Abstracts* (*IAA*). The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes—subject, personal author, corporate source, contract number, and report number—are included. The indexes are of the cumulating type throughout the year, with the fourth quarterly publication containing abstracts for the fourth quarter and index references for the four quarterly publications.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A76-10000 Series)

All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies are available at \$5.00 per document up to a maximum of 20 pages. The charge for each additional page is 25 cents. Microfiche⁽¹⁾ are available at the rate of \$1.50 per microfiche for documents identified by the # symbol following the accession number. A number of publications, because of their special characteristics, are available only for reference in the AIAA Technical Information Service Library. Minimum airmail postage to foreign countries is \$1.00. Please refer to the accession number, e.g., (A76-10147), when requesting publications.

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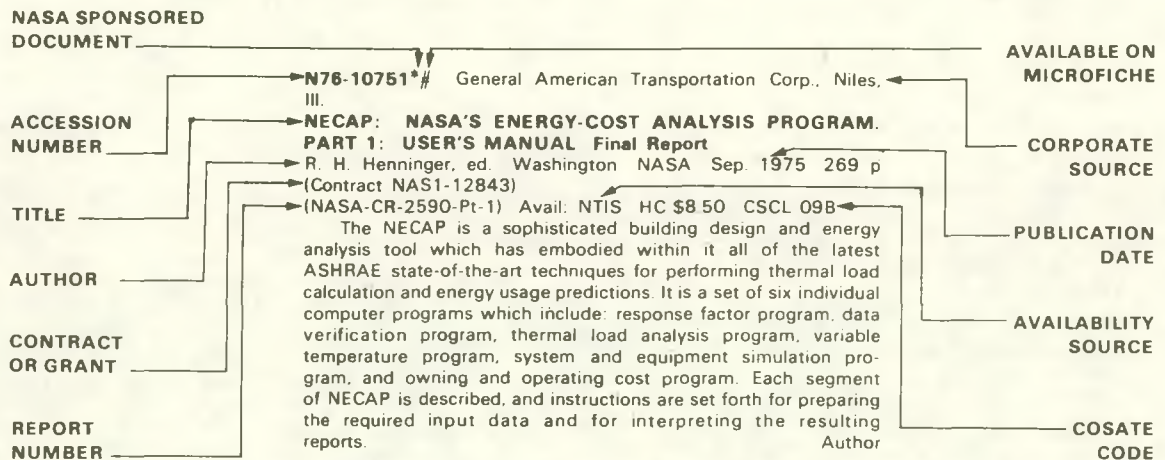
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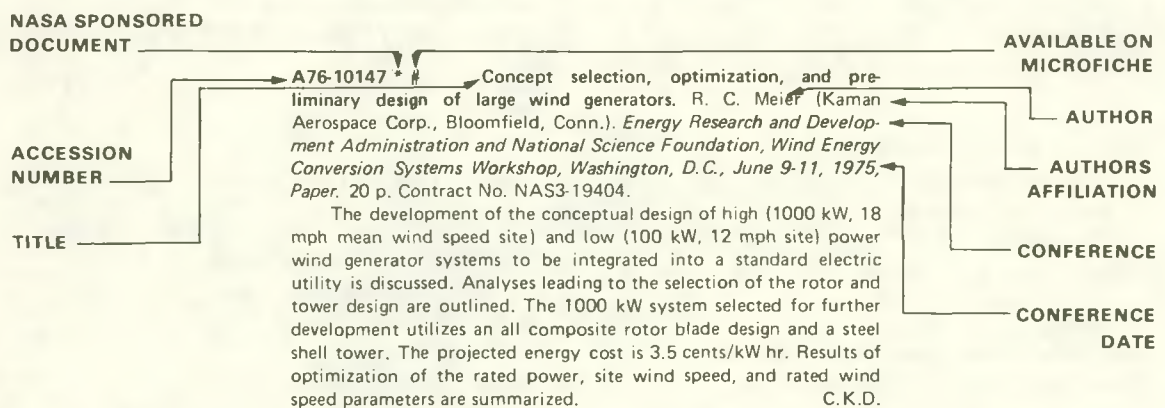
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TYPICAL CITATION AND ABSTRACT FROM IAA



A Listing of Energy Bibliographies Contained in This Publication:

1. Wind energy utilization: A bibliography with abstracts, cumulative volume
1944/1974 N76-15289 p0027

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IAA ENTRIES

A76-10147 * # Concept selection, optimization, and preliminary design of large wind generators. R. C. Meier (Kaman Aerospace Corp., Bloomfield, Conn.). *Energy Research and Development Administration and National Science Foundation, Wind Energy Conversion Systems Workshop, Washington, D.C., June 9-11, 1975, Paper*. 20 p. Contract No. NAS3-19404.

The development of the conceptual design of high (1000 kW, 18 mph mean wind speed site) and low (100 kW, 12 mph site) power wind generator systems to be integrated into a standard electric utility is discussed. Analyses leading to the selection of the rotor and tower design are outlined. The 1000 kW system selected for further development utilizes an all composite rotor blade design and a steel shell tower. The projected energy cost is 3.5 cents/kW hr. Results of optimization of the rated power, site wind speed, and rated wind speed parameters are summarized. C.K.D.

A76-10148 * # Northeast Utilities' participation in the Kaman/NASA wind power program. M. Lotker (Northeast Utilities, Hartford, Conn.). *Energy Research and Development Administration and National Science Foundation, Wind Energy Conversion Systems Workshop, Washington, D.C., June 9-11, 1975, Paper*. 9 p. Contract No. NAS3-19404.

The role of Northeast Utilities in the Kaman/NASA large wind generator study is reviewed. The participation falls into four principal areas: (1) technical assistance; (2) economic analysis; (3) applications; and (4) institutional and legal. A model for the economic viability of wind power is presented. B.J.

A76-10257 # Economic benefits of engine technology to commercial airline operators. J. R. Morello (General Electric Co., Cincinnati, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1205*. 10 p.

New technology commercial turbofan engines, characterized by high bypass ratios, entered airline service in 1970. Their productivity is considerably better which results in the high-bypass powered aircraft being superior to earlier aircraft in terms of available seat miles/operating dollars. Further, engine testing technology has advanced such that the number of new problems discovered in service can be significantly reduced thereby cutting maintenance costs. This paper discusses the productivity advantages of high-bypass engines, and the testing concepts used by General Electric in development of the CF6 engine family that has led to improvements in initial reliability and maturity compared to low-bypass engines. (Author)

A76-10259 * # An early glimpse at long-term subsonic commercial turbofan technology requirements. D. E. Gray (United Technologies Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) and J. F. Dugan (NASA, Lewis Research Center, Cleveland,

Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1207*. 7 p. Contract No. NAS3-19132.

This paper reports on the exploratory investigation and initial findings of the study of future turbofan concepts to conserve fuel. To date, these studies have indicated a potential reduction in cruise thrust specific fuel consumption in 1990 turbofans of approximately 15% relative to present day new engines through advances in internal aerodynamics, structure-mechanics, and materials. Advanced materials also offer the potential for fuel savings through engine weight reduction. Further studies are required to balance fuel consumption reduction with sound airlines operational economics. (Author)

A76-10390 # The airlines' prospect after the 1974 energy crisis. P. A. Biemond (KLM - Royal Dutch Airlines, Amsterdam, Netherlands). In: *International air transportation; Proceedings of the Conference, San Francisco, Calif., March 24-26, 1975*.

San Francisco, American Society of Civil Engineers, 1975, p. 3-17.

Views and facts are presented on the predicted impact of the 1974 fuel crisis on airline business prospects. Attention is called to (1) the posted airport prices, which are often wrongly taken for true price indicators, (2) the into-plane distribution concessions, which prevent the buying of spot sales, (3) the need for more viable spot and forward markets, and (4) the need for more openness in pricing, free access to the market from all sides, and a better organized forward price coverage system. P.T.H.

A76-10391 # The 1974 energy crisis - A perspective - The effect on commercial aircraft design. J. E. Steiner (Boeing Commercial Airplane Co., Renton, Wash.). In: *International air transportation; Proceedings of the Conference, San Francisco, Calif., March 24-26, 1975*. San Francisco, American Society of Civil Engineers, 1975, p. 19-31.

The paper identifies some aspects of aircraft design which have been and will be strongly affected by the design criterion of minimum fuel usage necessitated by the increased fuel costs in airline operation. Nonfan aircraft have either been retired or refurbished. Reduction of cruise speed yielded much greater savings on fuel than the increase in such items as crew pay account. Rescheduling was done to achieve higher load factors. Development of simple refan and high-bypass engines is necessary, but will also entail redesign of airfoil and airframe for optimal performance. Higher aspect ratio wing and cruise speed optimization will provide lower trip fuel, reduced engine size, and increased fuel volume. More accurate flying will result in fuel savings, which will hinge on automation in ATC and advanced navigation capability in aircraft. P.T.H.

A76-10392 # The effect of the energy crisis on economic regulation of the air transport industry. R. D. Timm (Civil Aeronautics Board, Washington, D.C.). In: *International air transportation; Proceedings of the Conference, San Francisco, Calif., March 24-26, 1975*. San Francisco, American Society of Civil Engineers, 1975, p. 33-37.

The paper discusses some of the responses of the Civil Aeronautics Board when several major U.S. carriers were faced with severe financial problems as a result of higher debt, higher interest rates, inflation costs, and the energy crisis. Three policies are

significant: (1) the Board held route authority expansion, particularly competitive expansion, to a minimum by not setting new cases in light of other matters requiring the Board's urgent attention; (2) the Board established standards for adjusting rates to costs in the Domestic Passenger Fare Investigation; and (3) the Board began to monitor poor performance and encourage service improvements.

P.T.H.

A76-10695 Magnetohydrodynamic converters of a new type (Convertisseurs magnétohydrodynamiques d'un genre nouveau). J.-P. Petit (Marseille, Observatoire, Marseille, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques*, vol. 281, no. 11, Sept. 15, 1975, p. 157-160. In French.

Some new design schemes for MHD generators with elliptic or hyperbolic configurations are examined. An MHD compressor whose walls form a two-sheeted hyperboloid could possibly serve as the basis for a laser fusion experiment. An accelerator with insulating wall in the shape of a hyperboloid with one sheet creates Lorentz forces tending to force MHD fluid through its neck, suggesting application in increasing the specific impulse of a jet engine. An MHD pump is formed by an elliptic accelerator whose insulating surface is a flattened ellipsoid. A possible experiment is described in which the Lorentz forces would reaccelerate fluid downstream of a shock, thereby attenuating and eliminating the shock.

P.T.H.

A76-10766 # Some results of full-scale tests of solar thermoelectric generators /STEG/ and method for calculating their efficiency (Nekotorye rezul'taty naturnykh ispytaniy i metodika rascheta proizvoditel'nosti solnechnykh termoelektrogeneratorov /STEG/). S. Khandovletov, Ch. Agabaev, Iu. N. Malevskii, and O. Annaev (Akademiia Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenkoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 4, 1975, p. 11-16. In Russian.

In a full-scale test of a solar thermoelectric generator used for raising water, insufficient optical quality of the concentrator led to nonuniform heating of the various sections of the generator and, consequently, to decreased power output. Calculations showed that uniform heating would lead to output satisfying practical requirements. Formulas are given for characterizing generator and water pump efficiency. Tables are presented showing electric energy output and water-raising efficiency of 7 water-raising facilities powered by a 1-kW solar thermoelectric generator.

P.T.H.

A76-10842 # Thrust in aircraft powerplants (Der Schub bei Luftfahrzeugantrieben). V. V. Shashkin (Akademiia Tsivilnoi Aviatsii, Leningrad, USSR) and E. Schesky (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 11, no. 4, 1975, p. 213-218. In German.

The basic characteristics of the Otto cycle and the Joule cycle, as they are realized in aircraft piston engines and gas turbine engines, are analyzed. Energy and thrust conversion in both cycles is considered from a unified viewpoint. Special attention is given to magnitude of thrust in relation to the internal power yield and the dependence of thrust on flight speed. The influence of mean effective working pressure in piston engines and of specific work and the bypass ratio in gas turbine engines is closely examined.

P.T.H.

A76-11185 Effect of cover plate treatment on efficiency of solar collectors. R. D. Goodman and A. G. Menke (Libbey-Owens-Ford Co., Toledo, Ohio). (*International Solar Energy Society, Annual Meeting, Colorado State University, Fort Collins, Colo., Aug. 21-23, 1974.*) *Solar Energy*, vol. 17, Sept. 1975, p. 207-211. 5 refs.

Various techniques for the varying of cover plates, including coating, de-reflecting, changing iron content and evacuating, are presented and the effect of such treatment on solar collector efficiency is discussed. The use of tin oxide as a radiation shield, of low-iron and dereflected soda lime glass and of an evacuated single cover plate with a selective black absorber are some of the techniques employed. It is shown that collector plates with tin oxide coated

glass and low iron glass attain higher equilibrium temperatures are more efficient.

L.S.S.

A76-11186 Update on the solar power system and component research program. F. A. Blake (Martin Marietta Aerospace, Denver, Colo.) and J. D. Walton (Georgia Institute of Technology, Atlanta, Ga.). (*International Solar Energy Society, Annual Meeting, Colorado State University, Fort Collins, Colo., Aug. 21-23, 1974.*) *Solar Energy*, vol. 17, Sept. 1975, p. 213-219. 7 refs. NSF Grant No. GI-41305.

Preliminary design features of the 'point design' 100 MWe central receiver/optical transmission solar energy conversion power system are described. Optimization of the concentrating heliostat and of factors contributing to overall thermal collection efficiency is discussed. Eight solar energy concentration/conversion fields containing 1840 mirrors each will supply the required 1250 psi, 510 C superheated steam for turbine operation. A program of component testing for a 200 kWe bench model boiler/superheater and the associated turbine generator, to be carried out in Southern France is outlined. Results of a user application analysis evaluating the potential contribution of the plant to a southwestern utility on the basis of 1973 local demand and solar weather patterns are presented.

C.K.D.

A76-11188 * Solar-assisted gas-energy water-heating feasibility for apartments. E. S. Davis (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). (*International Solar Energy Society, Annual Meeting, Colorado State University, Fort Collins, Colo., Aug. 21-23, 1974.*) *Solar Energy*, vol. 17, Sept. 1975, p. 237-243.

Studies of residential energy use, solar-energy technology for buildings, and the requirements for implementing technology in the housing industry led to a project to develop a solar water heater for apartments. A design study for a specific apartment was used to establish a solar water-heater cost model which is based on plumbing contractor bids and manufacturer estimates. The cost model was used to size the system to minimize the annualized cost of hot water. The annualized cost of solar-assisted gas-energy water heating is found to be less expensive than electric water heating but more expensive than gas water heating. The feasibility of a natural gas utility supplying the auxiliary fuel is evaluated. It is estimated that gas-utilizing companies will find it profitable to offer solar water heating as part of a total energy service option or on a lease basis when the price of new base-load supplies of natural gas reaches \$2.50-\$3.00 per million Btu.

(Author)

A76-11189 A methodology for selecting optimal components for solar thermal energy systems - Application to power generation. W. S. Duff (Colorado State University, Fort Collins, Colo.). (*International Solar Energy Society, Annual Meeting, Colorado State University, Fort Collins, Colo., Aug. 21-23, 1974.*) *Solar Energy*, vol. 17, Sept. 1975, p. 245-254. 12 refs.

A methodology is presented for determining the minimum-cost design for a solar thermal energy system. This approach builds up the minimum-cost system by adding one subsystem at a time until the desired system has been synthesized. At each step in the optimization procedure the intermediate system could be applied to an appropriate end use to find the minimum-cost design for that system. For example, a minimum-cost solar furnace could be designed. This systems optimization approach has two principal advantages over approaches that have traditionally been used for solar thermal energy systems. First, a vastly greater number of designs can be considered, and second, simplification of cost and performance models is not required. Cost and performance models may be in any form including tables or equations that must be solved implicitly. An example of the systems optimization of the concentrator and absorber-heat exchanger subsystems is included, and the application of this approach to power generation is discussed.

(Author)

A76-11190 Principles of cylindrical concentrators for solar energy. R. Winston (Chicago, University, Chicago; Argonne National Laboratory, Argonne, Ill.) and H. Hinterberger (ERDA, Fermi National Accelerator Laboratory, Batavia, Ill.). *Solar Energy*, vol. 17, Sept. 1975, p. 255-258. 6 refs. AEC-supported research.

Ideal cylindrical light collectors are trough-like reflecting wall light channels of a specific shape which concentrate radiant energy by the maximum amount allowed by phase space conservation. We propose a principle for maximally concentrating radiation onto a tube receiver of general shape. Employing this principle, we give a general prescription for designing concentrators appropriate to such tube receivers. This design may have advantages for solar-thermal and photovoltaic applications. (Author)

A76-11281 # Temperature control for solar heating and cooling of buildings. C. B. Winn (Colorado State University, Fort Collins, Colo.) and D. Hull. *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialist Conference, Nassau, Bahamas, July 28-30, 1975, AAS Paper 75-105*. 36 p. NSF Grant No. 75-03578.

The Energy Research and Development Administration has recently called for the development of control systems that allow the user to regulate the amount of solar and auxiliary supplied energy in the thermal control of buildings, the development of control systems that respond to variations in the use patterns of buildings on seasonal, daily, hourly and instantaneous bases, and the development of controls based on algorithms that minimize the total use of energy in heating and cooling buildings. This paper addresses each of these problem areas. First, a discussion of a control system presently being employed in existing solar energy buildings is presented. This controller is then discussed in terms of the above mentioned problem areas. Next, several heuristic control strategies are considered and examined in terms of their performance. Finally, a discussion of optimal control strategies is presented and compared with the controllers previously examined. (Author)

A76-11338 # Application of optimization techniques to solar heating and cooling. L. B. Anderson and H. E. Rauch (Lockheed Research Laboratories, Palo Alto, Calif.). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialist Conference, Nassau, Bahamas, July 28-30, 1975, AAS Paper 75-108*. 35 p.

This paper shows how optimization techniques can be applied to the operation of a solar driven heating and cooling system and outlines practical problems encountered in the design. In the optimization problem the loss function includes not only the cost of heating and cooling but also the equivalent cost of discomfort involved when the temperature is not held at its desired value. The discomfort is assumed to be a quadratic function of temperature. An interesting feature of the resulting optimization problem is a region of singular control because the Hamiltonian is linear in the heating and cooling variable. An optimal control strategy is derived and numerical examples are presented to show the desired building temperatures throughout the day which minimize the sum of energy consumption and the discomfort factor. (Author)

A76-11358 # Investigation of the mechanical characteristics of a dc motor with power supply from a solar thermoelectrogenerator with commensurable power (Issledovanie mekhanicheskikh kharakteristik dvigatelei postoiannogo toka pri pitanii ot solnechnogo termoelektrogeneratora /STEG/ soizmerimoi moshchnosti). Ch. Agabaev, O. Annaev, Iu. N. Malevskii, and S. Khandovletov (Akademiia Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmensoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 3, 1975, p. 13-17. In Russian.

A76-11676 Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings (L'esplorazione spaziale: La

conversione e lo sfruttamento dell'energia solare; Convegno Internazionale sullo Spazio, 15th, Rome, Italy, March 17-19, 1975, Atti). Conference sponsored by the Ministero degli Affari Esteri and Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975. 460 p. In Italian, English, German, and French.

Papers are presented describing orbital and spaceflight mechanics, remote sensing studies of earth resources and geological features, the development of the European Spacelab, and efforts in the harnessing and exploitation of solar energy. Some of the topics covered include comparison of methods for determining trajectories of interplanetary space probes, thermal control of the European Space Laboratory, remote measurements of the thermal pollution of a river, solar house system interfaced with a power utility grid, and the satellite solar power station as a new frontier for space technology.

P.T.H.

A76-11693 # A national and European program for the exploitation of solar energy (Un programma nazionale ed europeo per lo sfruttamento dell'energia solare). G. Cortellessa (Gabinetto del Ministro per il Coordinamento della Ricerca Scientifica e Tecnologica, Rome, Italy). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 317, 319-325. In Italian.

Some of the chief applications of solar energy are discussed, including low-temperature solar energy, high-temperature solar energy, conversion to chemical energy, and conversion to electrical energy. These are discussed in terms of Italian projects and also with a view to European cooperation. (Author)

P.T.H.

A76-11694 # Man's energy problems - Outlook for intense exploitation of solar energy (Problemi energetici dell'umanita - Prospettive di sfruttamento intensivo dell'energia solare). P. L. Finocchi (Compagnia Industriale Aerospaziale S.p.A., Rome, Italy). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 327, 329-337. In Italian.

The paper examines the potential of large-scale development of solar energy resources, and gives a general description of four main technologies for exploiting solar energy: (1) direct utilization in thermal form, (2) indirect utilization by using thermo-generator equipment for converting solar energy into electrical energy, (3) direct conversion into electricity, (4) indirect utilization by transforming (pyrolysis) of refuse material. The state of research in these fields is reviewed. (Author)

P.T.H.

A76-11695 # The physical principles of the solar cell - An introduction. P. T. Landsberg (Southampton, University, Southampton, England). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 339, 341-358. 20 refs.

This paper gives an elementary but in some ways novel introduction to the theoretical physical principles underlying solar cell operation. By simple concepts and mathematics this is achieved by first explaining the operation of p-n junctions and then focusing attention on ideas such as lifetimes, load matching and efficiencies. (Author)

(Author)

A76-11696 # Nonconventional energy sources, resources, environment, prospects in the use of solar energy (Fonti non convenzionali di energia, risorse, ambiente prospettive dell'uso dell'energia solare). G. Nebbia (Universita Internazionale Studi Sociali, Rome; Bari, Universita, Bari, Italy). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceed-

ings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 359, 361-372. 38 refs. In Italian.

The paper examines some potential ways of using solar energy and describes some schemes for exploiting low-temperature solar energy, high-temperature solar energy, and conversion of solar energy into chemical or electrical energy. The state of research in these fields is reviewed. Attention is given to solar stills, solar ponds, and solar cells. Some areas of needed research are indicated, such as data on available solar radiation intensity in various geographical areas.

P.T.H.

A76-11698 # Solar energy and the future (L'énergie solaire et l'avenir). M. Perrot (Alger, Université, Alger, Algeria; Marseille, Université, Marseille, France; Coopération Méditerranéenne pour l'Energie Solaire) and M. Touchais. In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 381, 383-392. In French.

Systems for the conversion of solar energy to heat, electricity, and chemical energy are reviewed, and experimental programs involving solar energy are described. The relative advantages and disadvantages of solar and nuclear energy are discussed, with special emphasis on their complementary roles in meeting future energy needs. It is concluded that although nuclear power will supply the largest share of the total energy supply in the future, solar energy may play a significant part in small-scale energy production where simplicity of design and operation and ready availability of the power source are major advantages.

C.K.D.

A76-11699 * # Solar house system interfaced with the power utility grid. K. W. Böer (Delaware, University, Newark, Del.). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 395, 397-407. 14 refs. NSF-Navy-NASA-supported research.

Photovoltaic cells may be used to convert sunlight directly into electrical energy and into low-grade heat to be used for large scale terrestrial solar energy conversion. Both forms of energy can be utilized if such cells are deployed in close proximity to the consumer (rooftop). CdS/Cu₂S solar cells are an example of cells which may be produced inexpensively enough to become economically attractive. Cell parameters relevant for combined solar conversion are presented. Critical issues, such as production yield, life expectancy, stability of performance, are discussed. Systems design parameters related to operating temperatures are analyzed. First results obtained on Solar One, the experimental solar house of the University of Delaware, are given. Economic aspects are discussed.

(Author)

A76-11700 # The solar cell today - A report on recent improvements. J. Allison (COMSAT Laboratories, Clarksburg, Md.). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 409, 411-422. 16 refs. Research sponsored by the Communications Satellite Corp.

The development of the Violet and Nonreflective cells, representing 30 and 50% improvements, respectively, over the efficiency of conventional solar cells, is discussed, and performance data for both cells are presented. The 30% improvement over state-of-the-art attained in the Violet cell is the result of enhancement of the blue-violet response by a reduction of the junction depth (to 120 nm) and changes in grid geometry, and of incorporation of an antireflection coating with improved refraction and absorption characteristics. Violet cell technology combined with a chemical etching technique producing a tetrahedral nonreflecting surface resulted in the Nonreflective cell. The maximum power output is 74 mW for the Violet cell and 85 mW for the Nonreflective cell,

corresponding to efficiencies of 13 and 15%. The performance of both cells was not susceptible to penetrating damaging space radiation. Results obtained during qualification testing of the Violet cell aboard three spacecraft indicate that the solar spectrum may contain more ultraviolet radiation than has been previously reported.

C.K.D.

A76-11701 # A solar energy power supply for terrestrial use (Impianto di alimentazione ad energia solare per uso terrestre). S. Roccucci (Selenia S.p.A., Rome, Italy). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 427, 429-436. In Italian.

The most interesting problems, encountered in the study of a solar cell power generator, are presented. The principal parameters to be taken into account for a correct design are outlined. Design criteria are given which allow the user requirements to be satisfied with a good compromise in terms of cost and performance. Experimental data, collected during one year of service of a small-scale generator, used in a lighthouse, are reported.

(Author)

A76-11702 # The Satellite Solar Power Station - A new frontier to space technology. K. R. Schreitmoller (Deutsche Forschung- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Energieforschung, Stuttgart, West Germany). In: Space exploration: Conversion and exploitation of solar energy; International Conference on Space, 15th, Rome, Italy, March 17-19, 1975, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1975, p. 437, 439-446. 7 refs.

Data on efficiencies which have been demonstrated for microwave power transmission systems suitable for use with a Satellite Solar Power Station are presented, and the technical difficulties confronting the development of such a station are briefly discussed. The most significant economic obstacles appear to be the costs of transportation and the energy converter; however, power costs should be brought below 100 DM/kW within the next 10-15 years for systems using photovoltaic, thermodynamic, and thermionic converters.

C.K.D.

A76-11846 The technological requirements for power by fusion. D. Steiner (Oak Ridge National Laboratory, Oak Ridge, Tenn.). (Nuclear Science and Engineering, Oct. 1975.) IEEE, Proceedings, vol. 63, Nov. 1975, p. 1568-1608. 158 refs. ERDA-supported research.

The major technological requirements for fusion power, as implied by current conceptual designs of fusion power plants, are elucidated and assessed. As the point of departure, the four fusion reactor concepts which have been most thoroughly considered in these design studies are described; they are the mirror, the theta-pinch, the Tokamak, and the laser-pellet concepts. The required technology is discussed relative to three principal areas of concern: (1) the power balance, that is, the unique power-handling requirements associated with the production of electrical power by fusion; (2) reactor design, focusing primarily on the requirements imposed by tritium-based fuel cycle, thermal-hydraulic considerations, and magnet systems; and (3) materials considerations, including surface erosion, radiation effects, materials compatibility, and neutron-induced activation. The major conclusions are summarized in a final section where it is noted that research and development programs have been initiated to satisfy the technological requirements associated with the realization of commercial fusion power.

(Author)

A76-11867 # A new dimensionless factor characterizing the degree of energy utilization in transport vehicles (Su un nuovo fattore adimensionale del grado di utilizzazione dell'energia nei veicoli da trasporto). G. Gabrielli (Torino, Politecnico, Turin, Italy). Rheinisch-Westfälische Technische Hochschule, Aerodynamisches Institut, Abhandlungen, no. 22, 1975, p. 116-120. In Italian.

A dimensionless parameter (f), expressed as the ratio of the product of payload times distance covered to energy consumed in mechanical units, is proposed as a factor for characterizing the degree of energy utilization by an arbitrary type of transport vehicle. Some values of f are calculated for some typical vehicles and discussed in terms of the characteristics of the vehicles themselves. Values of f for certain movements of the human body and for some vehicles driven by human muscle power are given. P.T.H.

A76-12159 **Airline profit pinch clouds harvest of gains.** W. H. Gregory. *Aviation Week and Space Technology*, vol. 103, Nov. 10, 1975, p. 32-34, 39, 41.

It is pointed out that enough new technology is at hand or clearly on the horizon to build a more economic, lower fuel consumption commercial transport. However, because of economic factors partly related to inflation it is uncertain whether and when such a transport will be developed. It is found that airlines and transport aircraft manufacturers are more sensitive to violent inflation than other industries. Attention is given to new technological developments and the prospects for the incorporation of these developments in the next-generation aircraft. G.R.

A76-12293 **Some comments on the evaluation of electrical parameters of a solar cell.** B. S. Murthy, P. Tiku, and N. K. Sharma (Indian Institute of Technology, Delhi, India). *Institution of Electronics and Telecommunication Engineers, Journal*, vol. 21, July 1975, p. 359-363. 5 refs.

Results of an evaluation of solar cells are presented. The parameters considered are: short-circuit current, open-circuit voltage, series resistance, forward-diode characteristic 'n' value, junction reverse current, and junction width. The advantage of this evaluation procedure over the method used by Mandelkorn et al. (1962) is pointed out. (Author)

A76-12382 **The potential of driven Tokamaks as thermonuclear reactors.** R. W. Conn and J. Kesner (Wisconsin, University, Madison, Wis.). *Nuclear Fusion*, vol. 15, Oct. 1975, p. 775-783. 30 refs. Research supported by the Wisconsin Electric Utilities Research Foundation and AEC.

The paper examines unignited or externally driven Tokamak plasmas for use in economic fusion reactors over range of machine sizes where the plasma amplification factor Q exceeds 15. Large driven Tokamaks are shown to achieve the highest Q value by operating with a 50-50 D-T plasma using the minimum amount of power to maintain the plasma in energy equilibrium, while for smaller Tokamaks the optimum Q is obtained by injecting deuterium neutral beams onto a pure tritium plasma and operating the device in two-energy-component mode. The potential benefits of low-Z liners in Tokamaks are also studied. B.J.

A76-12391 **Hierarchical systematics of fusion-fission energy systems.** A. A. Harms (McMaster University, Hamilton, Ontario, Canada). *Nuclear Fusion*, vol. 15, Oct. 1975, p. 939-944. 11 refs. Research supported by the National Research Council of Canada.

The basis for hybrid fusion-fission systems rests on the fact that D-T fusion reactions possess a greater neutron excess, while fission has a larger energy yield. The paper establishes a hierarchical framework for studying such fusion-fission systems on the basis of gross reactor physics parameters with emphasis on isotopic fuel dynamics, operational criteria, and fusion reactor power yield. A numerical example describing the fusion-breeder/fission-burner system is included. B.J.

A76-12392 **Steady-state thermonuclear power generation in a two-energy-component Astron device.** K. R. Chu (Science Applications, Inc., McLean, Va.) and C. A. Kapetanakis (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *Nuclear Fusion*, vol. 15, Oct. 1975, p. 947-951. 28 refs.

The paper describes a steady-state two-component Astron device with a tritium plasma confined in a field-reversing deuterium ion layer. Thermonuclear power is generated from the optimized layer-plasma fusion reactions. The system is maintained at steady state by the injection of neutral deuterium beams which penetrate freely through the vacuum magnetic field and, upon ionization in the plasma region, become an ion current due to the finite-ion-gyroradius effect. The power balance and power gain of the system are calculated. B.J.

A76-12626 **Prospects for the development of nuclear energy (Perspektivi na razvitiето na iadrenata energetika).** I. N. Pandev, Kh. D. Khristov, G. I. Stefanov, and V. I. Khristov (B'lgarska Akademiia na Naukite, Institut za Iadreni Izsledvaniia i Iadrena Energetika, Sofia, Bulgaria). *Iadrena Energiia*, no. 1, 1975, p. 10-21. 7 refs. In Bulgarian.

The paper examines predictions for the future needs for nuclear energy and the growth of nuclear facilities to meet these needs throughout the world, with emphasis on the situation in Bulgaria. The gradual replacement of thermal neutron reactors by fast breeder reactors by 1990 is envisaged. The capacity and efficiency of 5 types of power stations in Bulgaria are examined. P.T.H.

A76-12789 **Lightweight fuel cell powerplant for Tug.** L. M. Handley (United Technologies Corp., South Windsor, Conn.). *AAS, AIAA, IEEE, ORSA, and IMS, Meeting on Space Shuttle Missions of the 80's, Denver, Colo., Aug. 26-28, 1975, AAS Paper 75-143*. 14 p. 8 refs. Contracts No. NAS3-15339; No. NAS8-30637; No. NAS9-11034; No. F33615-72-C-1371.

The design and characteristics of a lightweight powerplant based on advanced cell technology to meet the requirements of the Space Tug are described. The powerplant can be operated off low-pressure hydrogen and oxygen rocket propellant tanks and avoid the need for a dedicated reactant supply. Product water can be condensed or not, depending on vehicle or payload requirements. The heart of the unit, the fuel cell power section, consist of lightweight, series-connected, alkaline cells, while the power section contains accessory components for reactant conditioning, distribution, and venting, coolant circulation, passive product water removal and electric control. The proposed design offers at least a 50 per cent saving in powerplant weight, so that the total estimated powerplant dry weight including structure, tubing, wiring, interface connectors, and interface heat exchanger is 48 lb. S.D.

A76-12840 **The satellite solar power station - A focus for future Space Shuttle missions.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *AAS, AIAA, IEEE, ORSA, and IMS, Meeting on Space Shuttle Missions of the 80's, Denver, Colo., Aug. 26-28, 1975, AAS Paper 75-281*. 27 p. 8 refs.

The option for using satellite solar power stations for large-scale power generation on earth, collecting and converting solar energy into microwave energy, transmitting it to the earth's surface, and transforming it into electricity, is reviewed. The current state of the technology and the necessary developments for accomplishing these functions are discussed, and the results of recent microwave transmission and rectification demonstration tests are mentioned. The requirements for earth-to-orbit transportation are presented. Considerations are given to cost projections, resource use and economic comparisons. Environmental issues, including impact of waste heat release, space vehicle exhaust, noise pollution and location of antenna sites are listed. Biological effects and radio frequency interference are explored. The time frame for accomplishing the operational system is outlined. (Author)

A76-12841 **A methodology for assessing reliability of coal conversion plants.** W. T. Long (Kaman Sciences Corp., Colorado Springs, Colo.). *AAS, AIAA, IEEE, ORSA, and IMS, Meeting on Space Shuttle Missions of the 80's, Denver, Colo., Aug. 26-28, 1975, AAS Paper 75-293*. 10 p.

A76-12842 # Nuclear power in the Shuttle era. S. R. Ross (Public Service Company of Colorado, Colo.). *AAS, AIAA, IEEE, ORSA, and IMS, Meeting on Space Shuttle Missions of the 80's, Denver, Colo., Aug. 26-28, 1975, AAS Paper 75-283*. 17 p.

