

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges:

IAA (A-10000 Series)

A78-20615 – A78-32509

STAR (N-10000 Series)

N78-15986 – N78-22018

Previous publications announced in this series/subject category include:

<i>DOCUMENT</i>	<i>DATE</i>	<i>COVERAGE</i>
NASA SP-7042	April 1974	January 1968 – December 1973
NASA SP-7043(01)	May 1974	January 1, 1974 – March 31, 1974
NASA SP-7043(02)	November 1974	April 1, 1974 – June 30, 1974
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NASA SP-7043(17)	April 1978	January 1, 1978 – March 31, 1978

ENERGY

A Continuing Bibliography

With Indexes

Issue 18

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 April 1 through June 30, 1978 in

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



Scientific and Technical Information Branch

1978

National Aeronautics and Space Administration

Washington, DC

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(18)) lists 1038 reports, journal articles, and other documents announced between April 1, 1978 and June 30, 1978 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.

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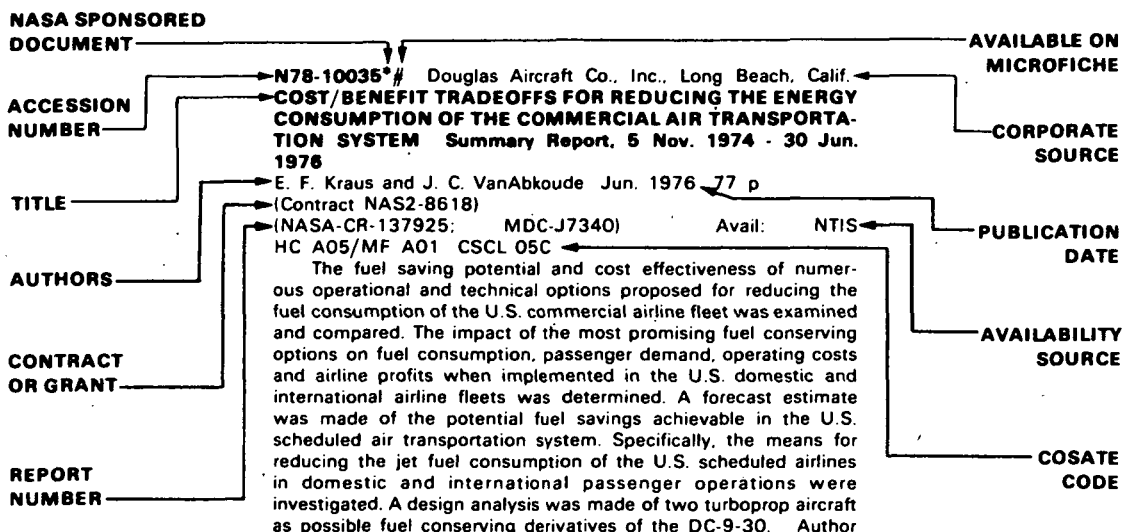
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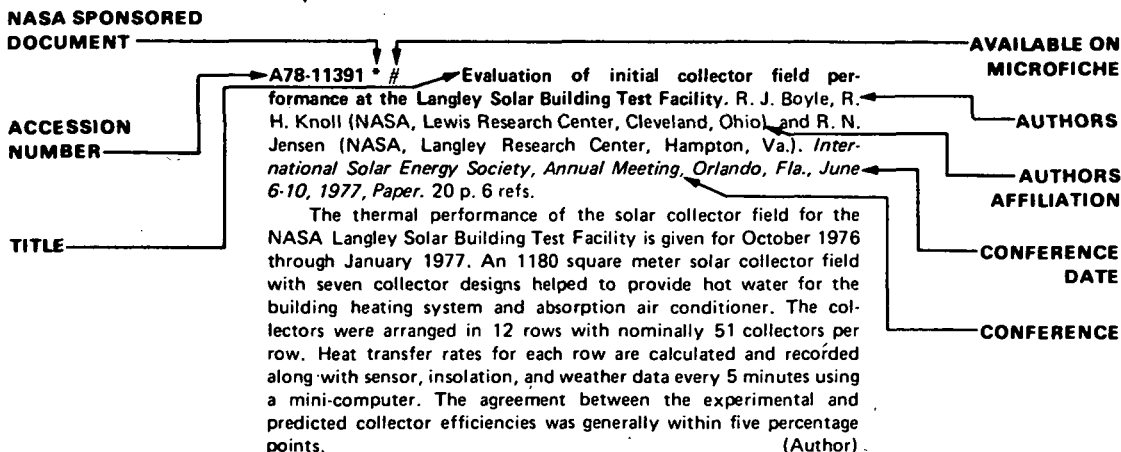
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TYPICAL CITATION AND ABSTRACT FROM STAR



TYPICAL CITATION AND ABSTRACT FROM IAA



A Listing of Energy Bibliographies Contained in this Publication:

1. Bibliography of Lewis Research Center technical contributions announced in 1976
p0252 N78-17921
2. RANN: Research Applied to National Needs. Wind Energy Conversion Research
p0270 N78-19677
3. Annotated bibliography of natural resource information: Northwestern New Mexico
p0273 N78-20597

AUGUST 1978

IAA ENTRIES

A78-20618 Energy supply-demand integrations to the year 2000: Global and national studies. Edited by P. S. Basile. Cambridge, Mass. and London, MIT Press, 1977. 720 p. \$29.95.

Energy supplies and demands are projected for Western European nations, Canada, the U.S., Mexico, and Japan during the period 1985 to 2000. Five scenarios for the 1972-1985 period and four for the period to 2000 are considered; the scenarios involve various economic growth rates, energy price structures, national energy policies, and principal replacement fuels used to fill the gap left by declining petroleum and natural gas production. Emphasis is placed on presenting information on a nation-by-nation basis that may aid in solving the problem of imbalance between limited supplies of certain fuels and accelerating demand for such fuels.

J.M.B.

A78-20620 Calculation of the energy delivered by a collector with the method of average direct optical output (Calcul de l'énergie délivrée par un capteur par la méthode du rendement optique direct moyen). B. Oquidam (Compagnie pour l'Etude de la Réalisation de Combustibles Atomiques, Groupe PUK, Romans-sur-Isère, Drôme, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Quarter, 1977, p. 17-25. 8 refs. In French.

A method is presented for calculating the energy output of a solar collector of specified orientation and arbitrary latitude and meteorological conditions. The method yields data on the energy resulting from direct irradiation, the thermal losses of the collector, and the variations in its internal heat. Integrations permit evaluations of these data for a period of one day. It is found that the daily average direct optical output varies little with latitude and meteorological conditions.

J.M.B.

A78-20621 Evaluation of the energy provided for a solar collector. D. Tinaut and F. Ramos Berjano (Consejo Superior de Investigaciones Científicas, Instituto de Optica, Madrid, Spain). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Quarter, 1977, p. 26-29.

An optimum design for a flat-plate solar collector located at the latitude of Madrid, Spain is presented. Energy output calculations involving different angles of orientation and inclination of the collector are carried out. An optimum collector size is found, based on an optimal inclination of 42 deg and a 0.8 summer/winter energy consumption ratio.

J.M.B.

A78-20622 Theoretical performance of a passive solar energy collection system for house heating. P. Ohanessian and W. W. S. Charters (Melbourne, University, Melbourne, Australia). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Quarter, 1977, p. 30-35. 7 refs.

A78-20623 A fluidized bed solar reactor - A thermochemical application (Réacteur solaire à lit fluidisé - Application à la thermochimie). G. Flamant, C. Bonet, D. Hernandez (CNRS, Laboratoire des Ultra-Réfractaires, Odeillo, Pyrénées-Orientales, France), and J.-P. Traverse (Toulouse III, Université, Toulouse, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Quarter, 1977, p. 39-43. 8 refs. In French.

The design of a fluidized bed thermochemical reactor powered by a 2-kW solar furnace is described; the reactor may provide a means for storing solar energy through application of solar power to such processes as the generation of hydrogen from the thermochemical decomposition of water. The projected reactor employs fluidized silica particles. As a sample process, the thermochemical decomposition of CaCO₃ is considered.

J.M.B.

A78-20624 Development of a ceramic receiver for a Brayton cycle solar electric power plant. J.-D. Walton and J.-N. Harris (Georgia Institute of Technology, Atlanta, Ga.). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Quarter, 1977, p. 50-53.

The successful development of a high temperature open air Brayton cycle system depends upon the development of a ceramic receiver (heat exchanger) in which air at 9-10 atmospheres can be heated to 1000 C. A program to design a solar electric power system utilizing an open air Brayton cycle turbine is described. The heat exchanger consists of silicon carbide tubes arranged around the inside periphery of a cavity type solar receiver. The criteria used for selecting the ceramic tube materials is reviewed and the high temperature radiant thermal testing of experimental tubes is described. The design of a 1 MWth solar receiver is presented. This receiver is scheduled to be completed at the end of 1977, and will be evaluated at a 5 MW solar test facility in Albuquerque, New Mexico, early in 1978.

(Author)

A78-20625 Solar and wind induced external coefficients - Solar collectors. J. H. Watmuff, W. W. S. Charters (Melbourne, University, Melbourne, Australia), and D. Proctor (Commonwealth Scientific and Industrial Research Organization, Mechanical Engineering Div., Highett, Victoria, Australia). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Quarter, 1977, p. 56. 8 refs.

An examination is conducted of the wind coefficient commonly adopted for evaluations of the external heat transfer from the cover glasses of solar collectors subjected to a range of windspeeds. The wind coefficient, derived from McAdams (1954) and in turn from Jürges (1924), includes a radiation term. This inclusion of a radiation term in the wind coefficient implies that analysts of collector models may have doubly accounted for radiative heat transfer from the cover surface.

J.M.B.

A78-20781 # Future aviation turbine fuels. A. V. Churchill, C. L. Delaney, and H. R. Lander (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan. 16-18, 1978, Paper 78-268*. 7 p. 6 refs.

This paper discusses an Air Force program which is being conducted to establish the properties of an aviation turbine fuel

which will result in adequate fuel availability for the Air Force at an acceptable cost. Results of recent processing studies on alternative hydrocarbon sources from coal and shale oil are presented, together with combustor studies directed to determining the effects of property variations on combustor performance, durability and level of harmful emissions. Also, results of a recent survey are given showing projected increases in turbine fuel availability resulting from turbine fuel property changes. A projection of the chemical and physical properties of the future Air Force aviation turbine fuel is presented. (Author)

A78-20785 # Wind power limitations associated with vortices. J. L. Loth (West Virginia University, Morgantown, W. Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan. 16-18, 1978, Paper 78-278*. 9 p. 13 refs. Contract No. E(40-1)-5135.

The total pressure dissipation inside vortices, due to viscous shear, has been analyzed. The reduced level of the total pressure flux, of the flow inside a vortex, has an adverse effect on all vortex ingesting wind machines. The Betz limit of wind turbines ingesting the vortex generated by an airfoil has been computed and is non-dimensionalized using the area of the vortex generator. The vacuum pumping ability of vortices is also limited. The Betz type limit for wind turbines exhausting into the core of a vortex has been computed for both wing tip and tornado tower type vortex generators. The energy required to eliminate a tornado has been computed. (Author)

A78-20786 # Land contouring to optimize wind power. S. E. Fuhs, A. E. Fuhs, and G. N. Vanderplaats (U.S. Naval Postgraduate School, Monterey, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan. 16-18, 1978, Paper 78-279*. 9 p. 7 refs.

Certain locations on a hill have higher local wind velocity than the freestream value. The augmentation of wind power depends on the shape of the hill. Using numerical optimization techniques, the optimum shape has been determined for several different constraints. Knowledge of the optimum shape is valuable for two reasons. First, the site selection is aided if the best contour is known; near optimum shapes may occur naturally. Second, for a given site, the excavation and fill necessary to achieve optimum shape can be determined. Four cases are discussed. Each case had different constraints and yielded different values of wind power augmentation as follows: Case 1, 226 percent; Case 2, 311 percent; Case 3, 210 percent; and Case 4, 156 percent. (Author)

A78-20788 # Mechanical energy storage systems - Compressed air and underground pumped hydro. H. H. Chiu, L. W. Rodgers, Z. A. Saleem, R. K. Ahluwalia (Illinois, University, Chicago, Ill.), G. T. Kartsounes, and F. W. Ahrens (Argonne National Laboratory, Argonne, Ill.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan. 16-18, 1978, Paper 78-281*. 15 p. 38 refs. ERDA-supported research.

Compressed air and underground pumped hydro storage are near-term load-leveling and peak-shaving technologies that are being considered by electric utilities. Assessments of the technical and economic feasibility of these storage systems have concluded that no major technical barriers for their implementation exist and that the systems are economically competitive with conventional peaker plants. This paper reviews and compares the characteristics of these two energy storage systems, evaluates their potential impacts, and presents recent research results with particular emphasis on air storage technology. In addition, advanced concepts and technical areas, where further work would be beneficial, are discussed. (Author)

A78-21030 # Experimental study of temperature fields in liquids in the steady state regime (Eksperimental'noe issledovanie temperaturnogo polia v zhidkostiakh v statsionarnom rezhime). E.

Annamukhamedov and Ch. Agabaev (Akademiiia Nauk Turkmen-skoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiiia Nauk Turkmen-skoi SSR, Izvestiia, Seriiia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 4, 1977, p. 32-36. In Russian.

Cooling liquids are used to equalize heat flux distribution on the hot surfaces of solar thermoelectric generators. This paper describes the testing of two such liquids - water and glycerin - performed for the case of heat flux energies of 0.25×10 to the 6th W/sq m fed to a heat-absorption surface with a Gaussian distribution. Temperature distribution on the heat-absorption and heat-removal surfaces was measured radially at points distributed every two centimeters by thermocouples. At optimal film thicknesses (150 mm for water and 100 mm for glycerin), the hot-surface temperature was reduced by 3-5% from maximum temperature. B.J.

A78-21034 # The efficiency of half-peak MHD electric power plant (K voprosu ob effektivnosti polupikovykh MGD-elektrostantsii). T. M. Biriukova, L. V. Iglova, G. B. Levental', A. R. Monastyrskaiia, V. S. Shul'gina, and L. K. Khokhlov. *Akademiiia Nauk SSSR, Izvestiia, Energetika i Transport*, Nov.-Dec. 1977, p. 43-48. In Russian.

The paper examines the efficiency of a MHD electric power plant which uses natural gas as fuel and preliminarily heated air or air enriched with oxygen as the oxidizing agent. Technical-economic indices for two operating regimes are analyzed. In one case, the MHD unit is switched off in the moment of load reduction in the electric energy system; in the second case, the MHD unit works with minimum power corresponding to the technical minimum of a steam turbine. M.L.

A78-21349 # Comparative evaluation of the radiation danger to the public caused by atmospheric emissions from thermal and atomic electric power plants (Srvnittel'naia otsenka radiatsionnoi opasnosti dlia naseleniia ot vybrosov v atmosferu teplovykh i atomnykh elektrostantsii). V. A. Knizhnikov and R. M. Barkhudarov. *Atomnaia Energiia*, vol. 43, Sept. 1977, p. 191-196. 25 refs. In Russian.

The paper examines the overall pattern of population irradiation resulting from coal combustion in thermal electric power plants. The danger from the release of radioactive compounds, formed from radionuclides naturally present in Donets coal, is considered both for the region immediately adjacent to the plant and for the population as a whole. Radioactive emission from two plants, the Kamensko-Dneprovsk thermal electric power plant and the Novovoronezh atomic electric power plant, are compared. Cancer mortality rates are also compared, and it is concluded that the thermal plant is responsible for a much higher incidence of cancer mortality than is caused by emissions from the atomic electric power plant. M.L.

A78-21350 # The contemporary state of studies on controlled thermonuclear fusion (Sovremennoe sostoiianie issledovaniia po upravliaemomu termoiadernomu sintezu). V. A. Chuianov. *Atomnaia Energiia*, vol. 43, Nov. 1977, p. 351-359. In Russian.

The article presents a broad overview of Soviet research in the field of thermonuclear fusion. The development of high temperature plasmas is noted along with the creation of magnetic configurations used to suppress plasma instabilities. The concept of Tokamaks is discussed with reference to various Tokamak designs. Processes for plasma heating are described in terms of obtaining the maximum plasma containment. Other toroidal systems for containing plasma are proposed, such as stellarators. Attention is given to the development of thermonuclear microexplosions and means to create plasmas via laser systems. S.C.S.

A78-21387 Coaxial, explosive-type MHD generator. Iu. A. Burenin and G. A. Shvetsov (Akademiiia Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR). (*Fizika Goreniia i Vzryva*, vol. 13, Jan.-Feb. 1977, p. 130-132.) *Combustion, Explosion, and Shock Waves*, vol. 13, no. 1, Sept. 1977, p. 110-112. Translation.

The paper presents a numerical investigation of the energetic characteristics of the three modes of operation of a coaxial explosion-type MHD generator. Ranges of initial parameters are determined for obtaining conversion efficiencies of energy of a moving piston to electromagnetic energy, close to one. B.J.

A78-21395 Problem of end effect in a linear induction MHD machine at arbitrary load current. A. Ia. Vijnitis. (*Magnitnaia Gidrodinamika*, Jan.-Mar. 1977, p. 63-72.) *Magneto hydrodynamics*, vol. 13, no. 1, Sept. 1977, p. 51-59. 12 refs. Translation.

The internal end-effect problem under consideration is solved by the method of varying the constants for an arbitrary surface current load, including the case of discrete windings. For the latter case, mathematically correct formulas are derived for calculating the mechanical coil forces and useful power. Some means of end-loss compensation are examined. V.P.

A78-21397 Evaluation of the feedback in MHD conduction machines. G. K. Grinberg. (*Magnitnaia Gidrodinamika*, Jan.-Mar. 1977, p. 107-114.) *Magneto hydrodynamics*, vol. 13, no. 1, Sept. 1977, p. 88-94. 15 refs. Translation.

The problem of self-excitation of a magnetic field in a moving and conducting liquid has engineering applications where large systems with a liquid-metal active medium are involved. Such a system, as illustrated by a magnetohydrodynamic dynamo (MHD), is feasible only at high values for the magnetic Reynolds number (R_m). A method for calculating the critical R_m is presented, which considers an MHD in the framework of equivalent circuits. Equations are given with attention to emf feedback and electrical resistance. A form factor is introduced to express actual current in terms of an equivalent current. Finally, the value of the magnetic field intensity is derived from calculations of electrical induction. D.M.W.

A78-21633 # Lift on a rotating porous cylinder. R. M. C. So (General Electric Co., Schenectady, N.Y.). *ASME, Transactions, Series I - Journal of Fluids Engineering*, vol. 99, Dec. 1977, p. 753-757. 7 refs. Research supported by the General Electric Co.

Two-dimensional flow past a rotating circular cylinder with uniform suction at the surface is considered. The method of solution follows closely that used by Glauert and the problem is solved for the case in which there is no viscous flow separation from the cylinder surface. Expressions in terms of the ratio of the cylinder peripheral velocity and a suction parameter are obtained for the lift and torque. The results show that uniform suction has a limited effect on the lift; however, the torque increases with suction. Possible application of these results to wind power generation is briefly discussed. (Author)

A78-21698 Solar collector design. D. K. Edwards (California, University, Los Angeles, Calif.). Research supported by the National Science Foundation and Energy Research and Development Administration. Philadelphia, Pa., Franklin Institute Press, 1977. 63 p. 153 refs. \$6.50.

Solar collector design is discussed, with attention given to air heaters and low- and high-pressure water heaters, fixed and tracking collectors, single- and double-glazed collectors and honeycomb collectors. Antireflection coatings, the control of reradiation and convection, as well as thermal insulation, are considered as means of collector heat loss control. In addition, heat collection and working fluid flow in solar collectors are analyzed. The effect of conduit

spacing and absorber plate thickness on the cost effectiveness of a typical solar collector is assessed. J.M.B.

A78-21699 Solar cooling. S. Karaki and P. J. Wilbur (Colorado State University, Fort Collins, Colo.). Philadelphia, Pa., Franklin Institute Press, 1977. 43 p. 49 refs. \$6.50.

Solar-powered cooling systems are discussed, with attention given to absorption refrigeration systems and Rankine cycle-vapor compression refrigeration systems. An absorption refrigeration system is designed on the basis of a detailed treatment of the thermodynamics of the lithium bromide-water combination selected as the absorbent-refrigerant pair. (Attention is also given to the aqua-ammonia combination.) Comparison with an ideal Carnot system provides an indication of the relative efficiencies of the absorption unit and a Rankine cycle-vapor compression unit, which can operate at higher temperatures than the lithium bromide absorption system. Energy storage, heat rejection, and the use of evaporative coolers or night radiation for cooling are also considered. J.M.B.

A78-21700 Bioconversion: Fuels from biomass. E. E. Robertson (Biomass Energy Institute, Inc., Winnipeg, Canada). Philadelphia, Pa., Franklin Institute Press, 1977. 72 p. 43 refs. \$6.50.

Topics related to the use of biomass for energy generation are surveyed. Urban and agricultural wastes as well as land and ocean farm products are common sources, while photosynthesis and anaerobic digestion are frequently used bioconversion processes. Subjects considered include the use of biomass to generate high temperatures, storing solar energy naturally, the biosphere's life support systems, the oxygen/carbon dioxide cycle, and self-reproducing machines and biomass. M.L.

A78-21821 # Comparison of calculated and observed characteristics of plumes from two coal-fired power plants located in complex terrain. J. F. Bowers, Jr. and H. E. Cramer (H. E. Cramer Co., Inc., Salt Lake City, Utah). In: Symposium on Atmospheric Turbulence, Diffusion, and Air Quality, 3rd, Raleigh, N.C., October 19-22, 1976, Preprints. Boston, Mass., American Meteorological Society, 1977, p. 463-469. 5 refs. U.S. Environmental Protection Agency Contract No. 68-02-1387.

A78-21833 # Ambient air quality in complex terrain. P. K. Wan and L. A. Hembree, Jr. (Bechtel Power Corp., Gaithersburg, Md.). In: Symposium on Atmospheric Turbulence, Diffusion, and Air Quality, 3rd, Raleigh, N.C., October 19-22, 1976, Preprints. Boston, Mass., American Meteorological Society, 1977, p. 561, 562. 7 refs.

A dispersion model based on the Gaussian dispersion and limited dispersion models together with Briggs' (1969) plume rise equations was used to estimate atmospheric SO₂ concentrations resulting from the combustion of fuel oil in power plants. The purpose is to estimate the maximum sulfur content in fuel oil which would not lead to violation of SO₂ air quality standards in a complex terrain region. The model was calibrated with SO₂ concentrations measured at continuous monitoring stations. The frequency distribution of violations by sulfur content is expressed in terms of the ratio of sulfur content to heat. M.L.

A78-22008 * Isoprenoid hydrocarbons produced by thermal alteration of *Nostoc muscorum* and *Rhodospseudomonas spheroides*. R. P. Philp, S. Brown, and M. Calvin (California, University, Berkeley, Calif.). *Geochimica et Cosmochimica Acta*, vol. 42, Jan. 1978, p. 63-68. 21 refs. Research supported by the National Academy of Sciences and ERDA; Grant No. NGL-05-003-003.

The potential of algae and photosynthetic bacteria to serve as precursors of kerogen was studied to determine what factors affect the relative rates of formation of precursor hydrocarbons. Cells of *Nostoc muscorum* and *Rhodospseudomonas spheroides* were subjected to thermal alteration (by heating samples in glass tubes sealed under nitrogen) for two, four, and twelve weeks. Both unextracted and extracted cells in the absence and presence of montmorillonite were investigated, and the isoprenoid hydrocarbons produced in

these experiments were determined. Phytane and five isomeric phytanes were the main hydrocarbons observed; their relative rates of formation in the different experimental conditions are described. No phytadienes, pristane, or pristenes were detected. M.L.

A78-22018 # Improvements in the design of solar selective thin film absorbers. L. C. Botten (Tasmania, University, Hobart, Australia) and I. T. Ritchie (Sydney, University, Sydney, Australia). *Optics, Communications*, vol. 23, Dec. 1977, p. 421-426. 16 refs. Research supported by the Australian Research Grants Committee, Science Foundation for Physics, and University of Sydney.

Surface roughening and refractive-index grading are shown to be capable of improving the solar absorptance of thin films. Both methods can eliminate undesirable interference features, but do so by vastly dissimilar mechanisms. Improvements in the integrated absorptance in excess of 10% have been achieved. (Author)

A78-22021 Contribution to the mineralogy of some Arabian oil-shales. S. A. Hussein (Ain Shams University, Cairo, Egypt). *Modern Geology*, vol. 6, no. 3, 1978, p. 163-170. 28 refs.

Several oil shale deposits are known to occur in different localities of Arabian Countries. The Syrian oil shales have been studied in detail from petrological, chemical and mineralogical points of view. These deposits were reported within rocks of the Cretaceous age, which consist mainly of limestone-phosphorite-black shale-chert assemblage. According to their mineral and textural features, they are classed as calcareous siltstones or carbonate-rich shales. Infrared and X-ray analyses of these shales revealed the presence of organic constituents, quartz, calcite, dolomite and clay minerals represented by kaolinite, illite and montmorillonite. A general discussion of their environments of deposition is also given. (Author)

A78-22064 High-efficiency solar energy conversion through flux concentration and spectrum splitting. W. Blocker (Aerospace Corp., Los Angeles, Calif.). *IEEE, Proceedings*, vol. 66, Jan. 1978, p. 104, 105; 9 refs.

One technique that has been studied to improve the performance and reduce the cost of solar cell power supplies is to concentrate the solar flux, which increases the conversion efficiency slightly, and greatly reduces the necessary solar cell area. Another is to split the solar spectrum into bands and convert the energy in each band by a cell optimized for that band. Both of these techniques have practical difficulties, and it has not been established that either would be superior to the present conventional way of using solar cells. The combination of these two techniques has apparently not been studied. It is suggested that the combination would preserve the separate advantages of each technique and at the same time eliminate the worst of their practical difficulties. (Author)

A78-22137 # Method for taking account of the effect of chemical kinetics on the thermodynamic properties of the working fluid in a supersonic MHD generator (Metodika ucheta vlianiia khimicheskoi kinetiki na termodinamicheskie svoistva rabochego tela v sverkhzvukovykh MGD-generatorakh). N. M. Prusova and N. N. Pshenichnov (Akademiia Nauk SSSR, Energeticheskii Institut, Irkutsk, USSR). *Teplotfizika Vysokikh Temperatur*, vol. 15, Sept.-Oct. 1977, p. 1071-1076. 23 refs. In Russian.

A78-22138 # The experimental MHD power plant of India (Indiiskaia eksperimental'naia MGD-ustanovka). V. R. Ramaprasad (Indiiskaia Kompaniia Tiazhelogo Elektricheskogo Oborudovaniia, Madras, India). *Teplotfizika Vysokikh Temperatur*, vol. 15, Sept.-Oct. 1977, p. 1077-1085. 15 refs. In Russian.

A review is presented of the Indian MHD energy program with emphasis on a detailed description (schematics are presented) of the U-05 experimental MHD power plant. Consideration is given to coal gasification processes (especially the Lurgi process) as one way to fuel such power plants and to the basic operating parameters of the U-05 plant. Lab and simulation studies in the field of MHD energy are discussed and attention is given to the reduction of nitrogen

oxide pollutants as a way to provide raw material for MHD enrichment processes. B.J.

A78-22139 # Choice of optimal configuration of frame and cross section shape for a frame-type MHD channel (O vybore optimal'noi konfiguratsii ramki i formy poperechnogo secheniia ramochnogo MGD-kanalu). V. A. Bitiurin and S. A. Medin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplotfizika Vysokikh Temperatur*, vol. 15, Sept.-Oct. 1977, p. 1086-1094. 6 refs. In Russian.

The variational problem of optimal distribution of current and potential in the cross section plane of a MHD generator channel is solved. In the case of a uniform distribution of velocity and a two-dimensional nonuniformity of distribution of conductivity, the potential distribution on the walls of the optimal channel is linear, i.e., the walls are formed of flat conducting frames. A numerical solution of the direct problem of electrodynamicity is used to investigate the effect of the cross section shape of the channel with flat frames on its characteristics. It is shown that channels of elliptical (or circular) cross section are more efficient than channels of rectangular cross section. B.J.

A78-22226 International Symposium on Wind Energy Systems, St. John's College, Cambridge, England, September 7-9, 1976, Proceedings. Symposium sponsored by the British Hydro-mechanics Research Association. Edited by H. S. Stephens, M. P. Patel, and N. G. Coles. Cranfield, Beds., England, British Hydro-mechanics Research Association, 1977. 482 p. \$36.50.

Aspects of large scale wind energy conversion system design and installation as affected by site wind energy characteristics, grouping arrangement, and social acceptance are considered along with the potential for power production by large dispersed arrays of wind turbines, the mathematical modeling of topographic effects on wind energy systems, computer-aided aerogenerator analysis and performance, a study on the use of windmills in Singapore, wind tunnel simulation of the influence of two dimensional ridges on wind speed and turbulence, and performance-optimized horizontal-axis wind turbines. Attention is also given to a crossflow wind turbine, a wind energy conversion system based on the tracked vehicle airfoil concept, design aspects of high-speed vertical-axis wind turbines, a performance prediction model for the Darrieus turbine, aerodynamic studies on a vertical-axis wind turbine, a variable geometry vertical axis windmill, a low cost windmill rotor, windmills with diffuser effect induced by small tipvanes, a self-contained 5000 kW capacity wind energy conversion system with storage, and underground gas storage in the U.S. and its potential application to wind-powered systems. G.R.

A78-22227 The potential for power production by large dispersed arrays of wind turbines. C. G. Justus (Georgia Institute of Technology, Atlanta, Ga.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydro-mechanics Research Association, 1977, p. A2-23 to A2-38; Discussion, p. X4-X6. NSF Grant No. AER-75-00547.

An evaluation is conducted of wind energy output statistics of simulated arrays of wind turbines in the New England and Middle Atlantic Federal Power Commission Regions of the U.S. Annual average capacity factors (fraction of rated power) of about 40 to 50% are obtained for 500 kW, about 15 to 25% for 1500 kW, and about 30 to 40% for 1000 kW machines. The investigation shows that the reliability of power outputs of 100 kW to 200 kW per generator can be significantly improved by dispersing the wind turbines in large arrays. Much better reliability can be achieved by the addition of 24 to 48 hours of storage capacity. Under conditions of reasonably steady high wind power in winter and high afternoon peak wind power in summer (corresponding to afternoon air conditioning loads) it might, however, be possible to achieve significant load displacement without use of storage. G.R.

A78-22228 **Mathematical modelling of topographic effects on wind energy systems.** B. E. Freeman and J. R. Taft (Science Applications, Inc., La Jolla, Calif.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. A3-39 to A3-51.

The reported investigation is concerned with the development of a methodology which employs theoretical/numerical methods to select wind energy sites on the basis of climatological data. The use of mathematical model-based meteorological prediction tools makes it possible to relate climatological data at National Weather Services and Aviation Weather stations in the region to corresponding data at the unmeasured locations within the region. Attention is given to a mesoscale meteorological computer code design and development, aspects of mathematical formulation, calculations of terrain effects, terrain coordinate transformation, relations between atmospheric pressure and wind speed, and horizontal wind vectors at various altitudes. G.R.

A78-22229 **Computer aided aerogenerator analysis and performance.** T. E. Base and L. J. Russell (Western Ontario, University, London, Canada). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. A4-53 to A4-74; Discussion, p. X6-X9. 12 refs. Research supported by the University of Western Ontario.

The general theory of windmills is examined, taking into account slow running and fast running windmills and the importance of inflow factors, which represent a modification to the flow field about rotating objects. Horizontal shaft windmills are considered, giving attention to linear and angular momentum changes considered in the Rankine-Froude momentum theory, the employment of the Newton-Raphson method of solving nonlinear differentiable equations, a computer program for the determination of torque coefficients, the distribution of the inflow factors, and the response of the windmill to turbulence. It is pointed out that much of today's wind energy research is being devoted to vertical axis machines. A logical approach to their theoretical analysis appears to follow that derived by Glauert for propellers. Computer programs for the study of vertical shaft windmill performance and their results are discussed along with inflow factors and experimentation. G.R.

A78-22230 **A study on the use of windmills in Singapore.** G. K. Nathan, G. P. D. Rajasooria, K. C. Tan, and T. L. Tan (University of Singapore, Singapore). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. A5-75 to A5-87. 6 refs.

A78-22231 **Wind tunnel simulation of the influence of two dimensional ridges on wind speed and turbulence.** R. N. Meroney, V. A. Sandborn, R. Bouwmeester, and M. Rider (Colorado State University, Fort Collins, Colo.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. A6-89 to A6-104. 38 refs. NSF Grant No. GAER-75-00702.

In connection with studies related to the selection of suitable sites in hilly country for the installation of aerogenerators and the general absence of specific wind data for such sites, it is important to be able to correlate wind behavior approaching a hill and the hill topography with the character of flow over the hill. It has been attempted to develop appropriate modeling procedures utilizing wind tunnels for the derivation of the needed correlation expressions. The conclusions of past investigations of topographical flow fields are reviewed and a description is presented of the wind tunnel facility. Attention is also given to aspects of experimental design and the results of laboratory simulation of flow over two-dimensional ridges. G.R.

A78-22232 **Performance-optimized horizontal-axis wind turbines.** R. E. Wilson and S. N. Walker (Oregon State University, Corvallis, Ore.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. B1-1 to B1-28, X23; Discussion, p. X24, X25. 17 refs. NSF Grant No. AER-74-04014-A03.

Design procedures for optimum wind turbines is shown to be different from that used for propellers. An optimum design generation approach for wind turbines is developed from a modified strip theory that includes tip-loss. The approach entails a local optimization of blade element parameters to maximize power output. Examples are presented that illustrate the optimum design generation procedure and off-design performance. (Author)

A78-22233 **A cross flow wind turbine.** M. J. Holgate (Durham, University, Durham, England). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. B2-29 to B2-38; Discussion, p. X25-X27.

A theoretical analysis is presented of the operation of a type of crossflow turbine that depends for its action on angular momentum conversion rather than aerodynamic lift. Experimental results confirm the theoretical predictions to a satisfactory degree. These are, that while the turbine does develop a starting torque and has a stable torque-speed characteristic, it runs at low velocity ratio and has a low efficiency of energy conversion. (Author)

A78-22234 **A wind energy conversion system based on the tracked vehicle airfoil concept.** R. E. Powe (Mississippi State University, Mississippi State, Miss.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. B3-39 to B3-54; Discussion, p. X27, X28. 23 refs. NSF Grant No. GI-39415.

It is pointed out that current investigations regarding wind-energy devices are either concerned with the conventional horizontal axis wind generator or with vertical axis devices. Little thoughtful effort has been devoted to the development of alternate types of devices for extraction of energy from the wind. The considered investigation was conducted to determine the technical feasibility of such an alternate wind energy conversion system. The investigated system is a novel momentum interchange device based on the tracked-vehicle airfoil concept. The system consists of airfoils mounted vertically on carriages which move around a horizontal, closed track system. It is shown that this system may possess certain significant advantages over the horizontal axis device for specific applications. G.R.

A78-22235 **Some design aspects of high-speed vertical-axis wind turbines.** R. J. Templin and P. South (National Research Council, Ottawa, Canada). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C1-1 to C1-20; Discussion, p. X37, X38.

The paper discusses the aerodynamic, mechanical and economic reasons for the choice of the various design parameters (rotor height to diameter ratio, solidity, number of blades, etc.) for high-speed vertical-axis wind turbines from kilowatt to megawatt sizes and shows that very large turbines are theoretically feasible. The paper also describes various methods to prevent overspeeding, to improve the starting characteristics, and to alleviate the effects of cyclic torque and drag loads. The operation of the turbine at constant efficiency is compared with operation at constant speed to show that as long as the rotor speed is properly selected the constant speed mode produces nearly as much average power as the constant efficiency mode. Finally, the economics of a large turbine feeding electrical energy into an existing thermal system are considered to

show that under the right circumstances the use of wind energy makes considerable financial savings possible. (Author)

A78-22236 General performance theory for crosswind axis turbines. P. B. S. Lissaman (AeroVironment, Inc., Pasadena, Calif.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C2-21 to C2-38. 6 refs. NSF Grants No. GI-41840; No. AER-74-04014-A03.

An analytical theory is presented for the determination of the performance characteristics of rotary crosswind axis machines. The considered approach can be used for the preliminary design of wind turbine geometry and the selection of blade sections. It is found that for high chordal ratio (C) devices the crosswind force has a significant adverse effect on power extraction as well as on aerodynamic loads. The theory considers wake induction and unsteady aerodynamics in the simplest way consistent with the objective of developing realistic engineering results. For low C devices this appears to be adequate for a first order analysis, but further refinement is desirable to predict aeroelastic behavior. For high C devices more data is required to validate the proposed viscous corrections. G.R.

A78-22237 A performance prediction model for the Darrieus turbine. J. H. Strickland (Texas Tech University, Lubbock, Tex.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C3-39 to C3-54; Discussion, p. X39, X40. 14 refs.

An analytical performance prediction model for the Darrieus turbine is described. Such a model is needed in connection with the recent interest in the Darrieus turbine as a wind energy conversion device. In an approach recently used by Templin (1974) the rotor is visualized as being enclosed in a single streamtube. In a more sophisticated model a series of streamtubes (actually stream filaments) are assumed to pass through the rotor. The development and utilization of such a multiple streamtube model is discussed. The basic aerodynamic model is first developed along with a description of a suitable iterative solution technique. A computer model is employed to predict the overall rotor power output and the distribution of aerodynamic forces along the rotor blades. The effects of rotor geometry variations can also be studied. G.R.

A78-22238 A contribution to the aerodynamic theory of the vertical-axis wind turbine. O. Holme (Saab-Scania AB, Aerospace Div., Linköping, Sweden). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C4-55 to C4-72; Discussion, p. X40, X41.

An analysis is made of the flow in the horizontal plane of symmetry of a fast running vertical-axis wind turbine having a great number of straight, very narrow blades and a high height-diameter ratio. The analysis is rigorously valid for only very lightly loaded turbines in incompressible nonviscous flow, but approximations for heavier loading and corrections for viscous effects are derived. It is found that half of the flow retardation caused by the turbine takes place within the turbine itself. Thus blade incidence and aerodynamic load on the blades are much higher on the windward than on the leeward side of the turbine. The maximum value of the power coefficient in nonviscous flow for this type of turbine is 92% of the theoretical maximum for an ideal wind turbine. (Author)

A78-22239 Aerodynamic studies on vertical-axis wind turbine. N. V. C. Swamy (Indian Institute of Technology, Madras, India) and A. A. Fritzsche (Dornier-System GmbH, Friedrichshafen, West Germany). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C5-73 to C5-80; Discussion, p. X41. 5 refs.

A description is presented of investigations which were conducted in West Germany and in India with the objective to improve the Darrieus type of motor. The conventional cross section of the blade for the Darrieus motor is that of a symmetrical airfoil section. Mathematical relations describing the blade geometry are presented and the behavior of the blade in a centrifugal force field is investigated, taking into account a comparison of the actual shape of the rotor blades with a quadratic parabola and a catenary for different rotor height-diameter ratios. The contribution to the torque provided by the various segments of the rotor is determined. There appears to be a distinct advantage in using a straight cylindrical section instead of curved blades. This hypothesis is to be investigated with the aid of a small model. G.R.

A78-22240 Status of the ERDA/Sandia 17-metre Darrieus turbine design. B. F. Blackwell (Sandia Laboratories, Albuquerque, N. Mex.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C6-81 to C6-86; Discussion, p. X42, X43.

A78-22241 The variable geometry vertical axis windmill. P. J. Musgrove (Reading, University, Reading, Berks., England). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C7-87 to C7-100; Discussion, p. X44, X45. 9 refs. Science Research Council Grant No. B/RG/9233.8.

The Variable Geometry Vertical Axis windmill (VGVAW), which was recently developed in the UK, uses straight blades that are hinged to a horizontal cross-arm. In low wind speeds the blades remain upright, providing maximum efficiency when it is most needed. In high wind speeds centrifugal forces, reacted by a central spring which is attached via tie-wires to the blades, make the blades incline outwards. The blade inclination progressively increases with increasing wind speed. This approach makes it possible to prevent excessive blade stresses, regardless of the wind speed. The maximum power output is limited to a small multiple of the average power output. The design of the VGVAW is described in some detail. It is indicated how the predicted performance of the windmill varies with wind speed and load. A 3 meter diameter prototype VGVAW has recently been constructed at Reading, and initial observations of its performance are reported. G.R.

A78-22242 A low cost windmill rotor. A. C. Baxter (Leicester, University, Leicester, England). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. C8-101 to C8-108; Discussion, p. X45, X46.

The economic feasibility of a use of windmills to obtain power for the generation of electricity depends primarily on the capital cost of the required installation. It appears that this capital cost is still too high. In this connection, a vertical axis, high speed rotor design has been proposed by Rangi et al. (1974), who estimate that the cost of their device would be about 1/6 of that of a conventional windmill. In the new windmill the expensive airfoil section blades, which form a main component of most windmills, are replaced with a simple steel framework round which a tensioned fabric cover is placed. A description is given of experiments in which models of the new airfoils are employed. Static aerodynamic tests of a vertical axis windmill rotor using flexible blades predict that the design appears promising. G.R.

A78-22243 Economics of a vertical-axis wind turbine. A. A. Fritzsche (Dornier-System GmbH, Friedrichshafen, West Germany). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. D1-1 to D1-6; Discussion, p. X58, X59.

Consideration is given to the energy conversion system and the operating characteristics of vertical-axis wind turbine configurations. Design features for several components of the turbine (including rotor blades, rotors, tower, blade and rotor bearings, and energy transmitting elements) are described and cost estimates are presented. It is found that: (1) based on current technology, vertical-axis wind turbines can cover a power range to 100 kW, (2) low manufacturing methods for small rotor blades may not be applied to large ones, (3) assuming identical generators for both turbines, the lower tip speed ratio requires a larger transmission ratio, and (4) the advantage of wind direction independence decreases for large power plants. S.C.S.

A78-22244 **WVU wind energy concentrators.** J. L. Loth (West Virginia University, Morgantown, W. Va.). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. E2-17 to E2-30. 9 refs. NSF Grant No. AER-75-00367-000.

The paper describes three types of wind concentrators, by means of which the coefficient of performance of a wind turbine may be increased beyond the theoretical Betz limit. The first type consists of a cylindrical obstruction which increases the wind kinetic energy available for harnessing. The second type is a cylindrical Darrieus rotor, which acts like a porous cylindrical obstruction to the wind. For high solidity rotors the inner blockage will increase the wind speed experienced by those blades that operate near the maximum width. The third type is the wing tip vortex type concentrator, based on creating a horizontal tornado-like vortex with its axis aligned with the wind. The cylindrical Darrieus rotor features passive aerodynamic angle-of-attack control and automatic feathering. P.T.H.

A78-22245 **Windmills with diffuser effect induced by small tipvanes.** T. van Holten (Delft, Technische Hogeschool, Delft, Netherlands). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. E3-31 to E3-46; Discussion, p. X65, X66. 5 refs.

Betz's formula for the maximum power output of windmills is valid only for windmill types exerting a steady, axial force on the air. Types not covered by Betz's analysis, such as windmills applying radial as well as axial forces to the air, may have a much larger power output. This report deals with a type of windmill where relatively small vanes, attached to the tips of the millblades, deflect the air radially outwards. The diffuser effect caused by the tipvanes downstream of the windmill is associated with a general type of flow resembling a Venturi-flow, where the windmill is placed near the narrowest part of the streamtube. The resulting increased mass flow through the disk plane of the windmill causes a larger power output per unit area swept by the millblades. (Author)

A78-22246 **A self-contained 5,000 kW capacity wind energy conversion system with storage.** G. I. Fekete (McGill University, Montreal, Canada). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings. Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. F2-13 to F2-29; Discussion, p. X71. 18 refs.

A wind energy conversion system intended to provide a minimum continuous output of 5000 kW even during the calmest month of the year is designed for the Magdalen Islands in the Gulf of St. Lawrence, one of the windiest areas in North America. In addition to 37.5-m diameter horizontal-axis wind turbines with 300-kW generators, the system includes extensive storage capacity responsible for almost half the total cost of the power plant. A capital cost of about 65 million 1974 dollars is projected for the entire system; the minimum cost of the electricity is put at about 20 cents per kilowatt-hour. J.M.B.

A78-22247 **Wind power installations for water pumping in developing countries.** M. E. Parkes (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England) and F. J. M. van de Laak (Shinyanga Regional Water Development Authority, Shinyanga, Tanzania). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. F3-31 to F3-40; Discussion, p. X71, X72. 17 refs.

A78-22248 **The regulation, storage, and conversion of wind produced electrical energy at the level of a few hundred watts.** P. Hirst (Marinair /Radar/, Ltd., England) and D. H. Rees. In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. F4-41 to F4-48; Discussion, p. X72, X73.

A wind-powered electrical energy supply capable of producing about 100 W for such applications as communications repeaters or navigational aids is described. The wind-powered energy supply is designed for sites characterized by a widely fluctuating average wind speed. A switching type converter is used as the battery charger, and a lead-acid type storage battery provides storage of the power extracted from the wind turbine. J.M.B.

A78-22249 **Wind energy research in New Zealand.** D. Lindley (Canterbury, University, Christchurch, New Zealand). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. X10-X20. 13 refs. Research supported by the New Zealand Energy Research and Development Committee and University Grants Committee.

A78-22250 **An aerodynamic performance theory for the Darrieus wind turbine.** D. J. Sharp (Kingston Polytechnic, Kingston-on-Thames, Surrey, England). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. X46-X53. 6 refs.

Blade element and momentum theories are used to predict the induced velocity distribution over the vertical height of the Darrieus wind turbine. The effect of local Reynolds number values on airfoil data is also taken into account. The airfoil for the turbine blades is the NACA 0012 profile; a blade shape of the troposkien type is adopted for the analysis. Results of the performance study indicate the marked influence of the wind speed Reynolds number and the need for correct airfoil data. J.M.B.

A78-22251 **A performance-optimised wind energy conversion system for space heating.** L. L. Freris (Imperial College of Science and Technology, London, England). In: International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings.

Cranfield, Beds., England, British Hydromechanics Research Association, 1977, p. X60, X61; Discussion, p. X61, X62.

A78-22267 **Thin Pt and Pd silicide Schottky barriers for silicon solar cells.** C. Canali, F. Catellani, S. Mantovani, and M. Prudenziati (Modena, Università, Modena, Italy). *Journal of Physics D - Applied Physics*, vol. 10, Dec. 21, 1977, p. 2481-2489. 15 refs. Research supported by the Commission of the European Communities.

The electrical properties of PtSi and Pd₂Si Schottky barriers grown on n-type monocrystalline silicon are investigated for silicide thicknesses ranging from 20 to 2000 Å. Homogeneous metallization may be obtained with a minimum silicide thickness of about 100 Å; the optimum photoelectric response occurs at about 150 Å for both types of Schottky diodes. Due to the higher barrier height and the smaller amount of metal involved in silicide formation, PtSi may be more suitable than PdSi for silicon solar cells. J.M.B.

A78-22531 # Energy characteristics of an MHD generator cycle with internal cooling of the channel (Energeticheskie osobennosti tsikla MGD generatora pri vnutrennem okhlazhdenii kanala). G. M. Shchegolev (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 33, 1977, p. 37-40. 8 refs. In Russian.

Two types of cooling systems for MHD generators are examined and compared: (1) external water-cooling and (2) blowing of an inert gas (internal cooling). Emphasis was placed on the latter method of cooling, which was analyzed by studying the relative decrease of effective electroconductivity of the plasma in the channel as a function of wall temperature and location, with consideration of the effects of turbulent boundary layers formed on the walls. It is shown that significant losses of plasma conductivity occur during gas blowing at low wall-temperatures; at maximum permissible temperatures for ordinary ceramic materials, the losses do not exceed 10% at the beginning of the channel and are negligible at the end. B.J.

A78-22537 # Investigation of hydrodynamic flows of a heat transfer fluid in zones of artificial porosity (Issledovanie gidrodinamicheskikh techenii teplonositelia v zonakh iskusstvennoi pronitsaemosti). A. V. Shurchkov, N. K. Prikhod'ko, G. N. Zabarnyi, and Iu. P. Morozov (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 33, 1977, p. 64-67. In Russian.

Analog simulation using conducting paper is employed to study the hydrodynamics of heat and mass transfer through zones of artificial porosity in a heat collector. Two two-dimensional problems (plane-radial flow in a vertical section and flow in a plane) are solved in an effort to give an overall picture of filtration flow through zones of artificial porosity. Consideration is given to the effects of increasing the radius of an artificial pore on flowrate through it and also to the effect of eccentricity of location of pores in the artificial porosity zone on their efficiency. As an example, fluid filtration is studied for the case of two peripheral pores and one central pore. The analysis described can be applied to the development of a heat transport system for underground geothermal boilers. B.J.

A78-22543 # Study of the driving forces of heat and mass transfer in a nozzle reflux device for heating air by water (Issledovanie dvizhushchikh sil teplo- i massopredachi v nasadochnom protivotochnom apparate pri nagrevanii vozdukh vodoi). A. K. Skalenko, I. A. Prokhorenko, and S. A. Makarov (Kievskii Inzhenerno-Stroitel'nyi Institut, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 33, 1977, p. 89-92. In Russian.

A78-22545 # World energy prospects to the year 2000. C. L. Wilson (MIT, Cambridge, Mass.). *Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences*, vol. 358, no. 1693, Jan. 6, 1978, p. 121-139.

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

A78-22558 # Research needs for U.S. Army aircraft propulsion. C. L. Walker (U.S. Army, Propulsion Laboratory, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan. 16-18, 1978, Paper 78-45*. 8 p. 18 refs.

Army aviation propulsion research, directed primarily toward the development of fuel-economizing gas turbine helicopter engines, is discussed. High pressure ratio single-stage centrifugal compressors are under investigation; centrifugal compressor impeller design,

thermal barrier coatings for turbine blades, and radial turbine lamination processes figure in the development program. In addition, high-speed shafting, spiral-groove seals, small-bore high-speed ball and roller bearings, and squeeze film dampers for bearing supports are under study in the research program. Characteristics of a 800-horse-power Advanced Technology Demonstrator Engine are presented. J.M.B.

A78-22612 # Experimental and analytical studies of the aerodynamic performance of windmills. R. L. Figard and J. A. Schetz (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan. 16-18, 1978, Paper 78-277*. 8 p. 9 refs. Research supported by the U.S. Department of Agriculture.

The aerodynamic performance of a modern, high tip speed, three-bladed windmill rated at 10 kW at 30 mph was studied by three methods. First, the results of field tests of the actual device with both a resistive and a battery-charging electric load are reported. Second, the predictions of a simple blade-element analysis are presented and compared with the field data. Aerodynamic blade section coefficients of an actual blade section were measured in a wind tunnel and used as input in the analysis. Third, wind tunnel test results for a 1/5th scale model are given. Reynolds number simulation from model to prototype is considered in detail. Finally, the results of all three efforts are compared. (Author)

A78-22741 Power Soletta: An industrial sun for Europe - Possibilities for an economically feasible supply with solar energy (KRAFTSOLETTA: eine Industrie-Sonne für Europa - Möglichkeiten kostenrealistischer Solarenergie). K. A. Ehrlicke. (*Hermann-Oberth-Gesellschaft, Raumfahrtkongress, 26th, Berlin, West Germany, Sept. 1-4, 1977*). *Astronautik*, vol. 14, no. 3, 1977, p. 85-87. In German.

The considered concept is concerned with a significant enhancement of the usefulness of the sun as an energy source for solar-electric power generation applications. It is envisaged to provide additional solar radiation by day or by night with the aid of a system of mirrors which are located in space in suitable circular orbits. The mirrors are to reflect solar light to certain areas of the terrestrial surface during appropriate time periods. It is pointed out that it would be feasible to provide a comparatively small area in Europe, or in other continents, with climatic conditions similar to those in the Australian desert. An area of about 1200 sq km would be sufficient for the installation of solar cell-based electric-power stations which could supply a considerable part of the electric energy required by Western Europe. No undesirable changes in the overall climate of Western Europe would be produced because of the comparative smallness of the area receiving the additional solar radiation. Details concerning the technical implementation of the considered project are discussed together with questions of economic feasibility. G.R.

A78-22795 # Photocells with intermediate conversion of radiation and which operate at an increased concentration /2500-fold/ of solar radiation (Fotoelementy s promezhutochnym preobrazovaniem izlucheniia, rabotaiushchie pri povyshennoi konsentratsii /K=2500/ solnechnoi radiatsii). Zh. I. Alferov, V. M. Andreev, D. Z. Garbuzov, V. R. Larianov, and V. D. Rumiantsv (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 3, Oct. 26, 1977, p. 1090-1093. 6 refs. In Russian.

The manufacture and properties of heterojunction photocells with intermediate conversion of radiation are described. Al and Zn are heated with a n-GaAs:Te substrate, and four epitaxial layers, distinguished by their concentrations of AlAs and Zn, are produced. The composition and p-n characteristics of the layers are explained, and the spectrum of the photoresponse, with a peak at about 780 nm, is shown. The volt-ampere characteristics for varying degrees (from 236- to 2470-fold) of concentration of solar radiation are also indicated and discussed. M.L.

A78-22806 Two-dimensional temperature distribution in a ceramic-based electrode. L. K. Kovalev and V. N. Poltavets (Moskovskii Aviatsionnyi Institut, Moscow, USSR). (*Inzhenerno-Fizicheskii Zhurnal*, vol. 32, Jan. 1977, p. 116-123.) *Journal of Engineering Physics*, vol. 32, no. 1, Sept. 10, 1977, p. 74-79. 8 refs. Translation.

Steady and unsteady temperature field in segmented ceramic electrodes intended for MHD channels are analyzed with allowance for the temperature dependence of the thermophysical properties of the electrode material. A numerical solution of an unsteady nonlinear heat equation is obtained by a finite-difference technique involving longitudinal and transverse difference factorization. The temperature distributions in ceramic electrodes with steel and copper matrices are determined. General relations describing the parameter dependence of heat transfer intensity in an MHD channel are derived, along with relations for calculating the geometrical electrode parameters for which the ceramic will sustain a temperature of 2000 K. The operational temperature ranges of ceramic electrodes of various type are identified. V.P.

A78-22819 Development of solar tower program in the United States. L. L. Vant-Hull (Houston, University, Houston, Tex.). *Optical Engineering*, vol. 16, Nov.-Dec. 1977, p. 575-579. 10 refs.

The history and development of the solar tower is traced from an idea in 1969 through the first Federal funding in 1973, to a program to initiate pilot plant construction in 1977. This program involves about 3000 heliostats reflecting sunlight onto a central receiver in which 500 C steam is generated to drive a turbogenerator. This 10 MWe plant is scheduled to feed electricity into a utility grid in 1980; a 50-100 MWe demonstration plant is proposed to be on line in 1985. B.J.

A78-22822 Reactions of fuel-nitrogen compounds under conditions of inert pyrolysis. A. E. Axworthy, V. H. Dayan (Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.), and G. B. Martin (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.). *Fuel*, vol. 57, Jan. 1978, p. 29-35. 29 refs. U.S. Environmental Protection Agency Contract No. 68-02-0635.

As part of a study of the chemical mechanisms involved in the conversion of fuel-nitrogen compounds to nitric oxide during combustion, fossil fuels and model nitrogen compounds were pyrolyzed in helium in a small quartz flow reactor. Hydrogen cyanide was the major nitrogen-containing product obtained in all cases indicating that hydrogen cyanide is formed during the initial pre-flame stages of combustion and is the principal intermediate in the formation of fuel nitric oxide. At a nominal residence time of one second, 50% decomposition of pyrrole, quinoline, benzonitrile and pyridine occurs at 905, 910, 922, and 954 C, respectively. The fraction of the nitrogen in pyridine that is converted to hydrogen cyanide increases from 40% at 960 C to 100% at 1100 C. Benzonitrile produces similar amounts of hydrogen cyanide (49 and 82%). The hydrogen cyanide yields from coals and residual fuel oils increase from the range of 15-25% at 950 C to 23-42% at 1100 C. It is not possible to determine from these single-stage experiments if most of the hydrogen cyanide forms in the primary pyrolysis process or in secondary reactions. (Author)

A78-22823 Effect of solvent on molecular composition in coal liquefaction. J. E. Schiller and C. L. Knudson (Grand Forks Energy Research Center, Grand Forks, N. Dak.). *Fuel*, vol. 57, Jan. 1978, p. 36-40. 9 refs.

The product from uncatalyzed liquefaction of lignite using synthesis gas (CO-steam process) was examined by column chromatography, high-resolution mass spectrometry, gas chromatography-mass spectrometry, and low-voltage mass spectrometry. The nature of the vehicle solvent affected the type and distribution of compounds in the product oil. Anthracene oil and recycle oil as solvents gave mainly aromatics and phenols. When tetralin was used as solvent, the product showed larger amounts of oxygen compounds, more hydroaromatic compounds, and a greater degree of alkylation in high-molecular-weight aromatics. Tetralin, therefore, appears to be a more powerful hydrogen donor than anthracene oil or recycle oil in stabilizing intermediate fragments that would

otherwise repolymerize. Carbon-number analysis data for liquids prepared using three different solvents are presented. (Author)

A78-22836 An expression for beta in linked Min-B configurations. K. Ikuta (Nagoya University, Nagoya, Japan). *Nuclear Fusion*, vol. 18, Feb. 1978, p. 294, 295.

The ratio of plasma pressure to magnetic pressure, known as beta, is an important parameter characterizing the economic feasibility of fusion reactors. An approximate formula is derived for the beta of a confined low-pressure plasma in linked magnetic wells within the magnetic surface. The plasma pressure is assumed to be anisotropic, which can be achieved by injecting an intense neutral beam into a magnetic well, perpendicular to the lines of force. Beta is approximately equal to the beta of a well times the ratio of the volume of a well to the total sum of the volumes of a well and a joint (between wells). S.D.

A78-22839 An experimental investigation of a class of resistance-type, direction-independent wind turbines. S. Sivasegaram (University of Sri Lanka, Paradeniya, Sri Lanka). *Energy (UK)*, vol. 3, Feb. 1978, p. 23-30. 7 refs.

The resistance-type, direction-independent wind turbine is suitable for the generation of power on a small scale in developing countries. So far, all work on this class of wind turbine seems to be restricted to the Savonius rotor. The present paper reports the findings of an experimental investigation of an entire class of wind turbines which includes the conventional Savonius rotor. The influence of four rotor-geometry parameters (i.e., number of blades, blade angle, blade location and angle of setting of the blade) is studied and discussed on the basis of two performance criteria (i.e., turbine efficiency and performance on the basis of blade area). The existence of optimum, design parameters is established and the possibility of improving substantially on the performance of the Savonius rotor is demonstrated. Some possible applications of the present class of turbines are briefly commented on. (Author)

A78-22840 Net energy analysis of in situ oil shale processing. G. Marland, A. M. Perry, and D. B. Reister (Oak Ridge Associated Universities, Oak Ridge, Tenn.). *Energy (UK)*, vol. 3, Feb. 1978, p. 31-41. 25 refs. Contract No. EY-76-C-05-0033.

Although the domestic resources of shale oil are large, there has been some question regarding the magnitude of the energy subsidy that must be committed in order to extract the contained oil. This study shows that for a 50,000-bbl-per-day, modified in situ extraction facility in 20-gal-per-ton Green River Shale, the energy yield is about 8.6 times the energy subsidy and that about 21% of the in-place oil can be thus recovered. If the mined-out shale is retorted at the surface rather than being discarded, the recovery factor rises to 37% and the net energy ratio should rise significantly as well. It is difficult to compare these figures with those for above ground retorts because oil burned in place for retorting never enters the energy accounts. However, the resource commitment per unit of recovered energy is more easily compared and is essentially indicated by the reciprocal of the recovery fraction. (Author)

A78-22841 A Fokker-Planck analysis of photovoltaic systems. L. H. Goldstein (Sandia Laboratories, Albuquerque, N. Mex.). *Energy (UK)*, vol. 3, Feb. 1978, p. 51-62. 7 refs.

The battery state-of-charge, $S(t)$, of an arbitrary photovoltaic system is analyzed as a Markov process driven by random white Gaussian perturbations of periodic insolation and load-demand profiles. A Fokker-Planck equation for the probability density function of $S(t)$ is derived, and $S(t)$ minus its mean is recognized as a nonhomogeneous Wiener-Levy process. The Fokker-Planck equation is solved under conditions of no barriers, one absorbing barrier, and two absorbing barriers, and the resulting probability density functions are used to obtain bounds on the complementary cumulative distribution function for the first passage time, $x(t) = P(T \text{ greater than } t) \text{ to the completely discharged or totally charged state}$. Limiting expressions for these bounds as t approaches 0 and t approaches infinity are obtained, and their asymptotic values are compared. Finally, a simple system is analyzed to provide insight into the meaning of the equations developed. (Author)

A78-22842 The use of heat pumps in reducing fuel consumption for nonsolar climate control of buildings. W. Leidenfrost (Purdue University, West Lafayette, Ind.). *Energy* (UK), vol. 3, Feb. 1978, p. 83-93. 11 refs.

A78-22843 From oil and gas to alternate fuels - The transition in conversion equipment. J. A. Belding and W. M. Burnett (ERDA, Div. of Conservation Research and Technology, Washington, D.C.). *Energy Conversion*, vol. 17, no. 2-3, 1977, p. 57-65. 8 refs.

The paper outlines a strategy for a smooth transition from oil and natural gas to alternate fuels, focusing on the areas of conversion and transmission. The strategy is based on a consideration of the four market sectors: electric utilities, transportation, industry, and commercial/residential. These are studied in terms of their technology options and driving/retarding forces. A near-term strategy is suggested for the utilities, involving development of technology for clean combustion of coal and developing high-efficiency generation equipment. Transportation requires near-term efforts on efficiency. The plan for industry involves waste energy reduction and process efficiency. P.T.H.

A78-22844 Methanol-air fuel cell with hydrophilic air electrodes. C. L. Sylwan (Kungl. Tekniska Hogskolan, Stockholm, Sweden). *Energy Conversion*, vol. 17, no. 2-3, 1977, p. 67-72. 16 refs.

A methanol-air fuel cell system with alkaline electrolyte and hydrophilic air electrodes was built and tested. Heat and fuel losses as well as auxiliary system power demand have been measured. Information is gained about attainable temperatures and voltage efficiencies as a function of the number of cells delivering a given electrical output. The effects of some stack imperfections are discussed. (Author)

A78-22846 Production of synthetic methanol from air and water using controlled thermonuclear reactor power. I - Technology and energy requirement. M. Steinberg and V.-D. Dang (Brookhaven National Laboratory, Upton, N.Y.). *Energy Conversion*, vol. 17, no. 2-3, 1977, p. 97-112. 43 refs. ERDA-sponsored research.

The paper studies the technology and energy requirements of methanol synthesis from carbon dioxide, hydrogen, and the energy from a controlled thermonuclear reactor. Several processes for extraction and recovery of CO₂ from the atmosphere and sea water are considered: (1) absorption/stripping of carbon dioxide from atmosphere by water at atmospheric pressure, (2) absorption/stripping of carbon dioxide from air with a cooling tower as part of the absorption unit at atmospheric pressure, (3) absorption/stripping of carbon dioxide from the air by water at high pressure, (4) absorption and stripping of CO₂ from air by methanol at high pressure and low temperature, (5) absorption/stripping of carbon dioxide from air by K₂CO₃ solution at atmospheric pressure, and (6) removal of water vapor from air by adsorption on molecular sieves and separation of carbon dioxide from dry air by adsorption/desorption on molecular sieves. P.T.H.

A78-22867 Entropy production, efficiency, and economics in the thermochemical generation of synthetic fuels. I - The hybrid sulfuric acid process. K. F. Knoche (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany) and J. E. Funk (Kentucky, University, Lexington, Ky.). (*Brennstoff-Wärme-Kraft*, vol. 29, Jan. 1977, p. 23-27.) *International Journal of Hydrogen Energy*, vol. 2, Dec. 23, 1977, p. 377-385. 5 refs. Translation.

A78-22868 Entropy production, efficiency, and economics in the thermochemical generation of synthetic fuels. II - The methanol water splitting cycle. K. F. Knoche (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany) and J. E. Funk (Kentucky, University, Lexington, Ky.). *International Journal of Hydrogen Energy*, vol. 2, Dec. 23, 1977, p. 387-393. 5 refs. Research supported by the Electric Power Research Institute.

The availability/heat penalty analysis described in an earlier paper (1977) has been applied to the methanol-sulfuric acid water splitting cycle proposed by Schulten and Behr (1976). This four-reaction thermochemical process has been evaluated in terms of preliminary engineering design and economics. The distribution of

heat penalties induced by thermodynamic irreversibilities in the plant is shown, and the quantitative relationship among capital costs, production costs, heat penalties, and process efficiency is presented. The total thermal energy output of the nuclear reactor is the sum of the theoretical heat requirement and all the heat penalties in the plant. The costs, heat penalties and efficiency are also shown for the hybrid sulfuric acid process. (Author)

A78-22869 Conceptual design of large scale water electrolysis plant using solid polymer electrolyte technology. L. J. Nuttall (General Electric Co., Wilmington, Mass.). *International Journal of Hydrogen Energy*, vol. 2, Dec. 23, 1977, p. 395-403.

In an energy conscious environment, the key to the applicability of water electrolysis as a means for generation of hydrogen in bulk quantities is the achievement of high efficiencies (over 90%) at high enough current densities to keep the capital costs within economic bounds. The solid polymer electrolyte (SPE) water electrolysis technology developed by the General Electric Company is now demonstrating these efficiencies at current densities up to 500 A/sq ft, and the results of recent laboratory testing show a potential for increasing this to 2000 A/sq ft within the next 10 years. This capability now makes water electrolysis one of the most promising methods for generating hydrogen from nuclear, solar or other nonfossil fuel energy sources. The performance and life test results are shown including laboratory cells on which future performance projections are based. The design and development status of a scaled-up electrolysis cell suitable for large-sized hydrogen generation plants is described. Estimated capital costs and operating costs are projected from which the resultant hydrogen costs are calculated. (Author)

A78-22942 Solar electricity - An economic approach to solar energy. W. Palz (Commission of the European Communities, Brussels, Belgium). Paris, United Nations Educational Scientific and Cultural Organization; London, Butterworth and Co. (Publishers), Ltd., 1978. 306 p. 50 refs. \$31.18.

Physical and technological aspects of solar energy as well as cost problems are surveyed with attention to the more sophisticated conversion methods for the production of electricity. Power resources, their distribution, and their possible future patterns of use are considered, as are the physical principles of large-scale conversion of solar radiation into heat. The generation of solar electricity from thermodynamic conversion is examined with reference to flat-plate collector type generators, linear-focus type generators, and central receiver solar power plants. The description of photovoltaic conversion is concerned with different kinds of solar cells and various kinds of photovoltaic generators. The prospects of solar power for large-scale electricity production are discussed. M.L.

A78-23241 An iron-air vehicle battery. L. Ujefors and L. Carlsson (Swedish National Development Co., Akersberga, Sweden). *Journal of Power Sources*, vol. 2, Feb. 1978, p. 287-296. 18 refs.

A 30 kWh iron-air battery system for traction applications, having an energy density of 80 Wh/kg at the 5 h rate has been developed and tested. A description is given of the system and its components. The special problems associated with metal-air batteries are discussed and results from full scale tests are given. (Author)

A78-23412 Power conditioning systems for high-power, airborne, pulsed applications. A. S. Gilmour, Jr. (New York, State University, Buffalo, N.Y.). (*Pulsed Power Systems Workshop, Silver Spring, Md., Sept. 1976.*) *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-13, Nov. 1977, p. 660-678. 23 refs. USAF-supported research.

Power conditioning systems and critical component developments are defined which will be required to interface airborne 10-50 MW sources. Power conditioning systems for use with MHD generators and turbine driven alternators, both conventional and superconducting, are considered. Component analyses include estimations of necessary development efforts and of specific weights and volumes for components. The primary components considered are transformers, (for alternator as well as inverter use), switches, capacitors, and inductors. Weight algorithms are developed for each

of these components. Subsystems such as inverters, and rectifier and filter packages are also examined. B.J.

A78-23420 # Where aerospace can serve afresh - Paths to energy independence. W. M. Hawkins (Lockheed California Co., Burbank, Calif.). *Astronautics and Aeronautics*, vol. 16, Feb. 1978, p. 32-36.

The national goal of independence from foreign energy sources, i.e., Mid-east oil, is considered with respect to the relationship between industry and government, and the feasibility of developing new energy technologies. Attention is given to the role the aerospace industry could play in contributing to U.S. energy self-sufficiency. Assets of the aerospace industry include: a proven diversity of engineering talent, experience with technological risk, and experience in dealing with a wide variety of government agencies. Among the new technologies proposed are: using fusion explosions to generate superheated steam, nuclear-based conversion of seawater to hydrogen, methane production from plants and waste, ocean thermal energy conversion, and coal gasification. D.M.W.

A78-23422 # Integrating space developments - 1980-95. I. Bekey (Aerospace Corp., El Segundo, Calif.). *Astronautics and Aeronautics*, vol. 16, Feb. 1978, p. 50-67. 7 refs.

Developments in space utilization, both for scientific research and economic gain, are charted for the 1980-2000 time period. Beginning with the Space Shuttle, larger and more numerous satellites and scientific probes are foreseen, including: LEO and GEO satellites for earth-observation, communication, navigation, and solar generated microwave power transmission up to the gigawatt range. Planetary missions including landing, sample-return, and cometary rendezvous are projected, and space manufacturing plants and large space habitats are described. Attention is given to the launching systems which will be used during this period, e.g., Space Shuttle, Heavy Lift Launch Vehicle (optimized for weight), and Large Volume Launch Vehicle (optimized for capacity). The possibility of eventually powering all earth's satellites by laser and microwave transmissions from large Space Solar Power Stations is also explored. D.M.W.

A78-23425 Passive solar heating and cooling systems. J. I. Yellott. (*American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Annual Meeting, Halifax, Canada, June 26-30, 1977.*) *ASHRAE Transactions*, vol. 83, pt. 2, 1977, p. 429-445. 19 refs.

Three types of passive solar heating and cooling are discussed: buildings admitting solar radiation through large south-facing windows; structures employing the roof and/or walls to absorb solar radiation; and systems that make use of the difference in density between warm and cool fluids to cause a natural circulation. Passive solar heating systems generally cost little more than conventional structures, but floors and walls for heat storage and special insulation procedures may involve additional expense. The designs of 29 residence and business structures using passive solar heating are presented. J.M.B.

A78-23492 West Antarctic ice sheet and CO2 greenhouse effect - A threat of disaster. J. H. Mercer (Ohio State University, Columbus, Ohio). *Nature*, vol. 271, Jan. 26, 1978, p. 321-325. 55 refs.

If the global consumption of fossil fuels continues to grow at its present rate, atmospheric CO2 content will double in about 50 years. Climatic models suggest that the resultant greenhouse-warming effect will be greatly magnified in high latitudes. The computed temperature rise at lat 80 deg S could start rapid deglaciation of West Antarctica, leading to a 5 m rise in sea level. (Author)

A78-23559 Process innovation and changes in industrial energy use. C. A. Berg. *Science*, vol. 199, Feb. 10, 1978, p. 608-614. 20 refs.

Shifts from one primary energy source to another are reviewed with reference to the industrial processes they facilitate. An

historical analysis of the U.S. 19th century transition from wood to coal is presented, together with comparisons between the French and British experience. Attention is given to the development of metal fabrication technology, and the development of the chemical industry as a result of increased coal use. It is suggested that the choice of an energy source is not totally predicated on a source's availability, but also upon the intrinsic physics and chemistry of important industries. D.M.W.

A78-23560 Industrial energy in transition - A petrochemical perspective. R. S. Wishart (Union Carbide Corp., New York, N.Y.). *Science*, vol. 199, Feb. 10, 1978, p. 614-618.

Sources of hydrocarbon feedstocks are reviewed in terms of present technology, and projected into the near-term future (1980-2000). During the next decade, improvements in current processes rather than completely new technologies are foreseen, including: more efficient refining of petroleum, and coal gasification. For the 1990's, oil recovery from shale and tar fields should become economical, as well as recovery of various hydrocarbons from biological sources. Attention is given to Union Carbide's contributions to hydrocarbon technology, specifically: the Advanced Cracking Reactor, soon to be operational for petroleum refining, and the PUROX process, which uses an oxygen-fed slag gasifier to extract hydrocarbons from organic materials. D.M.W.

A78-23561 Liquid fuels from coal - From R & D to an industry. L. E. Swabb, Jr. (Exxon Research and Engineering Co., Florham Park, N.J.). *Science*, vol. 199, Feb. 10, 1978, p. 619-622. 8 refs.

Rising prices for imported oil, combined with the political instability of many oil-producing regions, necessitate the development of domestic energy sources. Coal liquification should become economically feasible by around 1990. Thus far, two approaches have been studied to translate today's state-of-the-art liquification technology into an efficient industrial process: the demonstration plant, to be built by the Department of Energy, which will be an intermediate-size prototype of future plants and supported largely through federal funds, and the smaller pioneer plant, advocated in this study because it is more cost-effective and technologically thorough. The pioneer plant will be supported privately, thereby avoiding unnecessary bureaucracy in its construction and operation. D.M.W.

A78-23562 Energy and water. J. Harte (California, University, Berkeley, Calif.) and M. El-Gasseir. *Science*, vol. 199, Feb. 10, 1978, p. 623-634. 46 refs. ERDA-supported research.

Energy production is reviewed as a function of fresh water availability. Regions of energy resources (oil shale and coal) in the United States are cataloged with respect to the local hydrological parameters, and in terms of the environmental cost of exploiting those resources. Future projections of energy production, specifically, synthetic, gas, and liquid fuels, are correlated with freshwater supply constraints. Thus far, all economically feasible large-scale energy technologies have been fresh water-intensive. D.M.W.

A78-23563 Photovoltaic power systems - A tour through the alternatives. H. Kelly (U.S. Congress, Office of Technology Assessment, Washington, D.C.). *Science*, vol. 199, Feb. 10, 1978, p. 634-643. 63 refs.

Photovoltaic technology is reviewed in terms of present costs and effectiveness, and projected over the next two decades. Attention is given to research and development already in progress, including efforts to: reduce costs of single Si crystal cells, mass produce photovoltaic cells, develop CdS/Cu2S thin-film technology, and develop high efficiency cells to be installed at the focus of magnifying optical systems. Market forecasts from various federal agencies and private industries are presented; with the most optimistic predictions showing photovoltaic electrical generation price-competitive with other energy sources (nuclear and fossil fuel) by the 1990's. Back-up systems for photovoltaic generators are also discussed. D.M.W.

A78-23564 Solar energy for village development. N. L. Brown (U.S. Department of Energy, Office of International Programs, Washington, D.C.) and J. W. Howe. *Science*, vol. 199, Feb. 10, 1978, p. 651-657. 13 refs.

A hypothetical village of 300 persons in Tanzania is considered as a model of third world energy requirements. Small-scale solar power generation is proposed as the most efficient way of meeting those requirements. Both direct (photovoltaic cells and flat-plate solar cells), and indirect (wind, mini-hydroelectric generators, and methane production from organic wastes) forms of solar energy are compared with conventional diesel-fuel technology in terms of cost effectiveness for village use. D.M.W.

A78-23588 Waste management considerations for fusion power reactors. T. E. Botts and J. R. Powell (Brookhaven National Laboratory, Upton, N.Y.). *Nuclear Technology*, vol. 37, Feb. 1978, p. 129-137. 14 refs. ERDA-sponsored research.

To estimate the waste management needs of a fusion power reactor, a scheme for handling radioactive waste from a fusion plant has been devised. The handling scheme proceeds with radioactive waste, primarily from blanket replacement, being stored on-site; waste in cooled and shielded casks is then isolated off-site; finally, the materials are recycled. Using activities and component lifetimes supplied by designers, several conceptual fusion power reactors have been analyzed and their waste streams compared to fission reactors with regard to total activity, specific activity, and lifetimes of activity. (Author)

A78-23636 * Procedure for minimizing the cost per watt of photovoltaic systems. D. Redfield (RCA Laboratories, Princeton, N.J.). *RCA Review*, vol. 38, Dec. 1977, p. 463-474. Contract No. JPL-954352.

A general analytic procedure is developed that provides a quantitative method for optimizing any element or process in the fabrication of a photovoltaic energy conversion system by minimizing its impact on the cost per watt of the complete system. By determining the effective value of any power loss associated with each element of the system, this procedure furnishes the design specifications that optimize the cost-performance tradeoffs for each element. A general equation is derived that optimizes the properties of any part of the system in terms of appropriate cost and performance functions, although the power-handling components are found to have a different character from the cell and array steps. Another principal result is that a fractional performance loss occurring at any cell- or array-fabrication step produces that same fractional increase in the cost per watt of the complete array. It also follows that no element or process step can be optimized correctly by considering only its own cost and performance. (Author)

A78-23637 * Optimization of solar cell contacts by system cost-per-watt minimization. D. Redfield (RCA Laboratories, Princeton, N.J.). *RCA Review*, vol. 38, Dec. 1977, p. 475-485. 5 refs. ERDA-sponsored research; Contract No. JPL-954352.

New, and considerably altered, optimum dimensions for solar-cell metallization patterns are found using the recently developed procedure whose optimization criterion is the minimum cost-per-watt effect on the entire photovoltaic system. It is also found that the optimum shadow fraction by the fine grid is independent of metal cost and resistivity as well as cell size. The optimum thickness of the fine grid metal depends on all these factors, and in familiar cases it should be appreciably greater than that found by less complete analyses. The optimum bus bar thickness is much greater than those generally used. The cost-per-watt penalty due to the need for increased amounts of metal per unit area on larger cells is determined quantitatively and thereby provides a criterion for the minimum benefits that must be obtained in other process steps to make larger cells cost effective. (Author)

A78-23638 Optimum shape of the bus bar on solar cells of arbitrary shape. A. R. Moore (RCA Laboratories, Princeton, N.J.). *RCA Review*, vol. 38, Dec. 1977, p. 486-499. 5 refs.

A complete procedure is given for determining the optimum shape of a central bus-bar collecting current from a solar cell of circular or rectangular shape. It is applicable to cells of arbitrary shape. The method is a variational calculation that finds the form and adjusts the shape and thickness of the bus bar such that the dollar cost per watt of the photovoltaic conversion system is a minimum. The bus-bar shape found for a given cell contour is the best possible shape for the given set of parameters. Assuming screen-printed silver electrodes and array costs of \$1/W, the cost reduction over a rectangular bus bar that has also been optimized for minimum system cost is small. However, the thickness is reduced by about 25%. Compared with a currently manufactured 3-inch-diameter cell with an evaporated bus bar, the cost reduction is approximately \$0.072/W, a substantial amount. Also calculated is an optimum symmetrical bus bar that extracts the current through two leads, one at either end of the bus bar. (Author)

A78-23828 Gas turbine module performance analysis. A. R. Ebsstein (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif., Nov. 14-17, 1977, Paper 7709*, p. 15 p.

A new approach to analyzing changes in gas turbine engine module performance levels has been developed. This method utilizes two dimensional vector space diagrams and nomographs which describe module performance changes as a function of dependent gas path parameter changes. The slopes and magnitudes of the vectors are determined from influence coefficients for the engine cycle being analyzed. (Author)

A78-23896 A microprocessor-based control system for solar heated/cooled residential dwellings. B. A. Eisenberg, G. R. Johnson, D. V. Pryor, and S. F. McCormick (Colorado State University, Fort Collins, Colo.). In: *Joint Automatic Control Conference, San Francisco, Calif., June 22-24, 1977, Proceedings, Volume 2*. New York, Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1157-1162. 14 refs.

The object of this paper is the development, analysis, and simulated experimentation with a discrete control algorithm for optimal control of a solar energy system for heating and/or cooling of buildings. The contents include the mathematical formulation of the system and objective function, the techniques for its solution, the microprocessor system and its components, and the results of tests conducted using a control-driven dynamic simulation computer model to perform comparisons with conventional controls. (Author)

A78-23919 Cost-effective electricity rates - A stronger incentive to rational energy use (Ein kostengerechter Elektrizitäts-Tarif mit stärkerem Anreiz zur rationellen Energieanwendung). G. Luther (Saarland, Universität, Saarbrücken, West Germany). *Brennstoff-Wärme-Kraft*, vol. 30, Jan. 1978, p. 7-10. 9 refs. In German.

Due to energy shortages and rising energy costs, the old system of a flat billing rate for electricity would be replaced by a modified linear rate structure in which a customer would be billed according to the amount of electricity he actually uses. Attention is given to households and small businesses, and economic equations are presented illustrating the proposed changes. Comparisons are made with the billing system for gas and heating. D.M.W.

A78-23920 Influence of system exactness on the concentration factor of cylinder-parabolic solar energy collectors (Einfluss der Systemgenauigkeit auf den Konzentrationsfaktor beim zylinder-parabolischen Sonnenkollektor). M. Kuczera (Karlsruhe, Universität, Karlsruhe, West Germany). *Brennstoff-Wärme-Kraft*, vol. 30, Jan. 1978, p. 18-24. 9 refs. In German.

The focusing effectiveness of the solar collector plays a decisive role in determining the total effectiveness of a solar energy system. A cylinder-parabolic model is developed in which measured values of direct sunlight are correlated with various absorbers. Attention is given to the actual sunlight concentration as influenced by geometric

factors, including: specific dimensions, focusing accuracy, and reflecting ability. Also analyzed is the absorption temperature of various reflecting surfaces. D.M.W.

A78-23940 Input-output models support corrections of previous principles for the estimation of energy economy and development strategies in directed systems (Input-Output-Modelle begründen Korrekturen bisheriger Bewertungsprinzipien in der Energiewirtschaft und neuartige Entwicklungsstrategien in leitungsgebundenen Systemen). G. Cwienk (Stadtwerke Bochum GmbH, Bochum, West Germany). *Energiewirtschaftliche Tagesfragen*, vol. 28, Jan. 1978, p. 3-18. 8 refs. In German.

The present system of progressive tariffs for energy use is considered ineffective in promoting either efficient energy conservation or the development of new energy technologies. Input-output models are presented, analyzing flow patterns from energy source, through energy generation and distribution, to energy consumption. Attention is given to electricity for home heating, taking weather, size and location of dwelling, and related economic parameters into account. A new method of evaluating the efficiency of energy use is proposed, in which efficiency will be measured on the producing as well as the consuming end. D.M.W.

A78-23941 Securing energy production and protecting the environment (Sicherheit der Energieversorgung und Schutz der Umwelt). H. Trenkler. *Energiewirtschaftliche Tagesfragen*, vol. 28, Jan. 1978, p. 18, 19. In German.

The need to balance energy production, specifically the generation of electricity, with protection of the environment, is now part of the general consciousness of the industrialized nations. Attention is given to coal use in W. Germany, and the resulting SO₂ emissions. Although air pollution is still seen as a problem, especially in regions of heavy industry, e.g., the Ruhr valley, the concentration of harmful atmospheric pollutants have shown a marked decrease in the past decade, due to increased concern with the relationship between man and his environment on the part of society-at-large. D.M.W.

A78-23952 Terrestrial solar cells - Present and future. B. T. Debney (Plessey Co., Ltd., Allen Clark Research Centre, Towcester, Northants., England) and J. R. Knight (Oxford University, Oxford, England). *Contemporary Physics*, vol. 19, Jan. 1978, p. 25-45. 25 refs.

The physics of solar cells and possible future developments and deployment are discussed. Various photovoltaic materials and modes of organization (optical concentration versus flat arrays) are considered, and the attributes of solar cells intended for terrestrial use are examined with attention to their evolution from solar cells designed for space applications. Development programs are surveyed, and an analysis of market and economic factors is provided. It is suggested that the economic viability of photovoltaic power sources depends critically upon the magnitude of real interest rates, and that when inflation is taken into account, photovoltaic power sources are competitive in many situations. M.L.

A78-23975 Heat balance of a solar house: Rapid calculation method (Bilan thermique d'une maison solaire: Méthode de calcul rapide). P. Chouard, H. Michel, and M. F. Simon (Electricité de France, Paris, France). Paris, Eyrolles, Editeur (Electricité de France, Direction des Etudes et Recherches, Collection, No. 30), 1977. 166 p. 13 refs. In French. \$23.99.

The energy effectively recoverable from the liquid in a solar collector (without concentration) is assessed as a function of climate, geography, the specifications of the collector, and the operating temperature of the heat transfer fluid. The assessment is based on the fraction of insolation, a widely available datum. For single- and double-plate collectors, the energy effectively recoverable is calculated for regions in France. J.M.B.

A78-24001 # Overview of the Federal solar energy program. H. H. Marvin (U.S. Department of Energy, Div. of Solar Energy, Washington, D.C.). *American Institute of Aeronautics and Astro-*

navics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-290. 5 p.

Three separate organizations of the U.S. Department of Energy are concerned with the objectives of solar energy development. The Division of Solar Technology (DST) is to perform the research and development work which brings technologies to the point where they can be transferred to the Office of Conservation and Solar Applications or to Resource Applications. A summary is provided of the various DST technological programs. Approaches to reduce costs of the devices of photovoltaics are related to silicon array cost reductions, the use of concentrators, and CdS schemes. Costs of \$1-2 per watt are expected by 1982. Other technologies considered are based on a utilization of ocean thermal energy, wind, solar thermal systems, and biomass. A 100 kWe wind machine has been very successful, after some startup problems. G.R.

A78-24002 # Electricity from coal by the MHD process. J. B. Dicks (Tennessee, University, Tullahoma, Tenn.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-291.* 7 p. 10 refs. U.S. Department of Energy Contract No. 76-C-01-1760.

Central-station MHD power generation grew out of high-temperature gas-flow and combustion technology developed in rocket propulsion programs in the aerospace field during the 1950's. Rocket combustion technology modified to burn coal is coupled with fossil-fired boiler technology, increased understanding of the applications of MHD power generation, and innovative concepts in sulfur and NO(x) control to make possible MHD power plants which can, in early stages, convert coal commercially into electrical energy at overall efficiencies of 48 percent within the next 10 years. In later stages, efficiencies of 55 percent and above can be commercialized. A coal-fired MHD power system is described along with the next version of such a system, which will be capable of feeding coal at rates up to 10 tons per hour. The advances in this technology, future technology development required, and the cost effectiveness of this technical approach to power generation are discussed. (Author)

A78-24003 # Application of aerospace engineering to Ocean Thermal Energy Conversion and offshore petroleum production. W. F. Whitmore and C. E. Rudiger, Jr. (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-292.* 6 p. 5 refs.

The Ocean Thermal Energy Conversion (OTEC) project considered is based on a utilization of the 40 F temperature difference between tropical surface water and cold deep ocean water to drive a heat engine for the generation of electric power. The hot junction is supplied by sunlight; the heat sink is the ocean itself. The immediate goal of the U.S. Department of Energy (DOE) is to develop a technology base sufficient to design, construct, deploy, and operate OTEC power plants. The long-range objective is to promote commercial utilization of this technology. DOE has enlisted the help of the aerospace industry for the development work needed to overcome engineering problems related to the implementation of the OTEC project. Aerospace specialists have also been enlisted by several oil companies in connection with the study of offshore engineering problems. G.R.

A78-24004 # Coal conversion to liquid and gaseous fuels - Aerospace technology in a new role. J. Friedman and J. Silverman (Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-293.* 4 p. Contract No. EX-76-C-01-2044.

Aerospace technology has been successfully applied, in a DOE sponsored program, to the urgent national goal of coal conversion to liquid and gaseous fuels. The adaptation of rocket reactor technology to the direct hydrogenation of pulverized coal has resulted in a new generation of coal conversion reactor technology which can be used to efficiently produce a wide array of liquid and gaseous fuel products. Liquid rocket injection/mixing techniques are used to very

rapidly mix streams of pulverized coal and hot hydrogen to implement a direct hydrogenation reaction in a matter of milliseconds. The amount of reaction time determines the product mix. Reaction times have been varied from 33 to 600 milliseconds producing mainly liquid products at the shorter residence times and synthetic natural gas at the longer residence times. Continuing development of this process could result in the early and economical conversion of some of our plentiful coal supplies to much needed liquid and gaseous fuels. (Author)

A78-24005 * # Heat pipes in space and on earth. S. Ollendor (NASA, Goddard Space Flight Center, Scientific Satellites Thermal Control Section, Greenbelt, Md.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-295.* 5 p. 10 refs.

The heat pipe is a closed tube whose inner surfaces are lined with a porous capillary wick. The wick is saturated with the liquid phase of a working fluid. The heat supplied at one end of the tube, the evaporator, causes evaporation of the working fluid. The vapor will pass to the other end of the tube, the condenser, where it will condense and release the latent heat of vaporization to a heat sink in that section of the pipe. Problems concerning a design of heat pipes for space applications are related to certain difficulties regarding the prediction of device performance under zero-g conditions. Heat pipes are usually tested on the ground under the influence of gravity, and then their performance is extrapolated to space. A description is presented of the approaches used to insure good heat pipe performance in space. Attention is given to an international heat pipe experiment conducted to accumulate zero-g performance data for several new and unique heat pipe designs, heat pipes for ATS-6, cryogenic heat pipes, and future activities. G.R.

A78-24008 # Engine development toward lower energy consumption and reduced environmental impact. E. L. Smith and H. R. Bishop (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-307.* 12 p. 7 refs.

The paper discusses the current state of development of small gas turbine engines for General Aviation. Areas examined include powerplant types, developments in component efficiency and probable future improvements. Over the next 10 year period, small gas turbine engines are expected to evolve further towards still lower fuel consumption, continued high reliability, low operating cost and minimum environmental impact in terms of noise and emissions. Fixed wing powerplants are addressed in the paper but the engine improvements considered will be equally applicable to helicopter powerplants. (Author)

A78-24030 # Two phase working fluids in solar collectors. K. Bol and M. Lang (Northern Arizona University, Flagstaff, Ariz.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-354.* 5 p.

A study is presented of passive solar water heating using butane as a two-phase heat-transport fluid. This system utilizes phase-change energy rather than temperature-change energy. The responses and efficiencies are compared with forced-water and thermosyphon-type systems. There are many advantages to using a two-phase working fluid. They include: (1) the need for a pump and control systems to actuate it is eliminated; (2) there is no problem of freezing temperatures breaking the pipes; (3) it can be used in remote areas where the amount of external power is limited; (4) it is self-regulating; and (5) corrosion problems are eliminated. Experiments confirm that two-phase systems yield higher operating efficiencies than either forced-water or thermosyphon-type water-heating systems. Efficiencies above 60% are easily obtained. The advantages involved and the demonstrable high efficiencies show two-phase solar heaters to be a significant improvement over solar heating systems now in use. (Author)

A78-24032 # Fuels outlook I - Transportation and the U.S. petroleum resource, an aviation perspective. M. P. Miller and R. A. Mays (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-357.* 11 p. 24 refs.

The U.S. commercial aviation industry is meeting the continuing challenges of reduced fuel consumption, higher fuel prices, and increased passenger traffic. A disturbing fact is that the country has become increasingly dependent on imported petroleum fuels. In the event that import restrictions are imposed or that some form of rationing is required, federal fuel-allocation policies should be based on an informed understanding of user characteristics. This paper provides an overview of several facets of commercial aviation fuel consumption: the merits of its public services, the conservation measures taken to date, the consequences of future shortages, energy conservation strategies, modal efficiency comparisons, and alternate fuel considerations. The conclusion is reached that commercial aviation should be designated as a high-priority user of petroleum fuels in any government allocation program. (Author)

A78-24034 # The challenge of advanced fuel-conservative aircraft - A manufacturer's view. R. E. Hage and J. A. Stern (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D.C., Feb. 7-9, 1978, Paper 78-362.* 18 p.

Costs and technological problems associated with advanced fuel-conservative aircraft are discussed, with particular attention given to the current NASA Aircraft Energy Efficiency (ACEE) program, which focuses on engine component improvement, turboprops, laminar flow control and composites. In addition to the results of the ACEE program, aircraft manufacturers will need to deal during the next decade with the noise requirements established by FAR Part 36. Due to high costs and noise considerations, DC-8 and B707 fleets are expected to be replaced by the 1980s, and the demand for fuel-efficient aircraft in the 100- to 200-seat category will be significant. Fuselage cross-sections for such a category are considered; a comparison of the effectiveness of twin-jets and tri-jets for medium-range transport is also reported. J.M.B.

A78-24131 The efficiency of grating solar cells. A. K. Kong and M. A. Green (New South Wales, University, Kensington, Australia). *Journal of Applied Physics*, vol. 49, Jan. 1978, p. 437-442. 11 refs. Research supported by the Radio Research Board of Australia and Australian Research Grants Committee.

Computer simulation of grating solar cells is used to compare the performance of this type of device with more conventional cell geometries. Criteria for the grating design and their dependence upon substrate properties are discussed. The nature of the back contact to the cell is shown to play an important role in determining the cell efficiency. In order for the grating cell to be competitive in efficiency with the normal cell geometry, the back contact must have minority-carrier blocking properties. The efficiency of cells with ideal Ohmic back contacts is limited by geometrical effects. Recent experimental results are analyzed in terms of the results of the theoretical investigation. (Author)

A78-24262 # Determination of optimal arrangement-angles for the panels of a nonconvex solar array (Opredelenie optimal'nykh uglov ustanovki paneli solnechnoi batarei nevypukloi formy). V. S. Mikhalevich, S. V. Rzhetskii, O. N. Tokareva, and G. N. Iun. *Aviatsionnaia Tekhnika*, vol. 20, no. 3, 1977, p. 71-77. 5 refs. In Russian.

An optimization (continuous minimax with nonlinear programming) problem involving arrangement angles for a solar array (in the form of a system of M rectangular panels located along the contour of a regular polygon) which provides power for an earth-orbiting satellite is examined. The problem is to find such arrangement angles for the panels that the average energy conversion

efficiency coefficient is maximal for the 'worst' position of the satellite orbit relative to the sun. This coefficient represents the ratio of the area of the sum of projections of illuminated parts of panels on the plane perpendicular to the solar flux vector to the total area of all the panels.

B.J.

A78-24314 Nocturnal boundary-layer wind maxima and the problem of wind power assessment. D. L. Sisterson and P. Frenzen (Argonne National Laboratory, Argonne, Ill.). *Environmental Science and Technology*, vol. 12, Feb. 1978, p. 218-221. 15 refs. ERDA-sponsored research.

High-resolution measurements of wind profiles collected over central Illinois indicate that nocturnal, low-level wind maxima occur more frequently than previously supposed. Since the periodic contributions of these circulations have been neglected, wind power potentially available over the central U.S. has probably been underestimated, especially in the case of surveys that have used simple, power-law profiles. An alternative method of profile representation appropriate to stability conditions characteristic of nocturnal wind maxima is reviewed, and it is suggested that the strong wind shears associated with these phenomena may present a special hazard to the long rotor blades of large, horizontal axis wind energy conversion systems. (Author)

A78-24328 Key steps to coal conversion. G. Gould (Fuel Engineering Company of New York, New York, N.Y.). *Energy*, vol. 3, Winter 1978, p. 14-17.

The feasibility of using coal to power industrial plants is examined from the standpoint of coal availability, economy of extraction, ease of transportation from the mine to the factory, and environmental statutes regarding coal use. Modification of the original design parameters for a coal-fired plant is almost always necessary in order to comply with federal emissions (hydrocarbons and sulfur) standards. Various methods to eliminate harmful emissions are discussed, especially the flue gas desulfurization system (FGD), but it is expensive and not practical at all for smaller factories and generating plants. In short, the conversion to coal from other fossil fuels will cover only a limited portion of U.S. energy needs. D.M.W.

A78-24329 MHD electric power generation. R. W. Detra (Avco Everett Research Laboratory, Inc., Everett, Mass.). *Energy*, vol. 3, Winter 1978, p. 21-23.

Faraday's law of induction provides the principle for the operation of a magnetohydrodynamic (MHD) generator for the production of electricity from fossil fuels, i.e., coal. Tests conducted with a mini-MHD with an average output of 300 kW reveal that the extremely high operating temperatures of the system (4500-5000 F) yield high efficiency in energy production, while reducing by half the amount of coal used to produce the energy, and reducing by 90% sulfur and NO_x emissions. The high temperatures can be maintained because the whole surface of the MHD can be exposed to cooling. In addition, potassium carbonate seeding is used to fix pollutants in the combustion gases, lowering their rate of emission into the atmosphere still further. D.M.W.

A78-24344 A sheet-metal roof as a solar absorber (Blechdach als Solarabsorber). A. Urbanek. *Sonnenenergie*, vol. 2, Nov.-Dec. 1977, p. 43-45. In German.

A two-family house is presented as a model for a solar heating system, called the Pan-Therm-System, which concentrates its operating capacity on the absorber. The roof of the house, made of sheet-metal, presents no unusual problems in either architecture or construction. A schematic of the heat circulation and storage system is given, including a description of the heat pump which goes with it. The system has an operating temperature of 50 degrees Celsius, and a projected output of 65,000 kWh/year. D.M.W.

A78-24345 Solar house Höhenkirchen (Sonnenhaus Höhenkirchen). H. Grallert. *Sonnenenergie*, vol. 2, Nov.-Dec. 1977, p. 47, 48. In German.

A demonstration house was erected to assess: solar heating in a realistic environment, installation techniques, and efficiency

measurements under conditions of actual use. Technical parameters of the house are presented, including: a 35 square meter collector surface, a 4 cubic meter water storage capacity for heating and hot water use, automatic variable control of water circulation, and modular construction. Results showed unacceptable material strain, but a savings of 55% in heating oil. D.M.W.

A78-24377 Economic and environmental costs of satellite solar power. P. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *Mechanical Engineering*, vol. 100, Jan. 1978, p. 32-37. 10 refs.

Cost and environmental impacts of satellite solar power stations (SSPS) are evaluated using a 5 GW station as a model. Forty-five percent of the construction costs of the SSPS will be taken up by transportation costs alone, presumably using the Space Shuttle. Microwave transmissions to an earth-based power plant are foreseen, and the power generated thereby will be integrated into an already-existing utility net. Attention is given to microwave beam environmental effects, including: disturbance and deflection by atmospheric attenuation and ionospheric propagation, and biological effects. Other environmental considerations are also discussed, especially ozone depletion by the Space Shuttle engine exhaust. These dangers, while present, are looked upon as manageable, and far outweighed by the benefits resulting from a continuous supply of clean, cheap energy. D.M.W.

A78-24378 The new electric locomotives. M. Ephraim, Jr. and H. E. Quinn (General Motors Corp., Electro-Motive Div., La Grange, Ill.). *Mechanical Engineering*, vol. 100, Jan. 1978, p. 43-49.

Thyristor controlled, high horsepower-electric locomotives are evaluated in terms of costs and benefits. Various models of such locomotives are described, together with a discussion of their design and operating parameters. Generally, electric locomotives are found to be more expensive than diesel-powered trains, but less expensive to maintain. Savings on petroleum fuel can be substantial, but would be largely negated if the fuel used to generate the locomotive's electricity were itself petroleum. D.M.W.

A78-24400 * Energy resources of the developing countries and some priority markets for the use of solar energy. T. A. Siddiqi (East-West Center, Honolulu, Hawaii) and G. F. Hein (NASA, Lewis Research Center, Cleveland, Ohio). *Journal of Energy and Development*, vol. 3, Autumn 1977, p. 164-189.

Energy consumption for the developed and non-developed world is expressed as a function of GNP. An almost straight-line graph results when energy consumption statistics are treated in this manner. The richest countries consume the most energy, and the poorest countries the least. It therefore follows that greater energy production in the developing countries (leading to greater energy consumption) will contribute to their economic growth. Energy resources in the developing countries are compared, including: solid fossil fuels, crude oil, natural gas, oil shale, and uranium. Mention is also made of the potential of renewable energy resources, such as solar, wind, and hydroelectric power, in the underdeveloped world; and it is these resources which offer the greatest possibilities for economic improvement if the money is forthcoming, i.e., from the world bank, to fund the necessary technology. D.M.W.

A78-24405 # Properties of a solar cell array with mirrors and radiators (Eigenschaften einer Solarzellenanlage mit Spiegeln und Radiatoren). W.-D. Ebeling and D. Rex (Braunschweig, Technische Universität, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept. 13-15, 1977, Paper 77-011*. 24 p. In German. Research supported by the Bundesministerium für Forschung und Technologie.

A new mirror-radiator-generator concept is proposed for solar arrays to be borne on geosynchronous satellites. Solar radiation is focused on the solar cells by a cylindro-parabolical mirror, with the mirror surfaces simultaneously acting as radiators for the cells. Thermal optimization results are presented for the system with attention given to the choice of different fin (aluminum and CFRP)

and mirror (aluminum and quartz-coated silver) materials. In the thermal optimization, consideration is given mass to power ratio and conversion efficiency for different materials. Mass to power ratio is studied as a function of mirror misalignment. B.J.

A78-24406 # Development of a large-area roll-out solar generator for the multi-kW range (Entwicklung eines großflächig ausrollbaren Solargenerators für den multi-kW-Bereich). H. Bebermeier and U. Hoffmann (Telefunken AG, Frankfurt am Main, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept. 13-15, 1977, Paper 77-012*. 30 p. In German. Research supported by the Bundesministerium für Forschung und Technologie.

The concept of a two-sided roll-out solar generator for multi-kW performance in future communication satellites and space stations is presented. The discussion covers (1) design and function of components and systems of the generator, (2) analyses of thermal, electric, and dynamic behavior, (3) environmental tests, (4) qualification tests, and (5) possible applications of the design concept. P.T.H.

A78-24430 # The further development of the Spacelab/Space Shuttle system - A first step towards a space station (Die Weiterentwicklung des Space Shuttle/Spacelab-Systems - Ein erster Schritt zur Raumstation). K. Ziegenbein (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept. 13-15, 1977, Paper 77-041*. 27 p. 6 refs. In German.

The next phase of the space program, the Shuttle Era, will be concerned primarily with the exploitation of space for industrial and commercial development. The Spacelab system figures prominently toward this end, both in LEO as part of the Shuttle, or boosted to GEO by the Space Tug or Interim Upper Stage. Initially, the main areas of experimentation will include materials processing, pharmaceutical development, astronomy, and space physics. Later on, Spacelab modules will be combined into a larger space station; and using this station for support and maintenance, large space platforms can be built, specifically, satellite solar power systems (SSPS). Attention is given to the auxiliary power module, which will permit the longer, more ambitious Space Shuttle missions. D.M.W.

A78-24452 # Modular solar energy satellite - Project proposal and development strategy (Der modulare Sonnen-Energie-Satellit - Projektvorschlag und Entwicklungsstrategie). J. Ruth and W. Westphal (Berlin, Technische Universität, Berlin, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept. 13-15, 1977, Paper*. 20 p. 10 refs. In German.