Nuclear power is expected to represent about 25% of electric capacity in the United States by 1985. Light water reactors will be the predominant type installed in the country by that time. The High Temperature Gas-cooled Reactor (HTGR) is expected to assume a significant role in nuclear power production by the latter part of the 1980's. The nuclear generating station described in this paper is the first commercial nuclear plant with an HTGR. The thermal light water reactors and HTGR's are expected to be supplemented by fast breeder reactors in the future. (Author)

A76-13073 Rotors in reverse. D. Videan. *Shell Aviation News*, no. 431, 1975, p. 12-15.

Helicopter rotor blade technology is utilized in the design of a wind-actuated power generating unit. Available components are used in the secondary assemblies of the system, and new compact heat storage technology is exploited. Rotor design and transmission system design are detailed, and rotor design features are compared to some traditional windmill sail design features. A fully automatic maintenance-free low-cost system is offered for domestic space heating and direct heat conversion. R.D.V.

A76-13084 Laser plasmas and nuclear energy. H. Hora (New South Wales, University, Kensington, Australia; Rensselaer Polytechnic Institute of Connecticut, Inc., Hartford, Conn.). New York, Plenum Press, 1975. 464 p. 243 refs. \$29.50.

A survey on the laser, its mechanism, properties, and present status is presented and some important early experiments on plasma production by lasers are described. The microscopic properties of plasma are considered along with aspects of macroscopic plasma physics, questions concerning the refractive index and absorption, and details regarding dielectric nonlinear forces and dynamic absorption. The theory of laser-induced nuclear fusion is discussed, taking into account inertial confinement, gas-dynamic compression, direct and more efficient transfer of laser energy into mechanical compression, and a number of new concepts. A description of experiments for laser-induced nuclear fusion is also provided. G.R.

A76-13139 Thermal nuclear powerstations (Les centrales thermonucléaires). G. Parreins (Commissariat à l'Energie Atomique, Paris, France). *La Météorologie*, Sept. 1975, p. 70-78. In French.

The paper gives a qualitative description of the processes in a nuclear power station in which the thermal power for producing steam is provided by the fission reaction of a U-235-U-238 mixture initiated by neutron bombardment. The concept of moderation with graphite is discussed. The needs and production of enriched uranium in the next decade are studied. P.T.H.

A76-13141 Electrostatic wind energy conversion (Conversion éolienne électrostatique). P. Ricateau (Commissariat à l'Energie Atomique, Département des Programmes, Paris, France) and P. Zettwoog (Commissariat à l'Energie Atomique, Département de Protection, Fontenay-aux-Roses, Hauts-de-Seine, France). *La Météorologie*, Sept. 1975, p. 123-130. In French.

A theoretical analysis is given which studies the feasibility of converting wind energy into electricity in a device that would in effect constitute a Van de Graaf accelerator in which the gas flow provided by the wind plays the role of the belt. The wind transports ions created by a source upstream to a collection grid downstream, where the work done by the wind in moving the charges through the opposing space charge field is stored in electric form by an external circuit. A scheme for calculating energy yield is set forth. P.T.H.

A76-13386 Expenditure of energy in the free forging of reinforced metal composites. D. M. Karpinos, L. I. Tuchinskii, L. R. Vishniakov, and V. Ia. Fefer (Akademiia Nauk Ukrainskoi SSR, Institut Problem Materialovedeniia, Kiev, Ukrainian SSR). (*Poroshkovaia Metallurgii*, June 1975, p. 20-26.) *Soviet Powder*

Metallurgy and Metal Ceramics, vol. 14, no. 6, Nov. 1974. 447-452. 9 refs. Translation.

Results of an experimental study are presented on energy consumption in producing unidirectional reinforced materials in the systems KhN60V-tungsten wire and titanium (VTI-O)-molybdenum wire. The dependence of compaction work on fiber packing pitch and matrix layer thickness is determined. It is shown that energy expenditure can be satisfactorily described by the analytical expression proposed previously by the authors (1974). The discrepancy between theoretical and experimental results does not exceed 20-30%. Less upsetting is required for adhesion between the matrix layers of the reinforced material than in the case of adhesion between the layers of a non-reinforced laminated material. The mechanism accounting for lesser amount of upsetting in the reinforced materials is identified. S.D.

A76-13413 Advances in the development of flame-heated thermionic converters (Fortschritte in der Entwicklung flammbeheizter thermionischer Energiewandler). R. Henne (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Energiewandlung und elektrische Antriebe, Stuttgart, West Germany). *DFVLR-Nachrichten*, Nov. 1975, p. 708, 709. In German.

Attention is given to the development of small units of flame-heated generators as a basis for the study of the functional characteristics of such devices. Technical models of the thermionic converter which will provide the results obtained previously with expensive laboratory versions of the device are to be constructed. The difficulties inherent in the construction of such models are considered along with the approaches used to overcome the difficulties. G.R.

A76-13541 Fusion reactors. B. B. Kadomtsev (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR) and T. K. Fowler (California, University, Livermore, Calif.). *Physics Today*, vol. 28, Nov. 1975, p. 36-41, 43.

USSR physics institutes and their research projects based on Tokamak and stellarator toroidal machines and open-ended mirror machines are discussed together with exploratory work on pulsed fusion reactors, laser-induced fusion, and hybrid fusion-fission systems. Plasma heating, plasma generation and confinement, and instabilities are studied, as well as ion cyclotron resonance heating, microinstabilities, and production, injection, and use of neutral beams. Problems overcome in the recent past and current problems in research are mentioned. Related technologies development (cryogenics and superconductivity; damage to materials; neutron activation, shielding, and transport studies; direct energy conversion) are also mentioned. About half the Soviet research is being concentrated on Tokamak work. R.D.V.

A76-13675 # Economic viability of large wind generator rotors. G. Rosen, H. E. Deabler, and D. G. Hall (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Intersociety Energy Conversion Engineering Conference, 10th, University of Delaware, Newark, Del., Aug. 17-22, 1975, Paper. 7 p.* 12 refs.

Earlier attempts at large scale conversion of wind energy to electricity proved abortive because of excessive capital cost, particularly that of the air turbine. Current reassessment studies based on the modern aerospace technologies in aerodynamics, structural dynamics, materials, and fabrication processes have shown the way to reduce air turbine production costs by factors of 2 to 4. When integrated into the total wind energy conversion system (WECS) comparable overall cost reductions are indicated. This magnitude of cost reduction coupled with current high fuel costs now appears to make the large WECS cost competitive with today's conventional power plants. Continuing WECS technology refinements when reflected against projected increasing fuel cost trends should further enhance the WECS economic advantage. Thus, it is recommended that the electric power industry study the potential use of WECS as a substantial source of future energy generation. (Aut)

A76-13901 **Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Oklahoma State University, Stillwater, Okla., October 1, 2, 1975.** Conference sponsored by the Oklahoma State University. Stillwater, Oklahoma State University, 1975. 342 p. \$10.00.

Papers are presented that investigate new concepts in electric generation and energy storage, fuel resources technology, waste management methods and costs, and nuclear energy conversion. Some of the topics covered include progress with coal slurry pipelines, sulfur oxide removal by wet scrubbing, treatment of liquid wastes in the power industry, assessment of the economic incentive for the fast breeder reactor, long term aspects of the uranium supply, photovoltaic energy conversion under high radiation intensities, and the implications of high efficiency power cycles for electric power generation.

P.T.H.

A76-13902 # **Treatment of liquid wastes in the power industry.** G. R. Mace (Ecodyne Corp.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975. Stillwater, Oklahoma State University, 1975, p.

7-1 to 7-13.

The paper describes some recent developments concerning procedures for treating point source liquid pollutants from oil or coal fired power stations such as metal cleaning wastes, bottom ash transport water, fly ash slurries, cooling tower and boiler blowdown, scrubber effluents, coal pile and floor drain runoff, and sanitary wastes. Selection of the most cost effective waste water treatment equipment to meet federal and local discharge codes is discussed.

P.T.H.

A76-13903 # **Design of fossil-fuel power plant by-product resource storage areas.** A. M. DiGioia, Jr. (GAI Consultants, Inc.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975. Stillwater, Oklahoma State University, 1975, p. 8-1 to 8-34. 10 refs.

The paper discusses some criteria to be considered in the design of storage sites and facilities for the by-product resources of power plants such as fly ash, bottom ash, boiler slag, and SO₂ sludge. Site selection and design should be approached from the point of view of minimizing environmental impact, considering the storage site as a potentially valuable property. It is suggested that the development be designed in stages, and that the environment be inventoried at the same time as the technical investigation is made.

P.T.H.

A76-13904 # **Fuel cycle issues in perspective.** K. M. Broom, Jr. and S. H. Hobbs (Brown and Root, Inc., Houston, Tex.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975. Stillwater, Oklahoma State University, 1975, p. 11-1 to 11-17. 16 refs.

The paper reviews the chief elements of both the conventional, nonbreeding nuclear fuel cycle and the breeding fuel cycle, in which end-product plutonium is recycled, and then examines five key issues in the nuclear industry: (1) availability of fuel, (2) enrichment capacity, (3) reprocessing, (4) radioactive waste disposal, and (5) plutonium. Assuming that no new large unsuspected uranium resources are discovered and that plutonium recycle is not used, it is estimated that there are adequate, reasonably assured U308 reserves to go to nearly 1985 without the U308 cost exceeding \$15/lb, although the price trend is upward. The necessary legislation has not been acted on in Congress for allowing private industry to build and operate new enrichment facilities. No reprocessing plants are currently operating in the U.S., and even without favorable licensing decisions on increased storage facilities, nuclear plants will have to shut down because of inadequate reprocessing capacity. A rapid adoption of breeder reactor technology would greatly alleviate the fuel and energy shortage, but while few problems remain with respect to technology, roadblocks with regulation, licensing, and public understanding remain.

P.T.H.

A76-13905 # **Photovoltaic energy conversion under high radiation intensities.** J. R. Yeagan, D. L. Crook, and L. Forbes (Arkansas University, Fayetteville, Ark.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975.

Stillwater, Oklahoma State University, 1975, p. 13-1 to 13-17. 14 refs. Research supported by the University of Arkansas; NSF Grant No. GY-11234.

The paper reviews the operation of semiconductor photovoltaic devices and discusses design considerations for their operation under high intensity radiation. Some work on realizing high efficiency silicon photovoltaic cells for operating under radiation intensities as high as 10 watts per sq cm (100 suns) is described. The radiation is focused by inexpensive cylindrical Fresnel lenses made of acrylic plastic. The cylindrical configuration allows focusing to be achieved while tracking in only one plane. The application of this technique to both solar and thermophotovoltaic systems is discussed.

P.T.H.

A76-13906 # **An assessment of solar and wind energy from the electric utility view point.** R. Ramakumar and W. L. Hughes (Oklahoma State University, Stillwater, Okla.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975.

Stillwater, Oklahoma State University, 1975, p. 14-1 to 14-16. 30 refs. Research supported by the Oklahoma State University; NSF Grant No. AER-75-00647.

The paper discusses briefly the prospects of several technologies for supplementing energy resources in the coming decade, including wind energy, biomass, solar thermal conversion, ocean thermal gradient systems, and photovoltaic conversion, and then gives an assessment of solar and wind energy economics. Break-even capital cost limits for solar and wind energy systems have been calculated for different fuel costs, interest rates, and load factors. The necessity of the electric utility sector to look into such variable power sources as solar and wind is expressed.

P.T.H.

A76-13907 # **The implications of high efficiency power cycles for electric power generation.** J. R. Powell, F. J. Salzano, W.-S. Yu, and J. S. Milau (Brookhaven National Laboratory, Upton, N.Y.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975. Stillwater, Oklahoma State University, 1975, p. 16-1 to 16-48. 11 refs.

The paper proposes and analyzes a new kind of power conversion cycle - the HEP (High Efficiency Power) cycle - to be used for either central station or peaking generation. The HEP cycle is similar to a closed Brayton cycle, but instead of mechanically compressing the working gas, it is chemically absorbed in a metal hydride particulate bed and after saturation, the bed is heated to a higher temperature and the absorbed gas is desorbed at a higher pressure, the turbine inlet pressure. A low temperature heat input is required for this desorption. The bed is then cooled to ambient temperature and made ready for another cycle. The elimination of mechanical compressor work greatly increases the fraction of high temperature heat input converted to electricity. It is estimated that 90% of the high temperature heat can be converted to electricity. Low temperature solar or geothermal energy appear promising as sources for the low temperature heat input. Some experiment with metal hydride compressors are described, and project costs for the HEP cycle are discussed.

P.T.H.

A76-13908 # **A new concept in electric generation and energy storage.** C. F. Meyer and W. Hausz (GE TEMPO Center for Advanced Studies, Santa Barbara, Calif.). In: Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 1, 2, 1975. Stillwater, Oklahoma State University, 1975, p.

17-1 to 17-17. 24 refs.

The paper discusses technical and certain marketing and regulatory problems to be solved in order to realize multi-gigawatt total-energy systems, or integrated energy utilities. The concept of the heat storage well for storing large amounts of useful heat for 90 days or more at low cost with low loss is introduced. By this method,

heat would be stored in the form of hot water in a water well drilled into a confined aquifer. An argument is given for making more use of the topping cycle, that is, exploiting the heat energy produced but not used for work in electric power generation. The economics of heat transmission are discussed, and the efficiencies of an integrated energy utility, producing both electrical and heat energy, a conventional system, and an all-electric system are compared. Concepts of efficiency based on cheap and abundant fuel are now outmoded, although the technical feasibility of the heat storage well and integrated heat and electricity production requires further investigation. P.T.H.

A76-13909 # Electricity for twentieth century transportation. E. E. Ecklund (ERDA, Washington D.C.). In: *Energy - Environment - Engineering; Proceedings of the Eighth Annual Frontiers of Power Technology Conference*, Stillwater, Okla., October 1, 2, 1975. Stillwater, Oklahoma State University, 1975, p. 18-1 to 18-31. 23 refs.

The paper examines some alternatives to fossil fuels for powering vehicles that will have to be explored as petroleum resources of the U.S. become depleted towards the year 2000. Liquid synthetic fuels from nonpetroleum resources may not be available in sufficient quantities to replace petroleum. The benefits which accrue from conservation of and substitution for petroleum as an energy resource will be cumulative, stretching out the petroleum supply and buying time in the transition to alternative resources. Electric power is applicable to automotive and railroad use and can be made readily available assuming reasonable foresight as to needs. P.T.H.

A76-13996 * Space colonies and energy supply to the earth. G. K. O'Neill (Princeton University, Princeton, N.J.). *Science*, vol. 190, Dec. 5, 1975, p. 943-947. 22 refs. NASA-supported research.

It is pointed out that a space manufacturing facility may be economically more effective than alternative industries on the earth for the construction of products which are to be used in geosynchronous or higher orbits. The suggestion is made to construct solar power stations at a space colony and relocate them in geosynchronous orbit to supply energy to the earth. Attention is given to energy problems and approaches for solving them, taking into account environmental effects and economic factors. Economic aspects of space manufacturing are discussed in some detail. G.R.

A76-14016 An introduction to the theory of photovoltaic cells. P. T. Landsberg (Southampton University, Southampton, England). *Solid-State Electronics*, vol. 18, Dec. 1975, p. 1043-1052. 21 refs.

This paper seeks to furnish an elementary, but in some ways novel, introduction to the theoretical physical principles underlying solar cell operation. By simple concepts and mathematics this is achieved by first explaining the operation of p-n junctions and then focusing attention on ideas such as lifetimes, load matching and efficiencies. (Author)

A76-14022 Analysis of vertical multijunction solar cells using a distributed circuit model. P. Shah (Texas Instruments, Inc., Dallas, Tex.). *Solid-State Electronics*, vol. 18, Dec. 1975, p. 1099-1106. 7 refs.

This work describes an analysis of some of the vertical multijunction (VMJ) cell structures now being fabricated - especially the ones that combine the enhanced red response and radiation tolerance of the VMJ concept and blue response of conventional planar cells. A distributed equivalent circuit model is used for analysis of complicated junction configurations - which otherwise would be very cumbersome using conventional carrier transport equations. The VMJ cell structures were analyzed to study their device characteristics and their sensitivity to various material and fabrication parameters such as epitaxial layer resistivity and carrier lifetimes. The results show that the conversion efficiency is higher than conventional devices due to efficient carrier collection with a superior radiation tolerance. The cells, however, degrade more rapidly compared to planar cells at higher radiation levels determined by the structural parameters. (Author)

A76-14088 Comparison of solar heat exchange Lumsdaine (Tennessee, University, Knoxville, Tenn.). (*Intern Solar Energy Society, Meeting, Fort Collins, Colo., Aug. 1974*). *Solar Energy*, vol. 17, Nov. 1975, p. 269-275. 9 refs.

This paper summarizes and compares the theoretical heat transfer characteristics of solar heat exchangers. Comparisons are made with a number of heat exchanger targets used in solar energy applications. The efficiencies of flat-plate, circular flat-plate, cylindrical, cylindrical annulus, spherical annulus and elliptic cylindrical heat exchangers are presented for comparison. Simplified lumped analysis expressions are derived for these heat exchangers, and the results compare very well with the more complicated distributive analysis results over a range of Nusselt numbers frequently encountered in solar energy applications. The influence of thermal and velocity profiles is also discussed. From this study it appears that the annular geometry yields higher efficiencies especially at large Nusselt numbers. A secondary aim of this paper is to provide a summary of the heat transfer characteristics of heat exchangers with different geometries in sufficient detail that would allow a designer of solar energy equipment to quickly make calculations for a particular application. (Author)

A76-14089 Enhanced solar energy collection using reflector-solar thermal collector combinations. D. K. McDaniels, D. H. Lowndes, J. Reynolds, R. Gray (Oregon, University, Eugene, Ore.), and H. Mathew. *Solar Energy*, vol. 17, Nov. 1975, p. 277-283. 16 refs.

The amount of direct light gathered by a combination of reflector plus flat-plate collector has been analyzed. The calculations were done allowing variable reflector and collector orientation angles, variables latitude, and arbitrary sun hour angle away from solar noon. The effects of reflection and transmission losses and of polarization of the incident light were included. Correction was also made for the finite size of the reflector. It was found that the optimum orientation has the collector plane almost perpendicular to the plane of the reflector. This optimum orientation is almost independent of the sun's azimuthal dependence. The optimum reflector angle is found to be between 0 and 10 deg above the horizon for winter solar conditions. For typical winter operating conditions the enhancement in light gathering power for direct solar radiation is about a factor of 1.4-1.7. This results in an effective increase of 100% in the useful winter heat output from a practical reflector-collector combination with a reflector angle of 0 deg, over the useful heat output obtained with an optimally oriented simple flat-plate collector. An approximate calculation was also made of the overall enhancement in useful heat output for diffuse solar radiation. (Author)

A76-14090 Linear Fresnel lens concentrators. D. T. Nelson, D. L. Evans (Arizona State University, Tempe, Ariz.), and R. K. Bansal. *Solar Energy*, vol. 17, Nov. 1975, p. 285-289. 12 refs. NSF Grant No. GI-41894.

The use of the linear Fresnel lens as a seasonally adjusted or one-axis tracked solar concentrator is investigated. Ray tracing techniques are used to show that this type of concentrator is very good in the period of time within 1 hr of solar noon. However, increased refraction due to increased incident angles of the solar rays causes a sharp drop-off in energy delivered to the absorber at other hours of the day. Daily collection efficiencies are typically 50 per cent at concentration ratios of near 5. Effects of absorber width, distance from the lens to the absorber and alignment accuracy are considered in detail. Energy collected over a year's time is calculated assuming cloudless skies. Qualitative experimental results are presented that confirm the analytical results. (Author)

A76-14091 Collector performance enhancement with flat reflectors. S. C. Seitel (Colorado, University, Boulder, Colo.). *Solar Energy*, vol. 17, Nov. 1975, p. 291-295. 9 refs.

The use of diffuse and specular flat reflectors to enhance the performance of flat-plate solar collectors has been explored by means of Fortran routines which optimize the size, shape, and placement

reflector and collector. Configuration factors for systems with a diffuse reflector and a collector whose absorptance varies with incidence angle are presented. Specular reflectors are more effective than diffuse reflectors, and, if south-facing, should be used with collectors which are elongated in the east-west direction. Design curves for the specific system of horizontal collector and south-facing reflector are presented. In this system, a moderately sized reflector can increase the midwinter yield per unit collector area by several times. (Author)

A76-14092 Studies of the direct input of solar energy to a fossil-fueled central station team power plant. R. J. Zoschak and S. F. Wu (Foster Wheeler Corp., Livingston, N.J.). (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug. 1974.*) *Solar Energy*, vol. 17, Nov. 1975, p. 297-305. NSF Grant No. GI-41019.

A76-14093 A solar heat pump. J. A. Eibling and D. H. Frieling (Battelle Columbus Laboratories, Columbus, Ohio). (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug. 1974.*) *Solar Energy*, vol. 17, Nov. 1975, p. 313-315.

The design concept and system operation of a solar heat pump which can be embodied into the complete heating/cooling system of a house are described. Particular attention is paid to the design study of the heat pump compressor/expander unit. Instead of ordinary vanes used in the rotary vane devices, the concept uses pivoting tips on the vanes. The pivoting-tip vane is supported on a hydrodynamic gas film without sliding contact so that no liquid lubricant is required. Combining the compressor and the expander onto a single shaft reduces the number of parts required for the heat pump. The device offers many advantages, including high efficiency, low rotational speed, elimination of lubricants and valves, low manufacturing costs, and adaptability to a wide range of capacities. S.D.

A76-14094 The theoretical performance of the lithium bromide-water intermittent absorption refrigeration cycle. E. H. Perry (Memphis State University, Memphis, Tenn.). *Solar Energy*, vol. 17, Nov. 1975, p. 321-323. 9 refs.

The absorbent-refrigerant combination of lithium bromide and water as an intermittent cycle possibility is studied. The thermodynamic path for a typical ideal intermittent cycle is discussed along with the effects of operating temperatures. Although the lithium bromide-water intermittent absorption refrigeration cycle is similar in behavior to systems studied previously, its performance appears to be much better. Satisfactory performance can be obtained from the intermittent cycle even at high condenser and initial generator temperatures, provided high evaporator temperatures are acceptable. If experimental verification of the theoretical results presented is achieved, the cycle in question could be well suited for solar cooling applications. S.D.

A76-14100 # Electric power systems for space - A progress report. G. F. Turner (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). *Astronautics and Aeronautics*, vol. 13, Dec. 1975, p. 18-29.

Silver-zinc batteries, solar cells, fuel cells (ion exchange membrane type fuel cells and Bacon cells), and radioisotope thermoelectric generators are discussed. Other batteries (Ni-Cd, lithium non-aqueous) and other types of fuel cells (capillary matrix type, molten carbonate type, redox type solid-electrolyte fuel), organic Rankine-cycle heat engines, and secondary rechargeable electrochemical systems are also discussed. Improved methods of utilizing power packages, such as statistical analysis of sampled lots, measuring the amount of gas given off upon battery activation, or installing sets of load-sharing batteries operating in different temperature ranges, are also covered, along with an account of the flexible rolled-up solar array experiment (FRUSA). R.D.V.

A76-14108 Investigation of the optimal characteristics of a magnetohydrodynamic generator for an open-cycle combination magnetohydrodynamic electric-power plant. B. Ia. Shumiatskii, V. I. Kovbasiuk, G. M. Koriagina, and P. P. Ivanov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 13, Mar.-

Apr. 1975, p. 407-412.) *High Temperature*, vol. 13, no. 2, Mar.-Apr. 1975, p. 370-375. 9 refs. Translation.

A method for obtaining optimal MHD-channel flows is developed, using an improved quasi-one-dimensional flow model. The optimality criterion is formulated by analyzing a MHD power generator. V.P.

A76-14161 Ocean thermal power plants. G. L. Dugger, H. L. Olsen, W. B. Shippen, E. J. Francis, and W. H. Avery (Johns Hopkins University, Laurel, Md.). *APL Technical Digest*, vol. 14, Jan.-Mar. 1975, p. 2-20. 33 refs. Research supported by the U.S. Maritime Administration and ERDA.

Various ocean thermal energy conversion power plants are examined which are practical with current technology, and are capable of exploiting the temperature difference between the warm sun-heated surface of the tropical ocean and cooler lower depths. The power plant types include: a submerged catamaran configuration, a modular submerged automatic unmanned plant, an anchored spar-buoy plant, a foam-lift open-cycle plant, and a surface vessel ammonia synthesis plant. Electrolytic reduction of alumina (from land-mined bauxite), ammonia synthesis, winning magnesium from sea water, and mariculture (cultivation and harvesting of sea crops) are examined as profitable concurrent operations. Turbines, heat exchangers, cold-water and warm-water pipes, seawater pumps, plant operating costs, and growth potential of ocean thermal energy conversion power plants are studied. R.D.V.

A76-14163 Progress in laser-solenoid fusion. G. C. Vlases (Washington, University, Seattle, Wash.) and P. H. Rose (Mathematical Sciences Northwest, Inc., Seattle, Wash.). *Laser Focus*, vol. 11, Dec. 1975, p. 38-41. 13 refs.

Laser-heated magnetically confined linear plasma systems are less susceptible to instabilities and simpler in design than toroidal confinement systems, offer a simple and inexpensive way to generate intense neutron flux and X-rays, and can utilize existing CO₂ or CO long-wavelength lasers. Beam guiding along the solenoid axis, heating in steady-state fast solenoids, handling forward and backward ionization fronts, problems or advantages in the laser beam forming its own light pipe, hybrid fission-fusion reactor systems, and scale-up problems are discussed. R.D.V.

A76-14521 Performance measurement of a large scale solar heating and cooling system. S. C. Bailey, J. I. Craig, and J. G. Palfrey (Georgia Institute of Technology, Atlanta, Ga.). In: *Advances in test measurement. Volume 12 - Proceedings of the Twenty-first International Instrumentation Symposium, Philadelphia, Pa., May 19-21, 1975.* Pittsburgh, Pa., Instrument Society of America, 1975, p. 165-170.

The design for a building energy utilization evaluation system that is being used on a large scale solar heating and cooling project is presented. The present study is concerned with a detailed performance evaluation of the solar system. Solar systems use energy which is free but relatively expensive to collect and is of low thermodynamic quality. Consequently, it is important that such a system be operated at near peak efficiencies at all times if overall economic benefit is to be attained. Performance evaluation requires measurement of a large number of variables for each of the different operational modes that are used to maintain these efficiencies. A distributed minicomputer-based data acquisition system was selected for this study in order to handle the large number of variables and performance computations involved. The measurement system, its operational characteristics, and the various performance analysis procedures are discussed. (Author)

A76-14617 Design considerations for large wind mills. C. J. Wilcox (Carl J. Wilcox Associates, York, Pa.). In: *American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings.* New York, American Helicopter Society, Inc., 1975. 5 p.

The paper discusses considerations for calculating power output and blade loadings of large wind turbines. Procedures are outlined for determining blade loadings under several operating conditions: constant wind velocity condition, varying velocity condition, gust

condition, electrical disturbance condition, overspeed condition, and under idling and locked conditions, with or without ice. Failure of the Smith-Putnam wind turbine, constructed in 1939, is discussed.

P.T.H.

A76-14618 **Dynamic response of wind turbine rotor systems.** R. A. Ormiston (U.S. Army, Air Mobility R & D Laboratory, Moffett Field, Calif.). In: American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings. New York, American Helicopter Society, Inc., 1975. 18 p. 6 refs.

The basic response characteristics of wind turbine rotor blades are developed using elementary analytical techniques. The uncoupled flapping response to the vertical gradient of wind, crosswind, rotor shaft yaw precession, and gravity forces; and the uncoupled lead-lag response to gravity forces are treated. The influence of blade number and hub articulation on blade loads and tower loads is examined and basic scaling relationships are discussed. (Author)

A76-14619 * **How big is a windmill - Glauert revisited.** J. L. McCloud, III and J. C. Biggers (NASA, Ames Research Center, Moffett Field, Calif.). In: American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings. New York, American Helicopter Society, Inc., 1975. 9 p. 5 refs.

The obvious similarities to propellers and helicopter rotors suggest that helicopter technology might be used to improve wind generator performance, perhaps including development of a windmill airfoil. In a back-to-basics approach, this paper reviews the analyses of Glauert to determine basic size-power relations. The energy method of Wheatley developed for helicopter/auto-gyro performance prediction is then incorporated into the basic theory. Equations and charts are presented showing ratios of power output to the ideal power capability as functions of mean blade lift and drag coefficients, solidity and rotor tip speed ratio. It is found there is little possibility for improved performance by using improved airfoils. The basic assumptions of the Glauert theory are reviewed and means are suggested for achieving the basic power capability indicated by momentum theory. (Author)

A76-14620 **Performance and structural design aspects of a one-bladed electric-power-generating windmill.** R. R. Prunyn, W. Wiesner (Boeing Vertol Co., Philadelphia, Pa.), and P. G. Sulzer (Sulzer Associates, Stevensville, Md.). In: American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings. New York, American Helicopter Society, Inc., 1975. 9 p. 9 refs.

Design approaches to electric-power-generating windmills that may achieve economically attractive cost of energy are discussed. Innovative approaches to the design of the three highest cost components; rotor, gearbox, and tower are presented. Advantages of the one-bladed rotor are shown. The importance of rotor hub articulation is discussed. Sizing of the windmill so that there can be an adequate market to justify production is also considered. The need for standardization in assumptions made in the accounting aspects of cost analyses, and the requirements for wind prospecting to determine with assurance the geographic areas that have sufficient wind are shown. (Author)

A76-14621 * **Performance characteristics of aerodynamically optimum turbines for wind energy generators.** C. Rohrbach and R. Worobel (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). In: American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings. New York, American Helicopter Society, Inc., 1975. 10 p. 10 refs. Contract No. NAS3-194035.

This paper presents a brief discussion of the aerodynamic methodology for wind energy generator turbines, an approach to the design of aerodynamically optimum wind turbines covering a broad

range of design parameters, some insight on the effect on performance of nonoptimum blade shapes which may represent low fabrication costs, the annual wind turbine energy for a family of optimum wind turbines, and areas of needed research. On the basis of the investigation, it is concluded that optimum wind turbines show high performance over a wide range of design velocity ratios; that structural requirements impose constraints on blade geometry; that variable pitch wind turbines provide excellent power regulation and that annual energy output is insensitive to design rpm and solidity of optimum wind turbines. (Author)

A76-14622 * **Concept selection and analysis of large wind generator systems.** R. C. Meier (Kaman Aerospace Corp., Bloomfield, Conn.). In: American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings. New York, American Helicopter Society, Inc., 1975.

10 p. ERDA-supported research; Contract No. NAS3-19404.

The increasing need to develop alternative energy sources has renewed interest in the use of wind energy for the generation of utility quality electricity. This paper discusses a program to evolve a preliminary design of a cost competitive large wind generator system. An examination of a number of technically feasible alternative wind energy configurations is reported, and the rationale used in selecting the preferred system concept is presented. In addition, preliminary results of an optimization study conducted on the preferred concept are summarized. These show that considerable latitude in the selection of the system design parameters is possible. This permits design decisions to be based on other important factors such as development risk and the suitability of common component designs for systems with different power ratings. (Author)

A76-14623 * **100-kW hingeless metal wind turbine blade design, analysis and fabrication.** R. E. Donham, J. Schmidt (Lockheed-California Co., Burbank, Calif.), and B. S. Linscott (NASA, Lewis Research Center, Cleveland, Ohio). In: American Helicopter Society, Annual National Forum, 31st, Washington, D.C., May 13-15, 1975, Proceedings. New York, American Helicopter Society, Inc., 1975. 13 p. 8 refs. Contract No. NAS3-19235.

The design, fabrication and analysis of aluminum wind turbine rotor blades is discussed. The blades are designed to meet criteria established for a 100-kilowatt wind turbine generator operating between 8 and 60-mile-per-hour speeds at 40 revolutions per minute. The design wind speed is 18 miles per hour. Two rotor blades are used on a new facility which includes a hingeless hub and its shaft, gearbox, generator and tower. Experience shows that, for stopped rotors, safe wind speeds are strongly dependent on blade torsional and bending rigidities which the basic D spar structural blade design provides. The 0.25-inch-thick nose skin is brake/bump formed to provide the basic 'D' spar structure for the tapered, twisted blades. Adequate margins for flutter and divergence are predicted from the use of existing, correlated stopped rotor and helicopter rotor analysis programs. (Author)

A76-14629 # **Nonlinear stress analysis of vertical-axis wind turbine blades.** L. I. Weingarten and R. E. Nickell (Sandia Laboratories, Albuquerque, N. Mex.). (American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D.C., Sept. 17-19, 1975, Paper 75-DET-35.) ASME, Transactions, Series B - Journal of Engineering for Industry, vol. 97, Nov. 1975, p. 1234-1237. 6 refs. ERDA-supported research.

A Darrieus-type vertical-axis wind turbine has been proposed as an alternate to conventional horizontal axis, propeller-type machines. An advantage is that the blades will be primarily in tension, thus making for a more efficient design. In connection with its vertical-axis wind turbine program, Sandia Laboratories has developed the 'troposkien' (Greek for turning rope) shape for the blade design. The prototype blade shape is similar to that of the troposkien, but more easily manufactured. The effect on the stress distribution of this alternate blade shape is investigated. Analytical models of the blades were constructed using a general purpose, nonlinear, dynamic fin

ement structural code. This code accounts for the large deflection effects of the various blade shapes through incremental applications of angular velocity. (Author)

A76-14727 Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1975. 537 p. Members, \$22.50; nonmembers, \$30.

The papers deal with all major aspects of solar-cell technology, emphasizing silicon solar cells, solar-array technology, radiation and environmental effects, silicon technology for terrestrial applications, new approaches to solar-cell fabrication, and compound solar cells. Specific topics include high-efficiency silicon solar cells, material and junction properties, tests of solar arrays, satellite flight experiments, techniques for large-scale solar-cell production, and terrestrial photovoltaic systems. F.G.M.

A76-14737 Design of the IUE solar array. B. Görgens (Telefunken AG, Hamburg, West Germany) and E. G. Suppa (ESRO, European Space Research and Technology Centre, Noordwijk, Netherlands). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 110-116. 8 refs.

The International Ultraviolet Explorer (IUE) solar array has been designed to meet very stringent requirements concerning power output, weight, outgassing characteristics, and thermal environment. This led to the development of an advanced technology based on welded cell interconnections with silver-plated molybdenum interconnectors and module vacuum bonding on a low-weight honeycomb structure. The mission requirement of more than 2000 deep thermal cycles led to the optimization of the cell interconnector material and of the stress relief loop after an extended test sequence. IUE representative module samples have been successfully tested in 2160 cycles between -180 C and +80 C without failure of the cell interconnectors and other components. (Author)

A76-14738 The GEOS solar generator. G. Pohl and H. Braasch (Telefunken AG, Hamburg, West Germany). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 117-119.

The design, development, and qualification of the GEOS solar generator are presented. Due to the strong electromagnetic-compatibility requirements, the main design and development items were: a computer program for design optimization with regard to the requirements, use of conductively coated cover glasses, development of a module substrate and diode board, and a welding technique which was employed to connect the conductively coated cover glasses. All components and the generator have successfully passed the qualification. (Author)

A76-14744 * FEP-TEFLON encapsulated solar cell modules - Further progress. H. S. Rauschenbach, M. D. Cannady (TRW Systems Group, Redondo Beach, Calif.), and A. F. Ratajczak (NASA, Lewis Research Center, Cleveland, Ohio). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 162-168.

A progress report, starting with November 1973, is given in the design, development, and performance of lightweight flexible FET (Fluorinated Ethylene Propylene) encapsulated solar cell modules intended to form standardized building blocks for large roll-up or fold-up solar cell blankets with performances on the order of 100 W/sq m and 80 W/kg in near space. It is shown that interconnected FEP encapsulated modules of advanced design can withstand all typical ground handling, assembly, storage, and launch conditions, and are well suited for high-power space applications. V.P.

A76-14757 Mission analysis of photovoltaic conversion of ar energy for terrestrial applications. S. L. Leonard (Aerospace

Corp., Los Angeles, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 245-251. ERDA-supported research; NSF Grant No. GI-44099.

A methodology employing computer simulation has been developed for the technical and economic evaluation of the performance of a generalized photovoltaic solar energy conversion system in various 'on-site' missions (applications), where the electric power demand to be served is colocated with the system. Suitable representations for the time-varying demand have been prepared and a computerized system simulation model has also been developed. The methodology is now operational and preliminary results are being obtained. (Author)

A76-14758 Business analysis of solar photovoltaic energy conversion. P. D. Maycock and G. F. Wakefield (Texas Instruments, Inc., Dallas, Tex.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 252-255. 8 refs.

A design-to-cost analysis is used to develop the material and labor cost goals that must be met to allow profitable manufacture of solar photovoltaic panels that meet the Energy Research and Development Authority (ERDA) goals for 2000. Significant cost reduction (more than 10 times) must be achieved. Analysis of the solar-panel market versus price per peak kW indicates very little market opportunity for industry until \$1000/peak kW prices are obtained. Two government approaches are considered: massive procurement of panels and intensive R & D. The selected strategy is intense R & D to obtain \$2000/kW panel cost by 1979-1980. Because of the large gap between today's costs and those required to reach Project Independence goals, many gross and unproven forecasts are made. The approach developed in this paper is sufficiently broad so that it can be used to assess many other alternatives to the selected silicon photovoltaic system. (Author)

A76-14759 Mitre terrestrial photovoltaic energy system. G. M. Haas (Mitre Corp., McLean, Va.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 256-258.

The Mitre Corporation is developing a complete terrestrial photovoltaic energy system employing computer control and battery and hydrogen storage systems. The solar array has been installed and operated to obtain some of the information necessary for the control system design. (Author)

A76-14760 * EFG silicon ribbon solar cells. K. V. Ravi, H. B. Serreze, H. E. Bates, A. D. Morrison, D. N. Jewett, and J. C. T. Ho (Mobil Tyco Solar Energy Corp., Waltham, Mass.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 280-289. 16 refs.

NSF Grants No. GI-43873; No. GI-37067; Contract No. NAS7-100.

The growth and characteristics of edge defined, film fed grown (EFG) silicon ribbons are discussed. Factors involved in the growth of continuous lengths of 1 in. wide ribbons are examined. The structural and electrical characteristics of the ribbons have been studied and the results are presented. Solar cells have been fabricated using the ribbon crystals and typical AMO efficiencies of 6 to 10% have been realized. (Author)

A76-14764 Progress in new low cost processing methods. W. Wolf (Pennsylvania, University, Philadelphia, Pa.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 306-314. 7 refs. NSF Grant No. GI-29729.

A research program is being undertaken with the objective of obtaining new information on relatively little explored methods which hold a promise for providing extremely low cost processes

with potential for full automation and execution in large volume. The studies of the past year were directed towards new methods for obtaining silicon of adequate purity for high efficiency solar cell fabrication which is being reported in a separate paper (1975) and for the formation of large crystalline sheets of silicon. Emphasis in these investigations has centered on a silicon-difluoride transport and purification process with CVD potential, polycrystalline sheet generation by rolling or extrusion, and sheet recrystallization by floating molten zone regrowth. (Author)

A76-14765 * Recent advancements in low cost solar cell processing. E. L. Ralph (Spectrolab, Inc., Sylmar, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 315, 316. Contract No. NAS3-18566.

A proof-of-concept solar cell process has been developed that is adaptable to automation. This involved the development of a new contact system, a new antireflection coating system, a drift field cell design and a new contoured surface treatment. All these processes are performed without the use of vacuum chambers and expensive masking techniques, thus providing the possibility of reduced costs by automation using conventional semiconductor processing machinery. The contacts were printed on the cells by conventional silk screen machinery. The P(+) back field was formed by diffusing in aluminum from a printed aluminum back contact. The antireflection coating was formed by spinning on and baking a $\text{TiO}_2\text{-SiO}_2$ glass film. Air-mass-zero efficiencies of over 10% were achieved using this completely vacuum-free process. (Author)

A76-14767 Integration of photovoltaic and solar-thermal energy conversion systems. D. G. Schueler, J. G. Fossum, E. L. Burgess, and F. L. Vook (Sandia Laboratories, Albuquerque, N. Mex.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 327-331. 9 refs. ERDA-supported research.

This paper examines ways of reducing the effective cost of terrestrial photovoltaic conversion systems using single crystal silicon cells by taking advantage of their ability to operate efficiently at high illumination levels, and by combining photovoltaic and solar-thermal conversion processes in an integrated solar collector. A semiconductor device simulation computer code has been used to optimize the design of silicon solar cells operating in multi-sun, elevated temperature environments. The results of these calculations, along with evaluation of the performance of prototype cells, indicate that silicon cells with modified metallization and doping levels can achieve 12% conversion efficiency when operated at 40 suns terrestrial illumination and 100 C junction temperature. (Author)

A76-14768 * Experiments on solar photovoltaic power generation using concentrator and liquid cooling. B. H. Beam (Beam Engineering, Inc., Sunnyvale, Calif.) and C. F. Hansen (NASA, Ames Research Center, Gas-Dynamics and Lasers Branch, Moffett Field, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 332-337. 8 refs.

Calculations and experimental data are presented leading to the development of a practical, economical solar photovoltaic power supply. The concept involves concentration of sunlight up to about 100 times normal solar intensity in a solar tracking collector and directing this to an array of solar cells. The cells are immersed in water circulated from a thermal reservoir which limits cell temperature rise to about 20 C above ambient during the day and which cools to ambient temperature during the night. Experiments were conducted on solar cells using a Fresnel lens for magnification, a telescope equatorial mount with clock drive, and tap water circulated through the solar cell holder cavity. Test results show that cells operate satisfactorily under these conditions. Power outputs achieved experimentally with cell optimized for 25 suns were linear with concentration to about 15 suns. Cells optimized for 100 suns were

not available, but a corresponding linear relation of power output with concentration is anticipated. Test results have been used in design analysis of the cost of systems utilizing this technique.

(Author)

A76-14769 Peeled film technology for solar cells. A. G. Milnes and D. L. Feucht (Carnegie-Mellon University, Pittsburgh, Pa.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 338-341. 18 refs.

A concept is described for the fabrication of thin-film single-crystal semiconductor sheet for use in solar cells. For thin-film silicon the process would involve the epitaxial growth of a thin 15 to 20 micron Si sheet on a $\text{Si}(x)\text{Ge}(1-x)$ epitaxially coated single-crystal Si seed block and the subsequent detachment of the sheet by making the $\text{Si}(x)\text{Ge}(1-x)$ layer molten. Peeled-film technology should have the potential of yielding efficient solar cells (over 10%) at a cost below one dollar a watt in pilot scale production. Applicability of the technology to other semiconductors is discussed. (Author)

A76-14771 Fabrication of an improved vertical multi-junction solar cell. W. W. Lloyd (Texas Instruments Semiconductor Research and Engineering Laboratories, Dallas, Tex.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 349-355. 6 refs. Contract No. F33615-73-C-2019.

An open-groove, vertical multi-junction cell has been designed and fabricated that yields a highly-absorbing collecting surface and which should also eliminate the series-resistance problem intrinsic to previous designs. The processing sequence is greatly simplified when compared to some earlier approaches. Preliminary electrical characterization of the new cells indicate an excellent tolerance to radiation, a blue response comparable to any other cell and potential efficiencies over 15%. (Author)

A76-14776 * Improved Schottky barrier solar cells. Y.-C. M. Yeh and R. J. Stirn (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 391-397. 14 refs. Contract No. NAS7-100.

Schottky barrier (SB) solar cells have been fabricated for solar energy conversion using GaAs and GaAs 0.78P0.22. Conversion efficiencies of 9% for air mass zero and 12% for terrestrial sun were observed for antireflection coated GaAs0.78P0.22 SB cells. The corresponding efficiencies for GaAs SB cells were 7% and 10%, respectively. These efficiencies are for cells with no interfacial layer effect. The short circuit current density for GaAs SB cells has been improved. The use of an ellipsometer to determine the optimum antireflection coating parameters is illustrated. (Author)

A76-14777 In2O3/Si heterojunction solar cells. S. W. Lai, S. L. Franz, G. Kent, R. L. Anderson (Syracuse University, Syracuse, N.Y.), J. K. Clifton, and J. V. Masi (INNOTECH Corp., Norwalk, Conn.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 398-401. 6 refs. NSF Grant No. AER-74-17631.

The photovoltaic properties of n-In2O3/p-Si heterojunctions for use as solar cells have been investigated. The In2O3 was evaporated onto Si substrates and heat-treated at temperatures less than 400 C. The In2O3, in addition to being an integral part of the junction, acts as a transparent window to solar radiation and as an antireflection coating. When illuminated under simulated air-mass-one conditions of 100 mW per sq cm, typical cell parameters are: $J = 35 \text{ mA per sq cm}$, $V = 0.3 \text{ V}$, and conversion efficiency on the order of 6%. The low open circuit voltage and thus the low conversion efficiency relative to Si homojunction cells is attributed to a larger (0.30 eV) electron affinity in the In2O3 than in the Si. (Author)

76-14778 GaAs concentrator solar cells. L. W. James and L. Moon (Varian Associates, Palo Alto, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 402-408. 16 refs.

For terrestrial applications, the cost of photovoltaic power must be reduced by orders of magnitude. The usual approaches to low cost cell fabrication have many unsolved problems. Using specially constructed AlGaAs/GaAs heterojunction solar cells operating with large factors of solar concentration reduces the projected cell cost per watt to an economically feasible level. Experimental cells have been operated at a concentration of 1735 times with an output power density of 0.24 megawatts/sq m of cell area, at a conversion efficiency of 19%. (Author)

A76-14779 Large area GaAlAs/GaAs solar cell development. J. Ewan, G. S. Kamath, and R. C. Knechtli (Hughes Research Laboratories, Malibu, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 409-413. 13 refs.

Earlier studies have reported on high efficiency (GaAl)As-GaAs solar cells with the potential of improved radiation resistance. This paper reports on a unique modification of the infinite melt technique for the economic fabrication of large area solar cells. Epitaxial window layers larger than 4 sq cm and less than 1 micron thick can be reproducibly grown by this method. Spectral response measurements of the designed solar cells demonstrate the suitability of the Hughes technique for the practical production of large-area solar cells of this type. The results demonstrate the substantial improvement in the solar cell response that can be achieved by using sub-micron thickness for the (GaAl)As window layers. (Author)

A76-14780 * High efficiency graded band-gap Al_x/Ga_{1-x}/As-GaAs p-on-n solar cell. J. A. Hutchby (NASA, Langley Research Center, Hampton, Va.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 414-423. 30 refs.

A theoretical analysis of p-on-n (p/n) graded band-gap Al_x/Ga_{1-x}/As-GaAs solar cells including all practical energy loss mechanisms predicts air mass zero efficiencies of 17.3%. The energy losses include those due to spectral reflection, surface, bulk and junction recombination currents, and series resistance. The device consists of a layer of p-type Al_x/Ga_{1-x}/As 3.5-micron thick on top of an n-type GaAs substrate. The graded band-gap is achieved by decreasing x from 0.35 at the surface to zero at the junction. The same structure without the graded Al concentration, no longer an optimum device, has an efficiency of 10.4%. The primary function of the graded band-gap material is the reduction of surface and bulk recombination losses in the surface layer by a built-in electric field. A comparison of the p/n structure with an optimized n/p structure indicates that the latter has a slightly higher efficiency (17.7%) for assumed minority carrier diffusion lengths and surface recombination velocity. (Author)

A76-14781 Performance of germanium pin-photovoltaic cells at high incident radiation intensity. E. Kittl (U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, N.J.), M. D. Lammert, and R. J. Schwartz (Purdue University, Lafayette, Ind.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 424-430. 9 refs.

The performance of a 1-by-2-cm planar p-i-n-germanium photovoltaic cell developed for use in a thermovoltaic conversion system is studied. The cell, prepared from intrinsic germanium with interdigitated p+ and n+ junctions on the unilluminated side, was operated with monochromatic and chromatic radiation sources at incident radiation densities of up to 25 W/sq cm. The cell's spectral response characteristics differ from those of previously developed germanium and silicon cells in that they exhibit a unique enhanced

response at photon energies corresponding to twice and three times the direct gap energy in germanium. This unexpected significant enhancement of the short-wavelength response opens new development and application potentials for cells of this type. V. P.

A76-14790 Performance of Cu_x/S-CdS solar cells after additional Cu-treatment. F. Pfisterer, G. H. Hewig, and W. H. Bloss (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 460-463. 14 refs.

Parametric studies concerning the optimization of an additional copper treatment of Cu_x/S-CdS solar cells have been carried out. The optimum thickness of the copper deposition has been determined to about 70 to 150 Å. The duration of the post-heat treatment at 180 °C in air to achieve optimum photovoltaic efficiency has to be adjusted individually. Photovoltaic efficiencies of more than 6% have been achieved. It could be shown that the formation of a Schottky-barrier at the Cu-Cu_x/S interface and field enhanced Cu-diffusion are responsible for the reduced photovoltaic response of the cells immediately after Cu-deposition. The improvement of efficiency by heat treatment is believed to be due to the formation of an oxide layer at the surface. Similar results relating to efficiency and failure rate as compared to the post-dipping Cu-treatment could be obtained by Cu-doping of the CdS surface layer prior to dipping. (Author)

A76-14792 Evaluation of CdS solar cells as future contender for large scale electricity production. J. Besson, T. Nguyen-Duy, A. Gauthier (Société Anonyme des Télécommunications, Paris, France), W. Palz, C. Martin (Centre National d'Etudes Spatiales, Paris, France), and J. Vedel (Paris, Ecole Nationale Supérieure de Chimie, Paris, France). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 468-475. 10 refs. Research supported by the Centre National d'Etudes Spatiales and Délégation Générale à la Recherche Scientifique et Technique.

CdS solar cells which had been manufactured recently in France are presently submitted to a large test program. Those tests comprise long term illumination under artificial light and in situ tests in Paris and in the Pyrenees as well. The results obtained so far confirm that the present French manufacturing process using doped CdS is now well developed. All cells measured at temperatures as high as 60 °C show no sign of degradation. It is therefore concluded that CdS cells are definitely viable from a technical point of view. An attempt has been made to further clarify future production cost limits. Evaporated CdS layers and sprayed CdS have both been taken into account. The findings are that there are strong indications for a rapid break-through of the spray technique which could well meet the cost level of large scale terrestrial applications. (Author)

A76-14794 II-VI photovoltaic heterojunctions for solar energy conversion. A. L. Fahrenbruch, F. Buch, K. Mitchell, and R. H. Bube (Stanford University, Stanford, Calif.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 490-496. 21 refs. NSF-supported research.

Five II-VI heterojunction systems are of interest for investigation and development of large-area photovoltaic cells for solar energy conversion. To date we have devoted primary attention to the p-CdTe/n-CdS system and have produced cells by close-spaced vapor transport and by vacuum evaporation with quantum efficiency up to 0.85, open-circuit voltage up to 0.66 V, and solar efficiency of 4 percent. Major problem areas are the contact resistance, particularly to p-CdTe, and the forward leakage current of the cells. (Author)

A76-14795 A new look at CdTe solar cells. R. O. Bell, H. B. Serreze, and F. V. Wald (Mobil Tyco Solar Energy Corp., Waltham, Mass.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 497-502. 33 refs.

Calculations were performed to determine what the potential conversion efficiency of CdTe might be. It was concluded that 5-micron thick CdTe films having a minority carrier lifetime of approximately 0.1 microsec are needed to produce acceptable solar cells with over 10% efficiency. Experience based on impurity-native defect associated models has indicated that lifetimes of up to 1 microsec are indeed attainable in suitably doped material, and thus realization of 0.1 microsec material is apparently not limited by any fundamental mechanism. Also presented are some preliminary results with surface barrier devices to show the controlling role of surface layers and CdTe vacuum deposition experiments to indicate the importance of deposition rate and source temperature. (Author)

A76-14796 Preparation and properties of InP/CdS and CuInSe₂/CdS solar cells. J. L. Shay, S. Wagner (Bell Telephone Laboratories, Inc., Holmdel, N.J.), K. Bachmann, E. Buehler, and H. M. Kasper (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 503-507. 23 refs.

We describe the preparation and properties of the recently reported InP/CdS and CuInSe₂/CdS single crystal solar cells. Solar power conversion efficiencies of 12.5 and 12% have been observed respectively. The ultimate efficiency achievable with InP/CdS using state-of-the-art liquid encapsulated Czochralski p-type InP is calculated to be 17.2% for AM2 conditions and 14.0% for AM0 conditions. (Author)

A76-14798 Assessment of the international workshop on CdS solar cells. K. W. Böer (Delaware University, Newark, Del.). In: Photovoltaic Specialists Conference, 11th, Scottsdale, Ariz., May 6-8, 1975, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 514, 515.

One of the major points of agreement between the members of the workshop was that the complexity of CdS/Cu₂S solar cells and other heterogeneous cells calls for a concerted research program to systematically approach and solve the key problems of further improvements. Such improvements shall include an increase in conversion efficiency above 10%, a decrease in CdS layer thickness below 10 microns, and the development of an inexpensive grid and an inexpensive hermetic encapsulation. Further aims are the achievement of a production yield in excess of 90% for high-efficiency cells and a life expectancy in excess of 20 years under actual operating conditions. V.P.

A76-15048 Satellite solar-power stations. R. B. Aronson. *Machine Design*, vol. 47, Nov. 27, 1975, p. 18-20, 23.

The paper discusses two concepts for a satellite power station that would convert the electrical energy produced into microwave energy and transmit this microwave energy to earth, where it would be reconverted into electrical energy. One concept involves a 22-square mile mirror array that would concentrate the sun's rays on absorbers which would heat helium for a set of Brayton-cycle engines. Components of the 150 million kg satellite would be carried into a low earth orbit by some version of the space shuttle. The other concept involves a satellite consisting of solar panels delivering dc to an antenna which would beam the power to earth by microwave. A 5,000 MWe satellite would measure about 12 km by 4 km with two huge solar panels and a 1,000-m diameter sending antenna. Tests have been carried out on the performance of a 'rectenna', which both collects and rectifies a microwave signal. Over 30 kW of dc power was transmitted over a distance of 1.54 km. With a signal frequency of 2,388 MHz, conversion efficiency of microwave to dc was over 80%. P.T.H.

A76-15143 # The photovoltaic effect and large scale utilization of solar energy (Zjawisko fotowoltaiczne i szerokie wykorzystanie energii słonecznej). J. J. Loferski (Brown University, Providence, R.I.). (*Wojskowa Akademia Techniczna, Ogólnokrajowa*

Seminarium Związków Polprzewodnikowych AIBVI, 6th, Jaszwil Poland, Apr. 20-28, 1975.) *Postępy Fizyki*, vol. 26, no. 5, 1975, p. 535-560. 26 refs. In Polish. (Translation).

The principles underlying large scale solar energy utilization via the photovoltaic effect are examined. The theory of the photovoltaic effect indicates that efficiencies as high as 25% should be achievable in solar cells made from single semiconductors. Their energy gap should lie between 1.0 and 2.5 eV; they should preferably be direct gap semiconductors; the solar cells can be based on p/n homojunctions or heterojunctions or on metal semiconductor barriers. The current status and future prospects of solar cells made from silicon, cadmium sulfide thin films, gallium arsenide and other materials are reviewed. The possibility of achieving even higher efficiencies by combining cells made from semiconductors having different values of forbidden energy gaps is discussed. (Author)

A76-15163 Material and manufacturing considerations for vertical-axis wind turbines. L. I. Weingarten and L. V. Feltz (Sandia Laboratories, Albuquerque, N. Mex.). In: Materials review '75; Proceedings of the Seventh National Technical Conference, Albuquerque, N. Mex., October 14-16, 1975. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1975, p. 153-166. 7 refs.

Since 1973, Sandia Laboratories has been studying wind turbines and in particular Darrieus-type vertical-axis wind turbines (VAWT) for use in remote areas and as a fuel saver for electrical power grid application. The VAWT being investigated employs curved blades which minimize bending stresses. The tension-only stresses in the blades provide a variety of manufactured methods to be considered. Mathematical procedures that are being developed for structural analysis are discussed. (Author)

A76-15364 Sandia's Solar Total Energy Program. J. A. Leonard (Sandia Laboratories, Albuquerque, N. Mex.). In: Materials review '75; Proceedings of the Seventh National Technical Conference, Albuquerque, N. Mex., October 14-16, 1975, Supplement. Conference sponsored by the Society for the Advancement of Material and Process Engineering. Azusa, Calif., Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series. Volume 7), 1975, p. 16-22.

The program described is aimed at providing a versatile total energy system that may be used as an engineering evaluation center or test bed for further development of alternative subsystems and individual components. Further objectives are to establish the feasibility of the total energy concept by developing a demonstration system, to encourage private sector participation in the program, to determine the most pertinent areas of research and development, and to develop a systems analysis computer program capable of evaluating a variety of possible combinations of total energy system configurations. The system, its components, and performance characteristics are examined, and a status report is presented. V.P.

A76-15365 Practical aspects of solar heating - A review of materials use in solar heating applications. D. P. Grimmer and S. W. Moore (California, University, Los Alamos, N. Mex.). In: Materials review '75; Proceedings of the Seventh National Technical Conference, Albuquerque, N. Mex., October 14-16, 1975, Supplement. Conference sponsored by the Society for the Advancement of Material and Process Engineering. Azusa, Calif., Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series. Volume 7), 1975, p. 23-34. 19 refs. NSF-ERDA-sponsored research.

A review of materials use in solar heating of buildings is presented with the emphasis on outlining important criteria for selecting materials for a particular application. The most important criteria to consider in solar-heating materials applications are durability and cost-effectiveness. In the area of active solar heating systems, materials use in flat-plate collectors is discussed for the various collector components. In addition, materials use is presented for the area of passive solar systems (sun-tempered buildings).

(Authr)

A76-15451 Remote sensing: Energy-related studies; Proceedings of the Symposium, Miami, Fla., December 2-4, 1974. Symposium sponsored by the University of Miami. Edited by T. N. Veziroglu (Miami, University, Coral Gables, Fla.). Washington, D.C., Hemisphere Publishing Corp.; New York, Halsted Press (Advances in Thermal Engineering, Volume 5), 1975. 505 p. \$39.

Papers are presented dealing with remote sensing of (1) meteorological, climatological, and ecological parameters, (2) pollution (material or thermal), and (3) economic energy resources by surface, airborne, or spacecraft instruments scanning large areas of the earth (land and oceans) and the earth's atmosphere. Much of the work described centers around the Earth Resources Technology Satellite (ERTS) program. Topics include monitoring of environmental quality, monitoring of land use and waterway use, applications of active and passive sensors, imaging and mapping, and measurements of hydrological and atmospheric parameters.

R.D.V.

A76-15452 * Our national energy future - The role of remote sensing. H. H. Schmitt (NASA, Office of Energy Programs, Washington, D.C.; California Institute of Technology, Pasadena, Calif.). In: Remote sensing: Energy-related studies; Proceedings of the Symposium, Miami, Fla., December 2-4, 1974.

Washington, D.C., Hemisphere Publishing Corp.; New York, Halsted Press, 1975, p. 5-12.

An overview of problems and opportunities in remote sensing of resources. The need for independence from foreign and precarious energy sources, availability of fossil fuel materials for other purposes (petrochemicals, fertilizer), environmental conservation, and new energy sources are singled out as the main topics. Phases of response include: (1) crisis, with reduced use of petroleum and tapping of on-shore and off-shore resources combined; (2) a transition phase involving a shift from petroleum to coal and oil shale; and (3) exploitation of renewable (inexhaustible and clean) energy. Opportunities for remote sensing in fuel production and energy conservation are discussed along with problems in identifying the spectral signatures of productive and unproductive regions. Mapping of water resources, waste heat, byproducts, and wastes is considered in addition to opportunities for international collaboration. R.D.V.

A76-15454 * Exploration for fossil and nuclear fuels from orbital altitudes. N. M. Short (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md.). In: Remote sensing: Energy-related studies; Proceedings of the Symposium, Miami, Fla., December 2-4, 1974. Washington, D.C., Hemisphere Publishing Corp.; New York, Halsted Press, 1975, p. 189-232.

A review of satellite-based photographic (optical and infrared) and microwave exploration and large-area mapping of the earth's surface in the ERTS program. Synoptic cloud-free coverage of large areas has been achieved with planimetric vertical views of the earth's surface useful in compiling close-to-orthographic mosaics. Radar penetration of cloud cover and infrared penetration of forest cover have been successful to some extent. Geological applications include map editing (with corrections in scale and computer processing of images), landforms analysis, structural geology studies, lithological identification, and exploration for minerals and fuels. Limitations of the method are noted. R.D.V.

A76-15458 * Space acquired imagery, a versatile tool in the development of energy sources. D. L. Amsbury (NASA, Johnson Space Center, Houston, Tex.). In: Remote sensing: Energy-related studies; Proceedings of the Symposium, Miami, Fla., December 2-4, 1974. Washington, D.C., Hemisphere Publishing Corp.; New York, Halsted Press, 1975, p. 395-402. 8 refs.

The two-dimensional images acquired by satellite-borne instruments are continuous, they supplement surface data, subsurface data, and other geophysical data, and they can cut the amount of field work required for a given task by a whole order of magnitude.

Images acquired with instruments mounted on the Apollo and Skylab orbiting spacecraft, and on the RB-57 and U-2 aircraft, are displayed and discussed. R.D.V.

A76-15506 Radiation characteristics of honeycomb solar collectors. C. L. Tien and W. W. Yuen (California, University, Berkeley, Calif.). *International Journal of Heat and Mass Transfer*, vol. 18, Dec. 1975, p. 1409-1413. 6 refs.

A simple closed-form expression for the infrared emittance and the solar absorptance of honeycomb solar collectors has been obtained in terms of the passage transmittance function. The predicted results agree well with the existing data of infrared emittance for thin-walled square-cell honeycomb collectors in vacuum. A new concept of double-honeycomb structure is also introduced and analyzed. This concept provides considerable flexibility in various designs of honeycomb collectors. (Author)

A76-15624 Handbook of solar and wind energy. F. Hickok. Boston, Cahners Publishing Co., Inc., 1975. 131 p. \$20.

A general qualitative survey of the state of the art in solar and other nonfossil energy sources is presented together with a timetable of probable development. Attention is given to the relationship between solar and wind energy and the utility industry on the assumption that those most likely to exploit nonfossil energy sources are already in the energy business. Specific topics include a projection of energy requirements to the year 2020, the amount of solar energy available for conversion to a useable form, flat-plate collectors, the possibility of using flat-plate collectors to supply the energy needs of a model community, solar air-conditioning systems, second-generation solar collectors, solar-energy intensifiers, photovoltaic cells, the wind as an energy source, windmill designs and types, and unusual nonfossil energy sources. F.G.M.

A76-15660 Space monitoring of the thermal impact of energy use. S. S. Penner (California, University, La Jolla, Calif.). *Acta Astronautica*, vol. 2, Sept.-Oct. 1975, p. 755-769. 33 refs.

The current and anticipated thermal loadings associated with world-wide energy use represent potentially significant influences on local, synoptic, and world-wide meteorological conditions. The past, current, and anticipated future thermal loading associated with increasing energy consumption is discussed. Our limited knowledge of the environmental impacts of thermal plumes is briefly reviewed in an effort to define energy-use levels for which significant disturbances may occur. Consideration is given to the definition of a world-wide satellite network and the sensors which will be needed to provide the basic data input on which quantitative predictions of ultimately tolerable thermal loads must be based. (Author)

A76-16424 Solar use now - A resource for people; International Solar Energy Congress and Exposition, University of California, Los Angeles, Calif., July 28-August 1, 1975, Extended Abstracts. Congress supported by the International Solar Energy Society, ERDA, and UNESCO. Washington, D.C., Energy Research and Development Administration, 1975. 547 p.

National and regional solar energy programs are considered along with the legal and policy aspects of solar energy applications, the economic aspects of solar energy applications, applications in developing countries, meteorological measurements and data, photo-voltaic processes, photochemical and photobiological processes, and solar furnaces and their applications. Attention is also given to materials, aspects of energy storage, flat plate collectors, solar ponds, the solar heating and cooling of buildings, aspects of drying and distillation, focusing collectors, stationary concentrators, and power systems. G.R.

A76-16541 The necessity of fission power. H. A. Bethe. *Scientific American*, vol. 234, Jan. 1976, p. 21-31.

The paper reviews the situation in the U.S. with regard to energy sources for the present and future, taking into account rising costs of oil and an expected rise in energy needs, and then discusses nuclear

fission as the only major nonfossil power source the U.S. can rely on for the rest of this century and probably for some time afterward. At the same time, the importance of other energy sources and their development (solar energy, fusion energy, etc.) is also maintained. The status of nuclear fission is examined from the viewpoint of fears regarding its use and its economics (cost of fuel and construction costs).
P.T.H.

A76-16705 **Theoretical and experimental photovoltaic energy conversion in an organic film system.** P. J. Reucroft, K. Takahashi, and H. Ullal (Kentucky, University, Lexington, Ky.). *Journal of Applied Physics*, vol. 46, Dec. 1975, p. 5218-5223. 20 refs. Research supported by the Ashland Oil Foundation; NSF Grant No. GK-26154.

A theoretical model in which charge separation takes place at an electrode energy barrier has been extended to estimate the photovoltaic energy conversion efficiency as a function of film thickness and energy barrier for an organic film system based on the (1:1)PVK-TNF charge-transfer complex. The model predicts that the theoretical efficiency will be determined by space-charge-limited conduction for films of thickness greater than 0.1 micron. The efficiency is proportional to the inverse cube of the film thickness in this film thickness range. In the case of ultrathin (less than 0.1 micron) films, the model predicts that the efficiency will be determined by the photocarrier generation efficiency and can approach 1%. Experimental photovoltaic energy conversion efficiencies for films of thickness 5-25 micron are in agreement with the general features predicted by the model. (Author)

A76-16843 # **Economic optimization models of windpower systems.** H. M. Bae and M. D. Devine (Oklahoma, University, Norman, Okla.). *Operations Research Society of America and Institute of Management Sciences, Joint National Meeting, Las Vegas, Nev., Nov. 17-19, 1975, Paper*. 56 p. 18 refs.

The history of wind energy use is considered along with recent developments concerning a utilization of wind power. A technical description of the wind energy conversion system is given, taking into account wind-driven generators, energy storage techniques, wind speed and demand variations, and design questions. A model for windpower systems without storage is presented. The model makes use of a problem matrix which contains the piecewise linear approximations of the nonlinear terms in the objective function. A model for windpower systems with storage is also discussed. Attention is given to analytical storage models, approaches of economic optimization, and computational results. G.R.

A76-17053 **Thermal energy storage for solar heating and off-peak air conditioning.** H. G. Lorsch (Franklin Institute Research Laboratories, Philadelphia, Pa.), J. C. Denton (American Technological University, Killeen, Tex.), and K. W. Kauffman. *Energy Conversion*, vol. 15, no. 1-2, 1975, p. 1-8. 12 refs. NSF Grants No. GI-27976; No. GI-29729.

Latent heat thermal energy storage materials suitable for solar heating and off-peak air conditioning were investigated and evaluated in terms of criteria developed to judge their usefulness. Sodium sulfate decahydrate and its mixtures were shown to have undesirable melting properties. Parametric designs for two latent heat materials (sodium thiosulfate pentahydrate and a paraffin wax) and for a sensible heat material (a 1:1 mixture of water and ethylene glycol) were compared as to cost, performance, and space requirements. The conditions of equal cost for latent heat and sensible heat storage systems were determined as functions of latent heat capacity, thermal conductivity, and the temperature swing allowed in the sensible heat storage tank. (Author)

A76-17056 **The MHD induction converter compensated by superposition.** J. R. Wilhelmi (Centro de Estudios y Experimentación de Obras Públicas). *Energy Conversion*, vol. 15, no. 1-2, 1975, p. 21-24. 8 refs. Research supported by the Centro de Estudios y Experimentación de Obras Públicas.

A procedure to eliminate the end loss associated with the MHD induction converter is described briefly. Two exciting windings of different wavelengths are used, connected in parallel. Adjustment of the amplitudes and phases of the excitation currents is not required. The losses introduced by the compensation are quite small. (Author)

A76-17057 **Thermodynamic analysis of a coal fired MHD power cycle with chemical heat regeneration.** W. Pudlik (Gdansk, Politechnika, Gdansk, Poland). *Energy Conversion*, vol. 15, no. 1-2, 1975, p. 25-34. 13 refs. Research supported by the Polska Akademia Nauk.

Basic fluxes of matter and energy in an MHD power cycle with coal conversion by MHD generator exhaust gases are investigated. Variable oxidizer oxygen content is assumed. Properties and efficiency of the cycle are compared with those of a conventional MHD cycle with direct burning of coal. (Author)

A76-17060 **Investigation of some factors, limiting enthalpy extraction of MHD-generators.** Y. M. Volkov (Akademii Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Energy Conversion*, vol. 15, no. 1-2, 1975, p. 45-49. 16 refs.

Several of the most important factors which influence the efficiency of converting the thermal energy of a plasma flow into electrical energy are discussed and categorized on the basis of an approximate one-dimensional analysis. The realization of thermal efficiencies greater than 20-30% involves the utilization of plasma sources with high gas temperature and pressure, acceleration of the plasma to high Mach numbers, utilization of supersonic MHD channels with a moderate divergence ratio together with appropriate techniques to minimize electrode voltage losses and to prevent boundary layer separation and elimination or suppression of effects which arise from this separation. In order to make further progress toward large efficiencies it will be necessary to (1) develop methods for slowing down a supersonic flow as energy is extracted without the formation of shock waves as subsonic velocities are approached, and (2) utilize nonequilibrium ionization phenomena, even in molecular gases. (Author)

A76-17063 **Built-in electric field in the skin region and the performance of a GaAs solar cell.** S. Deb (Jadavpur University, Calcutta, India) and H. Saha (Jadavpur University, Calcutta; Kalyani, University, Nadia, West Bengal, India). *Energy Conversion*, vol. 15, no. 1-2, 1975, p. 71-79. 15 refs.