The concept of a modular solar energy satellite (MOSES) is presented, which will offer considerable cost savings on account of both its modular structure and the eventual possibility of being partially assembled in space. Basic advantages and disadvantages of the modular construction are discussed, and the selection of the best module shape is described. An evolutionary development strategy with the aid of the Space Shuttle/Spacelab research platform is suggested. P.T.H.

A78-24625 Coal-liquefaction products from major demonstration processes. I - Separation and analysis. I. Schwager and T. F. Yen (Southern California University, Los Angeles, Calif.). *Fuel*, vol. 57, Feb. 1978, p. 100-104. 13 refs. Contract No. E(49-18)-2031.

Coal liquids from five major processes (Synthoil, HRI H-Coal, FMC-COED, PAMCO SRC, and Catalytic Inc. SRC) have been separated reproducibly in high yields (94-99%) into five fractions by solvent fractionation. The coal liquids are first separated into three fractions: pentane-soluble, pentane-insoluble and benzene-soluble (crude asphaltene), and benzene-insoluble. The pentane-soluble fraction is further separated into a liquid propane-soluble fraction (oil) and a liquid propane-insoluble fraction (resin). The benzene-insoluble fraction is further separated into a carbon disulfide-soluble fraction (carbene) and carbon disulfide-insoluble fraction (carboid). (Author)

A78-24748 # Problem of the vulnerability of materials to radiation in relation to atomic and thermonuclear power engineering (Problema radiatsionnoi povrezhdaemosti materialov v svyazi s razvitiem atomnoi i termoiadernoi energetiki). Sh. Sh. Ibragimov. *Akademiia Nauk Kazakhskoi SSR, Vestnik*, Nov. 1977, p. 55-67. 27 refs. In Russian.

Studies of radiation-induced damage in metals and metal alloys used in nuclear reactor design are discussed. Changes in crystal structure, yield stress, mechanical properties, temperature-dependent stability, and volume are considered with reference to the problem of selecting suitable materials for different radiation environments. Also surveyed are the development of atomic reactors with increased power and their role in generating electricity in the USSR and in the world. M.L.

A78-24751 Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Edited by R. F. Hill. Washington, D.C., Government Institutes, Inc., 1977. 493 p. \$25.

Solar heating and cooling, natural gas and petroleum technology, nuclear power development, and the conversion of biomass and municipal solid waste to energy are discussed. Topics of the papers include the solar energy research sponsored by ERDA, economic and environmental constraints on coal-burning power plants, magnetic fusion power plant schemes, builders' and developers' reactions to the solar energy industry, solar heating and/or cooling for residences, schools and offices, flue gas desulfurization to limit SO₂ emissions from coal-burning power plants, and the production of methane from cattle feedlot residues. J.M.B.

A78-24752 Natural gas technology. L. H. Sutherland. In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 58-77. 19 refs.

The paper discusses the huge quantities of natural gas which can be produced from unconventional sources in the U.S.A. in order to bring great benefits to the gas consumers and the electric utility companies. Attention is directed at the geopressurized waters in the Gulf Coast in Texas, the Devonian shale, the tight sands, the unmined bituminous coal, and conventional unmined coal. Methods of raising and bringing the efficiency of gas-burning appliances to a maximum are discussed, with special emphasis on the pulse combustion furnace operating as a stationary ram jet combustor with a spark plug instead of a pilot to provide the original ignition. Different design systems of heat pumps intended for transferring heat from a cool to a warm environment with high efficiency and source energy savings are briefly outlined. S.D.

A78-24753 ERDA's Solar Energy Research and Development Program. R. L. Hirsch, H. H. Marvin, and J. A. Blasy (U.S. Department of Energy, Office of the Assistant Administrator for Solar Energy, Washington, D.C.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 112-135.

ERDA's Solar Energy Research and Development Program is reviewed, with particular reference to concepts and approaches for producing energy from the sun for various purposes. The discussion covers: (1) heating and cooling of buildings where the thermal energy from the sun is used directly; (2) thermal power systems in which solar energy is concentrated to produce steam, which is then used in a relatively conventional manner to produce mechanical energy in a powerplant to produce electricity; (3) the photovoltaic method, where solid-state solar cells are used to produce electricity directly without the intermediate step of producing heat; (4) ocean thermal energy systems, based on a temperature differential of about 30-40 F between the warm surface waters and the deeper cooler waters; (5) use of windmills in turning a generator to produce electricity or in direct pumping of liquids, and (6) terrestrial and marine biomass production and conversion as well as agricultural and forestry residue conversion to produce solid, liquid, and gaseous fuels. S.D.

A78-24754 Solar industry - Status report and forecast. S. H. Butt (Solar Energy Industries Association, Washington, D.C.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 136-143.

Although a strong future for photovoltaics and other new technologies is foreseen, they have not yet advanced to the point where forecasts detailing their impact upon the nation's energy economy can be developed. The present paper focuses on forecasts dealing only with solar heating and cooling, based essentially on the technology of flat plate solar collectors. It is shown how solar heating and cooling holds great promise of being able to make a major contribution to closing the national energy gap. Only through a combination of conservation, solar development, and other new and alternative design developments can the needs for the future be met with success. S.D.

A78-24755 Coal technology - Users' viewpoint. G. R. Hill (Electric Power Research Institute, Palo Alto, Calif.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 154-166.

While the potential coal resource in the U.S.A. is probably ten times the recoverable reserves, coal extraction should be maximized within acceptable environmental and safety techniques. Common sense, encouraged by the Federal Energy Agency pronouncements, will increasingly see that oil and gas are replaced by coal in new power plants and, where possible, in plants formerly fired with coal. A major endeavor is to upgrade the practices in existing plants and in plants shortly to be built to meet the newly imposed environmental, social, and economic constraints on electric power generation. Ways in which efforts should be made to maintain the quality of air, water, and the environment at their highest possible level are discussed. Reduction of oil consumption made possible by conversion to coal/oil slurry firing is stressed along with fluidized bed combustion of coal to produce electricity. S.D.

A78-24756 Status and prospects for continued progress in magnetic fusion energy research and development. E. E. Kintner (U.S. Department of Energy, Div. of Magnetic Fusion Energy, Washington, D.C.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 167-191.

The paper outlines the concept, advantages/disadvantages, and progress of magnetic confinement of fusion plasma to generate electrical power. In this concept, the constricted fields at the ends of the vacuum chamber in the mirror devices tend to deflect the ions back into the region of lower magnetic field in the center and thus contain the plasma. A simple chart is presented, showing how progress can be easily measured against the conditions needed for useful reactors. Also discussed is the steady progress achieved in generating, controlling, and heating fusion plasmas since 1950. S.D.

A78-24757 Solar challenges to consulting engineers. P. Flack (Flack and Kurtz Consulting Engineers, New York, N.Y.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 284-301.

The challenge to the consulting engineer is the optimization of solar component selection in relation to the mechanical-electrical equipment implementation in order to apply solar energy to heat and cool buildings and to provide hot water to significantly reduce the dependence of the U.S.A. on imported fuel. The generalized collector performance of different types of solar collectors is presented in graphical form. The design of more effective air conditioning systems awaits further development of heat pumps and absorption chillers at reasonable cost. Successful economic integration of solar systems necessitates differentiating between residential vs institutional large-scale installations. The ongoing program of R&D by the ERDA Division of Solar Energy in the development of the concentrating and evacuated collectors for solar heating and cooling

applications, and additional studies in storage and heat exchange as well as in air conditioning and heat pumps can lead to the creation of a viable solar industry. S.D.

A78-24758 Solar energy in perspective - Builder/developer's view of the industry. J. J. Kruse. In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 311-325.

The builder/developer's view of the solar energy industry is examined by applying the case study approach to the problem of installing solar energy space heating and/or hot water systems, with special emphasis on the description of a pyramidal optical concentrating system considered to be the best among a number of potential alternatives. Economics of solar energy both from the developer's standpoint and from the housing consumer's standpoint is evaluated on the basis of rental and owner-occupied properties. Financial aspects and government incentives for solar energy implementation are highlighted. S.D.

A78-24759 Application of solar energy to schools and residences. A. Weinstein, R. T. Duncan, Jr., and W. C. Sherbin (Westinghouse Electric Corp., Falls Church, Va.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 352-363. 5 refs.

Two government-sponsored projects of solar systems for heating and cooling of buildings are described: (1) a large-scale solar heating and cooling of an elementary school with a capacity of 500 students; and (2) a residential heating/cooling system in conjunction with a hot water system. The school heating/cooling system is discussed relative to solar collector array design, thermal storage, system operation, control system, and antifreeze and anticorrosion. After a year of detailed data collection and analysis, the system became operational in early 1977. As for the residential system, it is a solar-augmented heat pump system which utilizes air instead of water as the heat transfer fluid, rocks instead of water for heat storage, and a heat pump rather than a gas boiler as the conventional heating subsystem; the heat pump, in its summer mode, also provides a nonsolar cooling. The initial capital investment cost is high, but on a life-cycle basis solar systems are becoming competitive with conventional systems. S.D.

A78-24760 Solar energy in office and industrial buildings. A. D. Cohen (General Electric Co., Space Div., Philadelphia, Pa.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 364-382.

A brief description of the principal features for a number of solar heating, and solar heating and cooling projects designed by General Electric over the past three years is presented. These projects were for applications to industrial and office buildings. A process heat application for the textile industry is also discussed. Most of these projects are now in the process of construction and only limited performance data is now available. Key aspects of the system design and integration with the buildings are discussed. New developments in collector technology will aid in developing commercial applications. (Author)

A78-24761 Solar design and installation experience. E. M. Wormser (Wormser Scientific Corp., Stamford, Conn.). In: Energy technology IV; Proceedings of the Fourth Conference, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 383-406.

A solar system based on pyramidal optics for use in single- and multiple-family residential buildings is described. In the pyramidal optics concentrating type solar system, solar energy is incident on a segmented plexiglass window of 12 to 16 ft in slant height; the width of the window is determined by the width of the building and by the amount of solar energy required. A recent innovation is a dual source heat pump unit for use as an auxiliary unit in residential solar systems; for summer cooling the dual source heat pump operates in

the air-to-air mode with an outside remote condenser unit used for heat dissipation. Experimental data reveal a system performance better than was indicated by original estimates, and factors affecting these variations are identified. A description of the solar system for a four-townhouse condominium is presented, with particular reference to the cost-effectiveness of the auxiliary and distribution system.

S.D.

A78-24762 Sulfur control for coal combustion. F. T. Princiotta (U.S. Environmental Protection Agency, Energy Processes Div., Washington, D.C.). In: *Energy technology IV; Proceedings of the Fourth Conference*, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 407-423. 7 refs.

Techniques for limiting SO₂ emissions from coal-burning power plants in the next 10 to 20 years are discussed, with emphasis on flue gas desulfurization and physical coal cleaning. Relative costs and SO₂ removal efficiencies are considered for flue gas desulfurization schemes which yield non-useful products (lime scrubbing, limestone scrubbing and the double alkali process) and those which yield saleable products (magnesium oxide scrubbing and sodium sulfite scrubbing). In addition, the low-cost approach of physically removing pyritic sulfur from coal is assessed; analysis of 455 U.S. coal samples indicates that coal cleaning is most effective for Southern Appalachian and Alabama coals and least effective for Eastern and Western-Midwestern coals.

J.M.B.

A78-24763 Energy from municipal refuse. H. W. Schulz (Dynecon, Inc.; Columbia University, New York, N.Y.). In: *Energy technology IV; Proceedings of the Fourth Conference*, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 427-433.

Techniques for recovering energy and recycling materials from municipal solid waste are discussed. Although such recovery schemes are generally capital intensive, the rising cost of landfills and fuel price increases may make them economically attractive in the near future. Emphasis is placed on waterwall incinerators (producing steam) and the development of refuse-derived fuel (RDF). Air-classified RDF products, for example, have been employed with coal in existing plants, a concept which involves low capital investment. RDF production based on paper-making technology is also mentioned. In addition, attention is given to flash pyrolysis of waste to yield combustible liquids, and biochemical conversion processes to yield animal feed or ethyl alcohol.

J.M.B.

A78-24764 Biomass - Progress and plans. D. L. Wise (Dynatech R/D Co., Cambridge, Mass.). In: *Energy technology IV; Proceedings of the Fourth Conference*, Washington, D.C., March 14-16, 1977. Washington, D.C., Government Institutes, Inc., 1977, p. 434-454. 47 refs. Contract No. E(11-1)-1991.

Bioconversion processes are discussed, with attention given to anaerobic digestion of organic matter to produce methane, fermentation of biomass, and thermochemical bioconversion (including gasification and liquefaction processes as well as direct burning). Two case studies are presented, one involving acetic acid production from marine algae, a process which in the long term may provide up to 5% of the annual U.S. petrochemical feedstock requirement, and the other involving the production of methane from cattle feedlot residues. For the latter scheme, a production of 300 million cu ft of methane per day from a feed lot with 10,000 head of cattle is projected.

J.M.B.

A78-24775 Underground coal gasification via the LVW process. M. K. Buder and O. N. Terichow (Bechtel, Inc., San Francisco, Calif.). *Coal Mining and Processing*, vol. 15, Feb. 1978, p. 64-68, 88.

Linked vertical wells (LVW) are proposed as a method for recovering coal reserves which are not economically accessible by mining, and which must be extracted using underground coal gasification techniques (UCG). The LVW process occurs in two steps:

first, reverse combustion yields a permeable, linked path at the mine bottom between two boreholes; next, air is injected at high rates to initiate gasification. Cost estimates are presented for the operation, including labor, and the amount of energy recovered is evaluated in BTUs and in dollars. LVW is proven to be economically feasible in fields where there are thick seams, and where on-site utilization of the gas is possible.

D.M.W.

A78-24908 * # Optical and electrical properties of ion beam textured Kapton and Teflon. M. J. Mirtich and J. S. Sovey (NASA, Lewis Research Center, Cleveland, Ohio). *American Vacuum Society, National Vacuum Symposium, 24th, Boston, Mass., Nov. 8-11, 1977*, Paper. 15 p. 10 refs.

Results are given for ion beam texturing of polyimide (Kapton) and fluorinated ethylene propylene (Teflon) by means of a 30-cm diam electron bombardment argon ion source. Ion beam-textured Kapton and Teflon surfaces are evaluated for various beam energies, current densities, and exposure times. The optical properties and sheet resistance are measured after each exposure. Provided in the paper are optical spectral data, resistivity measurements, calculated absorbance and emittance measurements, and surface structure SEM micrographs for various exposures to argon ions. It is found that Kapton becomes conducting and Teflon nonconducting when ion beam-textured. Textured Kapton exhibits large changes in the transmittance and solar absorbance, but only slight changes in reflectance. Surface texturing of Teflon may allow better adherence of subsequent sputtered metallic films for a high absorbance value. The results are valuable in spacecraft charging applications.

S.D.

A78-24967 An optimum thickness indicator for evaporating metals on Schottky barrier solar cells. J. T. Lue (National Tsing Hua University, Hsinchu, Nationalist China). *Journal of Physics E - Scientific Instruments*, vol. 11, Jan. 1978, p. 84-86. 12 refs. Research supported by the National Science Council of Nationalist China.

The determination of the optimal thickness of the barrier metal on a Schottky solar cell is important to conversion efficiency. An equilibrium point indicator has been developed which uses sample-and-hold circuits to monitor the optimal thickness of the barrier metal film and the antireflection dielectric layer. The method splits the light from a 0.5 mW 632.8 nm laser into two beams. The first beam is detected by a photodiode whose output is amplified and yields the square-wave reference signal. The other beam is aligned to impinge on the solar cell being manufactured. During evaporation, the short-circuit photocurrent is monitored by placing the solar cell between two gold-plated stainless steel springs. The thickness of the metal film is simultaneously measured by a temperature-controlled crystal oscillator to an accuracy of plus or minus 0.1 nm.

S.C.S.

A78-25051 Materials requirements for fusion reactors. C. J. McHargue and J. L. Scott (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 151-159. 20 refs. Research sponsored by the U.S. Department of Energy.

A brief discussion of the basis of nuclear fusion energy production is followed by some of the expected materials problems. Examples are examined that illustrate problems generic to all Tokamak designs. Some materials requirements specific to other systems are also noted. Major fusion reactor components and materials options for each are tabulated. The most difficult problem appears to be the radiation damage to the structural first wall. For stainless steels and nickel-base alloys, the fusion environment can be simulated in a mixed-spectrum fission reactor. For refractory metals, a high-flux high-energy (about 15 MeV) neutron source is required. Regardless of the radiation damage, one must consider the effect of high heat fluxes, corrosion, tritium handling, fabrication, etc. Associated with materials problems is the development of superconducting magnets, with special emphasis on the conductor, supporting structure, and insulation.

S.D.

A78-25052 Materials engineering and development for coal fired MHD power generators. L. M. Raring (U.S. Department of

Energy, Div. of Magnetohydrodynamics, Washington, D.C.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 161-173. 31 refs.

After a brief description of coal-fired MHD power generator design principles, the generator's electrochemical and thermal stress environment is examined. A review of experimental test histories of two generator designs, representing extremes in operating conditions and materials selection, emphasizes the unique combination of fluid-dynamic, electrodynamic, electrochemical, and thermal conditions which MHD materials endure. In particular, slag-coated metal (Inconel) anodes are susceptible to localized oxidation at the leading edge, interelectrode insulation damage on metal electrode walls is mitigated by high thermal diffusivity electro-insulator design, and high-temperature ceramic electrodes may exhibit phase instabilities. S.D.

A78-25053 Materials problems in coal gasification and liquefaction. W. J. Lochmann (Ralph M. Parsons Co., Pasadena, Calif.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 175-181. 20 refs.

Materials problems associated with the conversion of 'dirty' (pollutant-producing) coal into clean-burning gaseous, liquid, or solid fuels are examined. Coal gasification and liquefaction processes are briefly outlined. Representative environmental conditions experienced by materials in coal conversion processes involving material deterioration and definitions of key equipment material problem areas are discussed. It is shown that the operational environments are high temperatures and high pressures, and contain substantial amounts of H₂S, H₂, and organic acids. Equipment material problem areas are identified as coal feed injection and slurry pumping, coal gasifier reactors, liquefaction reactors, and coal gas turbines. S.D.

A78-25054 Materials requirements for high performance secondary batteries. J. E. Battles, J. A. Smaga, and K. M. Myles (Argonne National Laboratory, Argonne, Ill.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 183-191. 23 refs. ERDA-sponsored research.

The paper presents a brief review of the characteristics and materials problems related to the more common ambient-temperature battery systems and the high-temperature (about 350 C) sodium/sulfur battery system. A detailed discussion is given on the materials requirements and problems concerning the development of lithium-aluminum/metal sulfide high-temperature (about 425 C) batteries. The study focuses on batteries for electric vehicle propulsion, but the materials problems are equally applicable to stationary energy-storage batteries. The materials selection process is described and experimental data on compatibility tests are provided. Additional research work is required for finding more economical materials and means of fabricating the structures and components for optimum cell performance. S.D.

A78-25055 Catalysis and unconventional energy systems: R. A. Strehlow (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 193-199. 45 refs. ERDA-sponsored research.

The paper considers catalysis and unconventional energy systems only from the standpoint of materials science associated with the carrying out of catalytic reactions. Attention is directed at a description of heterogeneous catalysis regarded as a reaction occurring at higher rates in the presence of a solid surface, at catalytic reactions in new energy systems with their associated materials needs, and at aspects of materials science which are especially relevant to catalysis. Heterogeneous catalytic processes are discussed in terms of fundamental processes of reactant diffusion to the surface, diffusion and reaction on the surface, and diffusion of products away from the reaction site. Catalytic reactions in new energy systems are examined relative to synthetic fuel generation by hydrogenation and gasification of coal, hydrogen from water, burning of fuels, fuel cells, and nuclear process heat. Physical changes experienced by catalysts in service are highlighted. S.D.

A78-25056 Materials problems in large scale production of hydrogen from water and in hydrogen storage. C. E. Bamberger and J. H. DeVan (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 201-206. 28 refs. Research sponsored by the U.S. Department of Energy.

Methods for the production of hydrogen from water are discussed with emphasis on thermochemical cycles. These consist of a series of reactions, performed at various temperatures up to about 1000 C, which by their nature involve some compounds that are aggressive toward containment materials. Experience with most such reactions is presently not available in the chemical industry, and a lack of knowledge is thus evident regarding corrosion-resistant materials. The most promising thermochemical cycles are described in terms of the aggressiveness of their reagents. Materials problems associated with the production of hydrogen by water electrolysis and hydrogen storage in the form of metallic hydrides are also reviewed. (Author)

A78-25057 Ocean thermal energy conversion material requirements for large-scale systems. J. G. McGowan and W. E. Heronemus (Massachusetts University, Amherst, Mass.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 9A, Feb. 1978, p. 207-214. 15 refs.

This paper summarizes the general concepts and current state of the art for Ocean Thermal Energy Conversion (OTEC) Systems, a large-scale solar energy driven resource. Specifically, it focuses on the varied material needs for such power plants. Each of the system's major components (turbine, heat exchanger, ocean platform or hull, and ocean water delivery system) is discussed with respect to material requirements (type and magnitude) needed for the various designs. The heat exchangers are considered to be the key power plant components and various designs and material choices are presented. Also, the impact on material resources for large-scale implementation of such systems is considered. (Author)

A78-25108 Design of superconducting magnets for full scale MHD generators. A. M. Hatch, J. Zar, and F. E. Becker (Avco Everett Research Laboratory, Inc., Everett, Mass.). *Cryogenics*, vol. 18, Feb. 1978, p. 67-72. ERDA-supported research.

This paper describes the results of conceptual design studies and preliminary design work carried out relative to full-scale superconducting magnets for base-load size MHD generators. Conceptual layouts and design data were prepared for 6 T magnets of alternate configurations (circular-saddle coil and rectangular saddle coil) and for 5 T and 7 T variations. The major characteristics of the various designs are summarized and compared. Problem areas revealed during the design effort are identified and specific recommendations for future investigations and R & D effort in support of large MHD magnet technology are made. (Author)

A78-25225 Oil Shale Symposium, 10th, Colorado School of Mines, Golden, Colo., April 21, 22, 1977, Proceedings. Symposium sponsored by the Colorado School of Mines. Edited by J. B. Reubens. Golden, Colo., Colorado School of Mines Press, 1977. 261 p. \$7.50.

Oil shale research is presented, with emphasis on in situ retorting to minimize solid materials handling problems, as well as toxic substances control and environmental planning needed for large-scale commercial oil shale operations. Topics discussed include production of gasoline from oil shale, the economics of combined in situ and surface retorting, pillar and longwall mining of oil shale, the dynamics of oil generation and degradation during oil shale retorting, microwave radiation assays of oil shale, the partitioning of As, Cd, Cu, Hg, Pb and Zn during oil shale retorting, legal problems involved in water usage for oil shale development in Colorado, and the effects of gas introduced during retorting. J.M.B.

A78-25256 Some aspects of the solar case study in Austria illustrated by the example of hybrid power plants. N. Weys

(International Institute for Applied Systems Analysis, Laxenburg, Austria). *Revue de l'Énergie*, vol. 28, Dec. 1977, p. 573-584. 9 refs. In English and French.

Consideration is given to a hybrid thermal power plant which alternately utilizes fossil fuels (when solar energy is not available) and solar energy for heating a working fluid and producing steam. It has been found that such a system is applicable to large areas in the climatic environment of Austria. Solar energy power plants may be integrated into larger interconnected networks or into annual energy storage facilities. A proposed arrangement of a hybrid thermal power plant, noting operating cycles for both solar and fossil fuel regimes, is presented. Procedures for calculating economic guidelines are outlined with reference to repayment time periods, the price of the system components, and the possible oil market trends. Factors to be considered in site selection are outlined in terms of how they influence obtainable solar energy and total power plant performance.

S.C.S.

A78-25257 Considerations of the World Energy Conference long-range review of energy problems /Istanbul - September 19-23, 1977/ (Réflexions sur la revue des problèmes d'énergie à long terme par la conférence mondiale de l'énergie /Istanbul - 19-23 septembre 1977/). P. Ailleret. *Revue de l'Énergie*, vol. 28, Dec. 1977, p. 591-598. In French.

The article presents an assessment of issues discussed at the World Energy Conference held in Istanbul. The date to which long-range plans should be directed is reviewed along with estimates of when the resources of various fuels are expected to be depleted. Various views concerning the future energy requirements are outlined in terms of countries with different degrees of industrialization. Means to anticipate the depletion of various resources are proposed, including energy conservation policies, the further development and improvement of urban mass transport, and the creation of alternative energy sources such as nuclear energy.

S.C.S.

A78-25301* Nuclear Science Symposium, 4th, and Nuclear Power Systems Symposium, 9th, San Francisco, Calif., October 19-21, 1977, Proceedings. Symposia sponsored by IEEE, ERDA, and NASA. *IEEE Transactions on Nuclear Science*, vol. NS-25, Feb. 1978. 891 p.

Consideration is given to the following types of high energy physics instrumentation: drift chambers, multiwire proportional chambers, calorimeters, optical detectors, ionization and scintillation detectors, solid state detectors, and electronic and digital subsystems. Attention is also paid to reactor instrumentation, nuclear medicine instrumentation, data acquisition systems for nuclear instrumentation, microprocessor applications in nuclear science, environmental instrumentation, control and instrumentation of nuclear power generating stations, and radiation monitoring. Papers are also presented on instrumentation for the High Energy Astronomy Observatory.

B.J.

A78-25302 # Some economic and environmental consequences of fusion power. C. D. Henning and J. E. Baublitz (U.S. Department of Energy, Washington, D.C.). (*IEEE, ERDA, and NASA, Nuclear Science Symposium, 4th, and Nuclear Power Systems Symposium, 9th, San Francisco, Calif., Oct. 19-21, 1977.*) *IEEE Transactions on Nuclear Science*, vol. NS-25, Feb. 1978, p. 23-27. 13 refs.

The typical capital cost of a fusion power plant is examined with attention given to costs of the magnets, plasma heating and fueling, and power conversion equipment. Some of the environmental and safety aspects of magnetic fusion are then reviewed with consideration of tritium handling, lithium handling, magnetic fields, reactor accidents, and nuclear wastes. The normalized GWe-year environmental impacts of some future energy sources, including fusion, are summarized. It is concluded that conventional economics and cost-benefit analysis cannot be applied to fusion power.

B.J.

A78-25322 Analysis and scale-up consideration of bituminous coal liquefaction rate processes. K. W. Han, V. B. Dixit, and C. Y. Wen (West Virginia University, Morgantown, W. Va.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, Jan. 1978, p. 16-21. 25 refs. Contract No. E(49-18)-2274.

Data from pilot units of coal liquefaction processes are analyzed in order to provide information for design and scale-up. Correlations of coal dissolution rate and hydrogen absorption in coal-derived solvents under hydrogen pressure are obtained. The rate-determining mechanism appears to change from mass transfer dominated regime to chemical reaction dominated regime as the flow of mixtures of gas and slurry becomes more turbulent, indicating a considerable hydrodynamic effect. The preheater section plays an important role during the initial stage of dissolution. The calculated values for coal dissolution and hydrogen absorption, based on the proposed correlation, are found to agree reasonably with observed values. The various pilot and laboratory units examined have reactor diameters ranging from 2 to 60 cm. The effects of temperature, hydrogen pressure, coal particle size, coal types, and presence of catalyst on coal dissolution rate and hydrogen consumption rate are also discussed.

(Author)

A78-25323 Mathematical model for the gasification of coal under pressure. V. Biba, J. Macak, E. Klose, and J. Malecha (Vysoka Skola Chemickotechnologica; Vedecko-Vyzkumni Ustav Paliv, Prague, Czechoslovakia; Freiberg, Bergakademie, Freiberg, East Germany). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, Jan. 1978, p. 92-98. 30 refs.

The detailed mathematical description of technological processes is a decisive prerequisite for an optimal operation and design of the respective plants. In line with this objective a mathematical model for the high-pressure gasification of solid fuels in the charged layer is presented which permits the quantitative description of the static behavior of the generator. With due consideration of the partial processes taking place in the high-pressure gasifier, the paper deals with the parameters of reaction kinetics and of the transfer of matter and energy which are necessary for developing the model of a fixed-bed reactor. To obtain a practicable model, simplifications are needed which concern the gasification, degasification, and drying processes. They are dealt with individually. For calculating the concentration and temperature profiles for the solid and gas phases along the gasification bed height, a system of differential equations was obtained which was supplemented by some algebraic equations. The modified Euler method was used for the solution. The algorithm for the solution of the system was programmed in FORTRAN. A Tesla 200 computer was used for calculations.

(Author)

A78-25380 An evaluation of control strategies for SO₂ emissions from petroleum refineries. P. T. Budzik (Petroleum Association for the Conservation of the Canadian Environment, Toronto, Canada). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-43.1*. 16 p.

A78-25386 Improving the emission performance of vehicles in the field. R. Reid (Fisheries and Environment Canada, Ottawa, Canada). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-3.4*. 13 p.

Limiting the adjustability of the idle air-fuel mixture of motor vehicles may provide a means for reducing pollutant emissions; furthermore, information on idle and fast idle CO and hydrocarbon emissions may aid in assessing the emissions performance of vehicles in the field. Canadian government studies of automobile CO emissions are cited in discussing the efficacy of a proposed tamper-proof carburetor intended to control the idle air-fuel mixture. Aside from CO emissions control, benefits of the proposal include fuel economy and reduced risk of exhaust system overheating.

J.M.B.

A78-25400 A continuous monitoring system for sulfur dioxide mass emissions from stationary sources. R. Rollins (U.S. Environmental Protection Agency, Research Triangle Park, N.C.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-27.5*. 13 p. U.S. Environmental Protection Agency Contracts No. 68-02-1400; No. 68-02-2566; No. 68-02-1406.

A commercially available monitoring system which provides sulfur dioxide mass emission rate data as a direct output was evaluated with respect to performance at a coal-fired power plant and at a sulfuric acid production facility over an extended period. The system measures effluent temperature, velocity, and SO₂ concentration independently and simultaneously, and then computes and records the instantaneous mass emission and volumetric flow rates on a continuous basis. Test procedures and plant characteristics are described. The system installed at the power plant obtained much higher SO₂ readings and lower velocity readings than did the reference methods. Low accuracy for results obtained by the monitor at the sulfuric acid facility was caused by zero drift of the SO₂ analyzer. M.L.

A78-25404 Emissions of trace elements from the combined firing of coal and RDF in a utility boiler. L. J. Shannon, P. G. Gorman, M. P. Schrag (Midwest Research Institute, Kansas City, Mo.), and J. D. Kilgroe (U.S. Environmental Protection Agency, Research Triangle Park, N.C.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-37.6*. 14 p. 5 refs. U.S. Environmental Protection Agency Contract No. 68-02-1871.

An investigation was conducted concerning the emissions of trace elements to air, water, and land when refuse-derived fuel (RDF) and coal were fired in a 125 MW boiler. The boiler used in the investigation is equipped with an electrostatic precipitator (ESP) for particulate control. Bottom ash is removed by sluicing to an ash pond. The tests involved sampling of all input/output streams to the boiler including coal, RDF, bottom ash, ESP hopper ash, and stack emissions. It was found that the use of RDF as a supplementary fuel increased the emissions of several trace elements in the outlet streams compared to levels observed when only coal was used. However, the magnitude of the increases of trace element emissions does not indicate that an employment of combined firing systems similar to the investigated unit will have severe environmental impacts. G.R.

A78-25406 Character and transformation of pollutants from major fossil-fuel energy sources. D. S. Shriner, S. B. McLaughlin, and C. F. Baes (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-15.1*. 24 p. 58 refs.

The physical and chemical characteristics of effluents from the stacks of a fossil-fuel energy source depend on source and fuel variables. An investigation is conducted concerning the potential significance of the more important of these variables in the transformation of effluents during the transport from the source. Compared to emissions from all sources, total estimated emissions from fuel combustion for electricity generation account for approximately 1% of the carbon monoxide, 25% of the particulates, 60% of the sulfur oxides, 25% of the nitrogen oxides, and 5% of the hydrocarbons. The high density of electric power plants in the East of the U.S. combined with high emissions from urban and industrial sources makes the widespread occurrence of potentially phytotoxic levels of combinations of pollutants particularly likely within this region. Attention is given to source-related emission trends, the spatial distribution of sources, regional meteorological factors affecting pollutant transport, and chemical characteristics affecting pollutant transport. G.R.

A78-25410 Control of fine particulate from coal-fired utility boilers. M. F. Szabo, R. W. Gerstle (PEDCo Environmental Inc., Cincinnati, Ohio), and K. P. Ananth (Midwest Research Institute, Kansas City, Mo.). *Air Pollution Control Association,*

Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-14.1. 24 p. 9 refs. U.S. Environmental Protection Agency Contract No. 68-02-2105.

Electrostatic precipitators, wet scrubbers, and fabric filters have been evaluated for controlling fine particulate emissions from coal-fired electric utilities. Of the three systems, electrostatic precipitators are most widely used. Few utilities use wet scrubbers and only three coal-fired utilities use fabric filters. A summary of important design parameters for each control device, common maintenance problems encountered with each device, and fractional efficiency data are presented. Fractional efficiency data for electrostatic precipitators show minimum collection efficiency in the size range of 0.1 to 1.0 micron. Similar results were obtained for a scrubber and a fabric filter. Wet scrubbers exhibit a lower efficiency than precipitators or fabric filters in the 0.1 to 1.0 micron size range and scrubber efficiency rapidly decreases with decreasing particle size. (Author)

A78-25412 Conversion rates of SO₂ to submicron sulfate in the plume of a coal-fired power plant in the western United States. W. O. Ursenbach, A. C. Hill, W. H. Edwards, S. M. Kunen (Utah, University, Salt Lake City, Utah), and J. A. Taylor (Arizona Public Service Co., Phoenix, Ariz.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-39.1*. 10 p. 11 refs. Research supported by West Associates.

A78-25424 Coal dryer emission control with the energy saving centripetal vortex wet scrubber. A. J. Buonicore, E. S. Yankura, and N. Ostojic (Entoleter, Inc., Hamden, Conn.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-17.5*. 17 p. 9 refs.

A78-25427 Air pollution potential of solar technologies. J. G. Holmes, P. E. Mihlmester, S. G. Miller, T. L. Super, and J. B. Thomasian (Energy and Environmental Analysis, Inc., Arlington, Va.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-37.1*. 14 p. 11 refs.

Air pollution associated with fabrication or operation of solar energy devices is considered. Impacts include: the release from cooling towers of liquid spray (called drift) containing dissolved substances; the emission of PH₃, POCl₃, and HF during silicon cell fabrication; possible release of As₂O₃ if a centralized GaAs array catches fire; and escape of gas from gasification units. The possibility that air pollution might result from biomass production and use or from the manufacture and use of photovoltaic cells is examined. M.L.

A78-25438 # The biological effects of air pollution from fossil fuel burning power plants in the Northcentral Great Plains. R. A. Lewis (U.S. Department of Energy, Washington, D.C.), E. M. Preston, and N. R. Glass (Corvallis Environmental Research Laboratory, Corvallis, Ore.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-15.4*. 17 p. 9 refs.

Environmental impact statements for the construction and operation of coal-fired power plants are critiqued, and results of an experimental program quantifying chronic and short-term power plant-induced pollution stress on a prairie environment are reported. The study area is located in southeastern Montana, which has never previously experienced significant air pollution stress. The experimental program includes the use of lichens to monitor sulfur uptake and honey bees to study fluoride accumulation; field tests involving air pollution effects in forests and grasslands are also being conducted. The goal is to develop a predictive capability to aid in power plant siting in the Northcentral United States. J.M.B.

A78-25443 Relationships among observed short-term maximum sulfur dioxide concentrations near coal-fired power plants. J. R. Martin (Meteorological Evaluation Services, Inc., Amityville, N.Y.) and R. W. Reeves (American Electric Power Service Corp.,

Canton, Ohio). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-29.5*. 15 p.

The relationships among short-term (1, 3, and 24-hour) sulfur dioxide concentrations observed during a one year period at areas near coal-fired power plants are studied. It is concluded that: (1) the maximum 3-hour running average SO₂ concentration is 77% of the maximum 1-hour concentration, (2) the maximum 24-hour running average concentration is 28% of the maximum 1-hour concentration, (3) the maximum 24-hour running average concentration is 37% of the maximum 3-hour concentration, (4) the highest ratios on all time scales were in a highly industrialized area with many SO₂ sources, and (5) the 24-hour primary standard level is more often exceeded than the 3-hour secondary standard level. S.C.S.

A78-25445 Economic comparison of selected scenarios for electrostatic precipitators and fabric filters. D. V. Bubenick (Research-Cottrell, Inc., Bound Brook, N.J.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-14.2*. 16 p. 9 refs.

The relative cost-effectiveness of fabric filters and cold, hot and cold SO₃-conditioned electrostatic precipitators are analyzed. The air-to-cloth ratio and power plant size are employed to define fabric filter performance; precipitator performance is defined in terms of specific collection area (SCA), power plant size, and SCA credits possible with hot and cold SO₃-conditioned precipitators. Capital investment requirements and annual costs figure in the comparative economic study. Fabric filters become competitive when a cold electrostatic precipitator requires SCA values greater than about 600 to 800, or when a hot precipitator requires equivalent cold precipitator SCA values greater than about 600 to 1000. J.M.B.

A78-25446 # Studies to define the role of coal cleaning in an SO₂ control strategy for TVA. G. A. Isaacs, T. W. Devitt (PEDCO Environmental, Inc., Cincinnati, Ohio), and J. T. Wilburn (U.S. Environmental Protection Agency, Atlanta, Ga.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-14.4*. 14 p.

Physical coal cleaning processes, including dense medium techniques, hydraulic methods, froth flotation and pneumatic procedures, are described. Particular attention is given to dense medium cyclones and hydraulic processes employing jigs, launders, hydro-cyclones and wet concentrating tables. In addition, washability data for coal supplied by 22 dealers to the Tennessee Valley Authority's 12 coal-fired power plants are analyzed. The data indicate that about 35% of the coal supply is suited for cleaning. However, it does not appear economical to meet, by coal cleaning techniques, a 1.2 lb SO₂ per million Btu restriction. J.M.B.

A78-25447 # Technical and economic impacts of the application of environmental control technology options. E. S. Hougland, L. S. Cockrum, G. A. Hollinden, W. L. Wells, and C. L. Massey (Tennessee Valley Authority, Chattanooga, Tenn.). *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-56.4*. 22 p. 9 refs.

The paper describes the current state of the art for SO₂, NO_x, and particulate control technology and the impacts of their application. Lime/limestone scrubbing, the most widely applied flue gas desulfurization process, is discussed, and double alkali scrubbing systems and recover systems are also considered. Lists of users of these desulfurization techniques are provided. Combustion modification procedures utilized to reduce NO_x are examined with attention to load reduction, excess air, biased firing, flue gas recirculation, and burner modifications. Particulate control techniques that might supersede electrostatic precipitators are described; these include the use of a high-intensity ionizer as a precharger to the precipitator, chemical additives injected to reduce the resistivity of fly ash, hot-side precipitators to ameliorate ash resistivity problems, bag-houses with special coated fabric filters, and wet scrubbers. M.L.

A78-25504 Experience at Edmonton /GLC/ of generating electricity using refuse as fuel. F. T. F. Wiggin (Slough Industrial Estates, Ltd., Slough, Bucks., England). *Institution of Electrical Engineers, Proceedings*, vol. 125, Feb. 1978, p. 169-172.

A continuous power-generation process has been developed for producing electricity from the incineration of domestic or industrial refuse. A schematic cross section of the incinerator-boiler unit is presented. It is noted that initial operations experienced blockages in the precipitator fly ash, riddling screw conveyor, and grit-removal systems. The modifications introduced to remedy these problems are discussed, such as the alteration of generation bank tubes to improve gas passages, and the introduction of an economizer surface to compensate for heat-transfer changes. S.C.S.

A78-25637 # Some problems in the operational analysis of a hydrogen-fueled gas turbine (Nekotorye voprosy analiza raboty gazoturbinnoi ustanovki na vodorodnom toplive). I. L. Varshavskii, P. M. Kanilo, and A. V. Ambrozhevich (Akademiia Nauk Ukrainsskoi SSR, Institut Problem Mashinostroeniia, Kharkov, Ukrainian SSR). *Problemy Mashinostroeniia*, no. 3, 1976, p. 85-92. In Russian.

An analysis is presented of the thermodynamic efficiency and operating characteristics of a hydrogen-fueled gas turbine engine. A method of fuel supply and automatic control for the engine are proposed. A hydrogen-fueled gas turbine is compared with a kerosene-fueled turbine in terms of efficiency. B.J.

A78-25700 Comparing the Ames and St. Louis resource recovery projects. R. Holloway (U.S. Environmental Protection Agency, Resource Recovery Div., Washington, D.C.). *Waste Age*, vol. 9, Feb. 1978, p. 33, 35-38, 40.

The Ames, Iowa, refuse-derived fuel (RDF) plant is described and compared with the St. Louis RDF demonstration project. The Ames plant consists of the (commercial and residential) waste processing plant where RDF is produced and materials recovered; and the adjacent municipal power plant where RDF is stored and can be fired into three small steam-electric boilers. The processing system is a single process line with a design capacity of 50 tons per hr. Metals recovery occurs between two stages of shredding. After secondary shredding, the material is density-separated in a vertical-chute air classifier similar to the unit installed at the St. Louis project. About 85% of the waste processed is recovered as RDF in the light fraction. Average RDF values are 5,700 Btu/lb, 22% moisture content, and 17% ash content. Problems include dust emissions within the processing plant, inability to fire waste in the suspension boiler, and inoperability of the aluminum recovery system. A cost summary is provided and the costs are analyzed. M.L.

A78-25718 Solar economics comes home. M. Hyman, Jr. (Solar Heat Corp., Arlington, Mass.). *Technology Review*, vol. 80, Feb. 1978, p. 28-35.

Rising fossil fuel costs have made solar heating systems increasingly attractive. Such a system is evaluated in terms of a two-storey frame house in Massachusetts, which was outfitted with 1,200 sq ft of absorbing surface. The system was designed to provide up to 100% of the house's heating requirements and up to 90% of its hot water. The rest would be taken up by conventional fuel sources. A description of the system parameters is presented, and correlated with seasonal sunlight and temperature variations. Performance was approximately as expected, but the long time span necessary for the system to amortise (25-30 years) makes it economically questionable at this point. D.M.W.

A78-25730 # The achievements and perspectives for the development of solar power engineering in the USSR (Dostizheniia i perspektivy razvitiia gelienergetiki v SSSR). S. A. Azimov. *Geliotekhnika*, no. 5, 1977, p. 3-8. In Russian.

The article presents a broad survey of the development of solar power engineering in the USSR. Attention is given to regional programs utilizing solar energy for various everyday tasks, the construction of solar-heated dwellings, the development of solar

distillers, and the construction of solar furnaces. Plans for building solar power stations are reviewed as are projects for the automatic transformation of solar into mechanical energy using the Stirling engine or Rankine cycles. Plans for the generation of energy from solar power using conical and cylindrical concentrators and Fresnel mirrors are proposed. Particular consideration is given to research in solar energy as applicable to agricultural projects. S.C.S.

A78-25731 # The development and use of the moiré method in solar engineering problems (Razvitie i primeneniye metoda muara v zadachakh geliotekhniki). Iu. K. Shcherbakov and L. P. Tairova (Moskovskoe Vyshee Tekhnicheskoe Uchilishche, Moscow, USSR). *Geliotekhnika*, no. 5, 1977, p. 9-17. 10 refs. In Russian.

Consideration is given to the moiré method as applied to measuring the angles of rotation of normals and the curvature of reflecting surfaces of solar engineering apparatus. Various procedures for visualizing moiré maps are discussed with reference to circular and hexagonal film facets. The results indicate that the proposed method is effective for defining the characteristics of flexible concentrators having various types of supports, two-dimensional laminar reflectors of various forms, and for the form control of reflecting surfaces during their manufacture and use. S.C.S.

A78-25732 # A paraboloid-toroidal conical concentrator as a secondary concentrator of solar energy (Parabolotricheskii fokus kak vtorichnyi konsentraty solnechnoi energii). V. K. Baranov. *Geliotekhnika*, no. 5, 1977, p. 18-25. 10 refs. In Russian.

Attention is given to the construction of conical and cylindrical concentrators noting their applications as secondary concentrators in solar furnaces and solar energy installations. A system designed for concentrating solar energy, and consisting of a paraboloid mirror and a paraboloid-toroidal conical concentrator is described. It is shown that the introduction of a conical concentrator into such a system may increase the illumination by ten times in those cases where the mirror's coverage angle is less than 20-25 degrees. When the angle is 25-65 degrees, the illumination increases to a small degree. The basic relationships between the parameters of the conical and cylindrical concentrators and those of the mirror and the lens system are identified. S.C.S.

A78-25733 # A comparative analysis of models describing the formation of irradiance fields in wide-aperture optical systems (Sravnitel'nyi analiz modelei formirovaniya polei obluchennosti v shirokooaperturnykh opticheskikh sistemakh). I. V. Baum and S. O. Mamedniiazov (Akademiya Nauk Tadzhikskoi SSR, Fiziko-Tekhnicheskii Institut, Dyushambe, Tadzhik SSR). *Geliotekhnika*, no. 5, 1977, p. 26-36. 14 refs. In Russian.

The article briefly discusses the development of wide-aperture optical systems used for concentrating radiated streams, and employed in devices such as optical furnaces with artificial sources, high-temperature solar furnaces, and parabolic reflectors in radio-telescopes. A comparative analysis is presented of various models of the irradiance fields of such wide-aperture optical systems. The analysis is based on mathematical calculations of the primary radiation source characteristics, concentrator parameters, and the thermal regimes of the receiver. S.C.S.

A78-25734 # Equalizing an irradiance field on the surface of a receiver (Vyravniwanie polya obluchennosti na poverkhnosti priemnika). I. V. Baum and S. O. Mamedniiazov (Akademiya Nauk Tadzhikskoi SSR, Fiziko-Tekhnicheskii Institut, Dyushambe, Tadzhik SSR). *Geliotekhnika*, no. 5, 1977, p. 37-43. In Russian.

For many types of equipment based on radial heating, the homogeneity of the irradiance field of solar concentrators has been emphasized. The article presents a computational procedure for evaluating the homogeneity of irradiance fields on the surface of two-dimensional receivers. Consideration is also given to losses in boundary homogeneity caused by the finite angular dimensions of the source. S.C.S.

A78-25735 # Estimating the deformation process in the formation of the reflecting surface of solar concentrators (K otsenke deformatsionnogo sposoba formobrazovaniya otrazhaiushchei poverkhnosti solnechnykh konsentratyrov). R. A. Zakhidov, Iu. A. Dudko, O. P. Petrosov, G. S. Zmener, and L. A. Dubrovskii (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priboro-stroeniya, Uzbek SSR). *Geliotekhnika*, no. 5, 1977, p. 44, 45. In Russian.

A78-25736 # The role of macrorelief of semiconductor branches during their commutation in thermoelements (O roli makrorel'efa poluprovodnikovyykh vetvei pri ikh kommutatsii v termoelementakh). E. A. Malygin and M. P. Kozorezov (Voronzhskii Politekhicheskii Institut, Voronezh, USSR). *Geliotekhnika*, no. 5, 1977, p. 46-48. In Russian.

A study is made to determine the dependency of the mechanical strength of a semiconductor on the degree of roughness of its branches. Low-temperature thermoelectric materials based on Bi, Se, Te, and Sb are considered. The branches were formed by a technique of compression followed by annealing. Geometrical impurities of the backing are found to significantly influence nucleation during condensation. Two types of impurities are identified: macroscopic and microscopic. Using microphotographs and corresponding profilograms, the influence of macrodefects on the surface of semiconductor branches is studied. S.C.S.

A78-25737 # Classification of methods for controlling the productivity of wind and solar power stations (Klassifikatsiya vidov regulirovaniya proizvoditel'nosti vetro- i gelioustanovok). R. B. Salieva (Tashkentskii Elektrotekhicheskii Institut Sviasi, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 5, 1977, p. 49-60. 14 refs. In Russian.

Consideration is given to monitoring the productivity of wind and solar power stations on daily, seasonal, and many-year bases. Methods for calculating the parameters of wind and solar energy collectors are proposed, noting those based on data gathered over many years, and those based on statistics and probability. The conditions under which each of the methods may be used are identified. S.C.S.

A78-25738 # The stability of polyurethane foam solar energy collectors to climatic effects (Ustoichivost' konsentratyrov solnechnoi energii na osnove penopoliiuretana k klimaticheskim vozddeystviyam). B. A. Bazarov, A. G. Dement'ev, and B. A. Kalinin (Akademiya Nauk Tadzhikskoi SSR, Fiziko-Tekhnicheskii Institut, Dyushambe, Tadzhik SSR). *Geliotekhnika*, no. 5, 1977, p. 67-71. 8 refs. In Russian.

A78-25739 # An absorption solar refrigerator having periodic operation (Absorbtsionnyi geliokholodil'nik periodicheskogo deystviya). A. T. Vakhidov and T. M. Maksudov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 5, 1977, p. 76-78. 8 refs. In Russian.

A study is made of an absorption solar refrigerator based on a liquid. Particular attention is given to a model solar refrigerator having periodic operation and using ammonia as a cooling agent and water as an absorber. It is found that the apparatus' thermal inertia is a function of heat capacity, generator-absorber mass, and the ammonia-water solution. A numerical procedure is derived for determining the necessary amount of this solution, and optimal concentrations are given for various times of the year. S.C.S.

A78-25946 # Development of a flow-model for energies and products. J. Kawakami and S. Matsuoka (Tokyo, University, Tokyo, Japan). *Tokyo, University, Faculty of Engineering, Journal, Series A*, no. 15, 1977, p. 34-37. In Japanese.

The paper describes a model to check validity of new energy technologies and policies. In this model, the energy system which converts primary energies into secondary energies is expressed by linear inequalities to considering substitution of energies and

technologies. The industry system which is divided into sectors is expressed by linear equalities like Leontief analysis. (Author)

A78-25947 # Computer simulation of ion extraction. M. Mori, N. Inoue, H. Nihei, J. Morikawa, T. Nakamura, and T. Uchida (Tokyo, University, Tokyo, Japan). *Tokyo, University, Faculty of Engineering, Journal, Series A*, no. 15, 1977, p. 48, 49. In Japanese.

The development of an intense ion source is an integral part of controlled thermonuclear fusion. One possible method is the heating of a plasma by an intense injection of a neutral beam. A computer-aided beam extractor design has been developed for such purposes. The design incorporates slot-type extractor electrodes having accel-decel geometry, and arbitrary shapes and dimensions of electrode cross-sections. Based on the influence of space charge and finite ion temperature, the boundary surface of the ion emitting surface is computed. The influence of multistage acceleration and electrode displacement is noted. S.C.S.

A78-26108 # Cogeneration - A systematic analysis of combined steam and power generation. H. Fox, J. E. Robbins (Pope, Evans and Robbins, Inc., New York, N.Y.), R. Tabi, and E. Nelson (Pope, Evans and Robbins, Inc.; New York Institute of Technology, New York, N.Y.). *Journal of Energy*, vol. 2, Jan.-Feb. 1978, p. 24-30. 13 refs. Contract No. N62472-76-C-1068.

A systematic analysis of a double autoextraction steam-turbine generator coupled to a model of an electric utility is presented. Optimum performance is sought in terms of the following parameters: for the utility-fuel adjustment factor, preceding adjusted peak demand, and current peak demand; for the self-generation turbine-steam flow rates, electric power demand, and incremental plant operation cost for self-generation as a function of steam cost at the turbine. A simple nomogram has been developed to facilitate rapid calculation of the cost of either total self-generation or total purchased power for a given electrical load. Numerical results are presented for conditions in between. (Author)

A78-26109 # Potential effects of coal slag condensation on plasma conductivity in MHD generators. M. Martinez-Sanchez, J. L. Kerrebrock (Aerodyne Research, Inc., Bedford; MIT, Cambridge, Mass.), and C. E. Kolb (Aerodyne Research, Inc., Bedford, Mass.). *Journal of Energy*, vol. 2, Jan.-Feb. 1978, p. 31-39. 17 refs. Contract No. EX-76-C-01-2478.

An analysis is presented of the possible effects of homogeneous nucleation of slag vapor on the electron density in coal combustion MHD generators. The range of operating conditions for which nucleation may occur is found to include those of interest for baseload applications, provided silica vaporization is not strongly inhibited in the burner. Calculations based on a steady-state ionization-recombination model including microscopic droplets show substantial electron density reductions, especially for drops with a high work function. Key uncertainties that may affect the accuracy of the results are pointed out. (Author)

A78-26110 * # ECAS Phase I fuel cell results. M. Warshay (NASA, Lewis Research Center, Fuel Cell Projects Office, Cleveland, Ohio). *Journal of Energy*, vol. 2, Jan.-Feb. 1978, p. 46-52. 10 refs.

This paper summarizes and discusses the fuel cell system results of Phase I of the Energy Conversion Alternatives Study (ECAS). Ten advanced electric powerplant systems for central-station baseload generation using coal were studied by NASA in ECAS. Three types of low-temperature fuel cells (solid polymer electrolyte, SPE, aqueous alkaline, and phosphoric acid) and two types of high-temperature fuel cells (molten carbonate, MC, and zirconia solid electrolyte, SE) were studied. The results indicate that (1) overall efficiency increases with fuel cell temperature, and (2) scale-up in powerplant size can produce a significant reduction in cost of electricity (COE) only when it is accompanied by utilization of waste fuel cell heat through a steam bottoming cycle and/or integration with a gasifier. For low-temperature fuel cell systems, the use of hydrogen results in the highest efficiency and lowest COE. In spite of

higher efficiencies, because of higher fuel cell replacement costs integrated SE systems have higher projected COEs than do integrated MC systems. Present data indicate that life can be projected to over 30,000 hr for MC fuel cells, but data are not yet sufficient for similarly projecting SE fuel cell life expectancy. (Author)

A78-26111 # Collection of ions by electric probes in combustion MHD plasmas - An overview. R. M. Clements (Victoria, University, Victoria, British Columbia, Canada) and P. R. Smy (Alberta, University, Edmonton, Canada). *Journal of Energy*, vol. 2, Jan.-Feb. 1978, p. 53-58. 26 refs. Research supported by the National Research Council of Canada, University of Alberta, and University of Victoria.

The use of negatively biased (ion-collecting) Langmuir (or electric) probes under conditions typical of MHD combustion plasmas is discussed. The interpretation of the measured probe current in order to yield ion density is also discussed, and it is shown that for many situations an extremely simple model is satisfactory. In this model, the ion flux convected by the bulk hydrodynamic flow into the sheath edge is equated to the mobility-dominated space-charge current inside the sheath. Some of the practical problems of using these probes in the rather harsh environment of a combustion MHD plasma are also considered. Specifically, problems arising from probe heating, seed and/or slag deposition are discussed. (Author)

A78-26112 * # Electron emission from nickel-alloy surfaces in cesium vapor. M. Manda and D. Jacobson (Arizona State University, Tempe, Ariz.). *Journal of Energy*, vol. 2, Jan.-Feb. 1978, p. 59-61. 8 refs. Grant No. NsG-7019.

An experimental apparatus and measurement techniques are described for measuring the thermionic emission from cesium-activated materials having adequate high-temperature properties such as creep strength and corrosion resistance, which might ultimately reduce the cost of thermionic converters. The electron emission characteristics are measured for nickel, Inconel 600, and Hastelloy X probes with a 412 K cesium reservoir. It is found that the nickel alloys exhibit a peak electron emission 1.4 to 2.1 times greater than pure nickel. Both the Inconel and the Hastelloy samples have work functions of 1.64 eV at peak emission. The minimum cesiated work functions are estimated to be 1.37 eV for Inconel at a probe temperature of 750 K and 1.4 eV for Hastelloy at a probe temperature of 665 K. The bare work functions for both alloys is estimated to be about the same as for pure nickel, 4.8 eV. S.D.

A78-26113 # Performance of counter- and corotating arrays of Savonius turbines. A. F. Charvat (California, University, Los Angeles, Calif.). *Journal of Energy*, vol. 2, Jan.-Feb. 1978, p. 61-63. 8 refs.

The mutual interaction of two closely-spaced corotating and counter-rotating Savonius rotors is studied experimentally. The Savonius rotor is a cross-wind (vertical-axis) wind turbine design which is simple, rugged, wind-direction insensitive and self-starting. In addition, Savonius rotors may be arranged in a parallel, closely-spaced array to provide a high degree of power extraction per site. Proper phasing of neighboring rotors can reduce lift due to the Magnus effect and thus improve performance. J.M.B.

A78-26144 Solar energy - Its nature and possibilities as a source of power for terrestrial use. S. Deb (Jadavpur University, Calcutta, India). *Institution of Electronics and Telecommunication Engineers, Journal*, vol. 23, Nov. 1977, p. 659-675. 66 refs.

Important data relating to the solar energy emitted and received on the earth are given and its composition and nature broadly outlined. The availabilities of the various sources of energy are compared to bring out the relative abundance and the perpetual character of solar energy as a source of power. The possible multifarious uses of solar radiation for terrestrial application are enumerated. The principle of construction and the current status of development of the more important components necessary for harnessing solar energy are briefly reviewed. A few typical systems

already realized or in course of being investigated are described. Harnessing of wind energy is also briefly referred to. The need for extensive investment on work relating to the use of solar energy for meeting the specific needs of vast and sun-rich developing countries like India is emphasized. (Author)

A78-26171 Future energy alternatives: Long-range energy prospects for America and the world. R. Meador. Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1978. 206 p. 122 refs. \$6.95.

Long-range prospects for energy production are assessed, with attention given to fusion reactors, solar energy systems, nuclear fission processes, the future uses of coal and hydrogen, as well as wind, tidal and geothermal power generation. In addition to Tokamak and stellarator fusion schemes, consideration is given to laser-pellet fusion reactions. Solar heating and domestic hot water system presently in use are described; coal gasification and oil shale exploitation are mentioned. Fast breeder reactors and municipal solid waste conversion processes also figure in the review. J.M.B.

A78-26173 International Topical Conference on High Power Electron and Ion Beam Research and Technology, 2nd, Cornell University, Ithaca, N.Y., October 3-5, 1977, Proceedings. Volumes 1 & 2. Conference sponsored by ERDA, USAF, and Cornell University. Edited by J. A. Nation and R. N. Sudan (Cornell University, Ithaca, N.Y.). Ithaca, N.Y., Cornell University, 1978. Vol. 1, 505 p.; vol. 2, 428 p.

Papers are presented on the generation and transport of intense beams, such as the magnetic self-insulation of vacuum transmission lines, intense ion beam acceleration and transport, and 100 KJ ion beams for pellet implosions. Attention is given to energy deposition in targets, noting electron beam-driven implosions, neutron production from advanced reb targets, and deflagration waves supported by thermal radiation. Beam-plasma interactions are described including the electron beam solenoid reactor concept, plasma heating by injection of relativistic electron beams, and stable propagation of an electron beam in gas. Charged particle rings are discussed in terms of intense relativistic electron rings for plasma confinement and reversed field geometry generated with a rotating E-beam. Consideration is given to collective accelerators with reference to transverse stability in an electron ring accelerator and an autoaccelerator. A review is presented of microwaves and unneutralized E-beams, e.g., microwave generation in the reflex triode, the electron cyclotron maser. Technological aspects are outlined with reference to microsecond intensive E-beams and super power generators, and laser applications are proposed. S.C.S.

A78-26250 An evaluation of in-situ recovery of tar sands. R. L. Arscott and A. David (Gulf Research and Development Co., Pittsburgh, Pa.). *In Situ*, vol. 1, no. 3, 1977, p. 249-266. 15 refs.

Several field tests of in-situ recovery of tar and heavy oil expose the difficulty of achieving an acceptable economic process. The technical problems encountered in achieving successful projects are: adequate communication between wells, mobilization of the tar and maintenance of production wells. If currently available technology for the recovery of tar sand is to compete economically with world prices for other resources, only the highly saturated, thick tar zones can be considered. The Alberta and Venezuelan resources qualify, but much of the U.S. resource is of questionable value. (Author)

A78-26265 # Voltage-regulation requirements in power-supply centers in the case of nonuniform user-loads (Trebovaniia k zakonam regulirovaniia napriazheniia v tsentrakh pitaniia pri neodnorodnykh nagruzkakh potrebitel'ei). Iu. S. Zhelezko and A. Kh. Khamza (Vsesoiuznyi Nauchno-Issledovatel'skii Institut. Elektroenergetiki, Moscow, USSR). *Problemy Tekhnicheskoi Elektrodinamiki*, no. 64, 1977, p. 52-54. 5 refs. In Russian.

Nonlinear systems of voltage regulation are recommended for power distribution grids, taking account of the demand of domestic and industrial users. Two approaches to nonlinear regulation are discussed: (1) the development of a regulator which carries out a current-associated correction more complex than linear; this is

effected by the introduction into the correction network of additional parameters whose values are established as a function of the degree of load-nonuniformity and the location of nonuniform users in the grid, and (2) the use of a regulator with a linear law of regulation, but with fictive (not sum) current supplied to the correction resistor; this fictive current is described by the expression $I(t) \cdot \alpha I\text{-nonuniform}(t)$, where $I\text{-nonuniform}(t)$ is the current load of nonuniform users and α is a coefficient accounting for the location of these users. B.J.

A78-26372 Re-circulating power, unit costs and thermal pollution of fusion power stations. P. A. Davenport (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). *Nuclear Fusion*, vol. 18, Mar. 1978, p. 420-422. 6 refs.

A figure of merit for the credibility of fusion systems as commercial reactors is defined as the fraction (epsilon) of electrical energy recirculated to reactor auxiliaries. It is pointed out that the quantity epsilon clearly indicates both the cost penalty arising from a high circulating power fraction and the consequent thermal pollution. These two factors are shown to scale as $(\text{const} + \epsilon)/(\epsilon - \epsilon)$. F.G.M.

A78-26399 * Regimes for the ocean, outer space, and weather. S. Brown, N. W. Cornell, L. L. Fabian, and E. B. Weiss. Research supported by NSF, NASA, Ford Foundation, and Rockefeller Foundation. Washington, D.C., Brookings Institution, 1977. 265 p. 203 refs. \$4.50.

The allocation of resources among users of the oceans, outer space and the weather is discussed. Attention is given to the international management of maritime navigation, the control of fisheries, offshore oil and gas exploitation, mineral exploitation in the deep seabed (especially the mining of manganese nodules), and the regulation of oceanographic studies. The management of outer space is considered, with special reference to remote sensing by satellites, television broadcasting, the technical requirements of maritime satellites, and problems associated with satellite frequency and orbit allocation. Rainmaking and typhoon modification, as well as the distribution of weather modification capabilities in the world, are also mentioned. The United Nations, international agencies and tribunals, and multi- or bilateral agreements are some of the implements suggested for use in the regulation of the oceans, outer space and the weather. J.M.B.

A78-26475 Retrofit precipitators meet rigid new standards. R. L. Griggs. *Power Engineering*, vol. 82, Feb. 1978, p. 56-59.

The paper describes the second electrostatic precipitator retrofit design specifications for a steam plant. Detailed specifications were developed since the retrofitting was a turnkey project. Characteristics of the original and the first retrofit are described. The requirements for the second retrofit were a guaranteed efficiency of 99.2% when handling either 500,000 or 700,000 acfm (depending on the plant unit) at 325 F and 2.34 gr/actual cu ft inlet flyash dust loading. Other required design conditions are stated, and the project statistics are surveyed. Installation difficulties caused by the presence of the first retrofit equipment are explained, and a satisfactory test performance obtained during the combustion of 0.9% sulfur coal is reported. M.L.

A78-26576 Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. Symposium sponsored by the American Chemical Society. Edited by R. T. Ellington (Fluor Engineers and Constructors, Inc., Houston, Tex.). New York, Academic Press, Inc., 1977. 289 p. \$14.50.

The role of the solvent in the solvent refined coal process is considered along with the products from two-step coal liquefaction using three different first-step reactor packings, the effect of coal minerals on reaction rates during coal liquefaction, the hydrogenation of phenanthrene over a commercial cobalt molybdenum sulfide catalyst under severe reaction conditions, new materials for

coal liquefaction, and the deactivation and attrition of Co-Mo catalyst during H-coal operations. Attention is also given to the catalytic liquefaction of coal, the kinetics of coal hydrodesulfurization in a batch reactor, kinetics and solubility of hydrogen in coal liquefaction reactions, techniques and product distributions related to short contact time coal liquefaction, the reformation of inorganic particulates suspended in coal derived liquids and improved separation, the coagulation and filtration of solids from liquefied coal of the Synthoil process, the filterability of coal-derived liquid, the analysis of liquid products derived from coal conversion processes, and the separation of coal liquids from major liquefaction processes into meaningful fractions. G.R.

A78-26577 The role of solvent in the solvent refined coal process. C. C. Kang, G. Nongbri (Hydrocarbon Research, Inc., Trenton, N.J.), and N. Stewart (Electric Power Research Institute, Palo Alto, Calif.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 1-17. 9 refs.

A preliminary study is conducted of the effect of the solvent upon solvent refined coal process performance. Two subbituminous coals, including Wyodak coal and Black Mesa coal, and one bituminous coal, involving Illinois No. 6 coal from the Monterey mine, were used in the study. The effect of the tetralin content of the solvent upon coal conversion in the case of Wyodak coal is discussed, taking into account two contactor temperatures. Attention is also given to the effect of other hydrogen donors in the case of Black Mesa coal operation, the effect of solvent quality upon coke formation in Monterey coal operation, a characterization of coke, and the mechanism of coke formation. It is found that the startup solvent and makeup solvent have a significant effect upon coal conversion. However, the use of a good startup solvent does not sustain good process performance under unfavorable process conditions and vice versa. G.R.

A78-26578 Products from two-step coal liquefaction using three different first-step reactor packings. C. Karr, Jr., W. T. Abel, and J. R. Comberlati (U.S. Department of Energy, Morgantown Energy Research Center, Morgantown, W. Va.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 19-44. 14 refs.

The results of a series of runs, with a laboratory-scale stirred batch reactor system, and a laboratory-scale continuous flow reactor system, designed to approximate the behavior of a two-step coal hydroliquefaction process, are presented. The results of detailed chemical and physical characterization of the products obtained with a slurry of coal and catalytically hydrogenated tar oil (representing recycle oil), using either vitrified ceramic, alpha-alumina, or silica for a nominally non-catalytic first-step reactor packing, are presented. The results of detailed characterization of the products obtained by catalytic hydrogenation of the filtered first-step product in a second-step reactor are presented, and the effects of the different second-step reactor feeds on the activity of the catalyst are described. Probable mechanisms for the functions of the first-step packing are described, as well as differences in the activity of the cobalt molybdate catalyst. (Author)

A78-26579 Effect of coal minerals on reaction rates during coal liquefaction. A. R. Tarrer, J. A. Guin, W. S. Pitts, J. P. Henley, J. W. Prather, and G. A. Styles (Auburn University, Auburn, Ala.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 45-61. 12 refs. Research supported by Auburn University and Alabama Mining Institute; NSF Grant No. 38701.

Four different types of experiments are reported, including catalyst screening, recycle of mineral residue, hydrogenation and hydrodesulfurization of demineralized coal, and hydrogenation and hydrodesulfurization using prehydrogenated solvent. It is found that

certain coal minerals, particularly pyrite, catalyze hydrogenation of coal-derived solvents such as creosote oil and solvent refined coal recycle solvent. The rate limiting step in liquefaction of coal is the transfer of hydrogen to donor solvent. The rate of liquefaction increases directly with the concentration of coal minerals. The physical state, as well as chemical composition, of the coal minerals affect hydrogenation and hydrodesulfurization activity during coal liquefaction. Coal mineral catalysis of hydrogenation and hydrodesulfurization reactions occurring in coal conversion processes may or may not be advantageous, depending on process objectives and on composition of the coal minerals. G.R.

A78-26580 Hydrogenation of phenanthrene over a commercial cobalt molybdenum sulfide catalyst under severe reaction conditions. C.-S. Huang, K.-C. Wang, and H. W. Haynes, Jr. (Mississippi University, University, Miss.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 63-78. 7 refs. NSF Grant No. AER-72-03562-A02.

The catalyst used in the reported investigation consisted of 12.5% MoO₃ and 3.5% Co₂O₃ supported on an alumina base. The surface area and total pore volume were 295 sq m/g and 0.55 cc/g respectively. A total of 18 yield periods was successfully completed in two series of experiments. As expected, the sharpest decline in catalyst activity was observed when the more severe operating conditions (1000 F, 1500-2500 psi) were examined. Large quantities of octahydrophenanthrene and perhydrophenanthrene isomers were observed in many of the products. With increasing temperatures the octahydrophenanthrenes are further hydrogenated to perhydrophenanthrenes until a maximum yield of approximately 62% perhydrophenanthrenes is reached at 750 F. Beyond this temperature the yield of perhydrophenanthrenes decreases as the thermodynamic equilibrium is shifted to favor the less saturated species. G.R.

A78-26581 New materials for coal liquefaction. R. B. Levy and J. A. Cusumano (Catalytica Associates, Inc., Palo Alto, Calif.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 79-87. 12 refs.

A description is presented of the general criteria for the selection of materials for coal liquefaction catalysis. In addition to their catalytical effectiveness prospective catalysts must be able to meet certain criteria regarding their thermal and chemical stability. By comparing free energies of formation, it is possible to make a qualitative evaluation of the relative stability of various compounds. Oxides are found to be the most stable compounds of the groups that are examined. One consequence of the stability trends is that most compounds are expected to be thermodynamically unstable in an oxidizing environment such as encountered in catalyst regeneration. The presence of H₂S poses the most severe problem. Compounds that resist sulfidation include a number of oxides, nitrides, borides, and silicides. G.R.

A78-26582 Deactivation and attrition of Co-Mo catalyst during H-Coal operations. C. C. Kang and E. S. Johanson (Hydrocarbon Research, Inc., Trenton, N.J.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 89-101. Research supported by the Electric Power Research Institute and ERDA.

The observed causes for the deactivation of the Co-Mo catalyst in the H-Coal process are related to sintering, metal deposition, and carbon deposition. The relative importance of these effects depends on the type of coal employed and the process conditions. In the H-Coal process, which has been under development for over ten years, coal is dried, pulverized, and slurried with coal-derived oil. The coal-oil slurry is charged continuously with hydrogen to a reactor containing a bed of catalyst wherein the coal is catalytically hydrogenated and converted to liquid and gaseous products. It is

found that the initial catalyst deactivation is caused by carbon deposition in the case of bituminous coal. Titanium deposition from the bituminous coal causes a gradual decline in catalyst activity. G.R.

A78-26583 Catalytic liquefaction of coal. Y. C. Fu and R. F. Batchelder (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 103-116.

High sulfur bituminous coal is liquefied and desulfurized by hydrotreating with syngas at 3,000 psi in the presence of added water, vehicle, and catalyst. Cobalt molybdate catalyst impregnated with alkali metal compounds, such as potassium carbonate, sodium carbonate, and potassium acetate exhibited good activities for liquefaction and desulfurization. High coal conversions and oil yields can be obtained in the temperature range of 400 to 450 C, and the asphaltene and the sulfur contents of the oil products are comparable to that obtained in coal liquefaction using pure hydrogen and cobalt molybdate under similar conditions. Further improvements in the oil quality could be attained under more severe conditions at 450 C and increased reaction time, but both syngas usage and hydrogen usage would increase substantially. Catalytic coal liquefaction using syngas gives an improved thermal efficiency and reduces the capital and operating costs by eliminating shift converters and purifying systems need for the liquefaction process using hydrogen. (Author)

A78-26584 Kinetics of coal hydrodesulfurization in a batch reactor. R. C. Koltz, R. M. Baldwin, R. L. Bain, J. O. Golden, and J. H. Gary (Colorado School of Mines, Golden, Colo.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 117-131. 18 refs. ERDA-supported research.

A utilization of high-sulfur coal as fuel requires an employment of special desulfurization techniques to maintain air quality standards. A kinetic model which represents the removal of the sulfur from the coal is developed. Experimental data for the model are obtained on the basis of a study in which bituminous coal from Kentucky is used. It is found that the percent desulfurization of coal is a function of both time and temperature. Increasing either of these variables within the range of the conditions considered will cause the conversion to increase. The reaction rate constant appears to be a variable of conversion as well as temperature. At low values of conversion the reaction rate constant shows a true Arrhenius temperature dependence. The value of the activation energy as calculated from the Arrhenius plot is 33.04 kcal/mole. G.R.

A78-26585 Kinetics and solubility of hydrogen in coal liquefaction reactions. J. A. Guin, A. R. Tarrer, W. S. Pitts, and J. W. Prather (Auburn University, Auburn, Ala.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 133-151. 26 refs. NSF Grant No. 38701.

A78-26586 Short contact time coal liquefaction - Techniques and product distributions. D. D. Whitehurst and T. O. Mitchell (Mobil Research and Development Corp., Princeton, N.J.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 153-172. Research sponsored by the Mobil Research and Development Corp. and Electric Power Research Institute.

Initial results are reported on investigations of coal liquefaction by the solvent refined coal process. A description is given of the design and operation of a short contact time reactor in which reaction times as short as 15 seconds can be achieved. The details of several runs and early key findings are given. Coal dissolution is very fast and requires very little hydrogen consumption. The presence of H₂ gas in the early stages of conversion is not critical, but a good H-donor solvent must be present. Sulfur and oxygen are removed in a

kinetically-parallel fashion. About 40% of each may be removed readily and rapidly with little or no H-consumption; thereafter, considerably more hydrogen is consumed than the stoichiometry requires for the production of H₂S and H₂O. The initial products of coal dissolution contain significant amounts of high molecular weight material which is rapidly converted to low molecular weight products. The highest SRC yield is obtained early in the reaction process; improvement of SRC quality is accompanied by a decrease in yield and a large increase in hydrogen consumption. (Author)

A78-26587 Coagulation and filtration of solids from liquefied coal of SYNTHOIL process. J. O. H. Newman, S. Akhtar, and P. M. Yavorsky (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 183-200. 10 refs.

A78-26588 Filterability of a coal-derived liquid. M. Weintraub, M. J. Weiss, S. Akhtar, and P. M. Yavorsky (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 201-220.

The separation of unliquefied coal and mineral matter, accompanying the coal, from the liquid stream which contains the product represents an important problem in all coal liquefaction processes. In the case of the SYNTHOIL process now being developed by ERDA, major advantages would be obtained if the solids removal process were improved. The reported investigation is concerned with the problem of improving product quality with centrifugation and with three approaches to filtration. Batch filtration is found to be a technically feasible method of removing ash from a SYNTHOIL product. The only remaining problem is the mechanics of scaled-up continuous filters. An improvement of the filtration process requires further studies related to particle size distribution, cake compressibility, and the effects of the observed non-Newtonian flow characteristics. G.R.

A78-26589 Analyzing liquid products derived from coal conversion processes. J. E. Dooley and C. J. Thompson (U.S. Department of Energy, Bartlesville Energy Research Center, Bartlesville, Okla.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 221-231. 18 refs.

Coal derived liquids were characterized by means of separation techniques such as distillation, gradient elution chromatography, acid and base extractions, and gel permeation chromatography (GPC) followed by instrumental analyses such as mass spectrometry and nuclear magnetic resonance spectrometry. Samples from the COED and SYNTHOIL liquefaction processes were studied. Results show liquids are amenable to the characterization procedure and provide basic data that should be useful in formulating refining processes for these materials. The procedure provides considerable detail in the analysis and relates chain carbons, naphthenic ring carbons, and aromatic ring carbons to established GPC-mass spectral correlations. (Author)

A78-26590 Separation of coal liquids from major liquefaction processes to meaningful fractions. I. Schwager and T. F. Yen (Southern California, University, Los Angeles, Calif.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 233-243. 12 refs. Contract No. E(49-18)-2031.

A preliminary examination of coal liquefaction products from four different coal liquefaction processes is conducted. Each coal liquid is separated into five different fractions by solvent fractionation. Total recoveries ranging from 93 to 97% by weight are obtained. The solvent fractions include oil, resin, asphaltene,

carbene, and carboid. Solvent elution chromatography with silica gel is utilized to separate the asphaltene fraction into two fractions of different polarities. Unlike the asphaltene separation method described by Sternberg et al. (1975), which introduces chlorine chemically into at least one of the separated components, the current method does not chemically alter the asphaltenes. The compositions of the starting coal liquids and the various solvent fractions are shown in a number of tables. G.R.

A78-26591 High pressure liquid chromatographic studies of coal liquefaction kinetics. J. W. Prather, A. R. Tarrer, J. A. Guin, D. R. Johnson, and W. C. Neely (Auburn University, Auburn, Ala.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 245-253. 10 refs. Research supported by Auburn University and Alabama Mining Institute; NSF Grant No. 38701.

High pressure liquid chromatography (HPLC) provides a relatively simple analytical method for analysis of the complex organic mixtures found in coal liquefaction processes. This technique offers the advantage that preparatory scale work is accomplished with relative ease allowing for positive identification of the various components by other methods, e.g., infrared and ultraviolet spectroscopy. The feasibility of using HPLC to characterize solvents used in the Solvent Refined Coal (SRC) process is reported. The effects of catalytic agents - namely, a commercial Co-Mo-Al catalyst; a coal mineral, iron pyrite; coal ash; and actual mineral residue from an SRC process on twelve constituents of a coal derived solvent, creosote oil - is monitored using HPLC. (Author)

A78-26592 A petrographic classification of solid residues derived from the hydrogenation of bituminous coals. G. D. Mitchell, A. Davis, and W. Spackman (Pennsylvania State University, University Park, Pa.). In: Liquid fuels from coal; Proceedings of the Symposium, San Francisco, Calif., August 29-September 3, 1976. New York, Academic Press, Inc., 1977, p. 255-270. 10 refs. Research supported by the Electric Power Research Institute and NSF.

A78-26614 Response of a solar cell partially illuminated by a nonuniform light source. M. K. Mukherjee and A. K. Das (Jadavpur University, Calcutta, India). *International Journal of Electronics*, vol. 44, Feb. 1978, p. 137-143. 9 refs.

The response of a solar cell with an incident light beam having a non-uniform intensity distribution is theoretically analysed. From the solution of the two-dimensional diffusion equation, the photo-generated carrier density in the illuminated zone is obtained, and the corresponding short-circuit current is estimated. Theoretical curves for current versus width of the exposer of the beam for different values of the thickness of the skin layer of the cell are plotted. This paper also presents an experimental procedure for measuring the response characteristics of the solar cell to a light beam having a non-uniform intensity distribution. A He-Ne laser beam is used as the source of light. Experiments are carried out and the results are compared with the theoretical curves. Results show a somewhat quantitative agreement with the theory. (Author)

A78-26616 On the theory of homojunction and heterojunction solar cells. M. A. Melehy (Connecticut, University, Storrs, Conn.). *International Journal of Electronics*, vol. 44, Feb. 1978, p. 211-217. 10 refs.

The existing theories of solar cells are mostly extensions of some p-n junction theories which were developed assuming dark conditions. Here we present a new physical solar-cell theory which considers the photon-generated carriers in the base region. By a novel, general thermodynamic method, we determine the interaction of this process with the transport of minority carriers in the base region and the carrier diffusion and drift at the junction in a homostructure, or a heterostructure. The consequent theoretical V-I equation has been found to be accurately in agreement with experiment for silicon homojunction solar cells. (Author)

A78-26622 # Electrical and thermal instabilities and their suppression in thermally equilibrium MHD plasma. Y. Ozawa, N. Kayukawa, T. Kon, S. Yatsu, and Y. Aoki. *Hokkaido University, Faculty of Engineering, Bulletin*, Feb. 1978, p. 91-101. 5 refs. In Japanese, with abstract in English.

Transition processes from the diffuse discharge to the constricted and/or filamentary arc discharge were analyzed for the MHD plasma-electrode contact region. The variational analysis for such an instability problem was successfully carried out. It was clarified that Hall's effect was one of the most influential parameters giving rise to the occurrence of the electrothermal instability. It was also concluded that by use of the spatially nonuniform magnetic field, which declines sharply within the hydrodynamical boundary layer was most effective in order to suppress the instability. (Author)

A78-26624 # Measurement of a theta-pinch plasma by holographic interferometry. Y. Ozawa, T. Enoto, Y. Yasutomo, S.-I. Himeno, K. Miyata, and M. Tanjo. *Hokkaido University, Faculty of Engineering, Bulletin*, Feb. 1978, p. 161-172. 12 refs. In Japanese, with abstract in English.

Holographic interferometry is a plasma diagnostic technique with good spatial-time resolving power. The paper considers side-on holographic interferometry applied to a two-coil mirror-type theta pinch plasma. Multicoil magnetic probes are used to measure magnetic field distribution. It is found that electron density at the mirror field midplane is very high. This is caused by injecting the plasma from the theta pinch coils, and confining it by the mirror field. S.C.S.

A78-26705 Ionic thermoelectric power of superionic conductors. M. Kobayashi and Y. Yamada (Niigata University, Niigata, Japan). *Physical Society of Japan, Journal*, vol. 44, Jan. 1978, p. 259-262. 11 refs.

The ionic thermoelectric power of a superionic conductor is calculated using a lattice gas model in one dimension for the case where the lattice sites are 50% occupied. The calculated thermoelectric power is inversely proportional to the absolute temperature and the activation energy for ionic conduction is equal to the heat of transport. The results explain experiments fairly good. (Author)

A78-26708 Damping of radial oscillation of a toroidal pinch plasma. M. Mimura and K.-I. Hirano (Nagoya University, Nagoya, Japan). *Physical Society of Japan, Journal*, vol. 44, Jan. 1978, p. 309-313. 7 refs.

Damping of radial oscillation of a pinch is studied in a toroidal pinch machine, STP-2, in which no endloss of plasma exists. The plasma density is varied from 2×10 to the 15th to 1×10 to the 16th/cu cm, and the temperature from 5 to 30 eV. The oscillation is measured by a diamagnetic loop and the electron temperature by laser scattering. Observed damping time agrees with the MHD calculation in which resistive damping at low temperature and ion viscous damping at high temperature are important. (Author)

A78-26717 The operation of the semiconductor-insulator-semiconductor (SIS) solar cell - Theory. J. Shewchun (Brown University, Providence, R.I.), J. Dubow (Colorado State University, Fort Collins, Colo.), A. Myszkowski, and R. Singh (McMaster University, Hamilton, Ontario, Canada). *Journal of Applied Physics*, vol. 49, Feb. 1978, p. 855-864. 62 refs. Contract No. E(04-3)-1203.

Recently 12% efficient indium tin oxide (ITO) on silicon solar cells have been reported. Experiments indicate the presence of a thin interfacial insulating layer. Thus, these devices appear to belong to a class of semiconductor-insulator-semiconductor (SIS) solar cells where one of the semiconductors is a degenerate wide-band-gap oxide. An applicable theory is developed in terms of a minority-carrier tunnel current transport through the interfacial layer where one semiconductor is in a nonequilibrium mode. The wide-band-gap semiconductor serves to block band-to-band majority-carrier current and thus give high performance. The effects of interfacial layer thickness, substrate doping level, surface states, interface charge, and

temperature on the performance of SIS solar cells have been calculated. These indicate that real-world ITO on silicon cells should be able to achieve 20% efficiency under AM1 illumination. (Author)

A78-26718 **Basic grain-boundary effects in polycrystalline heterostructure solar cells.** L. M. Fraas (Hughes Research Laboratories, Malibu, Calif.). *Journal of Applied Physics*, vol. 49, Feb. 1978, p. 871-875. 16 refs. Contract No. E(29-2)-3717.

A qualitative model describing grain-boundary effects in polycrystalline heterostructure solar cells is presented. Two salient observations of the model are (1) that an accumulated grain boundary in the light-absorbing layer can produce a surface field that serves to reduce grain-boundary recombination and increase device short-circuit current and (2) that the grain boundary in either the window layer or absorber layer should be depleted so as to avoid high device tunneling currents. Avoiding high tunneling currents leads to high device open-circuit voltages. The model describes additional electrical effects and suggests means of controlling and characterizing grain-boundary types. (Author)

A78-26823 **Space industrialization - Redefining the world.** D. McHugh (New York, Polytechnic Institute, Brooklyn, N.Y.). *Polytechnic Engineer*, vol. 18, Nov. 1977, p. 6-17. 33 refs.

Space industrialization has been defined as the use of the properties of the space environment (such as wide overview, high vacuum, variable gravity, intensive energy, or the use of materials from extraterrestrial bodies, like the moon) to produce unique products or services which corporations, governments, or individuals will pay for. Attention is given to geosynchronous satellite solar power stations, large public service platforms in space, biology-related advances possible on the basis of new space processing techniques, the development of a new materials science under space conditions, the employment of lunar material for the building of space-based structures, the construction of cylinder colonies in space, advantages and possibilities of asteroid mining, general aspects of space colonization, fusion research in space, and the creation of highly mobile habitats capable of reaching and operation around the furthest planets. G.R.

A78-26826 **Orbital power generation.** R. J. Levinson. *Polytechnic Engineer*, vol. 18, Nov. 1977, p. 48-52.

The Space Solar Power Station (SSPS) concept may possibly provide a solution to the energy crisis for the late twentieth and early twenty-first centuries. Generating approximately 5,000 million watts of electric power, the SSPS would beam this energy via microwave radiation to a ground based amplifying and receiving station for subsequent distribution to industry and homes. The types of powersats, as SSPS's are commonly called, are discussed, taking into account photovoltaic systems, the Brayton cycle with its helium/xenon working fluid, and the conversion of direct current into microwave energy with the aid of an amplatron. Attention is given to the use of the Heavy Lift Launch Vehicle (HLLV) for lifting the required materials into orbit, the development of a second generation space shuttle with a payload capacity similar to that of the HLLV, and the use of a nuclear tug to loft SSPS's into geosynchronous orbit. G.R.

A78-26950 **School and factory installations demonstrate solar energy in US northeast.** G. P. Hellhake and M. Van Horn (General Electric Co., Fairfield, Conn.). *Energy International*, vol. 15, Mar. 1978, p. 21-24.

A description is presented of an experimental solar heating system which was installed at a high school in Dorchester, Massachusetts. The system was designed to supply heat for a 1959 sq m two story section of the school. The solar system contains 144 flat plate panels, each measuring 1.22 by 2.44 m. The panels were mounted facing south at a 45 deg angle on the roof of the school building. The major part of the solar heating experiment was conducted during the 1974-5 heating season. The experiment proved conclusively that

solar heating is effective and feasible in the northeastern U.S. Another solar heating project reported involved the installation of solar panels with an area of approximately 456 sq m on the roof of a building of a U.S. aerospace company. This system provides heat and hot water for the plant's 1860 sq m cafeteria and kitchen complex. A third solar heating project discussed is related to a heating, cooling, and domestic hot water system for a newly constructed Environmental Education Center located in Lord Sterling Park, New Jersey. G.R.

A78-26967 **Solar biomass energy - An overview of U.S. potential.** C. C. Burwell (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Science*, vol. 199, Mar. 10, 1978, p. 1041-1048. 41 refs.

The article reviews the U.S. potential for using solar biomass energy, noting individual land use projects in terms of potential contributions to biomass fuel. These include cropland and forest land production, urban areas, noncommercial forests, pastures and ranges, and idle cropland. Estimates are made for gross and collectible net energy yields. The concept of intensive tree farming and the role of specialty crops in energy production are discussed. Current agricultural markets for cropland production are identified, and consideration is given to exports and livestock production. Various environmental considerations relating to the production and use of biomass energy are outlined such as stream pollution, loss of productive lands, and atmospheric pollution. Possibilities for increasing photosynthesis efficiency are proposed. S.C.S.

A78-27096 # **Indices and areas of application of gas-turbine-driven thermal power plants (Pokazateli i oblasti primeneniia gazoturbinnnykh TETs).** B. V. Sazonov, L. N. Albul, and T. A. Nikolaeva (Moskovskii Energeticheskii Institut, Moscow, USSR). *Teploenergetika*, Jan. 1978, p. 12-16. In Russian.

In the present paper, the operational and performance characteristics of gas-turbine-driven thermal power plants are analyzed, and the savings in fuel consumption relative to conventional steam power plants are calculated. It is shown that gas-turbine-driven plants retain their cost effectiveness even at low thermal loads (40 to 500 Gcal/hr). This extends considerably the range of applicability of gas-turbine-driven plants, since steam-turbine-driven plants are cost effective only at thermal loads above 500 Gcal/hr, and at the same time provides appreciable savings in fuel and cost. V.P.

A78-27127 # **Conditions for the constricted discharge at electrodes in a combustion product plasma (Ob usloviakh priekletroodnoi kontraktsii razriada v plazme produktov sgoraniia).** A. M. Virnik, N. M. Zykova, T. S. Kupakina, and E. V. Mel'nikov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Nov.-Dec. 1977, p. 1148-1151. 12 refs. In Russian.

The experiments described were carried out to study the processes occurring at the electrodes of an MHD power generator during the transition from a diffuse to a constricted discharge. The tests were performed with laboratory equipments simulating a combustion product plasma in a space charge layer (flow temperature of 2600 K, conductivity of 1.5 to 9 mho/m). The threshold current density of a diffuse discharge is plotted against the anode temperature and the plasma conductivity. V.P.

A78-27133 # **Calculation of electron heating in a non-equilibrium MHD channel (O raschete nagreva elektronov v kanale neravnovesnogo MGD-generatora).** N. A. Krushilin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Nov.-Dec. 1977, p. 1262-1268. 21 refs. In Russian.

In the present paper, available theoretical and experimental data on the properties of discharges in a strong magnetic field are used as a basis to arrive at certain conclusions concerning the calculation of the electron temperature in the channel of a Faraday MHD generator of nonuniform conductivity. It is shown that to calculate Joule dissipation in the channel; it is imperative to take into consideration

such experimentally observed phenomena as ionization turbulence and the presence of a mean Hall current. V.P.

A78-27136 # Investigation of the temperature dependence of the electrical conductivity of the working fluid of large MHD generators (Issledovanie temperaturnoi zavisimosti elektroprovodnosti rabocheho tela krupnykh MGD-generatorov). N. A. Balashov, I. A. Vasil'eva, I. M. Gaponov, G. P. Maliuzhonok, A. P. Nefedov, V. B. Novosadov, F. M. Oberman, L. P. Poberezhskii, and E. M. Shelkov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Nov.-Dec. 1977, p. 1284-1293. 15 refs. In Russian.

The paper deals with the results of a joint Soviet-American experiment which was carried out to measure the dependence of the electrical conductivity of the plasma of an open-cycle MHD generator on the temperature, the plasma pressure, the degree of oxygen enrichment, and the amount of ionizable addition. The U-25 and the AVCO Mark VI facilities employed in the experiments are described, along with the respective procedures. An approximate expression is derived which does not require a computer to calculate the electron density, electron mobility, and the electrical conductivity of the combustion-product plasma over the entire range of working-fluid parameters. V.P.

A78-27137 # The formation of electrode arcs and the electric fluctuations in an MHD channel (Voznikovenie mezhelektroodnykh dug i elektricheskii fluktuatsii v MGD-kanale). V. I. Kovbasiuk, N. N. Baranov, A. D. Iserov, and I. I. Klimovskii (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Nov.-Dec. 1977, p. 1294-1302. 21 refs. In Russian.

In the experiments described, the conditions leading to the onset of Hall (electrode) arcs in diagonal MHD channels were studied by recording and analyzing the fluctuations of the electrode potentials. The experiments were carried out with the U-25 facility, employing induced electric fields. It is shown that the onset of Hall arcs (breakdowns) in an induced electric field is accompanied by the onset of high-frequency (on the order of 100 kHz) noise in the spectrum of electrode voltage fluctuations, and that the moment of onset of Hall arcs depends strongly on the Faraday currents to the electrodes and on the magnetic field induction. V.P.

A78-27140 # Effectiveness of using a pulsed Faraday MHD generator in combination with a thermonuclear reactor (K voprosu ob effektivnosti impul'snogo Faradeevskogo MGD-generatora v skhema s termoiadernym reaktorom). V. V. Breev, V. P. Panchenko, and V. V. Chernukha (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Nov.-Dec. 1977, p. 1321-1323. In Russian.

The plasma-generating energy storage system examined in the present paper is composed of a pulsed MHD power generator and a pulsed thermonuclear reactor. The system is quasi-stationary in the sense that its parameters vary in time. The problem of defining the optimal configuration of the MHD channel and the optimal mode of operation is discussed, evaluating the efficiency of the system in terms of the ratio of the electric energy generated to the thermal energy of the source. The pressure, total temperature, current voltage characteristic, and effective conductance at the channel inlet are plotted vs time. It is shown that for operation at an active load the system efficiency may approach 30 percent. V.P.

A78-27171 Prototype testing of a rotary current train in the Berlin transit system (Betriebsprobung des Drehstromzuges der Berliner Verkehrs-Betriebe /BVG/). G. Ciessow and G. Steller (Berliner Verkehrs-Betriebe, Berlin, West Germany). *AEG-Telefunken, Technische Mitteilungen*, vol. 67, no. 7, 1977, p. 311-316. 7 refs. In German. Bundesministerium für Forschung und Technologie Contract No. TV-7629-B.

A German government sponsored program to test a rotary current locomotive in an actual-use situation is underway in Berlin.

Measurements of the train's operating characteristics are presented, with attention to their usefulness in developing a large-scale production series. Among the factors measured are: speed, acceleration, rate of energy use (30% less than with previous types of locomotives), amount of friction with the rails, degree of protection against sliding, and degree of system interference with the electrical current used to operate the train. In addition, a schematic of the electrical system is presented. D.M.W.

A78-27442 # Space solar power stations (Problemy solnechnykh kosmicheskikh elektrostantsii). V. A. Vanke, V. M. Lopukhin, and V. L. Savvin (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Uspekhi Fizicheskikh Nauk*, vol. 123, Dec. 1977, p. 633-655. 91 refs. In Russian.

The paper surveys the current status of studies on solar power stations in geosynchronous orbit, which would convert solar energy into electric power and transmit it to earth by microwave. Basic schemes for such a system are presented, economic estimates are made, and the prospects for developing orbiting solar power stations are discussed. P.T.H.

A78-27475 Future automotive fuels: Prospects, performance, perspective. Edited by J. M. Colucci and N. E. Gallopoulos (GM Research Laboratories, Warren, Mich.). New York, Plenum Press, 1977. 388 p. \$39.50.

Attention is given to the future demand for automotive fuels, the U.S. energy outlook through 1990, aspects of energy conservation and fuel-vehicle optimization, and opportunity for maximizing transportation energy conservation, the matching of future automotive fuels and engines for optimum energy efficiency, coal as a source of automotive fuels, motor fuels from oil shale, and the influence of nuclear energy on transportation fuels. The automotive utilization of intermediate-term future fuels is discussed, taking into account the characteristics of conventional fuels from nonpetroleum sources, the application of a new combustion analysis method in the study of alternate fuel combustion and emission characteristics, engine performance and exhaust emission characteristics of a methanol-fueled automobile, the combustion of methanol in an automotive gas turbine, and alternative fuels for automotive diesel engines. Hydrogen as a reciprocating engine fuel is considered in connection with an evaluation of long-term future fuels. The use of hydronitrogens, such as hydrazine and ammonia, as future automotive fuels is also discussed. G.R.

A78-27545 # Information system for transportation energy. V. Kouskoulas (Purdue University, Lafayette, Ind.), R. E. Goodson (Purdue University, West Lafayette, Ind.), and J. L. Staley. *ASCE, Transportation Engineering Journal*, vol. 103, Sept. 1977, p. 635-650. 16 refs.

Policy makers must often base their decision concerning complex issues of energy and transportation on incomplete information because the time available to them is not sufficient for a full utilization of the pertinent data in the form in which they are provided by the current information systems. It has, therefore, been suggested that a computerized interactive information system should be established. The reported investigation is concerned with the development of such a system. The system developed is distinguished from earlier mathematical models of aspects of transportation and energy by its informative character and simplicity. The model is utilized in predicting future energy and transportation trends on the basis of reasonable socioeconomic and technological upper or lower bounds. G.R.

A78-27550 # Biogasification using NaOH treated pig faeces. M. F. Ngian, S. H. Lin, G. R. Pearce (Melbourne, University, Parkville, Victoria, Australia), and K. F. Ngian. *American Society of Civil Engineers, Environmental Engineering Division, Journal*, vol. 103, Dec. 1977, p. 1131-1133. 5 refs.

Pig feces treated with various amounts of sodium hydroxide were used together with a rumen liquor inoculum in an anaerobic digester; methane and carbon dioxide production were monitored.

Sodium hydroxide treatments of 7 to 9% of feces dry weight resulted in increases of 33 and 30% in the volume of gas produced by the digester. The percentage of carbon dioxide in the gas products was 64%. J.M.B.

A78-27579 The use and performance of graphite and metal ISSECs in tokamak fusion reactors. H. I. Avci, T. Y. Sung, G. L. Kulcinski, C. W. Maynard (Wisconsin, University, Madison, Wis.), and Y. Gohar (Wisconsin, University, Madison, Wis.; Argonne National Laboratory, Argonne, Ill.). *Nuclear Engineering and Design*, vol. 45, no. 2, Feb. 1978, p. 285-310. 90 refs.

The cost of electricity produced in fusion reactors of the UWMAK-I and UWMAK-II type would be significantly decreased by increasing the lifetime of the first wall of the reactor. This can be done by placing a passive shield, called Internal Spectral Shifter and Energy Converter (ISSEC), between the plasma and the first wall. In the reported investigation the ISSEC concept, which was first investigated by Kulcinski et al. (1975) and Sze (1975), is expanded to the area of high temperature refractory metals. A study is conducted of the effects in a more realistic cylindrical geometry blanket model, taking into account the effects of breeding tritium. It is found that ISSECs reduce the displacement damage in the first structural wall. Reduction factors vary between 2-5 for a 10 cm thick ISSEC, between 5-50 for a 25 cm thick spectral shifter. The gas production rates in the first structural wall are also reduced by ISSECs. G.R.

A78-27700 Controlled nuclear fusion, a challenge to the engineer. II - Systems for fuel supply and fuel removal, plasma heating, and vacuum generation (Kontrollierte Kernfusion, eine Herausforderung an den Ingenieur. II - Systeme zur Brennstoffzufuhr und Brennstoffabfuhr, zur Plasmaheizung und zur Vakuumherzeugung). H. Frey (Deutsches Kunststoff-Institut, Darmstadt, West Germany). *VDI-Z*, vol. 120, no. 4, Feb. 1978, p. 161-167. 6 refs. In German.

The principles of operation for a tokamak fusion reactor and its current state of development are considered, taking into account the injection of neutral particles in the European fusion experiment JET, a tokamak test reactor with 12 injection systems in the U.S., the use of ion beams, the supply of pellets, and problems which have to be solved to remove the burnt fuel. Problems concerning the development laser fusion reactors are also examined. It appears that new high-performance laser systems with a power of 1000 TW must be developed. The power of current laser systems is limited to 1 TW. Difficulties regarding the design of a suitable system for the generation of a vacuum in fusion reactors are partly related to the necessity to avoid an introduction of impurities. The design of a vacuum pump for the JET experiment is shown. Liquid helium and liquid nitrogen are used for cooling. G.R.

A78-27725 Energy balance sheets and electricity-fuel equivalences concerning OECD reports (Bilans énergétiques et équivalences électricité-combustibles - A propos des bilans de l'OCDE). J.-R. Frisch and J. Lacoste (Electricité de France, Paris, France). *Revue de l'Energie*, vol. 29, Jan. 1978, p. 5-12. In French.

Based on studies made by the Organization for Economic Cooperation and Development (OECD) a simplified energy scheme is proposed. It traces the production of energy from primary energy, the transformation into secondary energy, distribution, and to actual use. This scheme is further applied in specific cases including water, geothermal, uranium, carbon, natural gas, and petroleum resources. Error sources in the OECD system are discussed including problems in system logic, theoretical errors, and actual errors encountered in experiments. A comparison is made between the conventional and OECD methods for determining energy equivalences and it is found that the conventional system is simpler, more realistic, and more representative of actual energy equivalences. S.C.S.

A78-27745 An investigation of coal solubility in anthracene oils. G. O. Davies, F. J. Derbyshire, and R. Price (Coal Research Establishment, Stoke Orchard, England). *Institute of Fuel, Journal*, vol. 50, Sept. 1977, p. 121-126. 14 refs.

Anthracene oil, a coal-tar fraction boiling from about 200 C upwards, has been widely used as an effective solvent for coal. The solubility of a low-rank coal has been measured in distillate fractions of an anthracene oil and in equivalent fractions of hydrogenated oil. The coal solubility in the lower-boiling (below 340 C) fractions of fresh anthracene oil varied appreciably (40-83%) and was related to its solubility in the principal component present in the particular fraction. The higher-boiling fractions, rich in polynuclear aromatics, were better and more consistent solvents (76-87%). All the fractions of the hydrogenated oil were superior coal solvents to those from fresh oil with coal solubilities of about 90%. This is believed to be due to the fact that high concentrations of hydroaromatic compounds are present, which assist liquefaction by a hydrogen-donor mechanism. Preliminary results have shown that the high-boiling distillates from the products of coal-extract hydrogenation are also good solvents with coal solubilities in the range 81-91%. (Author)

A78-27776 World Energy Conference, 10th, Istanbul, Turkey, September 19-23, 1977, Proceedings (Conférence Mondiale de l'Energie, 10th, Istanbul, Turkey, September 19-23, 1977, Proceedings.) *Revue de l'Energie*, vol. 28, Aug.-Sept. 1977. 218 p. In French and English.

A series of articles concerning perspectives for energy production is presented. Several aspects of developing national and international energy policies are outlined, with reference to Europe, U.S., Japan, USSR, India, and Algeria. Prospects for developing new energy sources from oil shale, heavy oil, petroleum reserves, deep sea oil, coal gasification, heat pumps, and natural photosynthesis are reviewed. S.C.S.

A78-27777 A European energy policy - Distant mirage or tomorrow's reality. H. Simonet (Communautés Européennes, Conseil des Ministres des Communautés Européennes, Brussels, Belgium). (Conférence Mondiale de l'Energie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.) *Revue de l'Energie*, vol. 28, Aug.-Sept. 1977, p. Sp. 15-Sp. 22. In English and French.

It is suggested that many misconceptions concerning present day energy resources exist. An assessment is made of the achievements and shortcomings of European energy conferences and the policies adopted, noting negotiating positions, plans for developing nuclear energy, financing energy investments, energy conservation programs, and legal measures concerning the development of standards. General proposals are made regarding future plans and goals. S.C.S.

A78-27778 Options of long-term energy strategy of Japan. M. Sakisaka (National Institute for Research Advancement, Japan). (Conférence Mondiale de l'Energie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.) *Revue de l'Energie*, vol. 28, Aug.-Sept. 1977, p. Sp. 27-Sp. 39. In English and French.

It is estimated that energy consumption in Japan will triple by the year 2000, and that by 1985 and 2000, energy conservation will reach 10 percent and 15 percent, respectively. Various means for ensuring an adequate supply of energy are proposed, noting the development of domestic resources, nuclear power generation, and the diversification of imported natural resources. Proposals for the development of nuclear energy are outlined, suggesting that capacity may reach 300 million kW by 2000. It is felt that the diversification of imported energy sources should center around the increased use of both coal and liquefied gas, and that economic and technical cooperation with oil-producing nations should be strengthened. S.C.S.

A78-27779 A few aspects of the Soviet energy policy. M. Grenon. (Conférence Mondiale de l'Energie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.) *Revue de l'Energie*, vol. 28, Aug.-Sept. 1977, p. Sp. 40-Sp. 49. In English and French.

Various aspects of the energy policy in the USSR are discussed, noting that 80 percent of Soviet energy resources are located about 3,500 km from the centers of consumption. Coal reserves are

outlined with reference to the locations of the major basins. These basins are subdivided into those having primarily underground mining operations, and those which may be strip mined. Soviet petroleum resources are reviewed in terms of drilling depths, the recovery of low-gravity oils, and off-shore drilling. S.C.S.

A78-27780 Scope for energy substitution policy in India. K. S. Parikh (International Institute for Applied Systems Analysis, Laxenburg, Austria). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 50-Sp. 57. In English and French.

Demographic and economic projections are made for the Indian population, urban population, national income, and national income growth rates for the 1978-2000 period. Based on these assumptions, estimates are made for industrial production and overall fuel requirements, noting individually coal, oil, electricity, firewood, animal wastes, and agricultural wastes. Possible substitutes for oil products are proposed, and it is felt that most such substitutions are most applicable to the transport sector. S.C.S.

A78-27781 A few aspects of the energy policy in Algeria. M. A. Keramane (Société Nationale de l'Électricité et du Gaz, Algeria). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 58-Sp. 77. In English and French.

Various aspects of the energy policy in Algeria are discussed. General guidelines are proposed for the recovery of natural resources, the development of crude oil production and refinery, the distribution of gas and petroleum, and the implementation of training programs. Energy programs undertaken in the 1967-1976 period are reviewed in detail for both the gas and electric power sectors. Prospects for energy development for the 1978-1985 period are suggested, including a forecast of the national energy balance, the major developments to be implemented, and prospects for producing nuclear and solar energy on a wide-scale basis. S.C.S.

A78-27782 The search for a reasonable world energy policy - Some basic considerations and options. A. A. Attiga (Organisation des Pays Arabes Exportateurs de Pétrole, Kuwait). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 78-Sp. 86. In English and French.

General observations are made concerning the direct cooperation between oil exporting and importing countries, and the formulation of medium and long-term energy policies on national and international scales. Consideration is given to the position of the oil exporters with reference to the depletion of hydrocarbons and the necessity to reduce their heavy dependence on the export of crude oil. It is suggested that the main factors to be considered in medium and long-range planning are: (1) the diversification of energy supplies, (2) the conservation of oil and gas, (3) pricing oil and gas on the basis of the cost of replacing supplies by other energy sources, and (4) the diversification of the economies of oil exporting countries. S.C.S.

A78-27783 The risks of energy shortage in the world level. P. Ailleret. (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 89-Sp. 102. In English and French.

Without considering political factors, the risks associated with the world-wide depletion of natural resources, primarily petroleum and gas, are discussed. Prospects for the wide-scale development of alternative energy sources are reviewed, noting wind, solar, and biomass energy. Various energy conservation techniques are suggested, including combined electricity-heating power stations and revised standards for automobile construction. General assumptions are made for future energy requirements and potential substitutions for petroleum (by coal or nuclear energy) are suggested. S.C.S.

A78-27784 Oil shale - Its time has come. T. F. Bradshaw (Atlantic Richfield Co., Los Angeles, Calif.). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 106-Sp. 115. In English and French.

Shale oil is considered a potential wide-scale alternative to conventional petroleum and natural gas reserves. Over half of the world's known oil shale reserves are located in the U.S., and it is estimated that a developed shale industry could produce about 12 percent of the current U.S. demand. Various techniques for extracting oil from shale are currently available, and it is noted that valuable by-products may also be yielded, including ammonia, sulfur, and coke. Environmental concerns associated with the development of oil shale have been identified, along with the projected socio-economic impact on the regions surrounding the oil shale reserves. The restraints to the commercial development of oil shale include rising development costs and governmental regulations. S.C.S.

A78-27785 The Syncrude Project and the future of heavy oil development. W. N. Sande (Syncrude Canada, Ltd., Edmonton, Alberta, Canada). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 116-Sp. 130. In English and French.

This article summarizes the history of the tar sands, describes the geology in general terms, describes the Syncrude Project from its inception and portrays the magnitude of the Project so that the reader will appreciate the problems associated with large scale tar sand recovery programs. With this background, the future of tar sand development, both mining and in-situ, is discussed. (Author)

A78-27786 Improving production from petroleum reserves - Enhanced recovery. L. Sajus (Institut Français du Pétrole, Rueil-Malmaison, Hauts-de-Seine, France). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 131-Sp. 148. In English and French.

The diversity of the nature of liquid hydrocarbon reserves necessitates the consideration of various methods for enhanced production. Major enhanced recovery techniques are water flooding (with several possible variants), gas injection, and thermal processes (such as steam stimulation, steam flooding, and in situ combustion). Each of these enhanced recovery techniques is applicable to certain types of oil fields, and procedures for choosing the best method have been established. This choice depends on considering the prevailing conditions, ascertaining a figure for the recovery rate, performing full-scale testing, and examining numerical models for anticipated production. General forecasts for the implementation of enhanced recovery techniques have been proposed. S.C.S.

A78-27787 Deep sea oil - Myth, reality of today, or future necessity. G. Rutman and F. Bernard (Société Nationale ELF-Aquitaine, France). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 149-Sp. 161. In English and French.

General predictions are made for crude oil requirements in the 1978-1985 period. The price structure for petroleum products is outlined in terms of supply, refining, and distribution costs. The anticipated distribution of recoverable reserves is reviewed noting onshore, offshore (0-200 m) and far offshore (over 200 m) supplies. The development of exploratory wells in deep water from 1967-1977 is discussed with reference to the major types of oil areas found. The present status of petroleum location and production, i.e., drilling, refinery, transport, is described along with the prospects for deep sea oil to become a major source of energy. S.C.S.

A78-27788 The gasification of coal. P. Gaussens (Gaz de France, Paris, France). (*Conférence Mondiale de l'Énergie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Énergie*, vol. 28, Aug.-Sept. 1977, p. Sp. 162-Sp. 175. In English and French.

A technique for producing synthetic natural gases (SNG) from coal at maximum grid system pressures is proposed. The method

basically consists of: (1) adjusting the carbon-to-hydrogen weight ratio of the reacting mixture, (2) causing the major part of the coal's carbon to react with the hydrogen, and (3) eliminating impurities. The Lurgi process is the most common method for producing SNG from solid fuels, and several large plants utilizing Lurgi reactors are presently being developed. In addition, various second generation processes are in the pilot stage, and it is estimated that by 1995 approximately 30 industrial plants may be fully operational. Third generation processes for producing SNG from coal with the aid of nuclear heat are being considered along with the underground gasification of coal in situ at depths to 300 m. S.C.S.

A78-27789 A short summary of present applications and hopes for the development of heat pumps in France. A. Robin (Electricité de France, Direction Générale, Paris, France). (*Conférence Mondiale de l'Energie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Energie*, vol. 28, Aug.-Sept. 1977, p. Sp. 176-Sp. 186. In English and French.

A78-27790 Energy resources offered by natural photosynthesis. E. Zedet. (*Conférence Mondiale de l'Energie, 10th, Istanbul, Turkey, Sept. 19-23, 1977.*) *Revue de l'Energie*, vol. 28, Aug.-Sept. 1977, p. Sp. 187-Sp. 201. In English and French.

A survey of energy resources available through natural photosynthesis is presented, noting wood, agricultural wastes, molasses, and household wastes. Techniques for treating the materials obtained from photosynthesis are discussed in detail, including those applicable to wood (combustion in air until incineration, pyrolysis) and the treatment of cellulose wastes from annual vegetation (methane fermentation, alcoholic fermentation). S.C.S.

A78-27801 Fuels from waste. Edited by L. L. Anderson (Utah, University, Salt Lake City, Utah) and D. A. Tillman (Materials Associates, Inc., Washington, D.C.). New York, Academic Press, Inc., 1977. 242 p. \$26.50.

Transformation of manure, agricultural crop wastes, urban refuse, sewage solids, industrial process wastes and logging and wood manufacturing residues to fuels is discussed; technologies considered include pyrolysis systems, fluidized-bed combustion, landfill gas extraction, anaerobic digestion and wood-waste liquefaction. Among the subjects of the papers are: a molten salt gasifier for production of low-Btu gas; hydrogasification of solid wastes; a mobile anaerobic digestion plant for methane production from feedlot residues; biomass conversion of aquatic and terrestrial plants; pyrolytic gasification of black liquors from the Kraft process; and fluidized-bed combustion of petrochemical wastes. J.M.B.

A78-27802 A wealth of waste - A shortage of energy. L. L. Anderson (Utah, University, Salt Lake City, Utah). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 1-16. 22 refs.

Organic wastes currently available for transformation to fuels in the U.S. are tabulated; attention is given to manure, agricultural crop wastes, urban refuse, sewage solids, industrial process wastes and logging and wood manufacturing residues. Heating values of the organic wastes, as well as the availability of large quantities of the waste materials in the vicinity of potential markets, determine the feasibility of the transformation to fuel. Advantages of using organic wastes for fuels include low pollutant levels resulting from the limited sulfur and ash contents of the wastes. J.M.B.

A78-27803 Energy from wastes - An overview of present technologies and programs. D. A. Tillman (Materials Associates, Inc., Washington, D.C.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 17-39. 11 refs.

Technologies for the conversion of municipal solid wastes to fuels are reviewed, with emphasis on liquid fuels production, production of substitute natural gas by thermal processing, fluidized-bed combustion, and landfill gas extraction. Mechanical beneficiation of municipal solid wastes, which yields cleaner solid fuels, also

figures in the review. In addition, attention is given to pyrolysis systems, including an installation which operates at a capacity of 200 tons per day with either as-received refuse or shredded, classified municipal solid wastes. Properties of the fuel gas produced by the pyrolysis systems are compared with those of methane and propane. J.M.B.

A78-27804 Production of low-Btu gas from wastes, using molten salts. S. J. Yosim and K. M. Barclay (Rockwell International Corp., Atomics International Div., Canoga Park, Calif.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 41-56.

A bench-scale molten salt gasifier has been employed for the production of low-Btu gas from materials such as rubber, sucrose, nitropropane, waste X-ray film, coal and fuel oil. The heating value of the product gas is found to decrease as the percentage of theoretical air in the materials decreases. In addition, the extraction of silver from waste X-ray film may accompany the low-Btu gas production process. J.M.B.

A78-27805 Pipeline gas from solid wastes by the Syngas recycling process. H. F. Feldmann, G. W. Felton, H. Nack (Battelle Columbus Laboratories, Columbus, Ohio), and J. Adlerstein (Syngas Recycling Corp., Toronto, Canada). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 57-72.

Hydrogasification of solid wastes is suggested as a simple and economical alternative to biological digestion for the production of synthetic fuel gas. A hydrogasification reactor under development preserves the recycle value of metal and glass, and is compatible with available gas purification and methanation technology. The methane production and gasification zones in the reactor are separated, thus ensuring that no methane is burned by the oxygen or reformed by the steam fed to the gasifier. Furthermore, short residence times required for the wastes make the reactor quite compact. J.M.B.

A78-27806 The nature of pyrolytic oil from municipal solid waste. K. W. Pober and H. F. Bauer (Occidental Research Corp., La Verne, Calif.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 73-85.

A pyrolysis process is under consideration for the production of synthetic fuel oils from organic solid wastes; the process involves near ambient pressure, no chemicals or catalysts, low capital investment, variability of temperature, and minimum feedstock pretreatment. Organic solid waste feedstocks tested in the pyrolytic fuel oil production system include animal wastes, rice hulls, fir bark, grass straw, and municipal solid wastes. The system, capable of delivering more than one barrel of pyrolytic oil per ton of as-received refuse, yields a low-sulfur, low-ash fuel oil which can be stored and transported. J.M.B.

A78-27807 The conversion of feedlot wastes into pipeline gas. F. T. Varani and J. J. Burford, Jr. (Bio-Gas of Colorado, Inc., Arvada, Colo.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 87-104. 11 refs.

An anaerobic digestion system for the production of methane from feedlot wastes is proposed for Colorado and other areas with large-scale animal husbandry operations. Eight potential sites in Colorado have been identified at which the amount of manure generated is sufficient to warrant a utility-scale methane facility; the manure is available at rates of two dollars per ton or less (\$0.615 to \$0.705 per million Btu), which makes it a cheaper fuel than coal. A mobile pilot plant capable of producing up to one thousand cu ft of methane per day is presently being demonstrated in the region. J.M.B.

A78-27808 Fuels and chemicals from crops. H. R. Bungay and R. F. Ward (U.S. Department of Energy, Div. of Solar Energy, Washington, D.C.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 105-120.

Biomass conversion processes designed to provide fuels and chemicals in the long term are discussed; conversion processes for

both aquatic and terrestrial plants are considered. Products of biomass conversion include synthesis gas, ammonia, methanol, formaldehyde, alcohols, aromatics, ethylene, heterocyclics, gum naval stores, and cellulose derivatives. Anaerobic digestion, pyrolysis, gasification, fermentation processes, and the production of hydrogen by biophotolysis are the chief processing methods applicable to biomass conversion. J.M.B.

A78-27809 The production of oil from wood waste. H. R. Appell (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 121-140. 14 refs.

Heavy oil or a bitumenlike material may be produced through processing of wood wastes with water, sodium carbonate and a gas rich in carbon monoxide at temperatures between 250 and 400 C and pressures of 1500 to 3500 psig. A pilot plant has been constructed to test this procedure on a commercial scale; the capacity of the plant is one ton of wood chips per day. The Btu content of oils and bitumens produced by the process is in the range of 13,000 to 17,000 Btu/lb, i.e., less than about 80% of the Btu content of a petroleum oil. J.M.B.

A78-27810 Fuels from wood waste. F. Shafizadeh (Montana University, Missoula, Mont.). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 141-159. 16 refs.

Thermal degradation of cellulose and hemicellulose to flammable volatile products and chars is discussed, with attention given to tar fractions, dehydration of sugar units, fission of sugar units and production of highly reactive carbonaceous residues. In particular, the pyrolysis products yielded by cellulose at 300 C under nitrogen, by cellulose and treated cellulose at 550 C, and by xylan and treated xylan at 500 C are tabulated. Heat contents of such fuels as Douglas fir lignin, larch, ponderosa pine, aspen, and Douglas fir bark are also analyzed. It is suggested that destructive distillation methods of wood residue treatment could be profitably replaced by fixed-bed pyrolysis or fluid-bed gasification to yield various types of fuel that are in demand. J.M.B.

A78-27811 Pyrolytic gasification of Kraft black liquors. K. T. Liu, E. P. Stambaugh, H. Nack, and J. H. Oxley (Battelle Columbus Laboratories, Columbus, Ohio). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 161-169. 7 refs.

Black liquors from the Kraft process presently provide the U.S. pulp and paper industry with about 0.675 quadrillion Btu/year of energy, mainly in the form of steam; increased energy extraction efficiency from the black liquors could be attained through application of a catalytic gasification process yielding fuel gas. Experimental trials indicate that hydrogen in concentrations greater than 85% may be obtained in the gas produced from pyrolytic gasification of black liquors to which caustic soda has been added. The black liquors appear to provide a better gasification feedstock than coal for the production of hydrogen. J.M.B.

A78-27812 Methanol production from organic waste. G. Haider (Utah University, Salt Lake City, Utah). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 171-193. 59 refs.

Methanol production from organic residues is reviewed, with attention given to the thermodynamics, kinetics and catalytic processes associated with the production, as well as to the economics of the high-, medium-, and low-pressure manufacturing techniques. For methanol synthesis from carbon monoxide and hydrogen, the effect of inlet gas composition on equilibrium methanol concentration in the effluent is analyzed, and side reactions are discussed. Reaction equilibria and side reactions are also investigated for methanol synthesis from carbon dioxide and hydrogen. Catalysts considered include zinc oxide, copper and chromium oxide. Selection of an appropriate pressure range for economical methanol manufacturing is generally dependent on the size of the plant. J.M.B.

A78-27813 Utilization of energy from organic wastes through fluidized-bed combustion. G. R. Smithson, Jr. (Battelle Columbus Laboratories, Columbus, Ohio). In: Fuels from waste. New York, Academic Press, Inc., 1977, p. 195-209.

Applications of fluidized-bed combustion to neutral sulfite semichemical pulping residues, magnesia-base pulping effluents, petrochemical refinery wastes and petrochemical wastes are described. Emphasis is placed on studying the feasibility of fluidized-bed combustion in bench-scale systems before proceeding to commercial-scale waste disposal and energy recovery plants. De-watering of petrochemical sludges and other techniques for separating organic material from waste liquors are mentioned; the control of exhaust-gas composition in fluidized-bed combustion is also considered. J.M.B.

A78-27823 Remote sensing of earth resources. Volume 5 - Annual Remote Sensing of Earth Resources Conference, 5th, Tullahoma, Tenn., March 29-31, 1976, Technical Papers. Edited by F. Shahrokhi (Tennessee University, Tullahoma, Tenn.). Tullahoma, University of Tennessee, 1977. 647 p. \$30.

Some topics related to the application of satellite data for land use studies include land use mapping for the Texas land information system, the application of remote sensing technology for effective barrier island management, and urban use inventories with high altitude photography. Some technical problems considered include the production of diazo color composite images with inexpensive equipment, the automatic analysis of data from the Skylab S-192 multispectral scanner for agricultural applications, and automated techniques to estimate litter moisture by objective analysis of SMS/GOES satellite data. Reports on studied substances or situations include the remote detection of chlorophyll-A in coastal waters, geological reconnaissance of an oil shale region by remote sensing techniques, and the remote sensing of forest fire smoke from space. Equipment studies are also presented, as are several other investigations on a variety of subjects. M.L.

A78-27824 Geothermal energy utilization. E. F. Wahl (Occidental Research Corp., La Verne, Calif.). New York, Wiley-Interscience, 1977. 315 p. 231 refs. \$22.

The book focuses on the process technology of geothermal fluids after they reach the surface. Information on researching, designing, or evaluating process systems for producing electricity, distributing thermal energy, or recovering minerals is provided. A compilation of current knowledge about the process chemistry and thermodynamics of geothermal energy utilization is included along with a discussion of basic theories and their interpretations. Topics of interest include the chemistry of carbonates and silica as related to geothermal brine utilization, scale deposition, electrical power production using expansion machines, and thermal utilization and mineral recovery. Uses and performance of combined systems are compared. S.D.

A78-27826 National Conference on Internal Combustion Engines and Combustion, 3rd, University of Roorkee, Roorkee, India, December 10-12, 1976, Proceedings. Conference sponsored by the Ministry of Defence and Department of Science and Technology of India, International Combustion Institute, et al. Meerut, India, Sarita Prakashan, 1976. 506 p. \$25.

Internal combustion engine technology is discussed, with emphasis on fuel types and advanced engine design to produce more efficient and pollution-free combustion. Topics of the papers include transient spray mixing of direct injection diesel engines, quench zone thickness in a spark ignition engine, spark-ignited stratified charge combustion engines, methanol and methanol-gasoline blends as fuels, a catalytic converter for HC/CO emission control, double concentric swirling jets, swirl effects on premixed and diffusion flames, an annular combustion chamber for gas turbine applications, turbulent flame propagation modeling; velocity histories of upward-injected fuel droplets, and solid propellant ignition theories. J.M.B.

A78-27827 # Use of methanol in diesel engine - An experimental study of engine performance. M. Saxena and K. K. Gandhi (Indian Institute of Petroleum, Dehra Dun, India). In: National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings.

Meerut, India, Sarita Prakashan, 1976, p. 139-146. 8

refs.

The paper discusses the performance of the engine with methanol as an auxiliary fuel. The effect of load on optimum methanol induction, input heat utilization, exhaust temperature and smoke density along with pressure-time diagrams were studied. The engine performance studies show that better heat utilization is achieved at and above rated load with reduced exhaust smoke density. From the peak pressure, rate of pressure rise and a study of delay periods, it is concluded that for methanol-diesel operation the engine can run economically (energy basis), with reduced engine vibrations, and higher power/weight ratio. In addition, for the case of field operation, engine performance for a constant quantity of methanol induction at any load was also done. (Author)

A78-27828 # Investigations into the suitability of methanol and methanol gasoline blends as s.i. engine fuels. H. B. Mathur and R. K. Bakshi (Indian Institute of Technology, New Delhi, India). In: National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings.

Meerut, India, Sarita Prakashan, 1976, p.

155-166. 10 refs.

A single-cylinder research engine is employed to test methanol and methanol-gasoline blends as fuels for spark ignition engines; power output, volume-based fuel economy and energy-based fuel economy are studied for the various fuel mixtures. A 10% methanol blend gives the best fuel economy on the volumetric as well as the equivalent energy basis; methanol blending also leads to decreases in exhaust carbon monoxide, unburnt hydrocarbons and oxides of nitrogen at all air/fuel ratios. J.M.B.

A78-27829 # Investigation of some factors affecting the performance of an alcohol-diesel oil dual fuel engine. K. R. Panchapakesan, M. Rajendran, K. V. Gopalakrishnan, and B. S. Murthy (Indian Institute of Technology, Madras, India). In: National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings.

Meerut, India, Sarita Prakashan, 1976, p. 167-176. 6

refs.

A78-27831 # A shock tube study of the ignition delay of methane at elevated temperatures. R. R. Kumar (College of Engineering, Trivandrum, India) and K. A. Bhaskaran (Indian Institute of Technology, Madras, India). In: National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings.

Meerut, India, Sarita Prakashan, 1976, p. 271-282. 12 refs.

A78-27834 # Nitric oxide formation in hydrocarbon-air flames. B. H. Rao (Banaras Hindu University, Varanasi, India) and P. S. Mehta (Roorkee, University, Roorkee, India). In: National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings.

Meerut, India, Sarita Prakashan, 1976, p. 305-310. 10

refs.

Oxides of nitrogen generated during combustion processes are recognized as major pollutants which react in the atmosphere to form photochemical smog and compounds that are hazardous to health. The predominant oxide of nitrogen associated with combustion products is nitric oxide which later oxidizes to nitrogen dioxide in the atmosphere. This work aims at obtaining information regarding the rate of formation of nitric oxide and reaction mechanism leading to its formation in hydrocarbon air flames. An eleven-component system is chosen for calculating the equilibrium composition of a hydrocarbon fuel and air combustion. Nitric oxide concentrations are computed for iso-octane and air combustion following Zeldovich and an extended Zeldovich mechanism. The

effects of varying pressure, temperature, and mixture strength are studied. (Author)

A78-27835 # Flame stabilization by wall recess technique. V. M. Domkundwar (Indian Institute of Technology, Madras, India) and D. Banerjee (Bengal Engineering College, Calcutta, India). In: National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings.

Meerut, India, Sarita Prakashan, 1976, p.

311-318.

The present work was carried out to find out potentialities of wall-recesses as a flame stabilizer using kerosene as a fuel. The pressure loss characteristics under cold and hot flow conditions and stability characteristics are investigated under different flow conditions using wall recesses of different dimensions. With the present investigation, it has been observed that the rectangular recess in the wall of a duct produces an oblong recirculation zone originating from the trailing edge to the leading edge of the recess. It is further observed that the recirculation zone varies in dimensions with the change in main stream velocity and recess dimensions. The maximum blow-out velocity obtained with the biggest recess was 70 m/sec at A:F ratio of 21:1 and the lowest velocity was 11.3 m/sec at A:F ratio of 42:1. The maximum pressure loss at the maximum blow-out velocity was 3.5 cm of water under hot condition. It is concluded that the wall recess technique is superior to other stabilizing techniques both with respect to stability limits and pressure loss characteristics. (Author)

A78-27852 Solar energy engineering. Edited by A. A. M. Sayigh (Riyadh, University, Riyadh, Saudi Arabia). New York, Academic Press, Inc., 1977. 525 p. 564 refs. \$36.

The total and spectral solar irradiance is considered along with a solar energy availability prediction from climatological data, heat transfer for solar energy utilization, liquid flat plate collectors, convective heat transfer effects within Honeycomb structures for flat plate solar collectors, solar air heaters and their applications, concentrating collectors, a solar pond, and solar furnaces. Attention is also given to photovoltaic conversion, an application of solar energy in space, the conversion of solar energy into electricity, the storage of solar energy, refrigeration and air conditioning, solar heating and cooling of homes, the solar production of hydrogen, solar energy measuring equipment, the fundamentals of water desalination, and questions regarding the economics of solar energy. G.R.

A78-27853 Solar irradiance, total and spectral. M. P. Thekaekara. In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 37-59.

Problems concerning a use of solar energy are related to the necessity to be able to build cost-effective solar energy conversion systems. A survey is conducted regarding the quantitative data on solar energy, which are currently available, to provide a basis for the design of such systems. Attention is given to the extraterrestrial solar energy, the solar constant, the solar spectral irradiance for zero/air mass, variations of the total solar irradiance outside the atmosphere in relation to changes in the sun-earth distance, the accuracy of the NASA/ASTM standard values, possible variations in solar energy output, the solar energy variation at ground level, the atmospheric attenuation of solar energy, and total and spectral solar irradiance at ground level. Tables which show the effect of turbidity and air mass on the total irradiance on the ground are presented. Two other atmospheric parameters which affect ground insolation are the amount of precipitable water vapor and of ozone. G.R.

A78-27854 Solar energy availability prediction from climatological data. A. A. M. Sayigh (Riyadh, University, Riyadh, Saudi Arabia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 61-82.

The solar radiation reaching the earth consists of direct and diffuse radiation. An accurate knowledge concerning the quantitative aspects of this radiation and its qualitative characteristics would be

important in connection with projects for the utilization of solar energy. However, solar radiation measuring equipment in the past was not very reliable and current instruments are expensive. Attempts have, therefore, been made to estimate the solar radiation using well-established climatological data. Formulas for estimating direct and diffuse solar radiation are discussed. It appears that several formulas have a reasonable accuracy in the range from ± 5 to $\pm 10\%$. It was found that it is difficult to obtain a general formula that could be used at any season and at any location with a very high accuracy. G.R.

A78-27855 Heat transfer for solar energy utilization. J. A. Sabbagh (Riyadh, University, Riyadh, Saudi Arabia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 83-103.

Heat transfer occurs mainly by the three mechanisms of conduction, radiation, and convection. It may be accompanied by other physical phenomena such as heat generation within the medium, vapor condensation, and liquid evaporation. The mathematical relations concerning the various processes involved are discussed, taking into account a conduction in extended surfaces, a forced convection over a flat plate, forced convection over a circular cylinder, natural convection over a flat plate and a circular cylinder, forced convection through a tube, natural and mixed convection inside a tube and between two parallel plates, convection transfer to the atmosphere, heat transfer with vapor condensation, liquid vaporization, radiation exchange between surfaces, thermal radiation exchange with the atmosphere, heat transfer through an insulated wall or pipe, the mean temperature difference in a heat exchanger, and aspects of friction in the heat exchangers. G.R.

A78-27856 Solar energy utilization - Liquid flat plate collectors. W. W. S. Charters (Melbourne, University, Melbourne, Australia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 105-135.

The basic elements of flat plate collectors include a flat plate upon which the short wave solar radiation falls and is transformed into thermal energy, an insulated container, one or more plates of glass or transparent plastic to reduce heat loss from the hot collector plate, and tubes or channels to circulate the liquid required to remove the thermal energy from the plate to the storage tank. These collectors are potentially useful in supplying low-grade thermal energy at temperatures generally less than 90 C and may be used in systems for the supply of domestic or industrial hot water or for space heating and/or cooling applications. The heat transfer processes which occur in the flat plate collector system are examined, giving attention to radiative effects, convection processes, steady state models of collector performance, and the performance characteristics of conventional tube and plate collectors. G.R.

A78-27857 Convective heat transfer effects within honeycomb structures for flat plate solar collectors. W. W. S. Charters (Melbourne, University, Melbourne, Australia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 137-153.

Honeycomb cellular structures have been used to modify the heat transfer processes which occur in the vicinity of a heated body. In terms of conduction effects, the cellular structure can be envisaged as an extended surface used to increase the heat transfer area. In terms of convection effects the structures have been proposed for the inhibition of, or modification to, the natural convection transport from a heated body. An investigation is conducted concerning the convective aspects of the general heat transfer problem, taking into account an inclined flat plate solar absorber with a honeycomb structure. Theoretical aspects of the free convection process for fluid layers are studied, giving attention to unconstrained fluid layers, the effect of constraining walls on a horizontal fluid layer (vertical cell), an unconstrained inclined fluid layer, an unconstrained vertical fluid layer (horizontal cell), and the effect of constraining walls on inclined fluid layers. G.R.

A78-27858 * Solar air heaters and their applications. M. K. Selcuk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 155-182.

The solar air heater appears to be the most logical choice, as far as the ultimate application of heating air to maintain a comfortable environment is concerned. One disadvantage of solar air heaters is the need for handling larger volumes of air than liquids due to the low density of air as a working substance. Another disadvantage is the low thermal capacity of air. In cases where thermal storage is needed, water is superior to air. Design variations of solar air heaters are discussed along with the calculation of the efficiency of a flat plate solar air heater, the performance of various collector types, and the applications of solar air heaters. Attention is given to collectors with nonporous absorber plates, collectors with porous absorbers, the performance of flat plate collectors with finned absorbers, a wire mesh absorber, and an overlapped glass plate air heater. G.R.

A78-27859 Concentrating collectors. A. B. Meinel (Arizona, University, Tucson, Ariz.). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 183-216.

The optical systems for solar concentrators include point focus and line focus systems. Point focus systems have circular symmetry and are generally used when high brightness concentration factors are required, as in solar furnaces and central receiver power systems. Line focus systems have cylindrical symmetry and are generally used when medium concentration is sufficient to reach the desired operating temperatures. A third group has occasionally been used that produces a line focus of limited length. Attention is given to parabolic mirrors, circular Fresnel lenses, the central receiver, limits of concentration, point focus mountings, fully tracking mounting configurations, the kinematics of fully tracking mountings, a generalized heliostat, line focus configurations, a parabolic cylinder, cylindrical optical mountings, fixed mirror line focus systems, and mirror materials. G.R.

A78-27860 Solar pond. S. B. Savage (McGill University, Montreal, Canada). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 217-232.

It has been proposed that nonconvective solar ponds should be used for collecting and storing energy on a large scale. A solar pond is a shallow body of water about one meter deep containing dissolved salts to generate a stable density gradient with fresh water on top and denser salt water at the bottom. Part of the incident solar radiation entering through the pond surface is absorbed throughout the depth. The remainder which penetrates the pond is absorbed at the black bottom. The density gradient is used to suppress convection. Heat is, therefore, lost from the lower layers only by conduction. Energy can be extracted from the pond by recycling the water in the hot layers of the pond through a heat exchanger. A review is conducted concerning the previous work on solar ponds, taking into account the physical principles of their operation and the practical difficulties which would have to be overcome. G.R.

A78-27861 Solar furnaces. T. Sakurai (Tohoku University, Sendai, Japan). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 233-262.

A solar furnace is a device for applying high temperatures to a specimen by concentrating solar radiation on it. A brief historical review concerning the development of solar furnaces is presented and fundamental operational and design principles for solar furnaces are discussed. A paraboloidal mirror is used as a radiation concentrator of the reflection type. According to the procedures used to keep the solar radiation incident upon a concentrator, parallel to the optical axis, solar furnaces can be divided into two types. In a furnace of the direct-incidence type, the concentrator itself is directed towards the sun. In the heliostat type, the radiation is directed into a fixed concentrator by means of a turnable mirror or 'heliostat'. Attention is given to the three sun-following methods used, the theoretical relations concerning the concentration of the solar energy by a

paraboloidal mirror, design examples for solar furnaces, and high-temperature investigations involving the use of a solar furnace. G.R.

A78-27862 Photovoltaic conversion. C. E. Backus (Arizona State University, Tempe, Ariz.). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 263-285.

Photovoltaic conversion involves the generation of an electromotive force as a result of the absorption of ionizing radiation. Devices which convert sunlight to electricity are called solar cells. A description is presented of the band theory of solids and the three processes required to obtain useful power from photon interactions in a semiconductor. Attention is also given to the transport characteristics of charge carriers in materials considered for solar cells, photovoltaic principles, the processing of silicon cells for terrestrial applications, the state of development of cadmium sulfide/copper sulfide cells, and the characteristics of gallium arsenide cells. It appears that the efficiencies of present silicon cells are approaching the expected limits. Major government programs have been established to reduce the cost of the production of the cells. G.R.

A78-27863 Application of solar energy in space. C. E. Backus (Arizona State University, Tempe, Ariz.). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 287-304.

Since the fall of 1959, essentially all spacecraft with a mission duration of more than a few weeks use solar cells as their prime power supply. This includes more than 1000 satellites with power outputs up to 20 kW. A description is presented of the fabrication of solar cells for space applications. Most space cells up through 1975 used SiO thin films as an antireflective coating. Cells using the new violet cell technology employ Ta₂O₅ which is transparent to radiation with a wavelength below 0.3 micrometers. The development of the violet cell and subsequently, the CNR cell has raised the efficiency of silicon cells to 15.3% when exposed to an air mass zero solar spectrum. Future advancements will most probably be in larger array technology, lighter weight cells, lower cost cells, and more radiation resistant cells. G.R.

A78-27864 Conversion of solar energy into electricity. M. A. Kettani (Petroleum and Minerals University, Dhahran, Saudi Arabia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 305-324.

The four main methods used for the direct conversion of solar energy into electricity are related to photovoltaic power conversion, photoemissive power conversion, photogalvanic power conversion, and photomagnetic power conversion. Indirect conversion methods involving a heat stage are also considered, taking into account the conversion of solar energy into heat, the conversion of solar heat directly into electricity, and the indirect conversion of solar heat into electricity. A description is presented of approaches involving the conversion of solar energy through a mechanical stage. The conversion of solar energy through a chemical stage is potentially also feasible. Attention is given to primary photochemical processes for the conversion of solar energy and basic concepts regarding a solar energy power system. G.R.

A78-27865 Storage of solar energy. M. A. Kettani (Petroleum and Minerals University, Dhahran, Saudi Arabia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 325-339.

An investigation is conducted concerning the various approaches which could be used for storing solar energy before or after it has been converted into electricity. It is found that an economical storage of energy in capacitors or inductors would require new technological developments which in the case of inductors might take the form of advances in superconducting materials. Attention is also given to the storage of electrical energy in chemical form in the primary cell, a storage of energy in the form of heat, a storage battery in which the reactant is generated by a photochemical reaction, energy storage involving a use of hydrogen obtained from water by one of a number of processes, the production of methane

by means of a process involving the anaerobic fermentation of algae with the aid of solar energy, photosynthesis, and energy storage in the form of potential hydraulic energy. G.R.

A78-27866 Refrigeration and air conditioning. B. J. Brinkworth (University College, Cardiff, Wales). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 341-364.

Requirements for cooling are related to the need to be able to maintain foodstuffs in good condition with the aid of refrigeration and the desirability to provide a comfortable indoor environment by air conditioning. The representation of the desired conditions in a room by a point on a psychrometric chart is considered together with processes of sensible cooling, cooling and dehumidification, and cooling and humidification which can be employed to produce these conditions. A description of refrigeration systems is presented, taking into account the characteristics of the ideal refrigerator, the vapor-compression refrigerator, absorption machines, the resorption cycle, dehumidification, and intermittent operation. In connection with an investigation of the possibilities of solar cooling attention is given to a collector/refrigerator combination, compression machines, absorption machines, and intermittent absorption. G.R.

A78-27867 Solar heating and cooling of homes. J. I. Yellott (Arizona State University, Tempe, Ariz.). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 365-383.

It is pointed out that the heating of residences by the use of solar radiation is a very ancient concept. The first scientific work on solar heating began in 1940 at MIT in Massachusetts. A tremendous amount of activity has been initiated in the U.S. as a result of the fuel crisis in 1973, and a gigantic program, by solar standards, is now under way to create a viable industry in the area of solar heating and cooling of buildings of all sorts. A description is presented of the systems which are currently in use for solar heating and cooling. The individual system components employed are considered, taking into account collectors, storage devices, distribution systems, auxiliary heating and cooling, standby heating and cooling, and cooling systems. A survey is conducted of significant solar-heated and cooled residences, giving attention to passive and active systems. G.R.

A78-27868 Solar production of hydrogen. T. N. Veziroglu (Miami University, Coral Gables, Fla.) and S. Kakac (Middle East Technical University, Ankara, Turkey). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 385-395.

For a large-scale utilization of solar energy it would be very convenient if the energy obtained could be stored for a use at times when solar energy is not sufficiently available. Possibilities to store solar energy as chemical energy in the form of hydrogen are discussed. This approach has also the advantage that the hydrogen as energy carrier could be transported to other locations where energy is needed. Thermochemical, electrolytical, thermal, and photo-synthetic methods are considered. The various methods are compared and the advantages of each are stated. Among the four basic methods for producing hydrogen from solar energy, the direct thermal method has the potential of highest thermal efficiency. It is expected that in the near future solar hydrogen could be produced using electrolysis, and later, thermochemical processes. In the years 2000s hydrogen could possibly be obtained by direct thermal water splitting. G.R.

A78-27869 Solar energy measuring equipment. B. D. Wood (Arizona State University, Tempe, Ariz.). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 397-429.

The optimization of processes based on a utilization of solar energy requires data concerning the daily, local, and seasonal variations in each radiation constituent along with information regarding the relationship of these variations with other meteorological elements. The equipment available for obtaining the required data

is discussed, taking into account pyrhemometers, pyranometers, pyrgeometers, and pyrriadiometers. Attention is given to the international pyrhemometric standard 1956, the international pyranometer standard, world-wide solar radiation measuring stations, a classification of radiation fluxes, sunshine records, the standardization of solar radiometers, and the characteristics of commercially available pyranometers. G.R.

A78-27870 The economics of solar energy. A. A. M. Sayigh (Riyadh, University, Riyadh, Saudi Arabia). In: Solar energy engineering. New York, Academic Press, Inc., 1977, p. 465-476.

In an analysis concerning the cost of a utilization of solar energy, the prime consideration should be given to the capital investment. Solar energy is best used in small power station generation involving usually 10 to 100 kW sizes with an upper limit of 1000 kW. This is due to the almost constant cost of electricity generation by solar energy, irrespective of the size of the station. The cost of solar appliances is discussed, taking into account solar pumps, solar stoves, solar heating and cooling, solar power plants, and solar stills. It is pointed out that the use of solar energy and its economics can only be judged relatively. Collector cost depends on method of construction, the type of material used, and the exact requirements for a particular collector. For generating electricity by the photovoltaic process, the cost is still ten to twenty times that of conventional methods. G.R.

A78-27889 Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, University of Western Ontario, London, Canada, August 24-28, 1976. Conference sponsored by the University of Western Ontario and Boston University. Edited by J. R. Bolton (Western Ontario, University, London, Canada). New York, Academic Press, Inc., 1977. 268 p. \$13.50.

The various possibilities for the photochemical conversion and storage of solar energy are examined. Attention is given to the chemical utilization of solar energy through systems in which the quanta of radiation are not degraded to heat but are utilized in atomic or molecular systems undergoing chemical changes. Topics of interest include power generation by photoelectrolysis, photogalvanic processes, photochemical production of a fuel, and ultrathin barriers in solar energy conversion. Organic molecular energy storage reactions are described along with the role of photosynthesis in energy production. S.D.

A78-27890 Photochemical conversion and storage of solar energy. G. Stein. In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada, August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 1-25.

21 refs.

The paper examines whether the systems required for the chemical utilization and storage of solar energy are able to compete efficiently and economically with other forms of solar energy utilization. The future role of wind, photosynthetic biomass (formation of biomass through photosynthesis), and hydroelectric power is discussed. Other topics of interest include electricity generation from solar power by decentralized chemical systems, homogeneous chemical systems for solar energy utilization, and thermally assisted photochemical reactions and photochemically assisted thermal reactions. It is suggested that in the near future some photochemical devices may become competitive with already marketable dry photovoltaic devices. S.D.

A78-27891 Will photosynthesis solve the energy problem. D. O. Hall (King's College, London, England). In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada, August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 27-50; Comments, p. 51, 52, 63 refs.

Photosynthesis is defined as the conversion of solar energy into fixed chemical energy ($\text{CO}_2 + \text{H}_2\text{O}$ yields organic material + O_2), the products of photosynthesis representing stored energy. Ways in which solar/biological systems can be realized to varying degrees of efficiency over the short and long term are examined. Some, such as the recycling of biological waste, use of leaf protein, and energy plantations (growing of plant materials for their fuel value) can be put into practice immediately, whereas others may never be feasible. Plant systems are diverse and adaptable, so that photobiological systems can be tailored to suit the energy needs of a country, taking into consideration energy availability, local food and fiber production, ecological aspects, climate, and land use. In all cases the total energy input (other than sunlight) into any biological system should be compared with the energy consumed in the construction of any other energy-producing system. Photosynthesis applicability might be immediate in some tropical areas and countries with large amounts of sunshine. S.D.

A78-27892 Power generation by photoelectrolysis. H. Gerischer (Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Fritz-Haber-Institut, Berlin, West Germany). In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada, August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 77-112; Comments, p. 113-117. 53 refs.

Photoelectrolysis is known to be a combination of a photochemical process and a photoelectric process. In the present paper, power generation by photoelectrolysis is restricted to systems in which the effective light absorption occurs either in the electrode or on its surface. The only electrode materials which have the property of storing light energy for a time long enough to be converted into other forms of energy are the semiconductors. To avoid high energy losses at the semiconductor electrode, only doped semiconductors with sufficiently high conductivity are suitable. Fundamental properties of semiconductor electrodes under illumination are summarized, along with particular systems that can be used either to generate a fuel for energy conversion or simply act as a power source by its electrolytic action. The prospects appear somewhat better for the use of a photoelectrolytic cell for power generation in the regenerative mode of operation. S.D.

A78-27893 Photogalvanic processes. N. N. Lichtin (Boston University, Boston, Mass.). In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada, August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 119-142; Comments, p. 143-145. 52 refs. NSF Grants No. GI-38103; No. AER-72-03579.

Photogalvanic processes are conveniently defined as the various types of physical and chemical processes essential to the conversion of a flux of electromagnetic radiation into electrical power by means of a photogalvanic device. In this paper, a photogalvanic device is taken to be a battery in which the cell solution (or equivalent) absorbs light directly to generate photochemically species which, upon back reaction through an external circuit with the aid of suitable electrodes, produce electrical power. In other terms, a photogalvanic device may function as a simple transducer or may store substantial amounts of energy as chemical potential under open circuit conditions and release it as electricity under closed external circuit conditions. The discussion focuses on the design concept and reactions of a prototypical iron-thionine photogalvanic cell, processes and figures of merit in photogalvanic cells without capacity for storage, sensitization related to absorption of sunlight, the primary quantum yield of charge carriers in solution, lifetime of charge carriers in solution, the quantum yield for current conversion, and limits on the voltage conversion efficiency. S.D.

A78-27894 Photochemical production of a fuel. L. Moggi (Bologna, Università, Bologna, Italy). In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada,

August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 147-161; Comments, p. 162-165. 17 refs.

Sunlight is converted into chemical energy in a photochemical fuel-production system, where a chemical product of higher energy than the original substrate but kinetically inert at normal ambient temperature is formed. The storage of the fuel is made possible because of its kinetic inertness. However, when this inertness is removed by increasing the temperature or by using a catalytic device, the stored fuel reacts to yield the original substrate (or some other more stable chemical species) and release energy in the form of heat or electric power, depending on the reaction conditions. Attention is given to direct intramolecular photoreactions, bimolecular redox processes, and photocatalyzed systems. The discussion indicates that some of the systems are not feasible and others are affected by severe limitations and defects. The applicability of a photochemical fuel-production system depends largely on the efficiency and cost of a large-scale plant. S.D.

A78-27895 Ultrathin barriers and solar energy conversion. H. T. Tien (Michigan State University, East Lansing, Mich.) and B. Karvaly (Hungarian Academy of Sciences, Institute of Biophysics, Szeged, Hungary). In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada, August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 167-223; Comments, p. 224, 225. 38 refs.

Solar energy as visible light can be converted directly into electrical or chemical energy via appropriate barriers with a thickness less than 100 Å. Such ultrathin barriers are present in several systems, viz. the n-p junction of the silicon voltaic cell, the thylakoid membrane of the chloroplast, and the pigmented bilayer lipid membrane (BLM). The paper deals primarily with the pigmented BLM and its potential development into an effective device for converting solar energy into electricity. Relation between photoelectric BLM, photosynthetic thylakoid membranes, and photo-voltaic silicon cells is examined. The crucial role of the ultrathin barrier in the above three systems in transducing solar energy into electricity and/or chemical energy is elucidated. The essential principles of the pigmented BLM system, modeled on the basis of rapidly growing knowledge of the photosynthetic thylakoid membrane of the green plant, are established. S.D.

A78-27896 Organic molecular energy storage reactions. W. H. F. Sasse (Commonwealth Scientific and Industrial Research Organization, Div. of Applied Organic Chemistry, Melbourne, Australia). In: Solar power and fuels; Proceedings of the First International Conference on the Photochemical Conversion and Storage of Solar Energy, London, Canada, August 24-28, 1976. New York, Academic Press, Inc., 1977, p. 227-245; Comments, p. 246-248. 62 refs.

The paper is concerned with systems that depend on light-induced covalent structural changes in organic compounds which can then produce heat in the second stage. Several key factors governing the performance of energy-storing organic photoreactions delivering heat are identified. Examples of such reactions are described and compared relative to photodimers of anthracenes, photodimers in the naphthalene series, naphthalene-diphenylacetylene photoadducts, dicyclopentadien-1-one, norbornadienes, and 1-ethoxycarbonyl-1H-azepine. Major improvements in storage rate can be achieved by gaining more insight into the influence of structural modifications on photophysical and photochemical performance. S.D.

A78-27919 Deactivation of hydrodesulfurization catalysts under coal liquids. I - Loss of hydrogenation activity due to carbonaceous deposits. A. Ocampo, J. T. Schrodt (Kentucky, University, Lexington, Ky.), and S. M. Kovach (Ashland Oil, Inc., Ashland, Ky.). *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 17, Mar. 1978, p. 56-61. 17 refs. NSF Grant No. G1-40533.

A78-27920 Deactivation of hydrodesulfurization catalysts under coal liquids. II - Loss of hydrogenation activity due to adsorption of metallics. S. M. Kovach, L. J. Castle, J. V. Bennett (Ashland Oil, Inc., Ashland, Ky.), and J. T. Schrodt (Kentucky, University, Lexington, Ky.). *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 17, Mar. 1978, p. 62-67. 5 refs. NSF Grant No. G1-40533.

A78-27922 Determination of the geometrical concentration of a solar collector using a spherical mirror (Détermination de la concentration géométrique d'un capteur solaire à miroir sphérique). B. Imbert and R. Pasquetti (Aix-Marseille I, Université, Marseille, France). *Journal of Optics*, vol. 9, Jan.-Feb. 1978, p. 25-29. In French.

This paper is a study of a focusing collector of solar radiation. The focusing reflector is a mobile spherical receptacle which follows the path of the sun; the energy converter opening is a disk, the radius and exact position of which are calculated. A relationship which permits the optimization of the collector has been established between the rate of geometrical concentration and the angle of the reflector opening. The imperfections of this reflector, or of the system for tracking the sun, are then considered. A comparison is finally made with solar collectors having parabolic reflectors. The spherical-type solar collector seems well adapted to the various uses which require geometrical concentrations on the order of several hundred power. One of these applications is the thermodynamic production of electricity. (Author)

A78-27927 # Transport. J. Grey (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 9-16.

Space transportation for industrial purposes is considered in terms of economy for various near-earth missions. Different means of propulsion are discussed for differing payloads and destinations, including the present Space Shuttle, a heavy lift launch vehicle (HLLV) based on Shuttle design but capable of launching heavier payloads into LEO, a single-stage-to-orbit vehicle, an advanced chemical propellant interim-upper-stage (IUS) for use in LEO to boost payloads to GEO, solar and nuclear reactor-driven propulsion for orbit-to-orbit maneuvering and for interplanetary flight, and mass drivers to accelerate payloads into space from the lunar surface or to transport asteroids for mining purposes. Attention is given to satellite solar power stations (SSPS) and the kinds of vehicles necessary to assemble them. D.M.W.

A78-27928 # Materials, processing, and construction. J. R. Arnold (California, University, San Diego, Calif.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 17-21.

Industry and colonies in outer space are considered in terms of materials, processing, and construction. Attention is given to the ease of metal extrusion and the use of composite materials, the possibility of constructing very large structures because of the lack of static loading in a zero-gravity environment, and the processing of satellite solar power stations (SSPS) and other objects which will serve the needs (both everyday and exotic) of man in space and on earth. D.M.W.

A78-27930 # Directions for research. G. K. O'Neill (MIT, Cambridge, Mass.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 27-32.

The practicality of using the outer space environment for manufacturing, colonization, and scientific research is discussed in terms of predictable advances in technology, and in terms of cost.

Attention is given to the construction of satellite solar power stations (SSPS) from space resources, i.e., using lunar ores transported to stable Lagrangian points by mass drivers, with the construction crews housed in colonies. Costs for the project are evaluated, and are expected to yield a profit within seven years of the beginning of the operation. Also considered are the prospects for large research expeditions to the outer planets and to the asteroid belt, using mass driver propulsion; possibly returning to near-earth space with an asteroid for mining purposes. D.M.W.

A78-27931 # Propulsion options for orbital transfers in cis-lunar space. J. P. Layton (Techno-Systems Analysis Corp., Princeton, N.J.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 53-64. 16 refs.

Mission characteristics for the economic exploitation of cis-lunar space are reviewed in terms of present technology, and projected until the end of the century; Attention is given to the construction of public service platforms (including SSPS) and the types of vehicles and propulsion systems which will be needed for their assembly, e.g., the Space Shuttle and its heavier derivatives, HLLV, IUS, manned orbital transfer vehicles, solar and nuclear electric propulsion, and solid core nuclear fission rockets. More exotic means of propulsion, for use during the 21 century, are also mentioned, including mass-drivers, nuclear fusion, lasers, and matter/anti-matter pods. D.M.W.

A78-27933 * # Demandite, lunar materials and space industrialization. D. R. Criswell (Lunar Science Institute, Houston, Tex.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 131-136; Discussion, p. 136, 137. 13 refs. Contract No. NSR-09-051-001.

Terrestrial industry consumes a wide range of elements in producing the outputs which support and make industrial societies possible. 'Demandite' is a conceptual or synthetic molecule which is composed of the weight fractions of the major elements consumed by industry. Demandite needed for mature industrial activities in space will differ from the terrestrial composition because solar energy must replace hydrocarbon-energy, lunar and asteroidal bulk compositions are different from mineral deposits on the earth, and the major bulk processing in space will be the creation of radiation shielding for human habitats to provide real estate in space complete with water, atmosphere and life-stock elements. Demandite cost may be dominated by earth to deep space transport cost of minor elemental constituents depleted in the lunar soils unless careful attention is given to substitution of materials, searches of the moon (polar regions) and asteroids for the depleted elements, and continuing lowering of earth to deep space transport costs. (Author)

A78-27934 # The economics of space industrialization - A phased approach. K. P. Heiss (ECON, Inc., Princeton, N.J.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977.

New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 295-302; Discussion, p. 303.

The total systems cost of the first L-5 unit, comprising 10,000 people, with the function of generating 17 Quads/year net energy output is conjectured to be about \$500 billion. The system can be proven to potentially break even economically by 2075, and regenerate itself thereafter with large potential cost reductions. No use of lunar bases or materials is made for the first L-5 unit. If the economic break-even point indeed is reached by 2075, then an irreversible point for essentially unlimited expansion will have been crossed. It is furthermore pointed out that the technology base and necessary funding to bring an L-5 unit about by the year 2075 may be the simple outgrowth of the current and foreseeable U.S. space program. Five phases of space industrialization are outlined, that will lead to a space habitation capability, where each phase has economic merits all its own, i.e., not requiring large-scale and very long term, risky commitments. (Author)

A78-27935 # Technological innovation and social exploration in economic growth and energy development. L. P. Gerlach (Minnesota, University, Minneapolis, Minn.). In: Space manufacturing facilities II - Space colonies; Proceedings of the Third Conference, Princeton, N.J., May 9-12, 1977. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 325-336. 42 refs. Research supported by Northwestern Area Foundation.

This paper discusses the choice between growth and no-growth as an economic policy. Attention is given to the development (or the curtailment) of energy production. Three modes of energy production are considered: Big, in which power is generated by large fossil fuel or nuclear installations and transmitted over long distances by high voltage lines (the present system); Small, which uses solar, wind, or biomass plants to generate small amounts of power for local use (also considered within the framework of energy conservation); and High, which uses SSPS to beam microwaves to earth-bound electric conversion stations. Development costs are compared with ecological and social factors in formulating the basis for decision. It is stressed that a no-growth policy, while environmentally desirable, will ensure that the economic status of the have-nots will remain poor. D.M.W.

A78-28086 # Some results of applying the MHD method in power engineering (Nekotorye itogi issledovaniia primeneniia MGD-metoda v energetike). E. M. Shelkov, S. I. Pishchikov, M. S. Pinkhasik, and Iu. A. Zakharko. *Magnitnaia Gidrodinamika*, Oct.-Dec. 1977, p. 87-97. 14 refs. In Russian.

The results of studies conducted with the aid of various MHD devices, including the U-02 and U-25, are presented. Particular attention is given to the preparation, supply, and heating of oxidants, the intake and outlet of admixtures, combustion chamber parameters, MHD generators, magnetic and inversion systems, and measurement and recording techniques. S.C.S.

A78-28087 # Integral characteristics of an induction MHD device at large parameters of electromagnetic interaction (Integralnye kharakteristiki induktsionnoi MGD-mashiny pri bol'shikh parametrokh elektromagnitnogo vzaimodeistviia). R. A. Valdmann, R. R. Krishberg, Ia. Ia. Lielpeter, Ch. K. Mikriukov, and L. Ia. Ulmanis. *Magnitnaia Gidrodinamika*, Oct.-Dec. 1977, p. 107-109. In Russian.

A78-28120 # Universal formula for the electroconductivity of a plasma formed from the combustion products of a hydrocarbon fuel (Universalnaia formula dlia elektroprovodnosti plazmy produktov sgoraniia uglevodorodnykh topliv). V. M. Atrazhev, B. V. Zelener, and I. T. Iakubov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 237, Dec. 1, 1977, p. 824-827. 8 refs. In Russian.

A78-28134 Photosensing arrays with improved spatial resolution. T. I. Kamins and G. T. Fong (Hewlett-Packard Laboratories, Palo Alto, Calif.). *IEEE Transactions on Electron Devices*, vol. ED-25, Feb. 1978, p. 154-159. 6 refs.

Diffusion of photogenerated carriers in a photosensing array can hinder spatial resolution even if scattered light is reduced. This paper discusses the incorporation of subsurface electric fields, which can be used to accelerate photogenerated carriers toward or away from the surface so that they do not diffuse to photosensing elements. Attention is given to the generation of the subsurface fields, outlining a technique whereby dopant concentration gradients are built into the structure. Improved spatial resolution for IR and visible light is analyzed in terms of the method described. (Author)

A78-28139 Infrared focal planes in intrinsic semiconductors. J. T. Longo, D. T. Cheung, A. M. Andrews, C. C. Wang, and J. M. Tracy (Rockwell International Science Center, Thousand Oaks, Calif.). *IEEE Transactions on Electron Devices*, vol. ED-25, Feb. 1978, p. 213-232. 55 refs.

Intrinsic semiconductor arrays are discussed in terms of present technology and predictable developments in the near future. Attention is given to an implementation of hybrid devices (spectral filtering and detection of incident photon flux), in which the signal processing is accomplished by a silicon multiplexer which is physically and electrically interfaced with an intrinsic semiconductor detector array, and monolithic charge transfer devices in which detection and signal processing are accomplished in the same semiconductor. Design and operating parameters of photodetector displays are described, including detector photoresponse analysis, focal plane structures and signal processing (CCD, CID, and X-Y addressed MOSFET switch) arrays, and on-focal-plane signal processing. Various materials for intrinsic semiconductors are analyzed, e.g., HgCdTe, HgCdSe, and PbSnTe/Si. In addition, the mechanical and structural characteristics of the physical interface of the hybrid focal plane are outlined. D.M.W.

A78-28141 Spectral responses limitation mechanisms of a shallow junction n(+)-p photodiode. S. G. Chamberlain, D. J. Roulston, and S. P. Desai (Waterloo, University, Waterloo, Ontario, Canada). *IEEE Transactions on Electron Devices*, vol. ED-25, Feb. 1978, p. 241-246. 14 refs. Research supported by the National Research Council of Canada.

Modulated monochromatic visible light at various wavelengths was used to generate photocurrent in a silicon n(+)-p diffused diode. A numerical model which includes electric field, heavy doping bandgap reduction, and doping level mobility dependence was used with fitting techniques to determine the carrier lifetime in the n(+)-region at each wavelength. From these measurements it was concluded that the physical mechanisms involved in limiting the spectral response of the n(+)-p photodiode at short wavelengths (0.42 micrometer) is due to heavy recombination of photogenerated carriers in the n(+)-region. The latter is caused by the heavy doping which results in a fraction of a nanosecond minority carrier lifetime and a retarding or reduced electric field in the n(+)-region. Surface recombination velocity has little influence on this loss mechanism.

(Author)

A78-28142 Thin silicon film p-i-n photodiodes with internal reflection. J. Müller (Braunschweig, Technische Universität, Braunschweig, West Germany). *IEEE Transactions on Electron Devices*, vol. ED-25, Feb. 1978, p. 247-253. 14 refs. Research supported by the Deutsche Forschungsgemeinschaft.

A silicon p-i-n photodiode using internal light reflection, which combines broad wavelength at high quantum efficiencies (450-900 nm/85%) with a response time below 100 ps is presented. Attention is given to theoretical and experimental expressions for different types of gratings, e.g., hemispherical, V-shaped, and sawtooth-shaped. Design and operating characteristics for both the diode and the gratings are given, including time and wavelength response parameters. D.M.W.

A78-28163 Wind-electric conversion utilizing field modulated generator systems. R. Ramakumar (Oklahoma State University, Stillwater, Okla.). *Solar Energy*, vol. 20, no. 2, 1978, p. 109-117. 26 refs. ERDA-sponsored research; NSF Grant No. AER-75-00647.

Variable-speed constant-frequency wind-electric systems operate at a constant tip speed ratio with varying wind speeds and enable the extraction of a part of the energy spilled by constant-speed constant-frequency systems. This paper describes the variable-speed constant-frequency wind-driven field modulated generator system under development at Oklahoma State University. Such systems appear to be most attractive in the 'small' (10-50 kW) and '100 kW scale' (50-250 kW) sizes and for use in large capacity 'multirotor on one tower' concepts. (Author)

A78-28164 Comparisons of deep well and insulated shallow earth storage of solar heat. R. L. Nicholls (Delaware, University, Newark, Del.). *Solar Energy*, vol. 20, no. 2, 1978, p. 127-137. 16 refs.

Four techniques for storing solar heat in earth are described and their costs are compared by a hypothetical example. They include heat storage by: (a) deep well; (b) deep well with a storage membrane; (c) insulated shallow earth heat exchange bed; and (d) insulated shallow earth tube exchanger. The cost comparison obtains optimal design parameters for each storage method and optimal surface area for an attached solar collector. Heat loss equations for insulated shallow earth storage are obtained by electrolytic tank models. Heat loss for deep well storage is derived by superposition of radial flow of water and diffusion of heat. (Author)

A78-28166 Measurements of the behaviour of adsorbent energy storage beds. T. L. Pryor and D. J. Close (North Queensland, James Cook University, Townsville, Australia). *Solar Energy*, vol. 20, no. 2, 1978, p. 151-155. 13 refs. Research supported by the Commonwealth Scientific and Industrial Research Organization.

This paper presents data from measurements made on an adsorbent energy storage bed. Comparisons between air outlet states predicted by a numerical model with constant system properties and the data show good agreement when the system is operated in a charge-discharge mode similar to the situation in a solar system. However, the agreement is not so satisfactory for the classical single blow case, and the discrepancy is attributed to the assumption of constant system properties. The long term storage ability of these bed is demonstrated by first charging the test bed, allowing it to cool to around 21 C and then extracting energy by admitting air to the bed at temperatures between 25 and 30 C. (Author)

A78-28167 A model for solar radiation conversion to algae in a shallow pond. F. P. Incropera and J. F. Thomas (Purdue University, West Lafayette, Ind.). *Solar Energy*, vol. 20, no. 2, 1978, p. 157-165. 30 refs. NSF Grant No. EPP-75-04328. DI Project A-042-IND.

In recent years there has been considerable interest in solar energy utilization through bioconversion, and a promising application involves the mass culture of unicellular algae. The purpose of this study has been to develop systematic procedures for predicting the yield of such cultures as a function of geographic location and diurnal and seasonal conditions. The procedures allow for the use of available insolation data and account for both the spectral and directional characteristics of the incident radiation. Calculations for the maximum hourly production of algae and oxygen have been performed for the Indianapolis, Indiana region, and the results are in reasonable agreement with field data obtained at similar latitudes. (Author)

A78-28168 The fraction of solar energy available for direct conversion processes. M. D. Archer (Cambridge University, Cambridge, England). *Solar Energy*, vol. 20, no. 2, 1978, p. 167-169. 16 refs.

The amount of solar energy which can actually be used by a photovoltaic converter to do useful work depends on a given threshold value. This value is a function of both, the design characteristics of the converter and of ambient atmospheric conditions. Below the threshold value, photons are absorbed and can not do work. This paper evaluates atmospheric variables and converter parameters in an effort to determine photon threshold values under different conditions. D.M.W.

A78-28169 Thermophotoelectrochemical cells for solar energy conversion. P. V. Kamat, M. D. Karkhanavala, and P. N. Moorthy (Bhabha Atomic Research Centre, Bombay, India). *Solar Energy*, vol. 20, no. 2, 1978, p. 171-173. 8 refs.

Photoelectric cells employing dye-redox and semiconductor-redox systems are useful because of their transmission in the visible and near-UV regions. Since their absorption is high in the infrared, it has been considered feasible to use IR heating to provide a temperature differential between the illuminated and dark half cells to improve system efficiency. This paper discusses experiments performed using a tungsten-halogen light source and constant water circulation to provide an even temperature. Photoelectrochemical

reactions in the system are outlined, and the results presented in a graph. D.M.W.

A78-28170 Photochemical storage of solar energy. J. R. Bolton (Western Ontario, University, London, Canada). *Solar Energy*, vol. 20, no. 2, 1978, p. 181-183. 14 refs. Department of Supply and Services Contract No. 1SQ5-0111.

Artificial systems are considered the only feasible method for the photochemical storage of solar energy. This paper suggests that the design of such systems be based on our knowledge of the mechanism of photosynthesis. Basic principles of photochemical storage are outlined, using daylight as a light source. Attention is given to transmission and absorption coefficients, and to the calculation of energy loss as certain threshold barriers in the photosynthetic process are surmounted. A scheme is proposed which could use the photochemical decomposition of water into hydrogen and oxygen by employing a photochemically reducing dye in a coupled system. The hydrogen would then be stored, to be used for efficient, pollution-free fuel as needed. D.M.W.

A78-28171 Radiative cooling of TiO₂ white paint. A. W. Harrison and M. R. Walton (Calgary, University, Calgary, Alberta, Canada). *Solar Energy*, vol. 20, no. 2, 1978, p. 185-188. 7 refs. Research supported by the University of Calgary.

Titanium oxide white paint has been found effective in cooling the radiating surface of solar collectors up to 15 C below ambient temperature. Experiments conducted in Calgary, Alberta are described to test TiO₂ paint under varying conditions, e.g., clear sky/direct sunlight, intermittent cloud cover, clear sky/indirect sunlight, and with varying amounts of atmospheric moisture. Although cooling is recorded in all instances, direct sunlight and elevated moisture levels were found to hinder performance. D.M.W.

A78-28172 Thermal optimization of compact solar water heaters. A. Bar-Cohen (Negev, University, Beersheba, Israel). *Solar Energy*, vol. 20, no. 2, 1978, p. 193-196. 7 refs. Research supported by the Ben-Gurion University of the Negev.

In an effort to reduce the effects of night-cooling on the efficiency of compact solar water heaters, a design is proposed which will optimize the storage volume to collector area ratio. An analytic model is presented comparing heater design parameters with expected environmental conditions. Under the proposed optimization scheme, early morning storage temperatures in excess of 40 C are theoretically feasible. D.M.W.

A78-28173 Solar insolation measurements at Las Vegas, Nevada. L. D. Spight (Nevada, University, Las Vegas, Nev.). *Solar Energy*, vol. 20, no. 2, 1978, p. 197-203.

An accurate assessment of local conditions is considered critical to the effective design of solar energy systems for a given area. Among the conditions which must be considered are: latitude, altitude, atmospheric clarity (degree of pollution and cloud cover), and generalized climate. Such conditions have been evaluated for Las Vegas, Nevada over four years, and are compared with other U.S. sites having widely differing climatic conditions. Attention is given to incident solar radiation, expressed in Langley's per day. D.M.W.

A78-28199 Solar progress Down Under. W. Scholes. *Machine Design*, vol. 50, Mar. 9, 1978, p. 26, 30, 32, 35.

Advances in solar energy research in Australia are briefly reviewed. Design concepts of effective solar-energy systems are discussed, including a system which would store enough solar energy by chemical means to supply a city of 600,000 inhabitants. Attention is given to the commercial development of efficient water heaters, the design of better solar collectors, a solar-power steam engine, kilns and stills for drinking water, and solar cells. S.D.

A78-28210 # Can coal-oil mixtures make it as industrial fuels. J. W. Eberle and R. H. Hickman (Forney Engineering Co., Carrollton, Tex.). *Mechanical Engineering*, vol. 100, Mar. 1978, p. 24-28. 8 refs.

The use of coal-oil fuels, generally in the ratio of approximately four parts coal to six parts oil, is discussed with attention to preparation, combustion, and economics. Mixtures of finely ground coal suspended in fuel oil have been used for fuel as early as 1917. Some present benefits include low cost (the mixture costs less than oil), utilization of existing facilities (the need of converting furnaces to coal is obviated), utilization of high-sulfur fuels (by combining high-sulfur and low-sulfur fuels), centralized fuel preparation (the viscous liquid can be pumped through pipelines), and reduced downtime (conversion can be begun during unit operation). M.L.

A78-28247 # Remote-sensing methods for monitoring surface coal mining in the northern Great Plains. N. Mamula, Jr. (Pennsylvania State University, University Park, Pa.). *U.S. Geological Survey, Journal of Research*, vol. 6, Mar.-Apr. 1978, p. 149-160. 12 refs.

Recent studies at a large surface coal mine in southern Montana confirm that remote sensing is both feasible and effective for gathering land-use and environmental data for large-scale surface mines in the northern Great Plains. A mine near Colstrip, Mont., was selected as a test site because it typifies surface operations in the Powder River Basin of Montana and Wyoming and elsewhere in the northern Great Plains. Several basic interpretive and analytical remote-sensing techniques were used to identify and delineate various categories of surface-mining operations and concurrent stages of reclamation that characterize most, if not all, such mining operations. Color infrared and black-and-white aerial photographs and a black-and-white band 5 Landsat image were used to identify (1) highwall and bench areas, (2) ungraded spoils, (3) graded and recontoured areas, (4) revegetated recontoured areas, (5) natural and impounded surface water, and (6) miscellaneous areas. Over the lifespan of an extensive surface mine, cultural and natural processes and cumulative environmental effects can be monitored by capitalizing on the close correlation between enhanced satellite imagery, infrared and (or) black-and-white aerial photography, standard large-scale topographic maps, and results of on-site inspection of mining and reclamation. (Author)

A78-28249 # Models for calculating density and vapor pressure of geothermal brines. R. W. Potter, II and J. L. Haas, Jr. *U.S. Geological Survey, Journal of Research*, vol. 6, Mar.-Apr. 1978, p. 247-257. 40 refs.

In a model for estimating density of a brine, the density of a natural brine at a known temperature, pressure, and composition can be calculated from the densities of the component salt solutions in the complex brine. A model for estimating vapor pressure requires two direct or indirect estimates of the vapor pressure and uses a published 'reference-substance principle' to extrapolate these data 200 to 300 deg above the temperature of the highest observation. The methods can be used to estimate the partial molal volume and partial molal enthalpy of H₂O in the natural brine and the partial molal volume change and partial molal heat change for the H₂O component in the vaporization process. The equations for density and vapor pressure and the derived thermochemical properties will help in designing turbines for operation with geothermal and geopressured brines, in optimizing production conditions, and in physical and chemical modeling of a geothermal reservoir. (Author)

A78-28271 Environmental assessment of the fluidized-bed combustion of coal - Methodology and initial results. K. S. Murthy, H. Nack (Battelle Columbus Laboratories, Columbus, Ohio), and D. B. Henschel (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.). *Air Pollution Control Association, Journal*, vol. 28, Mar. 1978, p. 213-220. 9 refs. U.S. Environmental Protection Agency Contract No. 68-02-2138.

A78-28351 **Biological solar energy conversion; Proceedings of the Conference, University of Miami, Miami, Fla., November 15-18, 1976.** Conference sponsored by the United States-Japan Cooperative Science Program, NSF, Japan Society for the Promotion of Science, and ERDA. Edited by A. Mitsui (Miami, University, Miami, Fla.), S. Miyachi (Tokyo, University, Tokyo, Japan), A. San Pietro (Indiana University, Bloomington, Ind.), and S. Tamura (Tokyo, University, Tokyo, Japan). New York, Academic Press, Inc., 1977. 465 p. \$18.50.

Hydrogen photoevolution in algae, kelp colonies for biomass conversion, and anaerobic fermentation of biomass are discussed. Topics of the papers include the anaerobic metabolism of green algae containing hydrogenase, methane production from sewage and algae, the catalytic activity of hydrogenase in biophotolysis, cell-free hydrogen photoevolution systems, development of mutant *Chlamydomonas reinhardi* cells possessing oxygen-resistant hydrogenase, the technique of single-turnover flashes for assessing photo-synthetic oxygen evolution in algae, an alfalfa bioconversion system, kelp plantations fertilized by deep-ocean water, the design and maintenance of seaweed colonies for biomass conversion, and the application of bioconversion principles to U.S. sugarcane production.

J.M.B.

A78-28352 **Photohydrogen production in green algae - Water serves as the primary substrate for hydrogen and oxygen production.** N. I. Bishop, M. Frick (Oregon State University, Corvallis, Ore.), and L. W. Jones (Tennessee, University, Knoxville, Tenn.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 3-22. 48 refs. NSF Grant No. BMS-75-18023.

The anaerobic metabolisms of several green algae containing hydrogenase, including *Scenedesmus obliquus* and a number of species of *Chlorella*, are discussed; emphasis is placed on the photohydrogen production capabilities of the anaerobically adapted algal cells. Rates of hydrogen and oxygen evolution for the species are tabulated. Photosystem I and Photosystem II, two basic mechanisms of photosynthesis functionally connected by inter-system electron transport, are considered in terms of their relevance for understanding the photohydrogen production. The hydrogen production process appears to be independent of ATP-dependent reverse electron flow.

J.M.B.

A78-28353 **Hydrogen production by marine photosynthetic organisms as a potential energy resource.** A. Mitsui and S. Kumazawa (Miami, University, Miami, Fla.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 23-51. 113 refs. Research supported by the Gulf Oil Foundation and Engineering Foundation; NSF Grant No. AER-75-11171.

Hydrogen production by marine photosynthetic organisms is discussed, with emphasis on means to increase the solar energy conversion efficiency of the process and techniques for circumventing problems associated with the sensitivity of photohydrogen production to oxygen inhibition. Cell-free hydrogen production, which eliminates many homeostatic mechanisms found in living-cell hydrogen evolution, is described. Particular attention is paid to techniques for collecting marine photosynthetic organisms and identifying highly active and stable hydrogen-producing species. Floating hydrogen production plants, methane production involving sewage and algae, and uses for the chemical products of algae are also mentioned.

J.M.B.

A78-28354 **Catalytic and structural properties of the enzyme hydrogenase and its role in biophotolysis of water.** A. I. Krasna (Columbia University, New York, N.Y.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 53-60.

Means for studying the catalytic activity of hydrogenase in biophotolytic hydrogen-production systems are described. Attention is given to the reduction of an acceptor by hydrogen, measurement of the enzymatic catalysis of the exchange reaction between hydrogen and deuterated or tritiated water, the assessment of hydride formation, and the heterolytic nature of hydrogen cleavage by hydrogenase. Laboratory investigations employing *Scenedesmus* and *Chlorella* species are reported; hydrogen photoproduction with *Chlorella* declines after a week of activity, possibly because of depletion of an endogeneous oxygen acceptor. Sodium dithionite, glucose and glucose oxidase are found to have limited usefulness as hydrogen production stimulants.

J.M.B.

A78-28355 **Use of an enzymic electric cell and immobilized hydrogenase in the study of the biophotolysis of water to produce hydrogen.** T. Yagi (Shizuoka University, Shizuoka, Japan). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 61-68. 18 refs. Ministry of Education of Japan Grant No. 111911.

A78-28356 **The mechanism of hydrogen photoevolution in photosynthetic organisms.** D. King, D. L. Erbes, A. Ben-Amotz, and M. Gibbs (Brandeis University, Waltham, Mass.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 69-75. 14 refs. NSF Grant No. BMS-71-00978; Contract No. ET(11-1)-3231.

A cell-free system for H₂ photoevolution was developed by sonication of the hydrogenase-containing system *Chlamydomonas reinhardi*. The algal cells were subjected to sonication in a medium of low osmolarity. The effects of ferredoxin, electron donors and inhibitors on the cell-free system were also investigated. Dithiothreitol and NADH appeared to be the most effective electron donors; the experimental evidence suggested that dithiothreitol and NADH donate electrons to both the oxidizing and reducing sites of Photosystem II.

J.M.B.

A78-28357 **Mutational analysis of *Chlamydomonas reinhardi* - Application to biological solar energy conversion.** A. C. McBride, S. Lien, R. K. Togasaki, and A. San Pietro (Indiana University, Bloomington, Ind.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 77-86. 22 refs. NSF Grants No. BMS-75-03415; No. BMS-75-19643; No. AER-75-16962.

Mutant strains of *Chlamydomonas reinhardi* were employed in studying hydrogen photoevolution. An investigation involving anaerobically adapted wild-type cells and two photosynthetically incompetent strains gave evidence that water is the primary source for rapid initial photoevolution. In addition, a mutant strain with a more oxygen-resistant hydrogenase than wild-type cells was sought. Finally, a selection program was initiated to isolate mutant strains with greater resistance to the inhibitory effects of the herbicide DCMU.

J.M.B.

A78-28358 **Hydrogen photoproduction from water.** S. Kurita, K. Toyoda, T. Endo, N. Mochizuki, M. Honya, and T. Onami (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 87-100. 17 refs. Research supported by the Ministry of International Trade and Industry of Japan.

An attempt has been made to photoproduce hydrogen from water using a hydroquinone-quinone redox system. The rate of hydrogen photoproduction from hydroquinone increased upon addition of either potassium ferricyanide, potassium ferrocyanide or methylviologen. The generation of hydroquinone was verified by absorption spectrometry. In further experiments with the same redox system using a photoelectrochemical cell, the rate of hydrogen evolution was found to increase with the intensity of incident sunlight.

(Author)

A78-28359 The molecular mechanisms of photosynthetic hydrogen and oxygen production. E. Greenbaum (Rockefeller University, New York, N.Y.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 101-107. 8 refs. NSF Grant No. PCM-74-11747.

A flow system and a zirconium oxide high-temperature electrode have been adopted for studies of photosynthetic oxygen evolution using the technique of single-turnover flashes. The flow apparatus is capable of absolute calibration and can detect oxygen and/or hydrogen evolved from photosynthetic organisms illuminated by single-turnover, saturating flashes. Data are presented to show the different yield rates of oxygen and hydrogen per mole of chlorophyll per flash. The oxygen evolution measurements are in contradiction with the four-step model for Photosystem II introduced by Kok et al. (1971). J.M.B.

A78-28360 Biological conversion of light energy into electrochemical potential. M. Nishimura, Y. Yamamoto, U. Takahama, M. Shimizu, and K. Matsuura (Kyushu University, Fukuoka, Japan). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 143-148. 7 refs.

The energetics and the relaxation characteristics of the energy transducing processes are discussed for the bioconversion of light energy into electrochemical potential. Cells, spheroblasts, spheroblast membrane vesicles, chromatopores and reconstituted protoleiposome vesicles of *Rhodospirillum rubrum* sphaeroides are used in investigating the sidedness of the proton pump and the electric field function in the photosynthetic membranes of the cells. In addition, the relationship between H(+) translocation in chloroplasts and the dissipation of membrane potential is analyzed. J.M.B.

A78-28361 Synthesis of organic compounds from carbon dioxide in land plants. J. A. Bassham (California, University, Berkeley, Calif.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 151-165. ERDA-sponsored research.

Factors limiting solar energy conversion efficiency in plants are reviewed, and energy farms capable of using land not suitable for agriculture are designed. The farms would yield enough biomass to make collection economical; in addition, a marketable food or chemical byproduct could enhance the economic attractiveness of the farms. Special attention is given to an alfalfa conversion plant operating in semidesert or desert areas with the aid of power-plant wastes. J.M.B.

A78-28362 Possibilities of biomass from the ocean - The Marine Farm Project. W. J. North (California Institute of Technology, Pasadena, Calif.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 347-361. Research supported by the American Gas Association, ERDA, and NSF.

Upwelling deep oceanic water provided by wave pumps was used in an attempt to fertilize *Macrocystis* (Giant Kelp) plantations; *Macrocystis* has been suggested as a raw material for methane production. However, the presence of one or more trace elements in the deep water apparently was responsible for inhibiting the kelp growth. It is suggested that EDTA might bind the inhibitory agent and increase production rates. J.M.B.

A78-28363 Mass production of algae - Bioengineering aspects. J. C. Goldman and J. H. Ryther (Woods Hole Oceanographic Institution, Woods Hole, Mass.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 367-378. 26 refs. Contract No. EG-77-5-02-4151.

It is argued that photosynthetic processes such as algal systems may not be justifiable if used solely as large-scale energy plantations. However, algal systems employed on a smaller scale in such energy-conserving programs as advanced wastewater treatment, raw protein production, fertilizer, drug and colloid manufacturing, and waste recycling-aquaculture process may be feasible. Particular attention is devoted to variables affecting algal culture growth; these include type of culture system (batch, continuous or semicontinuous), nutrient source, surface area and depth of the culture, mixing techniques and residence times. J.M.B.

A78-28364 A critical analysis of bioconversion with microalgae. W. J. Oswald and J. R. Benemann (California, University, Berkeley, Calif.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 379-396. 20 refs. NSF Grant No. AER-76-10809; Contract No. E(04-3)-34-239.

Productivity, net energy, harvesting techniques, species control and the variability of sewage media are discussed as limiting factors in large-scale algal bioconversion in the U.S. Methane production from algal ponds could be increased by recycling of nutrients from the methane digester to the ponds; without this nutrient integration, it is estimated that algal bioconversion could provide only one-tenth of a percent of national energy supplies by the year 2000. The energy value of photosynthetic oxygenation and fertilizer production would increase the role of algal bioconversion in the national energy budget. J.M.B.

A78-28365 Using sugar crops to capture solar energy. E. S. Lipinsky and T. A. McClure (Battelle Columbus Laboratories, Columbus, Ohio). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 397-410. 9 refs. ERDA-supported research.

The application of biomass conversion principles to sugarcane, a high-yield product requiring small amounts of arable land, is discussed. For purposes of bioconversion, sugar crops have an advantage over other plants in that they yield directly fermentable simple sugars. Sugarcane yield forecasts for high-quality and lower-quality land are presented; the importance of close-spacing during planting is also assessed. Areas suitable for growing sugarcane in Texas, Louisiana and Florida are estimated. Harvest costs are also mentioned. J.M.B.

A78-28366 Fuel gas production from selected biomass via anaerobic fermentation. D. L. Wise, R. L. Wentworth, and R. G. Kispert (Dynatech R/D Co., Cambridge, Mass.). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 411-426. 49 refs.

Fuel gas production through anaerobic fermentation of municipal solid wastes, animal wastes and seaweed is discussed; the manufacture of methane from coal is also described. Anaerobic digestion is held to be a more desirable alternative for treating solid wastes than conventional sewage sludge digestion. Anaerobic processing of animal waste appears to have the greatest potential for providing a source of fuel gas in the U.S. In addition, bioconversion concepts may be profitably applied to coal gasification; carbon monoxide, carbon dioxide and hydrogen are treated through anaerobic fermentation to yield methane. J.M.B.

A78-28367 Application of solar energy bioconversion in developing countries. U. Horstmann (Kiel, Neue Universität, Kiel, West Germany; San Carlos, University, Cebu City, Philippines). In: Biological solar energy conversion; Proceedings of the Conference, Miami, Fla., November 15-18, 1976. New York, Academic Press, Inc., 1977, p. 427-436. 11 refs.

A78-28368 Biological constraints on seaweed culture. G. A. Jackson (Woods Hole Oceanographic Institution, Woods Hole, Mass.). In: Biological solar energy conversion; Proceedings of the

Conference, Miami, Fla., November 15-18, 1976.

New York, Academic Press, Inc., 1977, p. 437-448. 25 refs.

Attention is given to the design and maintenance of seaweed systems used for biomass conversion applications. Regulation of pH in the maricultures and elimination of harmful concentrations of trace metals from upwelled deep seawater are considered. Transport process limitations in seawater also provide an important criterion for determining maximum seaweed production rates. Self-shading due to excessively concentrated growth may decrease production rates. In addition, losses due to storms and pathogen assaults are mentioned. J.M.B.

A78-28395 The detection of hydrocarbon sheets on the sea (La détection des nappes d'hydrocarbures sur la mer). A. Fontanel (Institut Français du Pétrole, Rueil-Malmaison, Hauts-de-Seine, France) and A. Roussel (Centre National pour l'Exploitation des Océans, Paris, France). In: Workshop on Remote Sensing, Toulouse, France, October 26-28, 1976, Proceedings. Volume 1. Toulouse, Groupement pour le Développement de la Télé-détection Aérospatiale, 1977, p. 347-365. 6 refs. In French.

Photographic emulsions, visible and infrared scanners, passive radiometers, as well as real- and synthetic-aperture side-looking radar systems are assessed in terms of their capability for remotely detecting oil spills in the ocean. Several types of heavy petroleum and diesel fuel are subjected to trial detection, and emissivity data for the various substances in water are presented. The difficulty of discriminating between petroleum spills and fish-processing refuse is also mentioned. J.M.B.

A78-28434 Some characteristics of oil consumption measured by hydrogen fueled engine. S. Furuhashi and M. Hiruma (Musashi Institute of Technology, Tokyo, Japan). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Joint Lubrication Conference, Kansas City, Mo., Oct. 3-5, 1977, ASLE Preprint 77-LC-5B-1*. 8 p. °

Although a number of studies have been conducted, the mechanism of oil consumption in a hydrogen-fueled engine is as yet not clear because of the lack of a suitable method for measuring consumption continuously and accurately. In this paper, a new measuring method is developed for easy continuous accurate measurement of oil consumption in a short period of time. An experimental apparatus is described and experiments are carried out, based on the concept that the carbon compounds - except for those in the ambient air - in the exhaust gas of a hydrogen-fueled spark-ignition engine are all attributable to the burning of lubricating oil. The oil consumption can therefore be measured continuously in a short period of time when the carbon compounds are oxidized to CO₂ and the concentration of CO₂ is continuously measured. Major conclusions are that the oil consumption is almost equivalent to that of gasoline engines if the combustion pressure and cylinder-wall temperature are equivalent, that oil consumption increases with a decrease in oil viscosity, and that about 10% of the total lubricating oil consumed in a four-stroke engine turns to HC while the remaining consumed oil is burnt completely. S.D.

A78-28475 Procedures for the production of hydrogen from natural gas and oil fractions (Verfahren zur Herstellung von Wasserstoff aus Erdgas und Erdölfraktionen). H. Jüntgen and J. Reichenberger (Bergbau-Forschung GmbH, Essen, West Germany). *Brennstoff-Wärme-Kraft*, vol. 30, Feb. 1978, p. 53-58. 10 refs. In German.

Two procedures for producing hydrogen, the catalytic decomposition of methane and low-boiling hydrocarbons in the presence of steam and the partial oxidation of heavy petroleum residues, are described and compared. Reactions and industry-scale processes are examined with attention to the desulfurization of the starting material. Although from a technical point of view the two procedures are of equal usefulness, installation costs are much higher for the partial oxidation procedure. The use of heat from nuclear reactors for hydrogen production is considered. M.L.

A78-28551 Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report (Energie vom Wind; Tagung, 4th, Bremen, West Germany, June 7, 8, 1977, Tagungsbericht). Meeting sponsored by the Deutsche Gesellschaft für Sonnenenergie. Edited by U. Bossel. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977. 380 p. In German and English. \$16.85.

The papers in this collection give descriptions of national wind energy research and development programs of various European countries, and also report on new developments in wind turbine design and wind energy system analysis. Topics covered include the wind energy programs of the Netherlands, Denmark, West Germany, and Sweden, possibilities of wind energy development in the Third World, cost analysis of horizontal-axis wind energy converters, aeroelastic problems of wind energy converters, concepts for intermediate storage of wind-produced secondary power, and costless water conveyance by wind power. P.T.H.

A78-28552 Possibilities and prospects for wind energy utilization (Möglichkeiten und Aussichten der Windenergienutzung). U. Hütter (Stuttgart, Universität, Stuttgart, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 1-15. 8 refs. In German.

Some data on the available wind power in Western European countries are presented. The possibility of using storage devices for smoothing the fluctuations in available wind energy is mentioned. A diagram is presented and discussed, showing the possible operating regions of the rotor elements in the turbine state, vortex state, and propeller state. A breakdown of the costs and masses with respect to the system groups of a complete wind energy system is given. P.T.H.

A78-28553 The Netherland's National Research Programme on Wind Energy. G. G. Piepers (Stichting Energieonderzoek Centrum Nederland, Petten, Netherlands). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 17-22.

The Dutch wind energy research program is now in its second phase, which is devoted to examining the problems regarding the siting of wind energy turbines and the economical and technological aspects. The effects of wind turbines on landscape, telecommunication, navigation, and migrating birds will be investigated. Economical studies, including the evaluation of capita and operational costs of wind energy conversion systems, will be made. An extensive test program with a vertical axis test facility of 5 m diameter is planned. The concept of a variable geometry will be tested. The design, fabrication, and assembly of an experimental horizontal axis wind turbine with a rotor diameter of 25 m and rated power of 150 kW are projected. The tip-vane concept will be investigated. P.T.H.

A78-28554 Wind energy program of the Danish government and the Danish electric power concerns (Windenergieprogramm der Dänischen Regierung und der Dänischen Elektrizitätsversorgungsunternehmen). H. Grastrup (ELSAM, Fredericia, Denmark). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 23-26. In German.

Projects called for the Danish government wind energy study program are enunciated. These include the reoperation of the Gedser turbine, a 200 kW, three-bladed machine that operated successfully without serious failure in the years 1957-1967. Its performance data will be analyzed and compared with data on recent American designs. Major effort will be concentrated to develop and build one or two larger facilities and to connect them with the common grid. The machines envisaged are of the propeller-turbine type, with propeller diameter in the range 35-45 m, delivering 400-600 kW. P.T.H.

A78-28555 The Swedish Wind Energy Programme. S. Hugosson. In: Energy from wind; Meeting, 4th, Bremen, West

Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 27-38.

Prospects and plans for wind energy development in Sweden are discussed. Most efforts will be devoted to developing large wind power units connected to the national grid. Most attention will be devoted to the horizontal-axis, propeller-type machine. Wind energy prospecting program will consist of a survey of winds in the 50-200 m height level. The Wind Power Experimental Unit will be equipped with an 18-m two-bladed aluminum turbine and a 50-kW induction generator. The height of the hub will be 25 m and the tower will be made of prestressed concrete. The system will be remotely controlled by minicomputer. P.T.H.

A78-28556 Program for wind energy utilization in the framework of nonnuclear energy research (Programm zur Nutzung der Windenergie im Rahmen der nichtnuklearen Energieforschung). R. Windheim (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 39-46. 5 refs. In German.

The goals and present status of a program studying the feasibility of wind energy development are discussed. Preliminary studies showed that at a site on the Schleswig-Holstein coast, the wind velocity at a height of 150 m is below 4 m/sec only 5% of the year, while 45% of the year it is greater than 12 m/sec. This means that a wind facility here would run at nominal load for nearly one-half the year. The central project envisaged in the program is the development and testing of a prototype facility called 'GROWIAN'. This facility will be of the horizontal-axis type, operating at constant rotational speed at nominal power between 2 and 3 MW. The rotor consists of two blades of composite construction. P.T.H.

A78-28557 Results of the German wind energy study (Ergebnisse der Deutschen Windenergiestudie). M. Meliss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 47-69. 23 refs. In German.

The paper discusses the physical basis and theoretical potential of wind energy. Attention is also given to the costs of wind energy development, environmental questions, and state of the art of wind power converters. A general means of obtaining a rough estimate of the feasibility of developing wind energy in a given region with given meteorological conditions is outlined. P.T.H.

A78-28558 Meteorology and wind energy utilization (Meteorologie und Windenergienutzung). R. Roth (Hannover, Technische Universität, Hanover, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 71-79. In German.

The paper discusses the type of information regarding field structure needed for estimating the feasibility of operating wind energy conversion systems. Some basics on planetary boundary layer theory are reviewed. The general problem of choosing a site for a wind energy converter is outlined, and a brief method of estimating the economic utility of a wind power generator for a given site is shown. P.T.H.

A78-28559 Wind energy conversion - Horizontal-axis machines (Windenergieumwandlung - Anlagen mit horizontaler Achse). H. Dörner (Stuttgart, Universität, Stuttgart, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 81-97. In German.

The paper discusses the various design options available for horizontal-axis wind energy converters. First the general requirements on such systems are enunciated, such as easy service accessibility, climatic stability of the components, modularity, and

low cost. Three size classes are characterized, corresponding to different user needs. The design options considered are those for the generator, the drive system, tower construction, and control. Comparisons are made between the performance of the free-running turbine with the horizontal axis, the shrouded turbine, the Savonius rotor; and the vertical-axis (Darrius) rotor, from which the superiority of the free-running machine with horizontal axis, in terms of the ratio of wind-exposed surface area to total material surface area, is revealed. P.T.H.

A78-28560 Mode of operation and characteristics of Darrius rotors (Arbeitsweise und Merkmale von Darrius-Rotoren). H. Selzer and C. Cohrt (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 111-124. In German.

Some of the main features of the operation of a vertical-axis (Darrius) rotor for wind energy conversion are examined. The basic method for calculating the performance index of a rotor is shown. Startup behavior, materials, conversion technique, and efficiency of operation are briefly discussed. Curves showing the dependence of the performance index on the high-speed rpm number for an experimental Darrius rotor are given along with a design chart giving the rotor diameter vs design wind speed relation for rotors of four different output classes from 1 kW to 100 kW. P.T.H.

A78-28561 Measurement program of the Dutch experimental vertical-axis wind turbine (Das Messprogramm der Niederländischen experimentellen Windanlage mit vertikaler Achse). J. B. D. H. Bolt (Fokker-VFW, Schiphol Airport, Netherlands). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 125-132e. In German.

The main design criteria met by the experimental Darrius (vertical-axis) rotor for the Dutch wind energy research program are enunciated. The two-bladed rotor was made of plastic, the diameter and composition of the blades being constant over their whole length. The blades were attached to the vertical axis in such a way that the stiffness of the joint could be later adjusted in order to accommodate possibly three blades and variable-diameter blades. Parameters measured in the experiments included rotor aerodynamic efficiency and its dependence on wind conditions, dynamic behavior of the whole turbine, static and dynamic loading of the blade roots during normal running and transient conditions, efficiency at constant and variable rpm number, stagnation region parameters and strength of vorticity behind the turbine. A diagram showing the installation and location of the measuring instruments is given. P.T.H.

A78-28562 Aeroelasticity problems in wind energy converters (Aeroelastische Probleme bei Windenergiekonvertern). F. Kiessling (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt Institut für Aeroelastik, Göttingen, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 133-164. 21 refs. In German.

A survey of the aeroelastic constraints on wind energy converters is given, with emphasis on horizontal-axis converters. Fundamental dynamic considerations are examined. The role of the natural vibration behavior of a system during aeroelastic processes is identified, with attention given to rotor and tower natural vibrations. Stability of the whole system is studied on the basis of a simplified model, for which possible instabilities are characterized. P.T.H.

A78-28563 Recent developments in wind turbines (Neuentwicklungen von Windturbinen). O. Ljungstrom. In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 165-186. In German.

Results of some systems studies on wind power development in Sweden are presented, and problems regarding blade design, size effects, material choice, weight, and costs are discussed. It is shown that increasing the installation size from 1 MW to 5 MW actually has the effect of a 50% reduction in required ground area. A study of the dependence of system investment on power output in the range 100 kW to 10 MW shows that, when investments in ground, roads, power circuits, and grid connection are taken into account, the minimum system cost tends toward large installations, about 2-5 MW. P.T.H.

A78-28564 Wind energy converter and mechanical energy converters - Matching and control (Windenergiekonverter und mechanische Energiewandler - Anpassung und Regelung). S. Heier (Kassel, Gesamthochschule, Kassel, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 187-222. 8 refs. In German.

The characterization of the performance of the impeller of a wind turbine in terms of the power coefficient, torque coefficient, and high-speed number is described. The basic characteristics of the main types of machines converting the shaft rotational energy into useful energy are discussed. These include pumps, dc shunt generators (both externally excited and self-excited types), synchronous generators on a rigid grid and with variable rotation speed and constant excitation, asynchronous machines as generator on a multiphase grid, and self-excited asynchronous generators. Different control modes corresponding to these conversion types are discussed. P.T.H.

A78-28565 Possibilities for demand-oriented delivery of wind energy. (Möglichkeiten zur Bedarfsorientierten Abgabe der Windenergie). J. P. Molly (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Bauwesen- und Konstruktionsforschung, Stuttgart, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 223-250. 14 refs. In German.

The paper outlines a design process for calculating optimum rotational speed of the rotor, specific surface yield, and the storage capacity necessary for a definite guaranteed delivery for a wind power plant. Problems involved in the operation of wind power plants interconnected with the main grid are discussed. P.T.H.

A78-28566 Novel wind turbine: Invention of a Viennese engineer - 'Fan principle' yields severalfold the current effective power (Neuartige Windturbine - Erfindung eines Wiener Ingenieurs - 'Fächerprinzip' ergibt Vielfaches der bisherigen Nutzleistung). G. Oppolzer. In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 228b-228e. In German.

The general idea of a new type of wind turbine is presented. The machine consists of two wind wheels rotating in a horizontal plane. The wheels are mounted on one axis at an angle to each other, so that from one direction they appear to interlock while on the opposite side they are spread wide apart, offering maximum surface to the wind. The machine operates at any wind speed and can start up under load. Performance data provided give a 6.3 kW output at wind speed of 7 m/sec and 55.4 kW at 15 m/sec for a machine having a rotor diameter of 11 m. P.T.H.

A78-28567 Concepts for the intermediate storage of wind-generated secondary energy (Konzepte zur Zwischenspeicherung von winderzeugter Sekundärenergie). J. Nitsch (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 251-274. 12 refs. In German.

Storage systems for wind-generated energy are discussed, with attention given to systems involving flywheels, hydraulic pumps,

electrochemical cells, air compressors, and hydrogen gas production. Storage concepts for small-scale (i.e., in the kilowatt range) generating plants, as well as large-scale plants (in the 1-3 megawatt range), are reviewed. Because of the small space required and the high energy storage efficiency involved, flywheel storage systems appear to offer the best option for commercial-scale wind-powered generating plants. J.M.B.

A78-28568 The coupling of solar energy utilization and wind energy utilization (Koppelung von Sonnen- und Windenergienutzung). U. Bossel (Aerodynamische Versuchsanstalt, Göttingen, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 275-303. In German.

The use of a combined solar-energy and wind-energy plant for space heating is described. In arguing for the feasibility of the combined solar/wind system, the complementary availability of solar radiation and wind energy over the course of a year or a single day is assessed. A sample plant involving a 10-kW wind energy converter, a power storage system and a solar energy collector is considered. J.M.B.

A78-28569 Possibilities for wind energy applications in nations of the Third World (Einsatzmöglichkeiten der Windenergie in Ländern der Dritten Welt). I. Vendolsky (Deutsche Gesellschaft für technische Zusammenarbeit GTZ, Eschborn, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 305-322. In German.

The possible uses of wind-powered generators in developing nations are reviewed, with emphasis on rural electrification projects, irrigation system employing ground water or water from streams, and drinking water pumping systems. The example of Malta, which has under consideration a system of wind generators for electrical energy production, is given particular attention. J.M.B.

A78-28570 Twind wind mill (Die Twindkraftmühle). S. Kalke, J. Gjerding, and F. Gustafsson (Vestjysk Energitkontor, Ulfborg, Denmark). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 323-327. In German.

The Twind wind mill (Twindkraftmühle) is a 2-megawatt high-speed engine consisting of a tower, a blade-holder, and three blades. The tower is 53 m high, the blade-holder is cigar-shaped and rotates on the top of the tower, and the blades are 27 m long, up to 2.1 m wide, and weigh about 4500 kg. Forty rpm is maximum, and is obtained with winds of 14 m/s. Technical parameters and information on costs and power output are provided. M.L.

A78-28571 Fully automatic wind power plant 125/220 V 4 KVA (Vollautomatische Windenergieanlage 125/220 V 4KVA). G. I. Mirus (Winson GmbH and Co., Eckernförde, West Germany). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 335-339. In German.

A fully automatic wind power plant is discussed with attention to its feathered propeller blades, generator, circuitry, and automatic steering. One of the functions of the automatic steering mechanism is to prevent damage from storms, and the stability required of windmills exposed to higher-than-normal winds is considered. The role of automatic switches and load increments is explained. M.L.

A78-28572 Maximum wind energy utilization by means of a single-unit wind turbine (Maximale Windenergienutzung durch Einheitswindturbinen EWT /DBPa.). W. Mayer-Schwinnig. In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 341-344. In German.

Factors relevant to the optimization of wind turbine performance are surveyed, and parameters for two wind turbine blades are

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presented. Four heights are considered for these height-dependent parameters, which define the theoretical yields and energies at average wind velocities and the optimum net yield and maximum energy output. Multiunit turbine arrangements, whose energy ratings are equal to the sum of the component unit energy ratings, are examined. M.L.

A78-28573 Criteria for the manufacture and operation of wind power installations with power up to 10 kW (Kriterien bei der Herstellung und dem Betrieb von Windkraftanlagen bis 10 KW). In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 353-362. In German.

Several topics relevant to the design of wind power installations are surveyed. Inherent limitations in power generation are considered, safety factors in blade construction and to protect against damage from high winds are examined, and the size, output, and construction of generators are briefly reviewed. Characteristics of batteries and transformers are also reported. M.L.

A78-28574 Cost-effective concept for utilization of wind energy - Results based on experience with the Sylt double rotor (Ein kostengünstiges Konzept zur Nutzung der Windenergie - Konsequenzen aus den Erfahrungen am Sylter Doppelrotor). H.-D. Goslich. In: Energy from wind; Meeting, 4th, Bremen, West Germany, June 7, 8, 1977, Report. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 363-369. In German.

A windmill design, based on the design of the windmill erected in 1973 on Sylt Island, West Germany, is described. The windmill would be able to generate 11 kW and would have a 10-m-diameter rotor, two blades with hinged flaps, either an 8 or 12 m mast, and a weight (excluding the mast) of 480 kg. The blades are a foot wider than the width indicated by theoretical analysis and will at first be constructed of fiberglass and later of aluminum, considered to be more economical. Design and operating parameters are discussed, experience with models is reported, and costs are examined. M.L.

A78-28576 Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2 - Practical technology for residences (Heizen mit Sonne II - Grundlagen der Solartechnik; Tagung, 3rd, Munich, West Germany, March 3, 4, 1977, Tagungsbericht. Volume 2 - Praxisnahe Haustechnik). Meeting sponsored by the Deutsche Gesellschaft für Sonnenenergie. Edited by U. Bossel. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977. 405 p. In German. \$19.23.

Consideration is given to various technical, operational and economic aspects of solar houses, where solar energy is collected by solar arrays and used primarily for space heating and cooling, and water heating. European energy policy to the extent it relates to solar houses is discussed. Solar heating is discussed in terms of architectural integration of solar systems into buildings and to the thermal design of solar houses. Problems of system technology and thermal engineering associated with solar houses are discussed along with problems of safety, law and economics. B.J.

A78-28577 Solar energy utilization in 1977 - Status, results, prospects (Sonnenenergienutzung 1977 - Stand, Erfahrungen, Aussichten). B. Ante (Battelle-Institut, Frankfurt am Main, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 3-28. 7 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

The article opens with a brief review of current and new (fusion, and direct and indirect solar energy) energy technology in the context of energy crisis and energy policy. Consideration is then given to the state of the art and the state of innovation in solar-energy technology with attention paid to the potential for the widespread practical utilization of solar energy, and to the worldwide

distribution and marketing of solar energy installations and, in particular, solar houses. The future market for one- and two-family solar houses is discussed. The extent to which solar energy can alleviate world energy problems is considered. B.J.

A78-28578 Solar energy research in the European Economic Community (Solarenergieforschung in der Europäischen Gemeinschaft). A. Strub (Kommission der Europäischen Gemeinschaften, Brussels, Belgium). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 29-41. 6 refs. In German.

A review is presented of EEC energy policy with regard to R&D in the field of solar energy. Brief descriptions are given of the following projects: flat-plate collectors and their application in buildings, solar thermal power plants, photoelectric conversion, photochemical and photosynthetic processes, bioconversion, and the collection of insolation data. The organization and management of the EEC solar R&D program are described. B.J.