A76-17525 **Fuel cells /revised and enlarged edition/. L. Oniciu (Cluj, Universitatea, Cluj, Rumania). Tunbridge Wells, Kent, England, Abacus Press, 1976. 178 p. 497 refs. Translation.**

The thermodynamics and kinetics of fuel cells are examined, taking into account the free enthalpy of electroactive reaction, thermodynamic free energies and equilibrium conditions, fuel cell efficiency, activation overvoltage, concentration overvoltage, and polarization curves. Electrodes and electrolytes in fuel cells are considered and a description is given of the various types of fuel cells. Applications of fuel cells are also discussed, giving attention to military applications, fuel cells in space flights, automobiles powered by fuel cells, the generation of electric energy in autonomous stations, and the employment of fuel cells in connection with the artificial heart. G.R.

A76-17549 **Effects of interfacial oxide layers on the performance of silicon Schottky-barrier solar cells.** D. R. Lillington and W. G. Townsend (Royal Military College of Science, Shrivenham, Wilts., England). *Applied Physics Letters*, vol. 28, Jan. 15, 1976, p. 97, 98. 5 refs.

Measurements have been made of the electrical and optical properties of Au-n-type silicon Schottky-barrier solar cells (SBSC) in which the metal and semiconductor are separated by a thin interfacial oxide layer about 10 to 23 Å thick. Measurements of the V-I characteristics showed that the value of the open-circuit voltage is increased by up to 38% and the maximum conversion efficiency by as much as 35% when compared with cells having no grown oxide layer. (Author)

A76-17746 # Investigation of a high-efficiency MHD generator with nonequilibrium conductivity (Issledovanie vysokoeffektivnogo MGD-generatora s neravnovesnoi provodimost'iu). A. D. Belykh, V. A. Gurashvili, and V. S. Golubev (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 13, Sept.-Oct. 1975, p. 1064-1071. 7 refs. In Russian.

Results are presented for an experimental study of a pulsed (2 microsec) MHD generator characterized by a nonequilibrium conductivity of the plasma. The experiments were carried out with a supersonic Faraday MHD channel in the case of full thermal power for the flow of the working medium (argon with cesium) up to 8 MW and stagnation temperatures of 5000-9000 K. The discussion covers measurements of the electrical and gasdynamic parameters of the MHD channel and various parameters of the plasma. It is shown that an effective MHD conversion from thermal to electrical energy with an up to 30% efficiency can be achieved under conditions of nonequilibrium conductivity of the plasma characterized by ionization turbulence, where the plasma is divided into layers located at an angle of 40-50 deg to the average Faraday current. S.D.

A76-18374 Optimal configuration of rotor blades for horizontal wind energy converters (Die optimale Auslegung rotierender Flügel für horizontale Windenergiekonverter). W. Weber (Stuttgart, Universität, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 23, Dec. 1975, p. 443-447. 8 refs. In German.

The paper proposes a formula for the total efficiency of a wind energy converter blade array and constructs on this basis a formula relating rotor blade configuration and efficiency with the aid of some auxiliary geometrical functions. The resulting function was evaluated by computer, and curves are presented showing calculated efficiencies for various blade geometries as blade arrangement is varied. P.T.H.

A76-18388 Solar heating and cooling. J. A. Duffie and W. A. Beckman (Wisconsin, University, Madison, Wis.). *Science*, vol. 191, Jan. 16, 1976, p. 143-149. 25 refs.

A review of the current status of solar energy systems and their thermal performance leads to the conclusion that adequate theory and engineering capability to design, install, and use equipment for solar heating of buildings are available. Energy can be delivered at costs that are competitive with high-cost energy sources, such as fuel-generated electrical resistance heating. Improvements of the technology of heating through advances in collector design and development of new materials and heating processes are examined. V.P.

A76-18421 Some energy sources and sinks in the upper atmosphere. C. B. Leovy (Washington, University, Seattle, Wash.). In: *Atmospheres of earth and the planets*; Proceedings of the Summer Advanced Study Institute, Liège, Belgium, July 29-August 9, 1974. (A76-18417 06-46) Dordrecht, D. Reidel Publishing Co., 1975, p. 73-86. 24 refs.

Mechanisms for upper atmospheric heating are considered with emphasis on solar energy absorption. A table is given for the average disposition of the incident solar flux. The role of infrared emission in the formation of the mesopause is discussed, and the role of hydrodynamic waves as heat sources for the thermosphere is briefly examined. B.J.

A76-18502 * # Current status of silicon solar cell technology. H. W. Brandhorst, Jr. (NASA, Lewis Research Center, Cleveland, Ohio). *Institute of Electrical and Electronics Engineers, International Electron Devices Meeting, Washington, D.C., Dec. 1-3, 1975, Paper. 7* p.

Recent advances in solar cell technology have led to the development of laboratory cells with efficiencies above 15% and production cells with efficiencies in the area of 13%. The increased output is largely the result of increases in the short-circuit current. The most significant gain in the amount of light entering the cell has been obtained through surface texturing by chemical etching techniques. Sheet resistances resulting from phosphorus diffusion in the 800 C temperature range yield junction depths on the order of 0.1 micrometer, leading to significant increases in the blue region of the cell spectral response. The inclusion of a back surface field in 10 ohm-cm cells has produced an increase in open-circuit voltage of about 50 mV and an increase in the minority carrier lifetime. It appears that a low emitter efficiency of the diffused region is the cause of poor voltages. Future research will be primarily directed toward correcting this deficiency and toward the development of low cost production methods. C.K.D.

A76-18505 * # Cost and size estimates for an electrochemical bulk energy storage concept. M. Warshaw and L. O. Wright (NASA, Lewis Research Center, Cleveland, Ohio). *Electrochemical Society, Meeting, 148th, Dallas, Tex., Oct. 5-9, 1975, Paper. 12* p. 7 refs.

Preliminary capital cost and size estimates were made for an electrochemical bulk energy storage concept for a redox-flow-cell system. Preliminary calculations showed that the redox-flow-cell system has great promise as a bulk energy storage system for power load leveling. The size of the system was estimated to be less than 2 percent of the size of a comparable pumped hydroelectric storage plant. V.P.

A76-18506 * # A generalized correlation of experimental flat-plate collector performance. F. F. Simon and D. R. Miller (NASA, Lewis Research Center, Cleveland, Ohio). *American Society for Testing and Materials and American National Standards Institute, Conference on Standards for Solar Heating and Cooling, Philadelphia, Pa., Oct. 14, 15, 1975, Paper. 19* p.

A generalized correlation of flat-plate collector performance obtained by outdoor and indoor test methods is presented. This correlation shows that the indoor (simulator) test approach is a special case of the general situation of variable solar conditions. The important feature of the generalized correlation is that it permits a separation of the solar variables (flux, incident angle, etc.) which affect collector performance from the collector parameters (absorptance, transmittance, heat loss, etc.) which also affect collector performance and which are uniquely part of a given collector design. The correlation permits an evaluation of the relative merits of using instantaneous, hourly and daily collector efficiencies in obtaining a good collector correlation. The question of the transient behavior outdoors of a collector is an important part of determining whether to use instantaneous, hourly or daily efficiency values in a correlation approach. Correlation of the experimental performance of collectors allows the following: (1) comparisons of different collector designs, (2) collector performance prediction under conditions that differ from the conditions of the test program, and (3) monitoring performance degradation effects. (Author)

A76-18532 # Technico-economic analysis of the utilization of inexhaustible energy sources (Tekhniko-ekonomicheskie raschety pri ispol'zovanii vozobnovliaemykh istochnikov energii). R. B. Salieva (Tashkentskii Institut Sviazi, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 5, 1975, p. 52-57. 8 refs. In Russian.

An economic analysis is conducted concerning the design, construction and utilization of solar power plants and wind power plants. Methods are presented for determining operational costs, for reducing them, and for calculating the real cost of producing solar and wind energy. Criteria are presented for selecting cost-optimal output power. B.J.

A76-18853 # Shrouds for aerogenerator. O. Igra (Negev, University, Beersheba, Israel). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D.C., Jan. 26-28, 1976, Paper 76-181*. 11 p. 15 refs. Research supported by the U.S.-Israel Binational Science Foundation.

In order to exploit the wind power as economically as possible, it was suggested that the wind-turbine be enclosed inside a specially-designed shroud. Past work has shown that such shrouds can increase the output power of a given turbine by a factor of 3 or so, as compared with the bare configuration under the same free stream conditions. However, the geometry of the first generation shrouds was unacceptable for economical use, i.e., the ratio of the shroud's total length to throat diameter was of the order of 7. The main purpose of the present work was to arrive at a compact shroud configuration without sacrificing good aerodynamic performance. The results clearly indicate that it is possible to obtain shrouds with total length to throat diameter ratio smaller than 3, with performance similar to the first-generation model. (Author)

STAR ENTRIES

N76-10231 Laboratoire Central de Telecommunications, Paris (France).

OPTIMAL ENERGY CONVERSION: INVESTIGATION OF A MAXIMUM POWER POINT TRACKING (MPPT) SYSTEM [CONVERSION OPTIMALE D'ENERGIE. ETUDE D'UN SYSTEME MPPT (MAXIMUM POWER POINT TRACKING)]

Y. Robin-Jouan. In ESA Spacecraft Power-Conditioning Electron. Seminar. Sep. 1974. p. 35-47. In FRENCH

New circuits were developed for conditioning and control of spacecraft power supply units, and a policy for optimization of the system is discussed and implemented. The goal of the optimization consists in maintaining the power supply system at maximum power point of the solar generator characteristics. The charge and discharge parameters of the battery are adjusted, so that global consumption is adapted exactly to the available power. ESA

N76-10487# California Univ., Los Angeles. Engineering Systems Dept.

STUDIES PERTAINING TO HYDROGEN CAR DEVELOPMENT. PART B: A COMPARATIVE STUDY OF ENGINE PERFORMANCE WITH GASOLINE AND HYDROGEN. PART C: HYDROGEN STORAGE AND FLOW SYSTEM

William D. VanVorst, David L. Douglas, and Didier DeFontaine. Oct. 1974. 55 p. refs.

(Contract DOT-OS-40011)

(PB-242131/1. UCLA-ENG-7489-Pt-B/C.

DOT/TST 75-99-Pt-B/C) Avail: NTIS HC \$4.25 CSCL 21D

A comparative study of the performance of an engine operating on gasoline and on hydrogen is presented. Results indicate thermal efficiencies of from 25 to 100% greater with hydrogen than with gasoline. The emission of nitrogen oxides was reduced approximately 90% when operating on hydrogen. With quality-governed, hydrogen operation, however, maximum power output is reduced by as much as 50%; with water injection, the figure might be 30%. The problem of the storage of hydrogen is addressed. In particular, metal hydride and liquid systems are compared. A liquid hydrogen system was developed and installed in a 1973 Jeep. Details of the system are presented. It was found to be basically feasible and operating experience thus far is favorable. GRA

N76-10562# Hittman Associates, Inc., Columbia, Md.
PROJECTIONS OF ENERGY AVAILABILITY, COST, AND AGGREGATE DEMAND FOR 1975, 1980, 1985, 1990 Final Report

H. M. Bernstein, B. K. Hinkle, and E. O. Bazques. May 1975. 138 p. refs.

(Contract DACA88-74-C-0040)

(AD-A010712. CERL-TR-E-58) Avail: NTIS CSCL 10/1

This report investigates the availability, cost, and aggregate demand of energy resources for 1975, 1980, 1985, and 1990. The consumption of energy resources for 1970 has been included for comparative purposes. The energy sources examined include: petroleum, gas, coal, nuclear, hydropower, solar, thermal, and electricity. GRA

N76-10565 Houston Univ., Tex.

PETROLEUM REFINERY LIQUID WASTES: ENVIRONMENTAL, ENERGY AND ECONOMIC IMPACTS Ph.D. Thesis
Stanley Finelt. 1975. 642 p.

Avail: Univ. Microfilms Order No. 75-22371

Analysis of the operation of a petroleum refinery has led to the development of simulation models for liquid waste generation and treatment. One model is based on a module concept whereby a refinery system is broken down into its smallest elements contributing to the liquid waste generated by the total system. In this way it was possible to account for the many variables associated with petroleum refining and liquid waste generation. A second model has been developed which simulates treatment of the liquid wastes generated by the refinery model. This model considers treatment to produce acceptable effluents suitable for discharge to the environment. Costs associated with the treatment system are generated from this model. The combination of the two models permits one to predict the economics of water reuse and recycle, and an example is given showing the application of water reuse to refinery operations in terms of economic incentives. Dissert. Abstr.

N76-10566*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CURRENT STATUS OF SILICON SOLAR CELL TECHNOLOGY

Henry W. Brandhorst, Jr. 1975. 8 p. Presented at Internatl. Electron Devices Meeting, Washington, D. C., 1-3 Dec. 1975. Sponsored by IEEE

(NASA-TM-X-71828; E-8534) Avail: NTIS HC \$3.25 CSCL 10A

In quest of higher efficiency, major progress has occurred in solar cell technology. Cell efficiency has climbed about 50 percent. Technical approaches leading to increased output include back surface fields, shallow junctions, improved antireflection coatings, surface texturizing, and fine grid patterns on the cell surface. The status of current solar cell technology and its incorporation into cell production is discussed. Research and development leading to improved performance and reduced cost are also described. Author

N76-10573# Abt Associates, Inc., Cambridge, Mass.

COST-EFFECTIVE METHODS TO REDUCE THE HEATING AND COOLING ENERGY REQUIREMENTS OF EXISTING SINGLE FAMILY RESIDENCES Final Report

Allan D. Ackerman, Peter T. Hogarth, Bryan J. Burke, and Robert F. Stone. Feb. 1975. 185 p. refs.

(Contract H-2179)

(PB-241919/O; AAI-75-19) Avail: NTIS HC \$7.00 CSCL 10A

This report investigates many practical ways to reduce energy consumed in the heating and cooling of family homes. Existing house construction types are studied, and energy conservation techniques that apply to these types are discussed with respect to cost and potential fuel savings. GRA

N76-10576# RAND Corp., Santa Monica, Calif.

EFFECTS OF ENERGY SHORTAGES ON THE WAY WE LIVE

Deane N. Morris. Dec. 1974. 25 p.

(AD-A010938; P-5377) Avail: NTIS CSCL 10/1

Energy use in personal transportation and residential buildings is briefly discussed along with methods that consumers have to reduce the impact of higher energy prices or scarcity of supplies. Government policy alternatives for energy conservation are noted. GRA

N76-10751*# General American Transportation Corp., Niles, Ill.

NECAP: NASA'S ENERGY-COST ANALYSIS PROGRAM. PART 1: USER'S MANUAL Final Report

R. H. Henninger, ed. Washington NASA Sep 1975 269 p (Contract NAS1-12843)

(NASA-CR-2590-Pt-1) Avail: NTIS HC \$8.50 CSCL 09B

The NECAP is a sophisticated building design and energy analysis tool which has embodied within it all of the latest ASHRAE state-of-the-art techniques for performing thermal load calculation and energy usage predictions. It is a set of six individual computer programs which include: response factor program, data verification program, thermal load analysis program, variable temperature program, system and equipment simulation program, and owning and operating cost program. Each segment of NECAP is described, and instructions are set forth for preparing the required input data and for interpreting the resulting reports.

Author

N76-10752*# General American Transportation Corp., Niles, Ill.

NECAP: NASA'S ENERGY-COST ANALYSIS PROGRAM. PART 2: ENGINEERING MANUAL Final Report

R. H. Henninger, ed. Washington NASA Sep. 1975 345 p (Contract NAS1-12843)

(NASA-CR-2590-Pt-2) Avail: NTIS HC \$9.50 CSCL 09B

Each segment of NECAP is described, and the algorithms that were programmed into each subroutine are presented. For part 1, see N76-10751.

M.J.S.

N76-11204 AEG-Telefunken, Backnang (West Germany). Fachbereich Weitverkehr und Kabeltechnik.

CONSIDERATIONS ON THE FEASIBILITY AND TECHNOLOGY OF SOLAR ENERGY SATELLITES AND ENERGY TRANSFER SATELLITES [BETRACHTUNGEN ZUR DURCHFUEHRBARKEIT UND TECHNOLOGIE VON SONNENENERGIE-SATELLITEN UND ENERGIEUEBERTRAGUNGS-SATELLITEN]

May 1975 91 p refs In GERMAN; ENGLISH summary Prepared jointly with Dornier System and Tech. Univ. Berlin (Contract GfW-RV-11-V-67/74-PZ-BB-74)

Copyright. Avail: Issuing Activity

An analysis of the technological development problems of using orbital systems (satellites) for the generation and transfer of energy from space was made. The possible role of solar energy and the use of satellites for the generation of energy in space or the transmission of energy through space were studied mainly in the U.S., with the conclusion that solar energy utilization could become attractive provided a number of technical and technological problems can be solved. Studies done so far are reviewed and problems concerning the realization of energy satellites are discussed. The main components of the systems studies are dealt with, transport problems and choice of orbits are indicated; and investment, operating, and energy costs are estimated.

ESA

N76-11427# California Univ., Livermore. Lawrence Livermore Lab.

LASER FUSION: CAPITAL COST OF INERTIAL CONFINEMENT

R. E. Kidder 11 Feb. 1975 5 p refs Presented at Intern. Conf. on Energy Storage, Compression and Switching, Turin, Italy, 5 Nov 1974 Sponsored by ERDA

(UCRL-76546; Conf-741113-10) Avail: NTIS HC \$4.00

In the context of laser-induced fusion of solid pellets, a quadratic relation between peak laser power and the inertial confinement parameter ρR is derived and discussed. This relation is combined with the linear relation between laser system cost and peak output power to obtain an estimate of the capital cost of inertial confinement.

Author (NSA)

N76-11556# Committee on Ways and Means (U. S. House) **THE ENERGY CRISIS AND PROPOSED SOLUTION: PART 1**

Washington GPO 1975 569 p refs Panel discussions before Comm. on Ways and Means, 94th Congr., 1st Sess., 3-7 Mar., 10-14 Mar., and 17 Mar. 1975

(GPO-49-192) Avail: Comm. on Ways and Means

Alternatives for reducing America's vulnerability to economic disruption as a result of foreign oil dependence and energy shortages are discussed. Energy conservation measures, import quotas, strategic reserves, and oil allocation programs are considered. Data are also given on oil tax policies and capital incentives.

E H.W.

N76-11557*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Telecommunications Div.

PERFORMANCE OF A SOLAR-THERMAL COLLECTOR

W. H. Higa 1 Nov. 1975 21 p refs

(Contract NAS7-100)

(NASA-CR-145623; JPL-TM-33-748) Avail: NTIS HC \$3.50 CSCL 10A

Possible means of achieving the technology required for field application of solar thermal power systems are discussed. Simplifications in construction techniques as well as in measurement techniques for parabolic trough collectors are described. Actual measurement data is also given.

Author

N76-11558*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.

TERRESTRIAL SOLAR THERMIONIC ENERGY CONVERSION SYSTEMS CONCEPT

K. Shimada and M. Swerdling 1 Nov. 1975 29 p refs

(Contract NAS7-100)

(NASA-CR-145622; JPL-TM-33-744) Avail: NTIS HC \$4.00 CSCL 10A

Results obtained from studies of a (1) solar concentrator, (2) solar energy receiver - thermionic converter system, and (3) solar thermionic topping system are described. Peripheral subsystems, which are required for any solar energy conversion system, are also discussed.

Author

N76-11562# European Space Agency, Paris (France).

FLAT SOLAR COLLECTORS: ENERGY BALANCE AND EFFICIENCY

Rainer Koehne Sep. 1975 43 p refs Transl. into ENGLISH of "Der flache Sonnenkollektor Energiebilanz u. Wirkungsgrad", DFVLR, Stuttgart Report DLR-FB-75-33, 7 Apr. 1975 Original German report available from DFVLR, Porz, West Ger. 17.70 DM

(ESA-TT-185; DLR-FB-75-33) Avail: NTIS HC \$4.00

A theoretical model for the flat solar collector is described and the energy balance equations considering the heat losses by convection, conduction, and radiation are derived. Efficiencies of various collector types as functions of solar flux and ambient temperature are given in graph form and compared with each other. It is shown that for the latitudes discussed (Germany) the most suitable type of collector is the one with two cover plates, attaining an average efficiency of about 50%, precise value depending on desired collector temperature and, therefore, water temperature.

Author (ESA)

N76-11566# Illinois Univ., Urbana. Center for Advanced Computation.

ENERGY CONSERVATION THROUGH TAXATION Interim Research Report

Clark W. Bullard Jan. 1974 31 p refs

(Grant NSF GI-35179)

(PB-242620/3; UIUC-CAC-DN-74-95; NSF/RA/N-74-206)

Avail: NTIS HC \$4.00 CSCL 05A

The growth of energy productivity has slowed in recent years. This trend implies that energy demands will rise at increasing rates if economic growth is sustained. In turn, environmental, fiscal, and national security problems associated with growing energy demands may increase faster than the ability to cope with them. To provide incentives for increasing energy productivity

n energy conservation tax is proposed. A linear model is used to estimate the impacts of such a tax on prices of final products. It is shown that an ad valorem tax could be more regressive than a specific tax based on energy units. GRA

N76-11567# National Bureau of Standards, Washington, D.C. Office of Building Standards and Codes Services.
EMERGENCY WORKSHOP ON ENERGY CONSERVATION IN BUILDINGS. NATIONAL CONFERENCE OF STATES ON BUILDING CODES AND STANDARDS AND NATIONAL BUREAU OF STANDARDS JOINT EMERGENCY WORKSHOP ON ENERGY CONSERVATION IN BUILDINGS Final Report

Sandra A. Berry Jul. 1975 34 p Workshop held at Washington, D. C. 19 June. 1973
(COM-75-10766/4; NBS-TN-789-1) Avail: NTIS HC \$4.00 HC also available from SOD as C13.46:789-1 CSCL 10A

This report contains the non-technical presentations given at the National Conference of States on Building Codes and Standard/National Bureau of Standards Joint Emergency Workshop on Energy Conservation in Buildings. Presentations included are those of other federal agencies, states, technical societies and industry organizations. GRA

N76-11570# Federal Energy Administration, Washington, D.C. Office of Energy Data Policy.
PROCEEDINGS OF THE NATIONAL ENERGY DATA WORKSHOP

Apr. 1975 261 p refs Workshop held at Lafayette, Ind., 30-31 Oct. 1974
(PB-241665/9; FEA/G-75/211R) Avail: NTIS HC \$9.00 CSCL 10A

The proceedings of the National Energy Data Workshop cover the two day conference co-sponsored by the Federal Energy Administration and Purdue University. Presentations given at the conference by federal and state officials include: (1) Petroleum information systems; (2) Information for contingency planning; (3) Long range data programs; (4) FEA data programs in relation to the states; (5) Should the states be in the energy information business. GRA

N76-11571# Federal Energy Administration, Washington, D.C. Office of Energy Resource Development.

THE UTILITY OIL SAVINGS STUDY Final Report

Jan. 1975 36 p
(PB-242493/5; FEA/G-75/255) Avail: NTIS HC \$4.00 CSCL 10A

This report includes an analysis of five measures to save oil in the utility sector and identifies the oil savings, associated costs, and constraints under alternative policy options. Particular emphasis is accorded to measuring the impact on the oil savings objective of those initiatives proposed by the President in the State of the Union Message. GRA

N76-11572# Resource Planning Associates, Inc., Cambridge, Mass.

ENERGY SUPPLY/DEMAND ALTERNATIVES FOR THE APPALACHIAN REGION, EXECUTIVE SUMMARY Final Report, Mar. - Dec. 1974

Mar. 1975 90 p Prepared in cooperation with Appalachian Regional Commission and NSF
(PB-242944/7; RA-74-18) Avail: NTIS HC \$5.00 CSCL 10A

The report is presented in two parts: (1) A description of the development of an analytic methodology, emphasizing the way it was used to estimate regional energy supply/demand balances and impacts; and (2) the findings and policy implications for the Appalachian Region resulting from the analysis of seven national energy scenarios. The most important effects analyzed included end use consumption patterns; required energy sources (especially coal) and conversion facilities; and economic, social, and environmental impacts on Appalachia and its subregions.

Author

N76-11574# California Univ., Berkeley. Sanitary Engineering Research Lab.

SOLAR ENERGY FIXATION AND CONVERSION WITH ALGAL BACTERIAL SYSTEMS Semiannual Progress Report, 1 Jul. - 30 Sep. 1974

Moshe Uziel, William J. Oswald, and G. Golueke 4 Dec. 1974 18 p

(Grant NSF GI-39216)

(PB-242362/2; SERL-74-3;

NSF/RANN/SE/GI-39216/PR/74-3; NSF/RA/N-74-195)

Avail: NTIS HC \$3.50 CSCL 13B

The overall objective of the study is to explore the feasibility of a process which is based on the utilization of algal-bacterial cultures integrated in such a manner that solar energy is 'fixed' into algal cellular material--material which in turn is converted to methane by way of anaerobic digestion. The process is coupled with waste-water treatment and nutrient recycle. An important specific objective is the assessment of the economic feasibility of the solar energy fixation-methane-production system in terms of generation of electricity through the combustion of the methane and of the recycling of the nutrients in waste water. A second important specific objective is an assessment of the comparative fermentability of several species of algae. GRA

N76-11578# Federal Energy Administration, Washington, D.C.
FEDERAL ENERGY ADMINISTRATION ELECTRICITY CONFERENCE

Feb. 1975 206 p refs Conf. held at Washington, D. C., 19-20 Sep. 1974

(PB-242472/9; FEA/G-75/179) Avail: NTIS HC \$7.75 CSCL 10B

The conference was devoted to a discussion of the serious financial problems which the electric utility industry is experiencing and electricity conservation. The present electric utility situation presents a serious threat to our nation's ability to achieve energy self-sufficiency over the next decade. Two of the more critical aspects of the current situation involve the ability of the utilities to obtain adequate financing for the shift to coal and nuclear generating plants and the implementation of more effective electrical energy conservation programs at every level. GRA

N76-11579# Carnegie-Mellon Univ., Pittsburgh, Pa.

SOLAR SEA POWER Quarterly Report, 1 Jul. - 30 Sep. 1974

Clarence Zener, Abraham Lavi, Robert R. Rothfus, Charles Kriebel, and Francis McMichael 31 Oct. 1974 17 p

(Grant NSF GI-39114)

(PB-242263/2; NSF/RA/N-74-200;

NSF/RANN/SE/GI-39114/PR-74-5; QR-5) Avail: NTIS HC \$3.50 CSCL 10B

Layouts for the solar sea power plant (SSPP) system component are worked out taking into account components cost and availability, plant maintenance, and ocean mooring. A 100 MWe net SSPP has been costed for a stationary plant located off a Caribbean island where a delta T = 40 degree F can be realized. The cost ranges from a low of \$290 to a high of \$530 per kW at the bus bar. Transmission or additional energy conversion costs have not been included. Material requirements on a per kW basis for 100 MWe plant have also been established. GRA

N76-11582# Massachusetts Univ., Amherst.

A PROPOSED OCEAN THERMAL ENERGY CONVERSION SYSTEMS PROGRAM PLAN (THE OTECS PLAN)

William E. Hernoemus Mar. 1975 72 p

(Grant NSF GI-34979)

(PB-242248/3; NSF/RA/N-75-030) Avail: NTIS HC \$4.50 CSCL 10B

A program plan for development and acquisition of significant Ocean Thermal Energy Conversion Systems (OTECS) is presented. Existing research results are to be reduced to one or more bidder's packages via a contract definition phase evolution of one year conducted from a new and appropriately staffed program management headquarters. A standardized nomenclature system for description of any OTECS is presented. A technical development

plan derived from existing research results is presented in considerable detail. Finally, a program summary is presented.

GRA

N76-11583# Carnegie-Mellon Univ., Pittsburgh, Pa.
MAJOR ELECTRIC EQUIPMENT COST FIGURES FOR SOLAR SEA POWER PLANTS

Leo A. Finzi 31 Oct. 1974 49 p
 (Grant NSF GI-39114)

(PB-242156/8; NSF/RA/N-74-201;
 NSF/RANN/SE/GI-39114/TR-74-5) Avail: NTIS HC \$4.00
 CSCL 10B

These figures are based on actual manufacturers' data. In addition, the dependence of cost on speed, frequency and shaft orientation for rotating machines is derived. The appendix includes the rules of similitudes of transformers and electric machines so that performance and materials requirements for different ratings can be derived from a given design and rating.

GRA

N76-11584# Massachusetts Univ., Amherst. Energy Alternatives Program.

DESIGN AND OFF-DESIGN PERFORMANCE ANALYSIS OF OCEAN THERMAL DIFFERENCE POWER PLANT TURBINES

R. J. Veenema, Jr. and L. L. Ambs May 1975 120 p refs
 (Grant NSF GI-34979)

(PB-242152/7; NSF/RA/N-75-031;
 NSF/RANN/SE/GI-34979/TR-75-5) Avail: NTIS HC \$5.50
 CSCL 10B

A procedure was developed to determine the axial-flow turbine design that operates at the maximum attainable efficiency for the design specific speed. The procedure uses the results of Balje's optimization study and accounts for the Reynolds number variation of Balje's optimized parameters. The procedure has been used to study the variation of the design parameters of ammonia and propane OTDM turbines. A procedure has been developed to predict the off-design performance of turbines designed by the previously mentioned design procedure. The inlet state, mass flow and rotational speed have been varied to produce performance maps for a series of ammonia and propane OTDM turbines.

GRA

N76-11585# Electric Power Research Inst., Palo Alto, Calif.
AN OVERALL PROGRAM FOR THE DEVELOPMENT OF OPEN CYCLE MHD POWER GENERATION

1 May 1975 107 p

(PB-242585/8; EPRI-SR-12) Avail: NTIS HC \$5.50 CSCL 10B

Open cycle MHD electrical power generation offers the potential of greatly improved efficiency in the use of coal and other fossil fuels. The program described in this document has been formulated to illustrate the type of overall planning required for the development of open cycle MHD power generation, and to provide an initial framework for the coordination of research efforts. The main emphasis of the program is on direct coal firing of open cycle MHD systems, although significant attention is directed toward the use of clean fuels.

GRA

N76-11587# Arizona Univ., Tucson. Optical Sciences Center.
RESEARCH APPLIED TO SOLAR-THERMAL POWER CONVERSION. VOLUME 1: EXECUTIVE SUMMARY Final Report, 1 Jun. 1971 - 31 Jan. 1973

Aden Meinal 1973 21 p

(Contract F33615-68-C-7111; Grant NSF GI-30022)

(PB-242086/7; NSF/RANN/SE/GI-30022/FR-73-1;

NSF/RA/N-73-010-Vol-1) Avail: NTIS HC \$3.50 CSCL 20F

Solar absorbing coatings of high selectivity, (a/e), and their influence on system design, operation, and economics are studied. Two basically different approaches to high (a/e) coatings were followed: (1) interference thin film coatings and (2) intrinsic absorber coatings using chemically vapor-deposited (CVD) silicon as the absorbing component.

GRA

N76-11588# Arizona Univ., Tucson. Optical Sciences Center.
RESEARCH APPLIED TO SOLAR-THERMAL POWER

CONVERSION. VOLUME 2: FINAL REPORT Final Report 1 Jun. 1971 - 31 Jan. 1973

Aden Meinal 31 Jan. 1973 215 p refs

(Contract F33615-68-C-7111; Grant NSF GI-30022)

(PB-242087/5; NSF/RANN/SE/GI-30022/FR-73-2;

NSF/RA/N-73-011) Avail: NTIS HC \$7.75 CSCL 20F

Laboratory fabrication and measurement of solar absorbing coatings of high selectivity, (a/e), and their evaluation for use in electrical power production by means of thermodynamic cycles are discussed. Two types of selective coatings were evaluated: one using interference thin film stacks, and the second using intrinsic optical absorption of CVD silicon.

GRA

N76-11830# California Univ., Livermore. Lawrence Livermore Lab.

THEORETICAL AND PRACTICAL ASPECTS OF ENERGY STORAGE AND COMPRESSION

O. S. F. Zucker and W. H. Bostick 7 Apr. 1975 24 p refs
 Presented at Intern. Conf. on Energy Storage, Compression, and Switching, Torino, Italy, 5 Nov. 1974 Sponsored by ERDA
 (UCRL-76091; Conf-741113-12) Avail: NTIS HC \$4.25

The theoretical and experimental aspects of energy storage and compression are reviewed. The role of complementary energy modes combined with nonlinearities in energy compression is described. The need for 'coherent nonlinearity' for efficient compression is emphasized. Various fundamental methods for compressions are described. Quantum mechanical limitations are discussed. Energy storage is reviewed from a theoretical and practical point of view with emphasis on new approaches.

Author (NSA)

N76-12267# Office of Telecommunications, Boulder, Colo.

TELECOMMUNICATIONS SUBSTITUTABILITY FOR TRAVEL: AN ENERGY CONSERVATION POTENTIAL

Charles E. Lathey Jan. 1975 106 p refs Prepared in cooperation with Federal Energy Admin.

(COM-75-10785/4; OTR-75-58) Avail: NTIS HC \$5.50 CSCL 17B

Telecommunications has the potential of conserving energy to a significant degree by substituting for the information handling functions currently being performed through the use of transportation. Two means of energy saving were explored: decentralization of work forces, which would reduce commuter travel, and the increased use of telecommunications by existing work forces in their current organizational structures. Energy consumption by telecommunications and transportation were explored as was the nature of the work forces and the factors influencing travel. Teleconferencing, both in the United States and abroad, is reviewed. An appendix, issued separately as a part of this document, contains abstracts of documents related to the subject.

GRA

N76-12455# Committee on Commerce (U. S. Senate).

NATURAL GAS PRODUCTION AND CONSERVATION ACT OF 1974

Washington GPO 1974 357 p refs Hearings before Comm. on Commerce, 93d Congr., 2d Sess., 4-5 Dec. 1974

(GPO-47-272) Avail: Comm. on Commerce

Testimony is provided on the reform of natural gas price regulation. Topics discussed include: allegations of false reporting by the oil industry of its discoveries and reserves on Federal lands; management of lands leased for oil and gas development; and possible withholding of supplies from pipelines by major producers in amounts that would evaporate the shortage of natural gas facing the Nation.

J.M.S.

N76-12458# North Carolina Univ., Chapel Hill. School of Law.