A78-28579 Solar-array installations operating in Germany (Ausgeführte Solaranlagen in Deutschland). A. Urbanek (Deutsche Gesellschaft für Sonnenenergie, Munich, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 43-60. In German.

A survey is presented of solar heating installations now in operation in West Germany. Consideration is given to the use of solar systems for swimming-pool heating, water heating, space heating, and hybrid heating systems. Also considered are solar heat pumps, solar energy conversion efficiency, low-temperature heating, types of collectors, storage technology, materials, and questions of solar-house architecture. The construction of solar systems in the well-insulated Baden-Württemberg area is discussed. B.J.

A78-28580 Buildings design with reference to the natural utilization of solar energy (Baugestaltung im Hinblick auf die natürliche Nutzung von Sonnenenergie). P. Steiger (Darmstadt, Technische Hochschule, Darmstadt; Steiger Partner AG, Düsseldorf, West Germany; Steiger Partner AG, Zurich, Switzerland). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 63-75. In German.

A simple hierarchical scheme is used to illustrate the utilization of solar energy as a primary (or central) energy source for buildings. The scheme in descending order includes: quantity of energy (insolation), mode of conversion (direct or indirect), efficiency, and time of utilization. A number of architectural questions concerning solar houses are examined. B.J.

A78-28581 Proposals for the design and construction of solar houses (Anregungen für Entwurf und Konstruktion von Sonnenhäusern). D. Althaus and P. Krusche (Hannover, Technische Universität, Hannover, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 77-114. 10 refs. In German.

A series of hand-drawn pictures is presented to illustrate how to integrate solar arrays into existing (retrofitted) or new solar-house designs and how to determine solar-heat-optimal architectural forms. Consideration is also given to optimal architectural integration of heat storage systems, wind protection, and radiation surfaces into solar houses. B.J.

A78-28582 Prospects for the development of solar houses (Entwicklungsperspektiven von Solarheizanlagen). H. Schweig (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2.

Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 115-129. In German.

A survey is presented of experience with demonstration houses with solar water-heating and space-heating in West Germany. Consideration is given to the MBB-Heliotherm prefabricated system and to conversion efficiency and ways to increase performance of solar houses. A cost-effectiveness analysis of solar houses is presented. B.J.

A78-28583 Thermal-engineering preliminaries for the retrofitting of old houses to solar-energy utilization (Wärmetechnische Vorarbeiten für die Umstellung von Altbauten auf Sonnenenergienutzung). K. Fantl. In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 131-149. In German.

Some guidelines for preparing old one- and two-family homes for conversion from conventional water-heating and space-heating to solar heating are presented. Emphasis is placed on the following thermal-engineering considerations: adequate thermal insulation of windows and walls, insulation of such additions as terraces and balconies, the insulation of cellars and adequate weather protection. Consideration is given to the architectural integration of house structure and solar system. B.J.

A78-28586 Integration of solar-energy designs with existing heating systems (Ankoppelung von solartechnischen Einrichtungen an vorhandene Heizsysteme). H. Krinninger (München, Fachhochschule, Munich, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 167-203. 6 refs. In German.

The article investigates to what extent the integration of solar systems with existing house heating (water and space heating) systems is technically feasible and cost effective. The incorporation of solar-system designs into a one-family house and into a bungalow are considered. Particular attention is paid to solar-heat-pump water heating. Insulation conditions for various months of the year are investigated; requirements regarding collector surfaces and heat-storage system dimensions are examined. B.J.

A78-28587 Aqueous heat-carrying liquids for solar houses (Wässrige Wärmeträgermedien für Solaranlagen). K. P. Barthold (BASF AG, Ludwigshafen, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 205-211. In German.

It is noted that none of the working fluids commonly used in solar houses: water, water with corrosion inhibitors, a specially inhibited glycol-water solution, and high-boiling-point hydrocarbon derivatives can meet the wide range of chemical, thermal and biological requirements that would make such fluids optimal. A working fluid - PKL 300 - has been developed which, nontoxic and corrosion-resistant, satisfies the requirements better than the other fluids. A table giving the physical parameters of PKL 300 is given. B.J.

A78-28588 The use of thermal oils for energy transfer in the primary cycle of solar heating systems and solar power plants (Die Verwendung von Thermoölen für den Energietransport im Primärkreislauf solarer Heizungssysteme und solarer Kraftwerke). F. W. Pieper (Rhône-Poulenc Chemie GmbH, Frankfurt am Main, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 213-229. In German.

Gilotherm ADX 10, a synthetic alkylbenzol-base heat-transfer fluid, is proposed as the working fluid for solar-house heating systems incorporating flat-plate collector arrays, and solar heating of

space and water. Gilotherm ADX 10 has good corrosion properties, good thermal stability, and good chemical and toxicity properties; figures describing the thermodynamic properties and heat transfer properties of the fluid are presented. Next, consideration is given to hydrogenated polyphenyl-base fluid, Gilotherm TH, to be used as the working fluid in focusing-collector power generation systems. The performance of the fluid is compared to that of other working fluids (water/steam and water/glycol). B.J.

A78-28589 Air as a heat-transfer fluid (Wärmeträgermedium Luft). A. Stork (Ingenieurbüro Stork München, Neubiberg, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 231-250. In German.

Consideration is given to the heat-transfer properties of moist air and experimental data are presented on these properties for different values of relative humidity. Quantitative data are presented on air heating and cooling rates for winter and summer, respectively, with emphasis placed on house heating and cooling conditions. Psychrometric diagrams are used to investigate the efficiency of moist air as a heat-transfer fluid for solar houses. The compatibility of air systems with different types of collectors is considered. B.J.

A78-28590 Water-storage in a solar-heating system - Cost effectiveness, realization and requirements (Brauchwasser-Speicher für die Nutzung von Sonnenenergie - Wirtschaftlichkeit, Ausführungen und Anforderungen). G. Wagner (Viessmann Werke, Allendorf über Frankenberg, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 251-270. In German.

Some preliminary considerations with regard to solar-house heating systems are presented: insulation and available quantity of solar energy, the yearly heat requirements for a building, the yearly oil-requirement for a conventional water-heating system, and the energy savings using a solar-collector system. Consideration is then given to the use of bivalent storage-systems for solar-heated water and to the technical realization of the VertiCell-Bivalent storage systems. Diagrams are presented illustrating the design of systems incorporating the VertiCell-8 and VertiCell-3 storage units. B.J.

A78-28591 Direct utilization of solar energy with the aid of low-temperature heating (Direkte Nutzung von Sonnenenergie mit Hilfe von Niedertemperaturheizungen). H. Bach (Stuttgart, Universität, Stuttgart, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 271-280. In German.

Direct solar heating of houses precludes the use of any energy sources but the sun as well as the use of heat pumps to raise the temperature of the heat-transfer fluid. The major components of the system, used here for low-temperature heating, are a solar-collector array, a heat-storage unit and the working fluid. In designing a low-temperature-heating solar house, consideration is given to month-by-month yearly heat requirements and to the optimal type of solar collector. B.J.

A78-28592 Integration of heat pumps into solar-heating systems (Einsatz von Wärmepumpen zur Unterstützung von Sonnenheizungen). A. Kehl (Robert Bosch GmbH, Stuttgart, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 281-300. In German.

Consideration is given first to the operation of a compression heat-pump (a heat-pump diagram is presented and the behavior of evaporation and condensation temperatures is examined) and then to the design and operation of solar-house heating systems. Several designs integrating heat pumps into solar systems are suggested; in

particular the use of a bivalent heat pump is investigated. A computer-simulation study of the performance of a solar-heating - heat-pump system is performed. B.J.

A78-28593 Technical safety questions concerning solar energy installations (Sicherheitstechnische Fragen bei Solaranlagen). K. Breuer (Zentralverband Sanitär, Heizung und Klimatechnik, Bonn, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 303-318. In German.

Fire and water-pressure regulations relevant to solar energy installations are examined in the framework of a discussion of solar installation safety. Solar energy installations are contrasted with roof heating systems. Topics considered include the pipe system, heat exchange system, temperature control, and means of preventing excessive water pressure. It is suggested that components should be tested with regard to their operation in unified systems. M.L.

A78-28594 Building rights, apartment- and residence-designing in the light of solar energy utilization (Baurecht, Hochbau- und Siedlungsplanung unter Berücksichtigung der Sonnenenergienutzung). R. Bierhals, G. Schäfer, and D. Weigert (Institut für Systemtechnik und Innovationsforschung, Karlsruhe, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 319-341. In German.

The feasibility of using solar energy systems for hot water and space heating in the German Federal Republic is reviewed, and the problems associated with wide-scale incorporation of solar energy systems into apartment and single-family residence designs are considered. Appropriate roofing materials for use with solar collectors are described. Particular attention is given to the problem of shadows which may be cast on solar collectors by neighboring buildings. J.M.B.

A78-28595 Legal problems of solar energy utilization (Rechtsprobleme der Sonnenenergienutzung). A. Hueber. In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 343-355. 20 refs. In German.

The extent to which people can have a right to sunlight for solar energy use is discussed with attention to the rights of neighbors whose exposure to the sun is reduced by the installation of solar energy devices. The angle of sunlight incidence is considered, and a formula for calculating the allowable distance between existing buildings in terms of the height of the added solar device is introduced. The use of regulations to ensure that new buildings possess solar collectors is examined, and the goals of a building code are indicated. M.L.

A78-28596 Energy conservation and energy source substitution in old buildings - Estimation of cost and efficacy (Energiesparen und Energieersatz bei Altbauten - Beurteilung von Aufwand und Wirkung). C. U. Brunner. In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 357-376. In German.

The use of the ratio of the number of users to surface area to evaluate the feasibility of utilizing solar energy for either room heating or water heating is analyzed, and the problem of minimizing the use temperature is discussed. Difficulties associated with the use of solar energy systems in already existing buildings are examined. The cost and efficacy of solar energy is considered in comparison with fossil fuels and with respect to the level of service to be provided to units in old apartment houses. M.L.

A78-28597 Heating costs and rentability - Projection of growth of demand in the housing market (Heizkosten und Vermietbarkeit - Vorschau auf die Bedarfsentwicklung auf dem Wohnungsmarkt). B. Weidlich (Battelle-Institut, Frankfurt am Main, West Germany). In: Heating with the sun II - Principles of solar technology; Meeting, 3rd, Munich, West Germany, March 3, 4, 1977, Report. Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p.377-396. 7 refs. In German.

Heating costs for low, middle, and high income families in West Germany are statistically analyzed, and it is concluded that the sharp increase in energy prices between 1973 and 1975 did not, from an overall point of view, increase heating costs, presumably because the winters in those years were mild and because energy conservation procedures were introduced. While, from an overall point of view, the energy price increases will not affect demand for housing, it is thought that the increases will actually depress demand because energy costs did rise significantly for many households. The possibilities of energy conservation in house heating are examined, and it is predicted that houses built between 1976 and 1985 will represent a maximum of 15% of the 1985 housing; this figure places practical limits on energy conservation. Long-term housing construction is estimated in the range of 330,000-380,000 units. M.L.

A78-28800 Monitoring solar space heat. M. Hyman, Jr. (Solar Heat Corp., Arlington, Va.). *ASHRAE Journal*, vol. 20, Mar. 1978, p. 23-25.

A 2300 sq ft house in Massachusetts, heated entirely by solar energy, is described. Solar heat is acquired in a conventional manner, i.e., a temperature probe contacts the metal absorber plate near the panels and a second probe is inserted in a 16,000 gal storage pool in the basement. A temperature differential of 15 deg F is required to start a 0.5 hp centrifugal pump. When the differential drops to 3 deg F, the pump stops and the water is drained. Heat distribution to the house is effected by circulating water. Optimum temperatures for day and night are maintained at 68 and 60 F, respectively. The efficiency of the system is evaluated for different seasons in terms of solar BTU input and heating output. Pay back time at current energy prices is estimated at 30 years. D.M.W.

A78-28843 Concentration of the sun's rays using catenary curves. G. A. Rottigni (Genova, Università, Genova, Italy). *Applied Optics*, vol. 17, Mar. 15, 1978, p. 969-974. 8 refs.

An examination has been carried out of the difficulties a horizontally placed parabola would encounter in concentrating the sun's rays when the angle of incidence between the axis of the parabola and parallel incident rays grows from 0 deg to 50 deg. The results obtained with two catenary curves formed by hypothetical reflecting adjustable sheets were compared with the parabola, showing that the concentration can be held at interesting levels as regards technical application. (Author)

A78-28888 # Structure of a beam reflected by a heliostat (Struktura puchka, otrazhennogo geliostatom). V. K. Baranov. *Geliotekhnika*, no. 6, 1977, p. 3-10. In Russian.

If a heliostat is situated at a considerable distance from the illuminated target, the structure of the reflected beam will be considerably different from that of the original solar beam. It is shown that for a heliostat-target distance of about 107 times the diameter of the heliostat aperture, there will be a central zone in the form of a convergent cone within which the flux density is uniform and varies little from the flux incident on the reflector. Further on there is a stretch, the central zone of which has the form of a divergent cone, where the flux density decreases with the square of the distance from the reflector. P.T.H.

A78-28890 # Engineering estimate of the quality of facets obtained by a deformation method of form giving (K tekhnologicheskoi otsenke kochestva fatset, poluchennykh deformatsionnym sposobom formobrazovaniia). R. A. Zakhidov, Iu. A. Dudko, and L.

A. Dubrovskii (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priboroostroeniia, Uzbek SSR). *Geliotekhnika*, no. 6, 1977, p. 19-22. In Russian.

A mixed numerical-experimental method of evaluating the quality of the facets of solar concentrators is proposed. The method is such that the quality of a facet, by which is meant principally the concentrating power of the facet, can be estimated during the development of a processing method. Hence it is based on results of local monitoring of the concentrating power, with comparisons being made with calculations for an ideal concentrator. P.T.H.

A78-28891 # Automating the control of the optical system of a tower-type solar power station (Avtomatizatsiia upravleniia opticheskoi sistemy SES bashennogo tipa). A. M. Khalykov and R. R. Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *Geliotekhnika*, no. 6, 1977, p. 23-31. 14 refs. In Russian.

Two possible schemes for controlling the mirror reflectors (heliostats) of the optical concentrator of a solar power station using the concept of a solar tower are outlined. The two schemes call for individual control and centralized control, respectively, of the system of heliostats. In the former concept, each heliostat has its own servosystem providing independent angular displacement. The latter concept, suited for large systems, incorporates into an individual control system the possibility of feedback and monitoring control. P.T.H.

A78-28892 # Photoelectric radiation-density meter (Fotoelektricheskii izmeritel' plotnosti izlucheniia). B. A. Bazarov, Kh. Bazarov, and D. S. Strebkov (Akademiia Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Geliotekhnika*, no. 6, 1977, p. 32-34. In Russian.

A method allowing measurement of radiation flux at any point of a region with high flux density is described. The sensitive element is a high-voltage matrix photocell. Several of these devices are displaced through the focal region of a concentrator at a velocity not exceeding the velocity corresponding to the maximal critical frequency of the p-n junctions of the photocells. If the energy flux exceeds 100,000 V/sq m, the matrix photocells are cooled in a quartz tube filled with circulating water. P.T.H.

A78-28895 # Study of physicochemical processes in fabrication of reflectors from polymer materials (Issledovanie fiziko-khimicheskikh protsessov pri izgotovlenii otrazhateli iz polimernykh materialov). O. Iu. Sobirov, A. M. Gafurov, S. N. Vil'kova, and G. Ia. Umarov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 6, 1977, p. 44-49. In Russian.

The study concerns the physicochemical processes involved in the formation of a strong bond between the coating material and the reflecting surface of a foam-film solar concentrator. Attention is given to (1) formation of contact, i.e., physical approach of the molecules of the vapor-deposited polymers and the substrate to the proper distance for chemical reaction, (2) activation and chemical interaction of the molecules, leading to a strong bond, (3) film formation, and (4) relaxation processes such as recrystallization, heterodiffusion, new phase formation, etc., which can either enhance or diminish the bond strength. The change in the contact surface during coalescence of like particles is analyzed, and the relation between temperature, viscosity and surface tension of the material is examined. Optimal process parameters are determined. P.T.H.

A78-28896 # Effect of heat treatment on optical properties of collectors for solar energy installations (Vlianie termicheskoi obrabotki na opticheskie svoystva kollektorov geliostanovok). A. A. Fattakhov, Sh. A. Faiziev, U. Kh. Gaziev, and V. S. Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 6, 1977, p. 50, 51. 8 refs. In Russian.

A78-28897 # Thin-film black-white coatings for the receivers of solar energy installations (Tonkoplennochnye cherno-belye pokrytiia dlia priemnikov solnechnykh energeticheskikh ustanovok). V. V. Li, Sh. A. Faiziev, U. Kh. Gaziev, and V. S. Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 6, 1977, p. 52-55. 8 refs. In Russian.

The paper describes the development of a high-temperature selective coating for solar receivers using SiO₂ and CeO₂ for the dielectric layers and a thin film of molybdenum as the metallic layer. Three different materials were used for the substrates: stainless steel, glass covered by an aluminum film, and molybdenum foil. The thicknesses of the metallic and dielectric layers were optimized experimentally. From transmission and reflection curves it was determined that the optimal thickness of the molybdenum film is 250-300 Å. By using two-layer antireflection coatings it was possible to raise the absorption coefficient to 0.85-0.9. When molybdenum foil or Al-coated glass are used as substrate, the integral radiation coefficient is lowered to 0.06-0.1. P.T.H.

A78-28899 # Calculation of the drag of a cylindrical pebble-type heat retainer (K raschetu gidrodinamicheskogo soprotivleniia galechnogo akkumuliatora tsilindricheskogo tipa). B. Khairitdinov, T. A. Sadykov, and A. B. Vardilashvili (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent; Karshinskii Gosudarstvennyi Pedagogicheskii Institut, Karshi, Uzbek SSR). *Geliotekhnika*, no. 6, 1977, p. 73-75. 8 refs. In Russian.

The paper describes an empirical method of determining the hydraulic resistance of an underground heat accumulator consisting of a cylinder filled with pebbles and wrapped in a transparent polyethylene film. The method is based on measuring the flow rate of water through the accumulator at various pressures. The dependence of hydraulic pressure on Reynolds number is determined. The results can be transferred to the case of air in order to determine the proper power of the fan. P.T.H.

A78-28924 * Limitation of 3547 to 1182 Å conversion efficiency in Xe. L. J. Zych and J. F. Young (Stanford University, Stanford, Calif.). *IEEE Journal of Quantum Electronics*, vol. QE-14 Mar. 1978, p. 147-149. 7 refs. Contract No. N00014-75-C-1175 Grant No. NGL-05-020-103.

It is found that the 3547 to 1182 Å conversion efficiency in Xe-Ar mixtures is limited to about 0.9% by Kerr-induced dispersion. The primary effect is felt to be produced by a mixed-frequency Kerr nonlinearity which changes the index of refraction at 1182 Å in the presence of large power densities at 3547 Å, affecting phase matching. It is suggested that a Xe-Mg-Ar mixture compensates for the Kerr-induced dispersion and permits increased efficiencies. S.C.S.

A78-28946 # Environmental transport model of heavy metals. R. J. Wagenet, W. J. Grenney, and J. J. Jurinak (Utah State University of Agriculture and Applied Science, Logan, Utah). *American Society of Civil Engineers, Environmental Engineering Division, Journal*, vol. 104, Feb. 1978, p. 61-76. 7 refs. Research supported by the Southern California Edison Co.

A general environmental model for estimating the mass flow transport of heavy metals in the atmosphere, soil and water has been applied to predict heavy-metal pollutant dispersal from stack emissions of a coal-fired electric power plant. Transport of such potentially toxic metals as mercury, lead, cadmium, chromium, zinc and beryllium was studied through use of the model. An atmospheric model, a rainfall-generating model, a terrestrial erosion model and a soil chemistry model provided mechanisms to represent 25-year loading by aerosol fallout into an environmental sink (a lake). Fallout of mercury accounted for 83% of that metal in the lake after 25 years; cadmium fallout contributed 6% of the loading of that metal into the lake. Contributions of other metals to the lake pollution were insignificant. J.M.B.

A78-28951 # Influence of the nonuniformity of the field of force on the flow in an MHD channel (O vliianii neodnorodnosti polia sily na techenia v MGD kanale). V. A. Bitiurin, V. N. Zatepin, and G. A. Liubimov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1978, p. 3-12. 12 refs. In Russian.

The transition of uniform flow into a complex three-dimensional flow in an MHD power generator is examined, and the factors responsible for the transition are discussed. Effects associated with secondary flows arising at the corners of a rectangular channel are reviewed. The analysis is centered on the interaction between an initially uniform flow of an electrically conducting ideal fluid and a nonconservative Lorentz force that generates a three-dimensional secondary flow. The solution obtained yields the three-dimensional pattern of the distribution of the velocity components and pressure in a rectangular MHD channel. V.P.

A78-29195 * Diffusion lengths in amphoteric GaAs heteroface solar cells. K. L. Ashley and S. W. Beal (Southern Methodist University, Dallas, Tex.). *Applied Physics Letters*, vol. 32, Mar. 15, 1978, p. 375, 376. NASA-supported research.

Minority-carrier diffusion lengths in amphoteric GaAs:Si were investigated. Electron and hole diffusion lengths in p- and n-type, respectively, were determined to be 13 microns and 7 microns. Preliminary efficiency measurements on heteroface structures based on amphoteric GaAs:Si p-n junctions indicated that these devices should make excellent solar cells. (Author)

A78-29199 Simplified fabrication of GaAs homojunction solar cells with increased conversion efficiencies. J. C. C. Fan, C. O. Bozler, and R. L. Chapman (MIT, Lexington, Mass.). *Applied Physics Letters*, vol. 32, Mar. 15, 1978, p. 390-392. 6 refs. USAF-sponsored research.

Conversion efficiencies as high as 20% of AM1 have been obtained for single-crystal GaAs shallow-homojunction solar cells without Ga(1-x)Al(x)As layers. These cells, which are fabricated by a simplified technique that does not require any vacuum processing steps, utilize an n(+)/p/p(+) structure with an antireflection coating prepared by anodic oxidation of the n(+) layer. (Author)

A78-29222 Harnessing the wind. J. T. Yen (Grumman Aerospace Corp., Bethpage, N.Y.). *IEEE Spectrum*, vol. 15, Mar. 1978, p. 42-47.

Conventional wind machines, such as the propeller and Darrieus types, are limited by areas having a low intensity of energy flux or where the wind has unpredictable fluctuations. It has been suggested that sizable storage devices may offset some of these problems. Limitations are also encountered with wind farms, i.e., clusters of wind machines. These include the need for considerable spacing and the possibility of injury resulting from blade failure. Various alternatives to these wind machines are being explored at the present such as the phi-Darrieus, Giromill and Madaras systems. Another possible alternative is the tornado wind-energy system where a large amount of wind is collected by a stationary, omnidirectional tower, forming a vortex within the tower. This system can use both low and high-grade heat energies, does not require cooling water, and avoids the chemical corrosion of the turbine blades. S.C.S.

A78-29226 Cogeneration. *Power Engineering*, vol. 82, Mar. 1978, p. 34-42.

Consideration is given to cogeneration, i.e., the simultaneous production of electricity and useful heat at one location. Five basic cogeneration systems are described and compared. Primary cogeneration cycles are explained, including gas turbine topping, diesel topping, steam topping, combined cycle, steam bottoming, and organic bottoming. Cogeneration growth potential is estimated for the period through 1985, and estimated cogeneration by various industries (food, textiles, pulp and paper, chemicals, petroleum refining, and steel) is posited for process steam, electric energy, and cogeneration capacity. Primary technical constraints are identified and various nontechnical constraints (institutional and financial) are noted. S.C.S.

A78-29227 Solar thermal test facility. C. A. Federer, Jr. *Sky and Telescope*, vol. 55, Apr. 1978, p. 286-291.

This paper describes the design and construction of a solar thermal test facility (STTF) in New Mexico. An array of 222 heliostat units is already in operation on the north side of an elevated boiling tower. Each unit is independently steerable and azimuth-adjustable. The combined focusing power of the entire heliostat array is 5 million watts thermal, with more power becoming available as more units are added to the other three sides of the tower. Electricity is to be generated by superheated steam, driving a conventional turbine. Also considered are systems for storing energy for use at night and during cloudy conditions, and safety systems. D.M.W.

A78-29289 Comparative energies of alternative fuels. E. M. Goodger (Cranfield Institute of Technology, Cranfield, Beds., England). *Applied Energy*, vol. 4, Jan. 1978, p. 39-50. 11 refs.

In order to provide additional design data on candidate alternative fuels, a broad comparison is made of the net calorific values of a wide variety of gaseous, liquid and solid fuels, including a number of alternatives of current interest, against a background of conventional fuels, some of which may have alternative applications. In general, higher gravimetric calorific values are shown by the lighter of the gaseous and liquid fuels and the heavier of the solid fuels. Volumetric calorific values rise with fuel density, with the exception of the fuel gases. Despite a wide overall range in calorific values, the gravimetric energy content of a stoichiometric fuel-air mixture is seen to be virtually independent of fuel type. In such applications as the spark-ignition piston engine and the rocket, additional combustion parameters arise which tend to overshadow calorific value and are therefore adopted for performance assessment. (Author)

A78-29290 Petroleum fuel additives - A case for recognition. D. W. Young (David W. Young and Associates, Inc., Chicago, Ill.) and M. J. Stacey (Triple-E /UK/, Ltd., London, England). *Applied Energy*, vol. 4, Jan. 1978, p. 51-73. 18 refs.

The use of additives with directly fired petroleum fuels is suggested. Several problems relating to fuel combustion are considered, and the potential role of additives in improving combustion efficiency is assessed. Carbon, sulfur, vanadium, inorganic, and other contaminants are discussed. Procedures for improving combustion and evaluating additives are examined, and a distinction is drawn between additives intended to improve actual combustion and additives which pass through the zones of combustion essentially unaltered to deal with problems further downstream. M.L.

A78-29291 Development of small-scale benign sources of energy in France. D. Probert (Cranfield Institute of Technology, Cranfield, Beds., England). *Applied Energy*, vol. 4, Jan. 1978, p. 75-84. 6 refs.

The paper reviews French approaches to harnessing 'alternate' sources of energy. Some of these approaches are intended for use in developing countries. Topics considered include solar energy collection for domestic use, power release, direct conversion of solar energy, bioconversion, wind power, the sea as an energy source, and geothermal energy. Agencies involved with each research project are identified. M.L.

A78-29330 * # General aviation energy-conservation research programs at NASA-Lewis Research Center. E. A. Willis (NASA, Lewis Research Center, Cleveland, Ohio). *Western Michigan University, Conference on Energy Conservation in General Aviation, Kalamazoo, Mich., Oct. 10, 11, 1977, Paper. 23* p. 14 refs.

A review is presented of non-turbine general aviation engine programs underway at the NASA-Lewis Research Center in Cleveland, Ohio. The program encompasses conventional, lightweight diesel and rotary engines. Its three major thrusts are, in order of priority: (1) reduced SFCs; (2) improved fuels tolerance; and (3) reducing emissions. Current and planned future programs in such

areas as lean operation, improved fuel management, advanced cooling techniques and advanced engine concepts, are described. These are expected to lay the technology base, by the mid to latter 1980s, for engines whose total fuel costs are as much as 30% lower than today's conventional engines. (Author)

A78-29331 * # Status of the DOE /STOR/-sponsored national program on hydrogen production from water via thermochemical cycles. C. E. Baker (NASA, Lewis Research Center, Cleveland, Ohio). U.S. Department of Energy and University of Miami, Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., Dec. 5-7, 1977, Paper. 15 p. 5 refs.

A pure thermochemical cycle is a system of linked regenerative chemical reactions which accepts only water and heat and produces hydrogen. Thermochemical cycles are potentially a more efficient and cheaper means of producing hydrogen from water than is the generation of electricity followed by electrolysis. The Energy Storage Systems Division of the Department of Energy is currently funding a national program on thermochemical hydrogen production. The National Aeronautics and Space Administration is responsible for the technical management of this program. The goal is to develop a cycle which can potentially operate with an efficiency greater than 40% using a heat source providing a maximum available temperature of 1150 K. A closed bench-scale demonstration of such a cycle would follow. This cycle would be labeled a 'reference cycle' and would serve as a baseline against which future cycles would be compared.

(Author)

A78-29427 Thermoelectric power of tin films at low temperatures. T. Fujita, S. Kobayashi, and T. Ohtsuka (Tohoku University, Sendai, Japan). *Physical Society of Japan, Journal*, vol. 44, Feb. 1978, p. 544-550. 24 refs.

The thermoelectric power of Sn films has been measured between 3.7 and 8 K. The temperature dependence observed for the film samples deposited on the glass substrate is found to be expressed as $S_{\text{sub } f} = a_{\text{sub } f} T + b_{\text{sub } f} T^2$. The mean free path theory of the size effect is applied to interpret the thickness dependence of a $S_{\text{sub } f}$ and to determine the energy dependence of the mean free path U and the Fermi surface area V . The second term of $S_{\text{sub } f}$ is discussed in terms of the strain-induced effects. (Author)

A78-29433 Destruction of magnetic surfaces near a separatrix of a stellarator attributed to perturbations of magnetic fields. Y. Tomita, Y. Nomura, H. Momota, and R. Itatani (Kyoto University, Kyoto, Japan). *Physical Society of Japan, Journal*, vol. 44, Feb. 1978, p. 637-642. 8 refs.

The destruction of magnetic surfaces in the vicinity of a separatrix of a stellarator and a torsatron is analyzed. Unperturbed magnetic surfaces formed by a straight helical current and a uniform magnetic field are assumed. Destruction of magnetic surfaces is attributed to perturbations of magnetic fields, which are assumed to be brought from toroidal effects of magnetic fields or discrete structure of magnetic coils, respectively. Analysis is based on 'Stochasticity' and a spread of a stochastic layer in the vicinity of the separatrix is calculated. (Author)

A78-29476 Annual Canadian Symposium on Reliability Engineering, 4th, Ottawa, Canada, October 13, 14, 1977, Proceedings. Symposium sponsored by the Society of Reliability Engineers. *Microelectronics and Reliability*, vol. 17, Jan. 1978. 218 p.

A collection of papers is presented regarding methods and programs of evaluating the reliability and maintainability of complex systems, with special emphasis on the effect of reliability programs on life cycle cost. These systems include advanced electronic equipment, nuclear power plants, communications systems, and mass transit systems. Topics of interest comprise structuring software development for reliability, optimization of maintainability, fault trees revisited, and engineering and reliability aspects of connectors in electronic system applications. S.D.

A78-29588 # Properties of fuels used in the Czechoslovak aircraft industry (Vlastnosti paliv pouzivaných v Cs. leteckém průmyslu). J. Krotky. (Konference na thema Regulace Leteckých Proudových Motorů, Velešín, Czechoslovakia, June 1-3, 1976.) *Zpravodaj VZLU*, no. 4, 1977, p. 181-187. In Czech.

Those characteristics of jet engine fuels that might influence the reliability of the fuel system are analyzed. Particular attention is given to antiwear properties, lubricating ability, and corrosive action. Causes of fuel pollution by mechanical microparticles, water, and microorganisms are examined. Higher standards for fuel purity are called for. P.T.H.

A78-29600 # For the latest in energy storage, try the flywheel. G. C. Chang (ERDA, Div. of Energy Storage Systems, Washington, D.C.) and F. Hirschfeld. *Mechanical Engineering*, vol. 100, Feb. 1978, p. 38-45. 5 refs.

Composite materials have made possible the construction of flywheels of light weight and high durability. Applications of the flywheel technique of energy storage are discussed with reference to automotive use. Energy otherwise dissipated during braking is stored by a flywheel to be used again during acceleration (regenerative braking). Various flywheel configurations are evaluated in terms of energy density, round trip efficiency, lifetime in years, and fixed spinning losses (stored energy). D.M.W.

A78-29620 The tokamak - Model T fusion reactor. D. Steiner (Oak Ridge National Laboratory, Oak Ridge, Tenn.) and J. F. Clarke (U.S. Department of Energy, Div. of Magnetic Fusion Energy, Washington, D.C.). *Science*, vol. 199, Mar. 31, 1978, p. 1395-1403. 36 refs. Research sponsored by the U.S. Department of Energy.

Present tokamak fusion technology is described in terms of cost, effectiveness as a power source, and as a foundation upon which more advanced fusion reactors can be built. A three-phase program, to be developed over the next 20 years, is outlined with reference to the design and operating parameters of essential reactor systems. Attention is given to the ORNL and UWMAK I designs. D.M.W.

A78-29623 Salt domes - Is there more energy available from their salt than from their oil. G. L. Wick and J. D. Isaacs (California, University, La Jolla, Calif.). *Science*, vol. 199, Mar. 31, 1978, p. 1436, 1437. 9 refs. Grant No. NOAA-04-6-158-4410. NOAA Project R/E-6.

The possibility of using the osmotic pressure differential in salt domes to generate electricity is investigated. The projected efficiency of energy production in various salt domes in Louisiana and Texas is evaluated, and compared with potential energy recovery from oil in the same domes. D.M.W.

A78-29625 Electromagnetic processes in ac/dc power converters. II - Symmetrical transient processes in power converters. III - Nonsymmetrical transient processes. M. A. Slonim (Negev, University, Beersheba, Israel). *IEEE Transactions on Industrial Electronics and Control Instrumentation*, vol. IECI-25, Feb. 1978, p. 65-73. 13 refs.

The article discusses electromagnetic processes occurring in ac/dc power converters. The study is based on a general equation which describes both transient and steady-state processes. In terms of symmetric transient processes, (1) calculations are made for the current at the beginning of the n-th repetition period, (2) an equivalent diagram is given, and (3) symmetrical transient processes (such as short circuits in ac and dc systems, or the inversion of dc voltage) are solved. In terms of nonsymmetrical transient processes, (1) processes occurring when converter symmetry is distorted are identified (one and two-phase faults, nonsymmetry of the firing angles), (2) the misfiring of the converter valve is discussed, and (3) arc-back processes are analyzed. S.C.S.

A78-29636 * Experiments with enhanced mode thermionic converters. P. E. Oettinger and F. N. Hussman (Thermo Electron Research and Development Center, Waltham, Mass.). *IEEE Transactions on Plasma Science*, vol. PS-6, Mar. 1978, p. 83-88. 8 refs. Contract No. NAS3-20302.

Reduction of the ionization and scattering losses associated with ignited mode cesium diodes is essential for high thermal-to-electrical conversion efficiency. Use of an auxiliary electrode in conjunction with a noble gas in the interelectrode space should permit more efficient ion generation for space charge neutralization. The characteristics of a thermionic triode utilizing a ring electrode and a dispenser cathode emitter have been studied as a function of xenon pressure, cesium reservoir temperature, spacing, electrode temperature and pulse parameters (i.e., potential, duration and repetition rate) applied to the auxiliary electrode. Pulsed operation significantly enhanced output power with uniform discharges appearing to be sustained at emitter-collector spacings as low as 0.5 mm. (Author)

A78-29660 Industrialization of space - Myth or the reality of tomorrow (L'industrialisation de l'espace - Mythe ou réalité de demain). A. Dupas (Paris XI, Université, Orsay, Essonne, France). *L'Aéronautique et l'Astronautique*, no. 68, 1978, p. 61-68. 13 refs. In French.

The paper reports some NASA concepts concerning the industrialization of space. Three types of activities - information acquisition and transmission, product fabrication, and energy production - are examined, and the technological requirements for these activities are briefly considered. Three phases of space occupation - easy access, permanent occupancy, and limited self-sufficiency - are described, and the development of space transport and the concept of a space construction base are explained. Also considered are industrial processes which can only be performed in space. M.L.

A78-29772 Global problems and energy. P. L. Kapitza (Akademii Nauk SSSR, Institut Fizicheskikh Problem, Moscow, USSR). (*Uspekhi Fizicheskikh Nauk*, vol. 122, June 1977, p. 327-337.) *Soviet Physics - Uspekhi*, vol. 20, June 1977, p. 547-553. 8 refs. Translation.

Processes characterized by geometric progression in amplitude and in rate of change, culminating in explosions or catastrophes, are considered in relation to global problems (population increase, energy consumption, living standards, exhaustion of natural resources - fuel and ores). The inadequacy of some renewable energy sources (solar, wind, geothermal) to meet major industrial needs is pointed out, and hazards inherent in nuclear industry (core meltdown, wastes disposal, plutonium proliferation), which could meet large-scale industrial energy needs, are discussed. Energy acquisition on a large scale via thermonuclear fusion or modifications of nuclear fission processes is considered, and energy from matter-antimatter interaction is mentioned speculatively. R.D.V.

A78-29868 Multi-stage digestion of municipal solid waste to fuel gas. D. L. Wise, R. L. Wentworth, D. C. Augenstein (Dynatech R/D Co., Cambridge, Mass.), and C. L. Cooney (MIT, Cambridge, Mass.). *Resource Recovery and Conservation*, vol. 3, Mar. 1978, p. 41-59. 16 refs. Research supported by the Consolidated Natural Gas Service Co.

The paper presents a study of municipal waste recovery in which acid formers in the waste material were separated from methane formers. A plug flow digesting system consisting of ten individual jars of 3.8 l each was constructed to suppress methane production, while solubilizing cellulosic material into organic breakdown products. The organics were then fed to an 83 l CSTR (continuous stirred tank reactor) for the generation of methane gas. Later, the same experiment was tried on a larger scale (2080 l total working volume, followed by a 2270 l CSTR). The combined system was found effective in reducing the need for gas scrubbing. Attention is given to acetic acid inhibition of acid forming microorganisms (which limit the solubilization in the plug flow unit). It is suggested that future research in this area focus on the development of microorganism populations which will tolerate higher levels of acetic acid. D.M.W.

A78-29873 What does it concern (De quoi s'agit-il). A. Dejou. *Sciences et Techniques*, Mar. 1978, p. 27-33. In French.

It is suggested that engineers apply the outlook of their discipline to distinguish between crucial and peripheral aspects of broad problems. The problem of interrelating energy production and ecological goals is discussed, and three general conclusions are advanced: (1) scientific and industrial progress does not benefit everyone simultaneously; (2) human activities are capable of degrading the environment; and (3) developed and developing countries will draw different conclusions from similar starting data. M.L.

A78-29904 Energy - Implications for transport. N. McMahon (Department of Transport and Power, Dublin, Ireland). *Chartered Institute of Transport Journal*, vol. 37, Dec. 1977, p. 365-369.

Various means of transportation are evaluated in terms of their fuel efficiency during the period since the 1973 oil embargo. Automobiles and trucks are seen as energy wasteful compared with railroads, but are too popular and convenient to eliminate. Instead, it is proposed that Europe adopt the miles per gallon regulations and lower speed limits of the United States. Ocean shipping has become dramatically more expensive over the last five years, resulting in excess capacity as shippers turn to the more fuel efficient larger ships. Airlines have managed to reduce fuel consumption by adjustments in routes and scheduling, and through the use of more fuel efficient aircraft. New fuel sources are also discussed, including synthetic hydrocarbons, electric batteries for large vehicles, and liquid hydrogen. D.M.W.

A78-29954 * High temperature materials for space power systems. J. J. Gangler (NASA, Washington, D.C.). In: Plansee Seminar, 9th, Reutte, Austria, May 23-26, 1977, Preprints. Volume 1. Reutte, Austria, Metallwerk Plansee AG, 1977. 8 p.

Future space power systems will largely be nuclear-driven or solar-driven Brayton cycle or thermionic converter systems. This paper presents some of the limited data available on the long-time properties of the superalloys and refractory metals that will have to be used in large parts of these systems. These data include vaporization rates of pure metals as a function of temperature, extrapolated stress for 1 percent creep in 10 years for selected superalloys, vacuum creep behavior of Mar M-509 at 900 C and 110 MN/sq m, extrapolated stress for 1 percent creep in 10 years for refractory alloys, and approximate useful temperature ranges for superalloys and refractory metals. P.T.H.

A78-29998 An analysis of an early hybrid fossil-geothermal power plant proposal. R. DiPippo. *Geothermal Energy*, vol. 6, Mar. 1978, p. 31-36. 16 refs. Contract No. EY-76-S-02-4051.

A thermodynamic analysis of Caufourier's proposal for a hybrid fossil-geothermal power plant (described in 1924) is presented. The proposed system would employ four stages of vapor generation by flashing followed by a fossil-fired superheater that produced both electricity and hot water. The described system would use a multiple-admission vertical-shaft axial-flow vacuum condensing turbine and four self-vaporizers which were vertical cylindrical vessels topped by a dome which housed the steam outlet and the vacuum-pump connection. Assumptions required for the analysis are discussed, and an effective efficiency of 20% for fossil-fuel utilization was found. An explanation for this value, which represents underutilization of fossil fuel, is offered. M.L.

A78-30035 # On vortex wind power. R. M. C. So (GE Corporate Research and Development Center, Schenectady, N.Y.). (*American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/FE-20.*) *ASME, Transactions, Journal of Fluids Engineering*, vol. 100, Mar. 1978, p. 79-82. 9 refs. Research supported by the General Electric Co.

An infinite viscous laminar vortex with no reverse flow region in the exit plane, but with axial inflow at the base, is analyzed. The axial inflow is assumed to be finite everywhere. From the analysis, the maximum wind power that can be obtained from such a vortex is

calculated. The results show that the power developed depends on the circulation at infinity and on the viscous radius of the core of the vortex. The significance of this result, as it relates to the recently proposed vortex wind energy system, is discussed. (Author)

A78-30039 # The effect of hub fairings on wind turbine rotor performance. R. E. Wilson (Oregon State University, Corvallis, Ore.). *ASME, Transactions, Journal of Fluids Engineering*, vol. 100, Mar. 1978, p. 120-122.

Studies are made of the effect of hub fairings on the performance of a wind turbine. The contribution of velocity change to the torque is calculated and it is found that the effect on power may be either positive or negative. Various hub fairings have been used to test both wind turbines and propellers. It is shown that the design of an effective hub fairing must take into account: the effect of velocity change on torque, blade section aerodynamics, and the potential flow around the center body in the rotor plane with reference to the specific center body being used. S.C.S.

A78-30188 Analysis of electrolyte shunt currents in fuel cell power plants. M. Katz (United Technologies Corp., Power Systems Div., South Windsor, Conn.). (*Electrochemical Society, Meeting, Philadelphia, Pa., May 8-13, 1977.*) *Electrochemical Society, Journal*, vol. 125, Apr. 1978, p. 515-520.

A general mathematical model is presented for calculating the shunt currents and effective operating potentials of the materials in multicell stacks which have electrolyte interconnections between the individual fuel cells. The analysis takes into account the electrochemical polarizations that occur at the positive and negative ends of each shunt path. Numerical results are presented for an acid electrolyte fuel cell stack design. (Author)

A78-30190 Solar cells from zone-refined metallurgical silicon. T. L. Chu, S. S. Chu, G. W. Wakefield (Southern Methodist University, Dallas, Tex.), and R. W. Kelm, Jr. (Texas Instruments, Inc., Dallas, Tex.). *Electrochemical Society, Journal*, vol. 125, Apr. 1978, p. 595-597. NSF Grant No. AER-73-07843; Contract No. E(04-3)-1285.

Metallurgical-grade silicon has been purified by the Czochralski pulling and floating-zone techniques. The purified material was used as substrates for the preparation of solar cells by diffusion and chemical vapor deposition techniques. The structure and electrical characteristics of purified metallurgical silicon and solar cells have been investigated. (Author)

A78-30191 Purification and characterization of metallurgical silicon. T. L. Chu, G. A. van der Leeden, and H. I. Yoo (Southern Methodist University, Dallas, Tex.). *Electrochemical Society, Journal*, vol. 125, Apr. 1978, p. 661-665. 17 refs. NSF Grant: No. AER-73-07843; Contract No. E(04-3)-1285.

Metallurgical-grade silicon is a convenient starting material for the preparation of solar cell-grade silicon. The purification of metallurgical silicon by the treatment of its melt with gaseous reagents and in some cases followed by unidirectional solidification, has been investigated. The purified material was analyzed for major impurities by the atomic absorption technique. Single crystals have been prepared from purified metallurgical silicon by the Czochralski technique, and their electrical properties, such as electrical resistivity, carrier mobility, and diffusion length, were measured. (Author)

A78-30192 * Annealing of GaAs solar cells damaged by electron irradiation. G. H. Walker and E. J. Conway (NASA, Langley Research Center, Hampton, Va.). *Electrochemical Society, Journal*, vol. 125, Apr. 1978, p. 676, 677.

Measurements of thermal annealing of GaAlAs/GaAs solar cells damaged by 1 MeV electron irradiation are reported, and the magnitude of the short-circuit current recovery is discussed. The damaged cells are annealed in a vacuum at 200 C. A cell irradiated at 10 to the 13th power electrons per sq cm recovers all its lost short-circuit current after 15 hours of annealing. Possible application of the annealing process to solar cells in space is also considered.

J.M.B.

A78-30195 Concepts and features of the automated unit control system for the Raccoon Mountain Pumped-Storage Plant. C. Harvey, III (Tennessee Valley Authority, Knoxville, Tenn.). (*Institute of Electrical and Electronics Engineers, Summer Meeting, Mexico City, Mexico, July 17-22, 1977, Paper F 77 672-9.*) *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-97, Mar.-Apr. 1978, p. 513-519.

This paper describes the man-machine interface requirements, the controlled components, the operating processes, and operating restraints which apply to the Raccoon Mountain Pumped-Storage Plant. It shows how the evaluation of these factors led to a definition of the degree of automation to be achieved and, to a large extent, to the choice of controlling mechanisms to be utilized. Finally, it describes, both in concept and in function, the resulting system which controls four of the world's largest reversible pump-turbines. (Author)

A78-30196 * Synchronization of wind turbine generators against an infinite bus under gusting wind conditions. H. H. Hwang (Hawaii, University, Honolulu, Hawaii) and L. J. Gilbert (NASA, Lewis Research Center, Cleveland, Ohio). (*Institute of Electrical and Electronics Engineers, Summer Meeting, Mexico City, Mexico, July 17-22, 1977, Paper F 77 675-2.*) *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-97, Mar.-Apr. 1978, p. 536-544. 6 refs. Research supported by the Hawaii Natural Energy Institute and NASA.

Studies of synchronizing a wind turbine generator against an infinite bus are performed on a digital computer. In the digital simulation, wind gusts of different magnitudes and durations are hypothesized. Prior to the synchronization, differences of the frequency and phase position between voltages of the alternator and the bus are also included in the simulation. Solutions for rotor speed, generator power angle, electromagnetic torque, wind turbine torque, wind turbine blade pitch angle, and armature current are simulated and presented graphically. The ERDA-NASA 100-kW wind turbine is used as a case study. The results so obtained will thus have immediate applications. (Author)

A78-30197 Economic design of wind electric systems. G. L. Johnson (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.). (*Institute of Electrical and Electronics Engineers, Summer Meeting, Mexico City, Mexico, July 17-22, 1977, Paper F 77 679-4.*) *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-97, Mar.-Apr. 1978, p. 554-562. 9 refs.

Long term wind records are used to select the rated wind speed for wind electric generators. The wind is characterized by a Weibull density function. Detailed results are presented for western Kansas. Graphs are presented which can be used to design a wind system for maximum specific output for a specified load factor at a given site. It is shown that a wind turbine rated at a wind speed of 9 m/s has a specific output within 80% of the maximum for a wide range of wind conditions. (Author)

A78-30200 # Gas turbines. Part 2 - Aerodynamic processes, regenerators, combustion chambers, and construction /2nd revised and enlarged edition/ (Gazovye turbiny. Part 2 - Aerodinamicheskie protsessy, regeneratory, kamery sgoraniia i konstruktiii /2nd revised and enlarged edition/). Ia. I. Shnee and Ia. S. Khainovskii. Kiev, Izdatel'skoe Ob'edinenie Vishcha Shkola, 1977. 314 p. 126 refs. In Russian.

Attention is given to various aspects of the construction and operation of gas turbines. Gas flow across the blades of a gas turbine is considered, noting lattice geometry and system losses. Heat exchange equipment is discussed with reference to the calculation of formulas for regenerator operation, the optimal rates for the motion of the cooling agent, regenerator construction, and air-cooling agents. Combustion processes and combustion chambers are outlined with reference to acceptable fuels, atomization, mixing mechanisms, and the hydraulic features of the combustion chamber. The application of gas turbines to various technical areas is described, including for electric and atomic power stations, the powering of ships and locomotives, and petroleum and chemical production. S.C.S.

A78-30226

A78-30226 # Heliotron as a D-D fusion reactor - Preliminary analysis. H. Nakashima and M. Ohta. *Kyushu University, Technology Reports*, vol. 50, Dec. 1977, p. 687-694. 14 refs. In Japanese.

A78-30257 Evolution of the aircraft gas turbine engine. M. A. Zipkin (General Electric Co., Advanced Engineering and Technology Programs Dept., Cincinnati, Ohio). (*Israel Annual Conference on Aviation and Astronautics, 19th, Tel Aviv and Haifa, Israel, May 2, 3, 1977.*) *Israel Journal of Technology*, vol. 15, no. 1-2, 1977, p. 44-58.

The history of the aircraft gas turbine engine is presented with attention to engine power (thrust) efficiency and weight as well as improvements in component technology. The development of gas turbine technology and its role in aircraft design are considered, engine performance trends are examined, future challenges posed by technological and environmental concerns are indicated, and new systems/applications are reported. M.L.

A78-30261 The flat solar collector - An approach to its evaluation. T. Sonnino (Soreq Nuclear Research Centre, Yavne, Israel). (*Israel Symposium on Solar Energy, 2nd, Beersheba, Israel, Nov. 8-10, 1976.*) *Israel Journal of Technology*, vol. 15, no. 3, 1977, p. 98-101. 5 refs.

The flat solar collector is the most widely used device for the utilization of solar energy, but its energetic and economic values are still debated. A preliminary energy and economic analysis is presented. The energy analysis indicates that the energy needed to produce one solar collector is equivalent to the electricity consumed by an electric water heater in roughly three months. The economic analysis indicates that the pay-back time for a solar collector varies from 5.5 to 7.7 yr, according to the discount rate. The economic analysis from a national point of view indicates that the use of solar collectors for domestic purposes only could reduce electricity consumption in Israel by 10%. (Author)

A78-30264 Demand sensitive energy storage in molten salts. J. J. Nemecek, D. E. Simmons, and T. A. Chubb (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). *Solar Energy*, vol. 20, no. 3, 1978, p. 213-217. 5 refs.

Heat-of-fusion energy storage and on-demand steam are obtained by means of heat pipe techniques which transfer heat to and from stacked salt cans and onto boiler tubes within a sealed 'energy storage boiler' tank. The described system consists of a large pressure-tight tank in which containers of salt eutectic are mounted on racks, largely filling the tank. The bottom of the tank contains the energy input region; energy input is effected by the chemical recombination of SO₂ and O₂ to produce SO₃. Experimental studies using a NaCl-KCl-MgCl₂ eutectic and m-terphenyl as the heat pipe fluid are reported, and the operation of the system is explained. M.L.

A78-30265 Application of chemical engineering to large scale solar energy. T. A. Chubb, J. J. Nemecek, and D. E. Simmons (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). *Solar Energy*, vol. 20, no. 3, 1978, p. 219-224. 5 refs.

The Solchem power station concept is described. The components include an energy collection field containing dispersed solar-furnace-heated chemical reactors, an assemblage of demand-responsive energy storage-boiler tanks in which large quantities of energy are stored as latent heat-of-fusion, and a conventional dry-steam turboelectric generating facility. A eutectic salt is used for energy storage, and heat pipe boilers provide on-demand power plant steam. An experimental study comparing SO₃ and steam-methane working fluids is reported. M.L.

A78-30266 Payback of solar systems. K. W. Böer (Dela-ware, University; SES, Inc., Newark, Del.). *Solar Energy*, vol. 20, no. 3, 1978, p. 225-232. 11 refs. Research sponsored by SES, Inc.

A variety of solar conversion systems is studied in a dynamic economical model in which the real cost of energy inflates. Payback times and dates of probable market entries are estimated. A distributed system to convert solar energy into heat and electricity in direct proximity to the consumer (Solar One system) is economically

attractive even for solar cells with well below 10 per cent conversion efficiency when these can be installed in flat plate collectors for less than 30 dollars/sq m, in addition to the collector cost. (Author)

A78-30267 Photon energy storage in organic materials - The case of linked anthracenes. G. Jones, II, T. E. Reinhardt (Boston University, Boston, Mass.), and W. R. Bergmark (Ithaca College, Ithaca, N.Y.). *Solar Energy*, vol. 20, no. 3, 1978, p. 241-248. 48 refs. Navy-supported research.

Criteria for the photochemical conversion of solar energy are reviewed in terms of utilization of photoactive organic materials. Endoergic valence isomerizations which may be driven by visible light are proposed for study. These isomerizations store electronic excitation energy as chemical potential energy. Products of the proposed photoreactions are kinetically stable for energy storage over controllable periods. Stored energy is retrieved by thermal or catalytic recycling to the original photoactive substance. Such organic materials are potentially useful as additives to working fluids of conventional solar-thermal conversion units. Photon energy storage is illustrated in several examples which utilize 300-500 nm radiation for isomerizations with storage capacities of about 400 J/g (about 100 cal/g). New data including quantum efficiencies, storage capacities, and conditions for recycling are presented for a series of linked anthracenes. A photocalorimeter capable of direct measurement of storage enthalpies is described. The economic and physical requirements of a photochemical storage material are outlined, and several systems for the conversion of solar energy on an appropriate scale are suggested. (Author)

A78-30268 * Development of low-cost silicon crystal growth techniques for terrestrial photovoltaic solar energy conversion. J. A. Zoutendyk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Solar Energy*, vol. 20, no. 3, 1978, p. 249-257. 23 refs.

A78-30269 Thermal simulation of a passive solar house using a Trombe-Michel wall structure. P. Ohanessian and W. W. S. Charters (Melbourne, University, Melbourne, Australia). *Solar Energy*, vol. 20, no. 3, 1978, p. 275-281. 9 refs.

A78-30270 Prediction of the monthly and annual performance of solar heating systems. P. J. Lunde (Center for the Environment and Man, Inc., Hartford, Conn.). *Solar Energy*, vol. 20, no. 3, 1978, p. 283-287. 8 refs.

Performance curves for predicting the long-term performance of solar heating systems are presented. The predictions, which are virtually interchangeable with a simulation, are based on the use of site-specific weather and radiation data. An integrated collector equation is derived and applied in an analysis of a specific solar heating system. The performance curves show how the proportion of monthly load carried by solar energy with a finite storage capacity changes as a function of two base temperature-related parameters, one of which is a measure of the radiation received on a unit of collector area, and the other of which is related to the losses from that same unit of collector area at base conditions. The accuracy of the performance curves and the 10-year accuracy are discussed. M.L.

A78-30275 A view of the government's role in energy research and development for the civilian sector. F. A. L. Holloway (Exxon Co., New York, N.Y.). *Energy Systems and Policy*, vol. 2, no. 2, 1978, p. 145-157.

The serious nature of the U.S. energy problem and the need for a coherent national policy to guide energy R&D are described. The important role of the private sector in energy R&D is contrasted with the necessary role of government in defense and space R&D. There are inhibitions to private R&D imposed by current economic and regulatory policies and government-funded R&D competition. Studies show that government-funded R&D to satisfy civilian market needs is not as effective as private, competitive R&D. Concern is expressed that ERDA constitutes a high-risk and difficult mission in which a failure would have adverse consequences. Pending development of national policy and strategy, ERDA is encouraged to shift

funds to universities, limit commercially oriented R&D in laboratories, avoid duplication of privately funded efforts, and modify contracting and management procedures. (Author)

A78-30297 Reflections on the energy wars. A. M. Weinberg (Oak Ridge Associated Universities, Inc., Oak Ridge, Tenn.). *American Scientist*, vol. 66, Mar.-Apr. 1978, p. 153-158. 8 refs.

The controversy over solar vs nuclear energy is examined, noting that there is irrationality on both sides, i.e., the nuclear power advocates tend to scoff at the practicality of solar power, while the solar advocates often exaggerate the dangers of nuclear power. It is pointed out that the generation of electricity from nuclear power plants is far cheaper, at present, than would be the comparable power derived from small, widely dispersed solar generators. Attention is given to the difficulty of electrical storage in solar power facilities, but also to the possibility of catastrophic accident from nuclear plants. The author advocates a cautious use of nuclear generated electricity for the short run, with increasing dependence on solar power once a more efficient solar technology comes on-line. D.M.W.

A78-30302 Possible selective solar photothermal absorber - Ni dendrites formed on Al surfaces by the CVD of Ni/CO/4. D. P. Grimmer, K. C. Herr, and W. J. McCreary (California, University, Los Alamos, N. Mex.). *Journal of Vacuum Science and Technology*, vol. 15, Jan.-Feb. 1978, p. 59-64. 11 refs. ERDA-sponsored research.

Suitably spaced Ni dendrites on Al substrates may be used to create a selective solar photothermal absorber. The dendrites are formed by chemical vapor deposition of Ni from Ni(CO)₄ onto the substrate. A solar absorptivity of 0.95 and an emissivity of 0.2 have been measured for the nickel dendrites. Problems associated with the adhesion of the coatings to the aluminum surface are also discussed. J.M.B.

A78-30303 Sputtered metal silicide solar selective absorbing surfaces. G. L. Harding (Sydney, University, Sydney, Australia). *Journal of Vacuum Science and Technology*, vol. 15, Jan.-Feb. 1978, p. 65-69. 11 refs. Research supported by the University of Sydney.

A range of metal silicide interference filters has been prepared on various metal substrates and aged in vacuum at elevated temperatures. These show promise as high-temperature stable selective surfaces for solar energy photothermal conversion. Solar absorptances of 75%-80% and emittances of about 2% can be obtained at room temperature for homogeneous metal silicide films on bulk copper. Higher absorptances are obtained using sputtered copper, bulk stainless steel, or evaporated nickel substrates. Emittances of homogeneous metal silicide films on bulk copper increase to about 5% at 500 C. The solar absorptance of an iron silicide on copper surface was temperature independent up to 500 C. Absorptances greater than 90% can be obtained for multilayer metal silicide films on copper. The emittances of these films are somewhat higher than for homogeneous films. (Author)

A78-30305 Silicon monoxide antireflection coatings for InP/CdS solar cells. D. H. Olson (Bell Telephone Laboratories, Inc., Holmdel, N.J.). *Journal of Vacuum Science and Technology*, vol. 15, Jan.-Feb. 1978, p. 130-132.

A hard and durable antireflection coating that bonds well to cadmium sulfide has been developed. Silicon monoxide films evaporated at 140 C substrate temperature produce homogeneous films with high adhesion and solvent resistance. These films raise the Air Mass two short circuit currents of single-crystal InP/CdS solar cells by 18.5% and of polycrystalline InP/CdS cells by 15.5%. (Author)

A78-30321 Simple solar technology for applications in rural areas (Einfache Solartechnik für die Landwirtschaft). H. Schulz. *Sonnenenergie*, vol. 3, Jan.-Feb. 1978, p. 8-10, 12-14, 17. In German.

Solar technology on a small scale, especially for space and water heating, can be particularly cost effective in rural areas. The paper

compares various methods of solar collection and storage, e.g., air and water media, with heat transfer effected by metal tubes, in terms of their usefulness either alone or in conjunction with wind generated electricity, and fuel generation by biomass. Heating requirements are assessed as a function of climate and local energy requirements. Finally, schematics of model collection systems are presented. D.M.W.

A78-30322 Europe's largest solar facility dries animal feed (Europas größte Solaranlage trockenet Grünfütter). A. Urbaneck. *Sonnenenergie*, vol. 3, Jan.-Feb. 1978, p. 21, 22. In German.

Design and operating parameters for a solar collection and storage system are outlined with reference to construction cost, and savings made possible by a reduced consumption of heating oil (180,000 l/yr). Energy production in the 1 MW range is obtained with a volume of 70,000 cu m of air, heated by a collector surface of 1,500 sq m. D.M.W.

A78-30323 The biogas facility at Benediktbeuern (Die Biogas-Anlage Benediktbeuern). W. Müller. *Sonnenenergie*, vol. 3, Jan.-Feb. 1978, p. 23, 24. In German.

A system for the generation of natural gas from organic material, the Schmidt-Eggersglüss system built in 1955, is still functioning efficiently and economically by producing over 300 cu m of gas per day for heating and cooking. The basic operating characteristics of the system are described in the paper. D.M.W.

A78-30366 Fuel vaporization - Economy with reduced exhaust emission. D. W. Hughes and J. R. Goulburn (Belfast, Queen's University, Belfast, Northern Ireland). *Institution of Mechanical Engineers, Proceedings*, vol. 190, no. 1, 1976, p. 1-11. 11 refs. Research supported by the Science Research Council.

This paper describes a simple system of controlling exhaust emissions from gasoline engine vehicles, using a coolant-heated fuel vaporiser in the inlet system. The object of complete vaporisation of the fuel is to create a homogeneous inlet charge, giving improved cylinder-to-cylinder distribution and permitting operation with very lean mixtures. This leads to low exhaust emissions of carbon monoxide, hydrocarbons and nitric oxides. The effects of vaporisation on the lean limit of operation, exhaust emissions, power output, fuel consumption and optimum spark ignition timing have been investigated, and are discussed in the paper. Results of tests on a 1.6 litre car are also presented. It was found that exhaust emissions were effectively controlled, while vehicle driveability remained acceptable. Engine power was reduced by 25-30%, although fuel consumption was not increased. (Author)

A78-30373 Energy recovery by the incineration of solid waste - Development, present status, and experiences in Germany (James Clayton Lecture). K. H. Thömen (Stadtwerke Düsseldorf AG, Düsseldorf, West Germany). *Institution of Mechanical Engineers, Proceedings*, vol. 190, no. 64, 1976, p. 601-610.

The development of incinerator plants from simple destruction units to installations for heat recovery is reviewed. The concept of 'heat production' is applied and the composition of the refuse and the operating conditions which are important in the planning and construction of an incinerator are considered. The paper then discusses the choice of furnace equipment and the conditions to be imposed on it, using as an example the 'Düsseldorf roller grate system'. The configuration of the furnaces is also dealt with in the light of experience in the construction of the boilers. Finally, under the heading 'Operating Experiences', facts are given about the reliability of incinerators, with special emphasis upon the problem of corrosion of the boiler tubes. (Author)

A78-30495 Investigation of gas-controlled cryogenic heat pipes. L. L. Vasil'ev and S. V. Konev (Akademiia Nauk Belorusskoi SSR, Institut Teplo- i Massoobmena, Minsk, Belorussian SSR). (Teplo- i Massoobmena - V; Vsesoiuznaia Konferentsiia po Teplo- i Massoobmenu, 5th, Minsk, Belorussian SSR, May 17-20, 1976, Materialy. Volume 3, Part 2, p. 232-235.) *Heat Transfer - Soviet*

Research, vol. 9, Mar.-Apr. 1977, p. 58-60. Translation.

The properties and design of cryogenic gas-regulated heat pipes are examined. It is shown to be advantageous to use a noncondensing gas in a cryogenic heat pipe in the presence of an additional reservoir. The effect of the amount of cryogen on the heat-carrying capacity was studied, and factors affecting the thermostability of gas-regulated liquid nitrogen heat pipe systems are considered. M.L.

A78-30496 The emission characteristics of liquid-fuel flames. M. V. Stradomskii, E. P. Vasil'ev, V. I. Kozlenko, and E. A. Efremova (Akademiia Nauk Ukrainkoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Heat Transfer - Soviet Research*, vol. 9, Mar.-Apr. 1977, p. 87-92. 6 refs. Translation.

Data are presented on the spectral and total absorptivities of enclosed industrial flames. The processes are considered as functions of fuel type, flame soot-particle concentration, particle size, and excess air. Flames produced by combustion of gasoline, kerosene, diesel fuel, and fuel oil are studied. Spectral emissivity was measured in two flame cross sections: 170 and 310 mm from the nozzle. Flame spectral absorptivity was determined by measurements of the intensity of flame monochromatic radiation, the reference lamp, and the flame together with the reference lamp. Soot concentration was measured by sampling the gas with a water-cooled probe using removable filters. Flame temperature was determined by thermocouples and checked against the color temperature. It was found that the spectral absorptivity of a sooty flame is independent of the wavelength of the flame's radiation and that the flame may be considered a grey emitter. S.C.S.

A78-30507 * Some opportunities in teleoperated mining. E. R. Palowitch (U.S. Bureau of Mines, Pittsburgh Mining and Safety Research Center, Pittsburgh, Pa.) and P. H. Broussard (NASA, Marshall Space Flight Center, Huntsville, Ala.). *Mechanism and Machine Theory*, vol. 12, no. 5, 1977, p. 493-501.

Processes involved in remote control mining (fragmentation, material handling, ground and environmental control) are discussed with reference to longwall shear mining, the method which affords the greatest potential for the use of teleoperated systems. The breakup and haulage procedures are outlined, with attention to environmental control subsystems, i.e., noise and dust abatement. A description of a four-legged chock, attached to a section of a face conveyor and operated remotely, is presented. D.M.W.

A78-30511 Surface ignition of coal and other fuel particles in radiative and diffusive environment. R. K. Ahluwalia and P. M. Chung (Illinois, University, Chicago, Ill.). *Combustion Science and Technology*, vol. 17, no. 5-6, 1978, p. 169-181. 10 refs.

Ignition of an impervious solid fuel of spherical shape in contact with a quiescent hot oxidizing medium is analyzed. The governing mass and energy balance equations are solved by employing the Laplace transformation technique, Mellin's complex inversion theorem, and the Laplace asymptotic method of evaluating integrals with large parameters. The model is used to study the ignition of coal particles in a typical MHD-open-cycle combustor environment. The effects of the initial coal temperature, combustor pressure, particle size, and combustor temperature on ignition time are discussed.

(Author)

A78-30512 Shock-tube combustion of high density hydrocarbon fuels. J. M. Brupbacher, M. T. McCall, and M. McCarty, Jr. (Martin Marietta Laboratories, Baltimore, Md.). *Combustion Science and Technology*, vol. 17, no. 5-6, 1978, p. 183-188. 6 refs. Navy-supported research.

Shock-tube techniques have been used to determine rates of carbon dioxide production in shock-wave heated mixtures of oxygen and hydrogenated dimers of bicycloheptadiene, components of the high density fuel RJ-5. Reaction profiles generated by this method have demonstrated that the combustion rate of the hydrocarbon vapors increases with fuel and oxygen concentration, but is not affected by the total pressure over the temperature (1900-3600 K) and pressure (1-1.5 atm) range investigated. An activation energy of

combustion was determined to be 18 ± 2 kcal/mole from the variation of combustion rate with temperature. An investigation of the individual components of RJ-5 revealed that their combustion does not differ significantly from that of RJ-5. (Author)

A78-30555 Physical and morphological studies of size-classified coal fly ash. G. L. Fisher, B. A. Prentice, D. Silberman (California, University, Davis, Calif.), J. M. Ondov, A. H. Biermann, R. C. Ragaini (California, University, Davis and Livermore, Calif.), and A. R. McFarland (California, University, Davis, Calif.; Texas A & M University, College Station, Tex.). *Environmental Science and Technology*, vol. 12, Apr. 1978, p. 447-451. 26 refs. ERDA-supported research.

A study of the physical and morphological properties of four fractions of size-classified coal fly ash is reported. Volume median diameters of the four size fractions are 2.2, 3.2, 6.3, and 20 microns, respectively. The size distributions of the four fractions are compared to isokinetically collected samples. Density variations and results of three standard particle sizing techniques are discussed in terms of particle size and morphological properties. Eleven morphological particle types are quantified by light microscopy. Relative abundances of the 11 morphological particle types within each size cut appear to be particle size dependent. The finest fraction is composed of 87% nonopaque solid spheres and 7.9% cenospheres in contrast to the coarsest fraction composed of 26% nonopaque solid spheres and 41% cenospheres. The density variation with particle size is explained in terms of the relative abundances of predominant particle types. On the basis of morphological appearance, a coal fly ash morphogenesis scheme is developed. (Author)

A78-30560 Ozonation of coal gasification plant wastewater. R. D. Neufeld (Pittsburgh, University, Pittsburgh, Pa.) and A. S. Spinola (United States Steel Research Center, Monroeville, Pa.). *Environmental Science and Technology*, vol. 12, Apr. 1978, p. 470-472. 5 refs.

A laboratory investigation is conducted on the ozonation of a liquid waste sample from an experimental coal gasification plant. A 30-in.-high, 2.75-in. i.d. packed glass column is used to counter-currently scrub the wastewater with a gas stream of 74 mg/L ozone. Specific component analyses are presented of the wastewater and its ozonated end products. These were done via both wet analyses and gas chromatography. Data examination indicates that higher ozone levels yield substantial reduction of cyanogen compounds and polydric phenols, with a simultaneous increase in the concentration of low boiling compounds measured as acetone, benzene, and methanol. (Author)

A78-30571 # Design and cost analysis of turbine penstocks for hydroelectric power plants located at the bottom of the dam (Metodika tekhniko-ekonomicheskikh raschetov turbinnykh truboprovodov priplotinnykh GES). Iu. S. Vasil'ev, B. A. Sokolov, L. I. Kubyskin, and M. G. Aleksandrov (Leningradskii Politekhnikeskii Institut, Leningrad, USSR). *Energetika*, vol. 21, Jan. 1978, p. 92-98. In Russian.

A dynamic programming technique is proposed for optimizing penstock parameters for hydroelectric power plants supplied from the lower level of the sluice gate. The influence of water hammer on the dynamic pressure is taken into consideration. The method is extended to include steel penstocks strengthened by a coating of reinforced concrete. A block diagram for calculating the thickness of the penstock wall and the reinforcement parameters is presented.

V.P.

A78-30644 Anomalous temperature dependence observed on the photovoltage of Se-based amorphous thin film-SnO₂ heterostructures. T. T. Nang, T. Matsushita, A. Suzuki (Osaka Prefecture, University, Osaka, Japan), and M. Okuda (Osaka Industrial University, Daito; Osaka Prefecture, University, Osaka, Japan). *Applied Physics Letters*, vol. 32, Apr. 15, 1978, p. 489, 490. 5 refs.

A78-30646 High-efficiency organic solar cells. D. L. Morel, A. K. Ghosh, T. Feng, E. L. Stogryn, P. E. Purwin, R. F. Shaw, and C. Fishman (Exxon Research and Engineering Co., Linden, N.J.). *Applied Physics Letters*, vol. 32, Apr. 15, 1978, p. 495-497. 7 refs.

Organic solar cells based on merocyanine dyes have exhibited sunlight efficiencies in excess of 1% at about 100 mW/sq cm. This represents a significant improvement over previously reported values and brings such devices into the realm of practicality. The devices exhibit V sub oc as high as 1.2 V but are presently limited by field-dependent energy-dependent quantum efficiency. Though monochromatic efficiencies approaching 100% occur at high photon energies, these diminish to about 35% at the main absorption peak in the visible. Based upon sunlight absorption, theoretical efficiencies for these devices appear high. (Author)

A78-30648 Observations of anisotropic diffused layer sheet resistance in EFG silicon ribbon solar cells. H. B. Serreze, K. V. Ravi, and C. V. Hari Rao (Mobil Tyco Solar Energy Corp., Waltham, Mass.). *Applied Physics Letters*, vol. 32, Apr. 15, 1978, p. 503-505. 8 refs.

Anisotropic electrical conductivity has been observed in the near-space-charge region of phosphorus-diffused EFG silicon ribbon solar cells during the course of junction profiling studies using Van der Pauw sheet-resistance measurement techniques. This anisotropy is believed due to either preferential diffusion of phosphorus down linear defect boundaries which are present in EFG silicon or to dislocation pile-up along these boundaries. (Author)

A78-30698 # Aviation fuel usage - Economy and conservation. V. F. J. Craig and B. G. Smith. (*Roads and Transportation Association of Canada, Annual Conference, 8th, Quebec City, Canada, Sept. 13, 1976.*) *Canadian Aeronautics and Space Journal*, vol. 24, Jan.-Feb. 1978, p. 34-49.

Methods of conserving aircraft fuel are discussed; the emphasis is on short-term operational and procedural measures. Reduction of required fuel reserves for flights operating under excellent weather conditions, minimization of jet-powered taxiing maneuvers, better sequencing of takeoffs at peak hours, and the selection of appropriate airspeed, altitude, climb, cruise and descent options are cited as means to limit unnecessary fuel consumption. In addition, the use of turboprop aircraft on short-haul sectors and more rational air routings and terminal area control are suggested to decrease fuel waste. J.M.B.

A78-30708 Bergbau-Forschung process for the desulfurization of flue gas. K. Knobloch, H. Jüntgen, and W. Peters (Bergbau-Forschung GmbH, Essen, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol. 31, Jan. 1978, p. 36-39. 23 refs.

A two-step method of flue gas desulfurization is described which employs hard coal to adsorb SO₂, O₂, and steam onto the coal's surface. In a secondary reaction, the SO₂ is converted to H₂SO₄ and retained in the pore system of the adsorbent. Thus, the SO₂ remains fixed even at high temperatures (up to 250 C). At higher temperatures the SO₂ is converted to elemental sulfur. Design and operation of a 120,000 cu m/hr prototype plant are reviewed, in which 80% SO₂ separation (and up to 60% NO_x separation) was effected. D.M.W.

A78-30709 What comes after oil and gas - Development trends offered by energy sources (Was kommt nach Öl und Gas - Entwicklungstendenzen der Energiedarbietung). E. Edey (Esso AG, Hamburg, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol. 31, Feb. 1978, p. 68-73. In German.

Sources of energy currently in use are examined in light of available technology for their exploitation, and with reference to their abundance and usefulness over the next century. Attention is given to coal liquification and gasification, and to nuclear fission, both breeder and non-breeder. It is noted that oil and natural gas

reserves will probably last only until the mid-21st century, and that uranium reserves will also become exhausted during the same period if breeder reactors are not developed. Coal should continue to be available after 2200. Solar and wind energy are also mentioned, although it is pointed out that they can not be considered reliable until a means for storing their energy can be perfected. D.M.W.

A78-30742 Spinning a turbine with sunlight. J. Bigger (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal*, vol. 3, Mar. 1978, p. 14-19.

Solar-thermal energy conversion for electricity generation can be divided into two categories. One category is the intermediate-temperature range between 100 and 400 C. The second category, the high-temperature range, 500 C and above, is especially useful for electricity generation. According to the power tower design concept of solar-thermal systems, a central boiler is surrounded by tracking mirrors which reflect and focus solar energy on the receiver. A second design concept uses distributed receivers. This concept avoids the cost of a tower but adds the cost of extensive insulated piping. Attention is given to the development of solar energy programs in the U.S., the testing of first generation devices, the design of the higher-efficiency systems of the second generation, closed-cycle gas turbines, the open-cycle gas turbine, approaches for lowering the capital cost, and projects for the development of the technology. G.R.

A78-30743 The sun on a semiconductor. M. Laliberte (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal*, vol. 3, Mar. 1978, p. 20-25.

Advantages of photovoltaic electric systems are related to the absence of intermediate conversion stages involving thermal and/or mechanical energy, potentially very long component lifetimes, low maintenance costs, the utilization of diffuse solar radiation, and the modular system characteristics. The main obstacle to a widespread use of photovoltaic systems is currently the high cost of device manufacture. In the case of silicon cells, the cost of a peak kilowatt of electric generating capacity is about \$15,000. This figure has to be compared with today's conventional power plant cost of \$200-\$1000 per kilowatt of rated generating capacity. DOE wants to achieve a cost of \$500 per peak kilowatt for single-crystal silicon cells encapsulated in panels for 1986. Alternative approaches for lowering costs are related to the concept of thin-film solar cells utilizing cadmium sulfide, indium phosphide, or amorphous silicon, deposited on an inexpensive substrate. G.R.

A78-30744 Utilities put the sun to work. R. Taylor (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal*, vol. 3, Mar. 1978, p. 26-32.

A description is presented of investigations regarding the use of solar collectors in North Dakota. The described project is one of 458 active projects which were compiled during the summer of 1977 to determine the extent of solar energy research sponsored by electric utilities throughout the country. A substantial majority of the solar research projects deal with solar heating and cooling or related research. The survey also identified 34 wind projects, 28 projects dealing with solar data collection, 22 solar-thermal power generation projects, and 12 projects related to photovoltaics. Attention is given to problems of data collection, approaches for reducing the cost of wind energy, the testing of a collector system, a house constructed for obtaining solar energy information, a solar space conditioning system, the integration of solar electric systems, the utilization of solar heat in the cloudy northwest, and a study of the performance of 20 solar homes in northern California. G.R.

A78-30745 The earth as a solar heat engine. J. Kenton (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal*, vol. 3, Mar. 1978, p. 43-48.

The utilization of indirect solar energy sources is discussed. New developments concerning the employment of wind power are partly related to research conducted by NASA working in cooperation with DOE. The huge airfoil blades on which modern wind-power machines are based are mounted with variable-pitch gears so that the blade

angle of attack can be varied to obtain optimal aerodynamic efficiency over a range of wind speeds. The federal wind energy program covers five areas, including program development and technology, small machines for farm and rural use, 100-kilowatt-scale systems, megawatt-scale systems, and large multiunit systems. Attention is also given to wind power problems, approaches for utilizing wave power, techniques for ocean-thermal conversion, tidal power problems, and the prospects of biomass conversion. G.R.

A78-30775 # Cooling turbine technology. G. R. Giles (Normalair Garrett, Ltd., Yeovil, Somerset, England). *Aircraft Engineering*, vol. 50, Mar. 1978, p. 14-16.

It is noted that the air conditioning system of an aircraft, supplied by an on-board auxiliary power unit (APU) uses approximately 50 gal of fuel for each hour in the air. For an average aircraft, this translates into a cost of \$80,000 yearly; not to mention reduced thrust and increased drag caused by offtake from the main engines. A method is proposed to save fuel by reducing air bleed from the turbines, i.e., the turbine outlet temperature would be reduced from its present 2C to as low as -40C. This, however, could lead to icing in humid weather. Tests to help solve the problem were conducted using the Westland Lynx helicopter. Water, extracted by condensation in a heat exchanger, is sprayed into the coolant airstream, thus cooling the overall system while keeping moisture away from the turbine outlets. D.M.W.

A78-30883 New developments in electromagnetic energy beaming. E. J. Nalos (Boeing Aerospace Co., Seattle, Wash.). *IEEE Proceedings*, vol. 66, Mar. 1978, p. 276-289. 20 refs.

New technologies, especially those related to the generation of microwaves, millimeter waves, lasers, and large aperture antennas, have made it possible to transmit energy of widely varying density (from 10 to the 10^4 W/sq cm to 1000 W/sq cm). High power electron beam and solid state devices for generation and rectification purposes have opened up a range of applications, from remote sensing, to navigation and communication, to the transmission of solar energy. Attention is given to the construction of large orbiting space platforms, which will provide the structure for high energy antennas, both for in-space use and for earth applications. Gradations of energy density are reviewed, with low densities used for active illumination, middle densities for communication and surveillance, and high densities for thermal interaction with materials. Also discussed is the potential for development of high energy beaming by atmospheric RPVs, ionospheric heating from ground antennas, and advanced microwave heating and communications systems. D.M.W.

A78-31008 Collapse of Alfvén waves. N. S. Erokhin, S. S. Moiseev, and V. V. Mukhin. (*Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 3, July 12, 1977, p. 629-632.) *Soviet Technical Physics Letters*, vol. 3, July 1977, p. 258, 259. 7 refs. Translation.

Wave collapse in a plasma is a nonlinear mechanism for wave dissipation and is an important aspect of rf plasma heating. Such collapses have been observed for various types of waves including Alfvén waves. It is found that Alfvén collapse leads to energy pumping to larger values of the wave vector components across the magnetic field. Waves are thus absorbed by a larger Cerenkov interaction with plasma electrons. The intersection of particle trajectories in the inhomogeneous collapse fields also leads to the dissipation of energy. When large average magnetic fields are generated during collapse, the field lines of the original magnetic field are observed to curve and particle diffusion is intensified. When intense Alfvén waves are excited, a disruption of magnetic surfaces may be produced by the collapse. This, in turn, may lead to a degradation of the plasma confinement. S.C.S.

A78-31011 Thermionic emission from electrodes with raised surfaces in a thermionic converter. A. P. Abramova, V. M. Gun'ko, and R. Ia. Kucherov. (*Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 3, July 26, 1977, p. 668-673.) *Soviet Technical Physics Letters*, vol. 3, July 1977, p. 271-273. Translation.

It has been found that by raising the electrode surfaces, the efficiency of a thermionic converter may be enhanced. Particularly, the effect of raised cathode and anode surfaces in the case where the scale dimension of the surface protuberance is much greater than the electron mean free path in the plasma and much less than the Debye length is studied. Boundary conditions for (1) the limiting cases of a one-dimensional surface protuberance and (2) a two-dimensional surface protuberance are defined. An expression is derived for the effect of a protuberance on voltage-current characteristics and plasma properties in the arc mode of a thermionic converter. The expression is based on the transport and continuity equations for electron current, ion current, and electron energy flux. S.C.S.

A78-31068 Uses and prospects of solar energy /2nd revised and enlarged edition/ (Utilisations et promesses de l'énergie solaire /2nd revised and enlarged edition/). J. R. Vaillant. Paris, Eyrolles, Editeur, 1978. 502 p. 158 refs. In French. \$55.10.

Procedures for collecting and converting solar energy are discussed with attention to characteristics of solar radiation, solar units for generating energy, and the production of algae and hydrogen as means of 'storing' solar energy. Several applications are examined - topics include domestic household uses, economic considerations, solar-energy architecture, and the uses of solar energy in urban and rural areas. Factors affecting the future extent of use of solar energy are considered. M.L.

A78-31069 Sulfur, energy, and environment. B. Meyer (Washington, University, Seattle, Wash.). Amsterdam, Elsevier Scientific Publishing Co., 1977. 457 p. 1613 refs. \$39.60.

Sulfur chemistry, production, and effects are reviewed. Technical topics discussed include the properties of several classes of compounds, corrosion, analytical chemistry; occurrence and sources; sulfur cycles, and recovery from combustion gases. More general topics include environmental control and legislation, medical use and health effects, sulfur in agriculture and food, and future trends. Other subjects include sulfur polymers, sulfur-containing materials, and the industrial uses of sulfur and its compounds. M.L.

A78-31071 Solar heating design, by the f-chart method. W. A. Beckman (Wisconsin, University, Madison, Wis.), S. A. Klein, and J. A. Duffie (Wisconsin, University, Madison, Wis.). Research supported by NSF, ERDA, and University of Wisconsin. New York, Wiley-Interscience, 1977. 214 p. 34 refs. \$14.95.

A practical technique for determining the optimal size of solar space and water heating system is presented. The technique, particularly suited to small systems, provides an optimization of solar collectors, storage tanks and heat exchangers; liquid or air may be the heat transfer agent. Detailed computer simulations correlating important dimensionless variables of solar heating systems with performance are presented in graphical and equation form. These charts, when used in conjunction with monthly average meteorological data and material costs, permit estimation of the long-term thermal performance of a solar heating system as a function of design parameters. J.M.B.

A78-31123 # Energy and environment /64th Thomas Hawksley Lecture/. M. Barrère (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Institution of Mechanical Engineers, Meeting, London, England, Mar. 8, 1978.*) ONERA, TP no. 1978-20, 1978. 27 p. 23 refs.

Solar thermodynamic power plants and electric power plants using the photovoltaic conversion principle are described, and energy conservation practices applicable to transport systems (in particular air transport) and industries are discussed. Details of a 30-kWe power plant with flat-plate collectors and a 300-kWe power plant with cylindrical parabolic collectors are presented. In a study of aircraft energy conservation, the fuel efficiencies of subsonic and supersonic transports are contrasted. The adoption of modular combustor design to improve engine operating efficiency also receives attention. J.M.B.

A78-31151 **Advancing technologies.** Edited by E. G. Semler. London, Mechanical Engineering Publications, Ltd., 1977. 190 p. \$12.

Attention is given to fast breeder reactors, the design of supersonic transport aircraft, aircraft turbofan design, superconducting d.c. motors and superconducting a.c. generators, fiber-reinforced composites, batteries for electric vehicles, the accuracy of machine tools, self-lubricating materials, polymer engineering, and ultrahigh-speed centrifuges. The emphasis in the papers is on practical applications, e.g., superconducting d.c. generators for ship propulsion, industrial drives or aluminum smelters, and ultrahigh-speed centrifuges for uranium enrichment. J.M.B.

A78-31154 **Superconducting machines.** A. D. Appleton (International Research and Development Co., Ltd., Newcastle-upon-Tyne, England). In: *Advancing technologies.* London, Mechanical Engineering Publications, Ltd., 1977, p. 41-59.

Superconducting d.c. machines and superconducting a.c. generators are described, and characteristics of superconducting elements and typical engineering superconductors are reviewed. Applications of the superconducting d.c. machines include ship propulsion and aluminum smelter power units; the excellent speed control, together with high power and good torque characteristics, may also make the d.c. superconducting motors suitable as drives for steel rolling mills and auxiliary drives in power stations. Superconducting a.c. generators which produce power densities greater than 400 MVA/m are feasible at present. These generators involve lower capital costs and may provide greater efficiency than conventional equipment. J.M.B.

A78-31175 **Advanced launch vehicle systems and technology.** M. W. J. Bell (Rockwell International Corp., Space Div., Downey, Calif.). *Spaceflight*, vol. 20, Apr. 1978, p. 135-143. 13 refs.

Refinements of existing Space Shuttle technology could lead to a million pound payload capability at a cost an order of magnitude lower per pound than is possible today. Several booster configurations are outlined with reference to mode of launch and recoverability. They range from vertically launched two-stage vehicles (IHLLV, or interim heavy lift launch vehicle) which follow a ballistic trajectory after injection of their payload into orbit, and land by parachute (possibly in the Australian desert), to single-stage-to-orbit (SSTO) low lift to drag ratio vehicles which could land horizontally. All would use LH₂/LO₂ propellants. Attention is given to booster protection and avionics for the descent to earth phase of the flight. Applications include the development of a large, multi-passenger transport, leading to the industrialization and colonization of space. D.M.W.

A78-31210 **Polycrystalline thin film CdS/CdTe solar cells.** H. Uda, H. Taniguchi, M. Yoshida, and T. Yamashita (Matsushita Electric Industrial Co., Ltd., Moriguchi, Osaka, Japan). *Japanese Journal of Applied Physics*, vol. 17, Mar. 1978, p. 585, 586. 7 refs. Research supported by the Agency of Industrial Science and Technology.

The characteristics and performance of thin-film n-CdS/p-CdTe heterojunction solar cells are discussed. The cells have a structure consisting of: a glass substrate, a transparent electrode, a chemically deposited CdS film, a vacuum-evaporated CdTe film, and a Cu(2-x)Te-Au electrode. Values are presented for current-voltage characteristics in the dark at room temperature, photocurrent-photovoltage characteristics measured under 70 mW/sq cm solar energy, and the spectral response of quantum efficiency at zero bias voltage. S.C.S.

A78-31215 **Mechanism for the omega/pe/ radiation in Tokamaks.** I. H. Hutchinson, K. Molvig, and S. Y. Yuen (MIT, Cambridge, Mass.). *Physical Review Letters*, vol. 40, Apr. 17, 1978, p. 1091-1094. 11 refs. Contract No. EG-77-G-01-4108.

The emission of a narrow line of electromagnetic radiation at the central plasma frequency, observed on several Tokamaks, is explained in terms of the scattering of enhanced plasma oscillations from thermal ion acoustic fluctuations. The emission and induced

absorption rates calculated for the plasma fluctuation levels expected are considerable and the radiation is self-absorbed to an effective black-body level. The frequency, power, and polarization then predicted are in agreement with the experiment. (Author)

A78-31245 # **Optimum testing period for new thermo-mechanical equipment (Optimal'noe vremia ispytaniia novogo teplo-mekhanicheskogo oborudovaniia).** G. S. Saprykin, E. A. Larin, O. V. Goncharenko, and I. A. Malomuzh (Saratovskii Politekhnikeskii Institut, Saratov, USSR). *Energetika*, vol. 20, Dec. 1977, p. 54-57. In Russian.

In the present paper, a minimax technique is used to calculate the optimum time for testing prototype power-plant equipments (such as turbines, boilers, etc.) under the proper operating conditions. An expression for calculating the optimal testing period is proposed. The influence of some basic gas-turbine parameters on the optimal testing period of the prototype unit is demonstrated. V.P.

A78-31272 **The production of substitute natural gas by oil gasification.** H. J. F. Stroud (British Gas Corp., Solihull, England). (*Institute of Fuel, Conference on Advancing Energy Technology, Eastbourne, Sussex, England, Oct. 31-Nov. 2, 1977.*) *Institute of Fuel, Journal*, vol. 51, Mar. 1978, p. 31-37. 5 refs.

In this paper the author describes the use of the whole range of petroleum fractions for the manufacture of substitute natural gas (SNG). The principal process steps are catalytic steam gasification and hydroconversion, and non-catalytic hydrogenation and steam-oxygen gasification. The integration of these steps into complete processes is presented in terms of the types of oil that each process can best accept. The presentation shows that oil gasification is thermally a very efficient means of providing a fuel that is very acceptable, not only to the consumer, but also environmentally. The ability to handle heavy oil fractions derived from high-sulphur crude oils without incurring high costs and in ways that allow efficient removal of the sulphur compounds without yielding undesirable by-products is discussed. (Author)

A78-31273 **M-Gas process for production of fuel gas from heavy oil.** M. Funaki (Mitsui Kozan Coking Industry Co., Ltd., Japan) and M. Ueda (Mitsui Engineering and Shipbuilding Co., Ltd., Japan). (*Institute of Fuel, Conference on Advancing Energy Technology, Eastbourne, Sussex, England, Oct. 31-Nov. 2, 1977.*) *Institute of Fuel, Journal*, vol. 51, Mar. 1978, p. 38-44.

A new steam gasification process, the M-Gas process, uses a two-vessel fluidized bed system. This can handle a wide range of petroleum hydrocarbons down to vacuum residual oil continuously without an oxygen plant and produces useful pollution-free gases such as fuel gas. An alkaline earth metal catalyst was developed for the process. The authors describe the steps taken in developing the process. As the result of bench-scale study and pilot-plant operation, it was found that, apart from the catalyst, steam/carbon ratio and reaction temperature were important for efficient gasmaking and plant operation. The optimum steam/carbon ratio and reaction temperature would be 1.5-2.5 and 900-920 C respectively. The preliminary cost estimate for production of 2 million cu m/day of fuel gas based on vacuum residual oil suggests that the process is economically feasible. (Author)

A78-31274 **Thermo-hydraulic energy from the sea.** D. G. Johnson (Norges Tekniske Hogskole, Trondheim, Norway). (*Institute of Fuel, Conference on Advancing Energy Technology, Eastbourne, Sussex, England, Oct. 31-Nov. 2, 1977.*) *Institute of Fuel, Journal*, vol. 51, Mar. 1978, p. 59-63. 8 refs.

The paper describes the possibilities and problems of thermal energy production from heat stored in tropic waters, so-called ocean thermal energy conversion (OTEC). OTEC plants, technically realizable today, have not yet been built, owing to prohibitively high investment costs. The author proposes a new thermo-hydraulic system named ocean thermo-hydraulic energy conversion (OTHEC). In this relatively cheap system water will be pumped by means of

steam and used for driving a water turbine. The simplest OTHEC plant will have a steam lift tube as a pumping device. Laboratory experiments have verified that the steam lift tube will work stably and give a positive static head of some 4 metres, when the temperature difference is 20 C and the hot water temperature 55 C. The effect though is small and efficiency low. Further research will be necessary, especially with lower hot water temperatures, to improve the steam lift tube design and also to investigate other possible OTHEC variants as well. (Author)

A78-31301 Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Symposium sponsored by NRC, Transport Canada, and CASI. Ottawa, Canadian Aeronautics and Space Institute, 1978. 284 p.

Consideration is given to energy savings related to overall aircraft design, to propulsion system design and to operational factors. Particular papers are presented on the NASA Aircraft Energy Efficiency Program, prospects for energy conserving STOL transports using prop-fans, improved energy efficiency for small CTOL transport aircraft, energy conserving aircraft from the engine viewpoint, thrust computing system applications to increase engine life and provide fuel conservation, and the energy cost of some noise abatement procedures. B.J.

A78-31302 * # The NASA Aircraft Energy Efficiency Program. J. M. Klineberg (NASA, Washington, D.C.). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 1-1 to 1-32.

The objective of the NASA Aircraft Energy Efficiency Program is to accelerate the development of advanced technology for more energy-efficient subsonic transport aircraft. This program will have application to current transport derivatives in the early 1980s and to all-new aircraft of the late 1980s and early 1990s. Six major technology projects were defined that could result in fuel savings in commercial aircraft: (1) Engine Component Improvement, (2) Energy Efficient Engine, (3) Advanced Turboprops, (4) Energy Efficiency Transport (aerodynamically speaking), (5) Laminar Flow Control, and (6) Composite Primary Structures. B.J.

A78-31304 * # Some aspects of powerplant airframe integration affecting fuel conservation. J. E. Farbridge (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 3-1 to 3-15. 12 refs. Research sponsored by the Department of National Defence of Canada and NASA.

The performance criteria for STOL transport aircraft place many constraints on engineering design, which, in turn, may have a direct bearing on fuel efficiency: these constraints become even more severe with the introduction of powered-lift for turboprop aircraft. Consideration is given to some aspects of performance and design which arise as a result of powerplant/airframe integration and an attempt is made to assess these factors in terms of transport fuel efficiency. The drag polars of various powered lift concepts are analyzed to determine the installed thrust/weight required and a simple method of relating this to fuel efficiency is suggested. Some other factors have been identified as being important to this aspect of design and these are discussed in more general terms. Finally, special consideration is given to recent Canadian research in the realm of supercritical airfoil technology as applied to a multi-foil section which could be utilized both for the STOL regime of flight and for cruise at transonic speeds. (Author)

A78-31305 # Improved energy efficiency for small CTOL transport aircraft. S. Bernstein, G. A. Adams, and A. Oberti (Canadair, Ltd., Montreal, Canada). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 4-1 to 4-14.

An exploratory investigation was carried out into potential improvements in fuel efficiency and direct operating costs (DOC) by the application of new airframe and propulsion system technologies (supercritical wings, advanced composite materials, high aspect ratio wings, advanced propulsion systems, wing tip winglets, active controls and laminar flow) to the smaller CTOL transport aircraft. Fuel savings of up to 12% are possible by increasing aspect ratio alone. Incorporation of supercritical airfoils and advanced composites with the higher aspect ratios can save a further 5%. Advanced propulsion system technology offers similar or higher potentials for fuel savings - 15-20% with new turbofans and a further 15-20% with prop-fans. Total cumulative fuel savings of 40-45% are possible with incorporation of all the new technologies investigated. Equivalent DOC improvements are of the order of 15-18% and these increase to 20-22% as the fuel cost increases from 40 to 70 cents per gallon. B.J.

A78-31306 * # Fuel saving potential of Mach 0.8 twin engine prop-fan transports. F. J. Davenport (Boeing Commercial Airplane Co., Seattle, Wash.). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 5-1 to 5-19. Contract No. NAS2-9104.

The fuel saving and economic potentials of the prop-fan high-speed propeller concept have been evaluated for twin-engine commercial transport airplanes designed for 3333.6 km range, 180 passengers, and Mach 0.8 cruise. A fuel saving of 9.7% at the design range was estimated for a prop-fan aircraft having wing-mounted engines, while a 5.8% saving was estimated for a design having the engines mounted on the aft body. The fuel savings and cost were found to be sensitive to the propeller noise level and to aerodynamic drag effects due to wing-slipstream interaction. Uncertainties in these effects could change the fuel savings as much as plus or minus 50%. A modest improvement in direct operating cost was estimated for the wing-mounted prop-fan at current fuel prices. (Author)

A78-31307 # Fuel efficiency - Where we are heading in the design of future jet transports. R. H. Hopps (Lockheed-California Co., Burbank, Calif.). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 6-1 to 6-16.

Consideration is given to the 1980s jet-transport market with emphasis on narrow-body vs wide-body aircraft, the benefits of increased size and capacity and the feasibility of superlarge aircraft. Technology of the 1980s relating to span, active controls and composites is briefly reviewed. Three potential technologies for the 1990s are discussed: laminar flow control, advanced turboprops and liquid hydrogen. It is noted that the technology of the 1980s will not offer dramatic improvements over all the aircraft flown today; large improvements can be offered only in comparison with the older narrow-body aircraft. B.J.

A78-31308 # Aviation fuels - A supplier's perspective. C. B. Ruper (Imperial Oil Enterprises, Ltd., Sarnia, Ontario, Canada). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 7-1 to 7-8.

Current availability of aviation kerosene is limited by the freeze point, flash point and aromatics content. In the future these constraints will become more critical as increasing volumes of synthetic liquids are produced to supplement natural petroleum. Ideally, to maximize security of supply and to control cost, the next generation of aircraft should be designed to operate safely and efficiently on fuels with a wider range of properties. (Author)

A78-31310 # Energy conserving aircraft from the engine viewpoint. R. M. Denning (Rolls-Royce, Ltd., Aero Div., Bristol, England). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 9-1 to 9-35. 5 refs.

The paper is mainly concerned with fuel-efficiency improvement in conventional gas turbine propulsion systems for airline operation; a broad philosophy of engine improvements for short, medium and long-haul aircraft is reviewed. It is stressed that minimizing all aircraft direct operating costs is the ultimate yardstick for the engine designer. Higher fuel prices may change priorities in engine design and justify more complex and expensive engines particularly for longer-range operations. Optimum engine design for shorter range can be significantly different because of the implication of cyclic life on air-cooled turbine blades. Lower-specific-thrust engines are worthy of close consideration particularly for short-haul operation. B.J.

A78-31311 # Thrust computing system applications to increase engine life and provide fuel conservation. G. B. Mackintosh (Computing Devices Co., Ottawa, Canada). In: Canadian Symposium on Energy Conserving Transport Aircraft, Ottawa, Canada, October 3, 4, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1978, p. 10-1 to 10-20. Research supported by the Canadian/United States Defense Production Sharing Program.

The paper describes a method of computing the gross thrust required by a jet engine based only on measurements of pressure in the engine tailpipe and of ambient static pressure. It is shown how this technique can be applied to improve the overall efficiency of engine operation; the result of this improvement is that the number of engines operating at abnormally high exhaust gas temperatures can be reduced. In addition to the fuel saving achieved, very great reductions in hot-section parts consumption and maintenance requirements can result from even a small decrease in operating temperature. The performance of the thrust computation procedure is substantiated by data obtained on military aircraft engines under USAF and Canadian Government contracts. B.J.

A78-31338 # Investigation of the electrical characteristics of low-temperature thermionic power generators (Issledovanie elektricheskikh kharakteristik nizkotemperaturnykh TEP). N. E. Menabde, V. K. Tskhakaia, L. M. Tsakadze, V. A. Iur'ev, and V. N. Lebedev (Akademiia Nauk Gruzinskoi SSR, Fiziko-Tekhnicheskii Institut, Sukhumi, Georgian SSR). *Zhurnal Tekhnicheskoi Fiziki*, vol. 48, Jan. 1978, p. 183, 184. In Russian.

The effectiveness of improving the output characteristics of thermionic electrical power generators by injecting oxygen into the electrode gap was studied at emitter temperatures between 1200 and 1400 C. The electrodes were of plane geometry. Tungsten (110) single crystals were used as the emitter material, and polycrystalline molybdenum or nickel (110) single crystals for the collectors. It is shown that thermionic generators with oxidized electrodes exhibit a better efficiency at emitter temperatures up to 1400 C than at higher temperatures (1450 to 1700 C). The electrical parameters established in the tests are plotted and compared. V.P.

A78-31364 # Analytic determination of the fuel effect of air storage gas turbine electric power stations (Analiticheskoe opredelenie toplivnogo effekta vozdušno-akkumuliruiushchei gazoturbinnoi elektrostantsii). A. S. Naksudian, Z. A. Alanian, and A. G. Boiadzhian (Nauchno-Issledovatel'skii Institut Energoset'proekt, Armenian SSR). *Teploenergetika*, Feb. 1978, p. 70-73. In Russian.

Air storage electric power stations operate to cover the peak loads of power systems and to balance out the nighttime dips. The amount of peak power developed by an air storage power installation significantly exceeds the required off-peak power. The fuel effect of air storage power stations is positive. The specific fuel saving in comparison with the alternative of water storage and supplementary gas turbine plant amounts to 0.03-0.125 kg fuel per kilowatt-hour. Regenerative heating of air leads to a sharp reduction in fuel consumption during unloading of an air storage power station. P.T.H.

A78-31385 Theoretical analysis of a novel MPN gallium arsenide Schottky barrier solar cell. S. S. Li (Florida, University, Gainesville, Fla.). *Solid-State Electronics*, vol. 21, Feb. 1978, p. 435-438. 16 refs.

An Au-p-n GaAs Schottky barrier solar cell is described. Solar cell performance is evaluated, neglecting losses due to series resistance and reflection and the effect of minority carrier injection. As functions of dopant density and thickness in the p and n regions, calculations are made for the effective barrier height, spectral dependence of photocurrent, dark current, open circuit voltage, and conversion efficiency. An AMO efficiency of about 22% may be obtained for appropriately chosen solar cell parameters. S.C.S.

A78-31423 Ionization equilibrium and radiative cooling of a high temperature plasma. C. Breton, C. de Michelis, and M. Mattioli (Commissariat à l'Energie Atomique, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay-aux-Roses, Hauts-de-Seine, France). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 19, Mar. 1978, p. 367-379. 42 refs.

The ionization equilibrium and rate of radiative cooling of a hot plasma were calculated as a function of electron temperature from a few eV up to several tens of keV. The most important elements detected in tokamak plasmas - O, N, C, Fe and Mo - are considered. Rate coefficients needed for the calculations are discussed and tables are given for the emission lines considered. Formulas for different losses are given explicitly and fractional abundances and radiated powers are evaluated as a function of electron temperature. B.J.

A78-31474 # Survey of atomic energy planning taking into account the production of energy in addition to electricity (Struktura atomnoi energetiki s uchëtom proizvodstva energii pomimo elektrichestva). A. P. Aleksandrov, V. A. Legasov, V. A. Sidorenko, N. N. Ponomarev-Stepnoi, A. N. Protsenko, V. N. Grebennik, and E. S. Glushkov. *Atomnaia Energiia*, vol. 43, Dec. 1977, p. 427-432. In Russian.

The paper discusses factors which are likely to affect the extent to which nonelectrical nuclear energy is used in the future. It is suggested that high-temperature helium reactors might be a future method of choice for satisfying energy needs. Changing patterns of energy production and cost are discussed, and characteristics of thermal and electrical nuclear energy plants are considered. M.L.

A78-31497 Catalytic gasification of coal with high-pressure steam. S. Peter, G. Woyke, and G. Baumgärtel (Erlangen-Nürnberg, Universität, Erlangen, West Germany). (*Chemie-Ingenieur-Technik*, vol. 48, no. 9, 1976, p. 742-749.) *International Chemical Engineering*, vol. 18, Apr. 1978, p. 213-220. 16 refs. Translation. Research supported by the Fund for Chemistry.

Simultaneous equilibria for steam-conversion of coal were computed for temperatures from 800 to 1100 K and for pressures to 600 bar. Real behavior of the gases was taken into account using the equation of state by Redlich and Kwong. An apparatus is described for investigating the gasification of lignite and bituminous coke at high pressures. Considerable accelerations of the reaction resulted from catalysts that are soluble in high-pressure steam, although the solubility in steam of the suitable alkali compounds is relatively slight under the conditions of the reaction. (Author)

A78-31498 Formation and growth of thermal NOx in hydrocarbon combustion. N. Arai, M. Hasatani, S. Sugiyama (Nagoya University, Nagoya, Japan), I. Shimura (Sumitomo Juki Co., Ltd., Japan), and Y. Watanabe (Kyokuto Boeki Co., Ltd., Japan). (*Japan Society of Chemical Engineers, Proceedings*, vol. 3, no. 1, 1977, p. 56-61.) *International Chemical Engineering*, vol. 18, Apr. 1978, p. 270-275. 15 refs. Translation. Research supported by the Ministry of International Trade and Industry and Fund for the Development of Technology for the Removal of Nitrogen Oxides in Iron and Steel Plants.

The amounts of NO formed in the primary combustion and the postcombustion zones during the combustion of propane were measured for the purpose of elucidating the roles of nitrogen and oxygen. Propane was burnt in pure oxygen or in a mixture of oxygen and argon, and NO formation was followed for widely varying N₂:O₂ ratios. It was found that the product of the nitrogen concentration and the square root of the oxygen concentration can be used to evaluate discrepancies between experimental results and

the theoretical results obtained from the Zel'dovich equation. Other results were also considered in terms of the Zel'dovich theory. It was observed that when the oxygen ratio is in the vicinity of 1.04, a direct relationship becomes apparent between the concentration of HCN and the final amount of NO formed. M.L.

A78-31500 * # Development and fabrication of a diffusion welded Columbian alloy heat exchanger. W. F. Zimmerman, E. C. Duderstadt, D. Wein (General Electric Co., Evendale, Ohio), and R. H. Titran (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, 107th, Denver, Colo., Feb. 26-Mar. 2, 1978, Paper A78-61*. 18 p. Contract No. NAS3-18541.

A Mini Brayton space power generation system required the development of a Columbian alloy heat exchanger to transfer heat from a radioisotope heat source to a He/Xe working fluid. A light-weight design featured the simultaneous diffusion welding of 148 longitudinal fins in an annular heat exchanger about 9-1/2 in. in diameter, 13-1/2 in. in length and 1/4 in. in radial thickness. To complete the heat exchanger, additional gas ducting elements and attachment supports were added by GTA welding in a vacuum-purged inert atmosphere welding chamber. The development required the modification of an existing large size hot isostatic press to achieve HIP capabilities of 2800 F and 10,000 psi for at least 3 hr. Excellent diffusion welds were achieved in a high-quality component which met all system requirements. (Author)

A78-31550 Economics of solar heating and cooling systems. W. L. Corcoran (U.S. Department of Energy, Demonstration Program Branch, Washington, D.C.). *ASHRAE Journal*, vol. 20, Apr. 1978, p. 47-50.

Solar heating and cooling for a private residence are discussed in terms of amortization time for a house with a 30 year mortgage at 8.5%. Different collector systems (tubular, flat, concentrating) and sizes are compared, with reference to their initial and life cycle costs. National energy savings are calculated for widespread use of solar power, which could reach the Quad level by 1990. Also mentioned is the prospect of job creation through the development of solar technology, possibly as many as 74,000 new jobs before the end of the century. Economic incentives to encourage home owners to use solar energy are discussed, including property tax exemption for solar units, income tax deductions, and low interest loans. D.M.W.

A78-31726 Two-dimensional analysis for Cu(x)S-CdS solar cells with nonuniform skin region. M. K. Mukherjee, A. R. Saha, and S. N. Das (Jadavpur University, Calcutta, India). *IEEE Transactions on Electron Devices*, vol. ED-25, Mar. 1978, p. 285-293. 15 refs.

Due to rapid diffusion of externally applied copper along the disordered region of the grain boundaries, the skin region of the Cu(x)S-CdS solar cell consists of alternate layers of thick and thin regions of p-Cu(x)S. A two-dimensional idealized analysis leading to the short-circuit current, open-circuit voltage, conversion efficiency and spectral response of the cell is presented. For a typical cell, the variations of these parameters with grain size and width of the disordered regions are shown. It is pointed out that for such a cell, there is an optimum crystallite size for maximum conversion efficiency of the cell. The spectral response characteristics shows a relative improvement in the low-frequency side with increase in density of the CdS crystallites. This is probably due to the vertical junctions formed at the disordered regions. (Author)

A78-31730 Increases in energy conversion efficiency for thin-film polycrystalline CdS/Cu₂S photovoltaic cells. A. M. Barnett, W. E. Devaney, G. M. Storti, and J. D. Meakin (Delaware, University, Newark, Del.). *IEEE Transactions on Electron Devices*, vol. ED-25, Mar. 1978, p. 377-379. 14 refs. NSF Grant No. AER-72-03478; Contract No. E(49-18)-2538.

A78-31731 * Experimental determination of series resistance of p-n junction diodes and solar cells. P. J. Chen, S. C. Pao, A. Neugroschel, and F. A. Lindholm (Florida, University, Gainesville, Fla.). *IEEE Transactions on Electron Devices*, vol. ED-25, Mar. 1978, p. 386-388. 7 refs. Grant No. NSG-3019; Contract No. E(40-1)-5134.

Various methods for determining the series resistance of p-n junction diodes and solar cells are described and compared. New methods involving the measurement of the ac admittance are shown to have certain advantages over methods proposed earlier. (Author)

A78-31732 Epitaxial silicon solar cells with uniformly doped layer. A. Usami and S. Ishihara (Nagoya Institute of Technology, Nagoya, Japan). *IEEE Transactions on Electron Devices*, vol. ED-25, Mar. 1978, p. 388, 389. 11 refs.

Solar cell structures have been prepared both by successive deposition of p-type and n-type silicon layers on p(+) type single-crystal silicon. Impurities are uniformly doped at epitaxial layers. Efficiency of 9.0% with the epitaxial layer junction structure and 12.8% with the diffused 0.3 micron junction depth structure have been achieved. (Author)

A78-31742 * Engineering aspects of geothermal development with emphasis on the Imperial Valley of California. M. Goldsmith (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Energy (UK)*, vol. 3, Apr. 1978, p. 127-148. 14 refs. NSF Grant No. AER-75-08793.

This review was prepared in support of a geothermal planning activity of the County of Imperial. Engineering features of potential geothermal development are outlined. Acreage requirements for drilling and powerplants are estimated, as are the costs for wells, fluid transmission pipes, and generating stations. Rough scaling relationships are developed for cost factors as a function of reservoir temperature. Estimates are made for cooling water requirements, and possible sources of cooling water are discussed. Availability and suitability of agricultural wastewater for cooling are emphasized. The utility of geothermal resources for fresh water production in the Imperial Valley is considered. (Author)

A78-31743 A scenario for geothermal electric power development in Imperial Valley. D. L. Ermak (California, University, Livermore, Calif.). *Energy (UK)*, vol. 3, Apr. 1978, p. 203-217. 24 refs.

The growth of geothermal electric power operations in Imperial Valley, California is projected over the next 40 yr. With commercial power forecast to become available in the 1980s, the scenario considers three subsequent growth rates of 40, 100 and 250 megawatts (MW) per year. These growth rates, along with estimates of the total resource size, result in a maximum level of electric power production ranging from 1000 to 8000 MW to be attained in the 2010 to 2020 time period. Power plant siting constraints are developed and used to make siting patterns for the 400 through the 8000 MW level of power production. Two geothermal technologies are included in the scenario: flashed steam systems which can produce their own cooling water from the geothermal steam condensate and which emit noncondensable gases to the atmosphere; and high pressure, confined flow systems which inject all the geothermal fluid back into the ground. An analysis of the scenario is made with regard to well drilling and power-plant construction rates, land use, cooling water requirements, and hydrogen sulfide emissions. (Author)

A78-31744 Energy savings from solid urban waste disposal systems in Italy. A. Saullo (Ente Nazionale per l'Energia Elettrica, Gruppo per le Ricerche Commerciali e della Programmazione, Milan, Italy). *Energy (UK)*, vol. 3, Apr. 1978, p. 219-231. 18 refs.

The paper reviews technologies being developed in Italy for the recovery of energy from urban solid wastes. Consideration is given the following aspects of solid waste: composition, disposal techniques, recyclable byproducts, and energy recovery through the recycling of byproducts. Emphasis is placed on two disposal methods which allow energy recovery: incineration with the production of steam and/or electric power and (2) conversion into liquid fuels or gas. It is concluded that the recovery of byproducts for recycling and incineration of residues alone produces an energy saving that may be compared with the saving obtained by urban-waste disposal through total incineration and steam production. B.J.

A78-31749 Chemistry, thermodynamics and kinetics of reactions of sulphur in coal-gas reactions - A review. A. Attar (Houston, University, Houston, Tex.). *Fuel*, vol. 57, Apr. 1978, p. 201-212. 127 refs.

A78-31750 Pyrolysis of subbituminous coal in relation to in-situ coal gasification. J. H. Campbell (California, University, Livermore, Calif.). *Fuel*, vol. 57, Apr. 1978, p. 217-224. 31 refs. Contract No. W-7405-eng-48.

Pyrolysis of Roland Seam (Wyodak) subbituminous coal has been investigated from 383 to 1273 K in an inert gas at 0.1 MPa (1 bar). The gas, liquid (condensibles at 0 C), and solid products were analyzed and characterized. Evolution of the major noncondensable gas products was measured quantitatively. By measuring the rate of gas evolution under linear heating conditions, the effective activation energy and kinetic frequency factor for release of each gas were determined. These activation energies range from about 80 to 150 kJ/mol. Most of the liquid product was released between 570 and 770 K and was approximately 75% water and 25% organic tar phase. The composition of the organic tar phase was characterized by its elemental composition, boiling-point range, and chromatographic 'finger-print'. The effect of temperature on the structure of char was determined by analyzing changes in elemental composition, surface area, and electrical conductivity. (Author)

A78-31751 # Coaxial MHD generator (Le générateur MHD coaxial). D. Homentcovschi and N. Galan (Bucuresti, Institutul Politehnic, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série Electro technique et Energétique*, vol. 23, Jan.-Mar. 1978, p. 93-101. 7 refs. In French.

The paper is concerned with the magnetic field distribution in the MHD generator channel under conditions of constant fluid velocity. The model used in the study involves two electrodes; the lower electrode is traversed by the excitation current. The induced electromagnetic voltage and the potential on neighboring surfaces at the electrodes are calculated. The significance of the magnetic Reynolds number is examined, and possible uses of the MHD generator for autoexcitation are indicated. M.L.

A78-31752 # The analysis of superconducting magnet systems for the M.H.D. energy conversion. G. Atanasiu, E. Constantin, I. Popa, D. Radu, and D. Dordea-Ionasa (Timisoara, Institutul Politehnic, Timisoara, Rumania). *Revue Roumaine des Sciences Techniques, Série Electro technique et Energétique*, vol. 23, Jan.-Mar. 1978, p. 103-109. 7 refs.

Design principles for the superconducting magnets used with MHD generators are discussed, and two magnet configurations, saddle coils and racetrack coils (Helmholtz) are considered for use with conversion channels of known geometry. For smaller generators, the Helmholtz type is preferable because its technology is simpler. For MHD systems with higher power, the Helmholtz type is not suitable because the nonuniformity of the magnetic field is too large while the magnitude of the stress forces makes the construction of the support structures very difficult. The saddle type winding is considered preferable for use with the higher-power MHD systems. Another advantage of the saddle type winding is its superior properties with respect to refrigeration. M.L.

A78-31767 Influence of light reflection on the collection efficiency of a solar cell. B. Jacobs (Gent, Rijksuniversiteit, Ghent, Belgium). *Archiv für Elektronik und Übertragungstechnik*, vol. 32, Mar. 1978, p. 127, 128. Research sponsored by the Instituut tot Aanmoediging van het Wetenschappelijk Onderzoek in Nijverheid en Landbouw.

An example is worked out investigating optimum thickness of a solar cell if the back electrode acts as a perfect mirror. As more light will be absorbed in the vicinity of the junction a higher collection efficiency can be expected. (Author)

A78-31772 # Nonconventional alternatives for conversion of nuclear energy (Posibilitati neconventionale de conversie a energiei nucleare). I. Ursu, I. I. Purica, and A. I. Badescu-Singureanu (Institutul Central de Fizica, Bucharest, Rumania). *Studii si Cercetari de Fizica*, vol. 30, no. 3, 1978, p. 221-239. 16 refs. In Rumanian.

Various systems for converting the energy of nuclear fission fragments into different forms of electromagnetic energy are discussed. Special attention is devoted to direct conversion cells, and a simple theoretical model is developed for the self-excitation of the anode voltage in a cell with grid at either positive or negative voltage. Theoretical predictions of anode voltages are compared with experimental data. P.T.H.

A78-31828 # Optimal control of flywheel hybrid transmissions. L. M. Sweet (Princeton University, Princeton, N.J.) and D. A. Anhalt (USAF, Weapons Laboratory, Kirtland AFB, Albuquerque, N. Mex.). (*American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Aut-3.*) *ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control*, vol. 100, Mar. 1978, p. 24-33. 18 refs.

Selection of variable transmission ratio in a vehicle with a flywheel energy storage element to maximize the kinetic energy transfer for specified vehicle accelerations is formulated as an optimal control problem. Models for single and parallel power-flow path configurations are presented as generic hybrid propulsion system types. For both systems variation of the ratio of the continuously variable transmission results in inherently nonlinear control, with velocity trajectories found by the solution of two-point boundary value problems. For the single power-flow path system a closed loop controller is synthesized which tracks acceleration command. For the parallel path system, which is representative of conventional power split transmissions, the open loop control yields useful information, indicating tradeoffs between system energy recovery efficiency and component design parameters. Maximum energy recovery during regenerative braking is achieved by minimizing power losses to vehicle drag and transmission elements. Planetary gear geometry is shown to have the strongest influence on efficiency, maximum transmission component loading, and CVT ratio range. (Author)

A78-31834 # The aerodynamic efficiency of windmills. G. M. Lilley (Southampton, University, Southampton, England). *Aeronautical Quarterly*, vol. 29, Feb. 1978, p. 1-17. 7 refs.

A preliminary evaluation of the design and performance of ducted windmills (Lilly and Rainbird, 1956) is reviewed, noting the vortex theory of windmills. The theory is then applied to the aerodynamic design of a horizontal-axis windmill. Differences between the vortex theory and that of Griffith (1977) concerning the effect of aerofoil characteristics on windmill performance are discussed. The differences originate in the fact that Griffith's theory is based on an actuator disk and is only applicable to an infinite number of blades. It is found that when allowances are made for the drag of the blades and hub, and for losses due to the tip and interference with the support tower, power output efficiency is typically 30-35% as compared to an ideal efficiency of 59%. S.C.S.

A78-31870 Effects of coal minerals on the hydrogenation, desulfurization, and solvent extraction of coal. J. A. Guin, A. R. Tarrer, J. W. Prather, D. R. Johnson, and J. M. Lee (Auburn University, Auburn, Ala.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, Apr. 1978, p. 118-126. 28 refs. Research supported by the Auburn University and Alabama Mining Institute; Contract No. EX-76-S-01-2454.

The purpose of this study was to demonstrate that certain coal minerals catalyze the hydrogenation and hydrodesulfurization of creosote oil, a coal-derived solvent used as a start-up solvent in the Solvent Refined Coal (SRC) process; to show that by accelerating hydrogenation of a process solvent such as creosote oil, coal mineral catalysis accelerates indirectly the rate of liquefaction on coal solids; and to provide better insight as to the process advantages and disadvantages of utilizing coal mineral catalysis. Several major constituents of coal mineral matter have been examined for possible

catalytic effects in the reactions of hydrogenation and hydrodesulfurization in coal liquefaction processes. Certain coal minerals, particularly those containing iron, were found to catalyze both hydrogenation and desulfurization reactions. The rate-limiting step in the liquefaction of coal appears to be the transfer of hydrogen to an appropriate donor solvent, and consequently the rate of liquefaction increases with the concentration of coal minerals. The physical state, as well as chemical composition, of the coal minerals also affects hydrogenation and hydrodesulfurization activity during coal liquefaction. (Author)

A78-31871 A dispersion model for the Solvent Refined Coal process. M.-H. Lee, J. A. Guin, and A. R. Tarrer (Auburn University, Auburn, Ala.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, Apr. 1978, p. 127-135. 30 refs. Contract No. EX-76-S-01-2454.

The axial dispersion model is applied to the reactor-dissolver in the Solvent Refined Coal (SRC) liquefaction process. The effect of mixing in the two-phase vertical flow coal liquefaction system is examined. The parameters arising in the model, such as the axial dispersion coefficient for both liquid and gas phases, the mass transfer coefficient, and the gas phase holdup, are obtainable independently from literature correlations. Reaction rate expressions for the coal liquefaction, hydrogenation, and hydrodesulfurization reactions in the SRC reactor are obtained from laboratory studies. A numerical simulation for the Wilsonville SRC pilot plant is given. The effects of flow behavior and mass transfer on the extent of coal dissolution, hydrogen consumption, and hydrodesulfurization are illustrated. The results predicted from the proposed model are also compared to those experimentally measured in the Wilsonville pilot plant. (Author)

A78-31872 Particle separation from a fluidized mixture - Simulation of the Westinghouse coal gasification combustor/gasifier operation. J. L.-P. Chen and D. L. Keairns (Westinghouse Research Laboratories, Pittsburgh, Pa.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, Apr. 1978, p. 135-141. 11 refs. Contract No. E(49-18)-1514.

Particle separation data from a 101.6-mm pressurized (up to 660 kPa) model operating at low gas velocity, near the minimum fluidizing velocity of the mixture, and from a 114-mm Plexiglass model operating at high gas velocity, near the terminal velocity of the mixture, with a nozzle located at the center of a conical bottom, are presented. These models were used to simulate the design and operation of alternative fluidized-bed agglomerating combustor/gasifier concepts. Comparison of the data obtained from these two modes of operation is made and a design for the separation of the agglomerated ash at low gas velocity is established. The data indicate that greater than 95% separation of the agglomerated ash from char at a rate of about 400 kg/min sq m of the separator cross-sectional area can be achieved if the operating gas velocity is close to the minimum fluidizing velocity of the agglomerated ash. (Author)

A78-31916 * # Effects of solar radiation pressure on the orbit of the Solar Power Satellite. O. F. Graf, Jr. (Analytical and Computational Mathematics, Inc., Houston, Tex.). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialist Conference, Jackson Hole, Wyo., Sept. 7-9, 1977, Paper*. 31 p. 18 refs. Contract No. NAS9-15171.

The surface area-to-weight ratio of the Solar Power Satellite (SPS) is of the order of sq m/kg. Therefore, solar radiation pressure will be an important perturbation on the orbit, causing large variations in eccentricity. An analytical solution is developed for the motion of eccentricity and the line of apsides. Included is a secular term due to the earth's orbital eccentricity. Several initial conditions are considered. For some cases, the eccentricity is nearly constant over a few years. General characteristics of the motion are discussed. Long-term (30 years) effects of gravity are investigated by using a numerical integration method. Eccentricities of approximately 0.08 can be expected for uncorrected SPS orbits. (Author)

A78-31953 # Catalyzed combustion in a flat plate boundary layer. I - Experimental measurements and comparison with numerical calculations. F. Robben, V. Agrawal, I. Namer (California, University, Berkeley, Calif.), and R. Schefer. *Combustion Institute, Fall Meeting, Stanford, Calif., Oct. 17, 18, 1977, Paper*. 55 p. 22 refs. USAF-supported research; Contract No. W-7405-eng-48. (LBL-6841)

A classic fluid mechanics boundary layer problem, flow over a sharp leading edge flat plate, has been used to study the effect of a heated surface on combustion in lean hydrogen-air mixtures. The velocity and density profiles of the boundary layer have been measured with laser Doppler velocimetry and Rayleigh scattering, respectively. Preliminary measurements on a silicon dioxide 'non-catalytic' surface indicate neither boundary layer nor surface combustion for wall temperatures up to 1250 K. Measurements on a platinum catalytic surface indicate that, at a surface temperature of 1000 K, not only is there significant surface combustion but that homogeneous combustion in the boundary layer is induced by active species generated at the catalytic surface. (Author)

A78-31957 # Inorganic pollutants from pulverized coal combustion /A review/. P. C. Malte (Washington State University, Pullman, Wash.). *Combustion Institute, Fall Meeting, Stanford, Calif., Oct. 17, 18, 1977, Paper* 77-48. 26 p. 36 refs. Research supported by Washington State University; Contract No. E(49-18)-2252.

The inorganic pollutants from pulverized coal combustion are discussed. It is noted that inorganic matter affects pollution in a variety of ways when the coal is pulverized and burned in the 1600-2000 K temperature range. FeS₂, the most significant inorganic pollutant, decomposes and forms SO₂+SO₃. Iron sulfate compounds, present in negligible amounts, also form SO₂+SO₃. Sulfate sulfur occurs as gypsum CaSO₄.2H₂O. Since the calcium sulfate resists decomposition, a portion of this sulfur is retained in the ash. The alkali material may reduce SO₂+SO₃ emissions. It has been suggested that F, Be, Ni, Cd, Cr(VI), As(III), Hg and Pb are potentially important pollutants. Most are heavy metals which volatilize during combustion, condense on submicron flyash particles and are inhaled within the lungs. Flyash particulate has been identified as a primary pollution concern. Further research is planned in areas including combustion mechanisms and kinetics, the speciation of combustion products, and the effects of combustion process variables on concentration and speciation. S.C.S.

A78-31959 # Modeling fluidized bed combustion. L. S. Caretto (California State University, Northridge, Calif.). *Combustion Institute, Fall Meeting, Stanford, Calif., Oct. 17, 18, 1977, Paper*. 26 p. 32 refs.

The purpose of this paper is to review past models of fluidized-bed combustion and indicate areas where improvements are needed in future modeling efforts. Basic models of fluidized beds are called two-phase models. The dense or emulsion phase is assumed to contain all the solids and the dilute or bubble phase is assumed to be solid free. Important parts of all models include the determination of heat and mass transfer between these two 'phases' chemical reactions and gas-solid interactions. It is necessary to consider the size distribution of bubbles and solid particles. Fluidized-bed combustion models must also consider the heating and devolatilization processes of the solid fuel and the burnout of char. The models considered in this review have generally coupled existing pictures of solid-combustion phenomena with existing models for fluidized beds. (Author)

A78-31968 # The role of a carbon burnup cell in reducing SO₂ emissions from fluidized-bed coal combustion plants. R. B. Snyder, J. C. Montagna, I. Wilson, I. Johnson, and J. Vogel (Argonne National Laboratory, Argonne, Ill.). *Combustion Institute, Fall Meeting, Stanford, Calif., Oct. 17, 18, 1977, Paper* 77-30. 20 p. 10 refs. ERDA-sponsored research.

The role of a carbon burnup cell (CBC) in reducing limestone requirements to meet EPA SO₂ emission requirements for fluidized-bed coal combustor plants was investigated. Four limestone feed

options were analyzed: (1) fresh limestone fed only to a combustor, (2) fresh limestone fed to both a combustor and a CBC, (3) fresh limestone fed to a CBC, after which the partially sulfated limestone from the CBC is fed to a combustor, and (4) fresh limestone fed to a combustor and a portion of the partially sulfated (in the combustor) limestone injected into the CBC. The reactivities of Tymochtee dolomite and Germany Valley limestone with SO₂ were compared with that of Greer limestone at identical conditions. Tymochtee dolomite is more reactive than Greer. Germany Valley, a high-calcium limestone, has poor reactivity and with any of the limestone feed options would require high Ca/S ratios to meet the EPA SO₂ standard. (Author)

A78-31974 * # Pulse battery charger employing 1000 ampere transistor switches. R. L. Steigerwald (General Electric Co., Schenectady, N.Y.). *Institute of Electrical and Electronics Engineers, Annual Conference, 12th, Los Angeles, Calif., Oct. 2-6, 1977, Paper. 6 p.* Contract No. NAS3-19750.

A pulse charger which uses water-cooled 1000-amp transistor switches has been developed to determine empirically the best methods of rapidly charging large cells in the one- to two-volt range. The pulse charger is capable of delivering a positive current from 0 to 1000 amps and extracting a negative current from 0 to 1000 amps. The charger can supply a 1000-amp DC charge or can switch 1000 amps at a rate of 1000 Hz. Special attention is given to problems associated with rapid switching of high currents through use of transistors. J.M.B.

A78-32049 The production of electricity from the wind - A preliminary feasibility study for Greece. N. Galanis (Sherbrooke, Université, Sherbrooke, Quebec, Canada). *Wind Engineering*, vol. 1, no. 4, 1977, p. 241-249. 6 refs. Research supported by the Centre of Planning and Economic Research.

A78-32050 Three-phase induction motor loads on a variable frequency wind electric generator. G. L. Johnson and H. S. Walker (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.). *Wind Engineering*, vol. 1, no. 4, 1977, p. 268-276.

The influence of three-phase induction motor loads on a variable-frequency wind electric generator is evaluated. An asynchronous wind electric generator is simulated by a dc motor driving an ac alternator. The output powers an air conditioning unit having a three-phase induction motor. It is found that the motors start and operate well for any frequency if the voltage is proportional to the frequency, and that the motor starts when the frequency is between 1 and 3 Hz. It has been noted that a wind turbine may be used to drive a permanent magnet alternator connected to such three-phase induction motors. In long periods of little wind the heat pump may be driven by utility power. S.C.S.

A78-32066 G2M, a two-dimensional diffusion time scale tokamak code. R. N. Byrne and H. H. Klein (Science Applications, Inc., La Jolla, Calif.). *Journal of Computational Physics*, vol. 26, Mar. 1978, p. 352-378. 24 refs. Contract No. AT(04-3)-1018.

The equations describing the diffusion time scale evolution of a tokamak separate into two types, a 2D elliptic equation and a set of 1D parabolic equations. The equations are coupled in that the 1D set provides the inhomogeneous source for the 2D equation, while the 2D equation provides both the source and the geometry for the 1D set. The G2M code solves these equations on a moving orthogonal coordinate system with the grid lines tied to magnetic flux, as a Lagrangian formulation of fluid mechanics ties the grid to the fluid. The techniques required to do this are described, and examples of code runs are presented. (Author)

A78-32067 Finite hybrid elements to compute the ideal magnetohydrodynamic spectrum of an axisymmetric plasma. R. Gruber (Lausanne, Ecole Polytechnique Fédérale, Lausanne, Switzerland).

land). *Journal of Computational Physics*, vol. 26, Mar. 1978, p. 379-389. 8 refs. Research supported by the Swiss National Science Foundation.

We propose a new method, the 'finite hybrid elements,' to compute the ideal MHD spectrum of an axisymmetric plasma. This approach is well suited to calculate even weakly unstable internal modes of a tokamak-like plasma. It consists in extending the number of variables in the Lagrangian by considering the derivatives of the displacements as additional variables and then introducing auxiliary constraints between the variables and their derivatives. The discretisation of the problem by extremizing the Lagrangian leads to an underestimation of the potential energy, contrary to the standard finite element method. The lowest order solution makes each term of the Lagrangian piecewise constant on each mesh cell which facilitates the use of numerical equilibria. The results of test cases show a considerable improvement over the regular finite element method. (Author)

A78-32068 Long-time-scale simulation of resonant particle effects in Langmuir and whistler waves. C. E. Rathmann, J. L. Vomvoridis, and J. Denavit (Northwestern University, Evanston, Ill.). *Journal of Computational Physics*, vol. 26, Mar. 1978, p. 408-442. 25 refs. NSF Grant No. ATM-75-02797-A01; Contracts No. N00014-75-0473; No. EY-76-S-02-2200.

A plasma particle-pushing algorithm is proposed, in which the particles, during each time step, follow trajectories which are first-order with respect to the wave fields and with respect to the inhomogeneities of either the medium or the waves. The time step is limited by nonlinearities and inhomogeneities. The algorithm is applicable to numerical simulations of resonant interactions of low-density energetic electrons with waves propagating in a dense, low-energy plasma, on a long time scale compared to the electron plasma period, electron cyclotron period, or electron transit time across a wavelength. The fields are specified in terms of their spectral representation, and the position and velocity increments must be computed for each mode. Two versions of the algorithm, applicable to Langmuir waves and to whistler waves, are presented. P.T.H.

A78-32074 Winds and wind system performance. C. G. Justus (Georgia Institute of Technology, Atlanta, Ga.). Research supported by the National Science Foundation and Energy Research and Development Administration. Philadelphia, Pa., Franklin Institute Press, 1978. 120 p. 94 refs. \$6.50.

Wind characteristics are discussed with reference to evaluation of wind energy conversion systems performance. Weather data sources and measurement methods are considered, and techniques applicable to large-scale (e.g., large multi-unit arrays) and to small scale (e.g., simple power regression relations) use are described. Calculation of output power is explained, factors relevant to system design, siting, and operation are taken into account, and special requirements necessary for performance evaluation are reported. M.L.

A78-32075 How to build wind wheels: Construction and calculation (Wie man Windräder baut: Konstruktion und Berechnung). F. von König. Munich, Udo Pfiemer Verlag GmbH, 1977. 141 p. 14 refs. In German. \$17.45.

Wind energy is now considered sufficiently practical to generate enough electric power to supply even large scale local commercial, industrial, and domestic enterprises. This book reviews some of the basic mechanical principles of wind turbines, and compares various suggestions for the design of modern wind wheels used to generate electricity. An American turbine, similar to the kind which has been traditionally used in the Mid-West, is presented as an illustration of efficiency using proven technology. D.M.W.

A78-32101 Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Meeting sponsored by the Institute of Environmental Sciences. Mount Prospect, Ill., Institute of Environmental Sciences, 1977. 465 p. \$22.

Environmental topics discussed include air and water quality assessment, solar energy utilization, waste management, and energy alternatives. Test methods, vibration/acoustic testing, dynamic analysis, and reliability testing methodology are examined. Subjects include computer-aided air quality control, moderate temperature geothermal resources, mechanical and pneumatic shakers, improvement in flight simulation of space vehicle acoustic tests, and the efficiency of a Fresnel lens solar collector. M.L.

A78-32104 Organics in aqueous process streams of a coal conversion bench-scale unit using the hydrocarbonization process - HPLC and GC/MS analysis. R. L. Jolley, W. W. Pitt, Jr., and J. E. Thompson (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 25-28. 8 refs. ERDA-sponsored research.

A bench-scale study of the coal hydrocarbonization process is being conducted at Oak Ridge National Laboratory. As part of this study, the organic constituents in the aqueous stream from the product scrubber are being characterized using high-pressure liquid chromatography (HPLC) for separation of the water-soluble organics and gas chromatography - mass spectrometry (GC/MS) for identification of the organics. For example, in one preparative-scale HPLC separation, more than 100 UV-absorbing constituents were detected and separated. Using GC/MS techniques, many of these chromatographic peaks were identified as phenolic compounds such as catechol, methylcatechols, orcinol, and resorcinol. These compounds were quantified at concentrations of 10 to 1000 milligrams/liter. Experimental methodology for HPLC and GC/MS techniques is discussed, and analytical results and possible environmental implications are presented. (Author)

A78-32108 Startup and operation of the Research-Cottrell/Bahco scrubber for removal of SO₂ and particulates from flue gas at Rickenbacker Air Force Base, Columbus, Ohio. J. E. McCarthy (Research-Cottrell, Inc., Bound Brook, N.J.). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 90-94.

A78-32112 Preliminary assessment of nontechnical issues related to industrial application of solar-thermal-energy systems. G. A. Watkins, M. L. Brown, B. Maiden, J. Moore, H. Smail, and S. Solomon (Battelle Columbus Laboratories, Columbus, Ohio). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 134-146. 24 refs.

A survey of attitudes concerning industrial application of solar energy systems is reported. Representatives of 20 selected process heat industries, eight public agencies, and four universities, as well as others who have knowledge or experience with solar energy systems expressed their opinions concerning 10 economic, institutional, and environmental issues, and the responses are characterized. The ten issues are: economic - technical uncertainties of solar collector systems, noncompatibility of heat requirements, cost differentials, present need for incentives, industry investment criteria; institutional - need for government incentives, impact of regulatory action; environmental - system land requirements, ecological effects of glare, pollution reduction. M.L.

A78-32113 Efficiency of Fresnel lens solar collector. M. H. Cobble, P. R. Smith, and J. D. Boyes (New Mexico State University, Las Cruces, N. Mex.). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los

Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 147-150. NSF Grant No. OIP-74-08333-A02.

A theoretical analysis is made of a series of Fresnel lens collectors, in parallel connection, that track the sun to produce wet steam. Equations are developed for the boiler efficiency, the steam quality, and the fluid temperature distribution to be expected in the fluid. A series of experiments run at three mass flow rates and at three pressures verify the theoretical predictions. (Author)

A78-32114 NMSU - Casa del Sol of the future. H. L. Horak (California, University, Los Alamos, N. Mex.). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 151-156.

A computer model for the thermal performance of a solar heated and cooled experimental residence constructed in 1976 in New Mexico is reported. The computer model consists of two basic parts, a house load section and a mechanical system heat balance section. The load section determines heat conduction through walls and roof by means of a one-dimensional transient finite difference technique. Interior heat, infiltration, and filter loads are calculated from empirical relations. The load received from incident sunlight on any of the outside house surfaces is determined by a separate subprogram. The mechanical system model solves heat balance equations for each component of the solar system simultaneously, for each time increment, with the aid of a Runge-Kutta integration technique. The model study indicates that the system design, derived from typical engineering practices, has very nearly the optimum size for the climatological region. M.L.

A78-32115 Energy savings through combining of operation of heat pump and air conditioning systems. P. Hrycak (New Jersey Institute of Technology, Newark, N.J.). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 157-160. 6 refs.

Considerable savings of energy are possible through improvement of the original coefficients of performance of air conditioning and heat pump systems by storing the energy rejected during the cooling season, in order to be picked up during the heating season. The storage facility considered is foundation soil. It is shown that capacity of such heat reservoirs is very considerable, and can be made an integral part of combined air conditioning/heat pump systems for a year-around operation. Inclusion of a solar heat collector into the system will give it an additional degree of flexibility. (Author)

A78-32116 Technologies for the utilization of waste energy. Y.-H. Kiang (Trane Thermal Co., Conshohocken, Pa.). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 161-167. 8 refs.

Available and proven technologies for the utilization of waste energy are reviewed with attention to the use of waste energy for reducing waste disposal expenses and for generating heat for process plant purposes. Four systems are discussed: gas to gas heat exchanger, steam generation, condensing type heat exchanger, and cryogenic heat transfer equipment. The equipment can also be used to recover heat from flue gases. The problem of timing, that is, of having waste heat available when it is required, is considered. M.L.

A78-32117 Making use of moderate temperature geothermal resources. J. F. Kunze (Idaho National Engineering Laboratory, Idaho Falls, Idaho) and S. G. Spencer (EG & G Idaho, Inc., Idaho). In: Environmental technology '77; Proceedings of the Twenty-third Annual Technical Meeting, Los Angeles, Calif., April 25-27, 1977. Mount Prospect, Ill., Institute of Environmental Sciences, 1977, p. 179-183.

Advantages and disadvantages of using moderate-temperature geothermal resources in comparison with high-temperature resources are examined, and research program for developing the geothermal resources of the Raft River Valley, Idaho is described. Geothermal technique improvements under study include lowering of the heat sink temperature for turbine heat, since use of organic working fluid makes very low condenser temperatures practical in the cold climate of the intermountain west; and use of concrete-asbestos pipelines in place of welded steel pipelines, since pipeline costs are a major capital item. Also considered are the development of low-cost high-performance heat exchangers, increasing well productivity, and injection of fluids back into the reservoir. M.L.

A78-32141 # Steady metal combustor as a closed thermal energy source. E. G. Groff and G. M. Faeth (Pennsylvania State University, University Park, Pa.). *Journal of Hydronautics*, vol. 12, Apr. 1978, p. 63-70. 14 refs. Navy-supported research.

A thermal energy source is described which can be used with closed thermodynamic cycles to obtain a power system that is independent of the environment. The energy source is based on the steady combustion of gaseous sulfur hexafluoride and liquid lithium, yielding liquid lithium fluoride and lithium sulfide as combustion products. For liquid bath temperatures between 1065 and 1638 K, lithium and the combustion products form an immiscible liquid mixture and the denser product liquid can be removed from the combustor through a trap in order to achieve steady operation. A combustor with a maximum thermal power of 25 kW was employed to study the operation of this system, to measure performance, and to determine the properties of the immiscible liquid mixture. The experiments also examined ignition characteristics, various modes of product collection, utilization of the reactants by the combustion process, and system capabilities for long term, variable-load operation as a thermal energy source. An analysis based on the van Laar thermodynamic model was developed which satisfactorily correlates both properties and the thermal performance of the system. (Author)

A78-32193 # The utilization of LaNi₅ as a hydrogen-storage medium for heat engines (Pro zastosovnist' LaNi₅ yak akumulirovannogo sredstva dlia teplovikh dviguniv). A. M. Pidgornii, I. L. Varshavskii, A. S. Mitrofanov, O. V. Sinogubova, S. E. Pitul'ko, and O. S. Lavoshnik (Akademiia Nauk Ukrain's'koi RSR, Institut Problem Mashinobudovannia, Kharkov, Ukrainian SSR). *Akademiia Nauk Ukrain's'koi RSR, Dopovidy, Serii A - Fiziko-Matematichni ta Tekhnichni Nauki*, Feb. 1978, p. 184-187. 9 refs. In Ukrainian.

Experiments investigating the kinetics of adsorption of hydrogen by the LaNi₅ alloy are described. It is found that the hydrogen-adsorption rate accelerates with decrease of temperature and increase of pressure, and that hydrogen dissociation rate is practically constant within a wide range of hydride compositions. Optimal conditions for the utilization of LaNi₅ as a hydrogen-storage medium for heat engines are discussed. B.J.

A78-32217 What's new in high temperature sulfur removal systems for fluidized-bed coal gasification. D. L. Keairns, R. A. Newby, E. P. O'Neill, and D. H. Archer (Westinghouse Research Laboratories, Pittsburgh, Pa.). *Air Pollution Control Association, Journal*, vol. 28, Apr. 1978, p. 328-333. 21 refs. Contract No. E(49-18)-1514.

An overview of a high-temperature sulfur removal system which uses calcium-based sorbents (e.g., dolomite) is presented. The system is designed for use in fluidized-bed coal gasification systems currently being developed for power generation. Topics considered include sulfur removal, sorbent selection, sorbent regeneration, regeneration chemistry, and spent sorbent disposition, which are examined with reference to the requirements for achieving a commercial system. M.L.

A78-32232 Thermal properties of battery systems. H. F. Gibbard (Gould Laboratories, Rolling Meadows, Ill.). (*Electrochemical Society, Meeting, Philadelphia, Pa., May 8-13, 1977*). *Electrochemical Society, Journal*, vol. 125, Mar. 1978, p. 353-358. 12 refs.

A compact expression is derived for the change in any extensive thermodynamic state variable which accompanies an electrochemical reaction. The distinction between an electrochemical reaction and the complete thermodynamic change in state is clearly drawn. The cases in which every reactant is in a single, pure phase and that in which some reactants are dissolved in solution are discussed. Detailed calculations of the change in enthalpy, the change in Gibbs energy, the cell potential, and the thermal efficiency of the lead/acid battery are presented as examples. Practical thermal efficiencies of 11 other systems are calculated and compared, where possible, with theoretical thermal efficiencies. Equations for the rate of heat flow from batteries are developed and applied to a typical duty cycle of a lead/acid battery for vehicular propulsion. (Author)

A78-32233 Semiconductor electrodes. XV - Photoelectrochemical cells with mixed polycrystalline n-type CdS-CdSe electrodes. R. N. Noufi, P. A. Kohl, and A. J. Bard (Texas University, Austin, Tex.). *Electrochemical Society, Journal*, vol. 125, Mar. 1978, p. 375-379. 29 refs. Research supported by the Robert A. Welch Foundation and NSF.

Solid solutions of CdS and CdSe of different compositions were prepared by sintering pressed pellets and vacuum evaporation. The bandgap of the mixtures varied monotonically with percent composition between that of CdS and CdSe. Studies of the photoassisted oxidation of sulfide with these electrodes with a 1M Na₂S, 0.1M NaOH electrolyte showed that the flatband potentials (V_{fb}) of the mixtures were shifted toward negative potentials with respect to pure CdS and CdSe. Solar cells using these electrodes formulated as (x)n-CdS (1-x)CdSe/1M Na₂S, 0.2M S, 0.1M NaOH/Pt are described. When x = 0.9, for a sintered pellet electrode, a power efficiency of 9% at a cell voltage of 202 mV (irradiation with 577 nm light of 1 mW/sq cm intensity) was obtained. (Author)

A78-32235 25 years of fuel cell development /1951-1976/. K. V. Kordesch (Union Carbide Corp., Battery Products Div., Parma, Ohio). *Electrochemical Society, Journal*, vol. 125, Mar. 1978, p. 77C-91C. 230 refs.

Areas of fuel cell research during the '50s are indicated and the recognition of the need for a stable large interface between electrode and electrolyte is credited with causing the sudden breakthrough in technology. A chronological survey of fuel cell systems is presented; fuel cells considered include high-temperature cells (molten carbonate cells), medium-temperature fuel cells (modifications of the Bacon cell), fuel cells with platinum black Teflon electrodes, fuel cells with porous metal electrodes, ion-exchange membrane cells, matrix (phosphoric acid) fuel cells, acidic methanol cells, alkaline cells with methanol or methanol-derived fuels, ammonia as fuel, sodium amalgam cells, regenerative H₂-O₂ fuel cell systems, thermally regenerative systems, radioactive regenerative fuel cells, chemical redox systems, the nitric acid-oxygen redox electrode, biochemical cells, direct hydrocarbon cells, and indirect hydrocarbon cells. M.L.

A78-32249 Renewable energy sources and storage. R. J. Leicester, V. G. Newman, and J. K. Wright (Central Electricity Generating Board, Planning Dept., London, England). *Nature*, vol. 272, Apr. 6, 1978, p. 518-521.

Studies conducted in Britain on the feasibility of large scale reliance on soft energy, e.g., wind, solar, and wave, have led to the conclusion that such sources can not now be considered replacements for fossil fuels and nuclear power because of climatic variations. In other words, difficulty in storing energy from soft sources necessitates that conventional sources, tied in to the existing electrical grid, still supply the bulk of Britain's power. D.M.W.

A78-32366 # Applications of wind tunnels to investigations of wind-engineering problems. J. E. Cermak (Colorado State University, Fort Collins, Colo.). In: *Aerodynamic Testing Conference, 10th, San Diego, Calif., April 19-21, 1978, Technical Papers*. New York, American Institute of Aeronautics

and Astronautics, Inc., 1978, p. 305-320. 63 refs. NSF Grant No. ENG-76-03135. (AIAA 78-812)

Physical modeling of the atmospheric boundary layer has been made possible by design and construction of special low-speed wind tunnels. This development enables natural winds at a particular site to be simulated for a wide range of meteorological conditions. Through measurements on small-scale models and use of appropriate similarity criteria the simulated natural winds can be used to obtain a wide variety of wind-effect data for planning and design purposes. Techniques for determination of mean wind forces, fluctuating pressures on exterior surfaces and dynamic response of structures are described. Applications to determination of air-pollutant concentrations near power-plant sites and methane concentrations resulting from LNG spills, to location of snow-drifts and to measurement of wind characteristics for improvement of pedestrian comfort, and for evaluation of flight safety during landing and takeoff are also discussed and illustrated by specific examples. (Author)

A78-32367 # An experimental facility for wind engineering research. P. M. Sforza, W. Stasi, and L. Gotkin (New York, Polytechnic Institute, Farmingdale, N.Y.). In: Aerodynamic Testing Conference, 10th, San Diego, Calif., April 19-21, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 321-329. 12 refs. Contract No. E(49-18)-2358. (AIAA 78-813)

Experimental research in wind engineering must rely on testing in a controlled laboratory environment as well as field testing in the uncontrolled natural wind. A facility for such research, developed in the Aerodynamics Laboratories of the Polytechnic Institute of New York, is described. This facility includes both a field test station and a laboratory test station for atmospheric boundary layer research. The utilization of this complex is discussed in terms of an ongoing project on wind energy conversion to illustrate the various capabilities that have been developed. Applications of this facility to other problems in wind engineering are also described. (Author)

A78-32372 # The use of fluidized beds for heating air for wind tunnels. V. Zakkay, G. Miller (New York University, Westbury, N.Y.), and S. Panunzio. In: Aerodynamic Testing Conference, 10th, San Diego, Calif., April 19-21, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 365-375. Contract No. EF-76-C-01-2256. (AIAA 78-818)

A method is presented herein whereby air passing through heat exchanger tubes is heated by the particles of a fluidized bed. This scheme, which has been used successfully in the coal industry for generating steam in boilers, could be modified and adopted for the purpose of generating high-temperature air for driving wind tunnels. Fluidized bed combustion can utilize any fossil fuel and therefore substantial cost saving can be derived if coal is utilized. The analysis presented indicates this method may be superior to regular pebble bed storage heaters which were developed for pre-heating air in the early 50's. This is due to the fact that such a process results in a substantially higher film coefficient and a cleaner product (the high-temperature air). (Author)

A78-32410 On the use of power laws for estimates of wind power potential. E. W. Peterson and J. P. Hennessey, Jr. (Oregon State University, Corvallis, Ore.). *Journal of Applied Meteorology*, vol. 17, Mar. 1978, p. 390-394. 19 refs. NSF Grant No. 62-3649; Grant No. DAAG29-0043.

The evaluation of wind power potential at a proposed aerogenerator site by extrapolation from measured winds at a reference level is investigated. It is shown that the total mean wind power density is not particularly sensitive to the selection of roughness length or power law exponent; over the entire likely range of these parameters the wind power in the mean flow at typical aerogenerator hub heights is within 1.4-4 times the power at a reference height of about 10 m. In lieu of in situ profile measurements, it is suggested that a power law exponent of 1/7 is adequate for realistic but

conservative estimates of the available wind power except at extremely rough sites where the estimates may only be conservative. (Author)

A78-32413 A note on vertical extrapolation formulas for Weibull velocity distribution parameters. J. C. Doran and M. G. Verholec (Battelle Pacific Northwest Laboratories, Richmond, Wash.). *Journal of Applied Meteorology*, vol. 17, Mar. 1978, p. 410-412. Contract No. EY-76-C-06-1830.

The paper is concerned with the adequacy of a vertical extrapolation scheme for Weibull wind speed distribution parameters proposed by Justus and Mikhail (1976). Justus et al. (1976) used the Weibull distribution to represent the wind velocity probability density function, and a set of formulas was proposed by Justus and Mikhail which allows extrapolations to be made of the Weibull scale factor and shape factor which occur in a certain expression. It is found that this technique, although useful for ensemble averages, can lead to significant errors in individual cases. M.L.

A78-32420 Momentum theory and flow states for windmills. F. S. Stoddard (Massachusetts University, Amherst, Mass.). *Wind Technology Journal*, vol. 1, Spring, 1977, p. 3-9. 11 refs.

The momentum theory expressions for thrust and power are discussed in relation to the various flow states which can be present on a rotor. Experience gained from helicopter and autogyro operation is used to gain understanding of the flow fields which cannot be fully described by momentum theory. Stability and control considerations are discussed in support of the emerging interest in defining suitable flight margins for wind generators. (Author)

A78-32421 Blade twist, droop snoot, and forward spars. J. M. Drees (Bell Helicopter Textron, Fort Worth, Tex.). *Wind Technology Journal*, vol. 1, Spring, 1977, p. 10-16. 11 refs.

A history of the development of some windmill blade features is presented. Evidence is provided that nonlinear blade twist and droop snoot (a sophisticated airfoil design with leading edge camber) were used in some large-diameter 17th-century windmill rotors. Location of the blade center of gravity and the main spar near the quarter chord also occurred in some large-diameter rotors of that period. The influence of Dutch windmill design on windmills constructed in areas of Dutch settlement in America is examined. M.L.

A78-32422 Blade design and fabrication - 17-meter VAWT. J. J. Barzda (Kaman Aerospace Corp., Bloomfield, Conn.). *Wind Technology Journal*, vol. 1, Spring, 1977, p. 17-22. Research supported by Sandia Laboratories.

Sandia Laboratories, Albuquerque, New Mexico, is erecting an experimental 17-meter vertical axis wind turbine (VAWT) power generating system. The subsystems are now being fabricated. The subject of this paper is the design and fabrication of the turbine rotor blades. The rotor will have three blades, stiffened with support struts. The design criteria, structural design, supporting engineering analysis, and fabrication methods are discussed. (Author)

A78-32423 Engineering of wind energy systems. J. F. Banas and W. N. Sullivan (Sandia Laboratories, Albuquerque, N. Mex.). *Wind Technology Journal*, vol. 1, Spring, 1977, p. 23-31. 11 refs.

This report addresses the engineering of wind energy systems from the point of view of component selection and performance assessment. Combinations of two load types (variable and constant speed) and three turbine types connected by a fixed-gear-ratio transmission constitute the various systems investigated. The three turbine types result from introducing the notions of nested, unnested, and hybrid power coefficients suggested by current performance characteristics of American Multiblade, Darrieus, and Darrieus/Savonius turbines. The engineering problems associated with these systems are discussed qualitatively, emphasizing the nature, magnitude, and variability of the problems. (Author)

A78-32425 Evolution of stimulated Brillouin to stimulated ion Compton scattering in a CO₂ laser-plasma interaction experiment. A. A. Offenberger, A. Ng, and M. R. Cervenak (Alberta, University, Edmonton, Canada). *Canadian Journal of Physics*, vol. 56, Mar. 1978, p. 381-386. 13 refs.

Strong backscatter (more than approximately 20%) has been observed in the interaction of focused CO₂ laser radiation (1 approximately 10 to the twelfth W/sq cm) with a hydrogen gas target plasma. Spectral measurements show it to arise from stimulated ion Compton scattering (SCS) at later times when the electron-ion temperature ratio is not large. The scattering growth rate was determined experimentally to be 3.4×10 to the twelfth/sec, in good agreement with theoretical predictions for our plasma parameters. Temporal modulation of the backscatter clearly shows buildup and decay of SCS during the interaction time. It may be anticipated that such scattering will be important in laser-pellet fusion experiments. (Author)

A78-32430 # Properties of a collectorless motor fed from a three-phase current-source (Svoistva beskollektornogo dvigatelja pri pitanii ego ot trekhfaznogo istochnika toka). Iu. I. Konev, Iu. N. Rozno, and O. E. Bochkarev. *Elektronnaja Tehnika v Avtomatike*, no. 9, 1977, p. 208-214. In Russian.

A method for increasing the energy conversion efficiency of a collectorless dc-motor is proposed. It is based on the use of a pulsed three-phase current-source to feed the motor winding. A circuit diagram of a collectorless motor with inverter operating in the pulsed-current mode is presented and attention is given to ways of suppressing phase-current fluctuations. It is shown that the use of a three-phase inverter of this type leads to a significant increase in output voltage without increase in heat losses; the power efficiency, meanwhile, is very high (close to 100%). B.J.

A78-32434 Laser-fusion experiments utilizing a 4/pi illumination system. E. K. Storm, J. E. Swain, H. G. Ahlstrom, M. J. Boyle, V. C. Rupert, and D. W. Phillion (California, University, Livermore, Calif.). *Journal of Applied Physics*, vol. 49, Mar. 1978, pt. 1, p. 959-964. 26 refs. Contract No. W-7405-eng-48.

A focusing system which utilizes two f/0.47 doublets in conjunction with ellipsoidal mirrors produces two focusing cones with half-angles of 81.5 degrees. This system has been used with a 10.6-micron laser to irradiate and implode DT-filled glass microspheres of about 70-micron diameter. The purpose of the system was to provide more uniform heating of the pusher and more uniform compression of the DT fuel than had been obtained when irradiating targets using f/1 lenses. Neutron yields of about 10 to the 7th power per event have been obtained at power levels of about 0.4 TW. X-ray micrographs show that improved uniformity of heating and implosion sphericity are achieved. Data are also presented which add further confirmation of the importance of absorption by plasma wave resonance for non-normal incidence of the laser light on the target surface. (Author)

A78-32436 * Power deposition in volumetric U-235/F6-He fission-pumped nuclear lasers. J. W. Wilson (NASA, Langley Research Center, Hampton, Va.) and R. J. DeYoung (Vanderbilt University, Nashville, Tenn.). *Journal of Applied Physics*, vol. 49, Mar. 1978, pt. 1, p. 989-993. 8 refs.

The power deposition in (U-235)F6-He fission-pumped nuclear lasers is studied. Specifically, means to maximize the energy density in the He gas are assessed. Primary loss mechanisms are identified as the fission-fragment transport to the laser-cell wall and UF₆ gas excitation. The losses are thus strongly dependent on UF₆ concentration. It is found that maximum power will be deposited in a laser tube when the tube radius is as large as the range of fission fragments. Experimental results indicate that when the tube radius equals the fission-fragment range, the ratio of a UF₆ partial pressure

to total pressure is 0.15, and the UF₆-He mixing ratio is 1:6, maximum power will be deposited. S.C.S.

A78-32439 Measurements of high-energy deuterons in the plasma-focus device. R. L. Gullickson and H. L. Sahlin (California, University, Livermore, Calif.). *Journal of Applied Physics*, vol. 49, Mar. 1978, pt. 1, p. 1099-1105. 35 refs. Contract No. W-7405-eng-48.

Nuclear activation techniques have been used to measure the fluence of high-energy deuterons in a plasma-focus device. Substantial activation of carbon and aluminum targets was observed on most shots where the deuterium pressure was less than 3 torr. Carbon activation indicates more than 10 to the 15th power deuterons above 330 keV on some high-intensity shots. Ratios of N-13 to Al-28, foil-stack activation measurements, and neutron time of flight all consistently show some deuterons have energies above 2 MeV. Measured N-13/Al-28 ratios also indicate more than 10 to the 12th power deuterons of energy greater than 5 MeV. These measurements illustrate that the plasma-focus device can be operated in two distinctly different modes, with low-pressure operation resulting in the acceleration of ions and electrons to many times the capacitor-bank charging voltage. Most of the neutron emission in low-pressure operation may come from beam-target reactions. (Author)

A78-32440 Implosion experiments with D₂, He-3 filled microspheres. V. W. Slivinsky, H. G. Ahlstrom, J. H. Nuckolls, J. T. Larsen, B. W. Weinstein, K. G. Tirsell, E. K. Storm, and G. R. Leipelt (California, University, Livermore, Calif.). *Journal of Applied Physics*, vol. 49, Mar. 1978, pt. 1, p. 1106-1109. 9 refs. Contract No. W-7405-eng-48.

Glass microspheres filled with D₂ and He-3 were imploded using the LLL 1.06-micron Argus laser. The energetic 14.7-MeV protons from the D-He-3 reactions were measured. By taking the ratio of the number of D-He-3 reactions to the D-D reactions, ion temperatures were calculated. The results were compared with numerical modeling of the experiments. (Author)

A78-32503 Reversible thermodynamics of the airlift pump. R. E. Barieau (West Texas State University, Canyon, Tex.). *Wind Technology Journal*, vol. 1, Fall 1977, p. 4-7. 5 refs. Research supported by the West Texas State University.

Formulas for calculating the reversible work required for pumping water by means of the airlift are derived. A sample calculation is presented. It is suggested how the reversible work could be used to calculate the parameters in an actual airlift installation. (Author)

A78-32504 How wind variability affects the potential power available from wind generators. A. S. Konigsberg (New York, State University, New Paltz, N.Y.). *Wind Technology Journal*, vol. 1, Fall 1977, p. 8-10.

An analysis is presented to show that two different areas having the same average wind could produce significantly different amounts of power from comparable wind generator systems. Information about average wind in the area is not sufficient for prediction because of topographic and similar features. Even knowledge of the average wind speed at the precise location under consideration does not guarantee adequate predictions. The analysis explained here permits greater accuracy by taking wind variability into account. Detailed analysis of wind speed at all potential sites is recommended. M.L.

A78-32505 Toroidal accelerator rotor platforms for wind energy conversion. A. L. Weisbrich (Kaman Aerospace Corp., Bloomfield, Conn.). *Wind Technology Journal*, vol. 1, Fall 1977, p. 11-20. 9 refs.

A toroidal accelerator rotor platform (TARP) design for wind energy conversion systems (WECS) application is described and analyzed for performance and economic viability using both experimental results and analytical approaches. As an obstruction type

A78-32506

flow concentrator and accelerator, a TARP generates low-pressure high-kinetic-wind-energy regions at its rotor disk sites. Since rotor performance is enhanced by flow augmentation, the calculated power output levels per unit disk area are three times the levels of conventional WECS. Advantages of TARP WECS involve reduced energy cost as well as applicability and interface adaptability to a broad range of uses, environment, and structures. The design is considered to have minimal environmental impact. M.L.

A78-32506 Empirical and theoretical statistics of wind-charger home heating potential. S. Stolt and R. L. Kirlin (Wyoming, University, Laramie, Wyo.). *Wind Technology Journal*, vol. 1, Fall 1977, p. 21-25.

Application of wind energy to home heating has drawn considerable interest recently and several windchargers are currently available at a small fraction of the average cost of a new home. The performance and economics of one of these is studied by using weather and home heating statistics at two geographical locations. It is shown that for the example chosen, wind energy is not quite economical. Due to the cooling effect of the wind, a statistical correlation between power availability and power demand was sought. However, this was not shown to be the case. The implication is that heat storage capability is necessary for high efficiency.

(Author)

A78-32507 The induction generator for wind energy conversion. D. Crosno. *Wind Technology Journal*, vol. 1, Fall 1977, p. 26-30. 9 refs.

The paper describes three-phase and single-phase induction generators which could be used for converting wind energy to electricity. A safety feature of these systems, in comparison with a.c. or d.c. generators, is that if the power line voltage becomes zero, the voltage of the induction generator instantly becomes zero. Connection of a wind-driven generator to a commercial power line is considered, sample calculations of the wind speed required for producing a given power output and of the ratio of windmill torques for two loads are presented, and the importance of not using an induction motor as an induction generator, unless the motor has been designed to operate above synchronous speed, is emphasized.

(Author)

A78-32509 Compact gas generator for fuel gasification aboard motor vehicles. W. Frie, H.-J. Henkel, H. Kostka, W. Küsebauch, A. Michel, B. Paul, and E. v. Szabo (Siemens AG, Forschungslaboratorien, Erlangen, West Germany). *Siemens Forschungs- und Entwicklungsberichte*, vol. 7, no. 2, 1978, p. 53-56. 6 refs.

The design and operation of a catalytic system for the conversion of liquid hydrocarbon fuel into a gaseous state for subsequent mixing with ambient air and injection into an automobile engine is described. The following characteristics are considered essential to the systems practicability: adiabatic operating mode with a view to rapid load changes, high efficiency, low volume and weight, independence from external water supply, and a catalyst life time of at least 300 hours. Operating temperature of the catalytic reaction is in the vicinity of 820 C, with an air/fuel mass ratio of 1.35. Also discussed is the potential of the system for reducing air pollution, especially through reduction of NOx. D.M.W.

STAR ENTRIES

N78-16053* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COLD-AIR PERFORMANCE OF FREE-POWER TURBINE DESIGNED FOR 112-KILOWATT AUTOMOTIVE GAS-TURBINE ENGINE. 1: DESIGN STATOR-VANE-CHORD SETTING ANGLE OF 35 DEG

Milton G. Kofskey and William J. Nusbaum Jan. 1978 23 p refs

(NASA-TP-1007; CONS/1011-12; E-8964) Avail: NTIS HC A02/MF A01 CSDL 21E

A cold air experimental investigation of a free power turbine designed for a 112-kW automotive gas-turbine was made over a range of speeds from 0 to 130 percent of design equivalent speeds and over a range of pressure ratio from 1.11 to 2.45. Results are presented in terms of equivalent power, torque, mass flow, and efficiency for the design power point setting of the variable stator. Author

N78-16090* Hughes Research Labs., Malibu, Calif.

EXTENDED PERFORMANCE SOLAR ELECTRIC PROPULSION THRUST SYSTEM STUDY. VOLUME 4: THRUSTER TECHNOLOGY EVALUATION Final Report, 14 Feb. - 29 Aug. 1977

R. L. Poeschel, E. I. Hawthorne, Y. C. Weisman, M. Frisman, G. C. Benson, R. J. McGrath, R. M. Martinelli, T. L. Linsenbardt, and J. R. Beattie Sep. 1977 110 p refs Prepared in cooperation with Hughes Space and Communications Group, Los Angeles (Contract NAS3-20395)

(NASA-CR-135281) Avail: NTIS HC A06/MF A01 CSDL 21C

Several thrust system design concepts were evaluated and compared using the specifications of the most advanced 30 cm engineering model thruster as the technology base. Emphasis was placed on relatively high power missions (60 to 100 kW) such as a Halley's comet rendezvous. The extensions in thruster performance required for the Halley's comet mission were defined and alternative thrust system concepts were designed in sufficient detail for comparing mass, efficiency, reliability, structure, and thermal characteristics. Confirmation testing and analysis of thruster and power processing components were performed, and the feasibility of satisfying extended performance requirements was verified. A baseline design was selected from the alternatives considered, and the design analysis and documentation were refined. The baseline thrust system design features modular construction, conventional power processing, and a concentrator solar array concept and is designed to interface with the Space Shuttle. Author

N78-16171 University of Southern Mississippi, Hattiesburg. **INVESTIGATIONS OF THE EFFECTS OF SHEAR DEGRADATION ON THE RHEOLOGICAL BEHAVIOR OF ULTRA-HIGH MOLECULAR WEIGHT WATER SOLUBLE POLYMERS AS APPLIED TO ENHANCE OIL RECOVERY Ph.D. Thesis**

Donald Edward McLemore 1977 164 p

Avail: Univ. Microfilms Order No. 77-22881

Characterization methods for water soluble polymers were developed. Structure property relationships were established and the effects of shear degradation on mobility control were evaluated. Polymers employed in the investigation included polyacrylamide, hydrolyzed polyacrylamides (24%, 34%, 37%) (HPAM), crosslinked HPAM, and xanthanomas polysaccharide. In the area of characterization techniques, a clarification procedure for use with light scattering molecular weight determinations

was discussed and Zimm plots illustrate the usefulness of the method for salt free and salt containing aqueous polymer solutions. An aqueous exclusion chromatographic system was developed to provide more rapid analysis of polymer molecular weights and molecular weight distributions. Controlled porosity glasses were used as column packings, and polystyrene sulfonates were prepared and used as calibrants. Dissert. Abstr.

N78-16177 Drexel Univ., Philadelphia, Pa. **SELECTIVE PAINTS FOR SOLAR ABSORBERS Ph.D. Thesis**

Janon Frederic Embury, Jr. 1977 140 p

Avail: Univ. Microfilms Order No. 77-23422

A theoretical investigation into the solar absorbance and infrared emittance of hypothetical black paints with pigment particle size in the Rayleigh region is carried out using radiative transfer theory. The influence of a number of factors on paint selectivity is determined; namely, specular and diffuse reflecting interfaces, absence of an interface, metal substrate reflectance, single scatter albedo, and optical depth at solar and infrared wavelengths. Improvements in selectivity are predicted and the extent of selectivity improvements are calculated which result from a glossy paint air interface, a diffuse reflecting substrate, low albedo values, intermediate optical depths, a selective metal substrate and lower ratios of IR optical depth over solar optical depth. An experiment was undertaken to evaluate the solar selective properties of black paints which can be inexpensively formulated from commercially available black pigments. Dissert. Abstr.

N78-16198# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.

STRATEGIC PETROLEUM RESERVE Final Environmental Impact Statement

Sep. 1977 266 p refs Supplement

(PB-273487/9; FEA/S-77/329; FEA-76/2-Draft-Suppl) Avail: NTIS HC A12/MF A01 CSDL 21D

The Strategic Petroleum Reserve mitigates the economic impacts of any future interruptions of petroleum imports. The impacts of storing one hundred fifty million barrels(MMB) of oil by 1978 and five hundred MMB by 1982 was addressed in the final programmatic EIS and the SPR plan. It is now proposed that the SPR be expanded to store a total of 1,000 MMB. The environmental impacts of proposed expansion was addressed. GRA

N78-16199# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

STUDIES OF HYDROGEN LIQUEFIER EFFICIENCY AND THE RECOVERY OF THE LIQUEFACTION ENERGY

R. O. Voth and W. R. Parrish Aug. 1977 63 p refs

(PB-274058/7; NBSIR-77-862) Avail: NTIS HC A04/MF A01 CSDL 21D

The economics of liquefying hydrogen are costly both in the energy required to produce the liquid and in the capital costs of the liquefier. These costs could be reduced by increasing the liquefier efficiency and/or by recovering a portion of the liquefaction energy at the use site. The maximum hydrogen liquefier efficiency is provided based on the efficiency of available components and the fraction of original liquefaction energy that can be recovered at the use site. Since the inefficient compressors and expanders are the major cause of liquefier inefficiency, no increase in liquefier efficiency above the current 30 to 35 percent is probable without a corresponding increase in compressor and expander efficiency -- a difficult task since both the compressors and expanders have a long and stable history of development. However, roughly one-third to one-half of the actual energy required to liquefy hydrogen can be recovered at the use site and this represents a cost credit for liquid hydrogen. GRA

N78-16280* North Carolina Agricultural and Technical State Univ., Greensboro.

INNOVATIONS IN MICROELECTRONICS AND SOLID STATE AT NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Leo Williams, Jr. /n NASA, Marshall Space Flight Center Proc. of the 1977 NASA/ISHM Microelectronics Conf. Nov. 1977 p 169-177 refs Submitted for publication

Avail: NTIS HC A08/MF A01 CSCL 09C

Research in the following areas is described: (1) Characterization and applications of metallic oxide devices; (2) Electronic properties and energy conversion in organic amorphous semiconductors; (3) Material growth and characterization directed toward improving 3-5 heterojunction solar cells. Author

N78-16327*# Dynatherm Corp., Cockeysville, Md.

HEAT PIPE DEVELOPMENT

Walter Bienert 31 Jul. 1973 67 p refs (Contract NAS5-11455)

(NASA-CR-156669; DTM-73-7) Avail: NTIS HC A04/MF A01 CSCL 20D

The objective of this program was to investigate analytically and experimentally the performance of heat pipes with composite wicks--specifically, those having pedestal arteries and screwthread circumferential grooves. An analytical model was developed to describe the effects of screwthreads and screen secondary wicks on the transport capability of the artery. The model describes the hydrodynamics of the circumferential flow in triangular grooves with azimuthally varying capillary menisci and liquid cross-sections. Normalized results were obtained which give the influence of evaporator heat flux on the axial heat transport capability of the arterial wick. In order to evaluate the priming behavior of composite wicks under actual load conditions, an 'inverted' glass heat pipe was designed and constructed. The results obtained from the analysis and from the tests with the glass heat pipe were applied to the OAO-C Level 5 heat pipe, and an improved correlation between predicted and measured evaporator and transport performance were obtained. Author

N78-16329*# Sigma Research, Inc., Richland, Wash.

TWO-PHASE WORKING FLUIDS FOR THE TEMPERATURE RANGE 50 TO 350 C Final Report

Elric W. Saaski and Peter C. Owzarski Jun. 1977 103 p refs (Contract NAS3-20222)

(NASA-CR-135255) Avail: NTIS HC A06/MF A01 CSCL 20D

The decomposition and corrosion of two-phase heat transfer liquids and metal envelopes have been investigated on the basis of molecular bond strengths and chemical thermodynamics. Potentially stable heat transfer fluids for the temperature range 100 C to 350 C have been identified, and reflux heat pipes tests initiated with 10 fluids and carbon steel and aluminum envelopes to experimentally establish corrosion behavior and noncondensable gas generation rates. Author

N78-16334# Argonne National Lab., Ill. Chemistry Div.

HYCSOS: A CHEMICAL HEAT PUMP AND ENERGY SYSTEM BASED ON METAL HYDRIDES

D. M. Gruen, I. Sheft, G. Lamich, M. Mendelsohn, L. Charlson, A. Knox, R. McBeth, J. Nixon, and F. Schreiner Jun. 1977 45 p refs

(Contract W-31-109-eng-38)

(ANL-77-39) Avail: NTIS HC A03/MF A01

The HYCSOS chemical heat pump and energy conversion system based on metal hydrides are described. The HYCSOS thermal energy storage and recovery modes; the chemical heat pump heating and cooling modes as well as the energy conversion mode are discussed in detail with the aid of heat transfer fluid and hydrogen flow diagrams. The thermodynamic efficiencies of the two metal hydride system were calculated for the heat pump and conversion modes. Design and construction features of a demonstration test facility which utilizes four stainless steel tanks holding 10 lbs. each of either LaNi₅ or CaNi₅ were given. The operation, instrumentation and control of the system were detailed with the aid of photographs, drawings and a system layout diagram. Initial operation of the system has shown that 33 moles of hydrogen can be transferred from CaNi₅ at approximately 100 C to LaNi₅ at approximately 40 C and recovered from LANi₅ at approximately 8 C to reform CaNi₅H₄ at 40 C with cycle times approaching 2 minutes for 50 percent hydrogen transfer. ERA

N78-16405 Oregon State Univ., Corvallis.

REMOTE SENSING APPLICATIONS IN HYDRO-GEOTHERMAL EXPLORATION OF THE NORTHERN BASIN AND RANGE PROVINCE Ph.D. Thesis

Thomas William Holder 1977 235 p

Avail: Univ. Microfilms Order No. 77-29413

An evaluation was conducted utilizing side-looking-airborne-radar (SLAR) and thermal infrared (TIR) detectors in a complementary fashion. The program consisted of preliminary overflights of SLAR for the detection of fault lineaments along which surface expressions of hydro-geothermal activity are localized. Interpretation of the SLAR imagery was used to generate TIR flightlines corresponding to the major lineaments. Subsequent flights incorporated TIR line scanners utilizing the mercury-cadmium-telluride, indium antimonide, and indium arsenide detectors. A map was produced depicting the interpreted data. The map graphically portrays the structural relationship between the interpreted surface hydro-geothermal sites and the fracture traces, at a scale of 1:500,000. Dissert. Abstr.

N78-16413# Shriver (R.) Associates, Parsippany, N. J.

US OIL AND NATURAL GAS FINDINGS COSTS. A STUDY FOR THE FEDERAL ENERGY ADMINISTRATION, VOLUME 1

Jul. 1977 172 p

(Contract FEA-CR-05-60731-00)

(PB-27400019; FEA/G-77/356-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 08I

Costs for historical U.S. oil and gas exploration efforts are presented and the level of such costs in 1980, 1985 and 1990 is projected. Data was developed for 17 onshore and 2 offshore regions in the Continental U.S. where the petroleum industry has traditionally focused its operations. In addition, 2 onshore and 2 offshore sectors of Alaska as well as the offshore Atlantic Coast region were also examined. Research is presented in terms of total dollar costs per foot drilled for oil and gas wells in 6 separate categories in each region. GRA

N78-16414# Shriver (R.) Associates, Parsippany, N. J.

US OIL AND NATURAL GAS FINDINGS COSTS. A STUDY FOR THE FEDERAL ENERGY ADMINISTRATION, VOLUME 2: STATISTICAL APPENDIX

1977 330 p

(Contract FEA-CR-05-60731-00)

(PB-2740017; FEA/G-77/356-Vol-2-App) Avail: NTIS HC A15/MF A01 CSCL 08I

Total finding costs per foot statistics are provided from 1961 through 1974 for historical regions. Exploratory drilling cost per foot statistics from 1961 through 1974 are also presented, along with projections for 1980, 1985 and 1990. Geological and geophysical costs, lease rental and bonus costs and historical surface costs are summarized. GRA

N78-16419# Bureau of Mines, Amarillo, Tex. Helium Operations.

ANALYSES OF NATURAL GASES, 1976 Annual Report, Information Circular 1977

B. J. Moore 1977 99 p refs Sponsored by Dept. of Interior (PB-272735/2; BM-IC-8749) Avail: NTIS HC A05/MF A01 CSCL 08I

Analyses and related source data are presented for 252 natural gas samples from wells and pipelines in 17 states. All samples were obtained and analyzed during calendar year 1976 as a part of Bureau of Mines investigations of the occurrences of helium in natural gases of countries with free market economies. GRA

N78-16422 Utah Univ., Salt Lake City.

TWO-STAGE COAL GASIFICATION TO HIGH-BTU GAS Ph.D. Thesis

Ying-Hsiao Li 1977 183 p

Avail: Univ. Microfilms Order No. 77-25073

A coal gasification process to produce a substitute for natural gas from coal without changing the form of carbon from coal to methane was developed. The catalyzed process is a two step operation. In the hydrosolvation stage, Hiawatha coal and the

catalyst were slurred in tetralin under hydrogen pressure in a batch stirred tank reactor. A conversion of 85 percent was obtained using sulfided nickel-molybdenum, supported on alumina as a catalyst. The hydrogasification stage was conducted in the flow system of a fixed catalyst bed. The overall process indicated that the coal was converted to 62 percent gas, 10 percent gasoline, 7 percent middle oil, 2 percent heavy oil, 19 percent char. The yield of methane was 77 weight percent of the total gas and the heating value was 1202 BTU per standard cubic foot. Dissert. Abstr.

N78-16423 Drexel Univ., Philadelphia, Pa.
AN ANALYSIS OF ALTERNATIVE RESIDENTIAL HEATING SYSTEMS IN TERMS OF THREE CRITERIA: ENERGY CONSERVATION, ENVIRONMENTAL IMPACT AND LIFE-CYCLE ECONOMICS Ph.D. Thesis
 Mark Joseph Wallin 1977 293 p
 Avail: Univ. Microfilms Order No. 77-22537

The performance of a number of heating systems are analyzed by dynamic computer simulations. The simulations make use of weather tapes with hourly data for the Delaware Valley region during the severe winter of 1963-64. The performance of the alternative heating systems are simulated by making use of a modular program. Environmental impact indices are assigned to each heating system in five categories: air pollution, water pollution, solid waste, land use and occupational safety and health. A life cycle economic analysis is carried out. The simulation technique is used to allow independent variables, including weather conditions, equipment costs, system life and fuel cost, to vary randomly and independently. A method of combining the three equally weighted criteria for each heating system is described. Dissert. Abstr.

N78-16425 Texas Technological Univ., Lubbock.
OPTICAL ANALYSIS OF SPHERICAL SEGMENT SOLAR COLLECTORS Ph.D. Thesis
 Billy Charles Brock 1977 281 p
 Avail: Univ. Microfilms Order No. 77-25501

An approach for the calculation of optical flux distributions and power concentration ratios is described which can be applied for mirrors of any shape, illuminated by a source of arbitrary angular extent provided appropriate structure relations can be determined. The method is not restricted to single reflections but is valid for light which reflects from the mirrors any number of times. The work focuses on spherical mirror segments with conical receivers. The result is an extremely accurate expression for the conical power concentration. The method is also applicable for point source illumination. Dissert. Abstr.

N78-16426 Wisconsin Univ., Madison.
AN ASYNCHRONOUS ac/dc/ac LINK FOR WIND POWER APPLICATION Ph.D. Thesis
 Bernard Thomas Merritt 1977 311 p
 Avail: Univ. Microfilms Order No. 77-17842

It is proven that an asynchronous ac/dc/ac electric link is a practical way of converting the kinetic energy in the wind to electrical energy. The ac/dc/ac link termed a wind energy conversion system (WECS) consists of a wind driven polyphase alternator, rectifier, inductor, and an inverter tied to the existing utility grid. The laboratory investigations studied various alternator types, types of inverters, and types of inverter control. Based on these laboratory tests, a WECS consisting of a modified commercial aerogenerator, a three phase, six pulse bridge rectifier, a bus stabilizer, and a single phase, four pulse, bridge inverter was designed, built and installed. Dissert. Abstr.

N78-16427 Miami Univ., Coral Gables, Fla.
THREE-REGION WORLD DYNAMICS OF FOSSIL/HYDROGEN ENERGY SYSTEM Ph.D. Thesis
 Nasser Sadat Forouzanmehr 1977 567 p
 Avail: Univ. Microfilms Order No. 77-29996

The world had been grouped into three regions with respect to energy: developed countries, petroleum producing countries and developing countries. A three-regional model for analysis of the world energy problems was developed including world dynamics of the fossil/hydrogen system. The most important

national, regional and global problems are identified. An explanation of why the attempts to deal with such problems have not been successful is given. Some useful statistical data for a period of almost two decades is summarized for use as basic data for the fundamental correlation and the initial input for system analysis. Dissert. Abstr.

N78-16428 Michigan Univ., Ann Arbor.
AN EXAMINATION OF SMALL WIND ELECTRIC SYSTEMS IN MICHIGAN Ph.D. Thesis
 Barry Norbert Haack 1977 223 p
 Avail: Univ. Microfilms Order No. 77-18041

The use of small wind powered generators for supplying electricity to individual households in Michigan is examined. Small wind electric systems are not currently economically competitive with electricity from utility companies. Increasing costs of electricity from utility companies, governmental subsidies for individuals installing wind electric systems, or decreased capital costs of these systems as a result of large volume production may greatly increase the economic competitiveness of small wind electric systems. The net energy analysis of small wind electric systems concluded that these systems are energetically competitive with existing utility company's systems. Direct environmental impacts from the normal or abnormal operation of small wind electric systems appear to be slight but indirect environmental impacts, e.g., incurred during acquisition of materials for construction, may be considerable. Dissert. Abstr.

N78-16429# Committee on Energy and Natural Resources (U.S. Senate).
ECONOMIC IMPACT OF PRESIDENT CARTER'S ENERGY PROGRAM

Washington GPO 1977 182 p refs Hearing before Comm. on Energy and Natural Resources, 95th Congr., 1st Sess., 3 May 1977
 (GPO-91-295; Publ-95-33)

The administration's national energy program was evaluated as to economic impact in regard to the consumer and energy prices, total energy savings, regional impacts, and energy supplies. The overall issue in question was whether or not the program can realistically be expected to meet legitimate national energy needs in 1985 and beyond. B.L.P.

N78-16430# Committee on Energy and Natural Resources (U.S. Senate).
IMPACT OF THE NATIONAL ENERGY PLAN

Washington GPO 1977 41 p refs Hearing before Comm. on Energy and Natural Resources, 95th Congr., 1st Sess., 19 May 1977
 (GPO-91-909) Avail: Comm. on Energy and Natural Resources

A thorough review was made by the jurisdictional committees of Congress of President Carter's national energy plan. The impact of specific portions of the plan were analyzed in order to establish a realistic perspective with respect to the goals enunciated by the President. Topics covered include predicted energy savings, cost of the plan, costs to the industry of coal conversion and higher prices for consumers. B.L.P.

N78-16431*# National Aeronautics and Space Administration, Washington, D. C.
CONSIDERATIONS ON COAL GASIFICATION

J. E. Franzen Jan. 1978 34 p refs Transl. into ENGLISH from 'Einige Ueberlegungen zur Kohlevergasung' (West Germany), v 35, Jan. 1977 p 83-94 Transl. by Kanner (Lan) Associates, Redwood City, Calif. Original doc. prep. by Tech. Mitt. Krupp, forschungsberichte
 (NASA-TM-75233) Avail: NTIS HC A03/MF A01 CSCL 10B

Commercial processes for the gasification of coal with oxygen are discussed. The Koppers-Totzek process for the gasification of coal dust entrained in a stream of gasifying agents is described in particular detail. The outlook for future applications of coal gasification is presented. Author

N78-16432*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

TEST AND ANALYSIS OF A NORTHRUP COLLECTOR CONTROLLER

D. R. Scott, R. R. Kissel, and H. Reid Jan. 1978 24 p ref (NASA-TM-78153) Avail: NTIS HC A02/MF A01 CSCL 10A

The collector controller was examined as a functioning control system that drives the Northrup collector from east to west to follow the sun then back to the east at sundown in readiness for the next sunrise. The major components were examined separately with particular emphasis placed on an analysis of the electronic drive circuit. Results are presented from hardware testing and analysis with recommended changes to improve the system. Author

N78-16433*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

THE SOLAR HEATING AND COOLING COMMERCIAL DEMONSTRATION PROGRAM: SOME EARLY PROBLEMS AND RESULTS

Robert L. Middleton Jan. 1978 31 p refs (NASA-TM-78152) Avail: NTIS HC A03/MF A01 CSCL 10A

The activities of the Marshall Space Flight Center of the National Aeronautics and Space Administration in the technical evaluation of proposals, contracts definitions, and program management details are defined and discussed. The significant problems were summarized in both technical and management aspects of the program. It was concluded that the program has significantly stimulated additional solar effort by the program participants. It was also concluded that the use of conventional construction industry organization with design/competitive bid procedures and standards has maintained a cost effective program. Author

N78-16434*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

APPROXIMATE METHOD FOR CALCULATING FREE VIBRATIONS OF A LARGE-WIND-TURBINE TOWER STRUCTURE

Sankar C. Das and Bradford S. Linscott Dec. 1977 46 p refs (Contract E(49-26)-1028)

(NASA-TM-73754; ERDA/NASA-1028/77/12) Avail: NTIS HC A03/MF A01 CSCL 10A

A set of ordinary differential equations were derived for a simplified structural dynamic lumped-mass model of a typical large-wind-turbine tower structure. Dunkerley's equation was used to arrive at a solution for the fundamental natural frequencies of the tower in bending and torsion. The ERDA-NASA 100-kW wind turbine tower structure was modeled, and the fundamental frequencies were determined by the simplified method described. The approximate fundamental natural frequencies for the tower agree within 18 percent with test data and predictions analyzed. Author

N78-16436# Nagoya Univ. (Japan). Inst. of Plasma Physics. **PROPOSED HIGH-POWER MICROWAVE SOURCE USING A SUPERCONDUCTING CAVITY AS AN ENERGY STORAGE**

Kazuo Minami Nov. 1977 33 p refs (IPPJ-T-30) Avail: NTIS HC A03/MF A01

A new principle of a high-power microwave source using a superconducting cavity as an energy storage is proposed. Since the quality factors about 10 to the 11th power and the electric field strength up to 60 MV/m are presently attainable, microwaves with energy density up to 0.016J/cum can be stored in a superconducting cavity. The stored energy can be released, in a short time, by changing mechanically the coupling factor between the cavity and a waveguide circuit. The technical possibilities are discussed in Rome detail. It is emphasized that, although the economical feasibilities are not assured at this stage of technology, this energy storage can be used to produce high-power microwave pulses which are not available in usual microwave oscillators. The resonant frequency energy storage presented here can be applied to the experiments in nuclear fusion research, because it is suited to a long-pulse operation of the order of 1 msec with an output power greater than 10 MW. Author

N78-16437*# Motorola, Inc., Phoenix, Ariz. Semiconductor Group.

LASER-ZONE GROWTH IN A RIBBON-TO-RIBBON, RTR, PROCESS SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Annual Report

R. W. Gurtler and A. Baghdadi Sep. 1977 121 p Sponsored in part by ERDA Prepared for JPL (Contracts NAS7-100; JPL-954376) (NASA-CR-155586; ERDA/JPL-954376-77/4) Avail: NTIS HC A06/MF A01 CSCL 10A

A ribbon-to-ribbon process was used for routine growth of samples for analysis and fabrication into solar cells. One lot of solar cells was completely evaluated: ribbon solar cell efficiencies averaged 9.23% with a highest efficiency of 11.7%. Spherical reflectors have demonstrated significant improvements in laser silicon coupling efficiencies. Material analyses were performed including silicon photovoltage and open circuit photovoltage diffusion length measurements, crystal morphology studies, modulus of rupture measurements, and annealing/gettering studies. An initial economic analysis was performed indicating that ribbon-to-ribbon add-on costs of \$.10/watt might be expected in the early 1980's. Author

N78-16438*# General Electric Co., Philadelphia, Pa. Valley Force Space Center.

SOLAR ARRAY CONCEPTUAL DESIGN FOR THE HALLEY'S COMET ION DRIVE MISSION, PHASE 2 Final Report

G. J. Rayl, K. M. Speight, and R. W. Stanhouse 31 Aug. 1977 87 p Prepared for JPL

(Contracts NAS7-100; JPL-954393) (NASA-CR-155594; Doc-77SDS4243) Avail: NTIS HC A05/MF A01 CSCL 10A

Conceptual design studies were performed directed toward a high power, ultralightweight solar array, compatible with the requirements for the Halley's Comet Ion Drive Mission. A planar, rollup array design concept capable of producing 120 kW at 1 AU and 6 kW at 4.5 AU, and a concentrator, rollup array design concept capable of producing 60 kW at 1 AU and 15.5 kW at 4.5 AU evolved. Both arrays make maximum use of thin film, lightweight technology. The Halley's Comet spacecraft and mission requirements developed from preliminary definition to a more finalized and mature design. As solar array requirements were updated, conceptual design iterations were necessary to keep pace with the rapidly changing program objectives and goals. The Halley's Comet Mission program status and design approaches were reviewed and more realistic power requirements at 4.5 AU for the ion engines were established at the 12 to 16 kW range. This higher power necessitated a change from the planar array design to a concentrator array design in order to remain within suitable cost and weight objectives. Author

N78-16444# Argonne National Lab., Ill. Engineering Div. **EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATOR PROGRAM Annual Report, Aug. 1975 - Sep. 1976**

M. Petrick, G. Fabris, E. S. Pierson, D. Carl, and A. K. Fischer Sep. 1977 101 p refs

(Contract N00014-76-F-0026) (AD-A046951; ANL-MHD-77-3) Avail: NTIS HC A06/MF A01 CSCL 10/2

The revised ambient-temperature NaK-nitrogen facility is described. The maximum liquid flow rate and generator inlet pressure are 10.9 kg/s (200 gpm) and 1.48 MPa absolute (200 psig), respectively, compared with the previous values of 6 kg/s (110 gpm) and 0.72 MPa absolute (90 psig). Satisfactory loop operation has been obtained, and new experiments with the second diverging-channel generator were completed. The principal experimental results were a higher density for the same generator operating conditions, and an apparent tendency for the efficiency to improve more with increasing quality at higher velocities than lower velocities. An evaluation of an annular generator geometry is presented. The advantages and disadvantages of the geometry are described, the equations developed, and solutions obtained for three cases--constant velocity and no armature reaction, laminar flow with no armature reaction, and

armature reaction with constant velocity. Numerical examples show that: (1) the attainable terminal voltages appear to be very low, (2) flow reversal and large viscous loss occurs at or below the desired power densities, and (3) armature reaction effects are important and compensation techniques appear impractical. Thus, this annular geometry does not appear attractive for either generator or pump operation. GRA

N78-16445# Colorado School of Mines, Golden. Dept. of Geophysics.

EXPLORATION FOR GEOTHERMAL ENERGY ON OAHU, HAWAII Final Report

George V. Keller, Jose Souto, and Augustine B. Furumoto 10 Nov. 1977 42 p refs

(Contract N00014-76-C-0824)

(AD-A046954) Avail: NTIS HC A03/MF A01 CSCL 08/7

Most interest in geothermal development in Hawaii up to the present time has centered on the development of thermal energy at Kilauea Volcano on the Island of Hawaii. Several test wells have yielded encouraging results with respect to further development of geothermal energy (Keller, et al, 1974). However, nearly 80% of the population of Hawaii resides on the Island of Oahu. In view of the larger market for energy there, it is reasonable to review the potential for the occurrence of commercial geothermal resources on Oahu. GRA

N78-16446# Energy Research and Development Administration, Washington, D. C.

UNDERGROUND COAL GASIFICATION PROGRAM

Mar. 1977 32 p refs

(ERDA-77-51) Avail: NTIS HC A03/MF A01

A brief overview of the ERDA program to develop underground coal gasification (UCG) technology is provided. The UCG program is part of ERDA's overall strategy to create energy choices for the future. General descriptions of the concept and its potential applications are included. The objective of the UCG program is to develop commercially viable, underground gasification processes for extracting energy from coal. Through government and industry joint participation, the technology will be developed, proved on a large scale, and transferred to the private sector; data will be provided to predict the economics of a commercial operation. ERDA's objectives and its support of national energy goals are shown. ERA

N78-16447# Bituminous Coal Research, Inc., Monroeville, Pa. **GAS GENERATOR RESEARCH AND DEVELOPMENT:**

BI-GAS PROCESS Quarterly Report, Jan. - Mar. 1977

Apr. 1977 76 p Prepared in cooperation with Phillips Petroleum Co., Homer City, Pa.

(Contract EF-77-C-01-1207)

(FE-1207-29) Avail: NTIS HC A05/MF A01

The continuing objective of this program to develop processes for gasifying coal to produce high-Btu pipeline gas is discussed. Laboratory-scale coal gasification experimentation will be conducted concurrently with a process and equipment development unit (PEDU). With the aid of engineering subcontractor(s), a BI-GAS pilot plant facility was designed and constructed. The combined bench-scale and PEDU studies will be conducted to develop a fluidized bed methanation process for use in upgrading a coal-derived synthesis gas. At the bench-scale level, catalysts will be investigated under conditions imposed by the BI-GAS process. These conditions include high carbon monoxide concentrations, high pressure, and a 3/1 hydrogen to carbon monoxide ratio. ERA

N78-16449# Battelle Pacific Northwest Labs., Richland, Wash. **ANALYSIS OF ELECTRICITY PRODUCTION COSTS FROM THE GEOPRESSURED GEOTHERMAL RESOURCE**

C. H. Bloomster and C. A. Knutsen Feb. 1977 75 p refs

(Contract EY-76-C-06-1830)

(BNWL-2192) Avail: NTIS HC A04/MF A01

The economics of the geopressured geothermal resource along the northern coast of the Gulf of Mexico was assessed. The costs of generating electricity from available methane were estimated. Methane content and selling prices were identified as important factors affecting the commercial potential of geopressured resources; therefore electrical generation must be viewed as a by-product of methane production. ERA

N78-16450# Brookhaven National Lab., Upton, N. Y.

LAND USE-ENERGY SIMULATION MODEL: A COMPUTER-BASED MODEL FOR EXPLORING LAND USE AND ENERGY RELATIONSHIPS

T. Owen Carroll, A. S. Kydes, and J. Sanborn Jun. 1977 69 p refs Prepared in cooperation with State University of New York, Stony Brook, N. Y.

(Contract EY-76-C-02-0016)

(BNL-50634) Avail: NTIS HC A04/MF A01

A simulation model with integrated capability for generating energy demand is disclosed. Its framework captures two essential features of the land use-energy utilization interaction: first, the spatial location of land use activity is implicit, and second, transportation energy demand is determined as an integral part of the spatial configuration. The model is divided both conceptually and computationally into three parts; the land use model, a submodel for transportation which provides the work and shop trip distributions for spatial allocation of activities within the land use submodel, and an energy submodel which determines the energy demand from the land use configuration. Specific types of applications of the computer model are described. The model was utilized to assess the energy demand of the Long Island region in New York, and it was applied to study the generic relationships between energy utilization and urban form. ERA

N78-16451# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.

OVERVIEW OF TECHNOLOGICAL-ECONOMIC MODELS FOR ENERGY POLICY ANALYSIS

David J. Behling, Jr., Ellen A. Cherniavsky, Kenneth C. Hoffman, and Dale W. Jorgenson (Harvard Univ.) 1977 29p refs Presented at Workshop on Energy Strategies, Laxenburg, Austria, 18 May 1977

(Contract EY-76-C-02-0016)

(BNL-22730; Conf-770549-1) Avail: NTIS HC A03/MF A01

The individual models that were assembled were the Hudson-Jorgenson model of the economy and interindustry transactions, and the Brookhaven energy system optimization model. Other data bases and fixed coefficient input/output models were employed as data sources and accounting frameworks to support this combined technological-economic model. The combined model was used to develop long range projections of energy-economic relationships and to perform cost/benefit analyses of the U. S. energy R and D programs. ERA

N78-16452# General Atomic Co., San Diego, Calif.

PRELIMINARY SYSTEM ANALYSIS OF A FIXED MIRROR SOLAR POWER CENTRAL STATION Final Report

J. L. Russell, Jr., G. Eggers, W. Emrich, F. Openshaw, and W. Walker Jun. 1977 74 p refs Sponsored by EPRI (EPRI Proj. 739-1)

(EPRI-ER-434(6-77)) Avail: NTIS HC A04/MF A01

A preliminary systems design was performed and an evaluation made of a fixed mirror solar concentrator (FMSC). A computer program was written to model a preliminary system definition of a power plant design for an FMSC, and analytical models were developed to simulate the performance and to model the cost of subsystems using both heat transfer salt (HITEC) and carbon dioxide gas as the primary heat transfer fluids. It was found that the cost of the Hitec system was about one-half that of the CO₂ system. The computer code was exercised to obtain preliminary plant cost estimates and data on the sensitivity of the plant cost to changes in design parameters. ERA

N78-16453# Institute of Gas Technology, Chicago, Ill.

ALTERNATIVE FORMS OF ENERGY TRANSMISSION FROM OTEC PLANTS

A. Konopka, N. Biederman, A. Talib, and B. Yudow 1977 12 p refs Presented at 4th Ocean Thermal Energy Conversion Conf., New Orleans, 22-24 Mar. 1977

(Contract EX-76-C-01-2426)

(CONF-770331-5) Avail: NTIS HC A02/MF A01

The transmission of OTEC-derived chemical and electrical energy is compared. The chemical energy-carriers considered are gaseous and liquid hydrogen, liquid ammonia, methanol, gasoline, hydrazine hydrate, anhydrous hydrazine, unsymmetrical dimethyl-

hydrazine, 1,7-octadiyne, and tetrahydrodicyclopentadiene. The assessment assumes that each of the above energy carriers were transported by barge and/or pipeline. The delivered costs were then compared with transmission of electricity by submarine cables. In addition to presenting the delivered cost and overall energy efficiency of the chemical energy-carriers, a discussion of the equipment, costs, and efficiencies of converting the hydrogen and ammonia delivered into electricity, and the electricity delivered into hydrogen and ammonia is provided. ERA

N78-16454# Institute of Gas Technology, Chicago, Ill.
ALTERNATIVE ENERGY TRANSMISSION SYSTEMS FROM OTEC PLANTS, PROJECT 8980 Third Quarter Progress Report, 1 Jan. - 31 Mar. 1977

B. Yudow, A. Konopka, and N. Biederman May 1977 20 p refs

(Contract EX-76-C-01-2426)

(DSE/2426-12) Avail: NTIS HC A02/MF A01

Three types of thermal energy storage media were considered for transport of OTEC energy. They were the following: (1) sensible heat media, which depends upon the heat capacity of the material for energy storage, (2) latent heat of fusion material, and (3) reversible chemical reactions. Only those systems operating in the nominal temperature range of 400 to 1000 F. were considered. Four thermal energy transport system concepts were selected and synthesized into conceptual systems that use OTEC energy to charge the thermal storage medium installed in a ship hull, then transported the heat storage system to shore for use, or converted the thermal energy to electricity using a heat engine. The four conceptual designs, of which two used sensible heat storage, one used the latent heat of fusion, and one used a reversible chemical reaction, were derived from thermal energy storage conceptual designs for solar thermal-electric power plants or solar total energy systems. ERA

N78-16455# Kaman Sciences Corp., Colorado Springs, Colo.
Energy Systems Development Group.
SYSTEMS APPROACH TO SOLAR HEATING AND COOLING SYSTEMS

Douglas M. Jardine 1977 56 p Presented at Energy Environment Conf., Kansas City, Mo., 29 Mar. 1977; sponsored by Am. Defense Preparedness Assoc.

(CONF-770359-1) Avail: NTIS HC A04/MF A01

Various energy systems were tested and their operational characteristics determined for baseline type comparison. Systems included the direct utilization of stored thermal energy, air-to-air heat pumps, fluid-to-air heat pumps, and electric resistance heaters to supplement house heating and to add heat to thermal storage during off-peak hours. ERA

N78-16456# Los Alamos Scientific Lab., N. Mex.
ENERGY FLOW PATTERNS FOR 1975

R. B. Kidman, R. J. Barrett, and D. R. Koenig Jun. 1977 72 p refs

(Contract W-7405-eng-36)

(LA-6770) Avail: NTIS HC A04/MF A01

Highly visual and self-explanatory energy flow diagrams are presented for each of the 50 states, the 10 US Federal Standard Regions, and the entire United States. Each diagram illustrates the energy produced and how it is consumed or lost. The diagrams are meant to serve as a convenient and useful reference (or starting point) for consideration of energy-related problems. ERA

N78-16457# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
INDUSTRIAL APPLICATIONS OF SOLAR ENERGY Quarterly Report

Jan. 1977 255 p refs

(Contract EY-76-C-03-1132)

(SAN/1132-1) Avail: NTIS HC A12/MF A01

Solar energy systems were defined that are technically and economically feasible, and can satisfy all or part of selected industry demands. The market potential of such systems was determined. Total energy conceptual designs to be generated for selected industries and ranked for subsequent preliminary design selection were considered. Major efforts during this

reporting period consisted of extending the program to include all of the United States, continued collection of demand data, selection of an insulation methodology, collector/conversion system trade studies, absorption/vapor cycle refrigeration trades, completion of the resizing of all first level designs, and initiation of the utility interface and market penetration investigation. ERA

N78-16459# Sandia Labs., Albuquerque, N. Mex. Solar Project Div.

TOWER DESIGN CONSIDERATIONS FOR THE SOLAR THERMAL CENTRAL RECEIVER SYSTEMS

L. M. Murphy Jun. 1977 27 p refs

(Contract EY-76-C-04-0789)

(SAND-77-8243) Avail: NTIS HC A03/MF A01

Some basic design considerations for concrete solar thermal power towers are described. Seismic disturbances are of primary concern for the large towers being proposed for some commercial systems. For the larger receiver/tower systems the tower top accelerations due to seismic disturbances are not significantly amplified. However, the attachment of the more massive receivers may become more difficult for the larger systems. ERA

N78-16460# Stanford Univ., Calif. Electronics Labs.
SILICON PHOTOVOLTAIC CELLS IN THERMOPHOTOVOLTAIC CONVERSION Progress Report

R. M. Swanson and R. N. Bracewell Feb. 1977 27 p

(EPRI Proj. 790-1)

(EPRI-ER-478) Avail: NTIS HC A03/MF A01

A preliminary assessment of the feasibility of a solar-electric thermophotovoltaic (TPV) system was performed. The proposed system uses concentrating mirrors focused on a TPV converter that operates at high power density and potentially high efficiency. Within the TPV converter, the concentrated sunlight heats a refractory radiator. A photovoltaic cell faces the radiator, receives incandescent radiation from it, and converts the radiation to electricity. A numerical model of TPV conversion was developed to assess TPV conversion and to facilitate an initial design of TPV photocells. Also, a facility for experimentally evaluating TPV photocells was designed and built. ERA

N78-16461# Virginia Univ., Charlottesville. Dept. of Mechanical Engineering.

ENGINEERING ANALYSIS AND TESTING OF WATER-TRICKLE SOLAR COLLECTORS Progress Report, Jun. 1975 - Nov. 1976

J. T. Beard Jan. 1977 46 p refs

(Contract EY-76-S-05-4927)

(ORO-4927-77/1; PR-3) Avail: NTIS HC A03/MF A01

An outdoor solar collector testing facility was for the purpose of conducting thermal performance evaluations of the Thomason SOLARIS watertrickle solar collector. The facility was used for simultaneously testing four SOLARIS collector panels under different operational conditions of inlet water temperatures and flow rates with the same atmospheric exposure. A near linear relationship of steady-state efficiency for the SOLARIS collector is displayed as a function of the difference between inlet water temperature and the ambient temperature, divided by the incident solar energy. The scatter in the data, results from other variables which are analyzed, and includes glazing cleanliness, angle of incidence and wind. Various glazing materials were also examined, and performance curves are presented for the water trickle collector with a mylar film and Tedlar PVF film. ERA

N78-16462# Boeing Co., Seattle, Wash. Engineering and Construction Div.

TECHNICAL AND ECONOMIC ASSESSMENT OF PHASE CHANGE AND THERMOCHEMICAL ADVANCED THERMAL ENERGY STORAGE (TES) SYSTEMS. VOLUME 4: SOLAR POWER PLANT OPERATION, ANALYSIS COMPUTER PROGRAM Final Report

Dec. 1976 182 p

(EPRI Proj. 788-1)

(EPRI-EM-256-Vol-4) Avail: NTIS HC A09/MF A01

The computer program used to simulate the operation of the high temperature gas cooled solar power plant is described. The program was used to assess the interrelations of plant components as opposed to the design of the individual elements.

The model estimates the effectiveness of the Brayton cycle solar power plant on an hourly, daily and yearly basis. A description of the program and how the program is used including inputs, outputs, outputs and operating instructions, was also included.