THE ROLE OF NORTH CAROLINA IN REGULATING OFFSHORE PETROLEUM DEVELOPMENT

Joseph E. Kilpatrick Apr. 1975 34 p refs

(Grant NOAA-04-3-158-40)

(COM-75-10854/8; UNC-SG-75-09; NOAA-75061002) Avail: NTIS HC \$4.00 CSCL 08I

Existing laws which may be applicable to the process of regulating offshore petroleum development are examined. The history of the legal conflict between the federal government and the coastal states in regulating offshore oil exploitation is traced. The legal difficulties encountered in determining the seaward and lateral marine boundaries of North Carolina, and the geological prospects of finding valuable oil deposits in marine areas adjacent to North Carolina are considered along with the legal framework--international, federal, and state--within which offshore petroleum development must take place. GRA

N76-12462 Florida Univ., Gainesville.
ENERGY BASIS FOR MIAMI, FLORIDA, AND OTHER URBAN SYSTEMS Ph.D. Thesis

James John Zucchetto 1975 263 p
 Avail: Univ. Microfilms Order No. 75-23930

A systems study is presented of Miami, Florida, with data collected for the years 1950-72. Cross-correlation analysis of the data, calculation of urban indices, computer simulation of mathematical models, and construction of a land use map are discussed along with calculation of major economic, fossil fuel, and natural energy flows, estimations of energy available from solar energy technology, and a theory relating economic competitiveness to the ratio of natural to fossil-fuel energies. The urban system of Miami and Dade County, Florida, was used as a study area but the theory and approach could be used for urban system. Dissert. Abstr.

N76-12464* Auburn Univ., Ala. Engineering Systems Design.

ECASTAR: ENERGY CONSERVATION. AN ASSESSMENT OF SYSTEMS, TECHNOLOGIES AND REQUIREMENTS
 Executive Summary

Sep. 1975 53 p Presented at the 1975 NASA/ASCE Systems Design Summer Program, Auburn, Ala., Sep. 1975 Sponsored in part by FEA

(Grant NGT-01-003-044)

(NASA-CR-145716) Avail: NTIS HC \$4.50 CSCL 10A

A methodology was presented for a systems approach to energy conservation actions and their potentials and impacts in the United States. Constraints affecting the approach were ranked, and the most important ones are the present economic and technical conditions. The following unresolved issues were identified: consumptive lifestyles vs. conservation ethic, environmental standards vs. energy conservation, capital availability, decentralization and vertical integration vs. centralization, fuel rich regions vs. fuel poor regions, supply vs. end use conservation, life cycle costing vs. initial cost, mandatory savings vs. voluntary savings, labor intensive vs. capital intensive, price control vs. free market. The following recommendations were made: provide action/impact assessment, establish regional energy centers, improve technology articulation with government, design total energy systems, utilize existing systems approach expertise.

N76-12467* Auburn Univ., Ala.

EXAMPLE OF INPUT-OUTPUT ANALYSIS

In its ECASTAR: Energy Conserv. An Assessment of Systems, Technol. and Requirements Sep. 1975 p 15-20

CSCL 10A

The thirty sectors included in the ECASTAR energy input-output model were listed. Five of these belong to energy producing sectors, fifteen to manufacturing industries, two to residential and commercial sectors, and eight to service industries. The model is capable of tracing impacts of an action in three dimensions: dollars, BTU's of energy, and labor. Four conservation actions considered were listed and then discussed separately, dealing with the following areas: increase in fuel efficiency, reduction in fuel used by the transportation and warehousing group, manufacturing of smaller automobiles, and a communications/transportation trade-off. Y.J.A.

N76-12468* Auburn Univ., Ala.

THREE STRATEGIES FOR CONSERVATION

In its ECASTAR: Energy Conserv. An Assessment of Systems, Technol. and Requirements Sep. 1975 p 20-30

CSCL 10A

The three strategies considered as energy conservation oriented were given: national energy conservation, electrification, and diversification. The first one applies to the near term period (now-1985), the second one to the mid term (1985-2000), and the third one to the far term (2000-). The rest of this section was focussed on the near term period. The following proposed actions were considered: (1) roll back the price of newly discovered oil, (2) force conversion of many power plants from gas and oil to coal, (3) freeze gasoline production for three years at 1972 levels, (4) mandate automobile mileage requirements, (5) require industry to improve energy efficiency, and (6) require manufacture of household appliances with greater efficiency. Each of these six actions was described and discussed in more detail. Y.J.A.

N76-12469* Auburn Univ., Ala.

ELECTRIFICATION: MID-TERM (1985 - 2000)

In its ECASTAR: Energy Conserv. An Assessment of Systems, Technol. and Requirements Sep. 1975 p 30-37

CSCL 10B

Electrification, intended to provide a basis for the mid term period of the energy conservation program, was defined as a set of actions and/or policies that leads to an increasing proportion of total energy used in the form of electricity. The important actions within electrification are those with the greatest impacts (coal and nuclear), the greatest technological requirements (peak shaving and transmission) and the greatest response from the decision makers (economic health and growth of utilities in an era of increasing energy costs). The following areas were discussed: increased power generation from coal action, increased use of nuclear power action, improved operation of public utilities action, actions to be taken in industry, transportation and residential/commercial areas. The various ways in which electrification leads to energy conservation were clarified, and a number of specific recommendations relative to electrification were suggested. Y.J.A.

N76-12471* Auburn Univ., Ala.

CITIZEN'S ACTIONS

In its ECASTAR: Energy Conserv. An Assessment of Systems, Technol. and Requirements Sep. 1975 p 42-49

CSCL 10A

The various ways in which energy may be conserved by individual citizens as consumers were explored. The following barriers against citizens implementing an effective conservation program were described: credibility gap between producers and consumers, consumptive lifestyles, inverted rate structure, low fuel costs, and initial costs compared to life cycle costs. The following indices for saving energy were identified: time to develop alternatives, scarcity of fuels, reduction of dependence on imports, and decreasing environmental pollution. The various approaches to encourage energy conservation by individuals were described, followed by specific conclusions and recommendations. Y.J.A.

N76-12474* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW COST SILICON SOLAR ARRAYS

John V. Goldsmith, J. W. Cleland, R. D. Westbrook, H. L. Davis, R. F. Wood, Joseph Lindmayer, and G. F. Wakefield In its Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 56-103

CSCL 10A

The economic production of silicon solar cell arrays circumvents p-n junction degradation by nuclear doping, in which the Si-30 transmutes to P-31 after thermal neutron capture. Also considered are chemical purity specifications for improved silicon bulk states, surface induced states, and surface states. G.G.

N76-12479* Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

STATUS OF ERDA-DOD APPLICATIONS PLANS

Donald B. Dinger *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 232-249
CSCL 10A

A demonstration program is reported that defines solar terrestrial photovoltaic systems as power sources for DOD applications by developing requirements and implementation plans for each demonstration project. Evaluation criteria emphasize military market potential and military advantages. G.G.

N76-12480* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

REVIEW OF TERRESTRIAL PHOTOVOLTAIC MEASUREMENTS WORKSHOP

Henry W. Brandhorst, Jr. *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 251-260
CSCL 10A

Measurement methods for terrestrial solar cells require calibration standards to set simulator irradiance levels or to monitor solar irradiance in outdoor measurements. Measurements of solar cell performance in terrestrial sunlight are the most acceptable, but an artificial light source can be used for laboratory measurements. Author

N76-12483* Sandia Labs., Albuquerque, N.Mex.

INTEGRATED PHOTOVOLTAIC-THERMAL SOLAR ENERGY CONVERSION SYSTEMS

George A. Samara *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 297-309 Sponsored by ERDA

CSCL 10A

A combined photovoltaic/thermal collector has been built and is now being tested. Initial tests have concentrated on evaluating the thermal efficiency of the collector before and after the silicon cells are mounted. With likely improvements in bonding between cells and receiver and in the absorptivity of the cells, thermal efficiencies greater than 50% can be expected for the combined receiver operating at 100 C. Author

N76-12484* Southern Methodist Univ., Dallas, Tex.

DEVELOPMENT OF LOW COST THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS FOR TERRESTRIAL APPLICATIONS

Ting L. Chu *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 310-329

(Grant NSF AER-73-07843)

CSCL 10A

The AMO efficiencies (no anti-reflection coating) obtained to date are 2.5% for solar cells deposited on graphite substrates, 3.5% for solar cells deposited on metallurgical silicon substrates, and 4.5% for solar cells fabricated from purified metallurgical silicon. Author

N76-12489* Delaware Univ., Newark. Inst. of Energy Conversion.

ASSESSMENT OF THE INTERNATIONAL WORKSHOP ON CdS SOLAR CELLS

Karl W. Boer *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 400-403

CSCL 10A

General problems relating to the basic understanding of CdS/Cu₂S solar cell operation, to material aspects of the cell and to manufacturing methods and cell engineering are discussed. Author

N76-12492* Delaware Univ., Newark. Inst. of Energy Conversion.

DIRECT SOLAR ENERGY CONVERSION FOR LARGE SCALE TERRESTRIAL USE

Karl W. Boer and John D. Meakin *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 442-460
(Grant NSF AER-72-03478)

CSCL 10A

Various techniques to increase the open circuit voltage are being explored. It had been previously observed that cells made on CdS deposited from a single source gave a consistently higher V sub oc. Further tests have now shown that this effect may in fact relate to differences in source and substrate temperatures. The resulting differences in CdS structure and crystallinity are being documented. Deposits of mixed CdS and ZnS are being produced and will be initially made into cells using the conventional barriering technique. Analysis of I-V characteristics at temperatures between 25 and 110 C is being perfected to provide nondestructive analysis of the Cu₂S. Changes due to vacuum heat treatments and exposure to oxygen are also being monitored by the same technique. Detailed spectral response measurements are being made. Author

N76-12498* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

LOW COST AMOS SOLAR CELL DEVELOPMENT

Richard J. Stirn *In* its Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 533-547

CSCL 10A

Recent developments at JPL have demonstrated that high conversion efficiencies are found with GaAs metal semiconductor solar cells when a particular heat treatment processing step is used to introduce an interfacial layer between the metal and the semiconductor. The new cell, called AMOS (Antireflection-Coated Metal-Oxide-Semiconductor), has open circuit voltages of 0.68-0.72 volts and efficiencies of 15% under terrestrial sunlight, as compared to values of 0.45-0.48 volts and 10%, respectively, for similar cells without an interfacial layer. Potentially higher efficiencies are feasible as further improvements are made in optimizing the interfacial layer effect and in increasing the blue response of the cells. A thin film AMOS cell is proposed that uses a thin recrystallized germanium (Ge) layer between a low cost metal substrate and the vapor phase epitaxially (VPE)-grown GaAs. Author

N76-12499* Rutgers Univ., New Brunswick, N.J. Electrical Engineering Dept.

SILICON SCHOTTKY PHOTOVOLTAIC DIODES FOR SOLAR ENERGY CONVERSION

Wayne Anderson *In* JPL Proc. of the 1st ERDA Semiann. Solar Photovoltaic Conversion Program Conf. 25 Jul. 1975 p 549-570
(Grant NSF AER-73-03197)

CSCL 10A

Various factors in Schottky barrier solar cell fabrication are evaluated in order to improve understanding of the current flow mechanism and to isolate processing variables that improve efficiency. Results of finger design, substrate resistivity, surface finishing and activation energy studies are detailed. An increased fill factor was obtained by baking of the vacuum system to remove moisture. G.G.

N76-12510# Committee on Ways and Means (U. S. House).

BACKGROUND READINGS ON ENERGY POLICY

Washington GPO 1 Mar. 1975 891 p refs Selected materials compiled by the staff of the Comm. on Ways and Means, 94th Congr., 1st Sess., 1 Mar. 1975 Prepared by the Library of Congr., Congressional Res. Service
(GPO-48-086) Avail. Comm. on Ways and Means

Information on various aspects of the energy issue is presented as background for the deliberations on and development of a national energy program. The possibilities for expanding alternative energy supplies and energy conservation are discussed. Topics discussed include energy needs and alternatives, natur.

gas supply and policy, tax policy in the energy sector, energy conservation potentials and policies, the impact of energy conservation, international implications of energy policy, alternative fuels, waste materials utilization, gasoline consumption and conservation, and the transportation sector. M.J.S.

N76-12511# Committee on Ways and Means (U. S. House). **SUMMARY OF ENERGY FACTS AND ISSUES** Washington GPO 1975 166 p refs Staff rept. presented to Comm. on Ways and Means, 94th Congr., 1st Sess., 4 Mar. 1975 Prepared by Library of Congr., Congressional Res. Service (H-Doc-94-42; GPO-48-269) Avail: Comm. on Ways and Means

Proposed energy legislation, and the economic impact of administration energy programs are reported along with briefs on natural gas, energy conservation, auto fuel economy incentives, and energy conservation in residential buildings. The agreement on an international energy program is included, and factual information and statistical tables are presented. F.O.S.

N76-12514# Battelle Columbus Labs., Ohio. **DEVELOPMENT OF INFORMATION FOR STANDARDS OF PERFORMANCE FOR THE FOSSIL FUEL CONVERSION INDUSTRY Final Report** B. Kim, J. Genco, J. Oxley, and P. Choi Oct. 1974 157 p refs (Contract EPA-68-02-0611) (PB-242543/7; EPA-450/3-75-029) Avail: NTIS MF \$6.75 CSDL 07A

Information pertaining to four SNG coal gasification processes (Lurgi, Synthane, Hygas and CO₂-Acceptor) and one Low-BTU fuel gasification process (Lurgi) is supplied. Commercial literature on another Low-BTU process (Koppers-Totzek) is also given. Control of sulfurous emissions is discussed. GRA

N76-12515# Carnegie-Mellon Univ., Pittsburgh, Pa. **SOLAR SEA POWER Final Report** Abraham Lavi 31 Jan. 1975 136 p refs (Grant NSF GI-39114) (PB-242264/0; NSF/RA/N-75-021; NSF/RANN/SE/GI-39114/PR-74-6) Avail: NTIS HC \$6.00 CSDL 10B

The solar energy stored in the tropical oceans as heat is converted into electricity by means of closed Rankine-cycle power plants. The process is analyzed, each component is evaluated, and a complete power plant is costed out. It is concluded that a power plant costing \$450 - 700/kw can be designed and enough power fed into the U.S. mainland to drastically reduce the nation's dependence on imported fuel by 1985. GRA

N76-12516# Delaware Univ., Newark. Inst. of Energy Conversion. **DIRECT SOLAR ENERGY CONVERSION FOR LARGE SCALE TERRESTRIAL USE Annual Progress Report, 1 Jan. 1973 - 31 Dec. 1973** Jan. 1974 95 p refs (Grant NSF GI-34872) (PB-242732/6; NSF/RA/N-74-006) Avail: NTIS HC \$5.00 CSDL 10B

Progress is reported on all aspects of the work on Cu₂S/CdS solar cells and their application to direct solar energy conversion for large scale terrestrial use. Topics covered are (1) basic studies of Cu(x)S/CdS layers (2) cell lifetimes (3) cell properties at elevated temperatures (4) improved production techniques (5) economic analyses of production costs (6) production of cells and demonstration units (7) systems analysis, and (8) environmental considerations. GRA

N76-12518# DSS Engineers, Inc., Fort Lauderdale, Fla. **DEVELOPMENT OF PLASTIC HEAT EXCHANGERS FOR SEA SOLAR POWER PLANTS Final Report, 10 Jun. 1974 - 28 Feb. 1975** W. B. Suratt, G. K. Hart, and E. N. Sieder 10 Mar. 1975 150 p refs

(Grants NSF AER-74-13030-A01; NSF GI-43444) (PB-242155/0; NSF/RA/N-75-026) Avail: NTIS HC \$6.00 CSDL 13A

Conceptual designs of heat exchangers for the sea solar power plant using lost cost plastic surfaces are evaluated. Composite walls of conductive, filled high density polyethylene and multilayered thin films of impermeable plastics are used as the reference material. Plate surfaces using thin falling films for evaporation and condensation of ammonia are identified as the least expensive concept. Horizontal tubular units are considered but cost and complexity are greater. Cost of heat exchangers for a 240 MW (gross) ammonia plant is estimated at \$47/kw which includes replacement of plastic surface twice during a 30 year plant life. GRA

N76-12519# Aerospace Corp., El Segundo, Calif. Energy and Research Div. **HIGHLIGHTS OF THE SOLAR THERMAL CONVERSION PROGRAM Semiannual Review, 23-24 Sep. 1974** Jan. 1975 50 p (Contract NSF C-933) (PB-243129/4; ATR-75(7370)-1; NSF/RA/N-75-039) Avail: NTIS HC \$4.00 CSDL 10B

The results are presented of the Solar Thermal Energy Conversion Program semi-annual review meeting held at the Martin Marietta plant in Littleton, Colorado, on 23, 24, and 25 September 1974. The review meeting agenda started with a presentation of progress made in the Mission Analysis Study, followed by the Central Receiver studies and then other research efforts directed at distributed systems, total energy systems, and selective optical coatings. GRA

N76-12520# Colorado Springs Dept. of Public Utilities, Colo. **ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEM IN A SUBURBAN DEVELOPMENT SETTING. SOLAR HEATED RESIDENCE TECHNICAL RESEARCH EXPERIMENT Quarterly Report, 1 Oct. 1974 - 31 Mar. 1975** James D. Phillips 10 Apr. 1975 66 p (Grant NSF GI-44210) (PB-242729/2; NSF/RA/G-75-007) Avail: NTIS HC \$4.50 CSDL 13A

An air to air pump was used to simulate a fluid to air heat pump. The operation of the system indicates that the optimized heat pump is very reliable, and that the storage system will sustain the optimized heat pump operation throughout the winter. The use of a heat transfer fluid such as Dowtherm J or Therminol 60 is an absolute necessity in the solar piping system and in the heat pump evaporator piping system. Other topics discussed include: building details, solar and mechanical systems operating modes, system component design and relationship to existing building codes, construction and operating costs, and comparison of heat transfer fluids. GRA

N76-12521# Colorado Springs Dept. of Public Utilities, Colo. **ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEM IN A SUBURBAN DEVELOPMENT SETTING Monthly Report, 10 Apr. - 10 May 1975** James D. Phillips 10 Apr. 1975 72 p refs (Grant NSF GI-44210) (PB-242728/4; NSF/RA/G-75-008) Avail: NTIS HC \$4.50 CSDL 13A

This report discusses technical operation and briefly notes the status of the preparation of legal research on a proposed zoning ordinance, an economic research study involving detailed analysis of two appraisals made on the solar home, insurance underwriting, load and demand on electric utilities, and the questionnaire which has been developed in the area of social research. GRA

N76-12522# RAND Corp., Santa Monica, Calif. **HOW TO SAVE GASOLINE: PUBLIC POLICY ALTERNATIVES FOR THE AUTOMOBILE (EXECUTIVE SUMMARY)** Sorrel Wildhorn, Burke K. Burright, John H. Enns, and Thomas F. Kirkwood Oct. 1974 16 p (Grant NSF GI-44)

(PB-242756/5; R-1560/1-NSF; NSF/RA/N-74-121) Avail: NTIS HC \$3.50 CSCL 10A

Alternative measures and public policies are discussed for conserving energy used by automobiles. The purpose of the study is: (1) to develop analytical tools to aid in evaluating national energy conservation policies for private auto transportation; and (2) to apply the tools in a systematic analysis and comparison of several alternative policy instruments. Policy instruments raising the price of driving and those designed to improve average auto fuel economy through regulatory means are considered. GRA

**N76-12523# RAND Corp., Santa Monica, Calif.
HOW TO SAVE GASOLINE: PUBLIC POLICY ALTERNATIVES FOR THE AUTOMOBILE**

Sorrel Wildhorn, Burke K. Burright, John H. Enns, and Thomas F. Kirkwood Oct. 1974 194 p
(Grant NSF G1-44)

(PB-242755/7; R-1560-NSF; NSF/RA/N-74-120) Avail: NTIS HC \$7.50 CSCL 10A

For abstract, see N76-12522.

N76-12527# Federal Energy Administration, Washington, D.C. Office of Energy Resource Development.

US PETROLEUM REFINING CAPACITY OVERVIEW

Michela English, Elaine Hahn, Eugene Peer, and Lisle Reed 31 Mar. 1975 20 p

(PB-242831/6; FEA/G-75/323) Avail: NTIS HC \$3.50 CSCL 07A

This report presents an overview of the present and projected U.S. refining capacity situation, a discussion of the problems facing refiners planning to construct new or additional capacity, and recommendations for government policy relating to U.S. refining capacity. GRA

**N76-12529# Naval Academy, Annapolis, Md.
SUITABILITY OF GUAM FROM AN ENVIRONMENTAL ASPECT AS A POTENTIAL SITE FOR OCEAN THERMAL ENERGY CONVERSION PLANTS Final Report, 1 Jul. 1974 - 1 Jan. 1975**

Roland Reece Corey, Jr. 1 Apr. 1975 21 p refs
(AD-A012500; USNA-EPRD-11) Avail: NTIS CSCL 10/1

The bottom drops off rapidly around Guam and depths suitable for ocean thermal energy systems are obtained reasonably close to shore, which increases the possibility that cold water discharge would have an environmental effect. Discharge of cold water into the open sea could have two results: Cold water could drift away at or near the surface, simulating natural upwelling with the same beneficial effects; or it could plunge to an intermediate depth with minimal environmental effects. Discharge of cold water, on the other hand, into near-shore environments would probably kill or injure many benthic forms and coral reefs. Prevailing currents in this area are from east to west; therefore, siting on the west side of the island would appear to be preferable. First, cold water would be carried out to sea rather than into shallow water near shore. Secondly, greater depths are available closer to shore on the western as opposed to the eastern side of the island. Most of the places which have been identified as potential fishing grounds are on the north or south of the island, so situated that discharges from eastern but not western plant sites could affect them.

Author (GRA)

**N76-12531# Battelle Columbus Labs., Ohio
INDUSTRIAL ENERGY STUDY OF THE GLASS INDUSTRY Final Report**

J. R. Schoor and G. A. Anderson 1 Dec. 1975 251 p refs
(Contract DI-14-01-0001-1667)

(PB-242832/4; FEA/B-75/385) Avail: NTIS HC \$9.00 CSCL 10A

Types and amounts of energy used within various industry segments are examined. The structure of each industry, how the energy is used, plant variations within an industry segment, energy supply situations, possible energy substitution and conservation technology, and constraints placed upon each industry segment as a result of energy and other shortages are included. GRA

N76-12532# Illinois Univ., Urbana. Center for Advance Computation.

REGIONAL PATTERNS OF ENERGY CONSUMPTION IN THE US, 1967 Final Report

R. Thomas VanArsdall Jan. 1975 146 p refs
(Grant NSF G1-35179)

(PB-242689/8; UIUC-CAC-DN-75-147; NSF/RA/N-75-038) Avail: NTIS HC \$6.00 CSCL 10A

Spatial patterns of direct energy consumption in the U.S. in 1967 are given. The energy forms examined are coal, crude oil, refined petroleum products (distillates and residuals), electricity, and natural gas. The physical units are converted to Btu's, with regional values where available. Results include three major end products: (1) direct energy consumption of distillate and residual fuel oils by two-digit manufacturing SIC's in 51 regions; (2) direct energy consumption of each of the five energy forms by 98 sectors in 51 regions; (3) overview of data quality. Recommendations for improvements in data base and suggestions for future analytical research are included. GRA

N76-12533# Federal Energy Administration, Washington, D.C. Office of Conservation and Environment.

FEDERAL ENERGY MANAGEMENT PROGRAM. FISCAL YEAR 1974 Annual Report

Dec. 1974 60 p refs

(PB-241820/0; FEA/D-74/194; AR-1) Avail: NTIS HC \$4.50 CSCL 10A

Government policies pertaining to energy conservation are reviewed and various agency programs and accomplishments noted. Summary sheets on energy usage by government agencies are included. GRA

N76-12534# Federal Energy Administration, Washington, D.C. Office of Energy Conversion and Environment.

FEDERAL ENERGY MANAGEMENT PROGRAM. FISCAL YEAR 1975 Quarterly Report, Jul. - Sep. 1974

Sep. 1974 11 p

(PB-241856/4; FEA/D-75/283R; QR-1; Paper-2) Avail: NTIS HC \$3.50 CSCL 10A

Statistical data on energy conservation performance by various government agencies during first quarter of fiscal year 1975 are presented. GRA

N76-12889# Illinois Univ., Urbana. Center For Advanced Computation.

ENERGY COST OF GOODS AND SERVICES, 1963 AND 1967 Interim Report

Robert A. Herendeen and Clark W. Bullard, III Nov. 1974 48 p refs

(Contract NSF SIA-72-03530)

(PB-242679/8; UIUC-CAC-DN-74-140; NSF/RA/N-74-208) Avail: NTIS HC \$4.00 CSCL 10A

The total energy cost of producing goods and services may be obtained from manipulation of the large data base of input-output economics, if various conceptual and procedural assumptions are made. An improved method and energy intensities for 357 sectors of the U.S. economy are presented. GRA

N76-12891 Florida Univ., Gainesville.

FEASIBILITY OF TRANSPORTATION PROJECTS: AN ENERGY-BASED METHODOLOGY Ph.D. Thesis

Jamie Woodrow Hurley, Jr. 1975 163 p

Avail: Univ. Microfilms Order No. 75-23896

The conceptual framework recommended for comparison of proposed transportation projects is the energy-based benefit/cost ratio. The energy-based benefit/cost analysis potentially forms a third general area to be considered in the transportation decision-making process, along with economic benefit/cost analysis and effectiveness analysis. The foundation for quantifying energy requirements for benefits and costs of transportation projects is based on total energy coefficients of BTU per dollar published for a 362-sector U.S. economy. These data are used to establish mathematical models and/or tables for estimating energy requirements for construction and equipment investments, operations and maintenance requirements, and road-user requirements at the project level. The technique is demonstrated

for a bus/car pool systems demonstration project being constructed in Miami, Florida. Reasonable results were obtained, and a comparison of these results with an economic analysis for the same project showed that the two types of analysis do not necessarily indicate a common preference among candidate project alternatives. Dissert. Abstr.

N76-13500*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AN IMPROVED ROTATABLE MASS FOR A FLYWHEEL Patent Application

George M. Weyler, Jr., inventor (to NASA) Filed 14 Nov. 1975 10 p (NASA-Case-MFS-23051-1; US-Patent-Appl-SN-632111) Avail: NTIS HC \$3.50 CSCL 20K

An improved rotatable mass adapted to be used as a flywheel in energy storage devices is reported. The flywheel is characterized by a plurality of coaxially aligned, contiguous disks mounted on a spin shaft. Each disk is formed of a plurality of woven fibers disposed in a plane transversely related to an axis of rotation with the fibers of alternate disks being continuous throughout their length. The midportion of the fibers of the remaining disks is removed for defining annular voids concentrically related to the spin shaft. NASA

N76-13574# Texas Governor's Energy Advisory Council, Austin. **AN ECONOMIC ANALYSIS OF DECLINING PETROLEUM SUPPLIES IN TEXAS: INCOME, EMPLOYMENT, TAX AND PRODUCTION EFFECTS AS MEASURED BY INPUT-OUTPUT AND SUPPLY-DEMAND SIMULATION MODELS Final Report**

Milton L. Holloway, Herbert W. Grubb, and W. Larry Grossman Feb. 1975 210 p refs (Grants NSF G1-44085; NSF SIA-73-05812) (PB-243320/9; NSF/RA/N-74-225) Avail: NTIS HC \$7.75 CSCL 08I

Demand is projected for Texas produced energy for the 1975-1000 period, and estimates are developed of relationships among production, processing, and distribution of oil, gas, distillates, coal, and nuclear energy. The present and future role of petroleum as a source of taxable income, employment, economic growth, importance as a raw material for the chemical industry, and changes in the economy of Texas that can be expected as a result of declining availability of domestic oil and gas were analyzed. GRA

N76-13575# Pennsylvania State Univ., University Park. **ECONOMIC ANALYSIS OF COAL SUPPLY: AN ASSESSMENT OF EXISTING STUDIES**

Richard L. Gordon May 1975 179 p refs (PB-243220/1; EPRI-335) Avail: NTIS HC \$7.50 CSCL 08I

The economics of coal mining and the factors affecting these economics are examined. Topic areas covered include: model mine cost studies; the economic impact of public policy on the Appalachian coal industry and the regional economy; price and availability of western coal in the midwestern electric utility market, 1975-1982; forecasts of coal supply functions in Southern West Virginia; coal availability and supply; U.S. coal and the electric power industry; low sulfur coal: a revision of reserve and supply estimates; coal surface mining and reclamation; and the demand and supply of manpower in the bituminous coal industry for the years 1985 and 2000. GRA

N76-13583# Texas Governor's Energy Advisory Council, Austin. **ENERGY DEVELOPMENT AND LAND USE IN TEXAS Final Report**

William F. McFarland Jan. 1975 129 p refs Prepared in cooperation with Texas Transportation Inst. (Grants NSF G1-44085) (PB-243328/2; NSF/RA/N-74-233) Avail: NTIS HC \$6.00 CSCL 13B

State-of-the-art information is presented concerning the interrelationships between energy and land-use, especially as these interrelationships may affect land-use and land values in Texas 10 years ahead. GRA

N76-13584# Texas Governor's Energy Advisory Council, Austin. **IMPORTING FUELS AND PETROCHEMICAL RAW MATERIALS FOR TEXAS**

Sadler Bridges Jan. 1975 100 p refs Prepared in cooperation with Texas Transportation Inst. (Grants NSF G1-44085; NSF SIA-73-05812) (PB-243322/5; NSF/RA/N-74-227) Avail: NTIS HC \$5.00 CSCL 10A

Energy requirements are evaluated for Texas from 1975 to 2000 along with the required transportation network. Major emphasis centers around the feasibility of importing western coal by rail. Of secondary importance are both the utilization of coal as a primary fuel and importing it by pipeline as either a slurry or high-Btu synthetic gas. GRA

N76-13587# Federal Energy Administration, Washington, D.C. Office of Policy and Analysis.

ENERGY INFORMATION REPORTED TO CONGRESS: AS REQUIRED BY PUBLIC LAW 930319, FIRST QUARTER 1975 Quarterly Report, Jan. - Mar. 1975

Jun. 1975 162 p refs (PB-242760/0; FEA/C-75/332) Avail: NTIS HC \$10.00/MF \$10.00; also available on subscription \$35.00/year domestic, \$40.00/year foreign CSCL 10A

Summaries and statistical tables on resource development and production, consumption, storage, distribution, imports, and exports of coal, natural gas, crude oil, and refined petroleum products are presented. An historical appendix is included of summaries and data tables on fuel exploration, drilling activity, reserves, and the above figures on a one-year or ten-year scale, as the data are available. A section on the development and operation of nuclear energy and nuclear powerplants is provided. GRA

N76-13589*+ New Mexico Univ., Albuquerque. Technology Application Center.

WIND ENERGY UTILIZATION: A BIBLIOGRAPHY WITH ABSTRACTS CUMULATIVE VOLUME 1944/1974

[1975] 503 p refs Sponsored by NSF and ERDA and NASA (NASA-CR-145816; TAC-W-75-700) Avail: NTIS HC \$10.00; Technology Application Center, Univ. of New Mexico, Albuquerque HC \$10.00 CSCL 10A

A bibliography of wind energy technology is presented. Major areas covered include: wind power generators, wind machines, energy storage, wind data and properties, control and regulation devices, blade design and rotors, wind tunnel simulation, and aerodynamics. J.M.S.

N76-13591*# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.

ELECTROMAGNETIC WAVE ENERGY CONVERSION RESEARCH Final Report, 1 Apr. - 30 Sep. 1975

Robert L. Bailey and Philip S. Callahan 30 Sep. 1975 119 p refs

(Grant NsG-5061; UF Proj. 2451-E43) (NASA-CR-145876) Avail: NTIS HC \$5.50 CSCL 10A

Known electromagnetic wave absorbing structures found in nature were first studied for clues of how one might later design large area man-made radiant-electric converters. This led to the study of the electro-optics of insect dielectric antennae. Insights were achieved into how these antennae probably operate in the infrared 7-14um range. EWEC theoretical models and relevant cases were concisely formulated and justified for metal and dielectric absorber materials. Finding the electromagnetic field solutions to these models is a problem not yet solved. A rough estimate of losses in metal, solid dielectric, and hollow dielectric waveguides indicates future radiant-electric EWEC research should aim toward dielectric materials for maximum conversion efficiency. It was also found that the absorber bandwidth is a theoretical limitation on radiant-electric conversion efficiency. Ideally, the absorbers' wavelength would be centered on the irradiating spectrum and have the same bandwidth as the irradiating wave. The EWEC concept appears to have a valid scientific basis, but considerable more research is needed before it is thoroughly understood, especially for the complex randomly polarized, wide band, phase incoherent spectrum of the sun. Specific recommended research areas are identified. Author

N76-13595*# Coile (Forrest) and Associates, Newport News, Va.

TECHNOLOGY UTILIZATION HOUSE STUDY REPORT

[1974] 79 p refs Prepared in cooperation with Moore (Charles W.) Associates, Essex, Conn.

(Contract NAS1-13874(C); Proj. TECH)

(NASA-CR-144896) Avail: NTIS HC \$5.00 CSCL 10A

The objectives of Project TECH are: (1) to construct a single family detached dwelling for demonstrating the application of advanced technology and minimizing the requirement for energy and utility services, and (2) to help influence future development in home construction by defining the interaction of integrated energy and water management systems with building configuration and construction materials. Components and methods expected to be cost effective over a 20 year span were studied. Emphasis was placed on the utilization of natural heating and cooling characteristics. Orientation and location of windows, landscaping, natural ventilation, and characteristics of the local climate and microclimate were intended to be used to best advantage. Energy conserving homes are most efficient when design for specific sites, therefore project TECH should not be considered a prototype design suitable for all locations. However, it does provide ideas and analytical methods which can be applied to some degree in all housing. Author

N76-13601# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

SOLAR THERMAL CONVERSION MISSION ANALYSIS. VOLUME 1: SUMMARY REPORT. SOUTHWESTERN UNITED STATES

Jan. 1975 212 p refs 5 Vol.