ERA

N78-16483# National Bureau of Standards, Washington, D. C. Center for Building Technology.
PROVISIONAL FLAT PLATE SOLAR COLLECTOR TESTING PROCEDURES Interim Report
Sep. 1977 57 p refs
(Contract EA-77-A-01-6010)
(PB-272500; NBSIR-77-1305) Avail: NTIS HC A04/MF A01 CSCL 10A

Test methods are presented for use in determining the thermal performance, and to aid in the assessment of the safety and durability/reliability of flat plate solar collectors. These test methods and rating criteria were selected after the review of over 400 accepted industry standards and are consistent with the intent of the U. S. Department of Housing and Urban Development Minimum Property Standards and the Interim Performance Criteria prepared by the National Bureau of Standards for ERDA and HUD respectively. GRA

N78-16484# McDonnell-Douglas Astronautics Co., Richland, Wash. Energy Lab.
IMPLANTED ENERGY CONVERSION SYSTEM Annual Report, 1 Jun. 1976 - 1 May 1977
R. P. Johnston, L. P. Bakker, A. Bennett, S. G. Emigh, and G. M. Englesby Aug. 1977 215 p ref
(Contract N01-HV-4-2901)
(PB-272609/9; MDC-G4449; NIH-N01-HU-4-2901-4) Avail: NTIS HC A10/MF A01 CSCL 06L

The REL power source combines the high efficiency of Stirling engines with the reliability, efficiency, and flexibility of hydraulic power transfer and control to ensure long system life and physiological effectiveness. Extended life testing was achieved with an engine and hydraulic actuator/controller. Peak power source efficiency is 15.5% on 5.10 watts delivered to the blood pump push plate with 33 watts steady thermal input. Planned incorporation of power source output control was expected to reduce daily average thermal input to 18 watts. Animal in-vivo tests with an assist heart consistently demonstrated required performance by biological synchronization and effective ventricle relief. GRA

N78-16465# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
PRELIMINARY ENVIRONMENTAL ASSESSMENT OF SOLAR ENERGY SYSTEMS Final Report
D. Richard Sears and Paul O. McCormick Aug. 1977 134 p refs
(Contract EPA-68-02-1331)
(PB-272352/6; LMSC-HREC-TR-D496748;
EPA-600/7-77-086) Avail: NTIS HC A07/MF A01 CSCL 10A

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

N78-16466# Michaud, Cooley, Hallburg, Erickson, and Associates, Inc., Minneapolis, Minn.
EVALUATION OF COMPUTERIZED ENERGY PROGRAMS FOR THE CALCULATION OF ENERGY USE IN NEW AND EXISTING BUILDINGS Final Report
Oct. 1975 152 p
(Contract FEA-CO-04-50040-00)
(PB-272337/7; FEA/D-77/380) Avail: NTIS
HC A08/MF A01 CSCL 10A

A number of existing load and energy computer programs were evaluated with relation to: the accuracy of the programs, the complexity of the programs to implement, and the cost to utilize the programs in order to determine whether any of the programs could be endorsed for use in meeting existing or

promulgated state building codes for the design of new buildings and retrofit of existing buildings. GRA

N78-16467# Federal Energy Administration, Washington, D. C. Office of Economic Impact Analysis.
REPORT TO CONGRESS ON THE ECONOMIC IMPACT OF ENERGY ACTIONS
Jun. 1977 197 p refs
(PB-272080/3; FEA/B-77/371) Avail: NTIS
HC A09/MF A01 CSCL 05C

The economic impact of last winter's natural gas supply problems was described and the impacts of specific FEA actions taken during that period were evaluated. Implemented energy actions, evaluated under the Economic Impact Evaluation Program and taken between 1 April 1976 and 1 July 1977 were summarized. An economic impact evaluation was performed for many proposed actions and their possible alternatives. GRA

N78-16468# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
A HYPOTHETICAL 1000 MWe PHOTOVOLTAIC SOLAR-ELECTRIC PLANT Final Environmental Impact Statement, 1 Apr. - 31 Jul. 1976
D. Richard Sears, Donald V. Merrifield, Morris M. Penny, and W. Glen Bradley (Environ. Consultants, Inc.) Jul. 1976 205 p refs
(Contract EPA-68-02-1331)
(PB-273108/1; LMSC-HREC-TR-D497914;
EPA-600/7-77-085) Avail: NTIS HC A10/MF A01 CSCL 10B

The hypothetical plant is 1000 MWe silicon photovoltaic, located on 52 sq km of desert. The principal adverse environmental impacts expected relate to the destruction of soil and vegetation on 52 sq km of desert terrain. GRA

N78-16469# BDM Corp., Vienna, Va.
DOD PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS MARKET INVENTORY AND ANALYSIS, VOLUME 1
Robert M. Terry, Clarence P. Carter, Judy Israel, Orin H. Merrill, and Michael G. Semmans Jun. 1977 219 p refs
(Contract FEA-CG-05-50081-1)
(PB-273969/6; FEA/G-77/282-Vol-1) Avail: NTIS
HC A10/MF A01; also available in set of 3 reports HC E11 as PB-273968-SET CSCL 10B

The potential Department of Defense market for photovoltaic energy systems, and the potential role of the DOD in promoting industry and market development were estimated. The focus of the study is on delineating near term markets. GRA

N78-16470# BDM Corp., Vienna, Va.
DOD PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS MARKET INVENTORY AND ANALYSIS, VOLUME 2
Robert M. Terry, Clarence P. Carter, Judy Israel, Orin H. Merrill, and Michael G. Semmans Jun. 1977 285 p refs 3 Vol.
(Contract FEA-CG-05-50081-1)
(PB-273970/4; FEA/G-77/283-Vol-2) Avail: NTIS
HC A13/MF A01; also available in set of 3 reports HC E11, PB-273968-SET CSCL 10B

Topics discussed include: (1) Statement of work; (2) Near term application of photovoltaic energy systems--detailed data and results; (3) Long term application of photovoltaic energy systems--detailed data and results; (4) Combined energy systems; (5) Market survey of technology transfer potential of the Department of Defense photovoltaic applications; and (6) Technology transfer potentials for non-Department of Defense applications. Author

N78-16471# BDM Corp., Vienna, Va.
DOD PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS MARKET INVENTORY AND ANALYSIS, SUMMARY VOLUME
Robert M. Terry, Clarence P. Carter, Judy Israel, Orin H. Merrill, and Michael G. Semmans Jun. 1977 40 p refs
(Contract FEA-CG-05-50081-1)
(PB-273971/2; FEA/G-77/362) HC A03/MF A01; HC also available in set of 3 reports PC e11, PB-273968-Set CSCL 10B

N78-16472

Estimates of the potential Department of Defense market for photovoltaic energy systems, and the potential role of the DOD in promoting industry and market development were provided. The focus was on delineating near term markets. It is hoped that rapid development of these markets will provide sufficient sales volume to promote industry automation and drive down the unit cost of photovoltaic energy systems to the point where large scale DOD and civilian markets will develop. GRA

N78-16472# George Washington Univ., Washington, D. C. Program of Policy Studies in Science and Technology.

LEGAL-INSTITUTIONAL IMPLICATIONS OF WIND ENERGY CONVERSION SYSTEMS (WECS), EXECUTIVE SUMMARY

Sep. 1977 39 p

(Grant NSF APR-75-19137)

(PB-273006/7; NSF/RA-770203)

Avail: NTIS

HC A03/MF A01 CSCL 10A

The legal issues presented by wind energy conversion systems (WECS) utilization are related to its structural and technological features, as well as to its economic and social implications. Some information about wind systems, their likely applications and problems, are briefly stated. The features of the existing legal structure which may facilitate the implementation of such systems are noted. The ways in which the legal situation varies with particular applications and which applications pose the greatest legal difficulties are summarized. The complex subject of offshore wind systems is discussed. GRA

N78-16473# Office of Technology Assessment, Washington, D. C.

ANALYSIS OF THE PROPOSED NATIONAL ENERGY PLAN

Aug. 1977 240 p refs

(PB-273148/7; OTA-E-51; LC-77-600034)

Avail: NTIS

HC A11/MF A01 CSCL 10A

The proposed National Energy Plan submitted to the Congress by the Carter Administration in April, 1977 is analyzed. The Administration's proposals and their technical, environmental, social, and economic impacts are discussed according to the Plan's impacts on energy supply, energy demand, and society. GRA

N78-16474# New York Univ., N. Y.

CONSEQUENCES OF NEW ENERGY PATTERNS

Final Report

Lawrence Fishbein (Natl. Center for Toxicol. Res.) Dec. 1976

39 p refs

(Grant PHS-1-R13-ES-01470-01)

(PB-273259/2; NIH/NIEHS-77/005)

Avail: NTIS

HC A03/MF A01 CSCL 10A

The potential problem areas and research needs as a consequence of new energy patterns impacting on the nation's water sources and quality are reviewed in terms of trends in energy demand. Coal, oil, nuclear energy, geothermal energy and oil shale are covered. GRA

N78-16475# National Bureau of Standards, Washington, D. C. **SOLAR ENERGY SYSTEMS. SURVEY OF MATERIALS PERFORMANCE** Final Report

L. F. Skoda and L. W. Masters Oct. 1977 115 p refs Sponsored by ERDA

(PB-273305/3; NBSIR-77-1314)

Avail: NTIS

HC A06/MF A01 CSCL 10A

Guidelines to aid the selection of materials for use in solar energy systems are given. Field inspections of approximately twenty-five operational solar energy systems were performed, and a questionnaire was sent to 459 manufacturers and installation contractors to obtain materials performance data. A primary conclusion is that the process of selecting materials for specific applications within solar energy systems is hindered by the lack of an adequate data base of materials performance under the conditions experienced in solar systems and subsystems. Recommendations are made that would help in establishing an improved data base. GRA

N78-16476# Environmental Research and Technology, Inc., Concord, Mass.

ENERGY CONSUMPTION OF ENVIRONMENTAL CONTROLS: FOSSIL FUEL STEAM ELECTRIC GENERATING INDUSTRY Final Report

Brian Murphy, James R. Mahoney, David Bearg, Gale Hoffnagle, and Joel Watson Aug. 1977 199 p refs

(Contract EPA-1AG-D6-E091)

(PB-273019/0; ERT-P-1839; EPA-600/7-77-101)

Avail: NTIS

HC A09/MF A01 CSCL 10B

The energy requirements for environmental control in the fossil fuel, steam electric industry are discussed. These requirements are computed for a variety of energy policy 'scenarios' to demonstrate the impact of altering current environmental regulations or of utilizing alternate strategies for achieving environmental goals. In particular, the effect of requiring 'Best Available Control Technologies' for power plants, of using tall stacks and/or supplementary control systems, and of using coal washing and/or blending to decrease the necessity for 'scrubbers' are examined in different scenarios. GRA

N78-16479 Florida Univ., Gainesville.

HEAVY METAL INTERACTIONS WITH NATURAL ORGANICS IN AQUATIC ENVIRONMENTS Ph.D. Thesis

Neil Edward Carrier 1977 165 p

Avail: Univ. Microfilms Order No. 77-29228

Analyses of concentration of eight heavy metals in several components of cypress domes showed that sediments and floating aquatic plants are the principal heavy metal sinks in these systems. Water samples from shallow wells surrounding the domes showed no evidence of heavy metal contamination of groundwater. Laboratory investigations demonstrated the general utility of duckweed in heavy metal phytotoxicity studies and revealed that organic fractions from both sewage and natural organic color complex gave significant amounts of heavy metals. Heavy metal interactions with these natural and sewage organics and with four model organic compounds were investigated by a variety of techniques including ultrafiltration, atomic absorption spectrophotometry, ion-selective electrodes, differential pulse anodic stripping voltammetry, and ion exchange equilibrium methods. Dissert. Abstr.

N78-16483# Exxon Research and Engineering Co., Linden, N. J. **EFFECT OF HYDROCARBON COMPOSITION ON OXIDANT-HYDROCARBON RELATIONSHIPS. PHASE 2. BLEND OF TOTAL HYDROCARBON EMISSIONS** Final Report

T. R. Powers Sep. 1977 110 p

(Contract EPA-68-02-1719)

(PB-273219/6; EPA-600/3-77-109b)

Avail: NTIS

HC A06/MF A01 CSCL 07D

Chamber irradiations were conducted using a hydrocarbon blend representing total hydrocarbon emissions in order to assess the formation of atmospheric oxidants resulting from exhaust emitted by catalyst-equipped vehicles. Results were compared with previous irradiation results using a hydrocarbon blend representing nonmethane, nonacetylene exhaust emissions from noncatalyst vehicles or catalyst-equipped vehicles. The blend representing total hydrocarbon emissions produced significantly less oxidants than either of the other two blends. GRA

N78-16494# Northwestern Univ., Evanston, Ill. Dept. of Chemical Engineering.

INTERFACIAL EFFECTS IN THE RECOVERY OF RESIDUAL OIL BY DISPLACEMENT: STUDIES AT NORTHWESTERN UNIVERSITY Annual Report, 1 Mar. 1976 - 28 Feb. 1977

J. C. Slattery and J. C. Kovitz Mar. 1977 12 p refs

(Contract EY-76-S-02-0039)

(COO-0039-5) Avail: NTIS HC A02/MF A01

A static analysis is reported of the displacement of an oil segment by an aqueous surfactant solution through a capillary whose radius is a sinusoidal function of axial position. The displacement is recognized as a dynamic process. The first dynamic problem was made as simple as possible while still preserving some degree of realism. An analysis of the displacement of a gas by a liquid in a straight capillary tube of uniform diameter assuming that the interface moves with a constant speed is being conducted. ERA

N78-16495# Institute for Energy Analysis, Oak Ridge, Tenn.
PRESENT AND FUTURE PRODUCTION OF CO2 FROM FOSSIL FUELS: A GLOBAL APPRAISAL

R. M. Rotty Jun. 1977 22 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA(O)-77-15) Avail: NTIS HC A02/MF A01

Levels of atmospheric carbon dioxide, a question of world-wide proportions, were investigated. It was stated that unilateral action by any one nation in planning alternatives to fossil fuel use will be ineffective in controlling carbon dioxide. Energy growth in the past has been largely based on fossil fuels and, consequently, the annual carbon dioxide production has increased steadily at 4.3%. In 1976, the global carbon dioxide production contained more than 5 billion metric tons of carbon. Of this, 27% was a result of activity in the United States, but by 2025 the total will have grown more than fivefold with the developing countries and communist Asia producing over half the global total. The challenge to the United States is to develop energy supply systems not based on fossil fuels which can and will be used by developing nations. ERA

N78-16499# Bureau of Mines, College Park, Md. Metallurgy Research Center.

METALS IN THE COMBUSTIBLE FRACTION OF MUNICIPAL SOLID WASTE

Benjamin W. Haynes, Stephen L. Law, and William J. Campbell 1977 22 p refs

(PB-272946/5; BM-RI-8244) Avail: NTIS HC A02/MF A01 CSCL 13B

The combustible fraction of urban refuse is being extensively considered as a fuel supplement for coal in the generation of heat and power. The objective of these analytical studies was to determine the concentration of major, minor, and trace elements in the combustible fractions collected at various locations in the urban refuse recycling pilot plant located at College Park, Md. The samples processed through the plant were submitted by various municipalities that are considering resource recovery as an alternative to landfill or other means of disposal. GRA

N78-16872# California Univ., Livermore. Lawrence Livermore Lab.

MAGNETIC FUSION ENERGY

B. McNamara 14 Jun. 1977 51 p

(Contract W-7405-eng-48)

(UCRL-79600) Avail: NTIS HC A04/MF A01

A brief review of fusion research during the last 20 years is given. Some highlights of theoretical-plasma physics are presented. The role that computational plasma physics is playing in analyzing and understanding the experiments is discussed. The magnetic mirror program is reviewed. ERA

N78-16874# Stanford Univ., Calif. High Temperature Gas Dynamics Lab.

HIGH MAGNETIC FIELD MHD GENERATOR PROGRAM Quarterly Report, Oct. - Dec. 1976

R. H. Eustis, C. H. Kruger, M. Mitchner, S. A. Self, and J. K. Koester Jan. 1977 24 p

(Contract EX-76-C-01-2341)

(FE-2341-1) Avail: NTIS HC A02/MF A01

Technical and programmatic progress on research related to high magnetic field effects in MHD generators is reported. An experiment to determine the possible growth of pressure fluctuations showed a three-fold increase in fluctuation amplitude at 2.4 tesla magnetic field compared to zero field. Experiments with a newly developed forward scatter laser anemometer were successful in measuring the velocity and turbulent intensity in the MHD combustor free jet. Refinements in the temperature measuring technique by line reversal resulted in spatial resolution of 300 microns at distances greater than 500 microns from the surface. Experiments related to the Hall field breakdown problem delineated further the character of fast and slow breakdown corresponding to the origin of the breakdown in the plasma or the insulator. Preliminary work on the disk generator for testing in the six tesla magnet is described. ERA

N78-16928*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE C. H. WATERMAN RENAULT 5 ELECTRIC PASSENGER VEHICLE

Noel B. Sargent, Edward F. McBrien, and Ralph Slavik Oct. 1977 58 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73759; E-9434; CONS/1011-4) Avail: NTIS HC A04/MF A01 CSCL 13F

The Waterman vehicle, a four passenger Renault 5 GTL performance test results are presented and characterized the state-of-the-art of electric vehicles. It was powered by sixteen 6-volt traction batteries through a two-step contactor controller actuated by a foot throttle to change the voltage applied to the 6.7-kilowatt motor. The motor output shaft was connected to a front-wheel-drive transaxle that contains a four-speed manual transmission and clutch. The braking system was a conventional hydraulic braking system. Author

N78-16931# Resource Planning Associates, Inc., Washington, D. C.

EUROPEAN WASTE-TO-ENERGY SYSTEMS. AN OVERVIEW

Jun. 1977 62 p Prepared in cooperation with Resource Planning Associates, Inc., Paris (France)

(Contract EX-76-C-01-2103)

(CONS/2103-6) Avail: NTIS HC A04/MF A01

The recovery of energy through the combustion of municipal solid wastes is a well-established technique for conserving energy. Combustion units can produce electricity; hot water for domestic use; and steam for district heating, industrial processes, or the drying of sewage sludge. There are fewer than 20 such waste-to-energy systems in the United States. In Western Europe, however, 243 combustion units are currently recovering energy from municipal solid wastes. The oldest of these facilities went into service before World War II. Some key facts about Western European countries and their waste-to-energy units are presented. The items discussed include: some common features of the Western European systems; the combustion techniques available; the end uses to which the recovered energy is put; and the economics of the systems. A tabulation of the systems currently operating or under construction in Western Europe is included. ERA

N78-16932# Resource Planning Associates, Inc., Washington, D. C.

EUROPEAN WASTE-TO-ENERGY SYSTEMS: CASE STUDY OF THE THERMAL COMPLEX OF TOULOUSE-LE MIRAIL (FRANCE)

May 1977 45 p refs Prepared in cooperation with Resource Planning Associates, Paris (France).

(Contract EC-77-C-01-2103)

(CONS/2103-1) Avail: NTIS HC A03/MF A01

The waste treatment system of Toulouse-Le Mirail (France) is a complex composed of an incinerator with heat-recovery equipment and an oil-fired heating facility. It was designed to burn the household waste of a city of 400,000 inhabitants while at the same time providing central heating and hot water to a suburb of 100,000 inhabitants. Sufficient electricity is also generated for in-plant use. Technical data for the system are reported in detail. The economics and management were reviewed. The system has operated for five years without major problems. Author (ERA)

N78-16933# Resource Planning Associates, Inc., Washington, D. C.

EUROPEAN WASTE-TO-ENERGY SYSTEMS: CASE STUDY OF MUNICH: MUNICH NORTH IA AND IB, MUNICH NORTH II, MUNICH SOUTH IV AND V

May 1977 92 p refs

(Contract EX-76-C-01-2103)

(CONS/2103-4) Avail: NTIS HC A05/MF A01

The city of Munich has a population of 1,315,000. Solid waste is collected by a city department and delivered to the city's own Electricity Works. The Electricity Works incinerate the waste in five incinerators in two separate locations (the North

and South plants). Munich's five incinerators represent three different designs for co-generation of heat and electrical energy. All burn both waste and fossil fuel and all use Benson boilers to produce steam at 184 bars and 540 C. The Electricity Works recovers energy in the form of electricity, hot water, and steam. The system is peakloaded both for electricity and for district heating, and as a result, is operated with some diseconomy. Over 450,000 metric tons of waste were burned in 1975. That amount represents practically all the solid waste collected in Munich. The rates charged appear to be far below actual costs of incineration, which suggests that the sale of electricity is subsidizing the cost of incineration. ERA

N78-16934# Resource Planning Associates, Inc., Washington, D. C.

EUROPEAN WASTE-TO-ENERGY SYSTEMS: CASE STUDY OF KOERSOR, DENMARK

May 1977 37 p

(Contract EX-76-C-01-2103)

(CONS/2103-3) Avail: NTIS HC A03/MF A01

Koersor, Denmark operates a waste-to-energy system for only 20,000 persons. Energy is recovered in the form of heat for district heating and the facility has been operating reliably for about four years. The apparent success of this installation suggests that the system may have applications in smaller communities. The design and operation of the facility is summarized. The energy recovered from the boiler amounts to about 7. kilotherms per year. The thermal efficiency of the plant is estimated at approximately 50 percent. Taking into account energy which is lost because it cannot be sold, the overall efficiency decreases to approximately 30 percent. The total cost of the complex was 7,000,000 Kr (\$944,700; 1971 or \$1,437,600; 1976) with 4,600,000 of that sum going for the incinerator. The overall cost of incineration is estimated today at 120 Kr per metric ton including both capital and operating cost, after making provision for the value of heat recovered. ERA

N78-16935# Resource Planning Associates, Inc., Washington, D. C.

EUROPEAN WASTE-TO-ENERGY SYSTEMS: CASE STUDY OF GENEVA-CHENEVIERS (SWITZERLAND)

May 1977 41 p refs

(Contract EX-76-C-01-2103)

(CONS/2103-2) Avail: NTIS HC A03/MF A01

The City of Geneva, population 159,000 is the administrative center of the Canton of Geneva, population 340,000. The Canton owns a number of facilities for the treatment of waste. Geneva's chief waste treatment facility is the Cheneviers Incinerator. Two outdated Von Roll integrated boiler incinerator furnaces have a rated capacity of 200 metric tons per day each. Superheated steam 360 C and 32.4 bars powers a 6200 kW turbo-generator unit. The electricity is sold to the cantonal grid. Total incinerable waste in the Canton of Geneva has varied from 120,000 to 130,000 metric tons annually during the last five years. For the last two years, total per capita tonnage has been declining. The remainder was landfilled, due to the lack of capacity at the incinerators. The system which began operating in 1966, cost approximately 40 million Swiss Francs. Three-quarters of this sum was for land, buildings, construction, and equipment. A large station and dock for the transfer of waste accounted for the remainder. ERA

N78-16936# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **COSTS AND ENERGY EFFICIENCY OF A DUAL-MODE SYSTEM**

R. C. Heft and C. S. Borden 30 Apr. 1977 76 p refs

(Contract DOT-AT-60008)

(PB-272714/7; UMTA-CA-06-0088-77-2)

Avail: NTIS

HC A05/MF A01 CSCL 13B

A more detailed examination is given of two areas of a previous analysis on a Dual-Mode System. The technical and cost data of the previous report and its life-cycle cost approach are used. This report consists of two parts plus the Appendices: (1) an economic analysis, and (2) an energy consumption analysis. The economic analysis examines the present value life-cycle costs of the system for both public and semi-private ownership and

presents the costs in terms of levelized required revenue per passenger mile. Two transit modes associated with a high-speed guideway system are included (pallets and command actuated passenger service (CAPS) vehicles). The energy consumption analysis considers the energy use of the various dual-mode vehicles by means of a detailed vehicle simulation program for the control policy and guideway system as described in the previous study. GRA

N78-16947# BDM Corp., McLean, Va. **A TECHNOLOGY ASSESSMENT OF OFFSHORE INDUSTRY, THE UNITED STATES OFFSHORE INDUSTRY. CURRENT STATUS, TRENDS AND FORECAST 1976 - 2000, VOLUME 1 Final Report**

James H. Durfee Aug. 1977 522 p refs 3 Vol.

(Contract MA-5-38024)

(PB-272983/8; BDM/W-77-425-TR-Vol-1;

MA-RD-940-78002-Vol-1) Avail: NTIS HC A22/MF A01; also available in set of 3 reports HC E12 as PB-272982-SET CSCL 081

The current status of the U.S. offshore industry, developing trends in the industry, and the various forces that influence development were discussed. A 25 year forecast of offshore industry development is included. Also included is a description of the U.S. commercial ocean fishing industry and a 25 year forecast of industry development. GRA

N78-16948# BDM Corp., McLean, Va. **A TECHNOLOGY ASSESSMENT OF OFFSHORE INDUSTRY AND ITS IMPACT ON THE MARITIME INDUSTRY 1976 - 2000, VOLUME 2 Final Report**

James H. Durfee Aug. 1977 144 p refs 3 Vol.

(Contract MA-5-38024)

(PB-272984/6; BDM/W-77-425-TR-Vol-2;

MA-RD-940-78003-Vol-2) Avail: NTIS HC A07/MF A01; also available in set of 3 reports HC E12 as PB-272982-SET CSCL 081

The various impacts on the traditional maritime industry of offshore industry development, and the areas of planning needed by the maritime industry to accommodate those impacts are described. GRA

N78-16949# BDM Corp., McLean, Va. **A TECHNOLOGY ASSESSMENT OF OFFSHORE INDUSTRY AND ITS IMPACT ON THE MARITIME INDUSTRY 1976 - 2000. EXECUTIVE SUMMARY Final Report**

James H. Durfee Aug. 1977 74 p refs 3 Vol.

(Contract MA-5-38024)

(PB-272985/3; BDM/W-77-425-TR; MA-RD-940-78001)

Avail: NTIS HC A22/MF A01; also available in set of 3 reports HC E12 as PB-272984 CSCL 081

Each segment of the offshore industry is described in terms of the current status of industry, trends that might influence the direction of future development, and forces acting on the industry to impede or encourage growth. Potential areas of impact on the maritime industry, such as financial, manpower, environmental, materials requirements, legislation and regulation, and new technologies, that might result from offshore industry development are examined. Changes likely to result in the maritime industry from the various impacts described and planning that will be needed to accommodate to the changes are discussed. GRA

N78-17011# Stuttgart Univ. (West Germany). Inst. fuer Aerodynamik und Gasdynamik.

ENERGETIC EVALUATION OF THE HYBRID TUNNEL PRINCIPLE AND POSSIBILITIES OF EFFICIENCY IMPROVEMENT [ENERGETISCHE BEWERTUNG DES HYBRIDKANAL-PRINZIPTS UND MOEGELICHKEITEN DER WIRKUNGS-GRADVERBESSERTUNG]

T. Hottner *In* DFVLR Contrib. to Steady and Unsteady Aerodyn. 10 Aug. 1977 p 93-110 refs *In* GERMAN

Avail: NTIS HC A13/MF A01; DFVLR Cologne DM 107,30

The hybrid tunnel is a cross between a wind tunnel and a tow tunnel. The power requirement and energy consumption are considerably lower for the hybrid tunnel than for the wind tunnel. An energetic evaluation measure can be given based on energy budgets between test intervals. Its efficiency essentially depends

on the duration of the air discharge from the tow tunnel in the low pressure tube as compared to the overall propagation time of the flow through the tow tunnel. It is shown how this time ratio can be improved by shock wave refraction at the bottom of the low pressure tube. ESA

N78-17060* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

GENERAL AVIATION ENERGY CONSERVATION RESEARCH PROGRAMS AT NASA-LEWIS RESEARCH CENTER

Edward A. Willis 1977 26 p refs Presented at the Conf. on Energy Conserv. in Gen. Aviation, Kalamazoo, Mich., 10 - 11 Oct. 1977; sponsored by Western Michigan Univ.

(NASA-TM-73884) Avail: NTIS HC A03/MF A01 CSCL 21E

The major thrust of NASA's nonturbine general aviation engine programs is directed toward (1) reduced specific fuel consumption, (2) improved fuel tolerance, and (3) emission reduction. Current and planned future programs in such areas as *lean operation*, improved fuel management, advanced cooling techniques and advanced engine concepts, are described. These are expected to lay the technology base, by the mid to latter 1980's, for engines whose total fuel costs are as much as 30% lower than today's conventional engines. Author

N78-17166 Washington Univ., Seattle.

KINETICS OF THERMOCHEMICAL DECOMPOSITION OF HYDROGEN SULFIDE FOR THE PURPOSE OF GENERATING HYDROGEN Ph.D. Thesis

Kenneth Lawrence Johnson 1977 164 p

Avail: Univ. Microfilms Order No. 77-26835

Thermochemical processes considered for hydrogen economy and the desulfurization of coal and crude oil include the formation of an intermediate metallic sulfide by reacting a metallic with hydrogen sulfide at low temperature and the subsequent decomposition of the sulfide at a higher temperature and subatmospheric pressure, in order to recover the metal. Electron microscopy, X-ray diffraction, and a NASA chemical equilibrium program was used to study the reaction kinetics between hydrogen sulfide and a thin bismuth slab, and to determine the extent of the reaction and identify the reaction products. Dissert. Abstr.

N78-17187* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

MATERIALS TECHNOLOGY ASSESSMENT FOR STIRLING ENGINES

Joseph R. Stephens, Walter R. Witzke, Gordon K. Watson, James R. Johnston, and William J. Croft (Army Materials and Mechanics Res. Center, Watertown, Mass.) Oct. 1977 16 p refs Presented at Dept. of Energy Highway Vehicle Sys. Contractors' Coordination Meeting, Dearborn, Mich., 4-6 Oct. 1977

(Contract EC-77-A-31-1011)

(NASA-TM-73789; E-9356; CONS/1011-22) Avail: NTIS HC A02/MF A01 CSCL 11F

A materials technology assessment of high temperature components in the improved (metal) and advanced (ceramic) Stirling engines was undertaken to evaluate the current state-of-the-art of metals and ceramics, identify materials research and development required to support the development of automotive Stirling engines, and to recommend materials technology programs to assure material readiness concurrent with engine system development programs. The most critical component for each engine is identified and some of the material problem areas are discussed. Author

N78-17223* Washington Univ., Seattle. Coll. of Engineering.

INTERDISCIPLINARY RESEARCH AND DEVELOPMENT ON THE EFFECTS OF THE NATURE AND PROPERTIES OF CERAMIC MATERIALS IN THE DESIGN OF ADVANCED STRUCTURAL COMPONENTS Semiannual Status Report

16 Jan. 1978 36 p refs

(Grant NGR-48-002-004)

(NASA-CR-155733; SASR-29) Avail: NTIS HC A03/MF A01 CSCL 11B

An educational development and supportive research program on ceramic materials established to advance design methodology, improve materials, and develop engineers knowledgeable in design with and use of high performance ceramic materials is described. Emphasis is on the structures and related materials problems in a ceramic turbine engine, but applications in coal gasification, solar conversion, and magnetohydrodynamic technologies are considered. Progress of various research projects in the areas of new materials, processing, characterization, and nondestructive testing is reported. Fracture toughness determination, extended X-ray absorption fine structure measurements, and grain boundary effects in β -alumina are among the topics covered. J.M.S.

N78-17229* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ALTERNATIVE AIRCRAFT FUELS

J. P. Longwell (MIT, Cambridge) and J. Grobman Jun. 1977 22 p refs Proposed for presentation at 23d Ann. Intern. Gas Turbine Conf., London, Engl., 9-13 Apr. 1978; sponsored by Am. Soc. of Mechan. Engineers

(NASA-TM-73836) Avail: NTIS HC A02/MF A01 CSCL 21D

The efficient utilization of fossil fuels by future jet aircraft may necessitate the broadening of current aviation turbine fuel specifications. The most significant changes in specifications would be an increased aromatics content and a higher final boiling point in order to minimize refinery energy consumption and costs. These changes would increase the freezing point and might lower the thermal stability of the fuel, and could cause increased pollutant emissions, increased combustor liner temperatures, and poorer ignition characteristics. The effects that broadened specification fuels may have on present-day jet aircraft and engine components and the technology required to use fuels with broadened specifications are discussed. Author

N78-17251* Razor Associates, Inc., Sunnyvale, Calif.

TELEC LASER EXPERIMENT

E. J. Britt Oct. 1977 53 p

(Contract NAS2-9109)

(NASA-CR-152077) Avail: NTIS HC A04/MF A01 CSCL 17I

An experimental thermoelectronic laser energy converter (TELEC) was constructed and tested with a 40 kW combustion laser operating at a wave length of 10.6 microns. The objective of the test was to demonstrate the feasibility of the TELEC concept for converting a laser beam into electric power. The TELEC System is intended as the receiver for a laser power transmission system in space. Author

N78-17296* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SHUNT REGULATION ELECTRIC POWER SYSTEM Patent

Warren H. Wright (TRW Inc., Redondo Beach, Calif.) and John J. Bless, inventors (to NASA) (TRW Inc., Redondo Beach, Calif.) Issued 17 Aug. 1971 9 p Filed 3 Oct. 1968 Sponsored by NASA

(NASA-Case-GSC-10135; US-Patent-3,600,599;

US-Patent-Appl-SN-764823; US-Patent-Class-307-53;

US-Patent-Class-307-69; US-Patent-Class-320-53;

US-Patent-Class-323-19) Avail: US Patent Office CSCL 09C

A regulated electric power system having load and return bus lines is described. A plurality of solar cells interconnected, in a power supplying relationship and having a power shunt tap point electrically spaced from the bus lines is provided. A power dissipator is connected to the shunt tap point and provides for a controllable dissipation of excess energy supplied by the solar cells. A dissipation driver is coupled to the power dissipator and controls its conductance and dissipation and is also connected to the solar cells in a power taping relationship to derive operating power therefrom. An error signal generator is coupled to the load bus and to a reference signal generator to provide an error output signal which is representative of the difference between the electric parameters existing at the load bus and the reference signal generator. An error amplifier is coupled to the error signal generator and the dissipation driver to provide the driver with controlling signals. Official Gazette of the U.S. Patent Office

N78-17336* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
HEAT PIPE WITH DUAL WORKING FLUIDS Patent
 Arnold P. Shlosinger, inventor (to NASA) (TRW Inc., Redondo Beach, Calif.) Issued 11 Dec. 1973 6 p Filed 1 Jun. 1970
 Sponsored by NASA
 (NASA-Case-ARC-10198; US-Patent-3,777,811;
 US-Patent-Appl-SN-42088; US-Patent-Class-165-105;
 US-Patent-Class-165-134) Avail: US Patent Office CSDL 20D

A heat pipe design is offered that utilizes an auxiliary working fluid. The fluid, although being less efficient than the main working fluid, remains liquid at low heat loads when the main working fluid freezes. Official Gazette of the U.S. Patent Office

N78-17339*# McDonnell Aircraft Co., St. Louis, Mo.
EVALUATION OF A LARGE CAPACITY HEAT PUMP CONCEPT FOR ACTIVE COOLING OF HYPERSONIC AIRCRAFT STRUCTURE
 L. L. Pagel and R. L. Herring Feb. 1978 47 p refs
 (Contract NAS1-14981)
 (NASA-CR-145301) Avail: NTIS HC A03/MF A01 CSDL 20D

Results of engineering analyses assessing the conceptual feasibility of a large capacity heat pump for enhancing active cooling of hypersonic aircraft structure are presented. A unique heat pump arrangement which permits cooling the structure of a Mach 6 transport to aluminum temperatures without the aid of thermal shielding is described. The selected concept is compatible with the use of conventional refrigerants, with Freon R-11 selected as the preferred refrigerant. Condenser temperatures were limited to levels compatible with the use of conventional refrigerants by incorporating a unique multipass condenser design, which extracts mechanical energy from the hydrogen fuel, prior to each subsequent pass through the condenser. Results show that it is technically feasible to use a large capacity heat pump in lieu of external shielding. Additional analyses are required to optimally apply this concept. Author

N78-17460* National Aeronautics and Space Administration, Pasadena Office, Calif.
LOW COST SOLAR ENERGY COLLECTION SYSTEM Patent
 Charles G. Miller (JPL) and James B. Stephans, inventors (to NASA) (JPL) Issued 27 Dec. 1977 26 p Filed 24 Jul. 1975
 Supersedes N75-28519 (13 - 19, p. 2406) Sponsored by NASA
 (NASA-Case-NPO-13579-1; US-Patent-4,065,053;
 US-Patent-Appl-SN-598969; US-Patent-Class-237-1A;
 US-Patent-Class-60-641; US-Patent-Class-62-4;
 US-Patent-Class-126-271; US-Patent-Class-126-263;
 US-Patent-Class-165-2) Avail: US Patent Office CSDL 10A

A fixed, linear, ground-based primary reflector having an extended, curved sawtooth contoured surface covered with a metallized polymeric reflecting material, reflected solar energy to a movably supported collector that was kept at the concentrated line focus of the reflector primary. Efficient utilization leading to high temperatures from the reflected solar energy was obtained by cylindrical shaped secondary reflectors that directed off-angle energy to the absorber pipe. Official Gazette of the U.S. Patent Office

N78-17462*# General Electric Co., Philadelphia, Pa.
DESIGN STUDY OF WIND TURBINES 50 kW TO 3000 kW FOR ELECTRIC UTILITY APPLICATIONS. VOLUME 2: ANALYSIS AND DESIGN Final Report
 Dec. 1976 328 p refs
 (Contract NAS3-19403)
 (NASA-CR-134935; ERDA/NASA-9403-76/2-Vol-2;
 GE-SD-76SDS4288-Vol-2) Avail: NTIS HC A15/MF A01 CSDL 10A

All possible overall system configurations, operating modes, and subsystem concepts for a wind turbine configuration for cost effective generation of electrical power were evaluated for both technical feasibility and compatibility with utility networks.

as well as for economic attractiveness. A design optimization computer code was developed to determine the cost sensitivity of the various design features, and thus establish the configuration and design conditions that would minimize the generated energy costs. The preliminary designs of both a 500 kW unit and a 1500 kW unit operating in a 12 mph and 18 mph median wind speed respectively, were developed. The various design features and components evaluated are described, and the rationale employed to select the final design configuration is given. All pertinent technical performance data and component cost data are included. The costs of all major subassemblies are estimated and the resultant energy costs for both the 500 kW and 1500 kW units are calculated. Author

N78-17463*# General Electric Co., Philadelphia, Pa.
DESIGN STUDY OF WIND TURBINES 50 kW TO 3000 kW FOR ELECTRIC UTILITY APPLICATIONS. VOLUME 3: SUPPLEMENTARY DESIGN AND ANALYSIS TASKS Final Report
 Dec. 1976 62 p refs
 (Contract NAS3-19403)
 (NASA-CR-135121; ERDA/NASA-9403-76/3-Vol-3) Avail: NTIS HC A04/MF A01 CSDL 10A

Additional design and analysis data are provided to supplement the results of the two parallel design study efforts. The key results of the three supplemental tasks investigated are: (1) The velocity duration profile has a significant effect in determining the optimum wind turbine design parameters and the energy generation cost. (2) Modest increases in capacity factor can be achieved with small increases in energy generation costs and capital costs. (3) Reinforced concrete towers that are esthetically attractive can be designed and built at a cost comparable to those for steel truss towers. The approach used, method of analysis, assumptions made, design requirements, and the results for each task are discussed in detail. Author

N78-17464*# Honeywell, Inc., Bloomington, Minn.
SILICON ON CERAMIC PROCESS. SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE-AREA SILICON SHEET TASK OF THE LOW-COST SILICON SOLAR ARRAY PROJECT Annual Report, 17 Sep. 1976 - 19 Sep. 1977
 J. D. Zook, J. D. Heaps, R. B. Maciolek, B. Koepke, C. D. Butter, and S. B. Schuldt 30 Sep. 1977 115 p refs
 (Contract NAS7-100)
 (NASA-CR-155613; ERDA/JPL-954356-77/3; AR-2) Avail: NTIS HC A06/MF A01 CSDL 10A

The technical and economic feasibility of producing solar-cell-quality sheet silicon was investigated. The sheets were made by coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. Significant progress was made in all areas of the program. Author

N78-17465*# General Electric Co., Philadelphia, Pa. Space Div.
CONCEPTUAL APPROACH STUDY OF A 200 WATT PER KILOGRAM SOLAR ARRAY, PHASE 1 Final Report
 G. J. Rayl, K. M. Speight, and R. W. Stanhouse 31 Aug. 1977 209 p refs
 (Contracts NAS7-100; JPL-954393)
 (NASA-CR-155614; DOC-77SDS4207) Avail: NTIS HC A10/MF A01 CSDL 10A

Two alternative designs were studied; one a retractable rollout design and the other a nonretractable foldout configuration. An end of life (EOL) power for either design of 0.79 beginning of life (BOL) is predicted based on one solar flare during a 3 year interplanetary mission. Both array configurations incorporate the features of flexible substrates and cover sheets. A power capacity of 10 kilowatt is achieved in a blanket area of 76 sq m with an area utilization factor of 0.8. A single array consists of two identical solar cell blankets deployed concurrently by a single, coilable tongeron boom. An out of plane angle of 8.25 deg is maintained between the two blankets so that the inherent inplane stiffness of the blankets may be used to obtain out of plane stiffness. This V-stiffened design results in a 67% reduction in the stiffness requirement for the boom. Since boom mass scales

with stiffness, a lower requirement on boom stiffness results in a lower mass for the boom. These solar arrays are designed to be compatible with the shuttle launch environment and shuttle cargo bay size limitations. Author

N78-17466*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TURBINE GENERATOR ROTOR BLADE CONCEPTS WITH LOW COST POTENTIAL

T. L. Sullivan, T. P. Cahill, D. G. Griffee, Jr. (United Technologies Corp., Windsor Locks, Conn.), and H. W. Gewehr (Karman Aerospace Corp.) Dec. 1977 38 p refs To be Presented at the 23rd Natl. SAMPE Symp., Anaheim, Calif., 2-4 May 1978 (Contract E(49-26)-1028)
 (NASA-TM-73835; DOE/NASA-1028-77/13; E-9422) Avail: NTIS HC A03/MF A01 CSCL 10A

Four processes for producing blades are examined. Two use filament winding techniques and two involve filling a mold or form to produce all or part of a blade. The processes are described and a comparison is made of cost, material properties, design and free vibration characteristics. Conclusions are made regarding the feasibility of each process to produce low cost, structurally adequate blades. Author

N78-17467*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SYNCHRONIZATION OF THE DOE/NASA 100-KILOWATT WIND TURBINE GENERATOR WITH A LARGE UTILITY NETWORK

Leonard J. Gilbert Dec. 1977 19 p refs
 (Contract E(49-26)-1028)
 (NASA-TM-73861; E-9450; DOE/NASA/1028/77/10) Avail: NTIS HC A02/MF A01 CSCL 10A

The DOE/NASA 100 kilowatt wind turbine generator system was synchronized with a large utility network. The system equipments and procedures associated with the synchronization process were described. Time history traces of typical synchronizations were presented indicating that power and current transients resulting from the synchronizing procedure are limited to acceptable magnitudes. Author

N78-17468*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD OF CONSTRUCTION OF A MULTI-CELL SOLAR ARRAY Patent Application

Donald E. Routh, Ben R. Hollis, and William R. Feltner, inventors (to NASA) Filed 23 Dec. 1977 9 p
 (NASA-Case-MFS-23540-1; US-Patent-Appl-SN-863773) Avail: NTIS HC A02/MF A01 CSCL 10A

A method of construction of photovoltaic devices, particularly of multi-cell photovoltaic devices used to form solar cell arrays, was delineated. The first step is to effect in a top surface region of substrate, a semiconductive layer by the diffusion of an impurity into the top surface region. Next, by photolithography and etching, the base region is divided into a plurality of base regions, and as separated, upper active surface regions are created in the top surface region of the base regions by diffusion of the opposite polarity type to that employed in the creation of base regions. Metal contacts are then formed which interconnect between the upper active region of one cell and the lower base region of the adjoining cell. In this manner, the cells are connected in series to make their voltages additive. NASA

N78-17470*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

PERFORMANCE EVALUATION OF TWO BLACK NICKEL AND TWO BLACK CHROME SOLAR COLLECTORS

R. Losey DOE Nov. 1977 21 p refs Prepared for DOE (Contract NAS8-32036)
 (NASA-CR-150497; WYLE-TR-531-3-Rev-A) Avail: NTIS HC A02/MF A01 CSCL 10A

The test program was based on the evaluation of four unique solar collectors described below: (1) black nickel collector surface with a desiccant drying bed, (2) black nickel collector surface without a desiccant drying bed, (3) black chrome collector surface with a desiccant drying bed, and (4) black chrome collector surface without a desiccant drying bed. The test program included

three distinct phases: Initial performance evaluation, natural environmental aging, and post-aging performance evaluation. Results of Phase 3 testing conclusively indicated a higher normalized efficiency for Black Chrome surfaces when compared to Black Nickel. Author

N78-17471*# Wyle Labs., Inc., Huntsville, Ala.
MSFC HOT AIR COLLECTORS. PHASE 1: TEST REPORT
 R. Losey DOE Nov. 1977 15 p Prepared for DOE (Contract NAS8-32036)
 (NASA-CR-150495; WYLE-TR-531-1-Rev-A) Avail: NTIS HC A02/MF A01 CSCL 10A

A development test program of 3 hot air flat plate solar collectors is described in detail. The pressure drop versus flow rate performance characteristics for these collectors, mounted in series, was determined under 14 different test conditions each of which was characterized by a unique combination of inlet air temperature and air flow rate. Characteristics of inlet, exit and transfer ducts of these collectors were also determined during this testing. The test results indicate that significant pressure drop occurs at air flow rates greater than 150 standard cubic feet per minute and this drop is not heavily dependent upon inlet air temperature; and inlet, exit and transfer duct characteristics differ sufficiently to suggest that system performance may be enhanced through careful design of each type of duct individually. Author

N78-17472*# Wyle Labs., Inc., Huntsville, Ala.
THERMAL PERFORMANCE OF HONEYWELL DOUBLE COVERED LIQUID SOLAR COLLECTOR
 R. Losey DOE Nov. 1977 22 p refs Prepared for DOE (Contract NAS8-32036)
 (NASA-CR-150505; WYLE-TR-531-04) Avail: NTIS HC A02/MF A01 CSCL 10A

The test procedures and results obtained during an evaluation test program to determine the outdoor performance characteristics of the Honeywell liquid solar collector are presented. The program was based on the thermal evaluation of a Honeywell double covered liquid solar collector. Initial plans included the simultaneous testing of a single covered Honeywell collector. During the initial testing, the single covered collector failed due to leakage; thus, testing continued on the double covered collector only. To better define the operating characteristics of the collector, several additional data points were obtained beyond those requested. Author

N78-17474*# Wyle Labs., Inc., Huntsville, Ala.
INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF LIBBEY-OWENS-FORD SOLAR COLLECTOR
 K. Shih DOE Nov. 1977 28 p Prepared for DOE (Contract NAS8-32036)
 (NASA-CR-150508; WYLE-TR-531-07-Rev-A) Avail: NTIS HC A03/MF A01 CSCL 10A

The thermal performance of a flat plate solar collector that uses liquid as the heat transfer medium was investigated under simulated conditions. The test conditions and thermal performance data obtained during the tests are presented in tabular form, as well as in graphs. Data obtained from a time constant test and incident angle modifier test, conducted to determine transient effect and the incident angle effect on the collector, are included. Author

N78-17475*# Southern Univ., Baton Rouge, La. Dept. of Mechanical Engineering.
INHIBITOR ANALYSIS FOR A SOLAR HEATING AND COOLING SYSTEM
 John H. Tabony DOE 1 Jun. 1977 25 p Prepared for DOE (Grant Nsg-8025)
 (NASA-CR-150513) Avail: NTIS HC A02/MF A01 CSCL 10A

A study of potential corrosion inhibitors for the NASA solar heating and cooling system which uses aluminum solar panels is provided. Research consisted of testing using a dynamic corrosion system, along with an economic analysis of proposed corrosion inhibitors. Very good progress was made in finding a suitable inhibitor for the system. Author

N78-17477*# Alabama Univ., University. Dept. of Physics and Astronomy.

DEVELOPMENT OF SURFACES OPTICALLY SUITABLE FOR FLAT SOLAR PANELS Quarterly Progress Report, 16 Aug. - 16 Nov. 1977

Donald DeSmet, Andrew Jason, and Albert Parr 16 Nov. 1977 29 p refs

(Contract NAS8-32481)

(NASA-CR-150539; QPR-2) Avail: NTIS HC A03/MF A01 CSCL 10A

Innovations in reflectometry techniques are described; and the development of an absorbing selective coating is discussed along with details of surface properties. Conclusions as to the parameterization desired for practical applications of selective surfaces are provided. Author

N78-17478*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

THERMAL PERFORMANCE EVALUATION OF SOLAR ENERGY PRODUCTS COMPANY (SEPCO) 'SOLORON' COLLECTOR TESTED OUTDOORS

J. Chiou, Sr. DOE Nov. 1977 91 p refs

(Contract NAS8-32036)

(NASA-CR-150509; WYLE-TR-531-08-Rev-B) Avail: NTIS HC A05/MF A01 CSCL 10A

The test article, Model EF-212, Serial Nr. 002, is a single glazed collector with a nonselective, absorber plate, using flowing air as the heat transfer medium. The absorber plate and box frame are aluminum and the insulation is one inch isocyanurate foam board with thermal conductivity of 0.11 (BTU/sq ft Hr/Oft.) The tests included the following. (1) time constant test, (2) collector efficiency test, (3) collector stagnation test, (4) incident angle modifier test, (5) load test, (6) weathering test, and (7) absorber plate optical properties test. The results of these tests are tabulated, graphed, or otherwise recorded. Author

N78-17479*# Life Sciences Engineering, Morrison, Colo. **COLLATION OF QUARTERLY REPORTS ON AIR FLAT PLATE COLLECTORS**

DOE 31 Oct. 1977 109 p Prepared for DOE

(Contract NAS8-32261)

(NASA-CR-150514) Avail: NTIS HC A06/MF A01 CSCL 10A

The solar 2 air flat plate collectors are described. The development and fabrication of a prototype air flat plate collector subsystem containing 320 square feet of collector area are described. Three instrumented panels were completely assembled with glazing and insulation. Manufacture of the last seven prototype collectors was completed in October 1977. Author

N78-17480*# Wyle Labs., Inc., Huntsville, Ala. **COMPARISON OF SOLAR SYSTEM MEASURED DATA FOR VARIOUS SAMPLE RATES**

J. Chiou, Sr. DOE Nov. 1977 30 p refs Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150496; WYLE-TR-531-02) Avail: NTIS HC A03/MF A01 CSCL 10A

The results of solar house data for sample rates of 50, 100, 250, 300, and 600 seconds were compared. The data considered for summer days were the heat incident on the collectors, the heat used by the air conditioner generator, and the heat used by the auxiliary heater. For winter days, the heat incident, the heat collected and the heat used by the heat exchanger were computed. These data were compared for different weather days such as clear days, partly cloudy days, cloudy days, and very cloudy days. Also, data for the integration of all these weather days were compared. The percentage differences for these data, using 50 second sample rate as a base, are also presented. Author

N78-17481*# Wyle Labs., Inc., Huntsville, Ala. **INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF LENOX-HONEYWELL SOLAR COLLECTOR**

Ken Shih DOE Nov. 1977 28 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150510; WYLE-TR-531-09-Rev-A) Avail: NTIS HC A03/MF A01 CSCL 10A

The test procedures used and the test results obtained from an evaluation test program conducted on a double-covered liquid solar collector under simulated conditions are presented. The test article was a flat plate solar collector using liquid as the heat transfer medium. The absorber plate was steel with the copper tubes bonded on the upper surface. The plate was coated with black chrome with an absorptivity factor of .95 and emissivity factor of .12. A time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector. Author

N78-17482*# Colt, Inc. of Southern California, Rancho Mirage. **PROTOTYPE SOLAR HEATING AND HOT WATER SYSTEMS Quarterly Report**

DOE Jan. 1978 26 p refs Prepared for DOE

(Contract NAS8-32242)

(NASA-CR-150525) Avail: NTIS HC A03/MF A01 CSCL 10A

Progress made in the development of a solar hot water and space heating system is described in four quarterly reports. The program schedules, technical status and other program activities from 6 October 1976 through 30 September 1977 are provided. Author

N78-17483*# IBM Federal Systems Div., Huntsville, Ala. **APPLICATION OF SOLAR ENERGY TO AIR CONDITIONING SYSTEMS**

Jonathan M. Nash and Andrew J. Harstad Nov. 1976 82 p refs Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150532; IBM-76W-0122) Avail: NTIS HC A05/MF A01 CSCL 10A

The results of a survey of solar energy system applications of air conditioning are summarized. Techniques discussed are both solar powered (absorption cycle and the heat engine/Rankine cycle) and solar related (heat pump). Brief descriptions of the physical implications of various air conditioning techniques, discussions of status, proposed technological improvements, methods of utilization and simulation models are presented, along with an extensive bibliography of related literature. Author

N78-17484*# IBM Federal Systems Div., Huntsville, Ala. **SIMS PROTOTYPE SYSTEM 1: DESIGN DATA BROCHURE**

Jan. 1978 69 p refs Revised Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150534; IBM-7933447) Avail: NTIS HC A04/MF A01 CSCL 10A

A prototype solar heating and hot water system using air as the collector fluid and a pebble bed for heat storage was designed for installation into a single family dwelling. The system, subsystem, and installation requirements are described. System operation and performance are discussed, and procedures for sizing the system to a specific site are presented. Author

N78-17486*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF SOLAR/FOSSIL HYBRID POWER SYSTEMS

Harvey S. Bloomfield and James E. Calogeras Dec. 1977 70 p refs

(NASA-TM-73820; E-9409) Avail: NTIS HC A04/MF A01 CSCL 10B

Results show that new hybrid systems utilizing fossil fuel augmentation of solar energy can provide significant capital and energy cost benefits when compared with solar thermal systems requiring thermal storage. These benefits accrue from a reduction of solar collection area that results from both the use of highly efficient gas and combined cycle energy conversion subsystems and elimination of the requirement for long-term energy storage subsystems. Technical feasibility and fuel savings benefits of solar hybrid retrofit to existing fossil-fired, gas and vapor cycle powerplants were confirmed; however, economic viability of steam cycle retrofit was found to be dependent on the thermodynamic and operational characteristics of the existing powerplant. Author

N78-17487# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

NET ENERGY ANALYSIS MODEL FOR THE EVALUATION OF A SOLAR HEATING, VENTILATION AND AIR CONDITIONING SYSTEM M.S. Thesis

Matt A. Christ and Michael F. Hrapla Sep. 1977 137 p refs (AD-A047433; AFIT-LSSR-32-77B) Avail: NTIS HC A07/MF A01 CSCL 10/2

This research develops a feasible net energy analysis model from current net energy theory. The net energy model's purpose is to be utilized as an evaluation tool. Net energy analysis is based on the net energy model. Net energy analysis concerns itself with evaluating any system by its performance and interrelationship with the total environment in which the system operates. The model developed specifically addresses a heating, ventilation and air conditioning (HVAC) system. The net energy model was applied to two types of HVAC systems: one powered with conventional fuel sources and one powered with solar energy utilizing a conventional fuel back-up system. The model provided a realistic representation of both HVAC systems. An analysis was conducted on the two systems using data for a base exchange facility at Randolph AFB. The analysis included the use of three net energy analysis measures: net energy, yield ratio, and investment ratio. The results from the net energy analysis were compared to an economic analysis previously conducted to identify differences between the two evaluation methods. Author (GRA)

N78-17489# Research Triangle Inst., Research Triangle Park, N. C. Center for the Synthesis and Study of Semiconducting Compounds.

SOLAR CELL DESIGN STUDY Final Report, 1 Apr. 1976 - 2 Jan. 1977

M. F. Lamorte, J. R. Hauser, M. A. Littlejohn, and M. Simons Wright-Patterson AFB, Ohio AFAL Aug. 1977 303 p refs (Contract F33615-76-C-1283) (AD-A048042; RTI-41U-1259; AFAL-TR-77-74) Avail: NTIS HC A14/MF A01 CSCL 10/2

This report reviews the present state-of-the-art in the technology of selected III-V compounds most applicable to solar cells. Emphasis is placed on those areas of III-V materials technology that can be advanced most effectively in the development of high efficiency solar cells for use in the near-earth space environment. Solar cell configurations evaluated or modeled include homojunctions, heterojunctions, Schottky barriers, graded-structures, and multijunction or cascade designs. Author (GRA)

N78-17490# Federal Energy Administration, Washington, D. C. Office of Specialty Fuels.

ALLOCATION OF PETROLEUM FEEDSTOCKS TO SYNTHETIC NATURAL GAS PLANTS Final Programmatic Environmental Impact Statement

Apr. 1977 1013 p refs (PB-273098/4; FEA/H-77/369; FES-77/4) Avail: NTIS HC A99/MF A01 CSCL 13B

The FEA proposes to reevaluate and possibly modify its current program of case-by-case review of applications for the allocation of naphtha and natural gas liquids (NGL) for use in the manufacture of synthetic natural gas (SNG). The FEA's programmatic environmental impact statement presents the impacts in 1980 and 1985 of (1) continuation of the current program, and (2) modification of that program through one of five options ranging from the adoption of a more restrictive policy toward the use of naphtha and NGL for SNG manufacture, to complete removal of controls on these products. GRA

N78-17491# Illinois Univ., Urbana-Champaign. Water Resources Center.

A LINEAR PROGRAMMING MODEL FOR ASSESSING THE REGIONAL IMPACTS OF ENERGY DEVELOPMENT ON WATER RESOURCES Project Completion Report

George Provenzano Jul. 1977 116 p refs (Contract DI-14-31-0001-4174) (PB-273022/4; UIIU-WRC-77-0126; W77-12633; OWRT-B-092-ILL(4)) Avail: NTIS HC A06/MF A01 CSCL 13B

A multiperiod, multiplant linear programming model of an energy production system and associated water supply components simultaneously appraises alternative expansion strategies and operating schedules for steam electric power generation and coal gasification industries. The model identifies the type, size, location, and sequence of construction of new energy production facilities; and the levels of energy production and transmission that minimize the costs of meeting demands for electricity and gas over a specified future time period. For each minimum-cost expansion strategy that is identified, corresponding information about the amount, location, and sequence with which water will be used in future energy production is determined. GRA

N78-17492# Bureau of Reclamation, Denver, Colo. Engineering and Research Center.

DIGITAL LOAD CONTROL FOR HYDROELECTRIC POWER-PLANTS

W. B. Gish Aug. 1977 80 p refs (PB-274027/2; REC-ERC-77-10) Avail: NTIS HC A05/MF A01 CSCL 10B

A typical load controller for a hydroelectric powerplant using a digital computer was described. Flow charts indicating the necessary timing, interface program interaction, logic, and calculations were included. Notes and suggestions to adapt the algorithm to specific applications were also included. Author

N78-17493# Rutgers - The State Univ., Piscataway, N. J. Dept. of Electrical Engineering.

SILICON SCHOTTKY PHOTOVOLTAIC DIODES FOR SOLAR ENERGY CONVERSION Quarterly Progress Report, 1 Jul. - 30 Sep. 1977

Wayne A. Anderson Oct. 1977 29 p refs (Grant NSF AER-73-03197) (PB-274041/3; NSF/RANN/SE/AER73-03197/PR/77) Avail: NTIS HC A03/MF A01 CSCL 10B

Higher efficiency cells were fabricated on single crystal silicon. The Schottky metal showed much promise for future high efficiency cells. It had the advantage of higher optical transmission compared to chromium. Surface state studies continued in an effort to clearly relate open circuit voltage and surface state density. A process for silicon deposition to form thin polycrystalline silicon films on metal substrates is being developed. GRA

N78-17505# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

OPERATION AND MAINTENANCE OF PARTICULATE CONTROL DEVICES ON COAL-FIRED UTILITY BOILERS Final Report

Michael F. Szabo and Richard W. Gerstle Jul. 1977 384 p refs (Contract EPA-68-02-2105) (PB-274104/9; EPA-600/2-77-129) Avail: NTIS HC A17/MF A01 CSCL 07A

The control of fine particulate from coal-fired utility boilers, using electrostatic precipitators (ESPs), wet scrubbers, and fabric filters is discussed. Guidelines are provided to utility personnel, on significant design and cost data correlations based on current design practice for ESPs and actual operating and cost data for wet scrubbers and fabric filters. Fractional efficiency prediction models for ESPs and wet scrubbers are given which allow comparison of capital and operating costs under different coal/boiler application conditions and different levels of fractional efficiency. GRA

N78-17514# Federal Energy Regulatory Commission, Washington, D. C.

ELECTRIC UTILITIES USE OF FLUE GAS DESULFURIZATION TECHNOLOGY IN THE UNITED STATES

Abdul Q. Dasti Oct. 1977 35 p refs (PB-274120/5) Avail: NTIS HC A03/MF A01 CSCL 07A

Flue gas desulfurization units in the planning stage, under construction and in operation were identified, according to geographical location. GRA

N78-17639# Bureau of Reclamation, Denver, Colo. Div. of Atmospheric Water Resources Management.

COST-EFFECTIVE ELECTRIC POWER GENERATION FROM THE WIND

C. J. Todd, R. L. Eddy, R. C. James, and W. E. Howell Aug. 1977 34 p refs Presented at The Intern. Solar Energy Soc., Orlando, Fla., 6-10 Jun. 1977

(PB-273582/7) Avail: NTIS HC A03/MF A01 CSCL 10B

The idea of generating windpower at the windiest available sites (wind farms) was examined for its effect on feasibility of large-scale windpower input to the nationwide electric power network. Windpower was considered in association with pumped-storage hydroelectric plants for load leveling and existing types of transmission lines for interconnecting the wind farms and energy storage sites with load centers up to 2000 km away. Potential energy harvest from wind farm sites in the 17 Western States was estimated at well over 100 GW, and many times this much in arctic North America. At the 100-GW level of development bus bar cost at the wind farm would be 3 mills/MJ (10 mills/kWh). GRA

N78-17856*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

OPTIMIZE OUT-OF-CORE THERMIONIC ENERGY CONVERSION FOR NUCLEAR ELECTRIC PROPULSION

James F. Morris Sep. 1977 15 p refs Proposed for presentation at Intern. Conf. on Plasma Sci., Monterey, Calif., 15-17 May 1978; sponsored by IEEE

(NASA-TM-73892) Avail: NTIS HC A02/MF A01 CSCL 18E

Current designs for out of core thermionic energy conversion (TEC) to power nuclear electric propulsion (NEP) were evaluated. Approaches to improve out of core TEC are emphasized and probabilities for success are indicated. TEC gains are available with higher emitter temperatures and greater power densities. Good potentialities for accommodating external high temperature, high power density TEC with heat pipe cooled reactors exist. Author

N78-17921*+ National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BIBLIOGRAPHY OF LEWIS RESEARCH CENTER TECHNICAL CONTRIBUTIONS ANNOUNCED IN 1976

Dec. 1977 192 p

(NASA-TM-73860; E-9449) Avail: NTIS HC A09 CSCL 05B

Abstracts of Lewis authored publications and publications resulting from Lewis managed contracts which were announced in the 1976 issues of STAR (Scientific and Technical Aerospace Reports) and IAA (International Aerospace Abstracts) are presented. Research reports, journal articles, conference presentations, patents and patent applications, and these are included. The arrangement is by NASA subject category. Citations indicate report literature (identified by their N-numbers) and the journal and conference presentations (identified by their A-numbers). A grouping of indexes helps locate specific publications by author (including contractor authors), contractor organization, contract number, and report number. Author

N78-17932# Committee on Science and Technology (U. S. House).

NASA AUTHORIZATION, 1979, PROGRAM REVIEW, VOLUME 2, PART 1

Washington GPO 1977 431 p refs Hearings before the Subcomm. on Transportation, Aviation, and Weather of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., No. 31, 20-21 Sep. 1977

(GPO-98-932) Avail: Subcomm. on Transportation, Aviation, and Weather

NASA programs in aeronautical research and development are described to justify budgetary requests for FY-1979. Included are statements regarding aircraft energy efficiency and technologies to reduce atmospheric pollution by aircraft. P.R.A.

N78-17933*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE AM GENERAL DJ-5E ELECTRUCK ELECTRIC DELIVERY VAN

Miles O. Dustin, Henry B. Tryon, and Noel B. Sargent Oct. 1977 45 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73758; E-9383; CONS/1011-3) Avail: NTIS HC A03/MF A01 CSCL 13F

An electric quarter ton truck designed for use as a postal delivery vehicle was tested to characterize the state of the art of electric vehicles. Vehicle performance test results are presented. It is powered by a single-module, 54 volt industrial battery through a silicon controlled rectifier continuously adjustable controller with regenerative braking applied to a direct current compound wound motor. Author

N78-17934*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE ZAGATO ELCAR ELECTRIC PASSENGER VEHICLE

Noel B. Sargent, Edward A. Maslowski, Ralph J. Slavick, and Richard F. Soltis Oct. 1977 36 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73764; CONS/1011-9; E-9442) Avail: NTIS HC A03/MF A01 CSCL 13F

The Elcar vehicle performance test results are presented. The Elcar Model 2000 is a two-passenger vehicle with a reinforced fiberglass body. It is powered by eight 12-volt batteries. The batteries are connected to the motor through an arrangement of contactors operated from a foot pedal in conjunction with a hand-operated switch. These contactors change the voltage applied to the 2-kilowatt motor. Acceleration tests, operating characteristics, and instrumentation are described. Author

N78-17935*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PHOTOVOLTAIC HIGHWAY APPLICATIONS: ASSESSMENT OF THE NEAR-TERM MARKET

Louis Rosenblum, Larry R. Scudder, William J. Bifano, and William A. Poley Dec. 1977 12 p ref

(Contract E(49-26)-1022)

(NASA-TM-73863; DOE/NASA/1022-77/22; E-9452) Avail: NTIS HC A02/MF A01 CSCL 05B

A preliminary assessment of the near-term market for photovoltaic highway applications is presented. Among the potential users, two market sectors are considered: government and commercial. Within these sectors, two possible application areas, signs and motorist aids, are discussed. Based on judgemental information, obtained by a brief survey of representatives of the two user sectors, the government sector appears more amenable to the introduction of photovoltaic power sources for highway applications in the near-term. However, considerable interest and potential opportunities were also found to exist in the commercial sector. Further studies to quantify the market for highway applications appear warranted. Author

N78-17936*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE POWER-TRAIN ELECTRIC DELIVERY VAN

Stacy Lumannick, Miles O. Dustin, and John M. Bozek Nov. 1977 60 p

(Contract EC-77-A-31-1011)

(NASA-TM-73765; E-9470; CONS/1011-10) Avail: NTIS HC A04/MF A01 CSCL 13F

Vehicle maximum speed, range at constant speed, range over stop-and-go driving schedules, maximum acceleration, gradeability, gradeability limit, road energy consumption, road power, indicated energy consumption, braking capability, battery charger efficiency, and battery characteristics were determined for a modified utility van powered by sixteen 6-volt batteries connected in series. A chopper controller actuated by a foot accelerator pedal changes the voltage applied to the 22-kilowatt (30-hp) series-wound drive motor. In addition to the conventional hydraulic braking system, the vehicle has hydraulic regenerative braking. Cycle tests and acceleration tests were conducted with and without hydraulic regeneration. Author

N78-17937*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

TEST AND EVALUATION OF 23 ELECTRIC VEHICLES FOR STATE-OF-THE-ART ASSESSMENT

Miles O. Dustin and Robert J. Denington 3 Mar. 1978 24 p refs Presented at the 1978 SAE Congr., Detroit, Mich., 27 Feb. - 3 Mar. 1978

(Contract EC-77-A-31-1011)

(NASA-TM-73850; E-9438; CONS/1011-21) Avail: NTIS HC A02/MF A01 CSCL 13F

Eleven of the electric vehicles were passenger cars and 12 were commercial vans. Tests were conducted in accordance with an ERDS test procedure which is based on the SAE J227a Test Procedure. Tests included range, acceleration, coast-down, and braking. The results of the tests are presented, and comments on reliability are made. Author

N78-17938* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE EVA CHANGE-OF-PACE COUPE ELECTRIC PASSENGER VEHICLE

John M. Bozek, Edward A. Maslowski, and Miles O. Dustin Nov. 1977 63 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73763; E-9469; CONS/1011-8) Avail: NTIS HC A04/MF A01 CSCL 13F

The EVA Change-of-Pace Coupe, is an electric passenger vehicle, to characterize the state-of-the-art of electric vehicles. The EVA Change-of-Pace Coupe is a four passenger sedan that has been converted to an electric vehicle. It is powered by twenty 6 volt traction batteries through a silicon controlled rectifier chopper controller actuated by a foot throttle to change the voltage applied to the series wound, direct current motor. Braking is accomplished with a vacuum assist hydraulic braking system. Regenerative braking is also provided. Author

N78-17939* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE EVA CONTRACTOR ELECTRIC PASSENGER VEHICLE

John M. Bozek, Henry B. Tryon, and Ralph J. Slavick Nov. 1977 57 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73762; E-9481; CONS/1011-7) Avail: NTIS HC A04/MF A01 CSCL 13F

The EVA Contactor four door sedan, an electric passenger vehicle, was tested to characterize the state-of-the-art of electric vehicles. It is a four passenger sedan that was converted to an electric vehicle. It is powered by 16 series connected 6 volt electric vehicle batteries through a four step contactor controller actuated by a foot accelerator pedal. The controller changes the voltage applied to the separately excited DC motor. The braking system is a vacuum assisted hydraulic braking system. Regenerative braking was also provided. Author

N78-17940* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE BATTRONIC MINIVAN ELECTRIC DELIVERY VAN

Miles O. Dustin, Richard F. Soltis, John M. Bozek, and Edward A. Maslowski Dec. 1977 52 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73761; E-9483; CONS/1011-6) Avail: NTIS HC A04/MF A01 CSCL 13F

An electric passenger vehicle was tested to develop data characterizing the state of the art of electric and hybrid vehicles. The test measured vehicle maximum speed, range at constant speed, range over stop-and-go driving schedules, maximum acceleration, gradeability and limit, road energy consumption, road power, indicated energy consumption, braking capability and battery charge efficiency. The data obtained are to serve as a baseline to compare improvements in electric and hybrid vehicle technologies and to assist in establishing performance standards. G.Y.

N78-17944# Denver Federal Executive Board, Colo. Committee on Energy and Environment.

CONFERENCE PROCEEDINGS: A CRITICAL ECONOMIC BALANCE: WATER, LAND, ENERGY, PEOPLE

Final Report

Polly Garrett, ed. (Federal Energy Administration), Glenn Kissinger, ed. (Colorado Dept. of Local Affairs), and Joe Newlin, ed. (Colorado State Univ.) Jun. 1977 122 p Proc. held at Pingree Park, Colo., 6-7 Jun. 1977 Sponsored by FEA, and Colorado State Rural Development Committee

(PB-274089/2; FEA-77-8-6) Avail: NTIS HC A06/MF A01 CSCL 13B

Objectives of the conference were to: encourage regional coordination in the delivery of services and programs which deal with water, energy, land, and population growth; stimulate participants to think critically and creatively about present and future issues, responsibilities and directions for effective economic planning; develop, based on the collective best thinking of the participants, contemporary statements concerning possible actions to be taken by decision makers in government, business, industry, and the public in effecting an economic balance in the region (and in the nation). GRA

N78-18088* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AIAA/MSFC SYMPOSIUM ON SPACE INDUSTRIALIZATION: PROCEEDINGS

1976 627 p refs Proc. held at Huntsville, Ala., 26-27 May, 1976

(NASA-CP-2026) Avail: NTIS HC A99/MF A01 CSCL 22A

Current and projected technologies required for utilizing extraterrestrial environments to produce energy, information, or materials and provide services of value on Earth or to Earth are discussed. Topics include: space habitats, space transportation, materials processing, solar space power, and exoindustrial management concepts. A.R.H.

N78-18091* National Aeronautics and Space Administration, Washington, D. C.

THE NEXT 25 YEARS: INDUSTRIALIZATION OF SPACE: RATIONALE FOR PLANNING

Jesco VonPuttkamer 1976 29 p refs Presented at Southeast 2001: The Next 25 Years. World Future Soc. Conf., Atlanta, 12-13 Nov. 1976

(NASA-TM-79360) Avail: NTIS HC A03/MF A01 CSCL 22A

The goals of NASA's space industrialization program include contributing to increased productivity on earth without taxing the environment, generating new values through extraterrestrial productivity, and providing new growth options for the future which include the permanent settlement of space and long-range colonization and exploration projects. In planning the long-range space program based on essentially utilitarian aspects, without losing sight of the more humanistically significant long term, and to forecast associated technology requirements, a realistic approach is obtained by combining extrapolative and normative planning modes so that common stepping stones can be identified. In the extrapolative view, alternative futures are projected on the basis of past and current trends and tendencies. In the normative view, some ideal state in the far future is envisioned or postulated, and policies and decisions are directed toward its attainment. A.R.H.

N78-18226# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

COMPARISON TESTS ON THE 100-GPM ELECTROKINETIC FUEL DECONTAMINATOR AND A 100-GPM MILITARY STANDARD FILTER/SEPARATOR Final Technical Report

William R. Williams Sep. 1977 35 p (AD-A048655; MERADCOM-2220) Avail: NTIS HC A03/MF A01 CSCL 21/4

This report covers identical tests performed on the 100-GPM Electrokinetic Fuel Decontaminator and a 100-GPM Military Standard Filter/Separator for the purpose of comparing performances. Performance is based upon the ability to remove emulsified water from fuel. Test fuels were turbine fuel JP-5 and diesel

fuel No. 2. Water is injected into the fuel upstream of a centrifugal pump out of the test vessel in concentrations of 0.5, 2, 5, and 10%. The effluent, pressure-drop readings are also taken. The effluent fuel from each test vessel is measured for water concentration using a turbidimeter. Tests are performed at ambient temperatures and low temperatures. Results are correlated, and the performances of the two test vessels are compared. Conclusions are as follows: (a) The Electrokinetic Fuel Decontaminator demonstrates improved, overall efficiency in removing water from turbine fuel and diesel fuel over the currently used Military Standard Filter/Separator. (b) The Electrokinetic Fuel Decontaminator demonstrates a lower, overall pressure drop than the Military Standard Filter/Separator. (c) The power consumption of the Electrokinetic Fuel Decontaminator is primarily dependent on the amount of water present and, to a lesser extent, on temperature. (d) The power consumption for decontaminating diesel fuel is approximately three times as great as that for decontaminating turbine fuel. (e) The current necessary to remove 1 gallon of water from turbine fuel is approximately 1 ampere; for diesel fuel, the current is approximately 3 amperes. Author (GRA)

N78-18357* National Aeronautics and Space Administration, Washington, D. C.

HEAT PIPES AND THEIR USE IN TECHNOLOGY

L. Vasilyev Aug. 1977 7 p Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 31, no. 5, Nov. 1976 p 905-907 Transl. by Scientific Translation Service, Santa Barbara, Calif. (NASA-TM-75148) Avail: NTIS HC A02/MF A01 CSCL 20D

Heat pipes may be employed as temperature regulators, heat diodes, transformers, storage batteries, or utilized for transforming thermal energy into mechanical, electric, or other forms of energy. General concepts were established for the analysis of the transfer process in heat pipes. A system of equations was developed to describe the thermodynamics of steam passage through a cross section of a heat pipe. P.R.A.

N78-18437# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES. REPORT NO. 8: MITSUBISHI MODEL 6DS7 DIESEL ENGINE Interim Report, Jul. 1975

W. F. Marshall and K. R. Stamper Aug. 1977 35 p (Contract DOT-TSC-RA-75-10) (PB-274374/8; BERC/OP-76/33; DOT-TSC-OST-77-48) Avail: NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen, and smoke) at steady-state engine operating modes. The objective was to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation were provided. GRA

N78-18438# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES. REPORT NO. 9: CHRYSLER (1975) 225-CID 1-bbl ENGINE Interim Report, Jan. - Feb. 1976

W. F. Marshall Aug. 1977 39 p (Contract DOT-TSC-RA-75-10) (PB-274375/5; BERC/OP-77/3; DOT-TSC-OST-77-49) Avail: NTIS HC A03/MF A01 CSCL 21G

For abstract, see N78-18437

N78-18439# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES. REPORT NO. 10: CHEVROLET (1975) 250 CID 1-bbl ENGINE Interim Report, Dec. 1975 - Jan. 1976

W. F. Marshall and K. R. Stamper Aug. 1977 42 p (Contract DOT/TSC-RA-75-10) (PB-274376/3; BERC/OP-77/4; DOT-TSC-OST-77-50; Rept-10) Avail: NTIS HC A03/MF A01 CSCL 21G

For abstract, see N78-18437.

N78-18440# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES. REPORT NO. 11: CHRYSLER (1975) 318-CID 2-bbl ENGINE Interim Report, Nov. - Dec. 1975

W. F. Marshall Aug. 1977 42 p (Contract DOT/TSC-RA-75-10) (PB-274377/1; BERC/OP-77/5; DOT-TSC-OST-77-51; Rept-11) Avail: NTIS HC A03/MF A01 CSCL 21G

For abstract, see N78-18437.

N78-18506# Bureau of Land Management, Washington, D. C. Div. of Minerals Environmental Assessment.

PROPOSED INCREASE IN OIL AND GAS LEASING ON THE OUTER CONTINENTAL SHELF, VOLUME 1 Final Environmental Statement

7 Jul. 1975 801 p (PB-273700/5; BLM-ME-78-14-Vol-1) Avail: NTIS HC A99/MF A01; HC also available in set of 3 reports HC E99, PB-273699-SET CSCL 13B

A proposal of the Department of the Interior is considered which would accelerate its Outer Continental Shelf (OCS) oil and gas leasing in the years 1975 through 1978. The program suggests conducting six lease sales each year. Lease sales in some or all frontier areas by 1978 are proposed. Many of the areas have little or no history of OCS oil and gas development. Volume 1 of the statement includes the description of the proposed action and the description of the environment in which the action would take place. GRA

N78-18507# Bureau of Land Management, Washington, D. C. Div. of Minerals Environmental Assessment.

PROPOSED INCREASE IN OIL AND GAS LEASING ON THE OUTER CONTINENTAL SHELF, VOLUME 2 Final Environmental Statement

7 Jul. 1975 1041 p refs (PB-273701/3; BLM-ME-78-15-Vol-2) Avail: NTIS HC A99/MF A01; also available in set of 3 reports HC E99 PB-273699-Set CSCL 13B

Volume 2 of the statement includes the environmental impact of the proposal and other impact analyses, mitigating measures, alternatives to the proposed action and consultation and coordination with others, including comments on the draft statement. GRA

N78-18508# Bureau of Land Management, Washington, D. C. Div. of Minerals Environmental Assessment.

PROPOSED INCREASE IN OIL AND GAS LEASING ON THE OUTER CONTINENTAL SHELF, VOLUME 3 Final Environmental Statement

7 Jul. 1975 938 p refs (PB-273702/1; BLM-ME-78-16-Vol-3) Avail: NTIS HC A99/MF A01; also available in set of 3 reports HC E99, PB-273699-SET CSCL 13B

For abstract, see N78-18506.

N78-18512 North Carolina State Univ., Raleigh.

A COMPUTER ANALYSIS OF HETEROJUNCTION AND GRADED BANDGAP SOLAR CELLS Ph.D. Thesis

Joseph Edward Sutherland 1977 149 p Avail: Univ. Microfilms Order No. 77-29659

A computer program was designed for the analysis of variable composition solar cells and the program was applied to several proposed solar cell structures using appropriate semiconductor materials. The program was completed and used to study devices made of Al(x)Ga(1-x)As, Ga(x)In(1-x)As and GaAs(1-x)P(x) with the intention of determining the material compositions and device dimensions that produce high conversion efficiency. Background

discussions are included concerning variable composition solar cell phenomena and the theoretical techniques used to model device behavior. The results of the computer analysis of various proposed cell structures are then presented. Dissert. Abstr.

N78-18513 North Carolina State Univ., Raleigh.
SOLAR ENERGY STORAGE SUBSYSTEM UTILIZING LATENT HEAT OF PHASE CHANGE Ph.D. Thesis
Kunjivihari Jagmohandas Mody 1977 83 p
Avail: Univ. Microfilms Order No. 77-29672

The problems of heat transfer associated with the design of a solar energy storage sub system utilizing latent heat of phase change also called thermal capacitor are examined. The solution of the fundamental problem of phase change with generalized boundary condition at the surface and the analysis of the finless thermal capacitor are presented. The arrangement selected consists of two slabs of phase change material with heat transfer medium circulating in between in a channel flow. The analysis of a single cell of finned thermal capacitor is also obtained; using known methods, by finite differences and by a new method. It is observed that the new method gives fairly good accuracy with considerably reduced computational time. The fin material content is optimized using this approximate method and finally the analysis of a finned thermal capacitor is presented.

Dissert. Abstr.

N78-18516* Motorola, Inc., Phoenix, Ariz. Semiconductor Group.

PHASE 1 OF THE AUTOMATED ARRAY ASSEMBLY TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Annual Technical Report

M. G. Coleman, R. A. Pryor, L. A. Grenon, and I. A. Lesk Feb. 1977 115 p refs Sponsored in part by ERDA Prepared for JPL

(Contracts NAS7-100; JPL-954363)
(NASA-CR-155935; ERDA/JPL-954363-77/1; Rept-2258/4)
Avail: NTIS HC A06/MF A01 CSCL 10A

The state of technology readiness for the automated production of solar cells and modules is reviewed. Individual process steps and process sequences for making solar cells and modules were evaluated both technically and economically. High efficiency with a suggested cell goal of 15% was stressed. It is concluded that the technology exists to manufacture solar cells which will meet program goals. J.M.S.

N78-18517* Pennsylvania Univ., Philadelphia.
HOT FORMING OF SILICON SHEET, SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Quarterly Report, 31 Mar. - 30 Jun. 1977

C. D. Graham, Jr., A. H. Gholamnezhad, C. Lall, D. P. Pope, P. Strauss, and M. Wolf 26 Jul. 1977 14 p Sponsored in part by ERDA Prepared for JPL

(Contracts NAS7-100; JPL-954506)
(NASA-CR-155934; QR-5; ERDA/JPL-954506-77/3) Avail:
NTIS HC A02/MF A01 CSCL 10A

Progress on a program to determine the conditions under which sheets of silicon might be produced by a rolling process is described. Samples of p-type polycrystalline silicon produced by chemical vapor deposition deformed at strain rates of 5 sec⁻¹ to strains of between 36% and 56% and are subsequently recrystallized and submitted for electrical evaluation. The effect of the environment in the deformation and annealing apparatus was determined. Author

N78-18519* Solarex Corp., Rockville, Md.
ENERGY REQUIREMENT FOR THE PRODUCTION OF SILICON SOLAR ARRAYS Quarterly Report, 21 Mar. - 20 Jun. 1977

Joseph Lindmayer, Manfred Wihl, Alan Scheinine, and Andrew Morrison Jul. 1977 61 p refs Sponsored in Part by ERDA Prepared for JPL

(Contracts NAS7-100; JPL-954606)
(NASA-CR-155932; QR-2; ERDA/JPL-954606-77/2) Avail:
NTIS HC A04/MF A01 CSCL 10A

An assessment of potential changes and alternative technologies which could impact the photovoltaic manufacturing process is presented. Topics discussed include: a multiple wire saw, ribbon growth techniques, silicon casting, and a computer model for a large-scale solar power plant. Emphasis is placed on reducing the energy demands of the manufacturing process. J.M.S.

N78-18520* Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

THERMAL ENERGY STORAGE Final Report
P. G. Grodzka and E. A. Picklesimer 10 Feb. 1978 28 p refs

(Contract NAS8-31100)
(NASA-CR-150563; LMSC-HREC-TR-D568188) Avail: NTIS
HC A03/MF A01 CSCL 10C

The general scope of study on thermal energy storage development includes: (1) survey and review possible concepts for storing thermal energy; (2) evaluate the potentials of the surveyed concepts for practical applications in the low and high temperature ranges for thermal control and storage, with particular emphasis on the low temperature range, and designate the most promising concepts; and (3) determine the nature of further studies required to expeditiously convert the most promising concept(s) to practical applications. Cryogenic temperature control by means of energy storage materials was also included. Author

N78-18521* Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

INDOOR THERMAL PERFORMANCE EVALUATION OF DAYSTAR SOLAR COLLECTOR

Ken Shih, Sr. Nov. 1977 50 p Revised Prepared for DOE
(Contract NAS8-32036)

(NASA-CR-150511; WYLE-TR-510-10-Rev-A) Avail: NTIS
HC A03/MF A01 CSCL 10A

The test procedures used and results obtained from a test program to obtain thermal performance data on a Daystar Model 21B, S/N 02210, Unit 2, liquid solar collector under simulated conditions are described. The test article is a flat plate solar collector using liquid as a heat transfer medium. The absorber plate is copper and coated with black paint. Between the tempered low iron glass and absorber plate is a polycarbonate trap used to suppress convective heat loss. The collector incorporates a convector heat dump panel to limit temperature excursions during stagnation. The following tests were conducted: (1) collector thermal efficiency; (2) collector time constant; (3) collector incident angle modifier; (4) collector heat loss coefficient; and (5) collector stagnation. Author

N78-18523* IBM Federal Systems Div., Huntsville, Ala.
INSTALLATION PACKAGE - SIMS PROTOTYPE SYSTEM 1A

Dec. 1976 35 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150524) Avail: NTIS HC A03/MF A01 CSCL
10A

This report consists of details for the installation, operation and maintenance of a prototype heating and hot water system, designed for residential or light commercial applications. This system consists of the following subsystems: air type collectors, pebble bed thermal storage, air handling unit, air to water heat exchanger, hot water preheat tank, auxiliary energy, ducting system. Author

N78-18524* IBM Federal Systems Div., Huntsville, Ala.
SITE DEPENDENT FACTORS AFFECTING THE ECONOMIC FEASIBILITY OF SOLAR POWERED ABSORPTION COOLING

J. C. Bartlett Jan. 1978 37 p Revised Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150533; Rept-76W-0128-Rev) Avail: NTIS
HC A03/MF A01 CSCL 10A

A procedure was developed to evaluate the cost effectiveness of combining an absorption cycle chiller with a solar energy system. A basic assumption of the procedure is that a solar energy system exists for meeting the heating load of the building, and that the building must be cooled. The decision to be made

is to either cool the building with a conventional vapor compression cycle chiller or to use the existing solar energy system to provide a heat input to the absorption chiller. Two methods of meeting the cooling load not supplied by solar energy were considered. In the first method, heat is supplied to the absorption chiller by a boiler using fossil fuel. In the second method, the load not met by solar energy is met by a conventional vapor compression chiller. In addition, the procedure can consider waste heat as another form of auxiliary energy. Commercial applications of solar cooling with an absorption chiller were found to be more cost effective than the residential applications. In general, it was found that the larger the chiller, the more economically feasible it would be. Also, it was found that a conventional vapor compression chiller is a viable alternative for the auxiliary cooling source, especially for the larger chillers. The results of the analysis give a relative rating of the sites considered as to their economic feasibility of solar cooling.

Author

N78-18525* Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

THERMAL PERFORMANCE OF MSFC HOT AIR COLLECTORS UNDER NATURAL AND SIMULATED CONDITIONS
K. Shih, Sr. Nov. 1977 39 p Revised Prepared for DOE
(Contract NAS8-32036)

(NASA-CR-150506; WYLE-TR-531-05-Rev-A) Avail: NTIS HC A03/MF A01 CSCL 10A

The procedures used and the results obtained from an evaluation test program conducted to determine the thermal performance and structural characteristics of selected MSFC-designed hot air collectors under both real and simulated environmental conditions are described. Five collectors were tested in the three phased program. A series of outdoor tests were conducted to determine stagnation temperatures on a typical bright day and to determine each collector's ability to withstand these temperatures. Two of the collectors experienced structural deformation sufficient to eliminate them from the remainder of the test program. A series of outdoor tests to evaluate the thermal performance of collector S/N 10 under certain test conditions were performed followed by a series of indoor tests to evaluate the thermal performance of the collector under closely controlled simulated conditions.

Author

N78-18526* Solafern Ltd., Bourne, Mass.
SOLAFERN SOLAR SYSTEM DESIGN BROCHURE
Dec. 1977 47 p Prepared for DOE

(Contract NAS8-32246)
(NASA-CR-150515) Avail: NTIS HC A03/MF A01 CSCL 10A

A complete residential solar space heating and hot water system is described. Low maintenance, durable, and efficient air heating collectors are used. The collectors have a selective absorber and a tempered glass cover nearly one-quarter of an inch thick with an aluminum frame. The solar energy can be delivered directly to the living area when there is a demand; otherwise, it is stored in the form of hot water. Hot water storage is accomplished through the use of an air-to-water exchanger. The hot water storage is used simultaneously to preheat the domestic hot water, as well as to store energy for space heating.

Author

N78-18527* IBM Federal Systems Div., Huntsville, Ala.
SIMS PROTOTYPE SYSTEM 1 TEST RESULTS: ENGINEERING ANALYSIS

19 Jan. 1978 70 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150522; IBM-77W-0061) Avail: NTIS HC A04/MF A01 CSCL 10A

The space and domestic water solar heating system designated SIMS Prototype Systems 1 was evaluated. The test system used 720 ft (gross) of Solar Energy Products Air Collectors, a Solar Control Corporation SAM 20 Air Handler with Model 75-175 control unit, a Jackson Solar Storage tank with Rho Sigma Mod 106 controller, and 20 tons of rack storage. The test data analysis performed evaluates the system performance and documents the suitability of SIMS Prototype System 1 hardware for field installation.

Author

N78-18528* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF REQUIREMENTS FOR ACCELERATING THE DEVELOPMENT OF GEOTHERMAL ENERGY RESOURCES IN CALIFORNIA

C. D. Fredrickson 3 Mar. 1978 178 p
(Contract NAS7-100)
(NASA-CR-155782; JPL-Pub-77-83) Avail: NTIS HC A09/MF A01 CSCL 10B

Various resource data are presented showing that geothermal energy has the potential of satisfying a significant part of California's increasing energy needs. General factors slowing the development of geothermal energy in California are discussed and required actions to accelerate its progress are presented. Finally, scenarios for developing the most promising prospects in the state directed at timely on-line power are given. Specific actions required to realize each of these individual scenarios are identified.

Author

N78-18529* Union Coll., Schenectady, N.Y.
EFFECTS OF ENERGY CONSTRAINTS ON TRANSPORTATION SYSTEMS

Ram K. Mittal, ed. Dec. 1977 559 p refs Presented at the 4th Natl. Conf. held at Union College, Schenectady, N. Y., 1-5 Aug. 1977

(Contract EC-77-G-01-60-87)
Avail: NTIS HC A24/MF A01

Energy conservation policies and methods are reviewed for all phases of the transportation industry, including ships, aircraft, trucks, automobiles, and rail transportation. Electrification and synthetic fuels are also considered.

N78-18530* Bureau of Mines, Washington, D. C. Div. of Interfuels Studies.

THE UNITED STATES ENERGY SCENE 1976-1985
Walter G. Dupree, Jr. In Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 1-32 refs

Avail: NTIS HC A24/MF A01

The prospective energy condition of the United States is considered. Various energy sources are discussed, along with their possible cost and longevity. Crude oil, natural gas, and coal resources are emphasized.

J.A.M.

N78-18531* Bureau of Mines, Washington, D. C. Div. of Interfuels Studies.

ENERGY CONSUMPTION IN THE TRANSPORTATION SECTOR
Walter G. Dupree, Jr. In Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 33-60 refs

Avail: NTIS HC A24/MF A01

A historical background is provided, regarding the percent of energy consumed and the types of energy consumed by the U.S. transportation sector. It was concluded that the transportation sector accounted for nearly 25 percent of the energy consumption over the last quarter of a century. During the same time period, its share of petroleum usage has risen from 78.5 percent to 96.9 percent. In 1950, coal usage was nearly 20 percent; it is now negligible. It was also concluded that the transportation sector uses nearly 50 percent of the total petroleum consumed in the U.S. The consumption of petroleum products (liquefied gases, jet fuel, gasoline, distillate fuel, residual fuel and lubes and waxes) by the transportation sector has shown some variation over time.

Author

N78-18532* New York State Dept. of Transportation, Albany.
LONG RANGE TRANSPORTATION PLANNING UNDER ENERGY CONSTRAINTS: A CRITICAL REVIEW OF CURRENT CAPABILITY

David T. Hartgen In Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 49-60 refs

Avail: NTIS HC A24/MF A01

Central issues for continuing planning were identified as: (1) reevaluation of long-range plans; (2) modal alternatives;

(3) investment needs; and (4) funding flow. The UTPS process was found to be capable of dealing quite well with certain energy policies (e.g., speed reductions, increased vehicle efficiency) but was generally a weaker tool in addressing other policies (e.g., rationing, Sunday driving bans, urban activity redistribution). Generally, the sensitivity analysis capability of UTPS appeared stronger than its capability to predict actual impacts. Specific information on gasoline price elasticity of travel by trip purpose, as well as trip priorities would greatly increase the predictive power of the system. Author

N78-18533# Texaco, Inc., Beacon, N. Y. Environmental Protection Dept.

OPTIMIZATION OF THE VEHICLE-FUEL-REFINERY SYSTEM

W. T. Tierney and R. F. Wilson *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 61-80 refs

Avail: NTIS HC A24/MF A01

It was concluded that system optimizations similar to the VFR system study must be more broadly applied between the various energy sources and final use devices to improve conservation in the entire spectrum of energy utilization. Author

N78-18534# Massachusetts Inst. of Tech., Cambridge.
ALTERNATIVE AUTOMOTIVE ENGINES AND ENERGY CONSERVATION

Lawrence H. Linden *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 81-114 refs Repr. from Energy and Transportation, SAE-SP-406, Feb. 1976

(Grant NSF PRA-76-81015)

Avail: NTIS HC A24/MF A01

While substantial savings can be expected in automobile energy consumption, the contributions towards these savings from alternative engines is not clear. Two issues are discussed: one pertains to uncertainties in current estimates of the benefits to be gained from alternative power-plants, and the other pertains to uncertainties in the role of the automobile in the industry's process of technological innovation. Thus, while the case was made that some of the more promising alternative engines offered the potential for significant savings in automotive fuel consumption, and were therefore options worth pursuing, the case was also made that these savings might be realized without the introduction of alternatives and the upheaval such introduction would bring. Author

N78-18535# SRI International Corp., Menlo Park, Calif. Center for Resource and Environmental Systems Studies.

SYNTHETIC LIQUID FUELS DEVELOPMENT: ASSESSMENT OF CRITICAL FACTORS

Barry L. Walton *In* Union Coll. Effects of Energy Constraints Dec. 1977 p 115-140 refs

Avail: NTIS HC A24/MF A01

The study related to the technology assessment of selected liquid fuels derived from coal and oil shale. These fuels were considered to be the most likely alternatives to substitute for/or augment petroleum derived fuels in the transportation sector in the 1980-2000 time frame. The core of the study deals with the preparation of maximum credible implementation (MCI) scenario for the deployment of a synthetic liquid fuel industry based on the use of coal and oil shale to produce synthetic crude oils and methanol. The preparation of the MCI was followed by detailed exploration of the broad consequences if the scenario were to become a reality. Author

N78-18536# Pennsylvania Univ., Philadelphia.
ENERGY USE IN INTERCITY FREIGHT TRANSPORT AND POLICY IMPLICATIONS

Edward K. Morlok *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 141-158 refs

Avail: NTIS HC A24/MF A01

The study included rail movement in conventional cars, rail movement in truck trailers on flat cars (TOFC or piggyback),

and over the road movement in various types of trailer trucks. Characteristics such as weight and size of shipments, the average speed, and route profile conditions were varied. In order to identify the effects of varying mode and market characteristics, the work requirements (foot-pounds) were estimated using engineering relationships in contrast to most prior comparisons which have used average empirical (statistical) data. The study concluded that route profile had a considerable effect on the propulsive work required. In general, the truck was least affected by undulating profiles and relatively large average and ruling grades, while both TOFC and conventional rail were very adversely affected. Author

N78-18537# Peat, Marwick, Mitchell and Co., Washington, D. C.
ENERGY AND ECONOMIC IMPACTS OF PROJECTED FREIGHT TRANSPORTATION IMPROVEMENTS

Robert H. Leilich *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 159-180 ref

Avail: NTIS HC A24/MF A01

The major goal was to estimate the current and future energy intensity for major freight modes. The economic impact of anticipated changes in freight systems (trucks, railroads, inland waterways, coastal and Great Lakes ships, pipe lines, and air freight) under various assumptions about freight demands for 1980 and 1985. The impact of certain vehicle types upon energy intensity was also examined. Statistical and engineering relationships were used for predicting the energy usage and intensity. The study was constrained by the nonavailability of good energy related data. It was highly recommended that attempts should be made to collect data which could enhance future studies related to energy conservation. Author

N78-18538# Cummins Engine Co., Inc., Columbus, Ind.
TRUCKING AND FUEL ECONOMY

David B. Stattenfield *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 181-196

Avail: NTIS HC A24/MF A01

Heavy duty trucks for freight movement are discussed in terms of energy and economic aspects. The recoverable and nonrecoverable aspects of energy were quantified ways of minimizing energy consumption. Considerable emphasis is placed on operational aspects which may provide some insights towards reducing the energy consumption in the intercity trucking industry. The simulation approach was demonstrated as a design tool for the selection of the optimum truck under given conditions. Details of the truck components (engine, transmissions, driving axles, tires) were provided. Author

N78-18539# Federal Highway Administration, Washington, D.C. Highway Statistics Div.

ESTIMATED HIGHWAY FUEL SAVINGS IN 1975

W. Johnson Page, Alexander French, and Joseph E. Ullman *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 197-213 refs

Avail: NTIS HC A24/MF A01

An analysis of the effectiveness of efforts to conserve motor fuel is presented, using data available through 1975. All states now have a 55 mph speed limit. This study attempted to answer the following set of questions: Did the energy crisis have a lasting effect in changing travel patterns and driving habits or are we back to business as usual, now that fuel is readily available again? Has there been any change in car pooling and public transportation patterns during the peak hours? How much has fuel consumption been affected by the increased proportion of smaller cars in the vehicle mix and the greater fuel efficiency of the more recent model year cars? Author

N78-18540*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AIR TRANSPORTATION ENERGY EFFICIENCY

Louis J. Williams *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 215-239 refs

Avail: NTIS HC A24/MF A01 CSCL 10B

The energy efficiency of air transportation, results of the recently completed RECAT studies on improvement alternatives, and the NASA Aircraft Energy Efficiency Research Program to develop the technology for significant improvements in future aircraft were reviewed. Author

N78-18541# Urban Mass Transportation Administration, Washington, D.C.

THE ENERGY EFFICIENCY OF URBAN TRANSIT SYSTEMS

H. Lee Tucker *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 241-262 refs

Avail: NTIS HC A24/MF A01

The energy consumption and efficiency were evaluated for urban automobile, bus, rail rapid, light rail and Automated Guideway Transit (AGT) modes. Transportation profiles are reviewed and the portion of total energy used by urban transit systems is identified. This was followed by an overview of the energy intensiveness of urban transit systems and the extent that each mode was used in the United States. The major components of operating and construction energy are listed and evaluated for each transit mode. Energy intensiveness estimates were then computed and normalized on the basis of recent system lifetime data (in terms of vehicle miles). Energy intensiveness is presented in terms of passenger seat miles where the effect of load factors on transit energy efficiency is treated parametrically due to the variability in load factor reference data. Author

N78-18542# Congressional Budget Office, Washington, D. C. **PRESIDENT CARTER'S AUTOMOBILE RELATED ENERGY CONSERVATION PROPOSALS**

Damian J. Kulash *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 263-304 refs

Avail: NTIS HC A24/MF A01

The energy conservation proposals were directed towards: (1) encouraging the manufacture and purchase of cars that are more fuel efficient through a system of taxes and rebates that would make more efficient cars cheaper and less efficient cars more expensive for the buyer; and (2) encouraging people to drive fewer miles by imposing taxes that would raise the price of gasoline. The study concludes that the gas guzzler excise taxes would have the largest effect on fuel consumption. At the same time, its effect on total car sales should be relatively minor, reaching a maximum reduction of about 280,000 new cars sold in 1985. As a whole, the President's proposals would reduce gasoline consumption by about 55,000 and 305,000 barrels per day in 1980 and 1985, respectively. Author

N78-18543# Ford Motor Co., Dearborn, Mich. Automotive Emissions and Fuel Economy Office.

POTENTIAL FOR AUTOMOTIVE FUEL ECONOMY IMPROVEMENT

Clay W. LaPointe *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 305-316

Avail: NTIS HC A24/MF A01

Various facets of the automotive fuel economy program were discussed. Auto makers under the enactment of the 'Energy Policy and Conservation Act' have to come up with a fleet average fuel economy of 27.5 mpg by 1985. The impact of various driving cycle approaches upon fuel economy were explained. Several components of work (rolling friction, aerodynamics, inertia, etc.) were examined in relation to the types of the driving cycle. An analysis of the methodology utilized behind the estimation of the rolling and aerodynamic resistance was provided. Data related to aerodynamic drag coefficient were provided for several cars and vans. A set of potential improvement actions which included: (1) reduction in weight of 20 percent with a fuel economy improvement in the range of 13-16 percent; and (2) stratified charge engine (high compression) which may improve efficiency by 20 percent were outlined. Author

N78-18544# Federal Railroad Administration, Washington, D. C. **OUTLINE OF THE ENERGY-RELATED PROJECTS SPONSORED BY THE FEDERAL RAILROAD ADMINISTRATION, DOT**

John Koper *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 317-327 ref

Avail: NTIS HC A24/MF A01

An overview of the energy related projects sponsored by the Office of Research and Development, FRA, DOT was given. An organizational chart with FRA was provided. It lists the specifics of the study in relation to fuel measurement of freight trains. The details of a study related to flywheel energy storage for classification yard switch locomotives were also listed. The 'Rail Electrification Study' which is examining the potential National benefits of electrifying the high density rail-lines, was examined. Author

N78-18545# Transportation Systems Center, Cambridge, Mass. **MEASUREMENT AND SIMULATION OF FUEL CONSUMPTION IN RAIL FREIGHT SERVICE**

John B. Hopkins *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 329-340

Avail: NTIS HC A24/MF A01

Fuel consumption measurements were carried out in cooperation with several railroads for a variety of types of revenue freight service. Intermodal operations were emphasized. Studies relating to branchline and general freight movements were also included. The wide range of operating parameters examined include train speed, weight, length, type, power to weight ratio, and terrain. In particular, the test conditions, operating parameters and fuel usage indices for 85 separate line haul movements on six different railroads, covering 52,700 train miles were described. In spite of considerable variation in relevant parameters and inherent imprecision in the data, the results are found to exhibit a basic consistency both internally and with past estimates. Author

N78-18546# Aerospace Corp., Los Angeles, Calif. Energy and Transportation Div.

INTERCITY RAIL ENERGY INTENSITY FOR PASSENGER MOVEMENT

Ram K. Mittal *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 341-372 refs

Avail: NTIS HC A24/MF A01

The impacts of operating conditions (speed, trip-length, load factor) and train-consists were studied. An extensive list of data used for evaluation purposes was documented. Impact of track on energy intensity is also examined. Several trains were simulated along the New York City to Buffalo Corridor. Increases in energy efficiency due to modernization of rolling stock and improvements of track and service conditions were also analyzed to insure equitable comparison among the competitive modes. It is concluded that, presently the energy intensity figures are high because the load factor is low, and there is a considerable potential for improving EI values by improving the attractiveness of the trains and also by using the contemporary rolling stocks. It is also concluded that improved track is the key for rehabilitation of the railroads in the United States. Electric trains were also studied and proved from an energy intensity viewpoint. A comprehensive study in the subject area of electric trains was represented. A comparative analysis of the 'EI' values of the intercity passenger transportation modes was also presented. Energy intensity values of several train-consists were provided in a tabular form. Author

N78-18547# Massachusetts Inst. of Tech., Cambridge. **A STUDY OF THE ENERGY CONSEQUENCES OF ALTERNATIVE TRANSPORT POLICIES IN INTERCITY FREIGHT MARKETS**

Paul O. Roberts *In* Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 373-398

Avail: NTIS HC A24/MF A01

The supply demand equilibrium problem was examined from the demand viewpoint, and alternative transport policies were evaluated. The freight market and policies were studied as well as logistic cost functions, and inventory control as a part of the logistics process. Basic concepts of a demand model were described and examined in detail. B.B.

N78-18548# Federal Energy Administration, Washington, D. C. Office of Conservation and Environment.

FEDERAL POLICY OPTIONS TO EFFECT FUEL CONSERVATION IN THE AIR INDUSTRY

Robert L. Bowles *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 399-408

Avail: NTIS HC A24/MF A01

Federal policies which may have potential for reducing petroleum consumption within the transportation sector are presented. Airlines consume nearly 10 percent of the transportation energy and constitute a considerable portion of the operating cost. Federal policies discussed include: (1) Fuel Allocation and Price Control; (2) Taxation; (3) Air Carrier Regulation; (4) Aviation System Regulation and (5) Federal Expenditures and Investment. Author

N78-18549# Bureau of Economic Analysis, Washington, D. C. **MEASURING THE IMPACT ON SCHEDULED AIR LINES OPERATIONS OF RESTRICTIONS IN FUEL AVAILABILITY**

J. C. Constanz *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 409-416

Avail: NTIS HC A24/MF A01

Airline and aircraft manufacturers' fuel conservation efforts are presented. A description was given of how since 1973, passengers flown per gallon of fuel used have increased by 19 percent. The airline reduced the average number of flights flown each day to conserve fuel and to take advantage of more efficient aircraft which carry more passengers per flight. Use of computerized flight plans (optimum routes, altitudes and speeds) reduced the use of fuel to a considerable extent. Use of flight simulators and fewer engines during taxiing reduced the consumption of petroleum. Author

N78-18550# General Electric Co., Erie, Pa. Transportation Systems Business Div.

ELECTRIFICATION OF RAILROADS PROBLEMS-POTENTIALS-ECONOMIC IMPACTS

Mertin D. Meeker *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 417-438 refs

Avail: NTIS HC A24/MF A01

A historical background of railroad electrification within the United States was given. Data related to percent electrification of railroad route miles within the major developed countries around the world were presented. An attempt was made to provide quantification of the benefits accrued due to electrification. The economic and technical characteristics between the diesel/electric and electric trains were compared. The following aspects of electrification were considered: electric locomotives have: 2/3 lower maintenance; twice economic life, and 1/2 the out of service time. Also listed were the components of cost for electrification and data were provided on the rate of return estimated under several scenarios. Author

N78-18551# General Research Corp., Santa Barbara, Calif. **ELECTRIC CAR TECHNOLOGY FOR DEMONSTRATION AND DEVELOPMENT**

William Hamilton *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 439-456

Avail: NTIS HC A24/MF A01

The performance characteristics of the electric cars which were developed around the world were characterized. It was reported that the acceleration capability of the electric cars is sluggish in comparison with the conventional ICE engines. Comprehensive data on the elements of operating cost as a

function of the service characteristics were provided. It concluded that the future potential of electric automobiles depends mainly upon battery development. Batteries have always imposed critical technical limitations on the range and speed of electric cars. There has been relatively little progress in propulsion batteries compared with improvements in ICE auto technology. The battery improvements are a prerequisite towards the introduction of electric cars in the urban arena. Life cycle cost per kilometer versus range were documented for several types of electric cars and compared with the conventional ICE car. Changes in fuel prices could reduce or eliminate the cost disadvantages of the electric cars. Author

N78-18552# General Research Corp., Santa Barbara, Calif. **URBAN APPLICATIONS AND ENERGY IMPACTS OF FUTURE ELECTRIC CARS**

William Hamilton *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 457-471

Avail: NTIS HC A24/MF A01

The potential applications of the electric cars within the urban arena were documented. Driving patterns within urban areas were studied. Based upon these patterns, data related to range for electric cars were examined. It is concluded that a range of 72 kilometers is within the reach of present technology, and easily achievable with technology expected in the coming decade. Yet it suffices for 17% of urban cars. Data were also provided for energy requirements of prospective electric cars. Projected petroleum savings as a function of future use of electric cars in Los Angeles, Philadelphia, and St. Louis are also provided. The petroleum savings are in the range of 2-8% of national oil use which appears to be a modest portion of the total U.S. petroleum used. It is also concluded that the substitution of electric cars might substantially reduce exposure of urban populations to excessive traffic noise. The life-cycle costs between subcompact cars are compared with electric cars and it is stated that the electric cars are 20 - 50% higher than those of the conventional car. Author

N78-18553# Energy Research and Development Administration, Washington, D. C.

ERDA FUNDING IN TRANSPORTATION ENERGY CONSERVATION AREA AND RESEARCH PLANS

Gene Mannella *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 473-484

Avail: NTIS HC A24/MF A01

Several facets of the Transportation Energy Conservation Program pursued by ERDA are presented. The program elements were divided into three categories: (1) Electric and Hybrid Vehicles; (2) Highway Systems; and (3) NonHighway Transport and Special Projects. The Highway System Program is directed towards improving propulsion system and researching alternative fuels. As part of the improvements towards propulsion systems, ERDA is undertaking research related to gas turbine engines and Stirling engines. ERDA plans to have demonstration models fitted with Stirling and gas turbine engines by 1982 with a view to decide on future R&D strategies. The NonHighway Transport Energy Conservation Program was directed towards: development and demonstration of energy saving technologies and operational strategies; encourage near term energy savings through improved operations and new concepts evaluation; define and assess environmental, socio-economic, institutional and other potential impacts. Author

N78-18554# Oak Ridge National Lab., Tenn. **DATA NEEDS IN TRANSPORTATION ENERGY CONSERVATION RESEARCH**

T. Patrick O'Connor and Andrew Loebel *In Union Coll. Effects of Energy Constraints on Transportation Systems* Dec. 1977 p 485-504 refs

Avail: NTIS HC A24/MF A01

An overview of the subject of data needs in transportation energy conservation research is presented. The discussion focuses upon data which are needed for analysis of economic, social

and technological factors which determine energy consumption and conservation aspects in the transportation sector. It is conceived that credible information related to energy supply and demand will help to facilitate a consensus about United States energy policy. Data needs which relate to patterns of energy consumption in the transportation sector were identified. Most of the topics discussed call for research in addition to data collection. It is concluded that tremendous deficiencies exist in regard to data needs for planning transportation systems under the current petroleum constraints. Author

N78-18555# Aerospace Corp., Los Angeles, Calif. Energy and Transportation Div.
ENERGY INTENSITY OF VARIOUS TRANSPORTATION MODES

Ram K. Mittal /in Union Coll. Effects of Energy Constraints on Transportation Systems Dec. 1977 p 505-536 refs

Avail: NTIS HC A24/MF A01

An overview of the existing literature related to Energy Intensity (EI) of various transportation modes is presented. These transportation modes include intracity (auto, bus, automated guideway transit system, vans, heavy rail, and light rail transit), and intercity (airplanes, autos, buses, trucks, rail, waterways and pipelines) modes of transportation for passenger and freight movement. Wherever possible, an attempt was made to correlate energy intensity as a function of operating conditions such as speed, load factor, type of commodities being moved, etc. Use of both statistical and engineering approaches were made for estimating energy intensity figures. It is concluded that energy intensity values have a considerable range depending upon the operating conditions, types of hardware, trip characteristics, load factor and type of commodities being shipped. The major output of the study is a list of suggested EI values (in tabular form) for several transportation modes. Guidelines are also provided for furthering the state of the art related to energy intensity work. Author

N78-18556# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

THEORY OF WIND TURBINES WITH CONTRAROTATION
 G. N. Patterson Jul. 1977 31 p refs

(UTIAS-218; CN-ISSN-0082-5255) Avail: NTIS HC A03/MF A01

Emphasis was placed on a ducted contrarotating system of high efficiency capable of a wide range of operating conditions. The report includes: (1) flow conditions; (2) blade element theory; (3) slipstream rotation between rotors and overall efficiencies; and (4) efficiency and the lift drag ratio. A procedure was suggested for the aerodynamic design of the system. J.C.S.

N78-18558*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTER PROGRAM FOR DESIGN AND PERFORMANCE ANALYSIS OF NAVIGATION-AID POWER SYSTEMS. PROGRAM DOCUMENTATION. VOLUME 1: SOFTWARE REQUIREMENTS DOCUMENT Final Report

G. Goltz, L. M. Kaiser, and H. Weiner Jul. 1977 182 p (AD-A047925; JPL-5040-27-Vol-1; USCG-D-11-77-Vol-1; CGR/DC-18/76-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 09/2

A computer program has been developed for designing and analyzing the performance of solar array/battery power systems for the U.S. Coast Guard Navigational Aids. This program is called the Design Synthesis/Performance Analysis (DSPA) Computer Program. The basic function of the Design Synthesis portion of the DSPA program is to evaluate functional and economic criteria to provide specifications for viable solar array/battery power systems. The basic function of the Performance Analysis portion of the DSPA program is to simulate the operation of solar array/battery power systems under specific loads and environmental conditions. This document establishes the software requirements for the DSPA computer program, discusses the processing that occurs within the program, and defines the necessary interfaces for operation. GRA

N78-18560# Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.

CLEAN COAL COMBUSTION THROUGH COAL WASHING AND BLENDING

O. W. Stewart and J. K. Shou May 1977 27 p (PB-274406/8; IMMR29-PD18-77) Avail: NTIS HC A03/MF A01 CSCL 081

Investigative work directed to the beneficiation of Kentucky coals is presented. General property analysis, pyritic sulfur reduction by the float-sink method, combustion characteristics of selected coals and coal blends, and characteristics of resulting ash were studied. The technical and economical aspects of high sulfur coal utilization through blending and washing, and stack gas cleanup strategies are discussed. GRA

N78-18561# Rensselaer Polytechnic Inst., Troy, N. Y.
FOCUSING SOLAR COLLECTOR DEVELOPMENT Final Report

W. E. Rogers, D. N. Borton, and A. A. Burr Jul. 1977 78 p (PB-275042/0; NYSERDA-75/34) Avail: NTIS HC A05/MF A01 CSCL 10A

Design modifications and engineering tests on a dual tracking focusing solar collector concept are discussed. The 360 square foot concentrator was constructed to evaluate performance of a heliostat design and of receivers at its focus, as well as to ascertain characteristics of insulation at the site. GRA

N78-18562# BDM Corp., Vienna, Va.
PRELIMINARY ANALYSIS OF AN OPTION FOR THE FEDERAL PHOTOVOLTAIC UTILIZATION PROGRAM

Orin H. Merrill, J. C. Belote, Mary R. Hamilton, J. Scott Hauger, and Judy Israel Nov. 1977 59 p refs (PB-274220/3; HCP/L4965-0001) Avail: NTIS HC A04/MF A01 CSCL 10B

The intention of the program is to provide significant, cost effective incentive for the accelerated development of an innovative, highly competitive industry capable of producing low cost, quality, photovoltaic systems. This industry would be capable of supplying the private sector with a major source of clean, nondepletable electrical energy. As a secondary benefit, the Federal government is expected to realize significant net cost savings. The option analyzed in this report would consist of a series of Federal procurements resulting in the installation of 152 megawatts peak of photovoltaic arrays over a five year period. GRA

N78-18564# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.

OTHER STORAGE RESERVE REPORT

16 Aug. 1977 72 p (PB-273474/7; FEA/S-77/359) Avail: NTIS HC A04/MF A01 CSCL 21D

Recommendations were set forth concerning the necessity for, and feasibility of, establishing: (1) Utility Reserves containing coal residual fuel oil, and refined petroleum products, to be established and maintained by major fossil fuel fired baseload electric power generating stations; (2) Coal Reserves to consist of (a) Federally owned coal which is mined by or for the United States from Federal lands, and (b) Federal lands from which coal could be produced with minimum delay; and (3) Remote Crude Oil and Natural Gas Reserves consisting of crude oil and natural gas to be acquired and stored by the United States. Author

N78-18565# Institute of Gas Technology, Chicago, Ill.

PILOT PLANT STUDY OF CONVERSION OF COAL TO LOW SULFUR FUEL Final Report, Jun. 1973 - Mar. 1975

Donald K. Flemming and Robert D. Smith Oct. 1977 156 p refs

(Contract EPA-68-02-1366) (PB-274113/0; EPA-600/2-77-206) Avail: NTIS HC A08/MF A01 CSCL 07A

Results are given of a program to develop, on bench and pilot scales, operating conditions for the key step in the process to desulfurize coal by thermal and chemical treatment. This process used the 'sulfur-getter' concept. (A sulfur-getter was a material that had a greater chemical affinity for sulfur than coal had.) Lime was the sulfur-getter for this program. GRA

N78-18566# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

PRELIMINARY EVALUATION OF SULFUR VARIABILITY IN LOW-SULFUR COALS FROM SELECTED MINES

A. Carl Nelson Nov. 1977 157 p refs
(Contract EPA-68-02-1321)
(PB-275000/8; EPA-450/3-77-044) Avail: NTIS
HC A08/MF A01 CSCL 21E

Data on the variability of sulfur content and heating value of coal were obtained from several coal and utility companies and analyzed to estimate the mean, standard deviation, and the frequency distribution of weight percent sulfur and the impact of this variability on the required average sulfur content to comply with an emission regulation. In order to assess the implications of sulfur variability for compliance with emission regulations, the relative standard deviation (RSD) of weight percent sulfur was estimated. These RSD's were used to estimate the required average sulfur content to yield 95 and 99 percent compliance with the emission limitations of 1.2 lb SO₂/MM Btu. GRA

N78-18567# National Bureau of Standards, Washington, D. C. Office of Building Standards and Codes Services.

STATE SOLAR ENERGY LEGISLATION OF 1976: A REVIEW OF STATUTES RELATING TO BUILDINGS Final Report

Robert M. Eisenhard Sep. 1977 258 p refs Sponsored by ERDA and HUD
(PB-273899/5; NBSIR-77/12) Avail: NTIS HC A12/MF A01 CSCL 10A

State legislation on solar energy use in buildings enacted in 1976 was reviewed. Acts involve tax incentives for the installation of solar devices, support for the proposed Solar Energy Research Institute, solar standards, state energy offices, studies, building requirements and solar projects. The Acts were identified and abstracted, and responsible state officials were listed. GRA

N78-18568# American Society of International Law, Washington, D. C.

OCEAN THERMAL ENERGY CONVERSION: LEGAL, POLITICAL, AND INSTITUTIONAL ASPECTS

H. Gary Knight, ed., J. D. Nyhart, ed., and Robert E. Stein, ed. 1977 255 p refs
(Grant NSF AER-75-00280-A02)

(PB-274123/9; ISBN-0-669-01441-9; NSF/RA-770273; LC-77-2049) Avail: NTIS MF A01 CSCL 10B

An overview of nonlegal issues, including the technical background of OTEC plants and an economic assessment of OTEC are presented. Also presented is an evaluation of the international legal aspects; international political implications of OTEC systems; spatial and emerging use conflicts of ocean space; international regulatory authority concerning OTEC devices; and international environmental aspects. GRA

N78-18567# Stanford Research Inst., Menlo Park, Calif.
ADVANCED FOSSIL FUEL AND THE ENVIRONMENT: AN EXECUTIVE REPORT

Phyllis Dorset, Dave Myers, Tom Parker, and Richard Laska Washington EPA Jun. 1977 30 p refs
(Contract EPA-68-01-2940)
(PB-274541/2; EPA-600/9-77-013) Avail: NTIS
HC A03/MF A01 CSCL 07A

An overview of some of the more advanced fossil fuel technologies is given, including several chemical coal cleaning and liquid fuels cleaning methods. Synthetic fuels, chemically active fluid beds, and oil shale were also considered as viable advanced processes and control technologies. Processes, state-of-the-art, and environmental impacts which are being, or were investigated are discussed. Author

N78-18590# Industrial Environmental Research Lab., Research Triangle Park, N. C.

PROCEEDINGS OF THE 2D STATIONARY SOURCE COMBUSTION SYMPOSIUM. VOLUME 5: ADDENDUM

Joshua S. Bowen and Robert E. Hall Jul. 1977 216 p refs Symp. held at New Orleans, 29 Aug. - 1 Sep. 1977
(PB-274897/8; EPA-600/7-77-073e) Avail: NTIS
HC A10/MF A01 CSCL 21D

Aspects of air pollution control discussed include the effects of fuel and atomization on NO_x control for heavy liquid fuel-fired package boilers, NO_x control techniques for package boilers, a comparison of burner design, fuel modification and combustion modification. Federal regulations, and existing stationary combustion source air pollution regulations are summarized. Fluidized bed combustion, coal-oil mixture combustion technology and advanced combustion systems for stationary gas turbines are also considered as are emission characteristics of small stationary diesel engines and combustor design concepts of advanced energy conversion systems. GRA

N78-18594# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.

SHIFT SCHEDULES FOR EMISSIONS AND FUEL ECONOMY TESTING Report on Technical Support for Regulatory Agencies

Richard A. Rykowski Nov. 1977 33 p refs
(PB-274865/5; LDTF-77-6) Avail: NTIS HC A03/MF A01 CSCL 13B

The current method for determining the shift schedules used during certification was examined and it was determined whether or not this method is resulting in shift schedules which are representative of those used by typical drivers. The history of the method of determining shift schedules for the certification process was first examined, then the current trends of shift schedules found in vehicle owner's manuals were determined, since these are the sources of the shift schedules used during certification. The methods of determining shift schedules of other automobile testing organizations were studied, as well as how people are taught to shift in driver's education schools. GRA

N78-18602 California Univ., Riverside.

HEAT FLOW IN A GEOTHERMALLY ACTIVE AREA: THE GEYSERS, CALIFORNIA Ph.D. Thesis

Iain Macdonald Jamieson 1976 176 p
Avail: Univ. Microfilms Order No. 77-27151

The Geysers steam field in northern California is well established with almost 200 geothermal wells in an area of approximately 16 square miles and an installed generating capacity of 522 megawatts. A study of temperature gradients, topographic effects, reservoir characteristics and their correlation was made in a portion of this area using data from shallow temperature gradient holes and from several suspended or abandoned wells. Analysis of the temperature gradients corrected for topographic effect indicates that gradients are extremely high over the known reservoir and that heat transfer from the reservoir to the surface is primarily by conduction. In close proximity to production, gradients corrected for topographic effect are much lower. This suggests a reservoir controlled by high angle fractures, a hypothesis which is in accord with data from drilling records in the area. Dissert. Abstr.

N78-18655# National Bureau of Standards, Washington, D. C. Thermal Engineering Section.

ESTIMATING THE ENERGY CONSERVATION POTENTIAL OF VENTILATION CONTROL THROUGH WEATHER DATA ANALYSIS Final Report

T. Kusuda and J. W. Bean Aug. 1977 52 p refs Sponsored by FE
(PB-273949/8; NBSIR-76-1088) Avail: NTIS
HC A04/MF A01 CSCL 04B

Hourly weather data for six selected cities in the United States covering eleven consecutive years were analyzed to aid in estimating the possible energy saving that could be achieved by closing the outdoor dampers during unoccupied hours. Hourly temperature and enthalpy values were presented in histogram form for occupied and unoccupied periods with the suggestion that similar data processing be carried out for other cities as well. Author

N78-18897*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ANALYSIS OF THE TECHNICAL STATUS OF HIGH LEVEL RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT SYSTEMS

N78-18988

T. English, C. Miller, E. Bullard, R. Campbell, A. Chockie, E. Divita, C. Douthitt, E. Edelson, and L. Lees 1 Dec. 1977
289 p refs
(Contract NAS7-100)
(NASA-CR-155313; JPL-Pub-77-69) Avail: NTIS
HC A13/MF A01 CSCL 18G

The technical status of the old U.S. mailine program for high level radioactive nuclear waste management, and the newly-developing program for disposal of unprocessed spent fuel was assessed. The method of long term containment for both of these waste forms is considered to be deep geologic isolation in bedded salt. Each major component of both waste management systems is analyzed in terms of its scientific feasibility, technical achievability and engineering achievability. The resulting matrix leads to a systematic identification of major unresolved technical or scientific questions and/or gaps in these programs. Author

N78-18988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STATE-OF-THE-ART ASSESSMENT OF ELECTRIC VEHICLES AND HYBRID VEHICLES

Sep. 1977 595 p refs
(Contract EC-77-A-31-1011)
(NASA-TM-73756; CONS/1011-1; E-9308) Avail: NTIS
HC A25/MF A01 CSCL 13F

The Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976 (PL 94-413) requires that data be developed to characterize the state of the art of vehicles powered by an electric motor and those propelled by a combination of an electric motor and an internal combustion engine or other power sources. Data obtained from controlled tests of a representative number of sample vehicles, from information supplied by manufacturers or contained in the literature, and from surveys of fleet operators of individual owners of electric vehicles is discussed. The results of track and dynamometer tests conducted by NASA on 22 electric, 2 hybrid, and 5 conventional vehicles, as well as on 5 spark-ignition-engine-powered vehicles, the conventional counterparts of 5 of the vehicles, are presented. Author

N78-19041*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **A LOW COST HIGH TEMPERATURE SUN TRACKING SOLAR ENERGY COLLECTOR.**

Gerald S. Perkins /in NASA. Goddard Res. Center The 11th Aerospace Mech. Symp. Apr. 1977 p 157-169

(Contract NAS7-100)

Avail: NTIS HC A11/MF A01 CSCL 10A

The design and economic evaluation of a low cost high temperature two axis sun tracking solar energy collector are described. The collector design is specifically intended for solar energy use with the freedom of motion about its two control axes being limited only to the amplitude required to track the sun. An examination of the performance criteria required in order to track the sun and perform the desired solar energy conversion is used as the starting point and guide to the design. This factor, along with its general configuration and structural aspect ratios, is the significant contributor to achieving low cost. The unique mechanical design allows the control system to counter wide tolerances that will be specified for the fabrication of the azimuth frame and perform within a small tracking error. Author

N78-19135*# KLM North Sea Helicopters, Amsterdam (Netherlands).

SOME ASPECTS OF OFFSHORE OPERATIONS IN THE NETHERLANDS

R. J. VanDerHarten /in AGARD Rotorcraft Design Jan. 1978 7 p refs

Avail: NTIS HC A15/MF A01

The sound film 'Bridging the Troubled Waters' (Sikorsky Aircraft), which gives a general impression of helicopter operations between mainland and naval destinations, is summarized. Problems which had to be solved in order to realize the required services on a 24-hour basis are reviewed. One of these problems was the certification of helicopter weather minima for IFR-flight. This involved the development and evaluation of

instrument procedures and the proper choice of instruments and panel layout, the navigational aids and the communication system. Special attention was paid to the radar system, which provides not only weather detection but is also used during the approach to the targets at sea, as well as to the recent evaluation of an integrated pilot display system, which has a great potential for very low weather minima without the use of automatic guidance. Author

N78-19162*# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

EFFECT OF FUEL BOUND NITROGEN ON OXIDES OF NITROGEN EMISSION FROM A GAS TURBINE ENGINE Interim Report

Anthony F. Klarman and Anthony J. Rollo Dec. 1977 33 p refs

(ZF57571004)

(AD-A048382; NACP-PE-1) Avail: NTIS HC A03/MF A01 CSCL 21/4

Fuels of varying nitrogen content were tested in a T63-A-5A engine to measure their effects on exhaust gas emissions. Five test fuels varying in fuel bound nitrogen content from 3 microgram (nitrogen)/g (fuel) to 902 microgram (nitrogen)/g (fuel) were evaluated. The nitrogen content in the fuel was adjusted by mixing a JP-5 type fuel derived from shale oil (902 microgram (nitrogen)/g (fuel)) and regular petroleum JP-5 fuel (3 microgram (nitrogen)/g (fuel)). Nitrogen content of the fuel had no effect on engine performance. The carbon monoxide and unburned hydrocarbon emissions were equivalent for all the fuels included in the test program. For the engine power ratings tested, the oxides of nitrogen emissions increased with increasing nitrogen content of the test fuel. The conversion efficiency of fuel bound nitrogen to oxides of nitrogen appears to be independent of the nitrogen content of the fuel. Difficulties in measuring small changes in oxides of nitrogen level resulting from low nitrogen content fuels (50 microgram nitrogen/g (fuel) or less) caused the conversion efficiency to be very variable. The conversion efficiency for fuels with a nitrogen content of 250 microgram (nitrogen)/g (fuel) or greater was approximately 45 percent. Author (GRA)

N78-19326*# Gordian Associates, Inc., New York.

COMPUTER MODEL FOR REFINERY OPERATIONS WITH EMPHASIS ON JET FUEL PRODUCTION. VOLUME 2: DATA AND TECHNICAL BASES Final Report

Daniel N. Dunbar and Barry G. Tunnah 21 Feb. 1978 55 p refs

(Contract NAS3-20620)

(NASA-CR-135334; Rept-1099-1) Avail: NTIS
HC A04/MF A01 CSCL 21D

The FORTRAN computing program predicts the flow streams and material, energy, and economic balances of a typical petroleum refinery, with particular emphasis on production of aviation turbine fuel of varying end point and hydrogen content specifications. The program has provision for shale oil and coal oil in addition to petroleum crudes. A case study feature permits dependent cases to be run for parametric or optimization studies by input of only the variables which are changed from the base case. The report has sufficient detail for the information of most readers. Author

N78-19382 Duke Univ., Durham, N. C.

A THEORY OF CONTROL FOR A CLASS OF ELECTRONIC POWER PROCESSING SYSTEMS: ENERGY-STORAGE dc-TO-dc CONVERTERS Ph.D. Thesis

William Wesley Burns, III 1977 257 p

Avail: Univ. Microfilms Order No. 7731660

An analytically derived approach to the control of energy storage dc-to-dc converters is presented which enables improved system performance and an extensive understanding of the manner in which this improved performance is accomplished. A graphical representation of the behavior of dc-to-dc converter systems yields considerable qualitative insight into the cause and effect relationships which exist between various commonly used converter control functions and the system performance which results from them such as the influence of parasitic losses in the converted power stage on the shape and location of a switching boundary. Simplification of the mathematical representation of

the switching boundary are presented. Digital computer simulation data and oscillograms from an experimental converter system are presented to illustrate and verify the theoretical discussions and subsequent control law presented. Dissert. Abstr.

N78-19455# California Univ., Livermore. Lawrence Livermore Lab.

METERING LOW-QUALITY STEAM-WATER FLOWS

C. T. Crowe and H. Weiss 26 Apr. 1977 33 p refs
(Contract W-7405-eng-48)

(UCRL-52271) Avail: NTIS HC A03/MF A01

The simultaneous measurement of mass flow rate and quality of low quality steamwater flows was of primary interest in evaluating and monitoring the flow from geothermal resources. The experience acquired at LLL in attempting to perform such measurements with a double flash arrangement using orifices and venturis was related. The mass flow correlations proposed in the literature were reviewed and a new correlation based on the energy equation was introduced. The data were presented and evaluated in light of these correlations. ERA

N78-19570# Stanford Univ., Calif. Remote Sensing Lab.
GEOLOGICAL AND GEOTHERMAL DATA USE INVESTIGATIONS FOR APPLICATION EXPLORER MISSION-A: HEAT CAPACITY MAPPING MISSION Progress Report, 1 Dec. 1977 - 28 Feb. 1978

R. J. P. Lyon and A. E. Prelat, Principal Investigators 28 Feb. 1978 10 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS5-24232)

(E78-10092; NASA-CR-155773) Avail: NTIS
HC A02/MF A01 CSCL 08B

The author has identified the following significant results. Analysis of local areas by point-to-point registration was achieved.

N78-19598 Texas Univ., Austin.
A DYNAMIC MODEL FOR THE EFFICIENT UTILIZATION OF EXHAUSTIBLE ENERGY RESOURCES Ph.D. Thesis

Charles Banks McLane 1977 207 p
Avail: Univ. Microfilms Order No. 77-29065

A control theoretic model for the study of optimality in a large dynamic interfuel substitution system was presented. Given a set of energy resources, costs for energy conversion technologies, exogenous demands categorized by substitution possibilities, and bounds on rates of conversion to alternative fuels, the model generates families of dynamic resource allocations that minimize the discounted cost of energy production over a planning horizon. The mathematical solution was based on Pontryagin's maximum principle. Strong structure in the Hamiltonian permits the development of an extremely efficient algorithm for solving the bounded derivative control problem. Dissert. Abstr.

N78-19599* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SELECTIVE COATING FOR SOLAR PANELS Patent

Glen E. McDonald, inventor (to NASA) Issued 25 Oct. 1977 6 p Filed 22 Dec. 1975 Supersedes N76-15603 (14 - 06, p 0741)

(NASA-Case-LEW-12159-1; US-Patent-4,055,707;
US-Patent-Appl-SN-643041; US-Patent-Class-428-652;
US-Patent-Class-126-270; US-Patent-Class-427-160;
US-Patent-Class-428-667; US-Patent-Class-428-679) Avail:
US Patent Office CSCL 10A

The energy absorbing properties of solar heating panels are improved by depositing a black chrome coating of controlled thickness on a specially prepared surface of a metal substrate. The surface is prepared by depositing a dull nickel on the substrate, and the black chrome is plated on this low emittance surface to a thickness between 0.5 micron and 2.5 microns.

Official Gazette of the U.S. Patent Office

N78-19601* Solaron Corp., Denver, Colo.
PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS, INCLUDING POTABLE HOT WATER Quarterly Report, 1 Jul. - 9 Nov. 1977

Don Bloomquist and Rodney L. Oonk Dec. 1977 126 p
(Contract NAS8-32249)

(NASA-CR-150576) Avail: NTIS HC A07/MF A01 CSCL 10A

Progress made in the development, delivery, and support of two prototype solar heating and cooling systems including potable hot water is reported. The system consists of the following subsystems: collector, auxiliary heating, potable hot water, storage, control, transport, and government-furnished site data acquisition. A comparison of the proposed Solaron Heat Pump and Solar Desiccant Heating and Cooling Systems, installation drawings, data on the Akron House at Akron, Ohio, and other program activities are included. Author

N78-19602* IBM Federal Systems Div., Huntsville, Ala.
SITE SELECTION FOR MSFC OPERATIONAL TESTS OF SOLAR HEATING AND COOLING SYSTEMS

10 Feb. 1978 49 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150537; IBM-78W-00009) Avail: NTIS
HC A03/MF A01 CSCL 10A

The criteria, methodology, and sequence aspects of the site selection process are presented. This report organized the logical thought process that should be applied to the site selection process, but final decisions are highly selective. Author

N78-19603* Honeywell, Inc., Minneapolis, Minn. Energy Resource Center.

SOLAR HEATING AND COOLING SYSTEMS DESIGN AND DEVELOPMENT Quarterly Report

11 Nov. 1977 18 p Prepared for DOE

(Contract NAS8-32093)

(NASA-CR-150542; F34370QR-106) Avail: NTIS
HC A02/MF A01 CSCL 10A

The development and delivery of eight prototype solar heating and cooling systems for installation and operational test was reported. Two heating and six heating and cooling units will be delivered for single family residences, multiple family residences and commercial applications. Author

N78-19604* IBM Federal Systems Div., Huntsville, Ala.
SIMS PROTOTYPE SYSTEM 2 TEST RESULTS: ENGINEERING ANALYSIS

Jan. 1978 46 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150544; IBM-78W-0003) Avail: NTIS
HC A03/MF A01 CSCL 10A

The testing, problems encountered, and the results and conclusions obtained from tests performed on the IBM Prototype System 2, solar hot water system, at the Marshall Space Flight Center Solar Test Facility was described. System 2 is a liquid, non draining solar energy system for supplying domestic hot water to single residences. The system consists of collectors, storage tank, heat exchanger, pumps and associated plumbing and controls. Author

N78-19605* Life Sciences Engineering, Morrison, Colo.
INSTALLATION PACKAGE FOR AIR FLAT PLATE COLLECTOR

Oct. 1977 28 p Prepared for DOE

(Contract NAS8-32261)

(NASA-CR-150536) Avail: NTIS HC A03/MF A01 CSCL 10A

The Solar 2 dimensions are four feet by eight feet by two and one half inches. The collector weighs 130 pounds and has an effective solar collection area of over 29.5 square feet. This area represents 95 percent of the total surface of the collector. The installation, operation and maintenance manual, safety hazard analysis, special handling instructions, materials list, installation concept drawings, warranty and certification statement are included in the installation package. Author

N78-19606* Solar Engineering and Mfg. Co., Ft. Lauderdale, Fla.

PROTOTYPE SOLAR DOMESTIC HOT WATER SYSTEMS Quarterly Reports, Nov. 1976 - Sep. 1977
 Feb. 1978 19 p Prepared for DOE
 (Contract NAS8-32248)
 (NASA-CR-150545) Avail: NTIS HC A02/MF A01 CSCL 10A

Construction of a double wall heat exchanger using soft copper tube coiled around a hot water storage tank was completed and preliminary tests were conducted. Solar transport water to tank potable water heat exchange tests were performed with a specially constructed test stand. Work was done to improve the component hardware and system design for the solar water heater. The installation of both a direct feed system and a double wall heat exchanger system provided experience and site data to enable informative decisions to be made as the solar market expands into areas where freeze protection is required. J.C.S.

N78-19607* National Solar Heating and Cooling Information Center, Rockville, Md.

A FORUM ON SOLAR ACCESS

Jul. 1977 81 p refs Proc. held at New York, 28 Jul. 1977 Sponsored in part by DOE
 Avail: NTIS HC A05/MF A01

The Forum on Solar Access was held to analyze various approaches to protecting access to sunlight. Presently, access to sunlight may be jeopardized by certain zoning regulations, architectural controls, and shade from structures and vegetation. The proceedings, as part of New York State legislation, should be of use to other state legislatures in developing policies on the subject of solar access. Author

N78-19609* National Aeronautics and Space Administration, Pasadena Office, Calif.

MICROWAVE POWER CONVERTER Patent Application

Richard M. Dickinson, inventor (to NASA) (JPL) Filed 8 Dec. 1977 12 p
 (Contract NAS7-100)

(NASA-Case-NPO-14068-1; US-Patent-Appl-SN-858769) Avail: NTIS HC A02/MF A01 CSCL 10A

A simple orbiting space station that converts sunlight into microwave power for transmission to earth was devised. The basic concept is to use a large mirror to concentrate sunlight onto a piston so that the radiation pressure of the sunlight moves the piston to compress a microwave cavity. Microwaves resonating in the cavity undergo an increase in frequency and therefore in power as the cavity is compressed. When the piston is close to the end wall, a switch is opened to allow most of the microwave power to pass to an antenna which radiates it to the earth. A rotary wheel with blades are turned by concentrated sunlight from a mirror. As the blade enters the space between a pair of parallel plates, it begins compressing the space to increase the microwave energy, some of which passes out through a switch. When the blade reaches position, the remaining microwave energy leaks under that blade but is stopped by the next blade. NASA

N78-19610* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **AN OVERVIEW OF US ENERGY OPTIONS: SUPPLY- AND DEMAND-SIDE HISTORY AND PROSPECTS**

A. S. Hirschberg 25 Feb. 1977 73 p refs
 (Contract NAS7-100)
 (NASA-CR-155946; JPL-PUB-77-77) Avail: NTIS HC A04/MF A01 CSCL 10B

An overview was provided of nonsolar energy policy options available to the United States until solar energy conversion and utilization devices can produce power at a cost competitive with that obtained from fossil fuels. The economics of the development of new fossil fuel sources and of mandatory conservation measures in energy usage were clarified in the context of the historic annual rate of increase in U.S. energy demand. An attempt was made to compare the costs and relative efficiencies of energy obtainable from various sources by correlating the many confusing measurement units in current use. Author

N78-19611* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **THE DIFFUSION OF THE USE OF NEW ENERGY TECHNOLOGY AS A CONTEXT FOR AN OVERVIEW OF SOLAR ENERGY TECHNOLOGIES**

A. S. Hirschberg Mar. 1977 58 p refs
 (Contract NAS7-100)
 (NASA-CR-155942; JPL-Pub-77-76) Avail: NTIS HC A04/MF A01 CSCL 10A

The process by which new solutions to the energy dilemma are generated and used as a context for an overview of solar energy economics and technologies. Author

N78-19612* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **UTILIZATION REQUIREMENTS. A SOUTHERN CALIFORNIA GAS COMPANY PROJECT SAGE REPORT: UTILIZATION REQUIREMENTS**

R. Barbieri, R. Schoen (Calif. Univ., Los Angeles), and A. S. Hirschberg Jan. 1978 42 p
 (Contract NAS7-100)
 (NASA-CR-155948; JPL-Pub-77-49) Avail: NTIS HC A03/MF A01 CSCL 10B

Utilization requirements are given and comparisons made of two phase III SAGE (solar assisted gas energy) installations in California: (1) a retrofit installation in an existing apartment building in El Toro, and (2) an installation in a new apartment building in Upland. Such testing in the field revealed the requirements to be met if SAGE-type installations are to become commercially practical on a widespread basis in electric and gas energy usage. Author

N78-19613* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **PUBLIC POLICY ISSUES. A SOUTHERN CALIFORNIA GAS COMPANY PROJECT SAGE REPORT**

R. Barbieri and A. S. Hirschberg Jan. 1978 24 p refs
 (Contract NAS7-100)
 (NASA-CR-155945; JPL-Pub-77-47) Avail: NTIS HC A02/MF A01 CSCL 10B

The use of solar energy to stretch our supplies of fossil fuels was investigated. Project SAGE (semi-automated ground environment) addresses itself to one application of this goal, solar assistance in central water heating systems for multifamily projects. Public policy issues that affect the rate of adoption of solar energy systems were investigated and policy actions were offered to accelerate the adoption of SAGE and other solar energy systems. Author

N78-19614* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **LSSA (LOW-COST SILICON SOLAR ARRAY) PROJECT Quarterly Report, Apr. - Jun. 1977**

Irene Mallock Jun. 1977 72 p refs Prepared for DOE
 (Contract NAS7-100)
 (NASA-CR-155944; JPL-PUB-78-9; DOE/JPL-1012-77/4; QR-5) Avail: NTIS HCA04/MF A01 CSCL 10A

Work performed in the field of photovoltaic research by the low cost silicon solar array project of jet propulsion laboratory was described. Background technical information was also furnished. Author

N78-19615* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **PROCEEDINGS OF SMALL POWER SYSTEMS SOLAR ELECTRIC WORKSHOP. VOLUME 2: INVITED PAPERS**

R. Ferber, ed. Feb. 1978 228 p Workshop held at Aspen, Colo., 10-12 Oct. 1977 Prepared for DOE
 (Contracts NAS7-100; EX-76-A-29-1060)
 (NASA-CR-155940; JPL-Pub-78-100; DOE/JPL-1060-78/1) Avail: NTIS HC A11/MF A01 CSCL 10A

The focus of this work shop was to present the commitment to the development of solar thermal power plants for a variety of applications including utility applications. Workshop activities included panel discussions, formal presentations, small group interactive discussions, question and answer periods, and informal gatherings. Discussion on topics include: (1) solar power technology options; (2) solar thermal power programs currently underway at the DOE, JPL, Electric Power Research Institute (EPRI), and Solar Energy Research Institute (SERI); (3) power

options competing with solar; (4) institutional issues; (5) environmental and siting issues; (6) financial issues; (7) energy storage; (8) site requirements for experimental solar installations, and (9) utility planning. Author

N78-19616* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

WIND TURBINE STRUCTURAL DYNAMICS

Dean R. Miller, ed. 1978 280 p refs Workshop held at Cleveland. 15-17 Nov. 1977; sponsored by DOE (NASA-CP-2034; DOE-Conf-771148; E-9518) Avail: NTIS HC A13/MF A01 CSCL 10A

A workshop on wind turbine structural dynamics was held to review and document current United States work on the dynamic behavior of large wind turbines, primarily of the horizontal-axis type, and to identify and discuss other wind turbine configurations that may have lower cost and weight. Information was exchanged on the following topics: (1) Methods for calculating dynamic loads; (2) Aeroelasticity stability (3) Wind loads, both steady and transient; (4) Critical design conditions; (5) Drive train dynamics; and (6) Behavior of operating wind turbines. Author

N78-19617* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF COMPUTER CODES FOR CALCULATING DYNAMIC LOADS IN WIND TURBINES

David A. Spera *In its* Wind Turbine Structural Dyn. 1978 p 1-13 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The development of computer codes for calculating dynamic loads in horizontal axis wind turbines was examined, and a brief overview of each code was given. The performance of individual codes was compared against two sets of test data measured on a 100 KW Mod-0 wind turbine. All codes are aeroelastic and include loads which are gravitational, inertial and aerodynamic in origin. Author

N78-19618* General Electric Co., Philadelphia, Pa.

MOD-1 WTG DYNAMIC ANALYSIS

Clyde V. Stahle, Jr. *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 15-29

Avail: NTIS HC A13/MF A01 CSCL 10A

An analysis of the MOD-1 2000 kW horizontal axis wind turbine was given. The MOD-1 design was briefly described, and the analysis used to evaluate the dynamic loads and structural interactions is discussed. The resonant frequency placement, the treatment of unsteady wind loading, and the dynamic load sensitivity to frequency shifts were reviewed for the design. Author

N78-19619* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SIMPLIFIED MODELING FOR WIND TURBINE MODAL ANALYSIS USING NASTRAN

Timothy L. Sullivan *In its* Wind Turbine Structural Dyn. 1978 p 31-38 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

A detailed finite element model of the MOD-0 wind turbine tower was reduced to six beam elements (stick model). The method used to calculate the properties of the beam elements in the stick model was explained and the accuracy of the stick model in predicting natural frequencies and mode shapes was examined. Computer times were compared and several applications where the stick model was used are described. From results obtained from the MOD-0 tower it is concluded that a tower of this type can be modeled as a simple cantilever beam for modal analysis. However, this model should be limited to tower torsional modes and tower bending modes where the mode shape resembles a cantilever beam first bending mode shape. Author

N78-19620* Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

USE OF ASYMPTOTIC METHODS IN VIBRATION ANALYSIS

Holt Ashley *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 39-52 refs

(Grant AF-AFOSR-2712-74)

Avail: NTIS HC A13/MF A01 CSCL 10A

The derivation of dynamic differential equations, suitable for studying the vibrations of rotating, curved, slender structures was examined, and the Hamiltonian procedure was advocated for this purpose. Various reductions of the full system are displayed, which govern the vibrating troposkien when various order of magnitude restrictions are placed on important parameters. Possible advantages of the WKB asymptotic method for solving these classes of problems are discussed. A special case of this method is used illustratively to calculate eigenvalues and eigenfunctions for a flat turbine blade with small flexural stiffness. Author

N78-19621* Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

AEROELASTIC ANALYSIS OF WIND ENERGY CONVERSION SYSTEMS

John Dugundji *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 53-60 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

An aeroelastic investigation of horizontal axis wind turbines is described. The study is divided into two simpler areas: (1) the aeroelastic stability of a single blade on a rigid tower; and (2) the mechanical vibrations of the rotor system on a flexible tower. Some resulting instabilities and forced vibration behavior are described. Author

N78-19622* Toledo Univ., Ohio.

AEROELASTIC STABILITY OF WIND TURBINE BLADES

Krishna Rao V. Kaza *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 81-89 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The second degree nonlinear aeroelastic equations for a flexible, twisted, nonuniform wind turbine blade were developed using Hamilton's principle. The derivation of these equations has its basis in the geometric nonlinear theory of elasticity. These equations with periodic coefficients are suitable for determining the aeroelastic stability and response of large wind turbine blades. Methods for solving these equations are discussed. Author

N78-19623* Battelle Pacific Northwest Labs., Richland, Wash. **FLOW FIELD ANALYSIS**

William C. Cliff and M. Gary Verholek *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 71-76

Avail: NTIS HC A13/MF A01 CSCL 10A

The average mean wind speed integrated over a disk is shown to be extremely close to the mean value of wind speed which would be measured at the center of a disk for most geometries in which a WECS (Wind Energy Conversion System) would operate. Field test results are presented which compare instantaneous records of wind speed integrated over a disk with the wind speed measured at the center of the disk. The wind field that a rotating element would experience is presented which was synthesized from the outputs of an array of anemometers. Author

N78-19624* Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

FLUTTER OF DARRIEUS WIND TURBINE BLADES

Norman D. Ham *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 77-93 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The testing of Darrieus wind turbines has indicated that under certain conditions, serious vibrations of the blades can occur, involving flatwise bending, torsion, and chordwise bending. A theoretical method of predicting the aeroelastic stability of the coupled bending and torsional motion of such blades with a

N78-19625

view to determining the cause of these vibrations, and a means of suppressing them was developed. Author

N78-19625* Kaman Aerospace Corp., Bloomfield, Conn.
ANALYTICAL TESTING TECHNIQUES
Robert Jones *In* NASA, Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 95-101

Avail: NTIS HC A13/MF A01 CSCL 10A

Structural dynamic analytical testing techniques can be a tool to determine the source of structural dynamic problems and the solution to these problems. Analytical testing techniques are based upon dynamic testing methods and analysis of test results. These methods apply primarily to constructed wind turbine systems. A summary of these methods is presented. Author

N78-19626* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF WIND TURBINE FOUNDATION
Suey T. Yee *In* its Wind Turbine Structural Dyn. 1978 p 103-108

Avail: NTIS HC A13/MF A01 CSCL 10A

The 200 kW Mod-0A wind turbine was modeled using a 3 lumped mass-spring system for the superstructure and a rotational spring for the foundation and supporting soil. Natural frequencies were calculated using soil elastic moduli varying from 3000 to 22,400 p.s.i. The reduction in natural frequencies from the rigid foundation case ranged up to 20 percent. Author

N78-19627* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SUMMARY OF STATIC LOAD TEST OF THE MOD-0 BLADE
Dean R. Miller *In* its Wind Turbine Structural Dyn. 1978 p 109-116 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

A static load test was performed on the spare Mod-0 wind turbine blade to define load transfer at the root end of the blade, and to validate stress analysis of this particular type of blade construction (frame and stringer). Analysis of the load transfer from the airfoil skin to the shank tube predicted a step change in spanwise stress in the airfoil skin at station 81.5 inches (STA 81.5). For flatwise bending a 40% reduction in spanwise stress was predicted, and for edgewise bending a 6% reduction. Experimental results verified the 40% reduction for flatwise bending, but indicated about a 30% reduction for edgewise bending. Author

N78-19628* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DOE/NASA MOD-0 100KW WIND TURBINE TEST RESULTS

John C. Glasgow *In* its Wind Turbine Structural Dyn. 1978 p 117-150 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The Wind Turbine demonstrates the capability of automatic unattended operation, including startup, achieving synchronism, and shutdown as dictated by wind conditions. During the course of these operations, a wealth of engineering data was generated. Some of the data which is associated with rotor and machine dynamics problems encountered, and the machine modifications incorporated as a solution are presented. These include high blade loads due to tower shadow, excessive nacelle yawing motion, and power oscillations. The results of efforts to correlate measured wind velocity with power output and wind turbine loads are also discussed. Author

N78-19629* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
POWER OSCILLATION OF THE MOD-0 WIND TURBINE
Robert C. Seidel *In* its Wind Turbine Structural Dyn. 1978 p 151-156

Avail: NTIS CSCL 10A

The Mod-0 power has noise components with varying frequency patterns. Magnitudes reach more than forty percent

power at the frequency of twice per rotor revolution. Analysis of a simple torsional model of the power train predicts less than half the observed magnitude and does not explain the shifting frequencies of the noise patterns. Author

N78-19630* Kaman Aerospace Corp., Bloomfield, Conn.
DRIVE TRAIN DYNAMIC ANALYSIS
Nicholas Giansante *In* NASA, Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 157-166 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

A method for parametric variations in drive train dynamic analysis is described. The method models the individual components of a drive system, forms the appropriate system interface coordinates and, calculates the system dynamic response at particular frequencies. Application of the method for prediction of the dynamic response characteristics of a helicopter transmission, and a comparison of results with test data are also included. Author

N78-19631* General Electric Co., Philadelphia, Pa. Valley Forge Space Center.
MOD-1 WIND TURBINE GENERATOR ANALYSIS
Robert S. Barton *In* NASA, Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 167-178 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

A general summary of the MOD-1 wind turbine generator control system and simulation is presented. Mechanical and speed stabilization control means to add drive train damping were mentioned and MOD-1 simulation results showing the effects of speed stabilization are displayed. Author

N78-19632* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
METHODS OF ATTENUATING WIND TURBINE ac GENERATOR OUTPUT VARIATIONS
Harold Gold *In* its Wind Turbine Structural Dyn. 1978 p 179-186 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

Wind speed variation, tower blockage and structural and inertial factors produce unsteady torque in wind turbines. Methods for modifying the turbine torque so that steady torque is delivered to the coupled ac generator are discussed. The method that may evolve will be influenced by the power use that develops and the trade-offs of cost, weight and complexity. Author

N78-19633* Massachusetts Inst. of Tech., Cambridge.
DYNAMICS OF DRIVE SYSTEMS FOR WIND ENERGY CONVERSION
Manuel Martinez-Sanchez *In* NASA, Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 187-193

Avail: NTIS HC A13/MF A01 CSCL 10A

Calculations are performed to determine the dynamic effects of mechanical power transmission from the nacelle of a horizontal axis wind machine to the ground or to an intermediate level. It is found that resonances are likely at 2 or 4/REV, but they occur at low power only, and seem easily correctable. Large reductions are found in the harmonic torque inputs to the generator at powers near rated. Author

N78-19634* Washington Univ., St. Louis, Mo.
SOME ALTERNATIVE DYNAMIC DESIGN CONFIGURATIONS FOR LARGE HORIZONTAL AXIS WECS
Kurt H. Hohenemser *In* NASA, Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 195-218 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The present U.S. development effort toward large horizontal axis WECS concentrates on the configuration with two rigid blades with collective pitch variation and a yaw gear drive. Alternative configurations without yaw gear drive were considered where the rotor is either selfcentering or where the yaw angle is controlled by blade cyclic pitch inputs. A preliminary evaluation

of the dynamic characteristics for these alternative design configurations is presented. Author

N78-19635*# Boeing Co., Seattle, Wash.
FATIGUE LOAD SPECTRA FOR UPWIND AND DOWNWIND ROTORS

John S. Andrews *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 219-225

Avail: NTIS HC A13/MF A01 CSCL 10A

Effect of both alternating and mean load on the fatigue life of an upwind and downwind MOD-2 wind turbine system is presented. It was shown that the fatigue damage varies as the product of the stress range cubed and the maximum stress. Hence, the alternating flapwise load caused by tower shadow and wind gradient is an important factor in determining rotor blade life. Author

N78-19636*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECTS OF ROTOR LOCATION, CONING, AND TILT ON CRITICAL LOADS IN LARGE WIND TURBINES

D. A. Spera and D. C. Janetzke *In its* Wind Turbine Structural Dyn. 1978 p 227-236 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

Several large (1500 kW) horizontal rotor configurations were analyzed to determine the effects on dynamic loads of upwind downwind rotor locations, coned and radial blade positions, and tilted and horizontal rotor axis positions. Loads were calculated for a range of wind velocities at three locations in the structure: (1) the blade shank; (2) the hub shaft; and (3) the yaw drive. Blade axis coning and rotor axis tilt were found to have minor effects on loads. However, locating the rotor upwind of the tower significantly reduced loads at all locations analyzed. Author

N78-19637*# United Technologies Research Center, East Hartford, Conn.

COMPARISON OF BLADE LOADS OF FIXED AND FREE YAWING WIND TURBINE

Marvin C. Cheney and Richard L. Bielawa *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 237-242 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The self regulating composite bearingless wind turbine utilizes an automatic pitch control concept and a completely unrestrained yawing degree of freedom. Aerodynamic moments caused by skewed flow provide the control to align the wind turbine with the wind. Model tests demonstrated the feasibility of the concept and analytical studies showed the free system to experience lower blade loads compared to the fixed system. Author

N78-19638*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FIXED PITCH WIND TURBINES

David B. Fenn and Larry A. Viterna *In its* Wind Turbine Structural Dyn. 1978 p 243-254

Avail: NTIS HC A13/MF A01 CSCL 10A

Wind turbines designed for fixed pitch operation offer potential reductions in the cost of the machine by eliminating many costly components. It was shown that a rotor can be designed which produces the same energy annually as Mod-0 but which regulates its power automatically by progressively stalling the blades as wind speed increases. Effects of blade twist, taper, root cutout, and airfoil shape on performance are discussed as well as various starting techniques. Author

N78-19639*# Akron Univ., Ohio.

RESEARCH OF LOW COST WIND GENERATOR ROTORS

Demeter G. Fertis and Robert S. Ross (Concept Development Inst. Inc., Hudson, Ohio) *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 257-260

Avail: NTIS HC A13/MF A01 CSCL 10A

A feasibility program determined that it would be possible to significantly reduce the cost of manufacturing wind generator

rotors by making them of cast urethane. Several high modulus urethanes which were structurally tested were developed. A section of rotor was also cast and tested showing the excellent aerodynamic surface which results. A design analysis indicated that a cost reduction of almost ten to one can be achieved with a small weight increase to achieve the same structural integrity as expected of current rotor systems. Author

N78-19640*# Paragon Pacific, Inc., El Segundo, Calif.
PLANS FOR WIND ENERGY SYSTEM SIMULATION

Mark E. Dreier *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 261-264

Avail: NTIS HC A13/MF A01 CSCL 10A

A digital computer code and a special purpose hybrid computer, were introduced. The digital computer program, the Root Perturbation Method or RPM, is an implementation of the classic floquet procedure which circumvents numerical problems associated with the extraction of Floquet roots. The hybrid computer, the Wind Energy System Time domain simulator (WEST), yields real time loads and deformation information essential to design and system stability investigations. Author

N78-19641*# Massachusetts Univ., Amherst. Mechanical Engineering Dept.

THE UMASS WIND FURNACE BLADE DESIGN

Duane E. Cromack *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 265-268 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

A brief description of the wind furnace concept is presented along with some preliminary performance data. Particular emphasis is placed on the design, construction, and manufacturing procedure for the 32.5 foot diameter GRP blades. Author

N78-19642*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL DATA AND THEORETICAL ANALYSIS OF AN OPERATING 100 kW WIND TURBINE

Bradford S. Linscott, John C. Glasgow, William D. Anderson (Lockheed California Co., Burbank), and Robert E. Donham (Lockheed California Co., Burbank) Jan. 1978 21 p refs Presented at 12th Intersoc. Energy Conversion Engr. Conf., Washington, D. C., 28 Aug. - 2 Sep. 1977; sponsored by Am. Nucl. Soc.

(Contract E(49-26)-1028)

(NASA-TM-73883; DOE/NASA/1028-78/15; E-9496) Avail: NTIS HC A02/MF A01 CSCL 10A

Experimental test data are correlated with analyses of turbine loads and complete system behavior of the ERDA-NASA 100 kW Mod-0 wind turbine generator over a broad range of steady state conditions, as well as during transient conditions. The deficit in the ambient wind field due to the upwind tower turbine support structure is found to be very significant in exciting higher harmonic loads associated with the flapping response of the blade in bending. Author

N78-19643*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PHOTOVOLTAIC VILLAGE POWER APPLICATION: ASSESSMENT OF THE NEAR-TERM MARKET

Louis Rosenblum, William J. Bifano, William A. Poley, and Larry R. Scudder Jan. 1978 29 p refs

(Contract E(49-26)-1022)

(NASA-TM-73893; DOE/NASA/1022-78/25; E-9510) Avail: NTIS HC A03/MF A01 CSCL 10B

The village power application represents a potential market for photovoltaics. The price of energy for photovoltaic systems was compared to that of utility line extensions and diesel generators. The potential domestic demand was defined in both the government and commercial sectors. The foreign demand and sources of funding for village power systems in the developing countries were also discussed briefly. It was concluded that a near term domestic market of at least 12 MW min and a foreign market of about 10 GW exists. Author

N78-19644*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PHOTOVOLTAIC WATER PUMPING APPLICATIONS: ASSESSMENT OF THE NEAR-TERM MARKET

Louis Rosenblum, William J. Bifano, Larry R. Scudder, William A. Poley, and James P. Cusik Mar. 1978 24 p refs (Contract E(49-26)-1022)

(NASA-TM-78847; E-9566; DOE/NASA/1022-78/29) Avail: NTIS HC A02/MF A01 CSCL 10B

Water pumping applications represent a potential market for photovoltaics. The price of energy for photovoltaic systems was compared to that of utility line extensions and diesel generators. The potential domestic demand was defined in the government, commercial/institutional and public sectors. The foreign demand and sources of funding for water pumping systems in the developing countries were also discussed briefly. It was concluded that a near term domestic market of at least 240 megawatts and a foreign market of about 6 gigawatts exist. Author

N78-19645*# IBM Federal Systems Div., Huntsville, Ala.

SITE SELECTION FEASIBILITY FOR A SOLAR ENERGY SYSTEM ON THE FAIRBANKS FEDERAL BUILDING

22 Feb. 1978 46 p Revised Prepared for DOE (Contract NAS8-32036)

(NASA-CR-150559; IBM-77W-0008-Rev) Avail: NTIS HC A03/MF A01 CSCL 10A

A feasibility study was performed for the installation of a solar energy system on the Federal Building in Fairbanks, Alaska, a multifloor office building with an enclosed parking garage. The study consisted of determining the collectable solar energy at the Fairbanks site on a monthly basis and comparing this to the monthly building heating load. Potential conventional fuel savings were calculated on a monthly basis and the overall economics of the solar system applications were considered. Possible solar system design considerations, collector and other system installation details, interface of the solar system with the conventional HVAC systems, and possible control modes were all addressed. Conclusions, recommendations and study details are presented. Author

N78-19649*# IBM Federal Systems Div., Huntsville, Ala. **DESIGN DATA BROCHURE: SIMS PROTOTYPE SYSTEM 2**

Dec. 1977 51 p Prepared for DOE (Contract NAS8-32036)

(NASA-CR-150558; IBM-7933656) Avail: NTIS HC A04/MF A01 CSCL 10A

Information is provided on the design and performance of the IBM SIMS Prototype System 2, solar domestic hot water system, for single family residences. The document provides sufficient data to permit procurement, installation, operation, and maintenance by qualified architectural engineers or contractors. Author

N78-19650*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF SUNWORKS (LIQUID) SOLAR COLLECTOR

Ken Shih Dec. 1977 34 p Prepared for DOE (NASA-CR-150573; WYLE-TR-531-15) Avail: NTIS HC A03/MF A01 CSCL 10A

Test procedures used and test results obtained from an evaluation test program conducted on a single covered liquid solar collector under simulated conditions are presented. The test article was a flat plate solar collector using water as the heat transfer medium. The absorber plate was copper with copper tubes bonded by soft solder. The plate was coated with Enthone selective black with an absorptivity factor of .87 approximately .92 and an emissivity factor of .10 approximately .20. A time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector. Author

N78-19652*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF THE SOLARON (AIR) SOLAR COLLECTOR

Jan. 1978 34 p Prepared for DOE

(Contract NAS8-32036) (NASA-CR-150572; WYLE-TR-531-16) Avail: NTIS HC A03/MF A01 CSCL 10A

The test procedure used and the results obtained from an evaluation test program, conducted to obtain thermal performance data on a Solaron double glazed air solar collector under simulated conditions in a solar simulator are described. A time constant test and incident angle modifier test were also conducted to determine the transient effect and the incident angle effect on the collector. These results and the results of the collector load test are also discussed. The Solaron collector absorber plate is made of 24-gage steel, the coating is baked-on black paint, the cover consists of two sheets of 1/8-inch low-iron tempered glass, and the insulation is one thickness of 3 5/8-inch fiberglass batting. Author

N78-19653*# Wormser Scientific Corp., Stamford, Conn.

PROTOTYPE SOLAR HEATING AND HOT WATER SYSTEM Quarterly Reports, 7 Oct. 1976 - 19 Oct. 1977

Oct. 1977 24 p Prepared for DOE (Contract NAS8-32250)

(NASA-CR-150575) Avail: NTIS HC A02/MF A01 CSCL 10A

Progress is reported in the development of a solar heating and hot water system which uses a pyramidal optics solar concentrator for heating, and consists of the following subsystems: collector, control, transport, and site data acquisition. Improvements made in the components and subsystems are discussed. Author

N78-19654*# ECON, Inc., Princeton, N. J. **A STUDY OF SOME ECONOMIC FACTORS RELATING TO THE DEVELOPMENT AND IMPLEMENTATION OF A SATELLITE POWER SYSTEM**

25 Jan. 1978 82 p refs (Contract NAS8-32698)

(NASA-CR-150602; Rept-77-146-1) Avail: NTIS HC A05/MF A01 CSCL 10A

Areas are examined relating to the design, development and implementation of a satellite power system (SPS): an analysis of the effect of energy R&D programs in general and SPS in particular on optimal fossil fuel consumption patterns, a study of alternative uses of SPS technologies, and a study of the electric power market penetration potential for SPS. It is shown that a credible program of R&D on long-range energy alternatives leads to lower optimal prices for fossil fuels, resulting in large short-term benefits accruing to the specific program elements. Several alternative uses of SPS technologies were identified; however the markets for these technologies are generally quite diffuse and difficult to assess. The notable exception is solar array technology which has, potentially, a very large non-SPS market. It is shown that the market for SPS units derives from two components of demand: the demand created by growth in the electrical energy demand which leads to an increased demand for baseload generating capacity, and a demand created by the need to replace retiring capacity. Author

N78-19655*# AiResearch Mfg. Co., Torrance, Calif.

PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS Progress Report, Jul. 1976 - Dec. 1977

Mar. 1978 248 p Prepared for DOE (Contract NAS8-32091)

(NASA-CR-150570) Avail: NTIS HC A11/MF A01 CSCL 10A

Prototype solar heating and cooling systems are described. Development, manufacture, test, system installation, maintenance, problem resolution, and performance evaluation are discussed. Author

N78-19656*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

REDOX FLOW CELL DEVELOPMENT AND DEMONSTRATION PROJECT, CALENDAR YEAR 1978

Dec. 1977 48 p refs

(Contract E(49-28)-1002)

(NASA-TM-73873; E-9354; CONS/1002-3) Avail: NTIS HC A03/MF A01 CSCL 10A

The major focus of the effort was the key technology issues that directly influence the fundamental feasibility of the overall redox concept. These issues were the development of a suitable semipermeable separator membrane for the system, the screening and study of candidate redox couples to achieve optimum cell performance, and the carrying out of systems analysis and modeling to develop system performance goals and cost estimates. Author

N70-18331/ Washington State Univ., Pullman.
ENERGY CONSERVATION POLICY - OPPORTUNITIES AND ASSOCIATED IMPACTS. STUDY MODULE 1-A. VOLUME 1, SUMMARY REPORT Final Report
Walter R. Butcher and George W. Hinman 1977 123 p
Sponsored by Northwest Policy Project, Portland, Oregon
(PB-274337/5) Avail: NTIS HC A06/MF A01 CSCL 10A

A number of conservation measures that could significantly reduce growth in the Pacific Northwest's demand for energy are identified. If the 19 principal measures discussed are universally adopted, future energy demands will be reduced approximately 35 percent from the levels which can be anticipated without further conservation actions. Tables are included which show the capital recovery periods for investments in a number of conservation measures in selected cases assuming different rates for energy price increases. GRA

N70-18332/ Rockwell International Corp., Anaheim, Calif. Electronic Devices Div.
ADVANCED SEMICONDUCTOR TECHNOLOGY FOR ALTERNATE ENERGY SOURCES: dc TO ac INVERTERS
C. T. Kleiner 15 Nov. 1977 14 p refs Presented at the Alternative Energy Sources Symp., Miami Beach, Fla., 5-7 Dec. 1977

(AD-A048806; X77-1210/501) Avail: NTIS HC A02/MF A01 CSCL 10/2

Alternate or advanced energy conversion methods frequently require d-c to a-c conversion since the energy output must be synchronized with an existing utility grid. The objective of this paper is to describe various preliminary system concepts for interfacing advanced solid-state energy converters to the utility grid with a significant potential for reducing initial capital investment. Recent ERDA sponsored studies have identified the solid-state d-c to a-c inverter as a key element for further development. These studies indicated that an inverter synchronized to the utility grid can directly transform solar photovoltaic array generated energy to local load (residence) demand with any excess energy feedback to the utility grid. Where the solar energy is insufficient to supply the local load, it is supplemented by the utility grid. Several key issues were identified in the referenced studies. One of these involved the considerable weight and cost associated with the d-c to a-c Inverter/Transformer vs a Transformerless Inverter that would have 'Float' with respect to the power grid return. This paper addresses this issue as well as the anticipated solution to the problem using advanced semiconductor technology. GRA

N70-18333/ Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

SOLAR ELECTRIC GENERATING SYSTEM RESOURCE REQUIREMENTS AND THE FEASIBILITY OF ORBITING SOLAR REFLECTORS M.S. Thesis

Rolf C. Enger Dec. 1977 187 p refs
(AD-A048908; AFIT/GEP/PH/77D-3) Avail: NTIS HC A09/MF A01 CSCL 10/1

The potential consumption of natural resources by four solar electric generating systems was evaluated. They included a terrestrial solar thermal, a terrestrial photovoltaic, an orbiting solar reflector, and a satellite solar power system. Each was evaluated on its projected consumption of materials, land, water, manpower, energy, and money. The evaluation demonstrated that, per megawatt of electrical generating capacity, the terrestrial systems would consume less resources mainly because they would not require massive space transportation and

construction systems and expensive developmental programs. It was also shown that construction of terrestrial systems would require fewer technological advancements and would pose less of a threat to the environment. A feasibility study of orbiting solar reflectors demonstrated that single-mirror systems may be useful for intra-space power generation. The report contains a 47-item bibliography. Author (GRA)

N70-18335/ California Univ., Livermore. Lawrence Livermore Lab.

ELECTROSTATIC DIRECT ENERGY CONVERTER PERFORMANCE AND COST SCALING LAWS

Myron A. Hoffman Aug. 1977 77 p refs
(Contract W-7405-eng-48)
(UCID-17560) Avail: NTIS HC A05/MF A01

Simplified equations were presented for each of the important loss mechanisms in both single stage direct converters and multistage venetian blind type direct converters. These equations can be used to estimate the efficiency and electric power output of the direct converter subsystem. Scaling relations for the cost of each major component in the direct converter subsystem were also given; these include the vacuum tank, direct converter modules, the dc power conditioning equipment, cryogenic vacuum pumping system and the thermal bottoming plant. The performance and cost scaling laws were developed primarily for use in overall fusion power plant systems codes. To illustrate their utility, cost-effectiveness studies of two specific reference direct converter designs were presented in terms of the specific capital costs for the direct converter subsystem alone. ERA

N70-18337/ Los Alamos Scientific Lab., N. Mex.
ASSESSMENT OF SOLAR HEATING AND COOLING TECHNOLOGY

J. D. Balcomb and J. E. Perry, Jr. May 1977 72 p refs
(Contract W-7405-eng-36)

(LA-6379-MS) Avail: NTIS HC A03/MF A01

In order to assess in detail the state of the technology for solar heating and cooling of buildings, five 2-day meetings were held. The meeting subjects were solar collectors, thermal storage, air conditioning and heat pumps, systems and controls, and non-engineering aspects of solar energy. A condensation of these meetings is offered, presenting for each topic discussed the details of the state of the art, the problem areas, and the objectives of necessary research and development. The existing state of technology for solar heating and cooling presents a mixed picture. Liquid-heating flatplate solar collectors, for example, are in a rather mature stage, and there is a small, viable industry producing components. Even here, however, there are problems of materials which, if solved, can reduce collector cost, improve performance, or increase lifetime. ERA

N70-18338/ Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand).

HAWAII GEOTHERMAL PROJECT. WELL COMPLETION REPORT, MGP-A
Sep. 1976 48 p

(Contract EY-76-C-03-1093)
(TID-27312) Avail: NTIS HC A03/MF A01

The project was organized to focus the federal, state and local resources on the identification, generation and utilization of geothermal energy on the Big Island of Hawaii. The project was organized into geophysical, engineering, environmental, socio-economic and research drilling programs. The procedures followed and equipment used in the completion of the well are described. ERA

N70-18339/ Lockheed-California Co., Burbank.
WIND ENERGY MISSION ANALYSIS, APPENDIX
Apr. 1976 288 p refs

(Contract EY-76-C-03-1075)
(SAN/1075-1/2) Avail: NTIS HC A12/MF A01

Information on the average power density of the wind for the U.S. and its territories, characteristics of the vertical axis machine, structural analysis details, aerodynamic analysis, cost factors, cost models, evaluation of utility applications, industrial cost of electricity, public acceptance, and environmental issues is presented. ERA

N78-19670

N78-19670# General Atomic Co., San Diego, Calif.
GAS TURBINE HTGR: A TOTAL ENERGY UTILIZATION OPTION

A. J. Goodjohn and S. H. Law (Northeast Utilities Serv. Co.)
Jul. 1977 21 p refs Presented at Conf. on New Options in
Energy Technol., San Francisco, 2-4 Aug. 1977 Submitted for
publication

(Contract EY-76-C-03-0167-046)

(GA-A-14484; Conf-770824-1) Avail: NTIS HC A02/MF A01

The high-temperature gas-cooled reactor used high-pressure helium as the working fluid and a power conversion system that used a closed-cycle gas turbine coupled directly to an electrical generator. The primary cycle was capable of yielding thermal-to-electrical efficiencies of 40 percent or higher. The heat rejected from the system was at a sufficiently high temperature to be effectively utilized without incurring penalties to the basic efficiency of the primary cycle. ERA

N78-19671# Energy Research and Development Administration, Washington, D. C.

HOT DRY ROCK GEOTHERMAL ENERGY: STATUS OF EXPLORATION AND ASSESSMENT. REPORT NO. 1 OF THE HOT DRY ROCK ASSESSMENT PANEL

Jun. 1977 219 p

(ERDA-77-74) Avail: NTIS HC A10/MF A01

The status of knowledge of attempts to utilize hot dry rock (HDR) geothermal energy is summarized. It contains (1) descriptions or case histories of the ERDA-funded projects at Marysville, MT, Fenton Hill, NM, and Coso Hot Springs, CA; (2) a review of the status of existing techniques available for exploration and delineation of HDR; (3) descriptions of other potential HDR sites; (4) definitions of the probable types of HDR resource localities; and (5) an estimate of the magnitude of the HDR resource base in the conterminous United States. The scope is limited to that part of HDR resource assessment related to the determination of the extent and character of HDR, with emphasis on the igneous-related type. It is estimated that approximately 74 Q of heat is stored in these sites within the conterminous U.S. at depths less than 10 km and temperatures above 150 C, the minimum for power generation. ERA

N78-19672# National Academy of Public Administration, Washington, D. C. Panel on Institutional Aspects of the Energy Centers Concept.

INSTITUTIONAL ASPECTS OF THE ENERGY CENTERS CONCEPT

Mar. 1977 342 p refs

(Contract EX-76-C-16-3086)

(ANE-3086-1) Avail: NTIS HC A15/MF A01

Information is presented concerning the socio-economic impacts of nuclear energy centers; equity considerations relating to taxation and revenue distribution; report on jurisdictional authorities of state and local government related to centralized and decentralized alternative energy systems; federal-state conflicts and cooperation in the siting of nuclear energy facilities; the energy park experience in Pennsylvania; and a socio-economic institution summary of energy centers in Washington State. ERA

N78-19673# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.

MAGNETIC CONFINEMENT FUSION ENERGY RESEARCH

H. Grad Mar. 1977 44 p refs Presented at the Ann. Meeting of the Am. Math. Soc., San Antonio, Jan. 1976

(Contract EY-76-C-02-3077)

(COO-3077-143; Conf-760158-1; MF-88) Avail: NTIS HC A03/MF A01

Controlled thermonuclear fusion offered a relatively clean energy solution with completely inexhaustible fuel and unlimited power capacity. The scientific and technological problem consisted in magnetically confining a hot, dense plasma for an appreciable fraction of a second. The scientific and mathematical problem was to describe the behavior, such as confinement, stability, flow, compression, heating, energy transfer and diffusion of this medium in the presence of electromagnetic fields. ERA

N78-19674# Los Alamos Scientific Lab., N. Mex.

PACER: SHORT CUT SOLUTION TO FUSION ENERGY PRODUCTION

1977 52 p ref

(Contract W-7405-eng-36)

(TID-27687) Avail: NTIS HC A04/MF A01

Proven hydrogen-weapon explosive technology was used to provide fusion power for the generation of electrical power, for the production of fissile material as fuel for light-water reactors, and perhaps for the production of gaseous hydrogen to extend our natural-gas resources. The PACER concept exploits the enormous amounts of energy released from a controlled fusion explosion that was safely contained within a large, steam-filled cavity. The energy was extracted from the steam and converted to electrical power by standard power-industry techniques. ERA

N78-19675# Minnesota Energy Agency, St. Paul.

ENERGY EMERGENCY CONSERVATION AND ALLOCATION PLAN

Jan. 1977 39 p

(PB-274492/8) Avail: NTIS HC A03/MF A01 CSCL 10A

In 1974 the Minnesota State Legislature directed that an Energy Emergency Conservation and Allocation Plan be prepared for use in the event of an energy supply emergency. The plan is intended to establish priorities of energy usage and to provide conservation actions for reducing energy usage. This report discusses details of the plan. GRA

N78-19676# Mathematical Sciences Northwest, Inc., Bellevue, Wash.

ENERGY DEMAND MODELING AND FORECASTING Final Report

W. Michael McHugh 1977 277 p refs Sponsored in part by Northwest Energy Policy Project, Portland, Ore., and Pacific Northwest Regional Commission, Vancouver, Wash.

(PB-274336/7) Avail: NTIS HC A13/MF A01 CSCL 10A

Results from an all energy econometric demand model were described and preserved. The model forecasts the demand for electricity, oil, natural gas, and coal for the Pacific Northwest as a whole, for the states of Idaho, Washington, and Oregon separately, and individually for seven distinct economic subregions therein. Individual forecasts were prepared for the residential, commercial, and industrial sectors and (by two-digit SIC code) transportation and irrigation. GRA

N78-19677# National Science Foundation, Washington, D. C.

RANN: RESEARCH APPLIED TO NATIONAL NEEDS. WIND ENERGY CONVERSION RESEARCH

Mar. 1977 23 p refs

(PB-271942/5; Bull-3-Rev-1; NSF/RA-770202) Avail: NTIS HC A02/MF A01 CSCL 10A

The NSF/RANN wind energy research reports listed are available for reading by the general public. Reports are indicated by RANN number, title, performing organization, author, date, grant number, abstract, descriptors, and availability. Also included is a list of 14 laboratory reports which address primarily the Darrieus vertical axis system and wind data. Author, title, report number, date, length, and price are indicated for each. Solar energy publications with wind energy sections also are indicated by title, performing organization, grant number, date and availability. GRA

N78-19683# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

INSPECTION MANUAL FOR THE ENFORCEMENT OF NEW SOURCE PERFORMANCE STANDARDS: COAL PREPARATION PLANTS Final Report

Yatendra M. Shah and James R. Burke Washington EPA Nov. 1977 149 p refs

(Contract EPA-68-01-3150)

(PB-274262/5; EPA-340/1-77-022) Avail: NTIS HC A07/MF A01 CSCL 21D

Procedures for inspection of coal preparation facilities toward determination of their compliance with NSPS are presented. Background information to aid the inspector in understanding the coal preparation process and the effects of operating parameters on process emission is also given. GRA

N78-19710* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio.

**PHOTOVOLTAIC REMOTE INSTRUMENT APPLICATIONS:
ASSESSMENT OF THE NEAR-TERM MARKET**

Louis Rosenblum, Larry R. Scudder, William A. Poley, and William
J. Bifano Dec. 1977 19 p refs

(Contract E(49-26)-1022)

(NASA-TM-73881; DOE/NASA/1022-77/24; E-9492) Avail:
NTIS HC A02/MF A01 CSCL 14B

A preliminary assessment of the near term market for photovoltaic remote instrument applications is presented. Among the potential users, two market sectors are considered: government and private. However, the majority of the remote systems studied are operated by or for the federal, state, or local governments. Environmental monitoring and surveillance remote instrument systems are discussed. Based on information obtained in this preliminary market survey, a domestic, civilian market of at least 1.3 MW sub pk is forecast for remote instrument systems. This estimate is exclusive of several potentially large scale markets for remote instruments which are identified but for which no hard data is available.

Author

N78-19957* California Univ., Livermore. Lawrence Livermore
Lab.

**LARGE-SCALE CRYOPUMPING FOR CONTROLLED
FUSION**

Lee C. Pittenger 25 Jul. 1977 20 p refs Presented at
Cryogenic Eng. Conf., Boulder, Colo., 2-5 Aug. 1977

(Contract W-7405-eng-48)

(UCRL-79381; Conf-770801-16)

Avail: NTIS

HC A02/MF A01

Vacuum pumping by freezing out or otherwise immobilizing the pumped gas is an old concept. In plasma physics experiments for controlled fusion research, cryopumping is used to provide clean, ultrahigh vacua. Cryopumping systems developed for neutral beam injection systems on several fusion experiments (HVTS, TFTR) and for the overall pumping of a large, high-throughput mirror containment experiment (MFTF) are described. In operation, these large cryopumps will require periodic defrosting, some schemes for which are discussed, long with other operational considerations. Likely paths for necessary further development for power-producing reactors are also discussed.

ERA

N78-20022* National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.

**PERFORMANCE OF CONVENTIONALLY POWERED
VEHICLES TESTED TO AN ELECTRIC VEHICLE TEST
PROCEDURE**

Ralph J. Slavik, Miles O. Dustin, and Stacy Lumannick Dec.
1977 82 p refs

(Contract EC-77-A-31-1011)

(NASA-TM-73768; E-9482; CONS/1011-13) Avail: NTIS
HC A04/MF A01 CSCL 13F

A conventional Volkswagen transporter, a Renault 5, a Pacer, and a U. S. Postal Service general DJ-5 delivery van were treated to an electric vehicle test procedure in order to allow direct comparison of conventional and electric vehicles. Performance test results for the four vehicles are presented.

Author

N78-20156* Boeing Aerospace Co., Seattle, Wash. Space
Div.

**SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 1 AND PART 2, VOLUME 2: TECHNICAL SUMMARY
Final Report**

Dec. 1977 202 p

(Contract NAS9-15196)

(NASA-CR-151666; D180-22876-2-Pt-1-Vol-2;

D180-22876-2-Pt-2-Vol-2) Avail: NTIS HC A10/MF A01 CSCL
10A

Practical designs for power transmission were developed to meet requirements and constraints. Microwave link error was analyzed to confirm attainability of acceptable link efficiency. Silicon photovoltaic was determined to be the best overall choice for energy conversion, with a potassium Rankine cycle as the backup choice. Space transportation operations provide low cost

because of traffic level, and the payload volume is the launch vehicle design driver. The power cost is 4 to 5 ¢/kwh, which will be competitive with fossil fuel sources by the year 2000.

Author

N78-20157* Boeing Aerospace Co., Seattle, Wash. Space
Div.

**SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 2, VOLUME 3: SPS SATELLITE SYSTEMS
Final Report**

Dec. 1977 221 p refs

(Contract NAS9-15196)

(NASA-CR-151667; D180-22876-3-Pt-2-Vol-3) Avail: NTIS
HC A10/MF A01 CSCL 10A

The differences in approach to solar energy conversion by solar cells and thermal engine systems are examined. Systems requirements for the solar power satellite (SPS) are given along with a description of the primary subsystems. Trades leading to exact configuration selection, for example, selection of the Rankine cycle operating temperatures are explained, and two satellite configurations are discussed.

Author

N78-20158* Boeing Aerospace Co., Seattle, Wash. Space
Div.

**SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 2, VOLUME 4: MICROWAVE POWER TRANSMISSION
SYSTEMS Final Report**

Dec. 1977 283 p refs

(Contract NAS9-15196)

(NASA-CR-151668; D180-22876-4-Pt-2-Vol-4) Avail: NTIS
HC A13/MF A01 CSCL 10A

A slotted waveguide planar array was established as the baseline design for the spaceborne transmitter antenna. Key aspects of efficient energy conversion at both ends of the power transfer link were analyzed and optimized alternate approaches in the areas of antenna and tube design are discussed. An integrated design concept was developed which meets design requirements, observes structural and thermal constraints, exhibits good performance and was developed in adequate depth to permit cost estimating at the subsystem/component level.

Author

N78-20159* Boeing Aerospace Co., Seattle, Wash. Space
Div.

**SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 2, VOLUME 5: SPACE OPERATIONS (CONSTRUCTION
AND TRANSPORTATION) Final Report**

Keith Miller and Eldon E. Davis Dec. 1977 282 p

(Contract NAS9-15196)

(NASA-CR-151669; D180-22876-5-Pt-2-Vol-5) Avail: NTIS
HC A13/MF A01 CSCL 10A

Construction and transportation systems and operations are described for the following combinations: (1) silicon photovoltaic CR=1 satellite constructed primarily in low earth orbit (LEO); (2) silicon photovoltaic CR=1 satellite constructed in geosynchronous earth orbit (GEO); (3) Rankine thermal engine satellite constructed primarily in LEO; and (4) Rankine thermal engine satellite constructed in GEO.

Author

N78-20160* Boeing Aerospace Co., Seattle, Wash. Space
Div.

**SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 2, VOLUME 6: EVALUATION DATA BOOK
Final Report**

Dec. 1977 307 p

(Contract NAS9-15196)

(NASA-CR-151670; D180-22876-6-Pt-2-Vol-6) Avail: NTIS
HC A14/MF A01 CSCL 10A

The actual calculations of mass properties, costs, and uncertainties are presented for the final reference designs of the solar power satellite system.

Author

N78-20161* Boeing Aerospace Co., Seattle, Wash. Space
Div.

**SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
VOLUME 7 Final Briefing**

13 Dec. 1977 442 p
(Contract NAS9-15196)
(NASA-CR-151671; D180-22876-7-Vol-7) Avail: NTIS
HC A19/MF A01 CSCL 10A

Guidelines and assumptions used in the design of a system of geosynchronous satellites for transmitting solar power to earth were discussed as well as the design evolutions of the principle types of solar power satellites and space support systems.

A.R.H.

N78-20162*# Boeing Aerospace Co., Seattle, Wash.)
SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 1 AND PART 2, VOLUME 1: EXECUTIVE SUMMARY

Dec. 1977 31 p
(Contract NAS9-15196)
(NASA-CR-151665; D180-22876-1-Pt-1-Vol-1;
D180-22876-1-Pt-2-Vol-1) Avail: NTIS HC A03/MF A01 CSCL
22B

The Solar Power Satellite principle is illustrated and it shows that in a geostationary orbit 36,000 km above the earth's equator, each SPS is in sunlight 99% of the time and in continuous line of sight contact with its ground receiving station. Electrical power produced on the satellite by photovoltaic or heat engine conversion of sunlight is then converted to radio frequency energy at high efficiency, and formed into a focused beam precisely aimed at the SP ground stations. The ground station receiving antenna reconverts the energy into electricity for distribution. Author

N78-20163*# Boeing Aerospace Co., Seattle, Wash.
SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY.
PART 2, VOLUME 8: SPS LAUNCH VEHICLE ASCENT
AND ENTRY SONIC OVERPRESSURE AND NOISE EFFECTS

Dec. 1977 70 p refs
(Contract NAS9-15196)
(NASA-CR-151672; D180-22876-8-Pt-2-Vol-8) Avail: NTIS
HC A04/MF A01 CSCL 22B

Recoverable launch vehicle concepts for the Solar Power Satellite program were identified. These large launch vehicles are powered by proposed engines in the F-1 thrust level class. A description of the candidate launch vehicles and their operating mode was provided. Predictions of the sonic over pressures during ascent and entry for both types of vehicles, and prediction of launch noise levels in the vicinity of the launch site were included. An overall assessment and criteria for sonic overpressure and noise levels was examined. Author

N78-20164*# Boeing Aerospace Co., Seattle, Wash.
SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY,
PART 3 Final Briefing
7 Mar. 1978 447 p
(Contract NAS9-15196)
(NASA-CR-151673; D180-24071-3-Pt-3) Avail: NTIS
HC A19/MF A01 CSCL 22B

A preliminary maintenance analysis was made and system maintenance costs were included. The far sidelobes for the SPS transmitters were studied and demonstration options for the SPS were evaluated. B.B.

N78-20269 Texas Technological Univ., Lubbock.
A SOLAR ADSORPTION COOLING SYSTEM: AN ANALYTICAL AND EXPERIMENTAL STUDY Ph.D. Thesis
Manit Thongprasert 1977 277 p
Avail: Univ. Microfilms Order No. 77-31166

The solar adsorption cooling system is one which shows economic promise with regard to use with solar energy. In this system, air is used as the refrigerant in a process which entails drying of the air by moisture adsorption into silica gel, sensible heat rejection to the atmosphere, and subsequent rehumidification to produce a cooling effect. The adsorbent material is continuously regenerated by using hot air heated by a solar collector. The major system component which was studied in detail was the rotary adsorber. A mathematical model for a rotary bed was formulated and a numerical solution was obtained. To verify the model, an experimental system was designated and constructed.

Using the model of a rotary bed along with the numerical model of other system components, a simulation was then formulated for predicting the thermal performance. Dissert. Abstr.

N78-20291# Mississippi Univ., University. Dept. of Chemical Engineering.

THE CONVERSION OF MODEL COAL LIQUIDS COMPOUNDS TO NAPHTHA SPECIES Final Report, 1 Jan. 1973 - 31 Oct. 1976

Henry W. Hayes, Jr. May 1977 201 p refs
(Grants NSF AER-72-03562; NSF GI-36567)
(PB-275891/0; NSF/RA-770322) Avail: NTIS
HC A10/MF A01 CSCL 07D

Several catalysts were tested in a laboratory trickle bed reactor for their activities and selectivities in hydrocracking phenanthrene. All the hydrogenation products of phenanthrene, including high yields of perhydrophenanthrene, were observed in the products from experiments with alumina supported cobalt molybdenum sulfide. In contrast the hydrogenation over chromia-alumina was terminated at symoctahydrophenanthrene. Hydrogenolysis reactions were also observed over these catalysts. The tendency was to successively hydrogenate and crack at terminal rings though some evidence of a minor reaction path involving saturation and cracking at the central ring was observed with chromia-alumina. Author

N78-20350*# Gordian Associates, Inc., New York.
COMPUTER MODEL FOR REFINERY OPERATIONS WITH EMPHASIS ON JET FUEL PRODUCTION. VOLUME 1: PROGRAM DESCRIPTION Final Report

Daniel N. Dunbar and Barry G. Tunnah 14 Feb. 1978 127 p refs
(Contract NAS3-20620)
(NASA-CR-135333; Rept-1099-1-Vol-1) Avail: NTIS
HC A07/MF A01 CSCL 21D

A FORTRAN computer program is described for predicting the flow streams and material, energy, and economic balances of a typical petroleum refinery, with particular emphasis on production of aviation turbine fuel of varying end point and hydrogen content specifications. The program has provision for shale oil and coal oil in addition to petroleum crudes. A case study feature permits dependent cases to be run for parametric or optimization studies by input of only the variables which are changed from the base case. Author

N78-20356# Mobil Research and Development Corp., Paulsboro, N. J.

FLUID BED PROCESS STUDIES ON SELECTIVE CONVERSION OF METHANOL TO HIGH OCTANE GASOLINE Monthly Report, May 1977

Jun. 1977 22 p refs
(Contract EX-76-C-01-2490)
(FE-2490-8) Avail: NTIS HC A02/MF A01

In the fluid bed flow studies the major accomplishments were the experimental testing of different designs for feed distributor and selection of a five prong nozzle with atomizer, design of capacitance probe for high temperature operation, and testing of reactor cyclone with subsequent design improvement. In the methanol to gasoline pilot plant design and construction, the major accomplishments were the completion of the assembly of the reactor regenerator system, completion of wiring on the instrument panel, and installation of heating elements on the reactor regenerator system. Author (ERA)

N78-20376# National Bureau of Standards, Washington, D. C. Cryogenics Div.

CRYOGENIC FLUIDS DENSITY REFERENCE SYSTEM: PROVISIONAL ACCURACY STATEMENT

J. D. Siegwarth, B. A. Younglove, and J. F. LaBrecque Nov. 1977 31 p refs Sponsored in part by Am. Gas Assoc.
(PB-275450; NBS-TN-698) Avail: NTIS HC A03/MF A01
CSCL 14B

The density reference system of the cryogenics division of the National Bureau of Standards is described. The system was used in making density measurements of cryogenic liquids. The methods of computation and the accuracy to which the density

of the liquid can be measured are discussed in detail. The estimate of sample standard deviation for a single density measurement made using the system is 0.016% (at 422.63 kg/cu m). Using three times this standard deviation as a limit for random error and using 0.028% as the bound for known sources of possible systematic error, the uncertainty of a single determination with this system is + or - 0.076%. GRA

N78-20380# Massachusetts Inst. of Tech., Cambridge. Dept. of Architecture.
LIGHTWEIGHT BUILDING MATERIALS FOR THE STORAGE OF SOLAR ENERGY Technical Report, May 1975 - May 1977

Timothy E. Johnson, Sean Wellesley-Miller, and Dennis Andrejko
Sep. 1977 77 p refs
(Grants NSF GI-41306; NSF AER-73-03341)
(PB-275684/9; NSF/RA-770326) Avail: NTIS
HC A05/MF A01 CSCL 13C

Case studies and computer simulations indicated storing heat sensibly in concrete slabs conflicts seriously with space conditioning and architectural needs. Materials for storing heat latently in sunlit floor and ceiling polymer concrete tiles were developed. The polyester concrete tiles are charged with thin layers of phase change material that stabilize room temperatures and store large quantities of heat without using weighty materials which are expensive to support. The project is limited to concept development, feasibility studies, and experimental programs. GRA

N78-20448# ASL Engineering, Goleta, Calif.
NEAR-TERM ELECTRIC VEHICLE PROGRAM, PHASE 1
Final Report

Aug. 1977 205 p refs
(Contract EY-76-C-03-1295)
(SAN/1295-1) Avail: NTIS HC A10/MF A01

A preliminary design study for a four passenger electric vehicle is described. Three major tasks were involved: (1) conceptual design/tradeoff study task in which design directions were established; (2) a preliminary design task which developed the designs in more detail; and (3) a development planning task which generated recommendations for a subsequent hardware development program. Each of these areas is discussed. The design and planning work was carried on under the guideline of using near term technology. Design aspects discussed include propulsion system; batteries/charger, body/structure, chassis system, accessories, and weight. ERA

N78-20471# Los Alamos Scientific Lab., N. Mex.
CONCEPTUAL DESIGN OF A HEAT PIPE RADIATOR

G. A. Bennett Sep. 1977 13 p refs
(Contract W-7405-eng-36)
(LA-6939-MS) Avail: NTIS HC A02/MF A01

A conceptual design of a waste heat radiator was developed for a thermoelectric space nuclear power system. The basic shape of the heat pipe radiator was a frustum of a right circular cone. The design included stringer heat pipes to carry reject heat from the thermoelectric modules to the radiator skin that was composed of small diameter, thin walled cross heat pipes. The stringer heat pipes were armored to resist puncture by a meteoroid. The cross heat pipes were designed to provide the necessary unpunctured radiating area at the mission end with a minimum initial system mass. Several design cases were developed in which the individual stringer survival probabilities were varied and the radiator system mass was calculated. Results were presented for system mass as a function of individual stringer survival probability for six candidate container materials, three candidate heat pipe fluids, two radiator operating temperatures, two meteoroid shield types, and two radiating surface cases. ERA

N78-20473# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemical Engineering.

SYNTHOIL HYDRODYNAMICS Final Report

H. Brenner, D. C. Prieve, and B. Fitch Mar. 1977 11 p
(Contract EY-76-S-02-0056)
(COO-0056-4) Avail: NTIS HC A02/MF A01

Mathematical models to explain and correlate the experimental data concerning two phase cocurrent upflow through packed beds, as found in the Synthoil reactor and the associated cold-model were developed. Such correlation and understanding will be useful in scale-up as well as optimum design of the reactor. ERA

N78-20612*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FRICION AND WEAR OF SELECTED METALS AND ALLOYS IN SLIDING CONTACT WITH AISI 440 C STAINLESS STEEL IN LIQUID METHANE AND IN LIQUID NATURAL GAS

Donald W. Wisander Feb. 1978 18 p refs
(NASA-TP-1150; E-9195) Avail: NTIS HC A02/MF A01 CSCL 20K

Aluminum, titanium, beryllium, nickel, iron, copper, and several copper alloys were run in sliding contact with AISI 440C in liquid methane and natural gas. All of the metals run except copper and the copper alloys of tin and tin-lead showed severely galled wear scars. Friction coefficients varied from 0.2 to 1.0, the lowest being for copper, copper-17 wt. % tin, and copper-8 wt. % tin-22 wt. % lead. The wear rate for copper was two orders of magnitude lower than that of the other metals run. An additional order of magnitude of wear reduction was achieved by the addition of tin and/or lead to copper. Author

N78-20567*# Nebraska Univ., Lincoln.
APPLICATIONS OF REMOTE SENSING IN RESOURCE MANAGEMENT IN NEBRASKA Annual Report, 1 May 1976 - 30 Apr. 1977

Marvin P. Carlson, Principal Investigator 30 Apr. 1977 92 p refs
Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Grant NGL-28-004-020)

(E78-10099; NASA-CR-155801) Avail: NTIS
HC A05/MF A01 CSCL 05A

N78-20573*# Southwest Research Inst., San Antonio, Tex.
COAL THICKNESS GAUGE USING RRAS TECHNIQUES, PART 1 Final Report

W. L. Rollwitz and J. Derwin King 20 Jan. 1978 97 p refs
(Contract NAS8-32606)
(NASA-CR-150625; SwRI-15-4967) Avail: NTIS
HC A05/MF A01 CSCL 08I

A noncontacting sensor having a measurement range of 0 to 6 in or more, and with an accuracy of 0.5 in or better is needed to control the machinery used in modern coal mining so that the thickness of the coal layer remaining over the rock is maintained within selected bounds. The feasibility of using the radiofrequency resonance absorption (RRAS) techniques of electron magnetic resonance (EMR) and nuclear magnetic resonance (NMR) as the basis of a coal thickness gauge is discussed. The EMR technique was found, by analysis and experiments, to be well suited for this application. Author

N78-20597# Ecology Consultants, Inc., Fort Collins, Colo.
ANNOTATED BIBLIOGRAPHY OF NATURAL RESOURCE INFORMATION: NORTHWESTERN NEW MEXICO
Final Report

Timothy W. Joseph and John Wood Sep. 1977 150 p Prepared in cooperation with Dames and Moore, Phoenix, Ariz.
(Contracts DI-14-16-0008-2156; DI-14-16-0006-3129)
(PB-276024/7; FWS/OBS-77/33; LC-77-90963) Avail: NTIS
HC A07/MF A01 CSCL 13B

The flora, fauna and selected physical characteristics of the northwestern New Mexico ecological test area being studied are presented. This test area covers known coal deposit sites in the state. Published and unpublished documents located by April 1977 and pertinent to the test area are listed. Subject, author, geographic and species indexes are included. GRA

N78-20599 Georgia Univ., Athens.
THE ENERGY QUESTION: A CASE STUDY IN MAJOR PUBLIC POLICY DEVELOPMENT IN A QUASI-FREE ENTERPRISE SOCIETY Ph.D. Thesis
 Howard Bucknell, III 1977 524 p
 Avail: Univ. Microfilms. Order No. 77-30452

The contemporary literature on policy analysis in the political science and public administration fields is presented, with some comment on purely economic approaches. The historic diversity of approaches was noted. The basic physical and economic factors involved in the energy situation are discussed, and the emerging and contending political, economic, and ideologic attitudes involved in perceptions of the energy situation are presented. Special emphasis is given to a rational resource allocation model developed empirically in the tradition of an older discipline, political economy. Dissert. Abstr.

N78-20600 California Univ., Berkeley.
COAL ENERGY AND THE ENVIRONMENT: ANALYSIS OF ECONOMIC AND ENERGY EFFICIENCY IMPLICATIONS OF ENVIRONMENTAL AND RESOURCE CONSTRAINTS ON THE UTILIZATION OF COAL TO PRODUCE ELECTRICITY Ph.D. Thesis

George Chandler Ferrell 1977 768 p
 Avail: Univ. Microfilms Order No. 7731350

Emphasis is placed on air quality, and on control of the three primary residuals: sulfur oxides, particulates and nitrogen oxides. Physical air quality, economic and health-related aspects of these residuals are reviewed and federal and state standards are briefly surveyed. Technologies that manage residuals in the coal-electric cycle are assessed in some detail, including the theory of operation, operating performance, commercial history, present status, potential commercial future, and cost. The technologies reviewed include: coal production, coal beneficiation, coal transportation, coal-electric generation, and emissions control technologies. Prior to an analysis of these technologies in case study coal-electric systems using modeling techniques, a brief energy and environmental modeling literature review is conducted. This survey emphasizes coal-energy and air quality modeling, including the topics of mathematical programming, optimal control, simulation, economic and planning methods, modeling workshops, and conferences. Dissert. Abstr.

N78-20601 Oklahoma State Univ., Stillwater.
AN EVALUATION OF GEOTHERMAL ENERGY POTENTIAL Ph.D. Thesis

Ashok R. Sapre 1974 156 p
 Avail: Univ. Microfilms Order No. 7801371

The cost of power generated by using low grade geothermal energy existing under a variety of naturally occurring conditions was assessed. The low grade geothermal energy as defined for this study is the geothermal energy available in the areas where the temperature gradient is between 2 F and 5 F per 100 feet. The assessment of the cost of geothermal power was accomplished via development of a techno-economic model for the total system. The development of the model was divided into two parts. First, a mathematical model of the system was developed and then a compatible economic model was built for the cost evaluation. A set of data was then used to arrive at the cost of geothermal power by using the techno-economic model. Using the techno-economic model of the geothermal power system, the cost of geothermal power was assessed to be between 1.2 cents/KWH and 4.9 cents/KWH. Dissert. Abstr.

N78-20602* Sigma Research, Inc., Richland, Wash.
INSTALLATION PACKAGE MAXI-THERM S-101 HEATING MODULE

12 Oct. 1977 33 p Prepared for DOE
 (Contract NAS8-32260)
 (NASA-CR-150512) Avail: NTIS HC A03/MF A01 CSCL 10A

The installation, operation and maintenance of the Maxi-Therm S-101 Thermosyphon Heating Module is described. The Maxi-Therm S-101 is a packaged unit, complete with air filter, blower, electrical controls, and a thermosyphon liquid to air heat exchanger. It is intended for use in residential solar heating systems and can utilize off-peak electrical power. Author

N78-20603* Hawaii Univ., Honolulu.
EMPLOYING STATIC EXCITATION CONTROL AND TIE LINE REACTANCE TO STABILIZE WIND TURBINE GENERATORS Final Report

H. H. Hwang, H. V. Mozeico, and Tenhwei Guo Apr. 1978 77 p refs
 (Grant NsG-3132; Contract E(49-26)-1004)
 (NASA-CR-135344; DOE/NASA/3132-78/1) Avail: NTIS HC A05/MF A01 CSCL 10A

An analytical representation of a wind turbine generator is presented which employs blade pitch angle feedback control. A mathematical model was formulated. With the functioning MOD-0 wind turbine serving as a practical case study, results of computer simulations of the model as applied to the problem of dynamic stability at rated load are also presented. The effect of the tower shadow was included in the input to the system. Different configurations of the drive train, and optimal values of the tie line reactance were used in the simulations. Computer results revealed that a static excitation control system coupled with optimal values of the tie line reactance would effectively reduce oscillations of the power output, without the use of a slip clutch. Author

N78-20604* IBM Federal Systems Div., Huntsville, Ala.
PRELIMINARY DESIGN REVIEW PACKAGE FOR THE SOLAR HEATING AND COOLING CENTRAL DATA PROCESSING SYSTEM

25 May 1976 153 p Prepared for DOE
 (Contract NAS8-32036)
 (NASA-CR-150594; IBM-76W-0060) Avail: NTIS HC A08/MF A01 CSCL 10A

The Central Data Processing System (CDPS) is designed to transform the raw data collected at remote sites into performance evaluation information for assessing the performance of solar heating and cooling systems. Software requirements for the CDPS are described. The programming standards to be used in development, documentation, and maintenance of the software are discussed along with the CDPS operations approach in support of daily data collection and processing. J.M.S.

N78-20605* Scattergood School, West Branch, Iowa.
SOLAR HEATING SYSTEM FOR RECREATION BUILDING AT SCATTERGOOD SCHOOL Final Report

Conrad F. Heins 3 Jan. 1978 140 p refs
 (Contract EX-76-C-01-2386)
 (NASA-CR-150553) Avail: NTIS HC A07/MF A01 CSCL 10A

The solar heating facility and the project involved in its construction are described. As such, it has both detailed drawings of the completed system and a section that discusses the bottlenecks that were encountered along the way. Author

N78-20606* Houston Chemical Co., Pittsburgh, Pa.
SOLAR HEAT TRANSPORT FLUIDS FOR SOLAR ENERGY COLLECTION SYSTEMS: A COLLECTION OF QUARTERLY REPORTS Progress Report, 15 Nov. 1976 - 15 Nov. 1977

Jan. 1978 52 p refs Prepared for DOE
 (Contract NAS8-32255)
 (NASA-CR-150560) Avail: NTIS HC A04/MF A01 CSCL 10A

Noncorrosive fluid subsystem is being developed that is compatible with closed-loop solar heating and combined heating and hot water systems. The system is also to be compatible with both metallic and nonmetallic plumbing systems, and any combination of these. At least 100 gallons of each type of fluid recommended by the contractor will be delivered. Author

N78-20609* IBM Federal Systems Div., Huntsville, Ala.
SUBSYSTEM DESIGN PACKAGE FOR MOD 2 SITE DATA ACQUISITION SYSTEM: SOLAR HEATING AND COOLING

Sep. 1977 31 p Prepared for DOE
 (Contract NAS8-32269)
 (NASA-CR-150588) Avail: NTIS HC A03/MF A01 CSCL 10A

The Mod 2 Site Data Acquisition Subsystem (SDAS) is designed to collect data from sensors located on residential or commercial buildings using a solar heating and/or cooling system. The SDAS takes the data obtained from sensors located on the solar heating and/or cooling system, processes the data into a suitable format, stores the data for a period of time, and provides the capability for both telephone retrieval by the Central Data Processing System (CDPS) and manual retrieval of the data for transfer to the central site. The unit is designed so it will not degrade the operation of the solar heating/cooling system which it is monitoring. Author

N78-20610*# Solar Engineering and Equipment Co., Metairie, La.
QUARTERLY AND MONTHLY REPORTS FOR SOLAR HEATING AND COOLING SYSTEMS Progress Report, 30 Sep. 1976 - 30 Sep. 1977
 Oct. 1977 29 p Prepared for DOE
 (Contract NAS8-32247)
 (NASA-CR-150589) Avail: NTIS HC A03/MF A01 CSCL 10A

Two prototype solar heating systems, consisting of the following subsystems: collector, control, and storage, are being developed; research progress is discussed. Author

N78-20611*# IBM Federal Systems Div., Huntsville, Ala.
DESIGN REVIEW PACKAGE FOR THE ON-SITE MONITOR FOR SOLAR HEATING AND COOLING SYSTEMS
 Jan. 1977 10 p Prepared for DOE
 (Contract NAS8-32036)
 (NASA-CR-150590) Avail: NTIS HC A02/MF A01 CSCL 10A

The performance specification and verification matrix for the on-site monitor (OSM) is presented. The OSM is a portable device which, when connected to the Site Data Acquisition Subsystem, allows readout of data on solar heating and cooling, operational test sites. Author

N78-20612*# Solafem Ltd., Bourne, Mass.
PROTOTYPE SOLAR HEATING AND HOT WATER SYSTEMS
 Quarterly Report, 7 Oct. 1976 - 28 Jan. 1977
 Jan. 1977 27 p refs Prepared for DOE
 (Contract NAS8-32246)
 (NASA-CR-150592) Avail: NTIS HC A03/MF A01 CSCL 10A

Alternative approaches to solar heating and hot water system configurations were studied, parametrizing the number and location of the dampers, the number and location of the fans, the interface locations with the furnace, the size and type of subsystems, and operating modes. A two-pass air-heating collector was selected based on efficiency and ease of installation. Also, an energy transport module was designed to compactly contain all the mechanical and electrical control components. System performance calculations were carried out over a heating season for the tentative site location at Tunkhanna, Pa. Results illustrate the effect of collector size, storage capacity, and use of a reflector. Factors which affected system performance include site location, insulative quality of the house, and of the system components. A preliminary system performance specification is given. J.M.S.