(Contract NSF C-797)

(PB-242898/5; ATR-74(7417-16)-2-Vol-1;

NSF/RA/N-74-205A-Vol-1) Avail: NTIS HC \$7.75; HC also available from NTIS \$30.00/set of 5 reports as PB-242897-SET CSCL 10B

The principal results are presented of the solar thermal conversion mission analysis applied to the Southwestern United States. The mission analysis methodology was applied on a consistent basis to the evaluation of alternative solar thermal conversion concepts for providing electrical power under realistic operating environments. Based upon the comparative technical and economic evaluation of the alternative concepts, preferred concepts were identified and technical and economic goals defined for these concepts. Subsequently, a preliminary market capture potential was made for the preferred systems. GRA

N76-13602# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

SOLAR THERMAL CONVERSION MISSION ANALYSIS. VOLUME 2: SOUTHWESTERN UNITED STATES. DEMAND ANALYSIS

15 Nov. 1974 178 p refs 5 Vol.

(Contract NSF C-797)

(PB-242899/3; ATR-74(7417-16)-2-Vol-2;

NSF/RA/N-74-205B-Vol-2) Avail: NTIS HC \$7.50; HC also available from NTIS \$30.00/set of 5 reports as PB-242897-SET CSCL 10B

Computer programs, data base, and forecast methodology capable of characterizing the hourly electric power demand for selected Southwestern United States load centers from 1980 to 2000 are discussed. GRA

N76-13603# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

SOLAR THERMAL CONVERSION MISSION ANALYSIS. VOLUME 3: SOUTHWESTERN UNITED STATES INSOLATION CLIMATOLOGY

15 Nov. 1974 220 p 5 Vol.

(Contract NSF C-797)

(PB-242900/9; ATR-74(7417-16)-2-Vol-3;

NSF/RA/N-74-205C-Vol-3) Avail: NTIS HC \$7.75; HC also available from NTIS \$30.00/set of 5 reports as PB-242897-SET CSCL 10B

An insolation data base consisting of hourly values of normal incidence or direct insolation and total insolation for a two-year

period has been prepared in computer compatible format for 20 stations characterizing the climatology of the Southwestern United States. The data base includes, in addition to the insolation data, solar position and weather information. When measured insolation values were unavailable, estimated values obtained by statistical procedures were developed in order to complete the insolation data base. GRA

N76-13604# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

SOLAR THERMAL CONVERSION MISSION ANALYSIS. SOUTHWESTERN UNITED STATES. VOLUME 4: COMPARATIVE SYSTEMS/ECONOMICS ANALYSES

15 Nov. 1974 247 p refs 5 Vol.

(Contract NSF C-797)

(PB-242901/7; ATR-74(7417-16)-1-Vol-4;

NSF/RA/N-74-205D-Vol-4) Avail: NTIS HC \$8.00; HC also available from NTIS \$30.00/set of 5 reports as PB-242897-SET CSCL 10B

Results are described of the comparative analyses conducted in evaluating the technical and economic performance of alternative solar thermal conversion concepts. A comparative technical evaluation, a margin analysis, a comparative economic evaluation, preferred system selection and definition, and environmental impact and market capture potential are among the topics discussed. GRA

N76-13605# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

SOLAR THERMAL CONVERSION MISSION ANALYSIS. VOLUME 5: SOUTHWESTERN UNITED STATES. AREA DEFINITION AND SITING ANALYSIS SOUTHWESTERN UNITED STATES

15 Nov. 1974 126 p refs 5 Vol.

(Contract NSF C-797)

(PB-242902/5; ATR-74(7417-16)-2-Vol-5;

NSF/RA/N-74-205E-Vol-5) Avail: NTIS HC \$6.00; HC also available from NTIS \$30.00/set of 5 reports as PB-242897-SET CSCL 10B

Results are presented of an area definition and siting analysis in support of the solar thermal conversion mission analysis study. The objectives of this effort were to define and characterize the Southwestern United States study region and to identify those areas within this region judged to be potentially suitable for siting large solar power plants. GRA

N76-13606# National Academy of Sciences - National Research Council, Washington, D.C.

CONFERENCE ON THERMODYNAMICS AND NATIONAL ENERGY PROBLEMS Final Report, Jun. 1974 - May 1975

C. W. Beckett, Leo Brewer, C. E. Holler, Jr., Ward Hubbard, and F. D. Rossini Jun. 1974 443 p refs Conf. held at Warrenton, Va., 10-12 Jun. 1974

(Grant AF-AFOSR-2741-74; AF Proj. 9750)

(AD-A012702) Avail: NTIS CSCL 07/4

This volume is the report of the Conference on Thermodynamics and National Energy Problems which was held at Airlie House, Warrenton, Va., 10-12 June 1974, and attended by about 110 scientists and engineers from universities, industry and government. The purpose of the Conference was to arrive at both the needs for thermodynamic data in a developed program to achieve national energy selfsufficiency, and the capability of thermodynamicists to meet those needs. To achieve this purpose, most of the time of the conference was spent in four parallel panel discussion sessions, on coal, fossil fuels other than coal, nuclear energy, geothermal energy, and solar energy and energy storage. The report includes a summary of each panel's recommendations and reasons for them, an overview summary, texts of prepared presentation, and all pertinent discussion. GRA

'6-13608# Hittman Associates, Inc., Columbia, Md.
ASSESSMENT OF SOLAR-POWERED COOLING OF BUILDINGS Final Report

H. M. Curran Apr. 1975 180 p refs Sponsored in part by ERDA

(Contract NSF C-858)

(PB-243455/3; NSF/RA/N-75-012) Avail: NTIS HC \$7.50 CSCL 13A

An assessment of solar-powered cooling of buildings using Rankine cycle engines or absorption cycle equipment is presented. In this type of application thermal energy obtained from the sun would be used to drive a Rankine engine or an absorption cooling unit. The report covers technical and economic feasibility of the concepts. GRA

N76-13609# Texas Governor's Energy Advisory Council, Austin.
FUEL CONSERVATION MEASURES. THE TRANSPORTATION SECTOR, VOLUME 1 Final Report

Ron Holder Jan. 1975 80 p refs Prepared by Tex. Transportation Inst.

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243324/1; NSF/RA/N-74-229-Vol-1) Avail: NTIS HC \$5.00 CSCL 10A

This report presents the evaluations of numerous suggested conservation measures that might be initiated to conserve transportation energy including mandatory government control, an economic pricing system and voluntary reduction. Estimates of potential fuel savings for each are also documented. For those instances in which data are available, an evaluation of the success of programs instituted since the energy shortage became public knowledge (such as reduced highway speed limits) is presented. GRA

N76-13610# Texas Governor's Energy Advisory Council, Austin.
FUEL CONSERVATION MEASURES. THE TRANSPORTATION SECTOR, VOLUME 2 Final Report

Ron Holder Jan. 1975 97 p refs Prepared in cooperation with Texas Transportation Inst.

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243325/8; NSF/RA/N-74-230-Vol-2) Avail: NTIS HC \$5.00 CSCL 10A

The magnitude of total transportation fuel consumption in Texas is discussed and that portion of total transportation fuel used for intercity travel is identified. Intercity movement of people and goods is covered along with the fuel efficiency of the intercity travel modes. An estimate is provided of existing and future passenger-miles and ton-miles of intercity travel in Texas. From these data, estimates of fuel consumption are formulated. Indications of the magnitude of fuel savings that might result from modal shifts are also presented. GRA

N76-13611# Colorado Springs Dept. of Public Utilities, Colo. Dept. of Public Utilities.

ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEM IN A SUBURBAN DEVELOPMENT SETTING Quarterly Report, Jul. - Sep. 1974

James D. Phillips 10 Oct. 1974 124 p

(PB-243548/5; NSF/RA/G-74-029) Avail: NTIS HC \$5.50 CSCL 13A

This report assesses a single family residence solar space heating system in a suburban development. The project provides for (1) experimentation with solar space heating systems technology in a community setting, and (2) experiments with a solar space heating system that uses heat pump/storage combination. The Honeywell data access and analysis system will be used to study system operation, performance and cost compared to conventional cost. The report includes information on visitors to the house and relevant publicity and communications, as well as a technical progress report and related documentation. GRA

N76-13612# Colorado Springs Dept. of Public Utilities, Colo. Dept. of Public Utilities.

ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEMS IN A SUBURBAN DEVELOPMENT SETTING Monthly Report

James D. Phillips 10 Feb. 1975 30 p

(Grant NSF GI-44210)

(PB-243549/3; NSF/RA/G-75-005) Avail: NTIS HC \$4.00 CSCL 13A

Research and related activities involving the engineering, economic, legal, and social aspects of the experimental solar house in Colorado Springs are described. Highlights included the installation of Honeywell measurement and analysis equipment; the press conference held in conjunction with the arrival of the family who will live in the home; and the purchase of the home by the City of Colorado Springs from the Phoenix Corporation. GRA

N76-13616# Texas Governor's Energy Advisory Council, Austin.
US ENERGY DEVELOPMENT: FOUR SCENARIOS Final Report

Frnak Maslan and Theodore J Gordon 15 Oct. 1974 155 p refs

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243356/3; NSF/RA/N-74-260) Avail: NTIS HC \$6.75 CSCL 10A

A set of scenarios is presented depicting the possible range of energy supply, demand, and policy in the United States for the periods between the present and 1985, and 1985 and 2000. GRA

N76-13617# Texas Governor's Energy Advisory Council, Austin.
R. X. ENERGY SCENARIOS Final Report

R. D. Finch (Houston Univ., Tex.), Harriet Hahn, M. L. Holloway, and J. S. Kelly Jan. 1975 93 p refs

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243357/1; NSF/RA/N-74-261) Avail: NTIS HC \$5.00 CSCL 10A

The first case is a Baseline Scenario which projects the future as it might have appeared during the relatively stable period from 1967 to 1970. This is then compared with a Market Forces Scenario in which various constraints on the operation of the U.S. market are removed. A Regulated Conservation Scenario and a New Technology Scenario are then presented to illustrate the trends that might result from government actions aimed at reducing demand or increasing supply. GRA

N76-13618# Texas Governor's Energy Advisory Council, Austin.
ENERGY CONSUMPTION CONSERVATION AND PROJECTED NEEDS FOR TEXAS AGRICULTURE Final Report

C. G. Coble and W. A. LePori 1 Jan. 1975 79 p refs Prepared in cooperation with Texas A and M Univ. College Station

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243327/4; NSF/RA/N-74-232) Avail: NTIS HC \$5.00 CSCL 10A

Energy inputs for Texas Agriculture were found to be 41.66×10 to the 13th power BTU's in 1973. This is about 7 percent of the total gross energy used in the state for 1972. Energy for irrigation was found to be the largest single input and represented about 39 percent of the total energy used in agriculture. Field operations for crop production required approximately 12 percent of the total energy input. Conservation practices were identified which show potential for reducing energy inputs to agriculture by about 7.84×10 the 13th power BTU's. These practices are considered to have little or no effect on output and are within present technological capabilities. GRA

N76-13621# Texas Governor's Energy Advisory Council, Austin.
ENERGY SUPPLY AND DEMAND IN TEXAS FOR THE PERIOD 1950 - 1973 Final Report

Herbert H. Grubb and Milton L. Holloway 15 Oct. 1974 120 p

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243319/1; NSF/RA/N-74-224) Avail: NTIS HC \$5.50 CSCL 10A

Data and information about the past and current energy production and consumption are examined. Approximately 75 individual Texas crude petroleum, refiner, natural gas, natural gas liquids, and electricity data items were identified. The data were obtained from official agencies and placed in computer machine readable form. County, regional, and state level of detail

were recorded for all items having these levels of detail reported. The report includes tabular materials, graphs, and charts of trends in energy production, and consumption. GRA

N76-13622# Texas Governor's Energy Advisory Council, Austin. **POTENTIAL FOR ENERGY CONSERVATION IN INDUSTRIAL OPERATIONS IN TEXAS Final Report**

H. William Prengle, Jr. Nov. 1974 240 p refs Prepared in cooperation with Houston Univ. (Grants NSF GI-44085; NSF SIA-73-05812) (PB-243326/6; NSF/RA/N-74-231) Avail: NTIS HC \$8.00 CSDL 10A

This project was undertaken to determine energy consumption and potential savings in the industrial sector in Texas, as measured by petroleum refining, chemical manufacture, pulp and paper, and metals production. Energy use was determined by actual survey of the 211 companies in the four subject industries. GRA

N76-13623# Texas Governor's Energy Advisory Council, Austin. **TEXAS ENERGY RESOURCES Final Report**

Jul. 1974 32 p refs (Grants NSF GI-44085; NSF SIA-73-05812) (PB-243318/3; NSF/RA/N-74-223) Avail: NTIS HC \$4.00 CSDL 10A

It is well known that Texas is the Nation's leading state in developing and sharing its oil and gas resources, and in this report it is pointed out that the State has other large energy resources that are less widely known. These include lignite, coal, geothermal energy and uranium ores. Texas also has the potential for solar, solid waste and wind energy. GRA

N76-13624# Texas Governor's Energy Advisory Council, Austin. **EXECUTIVE SUMMARIES OF PROJECT REPORTS OF THE COUNCIL**

1 Mar. 1975 142 p refs (Grants NSF GI-44085; NSF SIA-73-05812) (PB-243317/5; NSF/RA/N-74-222) Avail: NTIS HC \$6.00 CSDL 10A

As part of the work of the Texas Governor's Energy Advisory Council a series of special projects were initiated to gather information, provide back-ground, evolve technological assessments, and develop analyses and projections on a series of topics related to energy in Texas. Executive summaries of each of the reports are presented. A summary of the objectives, program, and management plan under which the work of the Council was carried out is included. GRA

N76-13625# Federal Power Commission, Washington, D.C. Bureau of Power. **POTENTIAL PUMPED STORAGE PROJECTS IN THE PACIFIC SOUTHWEST**

1975 42 p refs (PB-242798/7) Avail: NTIS HC \$4.00 CSDL 10B

The report identifies 155 potential pumped-storage hydroelectric power projects in a four-state area of the Pacific Southwest, with an ultimate installed capacity of 341,100 megawatts. GRA

N76-13627# American Physical Society, Washington, D.C. **ENERGY CONSERVATION AND WINDOW SYSTEMS. A REPORT OF THE SUMMER STUDY ON TECHNICAL ASPECTS OF EFFICIENT ENERGY UTILIZATION, JULY 1974 - APRIL 1975**

Samuel M. Berman, ed. (Stanford Univ., Calif.) and Seth D. Silverstein, ed. (Gen. Elec. Co., Schenectady, N. Y.) Jan. 1975 107 p Sponsored in part by NSF, FEA, and Elec. Power Res. Inst. (PB-243117/9) Avail: NTIS HC \$5.50 CSDL 10A

The architectural window is examined in detail to assess its role in reducing energy consumption for residential and commercial climate control. The cost-effectiveness of many existing and modified window systems is evaluated, and the positive role of solar heating through windows in winter is stressed. If properly designed, the winter solar heat gain (weather averaged) will exceed the thermal losses for east-, west-, and south-facing

windows over most of the continental U.S. The report assesses the physics and technology of selective coating materials which act primarily as infrared reflectors to reduce thermal radiation transport, reviewing the properties of existing materials, exploring new methods for the deposition of selective surfaces on plastics, and identifying classes of new and promising semiconductor materials. GRA

N76-13628# American Physical Society, Washington, D.C. **TECHNICAL ASPECTS OF EFFICIENT ENERGY UTILIZATION: 1974 SUMMER STUDY OF THE AMERICAN PHYSICAL SOCIETY Summary Report**

S. M. Berman, D. Hartley, M. Ross, and R. Socolow Jan. 1975 59 p Sponsored in part by FEA, NSF, and Elec. Power Res. Inst.

(PB-243116/1) Avail: NTIS HC \$4.50 CSDL 10A

Research opportunities in physics related to efficient energy utilization are identified. The first section stresses the usefulness of the conceptual framework of thermodynamics, especially as a tool for assessing the efficiency of the management of low quality heat. The second section deals with the role of physics in combustion, stressing numerical modeling, laser diagnostics, and the exploration of new concepts such as the combustion of emulsions. The third section, a detailed examination of the architectural window, evaluates the cost-effectiveness of existing and modified window systems. GRA

N76-13629# Federal Energy Administration, Washington, D.C. Office of Energy Conservation and Environment. **ENERGY CONSERVATION STUDY, REPORT TO CONGRESS**

Dec. 1974 181 p (PB-243369/6; FEA/D-74/231) Avail: NTIS HC \$7.50 CSDL 10A

This report discusses: (1) the energy conservation potential of restricting exports of fuels or energy-intensive products or goods, including an analysis of balance-of-payments and foreign relations implications of any such restrictions; (2) alternative requirements, incentives, or disincentives for increasing industrial recycling and resource recovery in order to reduce energy demand, including the economic costs and fuel consumption tradeoff which may be associated with such recycling and resource recovery in lieu of transportation and use of virgin materials; and (3) means of incentives or disincentives to increase efficiency of industrial use of energy. GRA

N76-13630# Federal Energy Administration, Washington, D.C. Office of Energy Resource Development. **A REPORT ON IMPROVING THE PRODUCTIVITY OF ELECTRIC POWERPLANTS**

Mar. 1975 83 p refs (PB-242473/7; FEA/G-75/263) Avail: NTIS HC \$5.00; HC also available SOD CSDL 10B

To help achieve the goals of Project Independence, the Federal Energy Office established in April 1974 the inter-agency task group on power plant reliability with the broad objective of improving the productivity of existing and planned large fossil-fired and nuclear electric powerplants. The task group was asked to identify the key problems and possible corrective actions associated with the reliability of nuclear and large fossil-fired units from the standpoint of their productivity. GRA

N76-13632# Texas Governor's Energy Advisory Council, Austin. **POTENTIAL FOR WIND GENERATED POWER IN TEXAS Final Report**

Vaughn Nelson and Earl Gilmore 15 Oct. 1974 168 p refs Prepared in cooperation with Amarillo Coll. and West Tex. State Univ. (Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243349/8; NSF/RA/N-74-253) Avail: NTIS HC \$6.75 CSDL 10B

General information on wind energy and a summary of current information on wind energy conversion systems are presented. The data from 15 National Weather Service stations in Texas (1959-1972) and 7 neighboring stations (1964-1973) are analyzed for average energy by month and year, wind speed

histograms, wind velocity and power duration curves, and probability of calm periods. Contour maps for energy at 23 ft. height and 300 ft. (estimated) and probability contours for wind speeds are plotted. Estimations of power possible uses and number of units to be built, estimations of costs, and storage are discussed for wind energy conversion systems. GRA

N76-13633# Texas Governor's Energy Advisory Council, Austin. **POTENTIAL OF TIDAL AND GULF STREAM POWER SOURCES** Final Report

John A. Savage Jan. 1975 56 p refs Prepared by Southern Methodist Univ.

(Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243350/6; NSF/RA/N-74-254) Avail: NTIS CSCL 10B

There are three basic methods that are considered for generation of energy along the Texas gulf coast. These are: (1) a propane heat cycle on a floating platform about 35 miles from shore (This makes use of the difference in temperature between surface and bottom water); (2) a hydroelectric installation on Padre Island that is driven by tidal and ocean current action (This makes use of pumped storage in a small lake); and (3) a wave action generator powered by the up and down motion of the waves (An air turbine is used to drive an alternator). GRA

N76-13653# Texas Governor's Energy Advisory Council, Austin. **IMPACT ON AIR QUALITY OF ALTERNATE STRATEGIES FOR THE PRODUCTION, DISTRIBUTION AND UTILIZATION OF ENERGY IN TEXAS 1975-2000** Final Report

Bill Stewart Jan. 1975 325 p refs Prepared in cooperation with Texas Air Control Board

(Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243329/0; NSF/RA/N-74-234) Avail: NTIS HC \$9.75 CSCL 13B

The impact of alternate fuel sources and growth on ambient air quality in Texas through the year 2000 is examined. Major energy consuming segments of society were examined for projected growth and possible changes in fuel sources. Major shifts in fuel composition are projected as a result of the decreased availability of natural gas. Projected capital costs for emission controls of stationary industrial plants in Texas are shown. GRA

N76-13656# Texas Governor's Energy Advisory Council, Austin. **IMPACT ON TEXAS WATER QUALITY AND RESOURCES OF ALTERNATE STRATEGIES FOR PRODUCTION DISTRIBUTION, AND UTILIZATION OF ENERGY IN TEXAS IN THE PERIOD 1974-2000** Final Report

Gerard A. Rohlich (Texas Univ., Austin) Jan. 1975 122 p refs

(Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243330/8; NSF/RA/N-74-235) Avail: NTIS HC \$5.50 CSCL 13B

The impact of alternate strategies of energy production and use on water quality and resources in Texas was considered. The analyses presented include information and projections on water demands, water consumption, wastewater flows, and pollution loads, costs for control of thermal discharges and for waste treatment facilities, and energy requirements for control of environmental quality as related to the water resource. The year 1970 was selected to establish baseline conditions. Projections were made for several intervening periods with particular emphasis on the periods from 1970 to 2000. In the first part of the report an overview of the impact of projected energy and water demands and alternate fuel strategies on the water resources of the state are given. The second part presents analyses for two river basins, the Colorado and the Neches.

GRA

N76-13657# Federal Energy Administration, Washington, D.C. Office of Energy Conservation and Environment. **ELECTRIC UTILITIES, CLEAN AIR ACT AMENDMENTS, AND SULFATES**

8 Jul. 1975 61 p refs

(PB-243574/1; FEA/D-75/373) Avail: NTIS HC \$4.50 CSCL 13B

The findings of the Government, the scientific community, and private industry in their analyses of the energy and economic

impacts of the Clean Air Act and the availability of clean fuels are given. Alternative public policies that would ensure the development of a coordinated environmental/energy program for the next decade and provide a factual basis for making decisions on the Clean Air Act Amendments of 1975 are examined. The basis is provided for the Administration's proposed Clean Air Act Amendments that apply to stationary sources and the use of coal along with background material on the energy problem, the President's proposed energy program, and the FEA's coal conversion and load management programs. GRA

N76-13904# Texas Governor's Energy Advisory Council, Austin. **TEXAS NUCLEAR POWER POLICIES. VOLUME 1: INTRODUCTION AND BACKGROUND** Final Report

Herbert H. Woodson, ed. (Texas Univ., Austin) and John H. Vanston, Jr., ed. (Texas Univ., Austin) Jan. 1975 153 p refs (Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243352/2; NSF/RA/N-74-256) Avail: NTIS HC \$6.75 CSCL 18E

This report, the first of five, provides an introduction to the project, a summary of the conclusions, a description of the history and present status of the nuclear power industry in Texas, and a discussion of incentive mechanisms which the state might use to begin implementation of any of five possible nuclear energy policies. GRA

N76-13977# Texas Governor's Energy Advisory Council, Austin. **RELATIONSHIP BETWEEN SUPPLY/DEMAND AND PRICING FOR ALTERNATE FUELS IN TEXAS: A STUDY IN ELASTICITIES** Final Report

Russell G. Thompson 1 Jan. 1975 71 p refs Prepared in cooperation with Houston Univ.

(Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243321/7; NSF/RA/N-74-226) Avail: NTIS HC \$4.50 CSCL 10A

The primary objectives of the energy supply, demand and price analysis studies were to determine (1) how profit-maximizing producers of oil and gas will increase production in response to higher oil and gas prices, (2) how cost conscious users of oil and gas will decrease use in response to higher oil and gas prices, and (3) how these producer and user responses will affect the market-clearing prices of oil and gas in Texas and in the nation. Responses of producers to price were developed to show the effects of higher oil and gas prices on the exploration and development of new reserves and the production of oil and gas from presently known and newly developed reserves. GRA

N76-13979# Texas Governor's Energy Advisory Council, Austin. **LEGAL ASPECTS OF STATE-OWNED OIL AND GAS ENERGY RESOURCES** Final Report

Dan S. Boyd 31 Oct. 1974 86 p refs

(Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243337/3; NSF/RA/N-74-241) Avail: NTIS HC \$5.00 CSCL 10A

Additional options in the field of energy policy that are open to the state by virtue of the state's ownership of significant oil and gas reserves are discussed. The legal status of these resources was examined, including the restrictions on the use of these resources in the state constitution, the statutory authority and administrative practices of the general land office and other bodies charged with maintaining and regulating the development of state-owned oil and gas, particular legal and administrative problems involved in end-use policies, possibilities of using in-kind royalties for allocation, and the restraints on state action imposed in this area by Federal law. GRA

N76-13980# Texas Governor's Energy Advisory Council, Austin. **LEGAL AND REGULATORY POLICY ASPECTS OF ENERGY ALLOCATION** Final Report

Diane Wood 15 Oct. 1974 59 p refs

(Grants NSF G1-44085; NSF SIA-73-05812)

(PB-243336/5; NSF/RA/N-74-240) Avail: NTIS HC \$4.50 CSCL 10A

Options the state of Texas has in the area of energy policy are discussed. What the state must do under the Federal programs, what it is permitted to do on its own, and what it is currently doing under existing laws are covered. Author

N76-14590# Mitre Corp., McLean, Va.
**WESTERN COAL DEVELOPMENT AND UTILIZATION. A
 POLICY ORIENTED, SELECTED BIBLIOGRAPHY WITH
 ABSTRACTS Final Report**
 D. Ellis and T. Bercal Jul. 1975 465 p refs
 (Grant NSF C-925)
 (PB-244271/3; MTR-6963) Avail: NTIS HC \$12.00 CSCL
 081

This bibliography is an aid to the identification and understanding of policy issues related to the development and use of western coal. It provides a means of facilitating communication among those involved in the related research. The research cited is directed at the states most affected by the expanded development of western coal resources. In addition, research is included which, while not directly addressing western coal, assists in the understanding of policies and problems related to its increased production. GRA

N76-14593# Bureau of Mines, Dallas, Tex. Mineral Supply
 Field Office.
**DEPTH AND PRODUCING RATE CLASSIFICATION OF
 PETROLEUM RESERVOIRS IN THE UNITED STATES,
 1971**
 W. D. Dietzman Jul. 1975 29 p
 (PB-244368/7; BM-IC-8675) Avail: NTIS HC \$4.00 CSCL
 081

This report presents statistics pertaining to distribution of petroleum reservoirs (or fields), wells, and production by depth and producing rate classification in the United States. Data are presented in tabular form by state for the 18 principal oil-producing states and by subdivision for the two largest oil producing states, Texas and Louisiana. Tabular summations and graphical illustrations are presented for the nation. The data are classified by four-barrels-of-oil-per-day rate increments up to 36 barrels and one increment of greater than 36 barrels of oil per day and 2,000-foot depth increments up to 8,000 feet and one depth increment of greater than 8,000 feet. GRA

N76-14594 British Library Lending Div., Boston Spa (England).
**SITUATION AND DEVELOPMENT OF DISTRICT HEATING
 IN UNICHAL MEMBER COUNTRIES**
 [1975] 35 p Transl into ENGLISH from Fernwarme Intern.
 (West Germany), v. 3, no. 1, 1974 p 3-12
 (BLL-CE-Trans-6668-(9022.09)) Avail: British Library Lending
 Div., Boston Spa, Engl.

The development of district heat supply in ten member countries of UNICHAL is described. The method of heat generation, the fuel used, the consumer structure, the competitive situation, and the expected trend of development are briefly examined. In the light of the most recent developments in the fuel market, the expectations regarding future annual growth rates in district heat supply are likely to be fully confirmed and probably exceeded. Author

N76-14596 British Library Lending Div., Boston Spa (England).
CAN FLYWHEELS REPLACE PUMPED STORAGE?
 T. Ginsburg [1974] 14 p refs Transl. into ENGLISH from
 Neue Zuercher Zeitung (West Germany), 15 Jul. 1974
 p 15-16
 (BLL-CE-Trans-6761-(9022.09)) Avail: British Library Lending
 Div., Boston Spa, Engl.

The feasibility of using a system of modern flywheels for energy storage is considered. Topics discussed include: energy storage as a buffer between production and consumption; energy storage capacity of a flywheel; fiber-reinforced plastics; design of a flywheel in terms of material selection; and economic and environmental factors. The concept of decentralized energy storage (flywheels) is compared to centralized energy storage (pumped storage stations) with emphasis on environmental and cost factors. J.M.S.

N76-14597 British Library Lending Div., Boston Spa (England).
**SYSTEMS OF CYBERNETIC SIMULATION OF POWER
 SYSTEMS**
 V. A. Venikov and Q. A. Sukhanov [1975] 17 p refs Transl.
 into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp.

(Moscow), no. 3, 1974 p 112-122
 (BLL-CE-Trans-6723-(9022.09)) Avail: British Library Lending
 Div., Boston Spa, Engl.

The mathematical methodology for calculating electric potential and impedances is discussed. Mathematical models, transformations, volterra equations, and algorithms are considered. Digital techniques are discussed, and block diagrams of electrical power systems and circuits are shown. The Kirchhoff law for electrical circuits and networks is also discussed. J.R.T.

N76-14599 Arizona Univ., Tucson.
**A SILICON JUNCTION SOLAR ENERGY CONVERTER Ph.D.
 Thesis**

Raymond Joseph Balda 1975 85 p
 Avail: Univ. Microfilms Order No. 75-26930

A description of a lateral collection pin solar cell is described. An intrinsic region serves as the active generation region of the cell, thus allowing long diffusion lengths for the optically generated carriers. Collecting junctions are formed in isotropically etched grooves which traverse the thickness of the cell in a nearly vertical manner. A method for the fabrication of this silicon device is presented, and processing problems which were encountered are discussed. Testing of this solar cell was carried out in sunlight, and a method of determining the solar input power at the earth's surface based on the atmospheric attenuation is illustrated. A mathematical model of this lateral collection device was derived which accounts for the solar spectral distribution, atmospheric attenuation, and the silicon optical absorption coefficient. Computer solutions of the model are presented, and the results provide an insight to the effects of material parameters and device design on the overall performance of this pin solar energy converter. Dissert. Abstr.

N76-14603# Bechtel Corp., San Francisco, Calif.
**FUELS FROM MUNICIPAL REFUSE FOR UTILITIES:
 TECHNOLOGY ASSESSMENT Final Report**
 Mar. 1975 181 p refs Sponsored by Elec. Power Res. Inst.
 (EPRI-261-1) Avail: NTIS HC \$7.50

Methods of processing municipal solid wastes are presented. Six types of processes available to prepare or use municipal solid wastes (MSW) are examined. They are: (1) preparation of MSW as a solid fuel, (2) pyrolysis of MSW to a fuel gas, (3) pyrolysis of MSW to a fuel oil, (4) anaerobic digestion of landfilled MSW to a fuel gas, (5) fluid-bed combustion/gas turboelectric generation, and (6) incineration of MSW with heat recovery. Flow charts and diagrams of the processes are included, along with cost estimates. J.R.T.

N76-14604# National Academy of Sciences - National Research
 Council, Washington, D.C. Commission on Sociotechnical
 Systems.

**MATERIALS TECHNOLOGY IN THE NEAR-TERM ENERGY
 PROGRAM**

1974 133 p refs
 (Contract NSF C-310)
 Avail: NTIS HC \$6.00

A semiquantitative measure is given of the influence which a given materials program might have on the energy supply/demand balance in 1985. The resulting sensitivity indices indicate that only a few program areas can have significant impact in this time frame. The most important programs from the materials point of view with respect to degree of impact are (1) pressure vessels in the nuclear power plants, (2) oil shale, (3) coal liquefaction, (4) fuel and materials recycling from municipal and agricultural waste, (5) coal gasification, (6) high temperature turbines, and (7) hot water geothermal. Other programs considered are judged to have less impact in this time frame: solar heating, extractive metallurgy processing, fuel cells, U-235 separation, and batteries and flywheels for energy storage. Research areas common to many of the energy programs are briefly summarized. Author

N76-14605*# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.
**INSTALLATION AND INITIAL OPERATION OF A 4100 WATT
 WIND TURBINE**

Henry B. Tryon and Timothy Richards. Dec. 1975. 29 p.
(NASA-TM-X-71831) Avail: NTIS HC \$4.00 CSCL 10A

The results are presented of 211 days of operation of the 4.1 kilowatt wind turbine, which was the largest commercially available wind turbine. The wind turbine, electric controls and load bank, and the pivoted tower are described. F.O.S.

N76-14606* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Structure and Propulsion Lab.

CONSIDERATIONS FOR PERFORMANCE EVALUATION OF SOLAR HEATING AND COOLING SYSTEMS

J. W. Littles and J. C. Cody. 14 Nov. 1975. 23 p. refs
(NASA-TM-X-64969) Avail: NTIS HC \$3.50 CSCL 10A

One of the many factors which must be considered in performance evaluation of solar energy systems is the relative merit of a given solar energy system when compared to a standard conventional system. Although initial and operational costs will be dominant factors in the comparison of the two types of systems and will be given prime consideration in system selection, sufficient data are not yet available for a definitive treatment of these variables. It is possible, however, to formulate relationships between the nonsolar energy requirements of the solar energy systems and the energy requirements of a conventional system in terms of the primary performance parameters of the systems. Derivations of such relationships, some parametric data for selected ranges of the performance parameters, and data with respect to limiting conditions are presented. Author

N76-14607# Committee on Ways and Means (U. S. House). **THE ENERGY CRISIS AND PROPOSED SOLUTIONS. PART 2: TAX POLICY IN THE ENERGY SECTOR, INTERNATIONAL FINANCIAL ASPECTS OF THE ENERGY PROBLEM**

Washington GPO 1975 554 p. refs. Panel discussions before Comm. on Ways and Means, 94th Congr., 1st Sess., 3-7 Mar., 10-14 Mar. and 17 Mar. 1975

(GPO-49-488) Avail: Comm. on Ways and Means

Proposed solutions to the energy crisis are discussed. Areas covered include: tax policy; international financial aspects of the energy problem; petroleum supply; gas and other energy sources; automobile efficiency and conservation; industrial, agriculture, and home energy problems; and transportation. For Vol. 1, see N76-11556. J.M.S.

N76-14608# Committee on Ways and Means (U. S. House). **THE ENERGY CRISIS AND PROPOSED SOLUTIONS. PART 3: PETROLEUM SUPPLY, GAS AND OTHER ENERGY SOURCES, AUTOMOBILE EFFICIENCY AND CONSERVATION**

Washington GPO 1975 489 p. refs. Panel discussions before Comm. on Ways and Means, 94th Congr., 1st Sess., 3-7 Mar., 10-14 Mar. and 17 Mar. 1975

(GPO-50-130) Avail: Comm. on Ways and Means

For abstract, see N76-14607.

N76-14609# Committee on Ways and Means (U. S. House). **THE ENERGY CRISIS AND PROPOSED SOLUTIONS. PART 4: INDUSTRIAL, AGRICULTURAL, AND HOME ENERGY PROBLEMS, TRANSPORTATION, ADDITIONAL TESTIMONY FROM GOVERNMENT OFFICIALS**

Washington GPO 1975 506 p. refs. Panel discussions before Comm. on Ways and Means, 94th Congr., 1st Sess., 3-7 Mar., 10-14 Mar. and 17 Mar. 1975

(GPO-50-199) Avail: Comm. on Ways and Means

For abstract, see N76-14607.

N76-14615# Texas Governor's Energy Advisory Council, Austin. **EXISTING ENERGY LAW AND REGULATORY PRACTICE IN TEXAS. Final Report**

Tom Edwards, John Gangstad, and Row Sandberg. 21 Nov. 1974. 108 p. refs

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243334/0; NSF/RA/N-74-238) Avail: NTIS CSCL 10A

Federal and state law affecting the production and use of energy in Texas is surveyed. The principal federal and state statutes

dealing with exploration, production, processing and conversion, transportation/transmission, distribution, and use of energy and relevant environmental restraints are summarized. Indexing and cross-referencing to administrative practices, caselaw, and more intensive scholarly analysis and commentary are included. GRA

N76-14616# Texas Governor's Energy Advisory Council, Austin. Legal and Regulatory Policy Committee.

ENERGY CONSERVATION. Final Report

Steve Van, ed., Joyce Carpenter, and Marc Wiegand. 25 Nov. 1974. 119 p. refs

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243335/7; NSF/RA/N-74-239) Avail: NTIS HC \$5.50 CSCL 10A

Various ways to conserve energy in the residential, commercial, transportation, industrial, and electric utilities sectors are discussed. Legal issues involved are noted. GRA

N76-14617# Texas Governor's Energy Advisory Council, Austin. **THE IMPACT OF AND POTENTIAL FOR ENERGY CONSERVATION PRACTICES IN RESIDENTIAL AND COMMERCIAL BUILDINGS IN TEXAS. Final Report**

Raymond D. Reed (Texas A and M Univ., College Station). 10 Dec. 1974. 130 p. refs

(Grants NSF GI-44085; NSF SIA-73-05812)

(PB-243323/3; NSF/RA/N-74-228) Avail: NTIS HC \$6.00 CSCL 10A

This study deals with the potential to conserve energy in the residential and commercial areas through the application of conservation oriented design practices and selected urban design and planning concepts. Profiles of energy consumption in the residential and commercial areas are reviewed and documented for comfort heating, cooking, and comfort cooling. Some of the many variables associated with the design of the built environment and their relationship to energy are reviewed. The spectrum of climatic conditions that exist in Texas is identified, categorized and studied to reflect more efficient energy uses as well as an architecture that supports rather than negates climatic factors. GRA

N76-14618# Aerospace Corp., El Segundo, Calif. Water Resources Research Inst.

SOLAR THERMAL CONVERSION CENTRAL RECEIVER PILOT PLANT SITING

31 Jan. 1975. 151 p. refs

(Contract NSF C-933)

(PB-243752/3; ATR-75(7370)-3; NSF/RA/N-75-039C) Avail: NTIS HC \$6.75 CSCL 10A

Technical and institutional criteria were developed and applied to identify twenty potentially suitable general locations. Facilities exist at these locations that could potentially supply logistical support during design, construction, and operation (at some locations) of the POCE. These potentially suitable locations were subsequently examined to assess climatological factors and to identify typical sites within the general area. A total of 29 sites were identified in the six southwestern states of Arizona, California, New Mexico, Nevada, Oklahoma, and Texas. Both favorable and unfavorable climatological features were identified at each site. GRA

N76-14619# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM: REVIEW AND SUMMARY OF AVAILABLE TEST FACILITIES

Jan. 1975. 72 p. refs

(Contract NSF C-933)

(PB-243751/5; ATR-75(7370)-2; NSF/RA/N-75-039B) Avail: NTIS HC \$4.50 CSCL 10A

The results are given of a study to define siting criteria and identify alternative solar power plant sites for a planned 10 MWe Central Receiver Proof-of-Concept Experiment (POCE) Pilot Plant. Technical and institutional criteria were developed and applied to identify twenty potentially suitable general locations. Facilities

N76-14620

exist at these locations that could potentially supply logistical support during design, construction, and operation (at some locations) of the POCE. GRA

N76-14620# Texas Governor's Energy Advisory Council, Austin. **STATE/FEDERAL REGULATION OF NATURAL GAS Final Report**

Mark Lee 29 Oct. 1974 59 p refs
(Grants NSF G1-44085; NSF SIA-73-05812)
(PB-243339/9; NSF/RA/N-74-243) Avail: NTIS HC \$4.50 CSCL 10A

Possible governmental responses to the disequilibrium in the supply of and the demand for natural gas are evaluated. The approach includes research and the relevant literature, statutes, cases, governmental reports, quantitative data, and proposed legislation. GRA

N76-14621# Texas Governor's Energy Advisory Council, Austin. **POTENTIAL OF SOLAR ENERGY FOR TEXAS Final Report** A. F. Hildebrandt (Houston Univ.) 15 Nov. 1974 44 p refs (Grants NSF G1-44085; NSF SIA-73-05812) (PR-243344/9; NSF/RA/N-74-248) Avail: NTIS HC \$4.00 CSCL 10A

Evaluated is the rapidly growing solar energy program and it is determined which areas are appropriate for immediate development in Texas. Home heating and cooling via solar energy as well as integration of solar energy into electric and gas utilities are considered. GRA

N76-14622# Texas Governor's Energy Advisory Council, Austin. **RESOURCES AND UTILIZATION OF TEXAS LIGNITE Final Report**

T. F. Edgar (Tex. Univ., Austin) and J. T. Richardson (Houston Univ., Tex.) 15 Nov. 1974 229 p refs
(Grants NSF G1-44085; NSF SIA-73-05812)
(PB-243343/1; NSF/RA/N-74-247) Avail: NTIS HC \$8.00

The Texas lignite resources and their use is evaluated. Specific areas covered include: (1) supplies of domestic and Texas coals; (2) transportation of coal and coal-derived energy; (3) conversion of coal to other energy forms; (4) synthetic fuel demand; (5) environmental factors in use of coal; and (6) research and development strategy for use of lignite. GRA

N76-14624# Federal Energy Administration, Washington, D.C. **Office of Quantitative Methods.**

NATIONAL PETROLEUM PRODUCT SUPPLY AND DEMAND, 1975 Quarterly Report, Oct. - Dec. 1975
25 Mar. 1975 227 p refs
(PB-243413/2; FEA-EATR-75-5; FEA/B-75/271) Avail: NTIS HC \$8.00 CSCL 21D

This report presents a documentation of the short-term petroleum product supply and demand forecasting methodology. In addition, two petroleum product supply and demand forecasts are presented for the period February through June 1975 by month and for the remainder of 1975 by quarter. The two forecasts represent a base case and a policy option case. GRA

N76-14629# Federal Energy Administration, Washington, D.C. **REPORT TO CONGRESS ON ECONOMIC IMPACT OF ENERGY ACTIONS**

Feb. 1975 52 p refs
(PB-243580/8; FEA/B-75/279) Avail: NTIS HC \$4.50 CSCL 10A

This report examines the impact of energy shortages on the economy for July 1 to October 10, 1974. Information is presented regarding the impact of energy shortages on employment and the economy. The study examines the evolution of the energy shortage and the impacts, where discernible and measurable, on employment and the general economic situation; it also examines the economic effects of the mandatory petroleum allocation and price regulations. GRA

N76-14630# Hawaii State Dept. of Planning and Economic Development, Honolulu. **STATE POLICY CONSIDERATIONS FOR GEOTHERMAL DEVELOPMENT IN HAWAII**

Eugene M. Grabbe and Robert M. Kamins Apr. 1975 24 refs Prepared in cooperation with Hawaii Univ.
(Grant NSF ISR-71-03844-A03)
(PB-243467/8; NSF/RA/G-75/014) Avail: NTIS HC \$3.50 CSCL 08I

Policy options open to Hawaii in developing its geothermal energy resources are discussed. Topics that are addressed included: uses of the resource; outcomes of exploration and development; constraints on geothermal drilling in Hawaii; state policies toward geothermal drilling and development; and, roles of state and county government in geothermal development. GRA

N76-14631# Mitre Corp., McLean, Va. **ANALYSIS OF STEAM COAL SALES AND PURCHASES** M. T. Lethi, J. Elliott, D. Ellis, and E. P. Krajewski Apr. 1975 139 p refs

(Contract FEA-C-05-50110-00)
(PB-243575/8; MTR-6878; FEA/G-75/348) Avail: NTIS HC \$6.00 CSCL 10A

Specific information on the steam coal market is provided. Investigated are coal purchasing and sales practices, factors influencing coal prices, and current and future contractual relationships between buyers and sellers. Potential problems in coal use and production and recommendations for solving these problems are identified. GRA

N76-14632# Texas Governor's Energy Advisory Council, Austin. **THE IMPACT OF STATE AND FEDERAL LAW ON DEVELOPMENT OF GEOTHERMAL RESOURCES IN TEXAS Final Report**

Tom Edwards Oct. 1974 56 p refs
(Grants NSF G1-44085; NSF SIA-73-05812)
(PB-243340/7; NSF/RA/N-74-244) Avail: NTIS HC \$4.50 CSCL 08I

On the basis of known facts concerning the resource and possible modes of utilizing it, the study attempts to predict how the common law rules of property, the terms of existing mineral leases, state statutes pertaining to state lands, resource production, and the environment, and federal law relating to taxation, the environment, and energy would be applied to geothermal resources and geothermal energy production in Texas. It is suggested that there are some very difficult legal problems to be resolved, but that there are no inseparable legal barriers to development of the resource at this time. On the question of ownership, it is indicated that the resource is most likely to be dealt with under common law rules pertaining to ground water, but that the same general results would follow as under oil and gas law, because the basic legal principles are the same in these areas as in Texas. Author

N76-14633# Texas Governor's Energy Advisory Council, Austin. **ALTERNATIVES FOR THE TEXAS ELECTRIC POWER INDUSTRY Final Report**

H. H. Woodson and C. D. Zinn 15 Oct. 1974 160 p refs
(Grants NSF G1-44085; NSF SIA-73-05812)
(PB-243345/6; NSF/RA/N-74-249) Avail: NTIS HC \$6.75 CSCL 10B

Technologies are assessed that may have an impact on the generation and transmission of electric energy for the state of Texas for the time period 1982 to 2000. Topic areas covered include: Light water reactors; High temperature gas cooled reactors; Breeder reactors; Offshore nuclear power plants; Fusion; Molten salt breeder reactor (MSBR); Direct combustion of coal; Gasification of coal; Liquefaction of coal; Gas turbines and combined cycles; Fuel cells; Magnetohydrodynamics and Transmission technologies. GRA

N76-14634# Texas Governor's Energy Advisory Council, Austin. **THE IMPLEMENTATION OF A HYDROGEN ENERGY SYSTEM IN TEXAS Final Report**

C. J. Huang (Houston Univ.) and John R. Howell (Houston Univ.) 15 Dec. 1974 88 p refs
(Grants NSF G1-44085; NSF SIA-73-05812)
(PB-243346/4; NSF/RA/N-74-250) Avail: NTIS HC \$5.00 CSCL 10A

Hydrogen production and distribution costs were researched, and the methods best suited to Texas were determined. A gaseous fuel supply/demand model for Texas was developed, based on an existing national natural gas model. This interactive computer model was used to project the price of natural gas scenarios. The ability of hydrogen to compete in such conditions was then examined, and the cost of state subsidies to bring hydrogen to compete in such conditions was then examined, and the cost of state subsidies to bring hydrogen into the market was forecast.

GRA

N76-14635# Texas Governor's Energy Advisory Council, Austin. **POTENTIAL FOR SOLID WASTE AS AN ENERGY SOURCE IN TEXAS** Final Report

James E. Halligan (Tex. Tech. Univ.) and William J. Huffman (Tex. Tech. Univ.) Nov. 1974 128 p refs
(Grants NSF GI-44085; NSF SIA-73-05812)
(PB-243351/4; NSF/RA/N-74-255) Avail: NTIS HC \$6.00 CSCL 10A

The technology is assessed of solid waste conversion for application to the needs of Texas. The production rate of solid wastes in the municipal, agricultural, and industrial sectors of the state is summarized. Research-development and legislative actions required to implement energy recovery from solid wastes and those locations in Texas where such conservation processes would be feasible are recommended.

GRA

N76-14636# Texas Governor's Energy Advisory Council, Austin. **AN ANALYSIS OF THE POTENTIAL USE OF GEOTHERMAL ENERGY FOR POWER GENERATION ALONG THE TEXAS GULF COAST** Final Report

John S. Wilson (Dow Chem. Co.), Burchard P. Shepherd (Dow Chem. Co.), and Sidney Kaufman (Dow Chem. Co.) 15 Oct. 1975 70 p refs
(Grants NSF GI-44085; NSF SIA-73-05812)
(PB-243342/3; NSF/RA/N-74-246) Avail: NTIS HC \$4.50 CSCL 08I

The possible potential energy resource represented by deep geopressed waters found along the Texas Gulf Coast are evaluated. The nature and extent of the resource, along with the methods and the economics of power production, are estimated.

GRA

N76-14639# American Univ., Washington, D.C. **RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS** Interim Progress Report, Apr. - Oct. 1974
Alayne A. Adams and Robert T. Foley Mar. 1975 31 p refs
(Contract DAAK02-72-C-0084; DA Proj. 1T1-61102-A-34A)
(AD-A014067; IPR-6) Avail: NTIS CSCL 10/2

The research has involved work on two tasks: a search for electrolytes alternative to phosphoric acid for direct and indirect hydrocarbon-air fuel cells, and a study of the corrosion characteristics of electrolytes for intermediate-temperature hydrocarbon-air fuel cells. The effort during this reporting period has been concentrated on the further investigation of the electrochemical behavior of trifluoromethanesulfonic acid monohydrate as a fuel cell electrolyte. The studies dealt with the use of methanol as a fuel, both from electrooxidation at a platinum electrode and from its tendency to interfere with the air electrode. Methanol dissolved in CF₃SO₃H.H₂O was electrooxidized over a temperature range of 23C to 135C with the highest rate in the neighborhood of 80C. At temperatures above 100C vaporization losses are excessive. Methanol interferes with the air electrode. The electrochemical activities of hydrogen, propane, and air were investigated at a platinum electrode in CF₃SO₃H.H₂O at 23C.

GRA

N76-14641 Houston Univ., Tex. **ENERGY USE AND THE ENVIRONMENT: THE EFFECTS OF ENVIRONMENTAL QUALITY STANDARDS ON THE SUPPLY, DEMAND, AND PRICE OF FOSSIL ENERGY** Ph.D. Thesis

Rodrigo Joseph Lievano 1975 129 p
Avail: Univ. Microfilms Order No. 75-28835

A normative economic model is developed for analyzing the effects of changes in (1) resource availabilities, (2) resource prices,

(3) operating environment (e.g., energy and environmental policy), and (4) patterns of energy demand, on the supply, demand, and price of fossil energy resources. The model is developed by interfacing (1) a normative economic model of oil and natural gas supply, and (2) an econometric demand model for the important fossil fuels and electricity, through a linear programming model of the energy conversion industries. This interface utilizes the economic theories of resource allocation and valuation, and of competitive markets and economic equilibrium. The model is used to evaluate the effects of currently announced limitations on waste discharges to the water and air by industrial sources on the supply, demand, and price of fossil energy resources. Results are presented and discussed.

Dissert. Abstr.

N76-14653# Naval Ship Research and Development Center, Bethesda, Md. Materials Dept.

DETERMINING THE CONCENTRATION OF OIL IN WATER SAMPLES BY INFRARED SPECTROPHOTOMETRY. PHASE 2: INTERLABORATORY STUDY, VOLUME 3 Evaluation Report

Stanley Finger, Harry Feingold, Ed Timko, and Sidney Orbach Jan. 1975 177 p
(SF57572701)

(AD-A011043; NSRDC-4536-Vol-3) Avail: NTIS CSCL 07/4

An interlaboratory study to validate a method for measuring the concentration of oil in water was conducted with the active participation of seven laboratories. This volume contains appendices presenting a description of samples shipped to laboratories participating in the interlaboratory study of the IR Oil Concentration Analysis Method, and data provided by laboratories participating in the interlaboratory study of the IR Oil Concentration Analysis Method.

GRA

N76-14806*# Missouri Univ., Columbia.

MULTIPLE NUTRIENT MARKERS. ENERGY AND NUTRIENT Final Report

T. D. Luckey, B. Venugopal, and D. P. Hutcheson 1975 139 p refs
(Contract NAS9-12369)

(NASA-CR-144635) Avail: NTIS HC \$6.00 CSCL 06K

A passive system to determine the in-flight intake of nutrients is developed. Nonabsorbed markers placed in all foods in proportion to the nutrients selected for study are analyzed by neutron activation analysis. Fecal analysis for each marker indicates how much of the nutrients were eaten and apparent digestibility. Results of feasibility tests in rats, mice, and monkeys indicate the diurnal variation of several markers, the transit time for markers in the alimentary tract, the recovery of several markers, and satisfactory use of selected markers to provide indirect measurement of apparent digestibility. Recommendations are provided for human feasibility studies.

Author

N76-14972# Joint Economic Committee (U. S. Congress).

NATIONAL PRIORITIES AND FEDERAL RESEARCH AND DEVELOPMENT PROGRAMS

Washington GPO 1974 240 p refs Hearings before Subcomm. on Priorities and Economy in Govt. of Joint Economic Comm., 93d Congr., 2d Sess., 20-22 May 1974
(GPO-40-686) Avail: SOD HC \$2.25

Selected aspects of Federal spending for research and development were studied in order to gain an insight into how resources in this area are used. Topics discussed include waste processing, petroleum production processes, cost analysis, methanol, synthetic alcohols, ethanol production, solid wastes, oil shale utilization, gasoline, and solar energy.

M.J.S.

N76-14973# Committee on Interstate and Foreign Commerce (U. S. House).

STANDBY ENERGY EMERGENCY AUTHORITIES ACT

Washington GPO 1974 357 p refs Hearings on H.R. 13834 before Comm. on Interstate and Foreign Commerce, 93d Congr., 2d Sess., 2-4 Apr. 1974
(GPO-32-544) Avail: Comm. on Interstate and Foreign Commerce

A legislative act to provide energy to meet the energy crisis is presented. Topics discussed are: (1) the Arab oil embargo,

(2) supply and demand factors for oil, (3) alternate fuel supplies other than oil, (4) oil monopolies, (5) the effect of energy shortages on unemployment and other aspects of the economy, and (6) energy conservation measures. J.R.T.

N76-15163# Committee on Aeronautical and Space Sciences (U. S. Senate).

AIRCRAFT FUEL EFFICIENCY PROGRAM

Washington GPO 1975 340 p refs Hearings before Comm. on Aeron. and Space Sci., 94th Congr., 1st Sess., 10 Sep., 23 Oct., and 4 Nov. 1975 (GPO-60-208) Avail: SOD HC \$3.40

Research project planning and cost estimates are discussed for proposed NASA programs for aircraft fuel conservation. Aircraft design using composite materials for lightweight airframe construction is discussed. Also discussed are the development and testing of jet (turbofan) engines that will conserve fuel. Photographs are shown. J.R.T.

N76-15257# Krupp (Fried.) G.m.b.H., Essen (West Germany). **EXPERIMENTAL WORK ON THE USE OF MEMORY ALLOY NiTi AS DRIVE FOR DEPLOYMENT OF ANTENNAS AND SOLAR CELL ARRAYS [EXPERIMENTALSTUDIE UEBER DIE MEMORY-LEGIERUNG NITI ALS ANTRIEB FUER DIE ENTFALTUNG VON ANTENNEN ODER SOLARZELLENAUSLEGERN]**

Frank Baumgart, Guenter Bensmann, Rainer Dietze, Joachim Jorde, Karl-Heinz Kramer, and Rudolf Mohs Bonn Bundesmin. fuer Forsch. und Technol. Jun. 1975 89 p refs In GERMAN; ENGLISH summary (Contracts BMFT-RFT-1072; GfW-RV-11-TA-2/72) (BMFT-FB-W-75-09) Avail: NTIS HC \$5.00; ZLDI, Munich DM 18.70

The memory effect of the alloy NiTi can be utilized for converting heat into mechanical work. Since this is attributable to a transformation of the crystal structure, there is no chance of a failure occurring. The material makes possible the identity of drive and structural components. A deployment drive based on the memory alloy NiTi for antennas or solar cell arrays was developed. After the alloy was subjected to application-oriented investigations and tested for the optimum melting procedure and processing, and after a suitable deployment mechanism was developed, a working model of a deployable antenna was built and operated to demonstrate that this concept can be realized. Author (ESA)

N76-15309# Naval Civil Engineering Lab., Port Hueneme, Calif. **METAL HYDRIDES FOR ENERGY STORAGE APPLICATIONS Technical Note, 1 Jul. 1973 - 30 Jun. 1974**

S. C. Garg and A. W. McClaine Jun. 1975 60 p refs (AD-A014174; CEL-TN-1393) Avail: NTIS CSCL 07/2

A survey was made of metal hydrides for energy storage in the form of hydrogen, heat, and a combination of both. Five intermetallic compounds were found to be promising energy storage vehicles. They were: MgNi, FeTi, LaNi₅, La(0.3)Ni₅, and Mischmetal Ni₅. The most important property common to all these hydrides is their ability to store large quantities of hydrogen per cubic foot of the hydride: between 5 and 7 pounds per cubic foot, compared to a liquid hydrogen density of about 4.4 pounds per cubic foot. Each of these compounds was found to be able to store hydrogen under different experimental conditions, and each has its unique properties and handling characteristics. The survey was followed by a consideration of areas of possible useful applications. Several areas where metal hydrides can be of use are discussed in detail, including energy storage at remote bases and combat zones, underwater fuel storage, fuel and heat storage in closed system operations, and their use in heat pumps and automotive applications. Because of the ability of metal hydrides to supply hydrogen and absorb exhaust heat at the same time, and to deliver this absorbed heat during recharging where it can be used, they are useful in achieving better utilization of available energy. GRA

N76-15323# Naval Civil Engineering Lab., Port Hueneme, Calif. **SEA CACHE: A MOBILE PETROLEUM, OILS, LUBRICANTS (POL) SEAFLOOR STORAGE AND SUPPLY SYSTEM FOR ADVANCED BASES Final Report, Jul. 1972 - Jun. 1973** N. D. Albertsen and H. H. Haynes Nov. 1974 24 p refs (Z61512001)

(AD-A004936; CEL-TN-1360) Avail: NTIS CSCL 15/5

The structural and operational characteristics of a mobile petroleum, oils, lubricants, (POL) logistics system are presented. The system is based on using large prestressed concrete structures to transport and store up to 27,000 barrels of POL product. Transport of the POL filled structures is by surface tow and storage is on the sea floor in water depths to 600 feet. The system can operate in conjunction with military forces at advanced bases where the seafloor structure is emptied via pipeline to the beach. In this manner, many of the hazards associated with on-land storage of POL are avoided. The structural and operational analyses show that this system is feasible and is a logical approach to meeting the military's advanced base POL requirements of today and of the future. GRA

N76-15567# Lewin and Associates, Inc., Washington, D.C. **REVIEW OF SECONDARY AND TERTIARY RECOVERY OF CRUDE OIL Final Report**

Jun. 1975 126 p (Contract D1-14-01-0001-2044)

(PB-244970/0; FEA/G-75/482) Avail: NTIS HC \$6.00 CSCL 081

Policy options are reviewed that could increase domestic crude oil production. The basic issue addressed is whether and to what extent, FEA should use its regulatory process to encourage investment in high recovery crude oil production technology that would contribute to the Nation's goal of domestic energy self sufficiency. Topics discussed include: technical review of primary/secondary/tertiary production; impact and expectations of enhanced recovery; objectives for an improved program of enhanced recovery; economics of enhanced recovery; policy alternative to handling enhanced recovery projects and expenses; and exempting from price controls production from high-cost exotic enhancement projects. GRA

N76-15569# Bureau of Mines, Denver, Colo. Intermountain Field Operation Center.

THE RESERVE BASE OF COAL FOR UNDERGROUND MINING IN THE WESTERN UNITED STATES Information Circular, 1975

Thomas K. Matson and Doss H. White, Jr. Jul. 1975 242 p refs (PB-244909/8; BM-IC-8678) Avail: NTIS HC \$7.75 CSCL 081

The coal reserve base in the Western United States is presented for coalbeds amenable to extraction by underground mining methods. The Federal Bureau of Mines has abstracted data on the quality and quantity of coal resources/reserves from numerous state and federal publications and modified such data as necessary to allow computer storage and retrieval. Tonnages are compiled by state, county, coalbed, and rank, and allotted to sulfur categories by statistical apportionment. GRA

N76-15571 Arizona Univ., Tucson. **A COMPUTERIZED INFORMATION SYSTEM ON THE IMPACTS OF COAL FIRED ENERGY DEVELOPMENT IN THE SOUTHWEST Ph.D. Thesis**

David Warren Layton 1975 118 p Avail: Univ. Microfilms Order No. 76-1602

A hybrid informatic system capable of communicating impact information derived from a variety of sources is described. Specifically, the system is able to either retrieve textual material stored in a base information file or to execute on-line simulation models and routines in order to describe environmental impacts. Interactions with the information system are performed at a remote computer terminal by an information specialist who, with the assistance of supporting documents, helps users select information of interest. Evaluation of the system was carried out by demonstrating it to prospective users from electric utilities.

overnment agencies, and the interested public in Arizona. The response of the users to the system shows that this type of communications technology is a viable means of transmitting environmental information. The results of the evaluation also indicate that the system's usefulness is more likely to depend on its credibility than on its convenience and that computer models are an effective way of describing cumulative impacts caused by a series of power plants. Dissort. Abstr.

N76-15573*# National Aeronautics and Space Administration. Pasadena Office, Calif.

CONTROL FOR NUCLEAR THERMIONIC POWER SOURCE Patent Application

Craig D. Sawyer, inventor (to NASA) (JPL) Filed 17 Oct. 1975 22 p

(Contract NAS7-100)

(NASA-Case-NPO-13114-2; US-Patent-Appi-SN-634214) Avail: NTIS HC \$3.50 CSCL 10B

A control system is presented for a thermionic reactor power source. It maintains a constant load voltage while minimizing emitter temperature variations, in spite of wide and sudden changes in load. The control system includes a neutron flux control circuit, and a separate variable gain power regulator that provides a constant voltage output to the load. The neutron flux control circuit compares the actual neutron flux to a linear function of current supplied by the thermionic converter of the reactor, and uses any difference as an error signal that drives a mechanism which alters the neutron flux. The variable gain regulator always draws enough current from the thermionic converter to supply the load with a constant voltage. Block diagrams of the system are shown. NASA

N76-15574*# General Atomic Co., San Diego, Calif.

STUDIES OF THE USE OF HIGH-TEMPERATURE NUCLEAR HEAT FROM AN HTGR FOR HYDROGEN PRODUCTION

D. D. Peterman, R. W. Fontaine, R. N. Quade, L. J. Halvers, and A. M. Jahromi 30 Sep. 1975 355 p refs

(Contract NAS3-18935)

(NASA-CR-134919; GA-A13391) Avail: NTIS HC \$10.50 CSCL 10A

The results of a study which surveyed various methods of hydrogen production using nuclear and fossil energy are presented. A description of these methods is provided, and efficiencies are calculated for each case. The process designs of systems that utilize the heat from a general atomic high temperature gas cooled reactor with a steam methane reformer and feed the reformer with substitute natural gas manufactured from coal, using reforming temperatures, are presented. The capital costs for these systems and the resultant hydrogen production price for these cases are discussed along with a research and development program.

N76-15576* General Atomic Co., San Diego, Calif.

HYDROGEN FROM COAL

In its Studies of the Use of High-Temp. Nucl. Heat from an HTGR for Hydrogen Production 30 Sep. 1975 8 p

CSCL 10A

Hydrogen production from coal by hydrogasification is described. The process involves the solubilization of coal to form coal liquids, which are hydrogasified to produce synthetic pipeline gas; steam reforming this synthetic gas by a nuclear heat source produces hydrogen. A description is given of the hydrogen plant, its performance, and its effect on the environment. E.H.W.

N76-15577* General Atomic Co., San Diego, Calif.

PRODUCTION OF HYDROGEN BY DIRECT GASIFICATION OF COAL WITH STEAM USING NUCLEAR HEAT

In its Studies of the Use of High-Temp. Nucl. Heat from an HTGR for Hydrogen Production 30 Sep. 1975 14 p

CSCL 10A

Problems related to: (1) high helium outlet temperature of reactor, and (2) gas generator design used in hydrogen

production are studied. Special attention was given to the use of Oklahoma coal in the gasification process. Plant performance, operation, and environmental considerations are covered. E.H.W.

N76-15578* General Atomic Co., San Diego, Calif.

HYDROGEN MANUFACTURE BY LURGI GASIFICATION OF OKLAHOMA COAL

In its Studies of the Use of High-Temp. Nucl. Heat from an HTGR for Hydrogen Production 30 Sep. 1975 14 p

CSCL 10A

Advantages and disadvantages of using the Lurgi gasification process to produce hydrogen from Oklahoma coal are listed. Special attention was given to the production of heat for the process; heat is generated by burning part of pretreated coal in the steam generator. Overall performance of the Lurgi process is summarized in tabular form. E.H.W.

N76-15580* General Atomic Co., San Diego, Calif.

ISPRA MARK-10 WATER SPLITTING PROCESS

In its Studies of the Use of High-Temp. Nucl. Heat from an HTGR for Hydrogen Production 30 Sep. 1975 52 p refs

CSCL 10A

A thermochemical water splitting process, the Ispra Mark-10 chemical reaction cycle, was chosen for examining the possibility of using water to produce hydrogen on a large scale for fuel and major industrial chemical uses. The assumed energy source for the process is an HTGR (helium cooled). A process flow diagram, a material balance, and an energy balance were developed for the thermochemical reaction cycle. Principal reactions which constitute the cycle are included. Author

N76-15582* General Atomic Co., San Diego, Calif.

PROCESS DESCRIPTION

In its Studies of the Use of High-Temp. Nucl. Heat from an HTGR for Hydrogen Production 30 Sep. 1975 96 p ref

CSCL 10A

The production of hydrogen from coal by hydrogasification and subsequent steam hydrocarbon reforming was studied. Process heat and power requirements are supplied by an HTGR. The process is examined as a function of a maximum reforming (process) temperature of 922 K (1200 F) to 1367 K (2000 F). The major parameters for the five cases selected are summarized in a table. A fixed thermal capacity of 3000 MW for the HTGR heat source was used as a basis. The resulting hydrogen production rates and the corresponding hydrogen purity are also given in a table. Author

N76-15587*# Alabama Univ., Huntsville. Center for Environmental and Energy Studies.

SOLAR HEATING AND COOLING: TECHNICAL DATA AND SYSTEMS ANALYSIS Progress Report, Oct. 1974 - Aug. 1975

D. L. Christensen Sep. 1975 67 p refs

(Contract NAS8-31293)

(NASA-CR-144110) Avail: NTIS HC \$4.50 CSCL 10A

The solar energy research is reported including climatic data, architectural data, heating and cooling equipment, thermal loads, and economic data. Lists of data sources presented include: selected data sources for solar energy heating and cooling; bibliography of solar energy, and other energy sources; sources for manufacturing and sales, solar energy collectors; and solar energy heating and cooling projects. F.O.S.

N76-15588*# Alabama Univ., Huntsville. Center for Environmental and Energy Studies.

SOLAR HEATING AND COOLING: TECHNICAL DATA AND SYSTEMS ANALYSIS. PRESENTATION CHARTS (BRIEFING TO NASA 17 SEPTEMBER 1975) Interim Status Report, Oct. 1974 - Aug. 1975

Sep. 1975 30 p

(Contract NAS8-31293)

(NASA-CR-144111) Avail: NTIS HC \$4.00 CSCL 10A

An interim status briefing concerning the solar energy research is presented. Systems planning, methodology and procedures, which might be applied to the current program are included.

F.O.S.

N76-15590*# Institute of Gas Technology, Chicago, Ill.
SURVEY OF HYDROGEN PRODUCTION AND UTILIZATION METHODS. VOLUME 1: EXECUTIVE SUMMARY Final Report

Derek P. Gregory, Jon B. Pangborn, and Jay C. Gillis Aug. 1975 41 p

(Contract NAS8-30757)

(NASA-CR-144127) Avail: NTIS HC \$4.00 CSCL 10B

The use of hydrogen as a synthetic fuel is considered. Processes for the production of hydrogen are described along with the present and future industrial uses of hydrogen as a fuel and as a chemical feedstock. Novel and unconventional hydrogen-production techniques are evaluated, with emphasis placed on thermochemical and electrolytic processes. Potential uses for hydrogen as a fuel in industrial and residential applications are identified and reviewed in the context of anticipated U.S. energy supplies and demands. A detailed plan for the period from 1975 to 1980 prepared for research on and development of hydrogen as an energy carrier is included. Author

N76-15591*# Institute of Gas Technology, Chicago, Ill.
SURVEY OF HYDROGEN PRODUCTION AND UTILIZATION METHODS. VOLUME 2: DISCUSSION Final Report

Jay C. Gillis, Derek P. Gregory, and Jon B. Pangborn Aug. 1975 477 p refs

(Contract NAS8-30757)

(NASA-CR-144128) Avail: NTIS HC \$12.50 CSCL 10B

For abstract, see N76-15590.

N76-15592*# Institute of Gas Technology, Chicago, Ill.
SURVEY OF HYDROGEN PRODUCTION AND UTILIZATION METHODS. VOLUME 3: APPENDIXES Final Report

Jay C. Gillis, Hansraj C. Maru, and John C. Sharer Aug. 1975 194 p refs

(Contract NAS8-30757)

(NASA-CR-144129) Avail: NTIS CSCL 10B

For abstract, see N76-15590.

N76-15599*# Westinghouse Astronuclear Lab., Pittsburgh, Pa.
STUDIES OF THE USE OF HEAT FROM HIGH TEMPERATURE NUCLEAR SOURCES FOR HYDROGEN PRODUCTION PROCESSES

G. H. Farbman Jan. 1976 328 p refs

(Contract NAS3-18934)

(NASA-CR-134918) Avail: NTIS HC \$10.00 CSCL 10B

Future uses of hydrogen and hydrogen production processes that can meet the demand for hydrogen in the coming decades were considered. To do this, a projection was made of the market for hydrogen through the year 2000. Four hydrogen production processes were selected, from among water electrolysis, fossil based and thermochemical water decomposition systems, and evaluated, using a consistent set of ground rules, in terms of relative performance, economics, resource requirements, and technology status. Author

N76-15600# Committee on Interior and Insular Affairs (U. S. Senate)

FACTORS AFFECTING COAL SUBSTITUTION FOR OTHER FOSSIL FUELS IN ELECTRIC POWER PRODUCTION AND INDUSTRIAL USES

Allen F. Agnew and David E. Gushee Washington GPO 1975 50 p refs Background paper pursuant to S. Res. 45 for Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 1975 Prepared by the Library of Congr., Congressional Res. Service (GPO-52-490) Avail: US Capitol, Senate Document Room

The impediments to greater utilization of coal involve basic questions of industrial and national policy. The mining industry must invest large quantities of capital, adapt to new health, safety, and environmental protection requirements, develop and

practice new mining technology, and move on a large scale into new geographical areas. The railroad and barge industries must expand their capacities, improve their facilities, and maximize the use of their stock. To meet these requirements, there must be assured markets of known dimensions. The utilities industry in particular is facing uncertainties regarding: (1) the availability of coal with the necessary distribution of sulfur, (2) the stringency of air quality standards, (3) Federal requirements for continuous sulfur oxide emission reductions, (4) oil price levels, and (5) the rapidity of the rise in demand for electricity in the face of higher rates. Steps must be taken to clarify these issues if coal is to be utilized more fully. Author

N76-15601# Committee on Interior and Insular Affairs (U. S. House).

OVERSIGHT HEARINGS ON NUCLEAR ENERGY: OVERVIEW OF THE MAJOR ISSUES, PART 1

Washington GPO 1975 907 p refs Hearings before Subcomm. on Energy and the Environment of Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 28-29 Apr., 1-2 May 1975

(GPO-52-367) Avail: Subcomm. on Energy and the Environment

Testimony is presented on the advantages and disadvantages of further development of nuclear energy as a means of meeting national energy requirements. Factors considered include: the regulatory process; reactor safety; long-term nuclear waste disposal; costs; and solar energy as an alternative to nuclear energy. J.M.S.

N76-15602# Committee on Interstate and Foreign Commerce (U. S. House).

ENERGY CONSERVATION AND OIL POLICY, PART 1

Washington GPO 1975 1113 p refs Hearings on Titles 2, 3, 4, 12 and 13 of H.R. 2633, identical Bill H.R. 2650, and H.R. 2151 before Subcomm. on Energy and Power of Comm. on Interstate and Foreign Commerce, 94th Congr., 1st Sess., 10-14 Mar., 17-21 Mar., and 7 May 1975

(GPO-53-518) Avail: SOD HC \$8.45

Testimony is presented on methods by which domestic energy supplies can be increased and energy demand decreased. Various means of preparing for energy emergencies are discussed along with the problem of imported oil and dollar outflow. J.M.S.

N76-15603*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SELECTIVE COATING FOR SOLAR PANELS Patent Application

Glen E. McDonald, inventor (to NASA) Filed 22 Dec. 1975 12 p

(NASA-Case-LEW-12159-1; US-Patent-Appl-SN-643041) Avail: NTIS HC \$3.50 CSCL 10A

A black chrome coating of controlled thickness (0.5 micron to 2.5 microns) which has improved energy absorbing properties is examined. The coating is deposited on a specially prepared metal substrate, and has high absorptivity for visible solar radiation, and low emissivity for infrared radiation. NASA

N76-15604*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHOTOVOLTAIC CONVERSION OF SOLAR ENERGY FOR TERRESTRIAL APPLICATIONS Executive Report

Ralph Lutwack 15 Oct. 1974 62 p refs Workshop Conf. held at Cherry Hill, N. J., 23-25 Oct. 1973 Sponsored by NASA

(Grant NSF AG-485)

(NASA-CR-145966; NSF/RA/N-74-073; PB-242529/6;

JPL-SP-43-12) Avail: NTIS HC \$4.50 CSCL 10B

This report is composed of a general overview of the Workshop Proceedings and deals primarily with the sections which treat the problems of using a photovoltaic conversion device for terrestrial applications. Topic areas covered include: single-crystal Si solar cell; CdS/Cu₂S solar cell; other materials and devices insolation, testing, and systems. GRA

N76-15605# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.

**SOLAR THERMAL ELECTRIC POWER SYSTEMS.
VOLUME 1: EXECUTIVE SUMMARY Final Report**

Nov. 1974 49 p refs Prepared in cooperation with Westinghouse Electric Corp., Pittsburgh, Pa.
(Grant NSF GI-37815)

(PB-243835/6; NSF/RANN/SE/GI-37815/FR-74-3;

NSF/RA/N-74-196-Vol-1) Avail: NTIS HC \$4.00 CSCL 10B

Design parameters are developed of systems for thermal/mechanical conversion of solar energy to electric power at minimum cost per kilowatt-hour generated. Systems of 3MW to 300MW sizes in a public utility network are considered. The three basic plant concepts considered for preliminary evaluation are: (1) a nonfocusing collector system using pressurized water at a temperature of 150C; (2) a line-focusing collector system using steam transport at 250C; and (3) a multiple tower/heliostat system generating steam at a temperature of 350C. Sketches of solar thermal power plant configurations and concepts of some components are shown. GRA

N76-15606# Colorado State Univ., Fort Collins.

**SOLAR THERMAL ELECTRIC POWER SYSTEMS.
VOLUME 2: SYSTEMS STUDIES AND ECONOMIC
EVALUATIONS**

Nov. 1974 235 p refs Prepared in cooperation with Westinghouse Electric Corp., Pittsburgh, Pa.

(Contract NSF GI-37815)

(PB-243836/4; NSF/RANN/SE/GI-37815/FR-74-3;

NSF/RA/N-74-197-Vol-2) Avail: NTIS HC \$8.00 CSCL 10B

Parametric performance and cost models are derived for key elements of the systems. A sequential optimization program was developed using these models to determine optimum subsystem sets and combinations which yield the least capital cost plants. A dynamic simulation program was developed to determine annual electric power produced by solar power systems at specific locations. Electric energy cost comparisons are made to select promising systems for generation of electricity from solar energy. GRA

N76-15607# Colorado State Univ., Fort Collins.

**SOLAR THERMAL ELECTRIC POWER SYSTEMS.
VOLUME 3: APPENDICES Final Report**

Nov. 1974 639 p refs Prepared in cooperation with Westinghouse Electric Corp., Pittsburgh, Pa.

(Grant NSF GI-37815)

(PB-243837/2; NSF/RANN/SE/GI-37815/FR-74-3;

NSF/RA/N-74-198-Vol-3) Avail: NTIS HC \$16.25 CSCL 10B

For abstract, see N76-15605.

N76-15613# Federal Energy Administration, Washington, D.C. Office of Energy Resource Development.

**TRENDS IN REFINERY CAPACITY AND UTILIZATION,
PETROLEUM REFINERIES IN THE UNITED STATES-
FOREIGN REFINERY EXPORTING CENTERS Annual
Report**

Eugene Peer Jun. 1975 45 p

(PB-244093/1; FEA/G-75/368) Avail: NTIS HC \$4.00 CSCL 07A

Estimates of U.S. petroleum refinery capacity growth in 1975 are examined. Included in the study are: (1) refining capacities as of January 1, 1960-1980; (2) new refineries, expansions, and reactivations; (3) revised summary of 1974 U.S. refinery capacity; (4) U.S. refineries planned but not constructed due to opposition on environmental grounds; and (5) world refining/export centers downstream equipment. The study also analyzes world refining exporting centers in the Bahamas/Caribbean, the Middle East, Eastern Canada, Italy, and Singapore, including petroleum product exports from those countries to the U.S. and a survey of current capacity and future firm projects in the above countries. GRA

N76-15614# Federal Energy Administration, Washington, D.C. Office of Energy Statistics.

**ENERGY INFORMATION REPORTED TO CONGRESS AS
REQUIRED BY PUBLIC LAW 93-319 Quarterly Report,
Jul. - Sep. 1974**

Dec. 1974 155 p refs

(PB-244605/2; FEA/C-75/173; QR-3) Avail: NTIS HC \$6.75 CSCL 10A

Summaries and statistical tables are given for the quarter on resource development and production, consumption, storage, distribution, imports, exports of coal, natural gas, crude oil, and refined petroleum products. GRA

N76-15615# Federal Energy Administration, Washington, D.C. Office of Energy Statistics.

**ENERGY INFORMATION REPORTED TO CONGRESS AS
REQUIRED BY PUBLIC LAW 93-319 Quarterly Report,
Oct. - Dec. 1974**

Mar. 1975 145 p refs

(PB-244606/0; FEA/C-75/239; QR-4) Avail: NTIS HC \$6.00 CSCL 10A

This report is prepared on a regular basis in compliance with provisions of the Energy Supply and Environmental Coordination Act of 1974 (Public Law 93-319). Each issue contains summaries and statistical tables for the quarter on resource development and production, consumption, storage, distribution, imports, exports of coal, natural gas, crude oil, and refined petroleum products. GRA

N76-15616# TRW Systems Group, Redondo Beach, Calif.

**EXPERIMENTAL GEOTHERMAL RESEARCH FACILITIES
STUDY (PHASE O), VOLUME 1 Final Report**

Robert H. Douglas, Carl E. Hilbers, and Russell O. Pearson 31 Dec. 1974 106 p refs 2 Vol.

(Grant NSF GI-44149)

(PB-243755/6; TRW-26405-6001-RU-00-Vol-1;

NSF/RA/N-74-263A) Avail: NTIS HC \$5.50 CSCL 10A

A representative liquid-dominated geothermal reservoir of moderate temperature and salinity is studied. Preliminary engineering design of an appropriate energy conversion system, identification of critical technology, and planning for implementation of experimental facilities are discussed. Results are summarized and recommendations and conclusions derived; implementation plans for the next two phases of the program are given. GRA

N76-15617# TRW Systems Group, Redondo Beach, Calif.

**EXPERIMENTAL GEOTHERMAL RESEARCH FACILITIES
STUDY (PHASE O), VOLUME 2 Final Report**

31 Dec. 1974 235 p refs 2 Vol.

(Grant NSF GI-44149)

(PB-243756/4; TRW-26405-6001-RU-00-Vol-2;

NSF/RA/N-74-263B) Avail: NTIS HC \$8.00 CSCL 10A

The following topics are discussed: geothermal resources of the western United States; site selection process and the East Mesa geothermal field; East Mesa geothermal field reservoir characteristics; thermodynamic analyses; materials and corrosion factors; preliminary reliability/maintainability analyses, and environmental impact analysis guidelines. GRA

N76-15618# Dow Chemical Co., Midland, Mich.

**ENERGY INDUSTRIAL CENTER STUDY Final Report, Jun.
1974 - Jun. 1975**

Jun. 1975 472 p refs Prepared in cooperation with Environmental Res. Inst. of Mich., Ann Arbor, Townsend-Greenspan and Co., Inc., N. Y., and Cravath, Swain and Moore, N. Y.
(Grant NSF OEP-74-20242)

(PB-243823/2) Avail: NTIS HC \$12.00 CSCL 10A

This report summarizes the findings of a study of the technical, environmental, economic, legal and regulatory aspects of two approaches to conserving fuel burned to produce steam; the generation of by-product electric power from the steam generated by industry for use in manufacturing, and the supplying of steam to industry from utility central power stations. Estimates were developed of the nationwide extent to which each approach is economically viable, and of the corresponding reductions in capital

investment and fuel consumption. An assessment is made of the potential impacts on the electric utility industry and on electric rates over the next decade. Environmental issues to be faced in specific instances of implementation are identified for the pulp and paper, petroleum refining, and chemical industries. GRA

N76-15620# Massachusetts Inst. of Tech., Cambridge. Energy Lab.

ENERGY SUPPLY DEMAND/NEED AND THE GAPS BETWEEN. VOLUME 1: AN OVERVIEW Final Report

James W. Meyer, William J. Jones, and Myer M. Kessler 1 Dec. 1974 80 p refs

(Contract EPA-8-02-1308)

(PB-243976/8; MIT-EL-75-012-Vol-1) Avail: NTIS HC \$5.00; HC also available in set of 2 reports as PB-243975-SET, PC \$12.00 CSCL 10A

Based on a critical review of selected literature, energy supply, demand/need imbalances, and the operational/technological developments needed to redress these imbalances are examined GRA

N76-15621# Massachusetts Inst. of Tech., Cambridge. Energy Lab.

ENERGY SUPPLY, DEMAND/NEED AND THE GAPS BETWEEN. VOLUME 2: MONOGRAPH, WORKING PAPERS AND APPENDIX PAPERS Final Report

James W. Meyer, William J. Jones, and Myer M. Kessler 1 Dec. 1974 300 p refs

(Contract EPA-8-02-1308)

(PB-243977/6; MIT-EL-75-013-Vol-2) Avail: NTIS HC \$9.25; HC also available in set of 2 reports as PB-243975-SET, PC \$12.00 CSCL 10A

A number of working papers and monographs written in nonscientific language are presented for the general public describing the state-of-the-art and possibilities of several alternatives for helping in the near- and long-term energy crisis. GRA

N76-15622# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

MODIFICATIONS TO THE LOCKHEED-HUNTSVILLE SOLAR HEATING AND COOLING SYSTEMS SIMULATION PROGRAM Final Report, 7 Jun. 1974 - 7 Jun. 1975

Paul O. McCormick 7 Jul. 1975 41 p refs

(Contract NSF C-898)

(PB-244174/9; LMSC-HREC-TR-D390846; NSF/RANN/SE/C-898/FR/75/2; NSF/RA/N-75-059) Avail: NTIS HC \$4.00 CSCL 13A

This study was undertaken to make the solar heating and cooling systems simulation program more adaptable to general use. During this study the program was made more flexible for the user by input/output modifications and model improvement. A sample parametric study is provided to demonstrate the typical utilization of the program. A section is included which describes the limitations of the model as well as a section on actual use of the program (input/output). GRA

N76-15623# Houston Univ., Tex. Dept. of Mechanical Engineering.

THE EVALUATION OF SURFACE GEOMETRY MODIFICATION TO IMPROVE THE DIRECTIONAL SELECTIVITY OF SOLAR ENERGY COLLECTORS Annual Progress Report, 1 Jan. - 31 Dec. 1974

John R. Howell and Richard B. Bannerot 31 Jan. 1975 77 p refs

(Grant NSF GI-41003)

(PB-244376/0; UHME/Sol/5; NSF/RANN/SE/GI-41003/PR-74-4; NSF/RA/N-75-074) Avail: NTIS HC \$5.00 CSCL 13A

The performance of a flat plate solar energy collector can be greatly enhanced with the addition of spectrally (wavelength) and/or directionally selective surfaces. Moderately concentrating collectors composed of parallel, east-west oriented, stationary, trapezoidal grooves are discussed. Computer simulations of radiative behavior with direct beam solar incidence are verified by model testing. GRA

N76-15625# Arizona State Univ., Tempe. Engineering Research Center.

TERRESTRIAL PHOTOVOLTAIC POWER SYSTEMS WITH SUNLIGHT CONCENTRATION Annual Progress Report, 15 Jan. - 31 Dec. 1974

C. E. Backus 31 Jan. 1975 171 p refs

(Grant NSF GI-41894)

(PB-244590/6; ERC-R-75003; NSF/RANN/SE/GI-41894/PR-74-4; NSF/RA/N-75-067) Avail: NTIS HC \$6.75 CSCL 10B

Results of an investigation of the technical and economical potential of using concentration of sunlight onto photovoltaic cells are given. Topic areas cover (1) solar cell and module design, (2) concentrator design, (3) optical filter design, (4) heat rejection, (5) solar tracking, and (6) system analysis. GRA

N76-15626# Oklahoma State Univ., Stillwater.

DEVELOPMENT OF AN ELECTRICAL GENERATOR AND ELECTROLYSIS CELL FOR A WIND ENERGY CONVERSION SYSTEM Final Report, 1 Jul. 1973 - 1 Jul. 1975

William L. Hughes, H. J. Allison, and R. G. Ramakumar 10 Jul. 1975 280 p refs

(Grant NSF GI-39457)

(PB-243909/9; NSF/RA/N-75-043) Avail: NTIS HC \$9.25 CSCL 10B

Progress made on wind energy utilization research is reported. The specific objectives of this research program were: (1) to develop and build a working field modulated generator system in the 10/20 kW range suitable for use in a wind energy system to deliver standard 110/220 V single-phase 60 Hz power over a 2 to 1 range of speeds; (2) to develop and build a working high-pressure moderate-temperature electrolysis system in the 2-3kW input range in the available high pressure test facility; and (3) to design and construct a wind generator test station at the Stillwater airport using existing field modulated generators and bicycle-wheel type aeroturbines developed by the American Wind Turbine Company. GRA

N76-15627# Wisconsin Univ., Madison. Inst. for Environmental Studies.

ENERGY SYSTEMS FORECASTING, PLANNING AND PRICING

C. J. Cicchetti and W. K. Foell Feb. 1975 404 p refs Proc. of a French-Am. Conf., Madison, Wis., 28 Sep. - 3 Oct. 1974

(Grant NSF GI-43088)

(PB-243985/9; NSF/RA/N-75-042; LC-74-33226) Avail: NTIS HC \$11.00 CSCL 10A

The French energy system is reviewed. Forecasting techniques, electricity planning and design, environmental impact analysis, electricity pricing (theory and practice), and price elasticity estimation are discussed. GRA

N76-15628# Cornell Univ., Ithaca, N.Y. Energy Project.

NATIONAL ENERGY NEEDS AND ENVIRONMENTAL QUALITY Final Report, 1 Aug. 1970 - 30 Apr. 1975

J. C. Thompson, Jr., W. R. Lynn, and J. G. Ebel 1975 100 p refs Sponsored by NSF

(PB-244411/5; NSF/RA/N-75-047) Avail: NTIS HC \$5.00 CSCL 10A

Abstracts of reports generated by the Cornell Energy Project are presented. Topic areas covered include: technology assessment of energy; biological and environmental costs of energy; economics and energy perspectives; and legal and regulatory aspects of energy. GRA

N76-15629# Syracuse Univ., N.Y.

COMMERCIAL BUILDING UNITARY HEAT PUMP SYSTEM WITH SOLAR HEATING Semiannual Progress Report, 1 Jul. - 31 Dec. 1974

Eugene E. Drucker, John LaGraff, Howard Card, William Fleming, and Manas Ucar 1 Feb. 1975 79 p refs

(Grant NSF GI-43895)

(PB-244488/3; NSF/RANN/SE/GI-43895/PR-74-4; NSF/RA/N-75-075) Avail: NTIS HC \$5.00 CSCL 13A

An algorithmic computational program has been written for determining the overall performance of a heating and cooling system for a school building. The system employs a series

water-to-air heat pumps connected in a closed loop, with a solar collector for heating and a large storage tank. The computer program includes an economic analysis of the solar assisted system on a 30 year life cycle basis. Preliminary computations were made on the school model for Washington, D.C., Boston, Mass., and Minneapolis, Minn., for an eight month heating season. GRA

N76-15630# Mitre Corp., McLean, Va.
IMPACT OF ENERGY DEVELOPMENTS ON THE SHEET METAL INDUSTRY

Arnold Cohen, Mary Harlow, and Augustus Johnson Jun. 1975 115 p

(PB-244274/7) Avail: NTIS HC \$5.50 CSCL 13A

The present energy situation, the federal government's energy policies and programs, and the state-of-the-art in solar heating and cooling of buildings and in energy conservation are surveyed. A program of specific action for the Sheet Metal Workers International Association which will, at the same time, serve the nation's energy needs and provide employment opportunities for the Union's members is recommended. GRA

N76-15631# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.

CHARACTERIZING COMBUSTIBLE PORTIONS OF URBAN REFUSE FOR POTENTIAL USE AS FUEL Report of Investigations

H. Schultz, P. M. Sullivan (Bur. of Mines, Coll. Park, Md.), and F. E. Walker Jul. 1975 32 p refs

(PB-244780/3; BM-RI-8044) Avail: NTIS HC \$4.00 CSCL 13B

Urban refuse that was mechanically separated at the U.S. Bureau of Mines pilot plant in College Park, Md., was successfully evaluated for its fuel values using standard coal analysis methods. Analyses performed on refuse samples taken from five sample points included moisture, ash, sulfur, chlorine, and heating value. It was recommended that characterization of the combustible portion of urban refuse by standard coal analysis procedures should be widely adopted. GRA

N76-15633# National Bureau of Standards, Washington, D.C. Building Economic Evaluation.

SOLAR HEATING AND COOLING IN BUILDINGS, METHODS OF ECONOMIC EVALUATION

Rosalie T. Ruegg Jul. 1975 48 p refs

(COM-75-11070/0; NBSIR-75-712) Avail: NTIS HC \$4.00 CSCL 13A

Economic issues important to the design and evaluation of solar heating and cooling systems in buildings are discussed. The use of life-cycle cost analysis and benefit-cost analysis to evaluate and compare the economic efficiency of solar and conventional energy systems is explained. The conditions for making cost-effective tradeoffs in solar system/building design are considered. By presenting the basic methods and assessing the appropriateness of alternative assumptions, the paper provides a resource document for researchers and analysts. GRA

N76-15634# Maryland Univ., College Park. Dept. of Mechanical Engineering.

PROCEEDINGS OF THE WORKSHOP ON SOLAR COLLECTORS FOR HEATING AND COOLING OF BUILDINGS

Stephen L. Sargent May 1975 500 p refs Workshop held at New York, 21-23 Nov. 1974

(Grant NSF AER-74-24639)

(PB-243908/1; NSF/RA/N-75-019) Avail: NTIS HC \$12.50 CSCL 13A

This report presents summaries of technical presentations and panel discussions. Technical session topics were flat plate liquid heating collectors; flat plate air heating collectors; focusing collectors; collector materials and components; numerical models; and testing and standards. Reports of working groups that met to consider each of these areas are included. GRA

N76-15635# Gordian Associates, Inc., New York.

INDUSTRIAL ENERGY CONSERVATION. THE CCMS PILOT STUDY. PROJECT AREA 1: AN INTERNATIONAL DATA BASE

25 Jun 1974 74 p Sponsored by FEA

(PB-243923/0; FEA/D-74/142) Avail: NTIS HC \$4.50 CSCL 10A

Information is presented on a data base already established for nine U. S. industries: aluminum, cement, copper, glass, paper, petroleum refining, plastic products, styrene butadiene rubber, and steel. GRA

N76-15637# Northwestern Univ., Evanston, Ill. Dept. of Chemical Engineering.

REPORT OF CONFERENCE ON INNOVATIVE DESIGN TECHNIQUES FOR ENERGY EFFICIENT PROCESSES Final Report

Richard S. Mah 30 May 1975 95 p refs Conf. held at Evanston, Ill., 13-14 Mar. 1975

(Grant NSF ENG-75-08617)

(PB-243651/7; NU-CHE-75-001) Avail: NTIS HC \$5.00 CSCL 10A

A number of pressing needs are identified of the process industries in meeting energy challenges. Increased NSF support is recommended in process-design related researches and graduate training in process design. Major areas of research are identified and specific recommendations are embodied. GRA

N76-15638# National Academy of Sciences - National Research Council, Washington, D.C. Numerical Data Advisory Board.

CONFERENCE ON THERMODYNAMICS AND NATIONAL ENERGY PROBLEMS

May 1975 441 p refs Conf. held at Warrenton, Va., 10-12 Jun. 1974

(Contracts AT(11-1)-2460; AT(49-18)-174; NSF C-310; Grant AF-AFOSR-2741)

(PB-243134/4; AMPS-65) Avail: NTIS HC \$11.75 CSCL 10A

The report gives a summary, details, and particular needs in meeting national energy problems in the following areas: coal; fossil fuels other than coal; nuclear energy; geothermal energy; and solar energy and energy storage. GRA

N76-15641# Resource Planning Associates, Inc., Cambridge, Mass.

ENERGY SUPPLY/DEMAND ALTERNATIVES FOR THE APPALACHIAN REGION Final Report

Mar. 1975 634 p refs

(PB-244621/9; RA-74-18; EQ-4A C022-V2) Avail: NTIS HC \$16.25 CSCL 10A

An analytical methodology is developed for assessing various regional energy supply-demand projections and their related impacts. Fuel requirements, potential coal production, energy infrastructure requirements and the socioeconomic and environmental impacts of energy-related development in the Appalachian Region are discussed. The report scenarios are reviewed, each describing a set of national energy-environmental policies and their implications for future Appalachian development. GRA

N76-15644# Battelle Columbus Labs., Ohio.

EVALUATION OF THE THEORETICAL POTENTIAL FOR ENERGY CONSERVATION IN SEVEN BASIC INDUSTRIES

E. H. Hall 11 Jul. 1975 444 p

(Contract DI-14-01-0001-1880)

(PB-244772/0; FEA/D-75/CE1) Avail: NTIS HC \$11.75 CSCL 10A

The minimum theoretical energy requirements in seven basic industries is discussed. Through a thermodynamic analysis of the processes employed in each industry. The steel, copper, aluminum, glass, synthetic rubber, selected plastics and paper industries are included. 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 the thermodynamics. The results identify where large energy or availability losses occur. GRA

N76-15645# Rockwell International Corp., Canoga Park, Calif.
DEVELOPMENT OF LITHIUM-METAL SULFIDE BATTERIES FOR LOAD LEVELING Interim Report

J. Hall, S. Lai, L. McCoy, and R. Saunders Jun. 1975 47 p refs
(PB-244390/1; EPRI-116) Avail: NTIS HC \$4.00 CSCL 10C

A lithium-iron sulfide battery was developed for electric utility energy storage which uses a molten KCl-LiCl electrolyte and is operated at about 400C. This report describes the work performed on iron sulfide positive electrodes and the status of associated elements of the project concerned with lithium negative electrodes, ceramic components, and cell design. Investigations of iron sulfide active materials, current conductive matrices, and electrode housings were made with the objective of developing low cost, long-lived iron sulfide electrodes. The iron sulfide electrodes were tested in cells using liquid lithium negative electrodes. Scaleup of iron sulfide electrodes from 5 sq cm to 25 sq cm in area was carried out successfully. A program for the preparation of high purity lithium-resistant ceramic components was initiated.

GRA

N76-15646# Auburn Univ., Ala.
POTENTIAL FOR CONVERSION AND UTILIZATION OF SOLAR ENERGY IN POULTRY PRODUCTION Progress Report, 15 Sep. 1974 - 31 Jan. 1975

Robert N. Brewer and Jerry R. Dunn 28 Jan. 1975 33 p refs

(Grant NSF PTP-74-23987)
(PB-244375/2; NSF/RA/N-75-066) Avail: NTIS HC \$4.00 CSCL 02E

Fuel use in the poultry industry is examined. Findings indicate primary fuel sources to be LP (liquid petroleum) gas, fuel oil, coal, natural gas and electricity. Solar systems evaluation, selection of sites for estimating solar requirements, and implementation of a model to simulate energy usage on a daily basis over the entire production period for a flock of birds are discussed. GRA

N76-15650# Army Foreign Science and Technology Center, Charlottesville, Va.

RESEARCH AND DEVELOPMENT PROJECT FOR NEW ENERGY TECHNOLOGY (SUNSHINE PLAN)

1974 787 p refs Transl. into ENGLISH from the monograph "Vita" Japan, 1974 410 p
(AD-A014534; FSTC-HT-23-0019-75) Avail: NTIS CSCL 10/1

In view of the world-wide energy crisis and environmental problems, it is recommended that Japan, as a country with no noteworthy natural resources, should immediately establish a national project in order to advance research and development programs of new energy technologies. The present status of technological development, in Japan and in other countries is reviewed. Solar energy, geothermal energy, synthetic natural gases and hydrogen energy are chosen as important subject matters of future research and development. If the presented time schedule is followed, a fairly large portion of the total demand for energy will be supplied by these new energy sources by the year 2000. GRA

N76-15652# Massachusetts Inst. of Tech., Cambridge. Energy Lab.

THE FEA PROJECT INDEPENDENCE REPORT: AN ANALYTICAL REVIEW AND EVALUATION Final Report May 1975 99 p refs

(Contract NSF C-1030)
(PB-244741/5; MIT-EL-75-017) Avail: NTIS HC \$5.00 CSCL 21D

Special attention is directed to presenting and evaluating the project independence evaluating system, the analytical system developed by FEA to support the study. Major problems in the

oil and gas supply and the econometric demand model are identified and discussed, as are important international issues and linkages not adequately incorporated into the FEA analysis. GRA

N76-15653# Massachusetts Univ., Amherst.
TECHNICAL AND ECONOMIC FEASIBILITY OF THE OCEAN THERMAL DIFFERENCES PROCESS Quarterly Report, 30 Jun. - 30 Sep. 1974

C. R. Adams, L. L. Ambs, A. Chajes, W. P. Goss, and W. E. Heronemus 1 Dec. 1974 108 p refs

(Grant NSF GI-34979)
(PB-244447/9; NSF/RA/N-74-265; NSF/RANN/SE/GI-34979/PR-74-3) Avail: NTIS HC \$5.50 CSCL 10B

Thermal cycle, machinery components, heat exchangers, hull structural mechanics, detail design, cold water inlet pipe structures, cold water and hot water hydraulics, resource hydrodynamics, statics and dynamics of naval architecture, and the biofueling problem and total system integration are covered. GRA

N76-15654# Battelle Columbus Labs., Ohio.
FUELS TECHNOLOGY: A STATE-OF-THE-ART REVIEW Final Environmental Protection Technology Series

E. H. Hall, D. B. Peterson, J. F. Foster, K. D. Kiang, and V. W. Ellzey Apr. 1975 264 p refs

(Contract EPA-68-02-1323)
(PB-242535/3; EPA-650/2-75-034) Avail: NTIS HC \$9.00 CSCL 07A

A state-of-the-art review is given of various fuel cleaning, fuel conversion, and emission control technologies. Included are the following classes of technologies: physical and chemical coal cleaning, residual oil desulfurization, coal refining (liquefaction), coal and oil gasification, fluidized bed combustion of coal, and stack gas cleaning. For each technology, the report presents the extent of current practice and the status of systems under development. GRA

N76-15739# National Climatic Center, Asheville, N.C.
INITIAL WIND ENERGY DATA ASSESSMENT STUDY

Michael J. Changery May 1975 132 p refs Proc. of the Data Assessment, Asheville, N. C., 29-31 Jul. 1974
(Grant NSF AG-517)

(PB-244132/7; NSF/RA/N-75-020) Avail: NTIS HC \$6.00 CSCL 04B

During a 3-day meeting held at the National Climatic Center on July 29-31, 1974, discussions were held on data availability, vertical and horizontal extrapolation problems and techniques, turbulence and gust effects, additional data requirement and remote sensing techniques. The discussion, recommendations and conclusions of that meeting are summarized and the results of the survey of existing and available data are presented. The report is divided into two sections; the first on meteorological data requirements and technique assessments, and the second on the wind data survey. GRA

N76-15915# Massachusetts Inst. of Tech., Cambridge.
MULTIREGIONAL ECONOMIC IMPACTS OF ENERGY AND TRANSPORTATION POLICIES

Karen R. Polenske and Paul F. Levy Mar. 1975 128 p refs
(Contract DOT-OS-30104)

(PB-244586/4; Rept-8) Avail: NTIS HC \$6.00 CSCL 05C

The report presents a multiregional empirical analysis of energy and transportation. The study shows how the multiregional input-output (MRIIO) model for the United States can be used to analyze energy and transportation policies in general. A specific study deals with the economic interaction between electricity, coal, and freight transportation created by changes in the regional technologies of generating electricity as well as alterations in the interregional shipments of coal. Recommendations are given for extending the MRIIO data base and modifying the MRIIO model to increase its usefulness for the study of energy and transportation at the regional level. GRA

N76-15922# Committee on Science and Technology (U. S. House).

AN ANALYSIS IDENTIFYING ISSUES IN THE FISCAL YEAR 1976 ERDA BUDGET

Washington GPO Mar. 1975 102 p Rept. prepared for Comm. on Sci. and Technol., Comm. on Interior and Insular Affairs, and Joint Comm. on Atomic Energy, 94th Congr., 1st Sess., Mar. 1975

(GPO-48-010) Avail: SOD HC \$1.25

Fiscal budgets for research projects in energy technology are presented. Various energy sources are discussed such as: (1) nuclear energy (power plants), (2) fossil fuels (coal, oil, and gas), (3) solar energy, (4) magnetohydrodynamics, and (5) waste energy utilization. Government and private industry capabilities are examined for developing the above energy sources to meet the Nations's energy needs.

J.R.T.

N76-15925# Committee on Interior and Insular Affairs (U. S. Senate)

ECONOMIC IMPACT OF PRESIDENT FORD'S ENERGY PROGRAM

Washington GPO 1975 864 p refs Hearings pursuant to S. Res. 45 before Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 31 Jan. and 12 Feb. 1975

(GPO-48-736) Avail: Comm. on Interior and Insular Affairs

A discussion is presented of the proposal to try and reduce energy consumption by imposing import tariffs and excises taxes and decontrolling oil prices. The basis for the selection of prohibitive pricing as the principal means of energy conservation in the program was studied. Topics discussed include current energy problems, oil prices, petroleum imports, import controls, gasoline rationing, economic supply and demand for petroleum products, inflation impact, international energy policy, and energy consumption.

M.J.S.

N76-15928# Committee on Interior and Insular Affairs (U. S. Senate).

OUTER CONTINENTAL SHELF LANDS ACT AMENDMENTS AND COASTAL ZONE MANAGEMENT ACT AMENDMENTS, PART 2

Washington GPO 1975 1069 p refs Joint hearings pursuant to S. Res. 45 and S. Res. 222 before Comm. on Interior and Insular Affairs and Commerce, 94th Congr., 1st Sess., 8-9 Apr. 1975

(GPO-51-748) Avail: Comm. on Interior and Insular Affairs

The leasing procedures of Federal offshore lands and possible changes to those procedures are discussed in detail. Topics reviewed and investigated include offshore oil and gas resources, oil prices, increased competition in the petroleum industry, exploration and development of the outer continental shelf, *legislation dealing with offshore development, financial management of offshore development, constraints to expanded production, and a national energy policy.* The coastal zone management act is considered which authorizes and assists the coastal states in studying, planning for, managing, and controlling the impact of energy resource development and production on coastal zones.

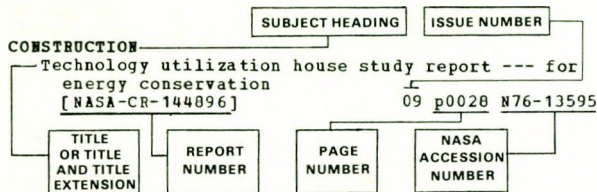
M.J.S.

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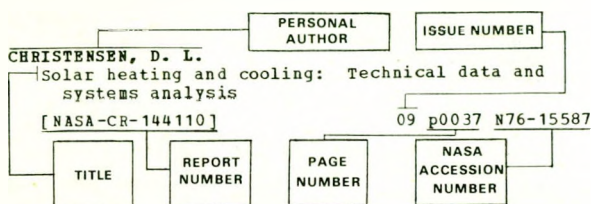
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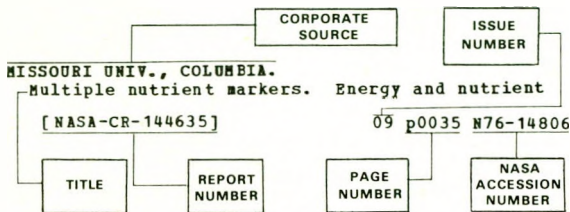
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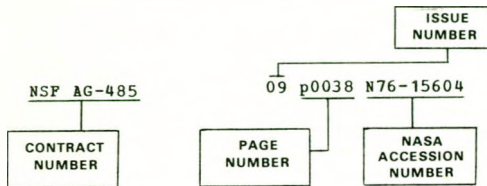
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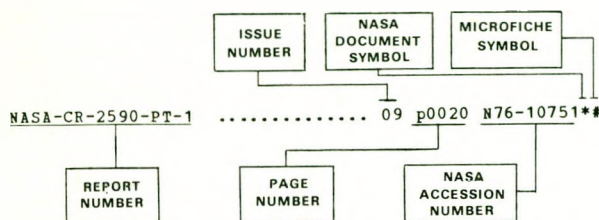
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