N78-20613*# Solar Control Corp., Boulder, Colo.
MODULAR CONTROL SUBSYSTEMS FOR USE IN SOLAR HEATING SYSTEMS FOR MULTI-FAMILY DWELLINGS
 Quarterly Report, 15 Oct. 1976 - 15 Jan. 1977
 Jan. 1977 9 p Prepared for DOE
 (Contract NAS8-32258)
 (NASA-CR-150593) Avail: NTIS HC A02/MF A01 CSCL 10A

Progress in the development of solar heating modular control subsystems is reported. Circuit design, circuit drawings, and printed circuit board layout are discussed along with maintenance manuals, installation instructions, and verification and acceptance tests. Calculations made to determine the predicted performance

of the differential thermostat are given including details and results of tests for the offset temperature, and boil and freeze protect points. J.M.S.

N78-20614*# CALMAC Mfg. Co., Englewood, N. J.
LIQUID FLAT PLATE COLLECTOR AND PUMP FOR SOLAR HEATING AND COOLING SYSTEMS: A COLLECTION OF QUARTERLY REPORTS Contractor Report, Oct. 1976 - Oct. 1977
 Jan. 1978 27 p Prepared for DOE
 (Contract NAS8-32253)
 (NASA-CR-150599) Avail: NTIS HC A03/MF A01 CSCL 10A

Progress in the development, fabrication, and delivery of solar subsystems consisting of a solar operated pump, and solar collectors which can be used in solar heating and cooling, or hot water, for single family, multifamily, or commercial applications is reported. Author

N78-20615*# Contemporary Systems, Inc., Jaffrey, N. H.
DESIGN DATA BROCHURE FOR CSI SERIES V SOLAR HEATING SYSTEM
 Jan. 1978 29 p Prepared for DOE
 (Contract NAS8-32243)
 (NASA-CR-150600) Avail: NTIS HC A03/MF A01 CSCL 10A

Generalized information on system configuration, system sizing, and mechanical layout is presented to assist the architect or designer in preparing construction drawings and specifications for the installation of the CSI integrated solar heating systems. Efficiency in space utilization of a full length collector and the importance of proper sizing of the collector array are among the topics discussed. Details of storage and transport subsystems are provided along with drawings and specifications of all components of the CSI system. J.M.S.

N78-20616*# Life Sciences Engineering, Morrison, Colo.
PRELIMINARY DESIGN REVIEW PACKAGE ON AIR FLAT PLATE COLLECTOR FOR SOLAR HEATING AND COOLING SYSTEM
 Jan. 1977 54 p refs Prepared for DOE
 (Contract NAS8-32261)
 (NASA-CR-150601) Avail: NTIS HC A04/MF A01 CSCL 10A

Guidelines to be used in the development and fabrication of a prototype air flat plate collector subsystem containing 320 square feet (10-4 ft x 8 ft panels) of collector area are presented. Topics discussed include: (1) verification plan; (2) thermal analysis; (3) safety hazard analysis; (4) drawing list; (5) special handling, installation and maintenance tools; (6) structural analysis; and (7) selected drawings. Author

N78-20617*# Tennessee Technological Univ., Cookeville. Dept. of Mechanical Engineering.
PUMP/CONTROL SYSTEM MINIMUM OPERATING COST TESTING
 7 Dec. 1977 72 p refs
 (Contract NAS8-31564)
 (NASA-CR-150604) Avail: NTIS HC A04/MF A01 CSCL 10A

A preliminary evaluation of pump performance was initiated to determine the efficiencies of an arbitrary group of small pumps. Trends in factors affecting energy usage in typical prime movers which might be used in liquid transport solar systems were assessed. Comparisons of centrifugal pump efficiencies were made from one manufacturer to another. Tests were also made on two positive-displacement pumps and comparisons with centrifugal pumps were observed. Author

N78-20618*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE GOLDSTONE ENERGY PROJECT Final Report
 K. P. Bartos 15 Feb. 1978 50 p refs
 (Contract NAS7-100)
 (NASA-CR-156133; JPL-Pub-78-5) Avail: NTIS HC A03/MF A01 CSCL 10B

The Golstone Energy Project was established in 1974 to investigate ways in which the Goldstone Deep Space Complex in California could be made partly or completely energy-sufficient, especially through the use of solar- and wind-derived energy resources. Ways in which energy could be conserved at the Complex were also studied. Findings included data on both wind and solar energy. Obstacles to demonstrating energy self-sufficiency are: (1) operation and maintenance costs of solar energy systems are estimated to be much higher than conventional energy systems, (2) initial capital costs of present-day technology solar collectors are high and are compounded by low collector efficiency, and (3) no significant market force exists to create the necessary industry to reduce costs through mass production and broad open-market competition. Author

N78-20619*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **SOLAR ENERGY FOR PROCESS HEAT: DESIGN/COST STUDIES OF FOUR INDUSTRIAL RETROFIT APPLICATIONS**

R. L. French and Ralph E. Bartera 1 Apr. 1978 62 p refs (Contract NAS7-100) (NASA-CR-156139; JPL-Pub-78-25) Avail: NTIS HC A04/MF A01 CSCL 10A

Five specific California plants with potentially attractive solar applications were identified in a process heat survey. These five plants were visited, process requirements evaluated, and conceptual solar system designs were generated. Four DOE (ERDA) sponsored solar energy system demonstration projects were also reviewed and compared to the design/cost cases included in this report. In four of the five cases investigated, retrofit installations providing significant amounts of thermal energy were found to be feasible. The fifth was rejected because of the condition of the building involved, but the process (soap making) appears to be an attractive potential solar application. Costs, however, tend to be high. Several potential areas for cost reduction were identified including larger collector modules and higher duty cycles. Author

N78-20620*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **MULTI-WIRE SLURRY WAFERING DEMONSTRATIONS**

C. P. Chen 22 Feb. 1978 95 p refs Prepared for DOE (Contract NAS7-100) (JPL-Pub-78-37; NASA-CR-156134) Avail: NTIS HC A05/MF A01 CSCL 10A

Ten slicing demonstrations on a multi-wire slurry saw, made to evaluate the silicon ingot wafering capabilities, reveal that the present sawing capabilities can provide usable wafer area from an ingot 1.05m/kg (e.g. kerf width 0.135 mm and wafer thickness 0.265 mm). Satisfactory surface qualities and excellent yield of silicon wafers were found. One drawback is that the add-on cost of producing water from this saw, as presently used, is considerably higher than other systems being developed for the low-cost silicon solar array project (LSSA), primarily because the saw uses a large quantity of wire. The add-on cost can be significantly reduced by extending the wire life and/or by rescue of properly plated wire to restore the diameter. Author

N78-20621*# Rocketdyne, Canoga Park, Calif. **HYDROGEN TURBINE POWER CONVERSION SYSTEM ASSESSMENT Final Report, Aug. 1973 - Apr. 1976**

D. E. Wright, A. D. Lucci, J. Campbell, and J. C. Lee 19 Apr. 1978 155 p refs (Contract NAS3-20388) (NASA-CR-135298; RI/RD77-252) Avail: NTIS HC A08/MF A01 CSCL 10A

A three part technical study was conducted whereby parametric technical and economic feasibility data were developed on several power conversion systems suitable for the generation of central station electric power through the combustion of hydrogen and the use of the resulting heat energy in turbogenerator equipment. The study assessed potential applications of hydrogen-fueled power conversion systems and identified the three most promising candidates: (1) Ericsson Cycle, (2) gas turbine, and (3) direct steam injection system for fossil fuel as well as nuclear powerplants. A technical and economic evaluation was performed on the three systems from which the direct injection system

(fossil fuel only) was selected for a preliminary conceptual design of an integrated hydrogen-fired power conversion system. Author

N78-20626# General Accounting Office, Washington, D. C. Energy and Minerals Div.

MORE ATTENTION SHOULD BE PAID TO MAKING THE U.S. LESS VULNERABLE TO FOREIGN OIL PRICE AND SUPPLY DECISIONS

3 Jan. 1978 107 p (PB-275309/3; EMD-78-24) Avail: NTIS HC A06/MF A01 CSCL 10A

Initiatives to make the supply of imported oil less subject to disruptions and price increases are presented. Author (GRA)

N78-20626# Little (Arthur D.), Inc., Cambridge, Mass. **ENERGY CONTINGENCY PLANNING Final Report**

1977 390 p Sponsored by Pacific Northwest Regional Commission, Vancouver, Wash. (PB-275371/3; NEPP-IV) Avail: NTIS HC A17/MF A01 CSCL 10A

Issues associated with the supply of electricity, natural gas, and petroleum were discussed along with the legal and administrative environment within which energy contingency planning can be performed. Technical aspects of action plans or contingency measures were considered and energy shortage measurement and triggering issues were examined. GRA

N78-20627# General Accounting Office, Washington, D. C. Energy and Mineral Div.

EVALUATION OF THE PLAN TO CONSERVE ENERGY IN FEDERAL BUILDINGS THROUGH RETROFIT PROGRAMS

22 Dec. 1977 16 p (PB-275311/9; EMD-78-2) Avail: NTIS HC A02/MF A01 CSCL 13A

Since the government owns over 400,000 buildings which consume about 753 trillion Btu of energy annually, retrofitting as a cornerstone of energy management in federal buildings is compelling. The department of energy proposes to require that each federal agency owning or operating buildings: reduce energy consumption in existing buildings by 20 percent compared to 1975 consumption; perform retrofit surveys on all federally owned buildings by the end of fiscal year 1981; establish formal operating and maintenance guidelines for energy conservation and management; prepare a 10-year plan which covers retrofitting existing buildings; submit data on its buildings and energy use with their plans, to be updated annually. GRA

N78-20628# Pennsylvania State Univ., University Park. Applied Research Lab.

HIGH-TEMPERATURE LINEAR RADIATION-CAVITY SOLAR COLLECTOR WITH A FRESNEL CONCENTRATOR Ph.D. Thesis

Zenen I. Antoniak 8 Dec. 1977 236 p refs (Contract N00017-73-C-1418) (AD-A049982; TM-77-326) Avail: NTIS HC A11/MF A01 CSCL 10/2

A model solar-thermal concentrator-collector that is 1/6th scale (in cross section) relative to a system considered to be of practical dimensions for power generation has been constructed and tested. It consists of an Archimedes (i.e., Fresnel) mirror-concentrator, 5 cm ID x 1.5 m long glass receiver pipe, 0.3 cm thick graphite absorber, and gaseous (Ar) heat transfer medium. On clear days (direct solar flux ca. 800 W/sq.m.), stagnation (i.e., no-flow condition) temperatures of ca. 370 C have been reached at the center of the experimental device, where end effects are minimal. Experiments have been performed with gas flow rates up to ca. 100 liters/min (200 RE 2000), resulting in a bulk fluid temperature rise in the axial (flow) direction of up to 285 C. These experiments have been utilized in a study of heat transfer processes within the collector. A computer model of this system which takes into account most of the influential variables (e.g., combined forced-free convection, establishment of velocity and temperature profiles, and axial heat conduction) has been developed. Its behavior agrees well with observations. Also, after ca. 200 h of high-temperature operation, materials degradation was measured and found to be very low. GRA

N78-20630# Civil and Environmental Engineering Development Office, Tyndall AFB, Fla.

A SURVEY OF CONSIDERATIONS FOR SOLAR ENERGY FACILITY APPLICATIONS Final Report, Mar. 1977

Marshall W. Nay, Jr. Dec. 1977 65 p refs
(AD-A049490; CEEDO-TR-77-39) Avail: NTIS
HC A04/MF A01 CSCL 13/1

The purpose of this report is to provide Air Force civil engineers some useful information for the planning and programming of solar energy systems to satisfy facility energy requirements. This report has been prepared in response to the belief that considerable interest in solar energy system technology, as well as other alternate energy schemes, is increasing at a rapid pace in the Air Force. A considerable effort is devoted to appraising the current status of fossil fuel energy resources in order to establish the need for expanded work in developing solar energy technology. The current and potential areas of application of solar energy technology are described with special attention devoted to space heating. Additionally, environmental considerations of solar energy technology are described along with the current Air Force solar energy program. This report concludes with some suggestions for establishing a solar energy program on an individual or installation basis. Author (GRA)

N78-20638# Holt (Ben) Co., Pasadena, Calif.
GEOTHERMAL DIRECT CONTACT HEAT EXCHANGE Final Report

A. V. Sims 10 Jun. 1977 115 p refs
(Contract EY-76-C-03-1116)
(SAN/1116-1) Avail: NTIS HC A06/MF A01

A glass direct contact heat exchange column was operated in the laboratory. The column was operated at atmospheric pressure using hot water and normal hexane. Column internals testing included an empty column, sieve trays, disk-and-doughnut trays, and two types of packing. Operation was very smooth in all cases and the minimum temperature approaches varied from less than 1 C for packing to 13 C for the empty column. High heat transfer rates were obtained in all cases, however, columns should be sized on the basis of liquid and vapor traffic. The solubilities of hydrocarbons were determined for normal hexane, pentane and butane in water and sodium chloride and calcium chloride brines at various temperatures. A computer program was used to study the effect of operating variables on the thermodynamic cycle efficiencies. A preliminary design for a 50 MWe plant was prepared and plant capital cost and operating cost were estimated. ERA

N78-20639# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

LOW-COST SOLAR AIR HEATER Semiannual Progress Report, 29 Jun. - 22 Dec. 1978

D. R. Rask and L. J. Mueller 22 Dec. 1977 89 p refs
(Contract EY-76-C-02-2929)
(COO-2929-6) Avail: NTIS HC A05/MF A01

A jet impingement concept was used as the absorber plate-to-air stream heat transfer mechanism. For comparison purposes, a baseline parallel plate collector was analyzed, fabricated and tested. Values for the average jet heat transfer coefficient were predicted. A computer simulation using a nodal network collector model was used to predict collector performance. The collector mechanical design effort involved a study of cost effective methods for assembly and material selection. A preliminary recommended design is presented. ERA

N78-20643# Little (Arthur D.), Inc., Cambridge, Mass.
EVALUATION OF A SEAFLOOR NUCLEAR POWER SUPPLY AND ITS POTENTIAL APPLICATIONS Final Report

30 Apr. 1977 94 p refs
(Contract EY-76-C-02-4123)
(COO-4123-1) Avail: NTIS HC A05/MF A01

The seafloor nuclear power supply concept was proposed as a source of electrical energy for subsea pumping of petroleum products. It consisted of a small nuclear reactor, moderated by zirconium hydride (ZrH) and cooled by liquid metal (NaK), which drove a 3-MW turbine/generator system which used toluene as

the working fluid. It was determined that the concept was technically feasible, with regard to the nuclear, marine, electrical, and petroleum engineering aspects. Fuel in the form of gas from the wells was available at near-zero cost in almost all cases of field development, so that operating expenses were minimal. Alternating-current systems were preferred at distances less than 20 miles; direct current was more economical at greater distances. ERA

N78-20644# Sandia Labs., Albuquerque, N. Mex. Solar Total Energy Program Div.
METHODOLOGY FOR SITE SELECTION OF A SOLAR TOTAL ENERGY LARGE SCALE EXPERIMENT

Robert W. Hunke Mar. 1977 18 p refs
(Contract EY-76-C-04-0788)
(SAND-77-0248) Avail: NTIS HC A02/MF A01

The development of the evaluation criteria for a site, a parcel of real property with a development - apparatus, equipment, facilities, etc. is described. The large scale experiment's desired characteristics are described, and the evaluation criteria are given together with an algorithm for the calculation of the expected value of proposals. ERA

N78-20645# General Atomic Co., San Diego, Calif.

HTS THERMAL STORAGE PEAKING PLANT

D. L. Vrable and R. N. Quade Apr. 1977 139 p refs
(Contract W-7405-eng-26)
(ORNL-Sub-4188-2; GA-A-14160) Avail: NTIS
HC A07/MF A01

Use of the high temperature gas cooled reactor to generate intermediate load and peak power by using heat transfer salt thermal storage was evaluated. Technical and economic aspects of the conceptual design were investigated to confirm the system's viability for this application. Using a reference thermal power level of 2000 MW(t), preliminary system analysis was performed and a selection of the system configuration was completed. The reference point design served as a basis for evaluating the technical and economic aspects of the system. Conceptual design data are provided for the major plant components. Preliminary cost estimates for the plant design and power costs were performed for the selected reference design. ERA

N78-20646# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

FLOATING POWER OPTIMIZATION STUDIES FOR THE COOLING SYSTEM OF A GEOTHERMAL POWER PLANT

C. J. Shaffer Aug. 1977 94 p refs
(Contract EY-76-C-07-1570)
(TREE-1164) Avail: NTIS HC A05/MF A01

The floating power concept was studied for a geothermal power plant as a method of increasing the plant efficiency and decreasing the cost of geothermal power. The stored cooling concept was studied as a method of reducing the power fluctuations of the floating power concept. Parametric and optimization studies were conducted for a variety of different types of cooling systems including wet and dry cooling towers, direct and indirect cooling systems, forced and natural draft cooling towers, and cooling ponds. An indirect forced draft wet cooling tower cooling system was used as a base case design for comparison purposes. ERA

N78-20648# Illinois Dept. of Business and Economic Development, Springfield. Div. of Energy.

THE ILLINOIS PROGRAM FOR COMPREHENSIVE SOLAR ENERGY LEGISLATION

Bruce D. Green, David Z. Pogany, and J. Ernest Dunwoody Jun. 1977 42 p refs Prepared in cooperation with Ill. Inst. Environ. Quality, Chicago
(PB-275565; ILLDOE-77/08) Avail: NTIS HC A03/MF A01
CSCL 10A

The development of a Solar Energy Program in Illinois, including the formulation of the Comprehensive Solar Energy Act of 1977 is examined. A discussion of the need for comprehensive legislation precedes the overview of dynamics. GRA

N78-20649# National Materials Advisory Board, Washington D. C.
EROSION CONTROL IN ENERGY SYSTEMS Final Report
 Nov. 1977 243 p refs
 (Contract EX-76-C-01-2112)
 (PB-275105; NMAB-334) Avail: NTIS HC A11/MF A01 CSCL 11F

The report of the findings of a Committee looking at erosion problems in energy systems: identifies the erosion conditions inherent in energy systems and categorizes them according to severity; describes the interplay between design and materials; describes the mechanisms of erosion and corrosion, and their combined effects; emphasizes the importance of test evaluation procedures; and summarizes government sponsored work in progress. The conclusions reached led to twelve recommendations aimed at advancing erosion/corrosion technology. These recommendations emphasize long range planning; development of a fundamental understanding of the erosion/corrosion process; development of erosion/corrosion models and meaningful correlations; development of testing procedures for material response investigations, engineering data and accelerated life tests; and design considerations. GRA

N78-20769# California Univ., Berkeley. Lawrence Berkeley Lab.
HEALTH AND SAFETY IMPACTS OF NUCLEAR, GEOTHERMAL AND FOSSIL-FUEL ELECTRIC GENERATION IN CALIFORNIA. VOLUME 2: RADIOLOGICAL HEALTH AND RELATED STANDARDS FOR NUCLEAR POWER PLANTS
 A. V. Nero and Y. C. Wong Jan. 1977 .91 p refs
 (Contracts W-7405-eng-48; CSERCDC-4-0123)
 (LBL-5285-Vol-2) Avail: NTIS HC A05/MF A01

The status and basis of radiation protection standards, and how they particularly apply to nuclear power plants are presented. The national and international organizations involved in the setting of standards are discussed, paying explicit attention to their jurisdictions and to the considerations they use in setting standards. The routine and accidental radioactive emissions from nuclear plants are characterized, and the effect of these emissions on ambient radiation levels is discussed. The state of information on the relationship between radiation exposures and health effects is summarized. ERA

N78-20802*# Boeing Computer Services, Inc., Seattle, Wash. Energy Technology Applications Div.
A SIMULATION MODEL FOR WIND ENERGY STORAGE SYSTEMS. VOLUME 1: TECHNICAL REPORT Final Report
 A. W. Warren, R. W. Edsinger, and Y. K. Chan Aug. 1977 101 p refs
 (Contracts NAS3-20385; E(49-28)-1026)
 (NASA-CR-135283; BCS-40180-1-Vol-1; CONS-038-5-1) Avail: NTIS HC A06/MF A01 CSCL 09B

A comprehensive computer program for the modeling of wind energy and storage systems utilizing any combination of five types of storage (pumped hydro, battery, thermal, flywheel and pneumatic) was developed. The level of detail of Simulation Model for Wind Energy Storage (SIMWEST) is consistent with a role of evaluating the economic feasibility as well as the general performance of wind energy systems. The software package consists of two basic programs and a library of system, environmental, and load components. The first program is a precompiler which generates computer models (in FORTRAN) of complex wind source storage application systems, from user specifications using the respective library components. The second program provides the techno-economic system analysis with the respective I/O, the integration of systems dynamics, and the iteration for conveyance of variables. SIMWEST program, as described, runs on the UNIVAC 1100 series computers. Author

N78-20803*# Boeing Computer Services, Inc., Seattle, Wash. Energy Technology Applications Div.
A SIMULATION MODEL FOR WIND ENERGY STORAGE SYSTEMS. VOLUME 2: OPERATION MANUAL Final Report

A. W. Warren, R. W. Edsinger, and J. D. Burroughs Aug. 1977 421 p refs 3 Vol.
 (Contracts NAS3-20385; E(49-28)-1026)
 (NASA-CR-135284; BCS-40180-2-Vol-2; CONS-0385-2) Avail: NTIS HC A18/MF A01 CSCL 09B

A comprehensive computer program (SIMWEST) developed for the modeling of wind energy/storage systems utilizing any combination of five types of storage (pumped hydro, battery, thermal, flywheel, and pneumatic) is described. Features of the program include: a precompiler which generates computer models (in FORTRAN) of complex wind source/storage/application systems, from user specifications using the respective library components; a program which provides the techno-economic system analysis with the respective I/O the integration of system dynamics, and the iteration for conveyance of variables; and capability to evaluate economic feasibility as well as general performance of wind energy systems. The SIMWEST operation manual is presented and the usage of the SIMWEST program and the design of the library components are described. A number of example simulations intended to familiarize the user with the program's operation is given along with a listing of each SIMWEST library subroutine. Author

N78-20804*# Boeing Computer Services, Inc., Seattle, Wash. Energy Technology Applications Div.
A SIMULATION MODEL FOR WIND ENERGY STORAGE SYSTEMS. VOLUME 3: PROGRAM DESCRIPTIONS Final Report
 A. W. Warren, R. W. Edsinger, and J. D. Burroughs Aug. 1977 234 p 3 Vol'

(Contracts NAS3-20385; E(49-28)-1026)
 (NASA-CR-135285; BCS-40180-3-Vol-3; CONS-0385-3) Avail: NTIS HC A11/MF A01 CSCL 09B
 Program descriptions, flow charts, and program listings for the SIMWEST model generation program, the simulation program, the file maintenance program, and the printer plotter program are given. Author

N78-20941# International Institute for Applied Systems Analysis, Laxenburg (Austria).
FUSION AND FAST BREEDER REACTORS
 D. Faude, ed. (Ges. fuer Kernforsch.), M. Helm, ed., and W. Weisz, ed. Jul. 1977 519 p refs
 (IIASA-RR-77-8) Avail: NTIS HC A22/MF A01

The liquid-metal fast breeder reactor (LMFBR) and the deuterium-tritium (Tokamak) fusion reactor were compared. Both nuclear reactors can potentially produce practically unlimited amounts of energy. This relates exactly to the theme of IASA's Energy Program, which studies the transition from today's supply systems that use limited but cheap resources to future supply systems that will use unlimited but possibly expensive means for the supply of large amounts of energy. Topics include the problem of fuel resources; present status of fission and fusion reactors; reference reactor systems; radioactive inventories of reactor economics; normal operating losses and exposures; nonroutine releases; safeguards; materials and impact of radiation damage; and requirements for commercialization. For individual titles, see N78-20942 through N78-20943.

N78-20942# Academy of Sciences (USSR), Moscow. Inst. of High Temperature.
A TOKAMAK REACTOR AND AN MHD ENERGY CONVERSION SYSTEM (THE TVE-2500 PROJECT)
 D. K. Kurbatov, G. E. Shatalov, and N. N. Vasiliev *In Intern. Inst. for Appl. Systems Anal. Fusion and Fast Breeder Reactors* Jul. 1977 p 163-171 refs

Avail: NTIS HC A22/MF A01
 Design studies for a fusion power plant equipped with a Tokamak reactor are reported. The main characteristic features of the project under consideration are gas cooling at coolant temperatures up to 1800 to 2100 K, and incorporation of the solid-graphite ceramic blanket. With such high working medium temperatures, MHD generators can be used; these generators have high thermodynamic efficiencies and are costly compared

to traditional power plants. Moreover, the realization of the high-temperature gas cooling process suggests using the plant as a high-temperature heat source in industry (in metallurgy, chemical hydrogen production, etc.). Neon was chosen as a gas coolant in the solid ceramic blanket and is used as a working medium in the heat power cycle of the plant. After power production in the MHD generator, where about one third of the initial enthalpy is converted into electricity, the working medium successively passes through the thermo-mechanical components: steam generator, recuperative heat exchanger; then the neon is forced back to the reactor. The compressor is driven by the turbine supplied with steam from the steam generator.

Author (ESA)

N78-21010* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE EPC HUMMINGBIRD ELECTRIC PASSENGER VEHICLE

Ralph J. Slavik, Edward A. Maslowski, Noel B. Sargent, and Arthur Birchenough Dec. 1977 46 p Prepared for DOE (Contract EC-77-A-31-1011)

(NASA-TM-73760; E-9485; CONS-1011-5) Avail: NTIS HC A03/MF A01 CSCL 13F

The rear-mounted internal combustion engine in a four-passenger Volkswagen Thing was replaced with an electric motor made by modifying an aircraft generator and powered by 12 heavy-duty, lead-acid battery modules. Vehicle performance tests were conducted to measure vehicle maximum speed, range at constant speed, range over stop-and-go driving schedules, maximum acceleration, gradeability limit, road energy consumption, road power, indicated energy consumption, braking capability, battery charger efficiency, and battery characteristics. Test results are presented in tables and charts.

Author

N78-21016* Energy Research and Development Administration, Washington, D. C. Div. of Transportation Energy Conservation.

INTRODUCTION TO THE ERDA ELECTRIC AND HYBRID DEMONSTRATION PROJECT

1 Mar. 1977 64 p refs

(ERHQ-0008) Avail: NTIS HC A04/MF A01

Provisions of the Legislative Act establishing an ERDA program for research, development, and demonstration designed to promote electric and hybrid technologies and to demonstrate their commercial feasibility are summarized. Emerging vehicle systems builders can draw on the accelerated technology through acquisition of improved competitively developed components, technology reports, and specifications. Further feedback to both systems and component developers will be provided through dissemination of user data from the demonstration program. An approach for implementation of the financial incentives for small business and loan guarantees as well as studies into other incentive areas as authorized in the legislation is discussed. Social and economic impacts are considered, and safety aspects are discussed.

ERA

N78-21095* Lockheed-California Co., Burbank, Commercial Advanced Design Div.

FUEL CONSERVATION MERITS OF ADVANCED TURBOPROP TRANSPORT AIRCRAFT Final Report, Jan. - Aug. 1977

J. D. Revell and R. H. Tullis Aug. 1977 154 p refs

(Contract NAS2-8612)

(NASA-CR-152096; LR-28283)

Avail: NTIS

HC A08/MF A01 CSCL 01C

The advantages of a propfan powered aircraft for the commercial air transportation system were assessed by the comparison with an equivalent turboprop transport. Comparisons were accomplished on the basis of fuel utilization and operating costs, as well as aircraft weight and size. Advantages of the propfan aircraft, concerning fuel utilization and operating costs, were accomplished by considering: (1) incorporation of propfan performance and acoustic data; (2) revised mission profiles (longer design range and reduction in: and cruise speed), and (3) utilization of alternate and advanced technology engines.

Author

N78-21123# Teledyne CAE, Toledo, Ohio.

THE STATUS OF SMALL, COOLED, AXIAL-FLOW TURBINES

H. F. Due, A. E. Easterling (Army AMRDL, Fort Eustis, Va.), and J. E. Haas (Army AMRDL, Cleveland) In AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 15 p refs

Avail: NTIS A25/MF A01

The design of a high performance small, cooled, axial flow turbine is considered in terms of aerodynamic performance, structural life, flow conditions, and cycle variations. Analytical techniques which predict losses, flow conditions, operating velocity triangles, and stage matching are reviewed. It is concluded that the design techniques are not adequate for meeting the requirements of high performance gas turbine engines without relying on semi-empirical relationships.

J.M.S.

N78-21179* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

CONSTRUCTION IN SPACE: A PROPOSED EXPERIMENT IN SUPPORT OF THE SPACE SOLAR POWER CONCEPT AND OTHER LARGE SPACE SYSTEMS

30 Mar. 1977 17 p

(NASA-TM-79435) Avail: NTIS HC A02/MF A01 CSCL 22A

The conceptual equipment and techniques for fabricating and assembling a ladder-like structure of triangular cross section trusses suitable for mounting solar cell arrays are described. The detail information is presented in the context of a proposed experiment to be conducted from the shuttle in the 1980-84 time period as an early experiment in the development of techniques for the construction of large space structures that would be required for space solar power stations and other large systems.

Author

N78-21227 Wisconsin Univ., Madison.

TIME- AND SPACE-RESOLVED SPECIES DETERMINATION IN DIESEL COMBUSTION USING CONTINUOUS FLOW GAS SAMPLING Ph.D. Thesis

Kyung Tai Rhee 1977 304 p

Avail: Univ. Microfilms Order No. 77-23733

Concentrations of the major combustion species (CO₂, CO, O₂ and NO_x), hydrocarbons (HCs) were measured as well as local fuel/air ratio in an operating open chamber type diesel engine cylinder during the reaction period. These data were obtained from several sampling positions in one of eight similar sprays in the combustion chamber so that both time- and space-resolved (T-S-R) species data were inferred. A rapid acting continuous flow type gas sampling system was developed. This system allowed a continuous flow of cylinder gases to pass thru the sampling valve orifice and upon demand diverted a small portion of this flow to a sample collection volume. Flow diversion was accomplished by action of an oscillating sampling tube. The minimum sampling period was approximately 0.5 msec and the portion of the sampling probe in the cylinder was 1/4 inch in diameter.

Dissert. Abstr.

N78-21312# National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.

CHEMICAL AND PHYSICAL PROPERTIES OF REFINED PETROLEUM PRODUCTS

Herbert Curl, Jr. and Kevin O'Donnell Oct. 1977 36 p

(PB-277100/4; NOAA-TM-ERL-MESA-17; NOAA-77122003)

Avail: NTIS HC A03/MF A01 CSCL 21D

No exact numbers were given for solubilities of fuel oil in water, because the composition of a fuel oil varies from one refinery to another. Hydrocarbons of a lower molecular weight were more soluble than those of a higher molecular weight. Under normal conditions of wind, waves and temperature on an open sea, the evaporation rate of spilled oil was quite significant. The most toxic components of fuel oils were the aromatics which are relatively highly soluble in water. Of the various fuels, the most toxic was probably gasoline because of its high content of aromatics and other low-boiling hydrocarbons.

GRA

N78-21313# General Accounting Office, Washington, D. C. Energy and Minerals Div.

EMERGENCY NATURAL GAS PURCHASES: ACTIONS NEEDED TO CORRECT PROGRAM ABUSES AND CONSUMER INEQUITIES

6 Jan. 1978 48 p
(PB-275876/1; EMD-78-10) Avail: NTIS HC A03/MF A01
CSCL 10A

Discussion is presented for improvements needed in the Federal regulation of natural gas obtained under emergency provisions to prevent its use counter to national conservation policies and to prevent the higher costs of natural gas so purchased from being borne inequitably. The report contains recommendations for consideration by the Congress. GRA

N78-21314# National Highway Traffic Safety Administration, Washington, D. C. Office of Program Analysis, Planning and Evaluation.

THE AUTOMOTIVE FUEL ECONOMY STANDARDS FOR MODEL YEAR 1981-1984 PASSENGER CARS Final Report

30 Jun. 1977 141 p refs
(PB-275827/4; DOT-HS-803-183) Avail: NTIS
HC A07/MF A01 CSCL 10A

Various micro- and macroeconomic impacts of the average fuel economy standards for model year 1981-84 passenger cars were evaluated. Such microeconomic impacts as cost and price changes for both the domestic manufacturers and the consumer were analyzed. Also examined were such macroeconomic impacts as employment, energy consumption and G.N.P. GRA

N78-21315# National Highway Traffic Safety Administration, Washington, D. C. Office of Automotive Fuel Economy.
RULEMAKING SUPPORT PAPER CONCERNING THE 1981-1984 PASSENGER AUTO AVERAGE FUEL ECONOMY STANDARDS

Jul. 1977 223 p refs
(PB-275895/1; DOT-HS-803-184) Avail: NTIS
HC A10/MF A01 CSCL 10A

The automobile industry's ability to produce more fuel efficient automobiles in the 1981-1984 time frame is assessed. The assessment included the following considerations: technology feasibility, economic practicability, effect of other Federal standards, and the need of the nation to conserve fuel. This assessment indicated that the manufacturers could achieve average fuel economy standards of 22 mpg in 1981, 24 mpg in 1982, 26 mpg in 1983 and 27 mpg in 1984. GRA

N78-21316# Lummus Co., New York.
PROTOTYPE PILOT PLANT OPERATION: SYNTHANE PROCESS Contractor Quarterly Operation Report No. 11, 1 Apr. - 30 Jun. 1977

Oct. 1977 15 p
(Contract EY-76-C-02-0003)
(COO-0003-8) Avail: NTIS HC A02/MF A01

During the run period, gas was produced for 76 hours. Feed rates and bed heights were varied at operating temperatures of 1500 F in an attempt to achieve over 70% carbon conversion. During other runs, emphasis was placed on attempting to make the internal cyclone operate. During these runs, considerable improvement was noted in the solids carryover into gas scrubbing. The fines return to the bed resulted in much lower densities and poor bed level control was experienced. The gasifier was operated for a period of eight days at varying conditions, in an attempt to achieve better operability with the low bed densities. ERA

N78-21317# Lummus Co., Bloomfield, N. J.
PROTOTYPE PILOT PLANT OPERATION, SYNTHANE PROCESS Contractor Monthly Activity Report No. 36, 1-31 Aug. 1977

Sep. 1977 14 p
(Contract EY-76-C-02-0003)
(COO-0003-10) Avail: NTIS HC A02/MF A01

During the operation period, oxygen and coal were fed for 190 hours, 98 hours of which were without interruption. The run produced ten steady state periods. Bed temperatures and feed rates were varied to study the effect of these variables on

conversions. Carbon conversions of 75 percent to 78 percent were achieved for extended periods of operation of feed rates of 2 to 3 tons per hour. The successful completion of this run finishes studies of Western subbituminous coal. ERA

N78-21318# Energy Research and Development Administration, Washington, D. C.

LOW-Btu COAL GASIFICATION

Aug. 1977 11 p
(ERHQ-0015) Avail: NTIS HC A02/MF A01

The evaluation of technical and economical integration of low Btu coal gasification technology in various operational environments was studied. The projects were to be limited to 8 t/hr capacity and only state of the art technologies were to be used. Projects were selected on the basis of overall technical feasibility, financial contribution by the participants, qualifications of the offerer and partners, ability to finance, total cost of the projects, application, and type of gasifiers. The projects include the use of anthracite coal as well as low and high sulfur bituminous coals. Also included were one and two stage gasifiers, oil, and tar removal and reuse, and secondary systems for sulfur removal from the product gas. ERA

N78-21319# Dynatech R/D Co., Cambridge, Mass.
INVESTIGATION OF CONVERTING THE PRODUCT OF COAL GASIFICATION TO METHANE BY THE ACTION OF MICROORGANISMS, PHASE 1 Quarterly Report, 1 Sep. - 1 Dec. 1976

Don C. Augenstein and Donald L. Wise 15 Dec. 1977 54 p
(Contract EX-76-C-01-2203)
(FE-2203-16; Rept-1559; QR-4) Avail: NTIS
HC A04/MF A01

The principal experimental objectives were to increase productivity through thermophilic operation in conjunction with recycle, to demonstrate high pressure, high-rate, thermophilic operation with recycle, and to demonstrate the practical biological shift conversion of carbon monoxide. Thermophilic operation with recycle has resulted in the highest productivities obtained to date. High productivities were delivered in thermophilic pressure fermentations to 120 psig with recycle. Encouragingly rapid rates of CO conversion were obtained in initial trials utilizing a new organism and medium; an initial shift rate and hydrogen productivity were attained. In trials to establish the sensitivity of the thermophilic culture to hydrogen sulfide, no inhibition of culture productivity was seen at hydrogen sulfide concentrations as high as 10 percent in the test gas mix. ERA

N78-21320# Dow Chemical Co., Midland, Mich.
CHEMICALS FROM COAL: USBM SYNTHOIL Interim Report

Bruce C. Peters Oct. 1977 88 p ref
(Contract EX-76-C-01-1534)
(FE-1534-49) Avail: NTIS HC A05/MF A01

Laboratory studies in metal reactors and computer and mathematical simulations were performed to provide overall material balance data for a conceptual plant. The mid-distillate was hydrocracked to produce naphtha which was further processed by hydrotreating and reforming. The reformate from the mid-distillate was then mathematically hydrodealkylated to convert it to a product slate consisting of methane, liquefied petroleum gases, benzene, and fuel, along with the total hydrogen consumed. The high aromatic yield obtained from the hydrocrackate naphtha makes this fraction very attractive as a petrochemical feedstock. ERA

N78-21321# Dynatech R/D Co., Cambridge, Mass.
FUEL GAS PRODUCTION FROM ANIMAL WASTE, PHASE 1 Annual Summary Report, 17 May 1976

17 May 1977
E. Ashare, R. L. Wentworth, D. L. Wise, and D. C. Augenstein
31 May 1977 30 p refs
(Contract EY-76-C-02-2991)
(COO-2991-17) Avail: NTIS HC A03/MF A01

An engineering and economic analysis was performed for an anaerobic digestion process for the production of fuel gas

from animal wastes. A comprehensive engineering report was prepared describing this study. A study of processes for the removal of acid gases from digester gas was initiated to review the technology and assess the technical and economic feasibility of gas scrubbing technology for removal of CO₂ from digester gas. ERA

N78-21322# California Univ., Livermore. Lawrence Livermore Lab.

ALTERNATIVE FUELS FOR TRANSPORTATION: IMPLICATIONS OF THE BROAD-CUT OPTION

C. J. Anderson 11 Jul. 1977 18 p refs
(Contract W-7405-eng-48)

(UCRL-52313) Avail: NTIS HC A02/MF A01

Broad-cut liquid hydrocarbon fuels could lead to important fuel savings through more efficient engines and fuel production. Broad-cut fuels could be made initially from petroleum and ultimately from coal, oil shale, or other economical sources. Engines designed for the fuels might include direct-injected, stratified, turbine, stirling, or spark-assisted diesel engines. ERA

N78-21323# Ad Hoc Committee on the Use of Hydrogen as a Supplement to Natural Gas.

EVALUATION OF THE USE OF HYDROGEN AS A SUPPLEMENT TO NATURAL GAS

Jun. 1977 72 p Prepared for DOE

(TID-27747) Avail: NTIS HC A04/MF A01

The potential for mid-term (1985-2000) commercial application of the use of hydrogen for blending into the present natural gas delivery system as an energy supplement was studied. Successful development of advanced electrolyzer technology and availability of low-cost off-peak and spinning reserve electric-generating capacity are basic to this concept. Because no source was found that would make such a concept economically viable in the near future, a major, federally funded R, D, and D program aimed at proving the technical feasibility is not justified within the next five years. No overriding environmental, safety, legal, code, or regulatory considerations were found that would preclude the hydrogen-natural gas supplementation concept. Fostering of long-term research activities for hydrogen production using gas electrolysis is recommended in connection with other prospective end uses. ERA

N78-21324# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

DIESEL FUEL OILS, 1977

Ella Mae Shelton Nov. 1977 37 p refs

(BERC/PPS-77/5) Avail: NTIS HC A03/MF A01

Tests of 215 samples of diesel fuel oils from 100 refineries throughout the country were made by 31 petroleum refining companies. The analyses of the fuels are listed in tables for four groups according to type of diesel fuel. Each group of analyses is subdivided into five tabulations according to five general regions of the country where the fuels are marketed. The regions, containing a total of 16 districts, are shown on a map in the report. A total of 13 laboratory tests are listed and arranged by geographic marketing districts in decreasing order of sales volumes. Charts are included showing trends of averages of certain properties for the four types of diesel fuels. ERA

N78-21325# Radian Corp., Austin, Tex.

ENVIRONMENTAL ASSESSMENT OF LOW/MEDIUM BTU GASIFICATION Annual Report, Mar. 1976 - Oct. 1977

E. C. Cavanaugh and W. C. Thomas Dec. 1977 35 p

(Contract EPA-68-02-2147)

(PB-276580/8; EPA-600/7-77-142)

Avail: NTIS HC A03/MF A01 CSCL 07A

Main areas discussed are the current process technology background, environmental data acquisition, and control technology assessment. Information presented gives a general understanding of what has been accomplished and what can be anticipated. GRA

N78-21441*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

A REVIEW OF THE THERMOELECTRONIC LASER ENERGY CONVERTER (TELEC) PROGRAM AT LEWIS RESEARCH CENTER

D. L. Alger, E. J. Manista, and R. W. Thompson 1978 19 p

refs Presented at 3d Cnfn. on Radiation Energy Conversion, Moffett Field, Calif., 26-27 Jan. 1978; sponsored by NASA

(NASA-TM-73888; E-9503) Avail: NTIS HC A02/MF A01 CSCL 20E

The investigation of the Thermo-electronic Laser Energy Converter (TELEC) concept began with a feasibility study of a 1 megawatt sized TELEC system. The TELEC was to use either cesium vapor or hydrogen as the plasma medium. The cesium vapor TELEC appears to be the more practical device studied with an overall calculated conversion efficiency of greater than 48%. Following this study, a small TELEC cell was fabricated which demonstrated the conversion of a small amount of laser power to electrical power. The cell developed a short circuit current of 0.7 amperes and an open circuit voltage, as extrapolated from volt-ampere curves, of about 1.5 volts. Author

N78-21469*# California State Univ., Northridge.

BALL TO SEPARATOR CONTACT FORCES IN ANGULAR CONTACT BALL BEARINGS UNDER THRUST AND RADIAL LOADS Final Report

Lester J. Nypan Apr. 1978 110 p refs

(Grant NsG-3065)

(NASA-CR-2976) Avail: NTIS HC A06/MF A01 CSCL 13I

Experimental data are reported on ball to cage contact forces in a 110 mm bore ball bearing operating at speeds to 12,000 rpm under radial and thrust loads. Information is also reported on cage to inner race land contact force, cage to inner race land clearance, and cage to shaft speed ratios. Author

N78-21472*# Mechanical Technology, Inc., Latham, N. Y.

HYDRODYNAMIC AIR LUBRICATED COMPLIANT SURFACE BEARING FOR AN AUTOMOTIVE GAS TURBINE ENGINE. 1: JOURNAL BEARING PERFORMANCE Final Report

D. Ruscitto, J. McCormick, and S. Gray Apr. 1978 145 p refs Prepared for DOE

(Contracts NAS3-19427; EC-77-A-31-1040)

(NASA-CR-135368; CONS/9427-1)

Avail: NTIS HC A07/MF A01 CSCL 20E

A 38.1 mm (1.5 inch) diameter Hydresil Compliant Surface Air Lubricated Journal Bearing was designed and tested to obtain bearing performance characteristics at both room temperature and 315 C (600 F). Testing was performed at various speeds up to 60,000 rpm with varying loads. Rotating sensors provided an opportunity to examine the film characteristics of the compliant surface bearing. In addition to providing minimum film thickness values and profiles, many other insights into bearing operation were gained such as the influence of bearing fabrication accuracy and the influence of smooth foil deflection between the bumps. Author

N78-21479# Chrysler Corp., Detroit, Mich.

BASELINE GAS TURBINE DEVELOPMENT PROGRAM Quarterly Progress Report

F. W. Schmidt, comp. and C. E. Wagner, comp. 30 Apr. 1977 261 p

(Contract EY-76-C-02-2749)

(COO-2749-18) Avail: NTIS HC A12/MF A01

Initial running of the upgraded engine took place on July 13, 1976. The engine proved to be mechanically sound, but was also 43% deficient in power. A continuing corrective development effort has to date reduced the power deficiency to 32%. Compressor efficiency was increased 2 points by changing to a 28-channel diffuser and tandem deswirl vanes; improved processing of seals has reduced regenerator leakage from about 5 to 2.5% of engine flow; a new compressor turbine nozzle has increased compressor turbine stage efficiency by about 1 point; and adjustments to burner mixing ports have reduced the pressure drop from 2.8 to 2.1% of engine pressure. ERA

N78-21480# Westinghouse Electric Corp., Lester, Pa. Generation Systems Div.

HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE 1: PROGRAM AND SYSTEM DEFINITION. TOPICAL REPORT: LOW BTU GAS COMBUSTOR TECHNOLOGY DEVELOPMENT PLAN

Feb. 1977 117 p refs
(Contract EX-78-C-01-2290)

(FE-2290-26) Avail: NTIS HC A06/MF A01

An advanced canannular type combustor intended for integration with the high temperature turbine subsystem in a coal gasification combined cycle power plant was selected for development to the status of technology readiness after a preliminary design evaluation of three different concepts. Plans for the design, fabrication, and testing of three initial versions of the advanced concept combustor as a means of design optimization are described. To assure the ultimate feasibility of the economically producing large-scale Lamilloy combustors, the recommended program includes work to develop the improved fabrication techniques required. A comprehensive analytical evaluation is planned to explore the feasibility of additional advanced design features which will further reduce combustor cooling-air requirements as necessary to permit firing-temperature growth to the 3000 F level. ERA

N78-21483# Oak Ridge National Lab., Tenn.
LOOSE-PARTS MONITORING: PRESENT STATUS OF THE TECHNOLOGY, ITS IMPLEMENTATION IN US REACTORS, AND SOME RECOMMENDATIONS FOR ACHIEVING IMPROVED PERFORMANCE

R. C. Kryter, C. W. Ricker, and J. E. Jones (Tenn. Univ., Knoxville) 1977 6 p Presented at Specialists Meeting on Reactor Noise, Gatlinburg, Tenn., 19 Sep. 1977
(Contract W-7405-eng-26)

(CONF-770902-5) Avail: NTIS HC A02/MF A01

An assessment of the technical development status of loose-parts monitoring systems (LPMS) and their performance record to date in commercial light-water-cooled nuclear reactor plants was made during the spring of 1977, using an on-site personal interview and equipment demonstration approach. The study revealed that while presently demonstrated LPMS technology does indeed provide a capability for detecting the presence of those relatively massive loose parts that would likely constitute a serious operational or safety hazard to the plant, it unfortunately affords little information useful to the determination of the part's safety significance and has not yet attained the levels of sophistication and reliability ordinarily associated with safety systems. ERA

N78-21516*# South Dakota State Univ., Brookings. Remote Sensing Inst.

HCMM ENERGY BUDGET DATA AS A MODEL INPUT FOR ASSESSING REGIONS OF HIGH POTENTIAL GROUNDWATER POLLUTION Interim Report, Jan. - Mar. 1978

Donald G. Moore, Principal Investigator and J. Heilman Mar. 1978 4 p ERTS

(Contract NAS5-24206)

(E78-10111; NASA-CR-156127) Avail: NTIS
HC A02/MF A01 CSCL 08H

N78-21580# Colorado State Univ., Fort Collins.
ANALYSES OF METHODS FOR THE DETERMINATION OF WATER AVAILABILITY FOR ENERGY DEVELOPMENT

May 1977 128 p refs Sponsored in part by ERDA Prepared in cooperation with Colorado Div. of Water Resources, Denver (Contract FEA-CA-05-50041-00)

(FEA/G-77/059) Avail: NTIS HC A07/MF A01

How computer programs, using hydrologic, climatic, legal and economic data, could be used to provide information for use by planners and water administrators in evaluating the impact of water availability on energy development is demonstrated. This included definition of the types of information needs, evaluation of existing computer program capabilities, analyses

of data requirements for specific computer programs and/or to provide the specific information, selection of a group of computer programs that could provide the various levels of needed information, linking the computer programs to data sources, and applying the specific methodologies to a prototype area to demonstrate how specific information would be made available for use in the decision process. ERA

N78-21587 Maryland Univ., College Park.
MODELING OF RANKINE CYCLE/VAPOR COMPRESSION CYCLE COOLING SYSTEMS FOR SOLAR ENERGY APPLICATIONS Ph.D. Thesis

Akife Niluefer Egrican 1977 219 p

Avail: Univ. Microfilms Order No. 78-00374

Solar cooling system computer simulations were utilized in the determination of daily and seasonal cooling performance and in determining design values such as cooling capacity, collector area, storage size, and sizes of pumps and piping. RC/VCC solar cooling systems converted collected solar heat into a cooling effect. This was accomplished at the site of the installation by using the Rankine cycle to generate the shaft work required to drive a vapor compression cycle. The onsite solar powered Rankine cycle differs from a central station Rankine cycle in that the solar powered Rankine cycle operated at a much lower boiler temperature consistent with the use of flat plate or low concentration ratio collectors. Design and off design techniques were developed which took into account heat transfer effects and rotational component inefficiencies. Dissert. Abstr.

N78-21589*# IBM Federal Systems Div., Huntsville, Ala.
SYSTEM DESIGN PACKAGE FOR IBM SYSTEM ONE: SOLAR HEATING AND DOMESTIC HOT WATER

Feb. 1977 174 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150614) Avail: NTIS HC A08/MF A01 CSCL 10A

This report is a collation of documents and drawings that describe a prototype solar heating and hot water system using air as the collector fluid and a pebble bed for heat storage. The system was designed for installation into a single family dwelling. The description, performance specification, subsystem drawings, verification plan/procedure, and hazard analysis of the system was packaged for evaluation of the system with information sufficient to assemble a similar system. Author

N78-21590*# Joint Center for Graduate Study, Richland, Wash.
SPACE ELECTRIC POWER DESIGN STUDY

W. R. Martini Dec. 1976 126 p refs

(NASA Order A-29674B)

(NASA-CR-152031) Avail: NTIS HC A07/MF A01 CSCL 10A

The conversion of laser energy to electrical energy is discussed. Heat engines in which the laser heats the gas inside the engine through a window as well as heat engines in which the gas is heated by a thermal energy storage reservoir which has been heated by laser radiation are both evaluated, as well as the necessary energy storage, transmission and conversion components needed for a full system. Preliminary system concepts are presented and a recommended development program is outlined. It appears possible that a free displacer Stirling engine operating directly a linear electric generator can convert 65% of the incident laser energy into electricity. Author

N78-21591*# Elcam, Inc., Santa Barbara, Calif.
PROTOTYPE SOLAR HEATED HOT WATER SYSTEMS AND DOUBLE-WALLED HEAT EXCHANGERS: A COLLECTION OF QUARTERLY REPORTS Contractor Report, Sep. 1976 - Dec. 1977

Jan. 1978 34 p Prepared for DOE

(Contract NAS8-32245)

(NASA-CR-150591) Avail: NTIS HC A03/MF A01 CSCL 10A

The plan schedule and status of multiple objectives to be achieved in the development, manufacture, installation, and maintenance of two solar heated hot water prototype systems and two heat exchangers are reported. A computer program

developed to resolve problems and evaluate system performance is described. Author

N78-21592*# Houston Chemical Co., Corpus Christi, Tex.
SOLAR HEAT TRANSPORT FLUID Quarterly Report, Nov. 1977 - Jan. 1978

Feb. 1978 18 p Prepared for DOE
(Contract NAS8-32255)

(NASA-CR-150612) Avail: NTIS HC A02/MF A01 CSCL 10A

The progress made on the development and delivery of noncorrosive fluid subsystems is reported. These subsystems are to be compatible with closed-loop solar heating or combined heating and hot water systems. They are also to be compatible with both metallic and non-metallic plumbing systems. At least 100 gallons of each type of fluid recommended by the contractor will be delivered under the contract. The performance testing of a number of fluids is described. Author

N78-21595*# IBM Federal Systems Div., Huntsville, Ala.
CENTRAL DATA PROCESSING SYSTEM (CDPS) USER'S MANUAL: SOLAR HEATING AND COOLING PROGRAM
Sep. 1976 168 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150580; IBM-7933252) Avail: NTIS HC A08/MF A01 CSCL 10A

The software and data base management system required to assess the performance of solar heating and cooling systems installed at multiple sites is presented. The instrumentation data associated with these systems is collected, processed, and presented in a form which supported continuity of performance evaluation across all applications. The CDPS consisted of three major elements: communication interface computer, central data processing computer, and performance evaluation data base. Users of the performance data base were identified, and procedures for operation, and guidelines for software maintenance were outlined. The manual also defined the output capabilities of the CDPS in support of external users of the system. Author

N78-21596*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFLUENT CHARACTERIZATION FROM A CONICAL PRESSURIZED FLUID BED

R. J. Priem, R. J. Rollbuhler, and R. W. Patch Dec. 1977 15 p refs Presented at the 5th Intern. Conf. on Fluidized-Bed Combust., Washington, D. C., 12-14 Dec. 1977

(NASA-TM-73897; E-9524) Avail: NTIS HC A02/MF A01 CSCL 10A

To obtain useable corrosion and erosion results it was necessary to have data with several levels of particulate matter in the hot gases. One level of particulate loading was as low as possible so that ideally no erosion and only corrosion occurred. A conical fluidized bed was used to obtain some degree of filtration through the top of the bed which would not be highly fluidized. This would minimize the filtration required for the hot gases or conversely the amount of particulate matter in the hot gases after a given level of filtration by cyclones and/or filters. The data obtained during testing characterized the effluent from the bed at different test conditions. A range of bed heights, coal flows, air flows, limestone flows, and pressure are represented. These tests were made to determine the best operating conditions prior to using the bed to determine erosion and corrosion rates of typical turbine blade materials. Author

N78-21597*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
OWENS-ILLINOIS LIQUID SOLAR COLLECTOR MATERIALS ASSESSMENT

R. L. Nichols Mar. 1978 36 p Prepared for DOE

(NASA-TM-78163) Avail: NTIS HC A03/MF A01 CSCL 10A

From the beginning, it was noted that the baseline drawings for the liquid solar collector exhibited a distinct weakness concerning materials specification where elastomers, plastics, and foam insulation materials were utilized. A relatively small effort by a competent design organization would alleviate this deficiency.

Based on results obtained from boilout and stagnation tests on the solar simulator, it was concluded that proof testing of the collector tubes prior to use helps to predict their performance for limited service life. Fracture mechanics data are desirable for predicting extended service life and establishing a minimum proof pressure level requirement. The temperature capability of this collector system was increased as the design matured and the coating efficiency improved. This higher temperature demands the use of higher temperature materials at critical locations in the collector. Author

N78-21599*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SMALL POWER SYSTEMS SOLAR ELECTRIC WORKSHOP PROCEEDINGS, VOLUME 1: EXECUTIVE REPORT, VOLUME 2: INVITED PAPERS

R. Ferber, ed. and D. Evans, ed. Feb. 1978 24 p Workshop held at Aspen, Colo., 10-12 Oct. 1977

(Contract NAS7-100)

(NASA-CR-156165; JPL-Pub-78-10-Vol-1;

DOE/JPL-1060-78/1) Avail: NTIS HC A02/MF A01 CSCL 10B

The background, objectives and methodology used for the Small Power Systems Solar Electric Workshop are described, and a summary of the results and conclusions developed at the workshop regarding small solar thermal electric power systems is presented. Author

N78-21601*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHARACTERIZATION OF SOLAR CELLS FOR SPACE APPLICATIONS, VOLUME 1: ELECTRICAL CHARACTERISTICS OF OCLI VIOLET SOLAR CELLS AS A FUNCTION OF INTENSITY AND TEMPERATURE

T. A. Casad, R. G. Downing, and R. S. Weiss 15 Mar. 1978 38 p

(Contract NAS7-100)

(NASA-CR-156162; JPL-Pub-78-15-Vol-1)

Avail: NTIS HC A03/MF A01 CSCL 10A

Electrical characteristics of OCLI violet N/P silicon cells are presented in graphical and tabular format as function of solar illumination intensity and temperature. Author

N78-21602*# Life Sciences Engineering, Morrison, Colo.
SUBSYSTEM DESIGN PACKAGE FOR SOLAR II COLLECTOR Contractor Report, May 1977 - Dec. 1977

Jan. 1978 38 p Prepared for DOE

(Contract NAS8-32261)

(NASA-CR-150611) Avail: NTIS HC A03/MF A01 CSCL 10A

The requirements for the design and performance of the Solar 2 Collector Subsystem developed for use in solar heating of single family residences and mobile homes are presented. Installation drawings are included. J.M.S.

N78-21603*# Solar Engineering and Mfg. Co., Deerfield Beach, Fla.

PRELIMINARY DESIGN PACKAGE FOR SOLAR HOT WATER SYSTEM

Dec. 1977 18 p refs Prepared for DOE

(Contract NAS8-32248)

(NASA-CR-150617) Avail: NTIS HC A02/MF A01 CSCL 10A

This package includes technical information, schematics, drawings and brochures of the solar hot water system. This system consists of the following subsystems: collector, storage, transport, control, auxiliary energy, and Government-furnished site data acquisition. The two units being manufactured will be installed at Loxahatchee, Florida, and Macon, Georgia. Author

N78-21604*# Owens-Illinois, Inc., Toledo, Ohio.
DEVELOPMENT OF PROTOTYPE AIR/LIQUID SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Nov. 1977 - 31 Jan. 1978

Jan. 1978 9 p Prepared for DOE

(Contract NAS8-32259)

(NASA-CR-150627; QR-5) Avail: NTIS HC A02/MF A01 CSCL 10A

The installation and layout design, and parts fabrication are described. The master development schedule for the design of the system is also included. Author

N78-21606* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala. Structures and Propulsion Lab.

USE OF THE MARSHALL SPACE FLIGHT CENTER SOLAR SIMULATOR IN COLLECTOR PERFORMANCE EVALUATION

William R. Humphries Apr. 1978 128 p refs Prepared for DOE

(NASA-TM-78165) Avail: NTIS HC A07/MF A01 CSCL 10A

Actual measured values from simulator checkout tests are detailed. Problems encountered during initial startup are discussed and solutions described. Techniques utilized to evaluate collector performance from simulator test data are given. Performance data generated in the simulator are compared to equivalent data generated during natural outdoor testing. Finally, a summary of collector performance parameters generated to date as a result of simulator testing are given. Author

N78-21607# Tennessee Univ., Knoxville. Environment Center.

ENERGY CONSERVATION IN THE HOME: AN ENERGY EDUCATION/CONSERVATION CURRICULUM GUIDE FOR HOME ECONOMICS TEACHERS

Lil Clinard and Nancy Collins Oct. 1977 332 p refs (Contract EY-76-S-05-5049)

(EDM-1028) Avail: NTIS HC A15/MF A01

A guide designed for home economics teachers as a source of information, instructional materials, and suggested references about the energy situation as a whole, energy concepts, and the use of energy in the home is presented. Emphasis is placed on conservation measures applicable to the home. J.M.S.

N78-21608# Open Univ., Milton (England).

COMBINED HEAT AND POWER: A DISCUSSION OF ENERGY PAPER 20

Rosalind Armson Jun. 1977 51 p refs

(ERG-018) Avail: NTIS HC A04/MF A01; Secretary, Energy Research Group, Milton Keynes, Engl. HC £ 2.50

The implications of a combined heat and power (CHP) district heating program were examined. The system used a modified steam cycle so that heat at a temperature of 100 C could be bled off and sold to consumers. Thermodynamic efficiency of the cycle depended upon the difference between the upper and lower temperatures; an increase in the lower temperature decreased the efficiency of generation of electricity. The CHP was discussed in terms of cost effectiveness, heating strategies, insulation, solar technology, and social factors. Author

N78-21610# Committee on Public Works and Transportation (U. S. House).

USE OF SOLAR ENERGY IN FEDERAL BUILDINGS

Washington GPO, 1977 308 p refs Hearings on H.R. 5821, H.R. 5778, H. Res. 322 and H.R. 6831 (sections 721 through 746) before Subcomm. on Public Buildings and Grounds of the Comm. on Public Works and Transportation, 95th Congr., 1st Sess., 2-4 May and 22-23 Jun. 1977

(GPO-94-365) Avail: Subcomm. on Public Buildings and Grounds

Presented are testimonies, bills and acts for the use of solar energy in Federal Buildings. The bills are designed to insure energy conservation by development of renewable and inexhaustible energy sources to insure long term economic growth. The bills will allow Government to provide leadership which will then be passed on to the private sector. A program is presented to promote the use of commonly accepted methods to establish and compare the life-cycle costs of operating residential, commercial and industrial buildings, and the life-cycle fuel and energy requirements of such buildings. A five year energy-in-Government program is established for the procurement and installation of solar systems for hot water, space heating and electricity production in new and existing Federal Buildings. GY

N78-21611* National Aeronautics and Space Administration, Washington, D. C.

SPACE SOLAR POWER. DESCRIPTION OF CONCEPT, RESULTS OF PRELIMINARY STUDIES, REQUIREMENTS FOR EVALUATION

30 Mar. 1977 21 p

(NASA-TM-79436) Avail: NTIS HC A02/MF A01 CSCL 10A

The nation is actively pursuing alternate sources of energy because of the problems or concerns related to obtaining required energy for the future from oil, gas, nuclear, and coal sources. Solar energy is an obvious candidate for consideration. Its use in the past has been limited by the relative cost of collecting and converting solar energy into electrical power. The increasing costs of other energy sources will make solar energy more attractive. During recent years a new concept for the collection of solar energy has been developed. This concept involves the location of solar power stations in space. The concept, results of preliminary studies, and requirements for space evaluation of such a project are discussed. Author

N78-21612* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

SOLAR POWER SATELLITES

Christopher C. Kraft, Jr. [1977] 7 p

(NASA-TM-79434) Avail: NTIS HC A02/MF A01 CSCL 10A

A satellite based energy concept is described, including the advantages of the basic concept, system characteristics, cost, and environmental considerations. An outline of a plan for the further evaluation and implementation of the system is given. It is concluded that the satellite concept is competitive with other advanced power generation systems when a variety of factors are considered, including technical feasibility, cost, safety, natural resources, environment, baseload capability, location flexibility, land use, and existing industrial base for implementation. Author

N78-21613# Committee on Finance (U. S. Senate).

INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES

Washington GPO 1977 248 p refs Hearings before Subcomm. on Energy and Foundations of the Comm. on Finance, 95th Congr., 1st Sess., 20-21 Jun. 1977

(GPO-93-810) Avail: SOD

Testimony was given by all sectors of the energy community in an attempt to define the problems in energy production and to clarify the alternatives available with existing technology. Some of the energy technologies discussed were: coal gasification, geothermal utilization, organic waste conversion, and solar energy. Various economic incentives were proposed to encourage energy exploration and development by industry. P.R.A.

N78-21616# Naval Postgraduate School, Monterey, Calif.

SOLAR ENERGY FOR THE NAVAL SHORE ESTABLISHMENT M.S. Thesis

Bruce Burgee Geibel Dec. 1977 249 p refs

(AD-A050026) Avail: NTIS HC A11/MF A01 CSCL 03/2

This thesis discusses the background and extent of the current national energy crisis, and reviews the alternative energy sources available to the United States Navy other than conventional fossil fuels. An in-depth analysis is made of the advantages, disadvantages and techniques of one of these alternatives, solar energy conversion. The National Solar Energy Program is reviewed, as is the role of the Department of Defense and the United States Navy in this program. Methods of 'retrofitting' existing Navy facilities with solar energy systems are discussed, as are new construction techniques. The thesis further contains techniques for life-cycle costing of alternative solar energy systems, which include computer model programs such as BASIC Language, F-Chart calculations, and SOLCOST calculations. The thesis concludes with suggestions for establishing a viable solar energy program on an activity or individual basis. A comprehensive reference list and bibliography is provided to identify where technical and engineering details can be found. Author (GRA)

N78-21619# General Accounting Office, Washington, D. C. International Div.

US ENERGY CONSERVATION COULD BENEFIT FROM EXPERIENCES OF OTHER COUNTRIES

10 Jan. 1978 41 p
(PB-276006/4; ID-78-4) Avail: NTIS HC A03/MF A01 CSCL 10A

Energy conservation policies and practices of four European countries are discussed. Information on those effective measures which seemed to be applicable to U.S. efforts are noted. GRA

N78-21620# Williamson Engineering Associates, Inc., Navarre, Fla.

THE APPLICATION OF WIND ENERGY SYSTEMS TO DESALINATION

William R. Williamson, John E. Westberg, and William R. Williamson 22 Apr. 1977 68 p refs
(Contract D1-14-34-0001-7523)
(PB-276174/O; W78-02701; OWRT/S-78/1) Avail: NTIS HC A04/MF A01 CSCL 10B

The application of wind energy systems to membrane processes for brackish water conversion is presented. Commercially available wind turbines and those under development were available for producing electrical energy at costs ranging from 5 cents down to 1.8 cents per kilowatt hour. It was still possible to reach costs for desalting brackish water at less than \$1.00 per thousand gallons with large wind energy/desalination systems. The coupling of wind energy turbines to electro dialysis and reverse osmosis offered technological advantages, such as variable energy outputs from wind turbines, to optimize variable fluid flows in the desalination processes for maximum, economic production of potable water. Research and development efforts in this direction are indicated. GRA

N78-21621# Federal Energy Regulatory Commission, Washington, D. C. Office of Electric Power Regulation.

PROJECTED 1977 - 1978 WINTER ELECTRIC LOAD-SUPPLY SITUATION, CONTIGUOUS UNITED STATES

1 Dec. 1977 35 p
(PB-276269/8) Avail: NTIS HC A03/MF A01 CSCL 10A
Data concerning projected electrical peak loads and available power resources for the 1977-78 winter period are presented, as reported by electric utilities. GRA

N78-21622# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

STUDY OF TREATMENT METHODS FOR GEOTHERMAL FLUIDS

Sidney L. Phillips, Ashwani K. Mathur, and Raymond E. Doebler May 1977 13 p refs Presented at the SPE Intern. Symp. on Oilfield and Geothermal Chem., Calif. Univ., San Diego, 27-29 Jun. 1977

(Contract W-7405-eng-48)
(LBL-6337; Conf-770609-5) Avail: NTIS HC A02/MF A01
The methodology used to control geothermal scaling and corrosion was studied. The information used for this study was screened from the geothermal, oil and gas, waste water disposal, and boiler water treatment industries. Current methods of corrosion control center around planned replacement of piping and other plant components, development of materials with improved corrosion resistance. ERA

N78-21623# California Univ., Berkeley. Lawrence Berkeley Lab.

DISTRIBUTED TECHNOLOGIES IN CALIFORNIA'S ENERGY FUTURE, VOLUME 1

M. Christensen, ed., P. Craig, ed., C. B. McGuire, ed., and M. Simmons, ed. Sep. 1977 248 p refs
(Contract W-7405-eng-48)
(LBL-6831-Vol-1) Avail: NTIS HC A11/MF A01

Alternative energy sources based on renewable energy forms are considered in terms of development of distribution energy systems with emphasis on the California setting. Trends in energy supply and patterns of energy use are reviewed, energy resources are discussed including biomass, solar energy, geothermal energy, and wind energy, and environmental and land use factors are considered. Economic, social, and political issues are included. It is concluded that it is possible to run a complex, highly industrialized, post-industrial society entirely on renewable

resources internal to the state, and that this can occur in the presence of growth in gross state product. J.M.S.

N78-21624# Waterloo Univ. (Ontario). Research Inst.
STUDIES ON METHODS OF REDUCING HEAT LOSSES FROM FLAT PLATE SOLAR COLLECTORS, PHASE 2 Annual Progress Report, 1 Feb. 1978 - 1 Jan. 1977

K. G. T. Hollands, G. D. Raithby, and T. E. Unny Jan. 1977 44 p refs
(Contract EY-76-C-02-2597)
(COO/2597-3) Avail: NTIS HC A03/MF A01

Free convective heat loss from V corrugated absorber plate to a plane glass cover, has shown that, for the same average spacing, the free convective heat loss was greater for a V corrugated absorber plate than for a plane absorber plate. However, provided the average spacing was large enough, the amount of increase was slight. Free convective heat loss in a honeycomb solar collector in which the honeycomb consisted of a set of horizontal partitions, or slits, has shown that provided the solar collector was tilted to near vertical, such a honeycomb gave better free convective loss suppression than did a square-celled honeycomb having the same amount of material. ERA

N78-21626# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Quarterly Report

R. R. Hautala and C. R. Kotal 15 Sep. 1977 40 p refs
(Contract EY-76-S-09-0893)
(SRO-893-6) Avail: NTIS HC A02/MF A01

It was found that the triphenylcyclopropenyl-nickel compound was an active catalyst for the conversion of quadricyclene to norbornadiene. A variety of triphenylcyclopropenyl-nickel derivatives were synthesized in order to determine their structure activity relationships with respect to catalysis of the conversion of quadricyclene to norbornadiene. An approach to the development of a polymer bound catalyst for the conversion of quadricyclene to norbornadiene based on an ion exchange resin was also explored. ERA

N78-21627# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Quarterly Report

R. R. Hautala and C. R. Kotal 15 Mar. 1977 15 p refs
(Contract EY-76-S-09-0893)
(SRO-893-8) Avail: NTIS HC A02/MF A01

Research on polymer organic sensitizers and polymer inorganic sensitizers for the conversion of norbornadiene to quadricyclene, for thermochemical storage of solar heat is described. Also, research on the catalysis of the conversion of quadricyclene to norbornadiene is described. ERA

N78-21628# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Annual Report, 15 Jun. 1978 - 14 Jun. 1977

R. R. Hautala and C. R. Kotal 15 Mar. 1977 16 p refs
(Contract EY-76-S-09-0893)
(SRO-893-9) Avail: NTIS HC A02/MF A01

Significant progress toward the development of a solar energy storage system based on the norbornadiene-quadricyclene interconversion was achieved. New sensitizers and catalysts were discovered and conditions found where single cycles of the photosensitization step and the catalytic reversion step appear to be quantitative. Both sensitizers and catalysts were successfully incorporated onto insoluble polymeric supports. The long term stability of these components is currently being tested using a recently constructed prototype device designed for multiple recycling experiments. Investigations are also underway on design modifications which will allow incorporation of the norbornadiene-quadricyclene system into currently available state-of-the-art solar collectors. ERA

N78-21629# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Quarterly Report

R. R. Hautala and C. R. Kotal 15 Jun. 1977 22 p refs
(Contract EY-76-S-09-0893)
(SRO-893-10) Avail: NTIS HC A02/MF A01

Research on polymeric organic sensitizers and polymeric inorganic sensitizers for the conversion of norbornadene to quadricyclene and catalysts for the conversion of quadricyclene to norbornadene is described. The interconversion of norbornadene and quadricyclene is studied for its possible use for thermochemical solar energy storage. ERA

N78-21630# San Diego Gas and Electric Co., Calif.
GEOTHERMAL ENVIRONMENTAL STUDIES, HEBER REGION, IMPERIAL VALLEY, CALIFORNIA. ENVIRONMENTAL BASELINE DATA ACQUISITION Final Report
Feb. 1977 308 p refs
(EPRI-ER-352) Avail: NTIS HC A14/MF A01

The Heber area of the Imperial Valley was selected as one of the candidate geothermal reservoirs. Documentation of the environmental conditions presently existing in the Heber area was required for assessment of environmental impacts of future development. An environmental baseline data acquisition program to compile available data on the environment of the Heber area was reported. The program included a review of pertinent existing literature, interviews with academic, governmental, and private entities, combined with field investigations and meteorological monitoring to collect primary data. Results of the data acquisition program were compiled in terms of three elements: the physical, the biological, and socioeconomic settings. ERA

N78-21631# California Univ., Berkeley. Lawrence Berkeley Lab.
RESULTS OF RESERVOIR EVALUATION TESTS, 1976 EAST MESA GEOTHERMAL FIELD, CALIFORNIA
T. N. Narasimhan, D. G. McEdwards, and P. A. Witherspoon
Jul. 1977 11 p
(Contract W-7405-eng-48)
(LBL-6369) Avail: NTIS HC A02/MF A01

Two interference well tests were conducted to define the geothermal reservoir's geometry and hydrologic characteristics. Temperature profiles taken indicate that the reservoir is approximately 3000 feet thick and is located about 6000 feet below the ground surface. The temperature at depth is approximately 350 C. The two well tests, each of approximately 10 days' duration yield respectively reservoir transmissivities of 11,200 and 29,500 millidarcy-feet and compressibilities of 5.7 x .001 and 2.1 x .001 feet per psi. The tests also indicate the possible presences of a sealed fault and a leaky fault in the reservoir. ERA

N78-21632# Commonwealth Research Corp., Chicago, Ill.
GASIFICATION COMBINED CYCLE TEST FACILITY, PEKIN, ILLINOIS Monthly Technical Progress Report, 25 Jun. - 26 Jul. 1977
Aug. 1977 20 p refs
(Contract EF-77-C-01-2352)
(FE-2352-03) Avail: NTIS HC A02/MF A01

Progress in developing a prototype combined cycle power plant which includes a coal gasification plant is reported. Information is included on meetings held; completion of procurement procedures; gas turbine, compressors, blowers, and heat exchanger; specifications for heat recovery steam generators and auxiliary equipment; control systems; electrical equipment; and vessels. ERA

N78-21633# Brookhaven National Lab., Upton, N. Y.
ENERGY SYSTEMS ANALYSIS AND DEVELOPMENT
P. F. Palmedo 5 Jul. 1977 23 p refs Presented at Workshop on Systems Develop., Seoul, Rep. of Korea, 12-15 Jul. 1977
(Contract EY-76-C-02-0016)
(BNL-22969; Conf-770742-1) Avail: NTIS HC A02/MF A01
Systems analysis of energy problems, their technical and social complexity, and their long time scale is discussed in terms of formulating national energy policy. A number of models developed for such analysis are described. ERA

N78-21634# Brookhaven National Lab., Upton, N. Y.
PLANNER'S ENERGY WORKBOOK: A MANUAL FOR EXPLORING RELATIONSHIPS BETWEEN LAND USE AND ENERGY UTILIZATION

T. Owen Carroll, Robert Nathans, Philip F. Palemedo, and Robert Stern Jun. 1977 129 p refs Prepared in cooperation with State Univ. of New York, Stony Brook
(Contract EY-76-C-02-0016)
(BNL-50633) Avail: NTIS HC A07/MF A01

Procedures that were used to carry out community and regional energy analyses are described. The choice of land use activity parameters and their relations to energy use characteristics are associated with the normal planning concepts of land use density, type of residential development, commercial floorspace, industrial sales and employment, and shopping and work trip lengths. Energy related intensity coefficient are expressed in a form that permits the analysis of short-term conservation strategies such as the retrofit of insulation and the introduction of new technologies such as solar energy. An integrating framework is provided to construct total community or area energy consumption profiles and future needs; to examine compatibility between area requirements and the energy supply-distribution system serving the area; and to evaluate the implications for energy use of the physical configuration of urban, suburban and rural areas. ERA

N78-21635# California Univ., Berkeley. Lawrence Berkeley Lab.
DISTRIBUTED TECHNOLOGIES IN CALIFORNIA'S ENERGY FUTURE: A PRELIMINARY REPORT, VOLUME 2
M. Christensen, ed., P. Craig, ed., C. B. McGuire, ed., and M. Simmons, ed. Sep. 1977 381 p refs
(Contract W-7405-eng-48)
(LBL-6831-Vol-2) Avail: NTIS HC A17/MF A01

Given a perspective that places environmental and social impacts at the heart of the energy predicament rather than on the periphery, it becomes essential to compare the impacts produced by alternative energy options systematically, comprehensively, and objectively. The information needed to do this properly, even for a limited set of technologies and a limited geographic and cultural context (e.g., California), unfortunately does not exist. An attempt was made to outline a logical framework for such a comparison, and to hang on that framework the partial information that is available on the environmental impacts of some major conventional and nonconventional energy options for California. The objective was to permit at least some partial and preliminary conclusions about this aspect of the soft energy options, and to identify those areas where additional knowledge is most badly needed. Author

N78-21637# SRI International Corp., Menlo Park, Calif.
FUEL AND ENERGY PRICE FORECASTS: QUANTITIES AND LONG-TERM MARGINAL PRICES, VOLUME 1 Final Report
Sep. 1977 169 p
(EPRI Proj. 759-1)
(EPRI-EA-433-Vol-1) Avail: NTIS HC A08/MF A01

Forecasts of long-term marginal fuel and energy prices over the period 1985 to 2000 are shown in constant 1975 dollars on a regional basis for the United States. The major sources of energy analyzed are coal, uranium, crude oil, syncrude (produced from coal or oil shale), petroleum products, natural gas, and synthetic gas. Prices are shown at different levels of the energy system, e.g., from the point of production through consumption. Prices of delivered fuels are presented for four sectors: electric power generation, residential/commercial, industrial, and transportation. Because all fuels in the energy system are interrelated, the emphasis was to specify these relationships and to forecast prices (and quantities) at every level of the energy system. This was done within the framework of the SRI National Energy Model that explicitly models primary energy production and conversion, transportation and distribution, and end-use conversion. ERA

N78-21638# Minnesota Univ., Minneapolis.
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY

SYSTEM, EXECUTIVE SUMMARY, PHASE 1 Final Report, 1 Feb. - 31 May 1977

Jun. 1977 122 p

(Contract EC-77-C-02-4210)

(COO/4210-1-Summ) Avail: NTIS HC A06/MF A01

The community energy system focused on modifications to the central heating plant, wherein the capability of generating additional steam and by product electricity will be established by acquiring a retired generating plant. Adding on of community gas/oil committed loads to the coal fired system is examined and the installation of a pyrolysis system for the safe disposal of infections and hazardous waste whereby a low Btu gas will be generated is investigated. This will then be utilized in the plant as a supplement to its primary fuel requirements. The conversion of part of the steam distribution system to a variable flow and variable temperature hot water system is presented.

ERA

N78-21639# City of Trenton, N. J. Dept. of Planning and Development.**TRENTON ICES, VOLUME 1, PHASE 1 Final Report**

14 Jul. 1977 68 p

(Contract EC-77-C-02-4212)

(COO/4212-1/1-Vol-1) Avail: NTIS HC A04/MF A01

Phase 1 Preliminary Design and Evaluation for a Grid Connected Thermally Controlled Integrated Community Energy System (ICES) for Trenton, New Jersey has been carried out. The findings of the study are that: it is technically feasible, utilizing commercially available hardware; it is economically competitive with conventional alternatives for heating and cooling buildings; it will produce an overall reduction in fuel consumed of 32 to 43% when compared with conventional alternatives for heating and cooling buildings; it will consume 4 to 9% more oil than will conventional alternatives for heating and cooling buildings; it should be owned and operated by Public Service Electric and Gas Co. (PSE and G); and it can provide thermal energy 21 months after the start of Phase II and electrical energy 32 months after the start of Phase II.

ERA

N78-21640# California State Dept. of Housing and Community Development, Sacramento.**CALIFORNIA RESIDENTIAL ENERGY STANDARDS: PROBLEMS AND RECOMMENDATIONS RELATING TO IMPLEMENTATION, ENFORCEMENT, DESIGN**

Aug. 1977 373 p

(Contract EY-76-C-03-1178)

(SAN/1178-1) Avail: NTIS HC A16/MF A01

Documents relevant to the development and implementation of the California energy insulation standards for new residential buildings were evaluated and a survey was conducted to determine problems encountered in the implementation, enforcement, and design aspects of the standards. The impact of the standards on enforcement agencies, designers, builders and developers, manufacturers and suppliers, consumers, and the building process in general is summarized. The impact on construction costs and energy savings varies considerably because of the wide variation in prior insulation practices and climatic conditions in California. The report concludes with a series of recommendations covering all levels of government and the building process.

ERA

N78-21641# De Laureal Engineers, Inc., New Orleans, La. GRID-CONNECTED ICES PRELIMINARY FEASIBILITY ANALYSIS AND EVALUATION, VOLUME 1: EXECUTIVE SUMMARY Final Report

30 Jun. 1977 56 p Prepared in cooperation with Health Educ. Authority of La., New Orleans, New Orleans Public Serv., Inc., La. and Orr-Schelen-Maxeron and Associates, Inc., Minneapolis, Minn.

(Contract EC-77-C-02-4214)

(COO/4214-1/1-Vol-1) Avail: NTIS HC A04/MF A01

A group of hospitals, clinics, research facilities, and medical education facilities, was chosen as the site for the demonstration of a grid-connected integrated community energy system (ICES). The contract work included a preliminary energy supply/demand assessment of the demonstration community, a preliminary feasibility analysis and conceptual design of a candidate demon-

stration system, preliminary assessment of institutional factors, preparation of a detailed work management plan for subsequent phases of the demonstration program, firming up of commitments from participating parties, and reporting thereon. ERA

N78-21642# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.**ENERGY ORIENTED STUDY OF INDUSTRIAL CYCLONE SEPARATORS**

Neil D. Cox, Allan S. Richardson, and W. Paul Jensen Sep. 1977 40 p refs

(Contract EY-76-C-07-1570)

(TREE-1174) Avail: NTIS HC A03/MF A01

This study was conducted to obtain data for an estimate of the current and anticipated energy demand for the operation of industrial cyclone separators. The information sources used were technical papers and texts on the subject and a survey of manufacturers of cyclone separators. Estimates of the nationwide energy consumption of single gas cyclones, multiple tube gas cyclones, and liquid cyclones were obtained separately. These were added to obtain the total consumption for the three types. To this total was added an energy consumption estimate for the wet cyclone scrubbers manufactured by a single company. The final estimate of the gross annual energy consumption of cyclone devices is 0.38 exajoule (0.37 quad). ERA

N78-21643# Institute for Energy Analysis, Oak Ridge, Tenn. THERMODYNAMICS AND ENERGY POLICY

R. M. Rotty and E. R. VanArtsdalen Jul. 1977 26 p refs

(Contract EY-76-C-05-0033)

(ORAU-IEA-M-77-18) Avail: NTIS HC A03/MF A01

Thermal efficiency was widely used in evaluating energy exchanges, but this procedure gave no consideration to quality of energy being used. Thermodynamics indicated that different energy quantities had different energy quality, and efficient use of energy required a matching of the energy quality supplied to that required for the given task. Thermodynamic efficiency as a figure of merit in evaluating energy exchanges had the advantage of considering energy quality. It did not give information to assist in the trade offs between resources and the other considerations that were made in the formulation of an energy policy. ERA

N78-21644# National Consumer Research Inst., Washington, D. C.**PROCEEDINGS OF THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION CONFERENCE ON COGENERATION AND INTEGRATED ENERGY/UTILITY SYSTEMS**

1977 209 p refs Proc. held at Washington, D. C., 3 Jun. 1977 Prepared for Argonne National Lab.

(Contracts W-31-109-eng-38)

(CONF-770632) Avail: NTIS HC A10/MF A01

Cogeneration or integrated energy/utility systems have established their place in contributing energy supply in major cities throughout the United States. Cogeneration has been primarily associated with industrial processes, while integrated energy systems have been primarily associated with residential and commercial applications or with district heating of large metropolitan areas. The conference was conceived to bring the two ideas together as much as technically and economically possible. An attempt was made to broaden the scope and integrate the two concepts establishing a very workable basis for the utilization of both in the performance of providing utility services to industrial applications and population centers. The resurgence of cogeneration evolves through the efforts to maximize the use of resources in the United States today. This forum, brought together some of the most prominent individuals associated with the concepts of cogeneration, community energy systems, and integrated utility systems. Author (ERA)

N78-21645# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.**SOLAR SPACE HEATING SYSTEMS USING ANNUAL HEAT STORAGE Progress Report, 1 Jul. - 31 Dec. 1976**

F. C. Hooper and C. R. Attwater Apr. 1977 99 p

(Contract EY-76-C-02-2939)

(COO/2939-1) Avail: NTIS HC A05/MF A01

N78-21647

The assumptions made in the development of the computer simulation used for modeling annual storage solar heating systems are outlined. A vertical cylindrical storage tank was used with homogeneous soil properties and a water table and ground surface acting as sinks. The equations are described in a general way. ERA

N78-21647# Oak Ridge National Lab., Tenn.
ANNUAL CYCLE ENERGY SYSTEM CONCEPT AND APPLICATION

John C. Moyers and Eugene C. Hise 1977 8 p refs Presented at Faculty Inst. Energy Conserv.: Theory and Practice, Oak Ridge, Tenn., 1 Aug. 1977

(Contract W-7405-eng-26)

(CONF-770870-1) Avail: NTIS HC A02/MF A01

The Annual Cycle Energy System (ACES), under development at ERDA's Oak Ridge National Laboratory, promises to provide space heating, air conditioning, and water heating at a significantly lower expenditure of energy than conventional space conditioning and water heating systems. The ACES embodies heat pumping, thermal storage and, where climate dictates, solar assistance. The concept is described, along with variations in design that permit flexibility to maximize energy conservation or to provide load management capabilities. Installations that exist or are under construction are described and variations that are incorporated to meet specific objectives are discussed. ERA

N78-21648# Oak Ridge National Lab., Tenn.
CONSERVATION AND THE CONTRIBUTIONS FROM ADVANCED ENERGY SOURCE

S. E. Beall, Jr. 1977 31 p Presented at Faculty Inst. Energy Conserv.: Theory and Practice, Oak Ridge, Tenn., 2 Aug. 1977 (Contract W-7405-eng-26)

(CONF-770870-2) Avail: NTIS HC A03/MF A01

Advanced energy sources being developed by ERDA are discussed, along with contribution of 1 Q (quadrillion Btu) or less in 1985, and estimates perhaps optimistically that these new technologies can contribute as much as 25 Q of our energy needs by 2000 A.D. ERA

N78-21649# Battelle Pacific Northwest Labs., Richland, Wash.
GEOTHERMAL ENERGY POTENTIAL FOR DISTRICT AND PROCESS HEATING APPLICATIONS IN THE US: AN ECONOMIC ANALYSIS

C. H. Bloomster, L. L. Fassbender, and C. L. McDonald Aug. 1977 61 p refs

(Contract EY-76-C-06-1830)

(BNWL-2311) Avail: NTIS HC A04/MF A01

Geothermal energy is competitive for space and process heating applications over significant distances when employed on a large scale to serve concentrated markets. Under these conditions geothermal energy from 90 to 150 C hydrothermal resources should be economically competitive for high density urban district heating out to distances of 50 miles from the wellhead. Supply curves (price-quantity relationships) were developed for both process heating and district heating applications for distances out to 50 miles. The 90 to 150 C hydrothermal resources, which were identified in the assessment of geothermal resources by the U.S. Geological Survey, contain usable energy for space and process heat equivalent to 50 billion barrels of oil. The potential demand for space and process heat near these hydrothermal resources is large; over 10% of the U.S. population resides within 40 miles of the resources. ERA

N78-21650# Bechtel Corp., San Francisco, Calif.
DEFINITION OF REQUIREMENTS FOR GEOTHERMAL POWER CONVERSION SYSTEM STUDIES

30 Jun. 1977 45 p refs

(Contract W-7405-eng-48)

(UCRL-13751) Avail: NTIS HC A03/MF A01

Candidate power conversion systems and criteria for comparing these systems are listed. The elements of each conceptual design and standard approaches to equipment design are described. The methods used to calculate heat and mass

balances and the data used in the calculations are described. The method used in developing the economics of each system is described and factors such as construction wage rates common to all systems are included. Standard methods for developing the conceptual designs and corresponding economics are defined so that the results of each system study can be readily compared to those of the others. The candidate conversion systems are: multistage flash/binary; two stage flash with scrubbing; total flow; multistage flash/direct contact (Bechtel patented process); four stage flash/binary; binary with direct contact heat exchangers; hybrid-flash/binary; hybrid-flash/total flow; and flash/dual cycle binary. ERA

N78-21651# General Electric Co., Schenectady, N. Y. Corporate Research and Development Div.

STUDY OF PRACTICAL CYCLES FOR GEOTHERMAL POWER PLANTS Final Report, 15 Jun. 1975 - 15 Mar. 1977

J. H. Eskesen Apr. 1977 160 p refs

(Contract EY-76-C-02-2619)

(COO-2619-1) Avail: NTIS HC A08/MF A01

A comparison was made of the performance and cost of geothermal power cycles designed specifically, utilizing existing technology, to exploit the high temperature, high salinity resource at Niland and the moderate temperature, moderately saline resource at East Mesa in California's Imperial Valley. Only two kinds of cycles were considered in the analysis. Both employed a dual flash arrangement and the liberated steam was either utilized directly in a condensing steam turbine or used to heat a secondary working fluid in a closed Rankine (binary) cycle. The performance of several organic fluids was investigated for the closed cycle and the most promising were selected for detailed analysis with the given resource conditions. Results showed for the temperature range that if the noncondensable gas content in the brine was low, a dual flash condensing steam turbine cycle was potentially better in terms of resource utilization than a dual flash binary cycle. ERA

N78-21652# Institute for Energy Analysis, Oak Ridge, Tenn.
NET ENERGY ANALYSIS OF AN OCEAN THERMAL ENERGY CONVERSION (OTEC) SYSTEM

A. M. Perry, G. Marland, and L. W. Zelby Feb. 1977 55 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA(M)-77-1) Avail: NTIS HC A04/MF A01

The system used a Rankine power cycle with ammonia as the working fluid, and was based on essentially available technology. The plant would be located about 20 miles offshore and would produce 160 MW(e) of net electricity which would be carried ashore by underwater cable for transmission and distribution by conventional means. Evaporators and condensers for the ammonia power cycle were assumed to be made of titanium (for resistance to corrosion) although it was recognized that aluminum alloys-preferable from a cost standpoint-would prove to have acceptable corrosion resistance. Net electrical output of the plant at an assumed 90% plant factor was 1.26 x 10 to the 9th kWh(e) per year. ERA

N78-21653# Institute for Energy Analysis, Oak Ridge, Tenn.
NET ENERGY FROM MUNICIPAL SOLID WASTE

Ned L. Treat Feb. 1977 42 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA(M)-77-5) Avail: NTIS HC A03/MF A01

Technologies for producing energy from municipal solid waste are compared. The system that produced solid fuel and used it as a supplemental fuel at an existing coal burning steam plant is used as a surrogate system. A description of each of the components of this system is given. An analysis of the expenditures and the energy savings for each component is made. The ratio of energy savings for the entire system is found to be approximately 9 percent. ERA

N78-21654# Energy Task Force, Inc., New York
WINDMILL POWER FOR CITY PEOPLE Final Report
Mary Christianson May 1977 73 p
(Grant CSA-20156)

(PB-275658/3; OEO-LN-2137) Avail: NTIS HC A04/MF A01 CSCL 10B

Findings show that the energy produced from the windmill is an important renewable energy resource which can be used in most urban areas and which reduces dependency on utility companies. A brief history of the windmill's origin, design and installation procedures are outlined. Also included are comparisons of energy savings of the windmill energy versus the utility companies. An appendix consists of literature, resources, a wind speed and direction map, structural engineering calculations and an explanation of windforces on windmills. GRA

N78-21655# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
ANALYSIS OF DATA AND RESULTS FOR THE ROUND-ROBIN FLAT-PLATE COLLECTOR TEST PROGRAM Final Report

W. C. Thomas and A. G. Dawson 14 Dec. 1977 87 p refs Revised Sponsored by NBS
(PB-275576/7; VPI-SU-ENG-77-23-Rev; NBS/GCR-77-109-Rev) Avail: NTIS HC A05/MF A01 CSCL 10A

A roundrobin test program was conducted to evaluate a proposed method for rating solar collectors with respect to thermal performance. The approach used was to reference the measured results to a common set of environmental and operating conditions using thermal performance theory. Environmental conditions were wind speed, ambient temperature, and the amount and structure of solar radiation. Operating conditions considered were the transfer fluid (composition and flow rate) and collector orientation. GRA

N78-21657# State Univ. of New York, Albany. Atmospheric Sciences Research Center.

ENERGY CONSERVATION VIA SOLAR ENERGY APPLICATIONS TO MULTI-FAMILY AND COMMERCIAL STRUCTURES. VOLUME 3: AN ENERGY, ENGINEERING AND ECONOMIC ANALYSIS OF HEATING AND COOLING SYSTEMS FOR MULTI-FAMILY STRUCTURES

William S. Fleming, Thomas Bender, Thaddeus Jaguszyn, Phillip Parkman, and Donald Sweetser 7 Sep. 1977 107 p refs Sponsored in part by New York State Energy Research and Development Authority
(PB-276131/0; ASRC-SUNY-PUB-420; NYSERDA175/126) Avail: NTIS HC A06/MF A01 CSCL 13A

An energy analysis was made for a multi family apartment model involving the heating, cooling, lumination and miscellaneous equipments energy consumption. The analysis compared various heating, ventilating and air conditioning systems with and without solar assistance to determine their merits on the basis of energy conservation and economic value. An electric resistance heating and electric air conditioning system were utilized as the basis for system comparison. The buildings orientation, U value and infiltration were also analyzed for consideration of architectural variables. GRA

N78-21669# Bureau of the Census, Washington, D. C.
ANNUAL SURVEY OF MANUFACTURES, 1976. FUELS AND ELECTRIC ENERGY CONSUMED. STATISTICS FOR THE UNITED STATES

Sep. 1977 259 p
(PB-275772/2; M75(AS)-4) Avail: NTIS MF A01; HC avail: Subscriber Services Section (Publications), Bureau of the Census, Washington, D. C. 20233 CSCL 10A

Data are shown on the total cost of fuels, quantity and cost of electric energy purchased for use and quantity of electric energy generated and used in manufacturing plants. Revisions of 1974 quantity and cost of distillate and residual fuel oil statistics for the United States, regions, and states are included. GRA

N78-21660# Ernst and Ernst, Washington, D. C.
THE LONG-RUN INCREMENTAL COST OF ELECTRIC UTILITIES Final Draft Report

Oct. 1977 214 p ref
(Grant NSF APR-75-166666)
(PB-276082/5; NSF/RA-770335) Avail: NTIS HC A10/MF A01 CSCL 10B

Three methods for determining the marginal cost of electricity generation, transmission, and distribution were evaluated. A description of the model developed during this project and the test results are included. A production function was estimated and a longrun total cost equation was derived by minimizing cost subject to the production function and required outputs. The total cost function was then differentiated to arrive at the marginal costs. GRA

N78-21661# Mitre Corp., McLean, Va. METREK Div.
ALASKAN OIL TRANSPORTATION ISSUES

Richard Brown Oct. 1977 17 p refs
(Contract EPA-68-01-3188)
(PB-276449/6; EPA-600/9-77-019) Avail: NTIS HC A02/MF A01 CSCL 10A

The transport and distribution of Alaskan oil poses serious problems with respect to potential impacts upon the quality of air, water, and land, especially in the western United States. The history and problems associated with assuring environmental compatibility in the disposition of Alaskan oil reserves is presented. GRA

N78-21662# Atomic Energy Organization of Iran, Teheran. Reactor Technology Section.

STUDY OF SOME RECENT ADVANCES IN THE CONCEPT AND DESIGN OF MHD GENERATORS

M. Vakilian Feb. 1976 19 p refs
(AE01-26; NRC-76-20) Avail: NTIS (US Sales Only) HC A02/MF A01; ERDA Depository Libraries

Direct conversion of energy using a high temperature working fluid makes magnetohydrodynamics (MHD) power plants potentially much more efficient than steam power stations. The study indicated an overall efficiency of 50 percent to 60 percent. This compared with most modern fossil-fuel plants at 40 percent efficiency. Advances in design and construction of experimental and commercial MHD plants developed in various countries are presented. Environmental effects and advantages of the MHD power plants over the more conventional fossil and nuclear plants are discussed. ERA

N78-21667# GCA Corp., Bedford, Mass. GCA Technology Div.

FILTRATION MODEL FOR COAL FLY ASH WITH GLASS FABRICS Final Task Report, Jun. 1974 - Jun. 1977

Richard Dennis, R. W. Cass, D. W. Cooper, R. R. Hall, and Vladimir Hampl Aug. 1977 490 p refs
(Contract EPA-68-02-1438)
(PB-276489/2; GCA-TR-75-17-G; EPA-600/7-77-084) Avail: NTIS HC A21/MF A01 CSCL 13K

An extensive bench and pilot scale laboratory investigation of several dust/fabric combinations were studied. Also included were field data from three prior GCA studies involving coal fly ash filtration with glass fabrics and past GCA studies of fabric filter cleaning mechanisms. The introduction and experimental confirmation of two basic concepts were instrumental in model design: one relates to the way dust dislodges from a fabric and its subsequent impact upon resistance and penetration in a multichambered system; the other, to the relatively large fly ash fractions that pass with minimal collection through temporarily or permanently unblocked pores or pinholes. GRA

N78-21669# Energy, Inc., Idaho Falls, Idaho.
ENERGY SUPPLY AND ENVIRONMENTAL IMPACTS: CONVENTIONAL ENERGY SOURCES Final Report

James McFadden 1977 349 p Sponsored in part by Northwest Energy Policy Project, Portland, Ore. and by Pacific Northwest Regional Commission, Vancouver, Wash.
(PB-276410/8; NEPP-III-A) Avail: NTIS HCA15/MF A01 CSCL 10A

The future supplies and prices of all forms of energy consumed in the Pacific Northwest (electricity, natural gas, petroleum, and coal) through the year 2000 are examined. Sets of alternative assumptions on the availability, price and use of these forms of energy are used to develop scenarios leading to low, moderate, and high rates of growth in supply and demand. Quantified estimates of the environmental impacts likely to occur at each rate of growth are given. GRA

N78-21671# Battelle Pacific Northwest Labs., Richland, Wash.
DESCRIPTION AND COMPARISON OF ENERGY IMPACT ASSESSMENT MODELS

R. A. Burnett and D. W. Fraley Apr. 1977 96 p refs
 (Contract EY-76-C-06-1830)
 (BNWL-2107) Avail: NTIS HC A05/MF A01

During the past few years the need for more comprehensive analytical techniques for assessing the environmental, economic, and social impacts of energy supply-demand systems and related public policy-making activities has increased. The research and academic communities have responded to this need by developing a wide range of models and other analytical tools for energy impact estimation. The models generally fall into two categories: large-scale and specialized. This report examines the general features and shortcomings of current large-scale and specialized modeling efforts from the point of view of energy impact assessment. Characteristics deemed desirable in large-scale energy-impact-assessment models and related studies are discussed. An outline of criteria for describing and comparing such models is presented, from which seven large-scale energy models and one impact-assessment study are described and compared in considerable detail. Tables are also presented which summarize the results of the categorizations. ERA

N78-21693# Lockheed Missiles and Space Co., Palo Alto, Calif.
USE OF THE METHOD OF ONE-DIMENSIONAL NONLINEAR TRANSFORMATIONS TO FORECAST THE NATURAL MODEL OF AN OIL STRATUM

T. A. Badalov [1977] 4 p refs Transl. into ENGLISH of the book "Raspoznavanie Obrazov" Moscow, Nauka, 1977 p 27-30

Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The goal of estimating the possibility of forecasting the natural mode of a stratum according to a set of geological-physical criteria and also of setting up a connection between the quantity being forecasted and the criteria is the objective of this paper. Author

N78-21710# California Univ., Berkeley. Lawrence Berkeley Lab.

ANALYSIS OF THE BIPOLE-DIPOLE RESISTIVITY METHOD FOR GEOTHERMAL EXPLORATION

A. Dey Jun. 1977 63 p refs

(Contract W-7405-eng-48)

(LBL-6332) Avail: NTIS HC A04/MF A01

Apparent resistivities were blotted at roving dipole receiver locations and the current source (bipole) was left fixed. Interpretation to date was in terms of simple layered, dike, vertical contact, or sphere models. In the case of more complicated two dimensional models the interpretation was ambiguous and the detection of buried conductors depended on the choice of transmitter location. Since apparent resistivities taken on a line collinear with the bipole were roughly equivalent to the apparent resistivities for one sounding in a dipole-dipole pseudo-section, the two methods were compared for several two dimensional models. ERA

N78-21927# Electric Power Research Inst., Palo Alto, Calif.
FOUR WORKSHOPS IN ALTERNATE CONCEPTS IN CONTROLLED FUSION. PART A: EXECUTIVE SUMMARIES. PART B: EXTENDED SUMMARIES. PART C: CTR USING THE p-B-11 REACTION

John M. Dawson and Francis F. Chen, ed. May 1977 256 p refs Workshops held at Palo Alto, Calif., 13-14 Aug., 9-10 Sep. 1975, 23-24 Feb. and 8-9 Mar. 1976

(EPRI-ER-429-SR-Pt-A; EPRI-ER-429-SR-Pt-B;

EPRI-ER-429-SR-Pt-C) Avail: NTIS HC A12/MF A01

A review has been completed of fourteen alternate fusion reactor concepts that could lead to more practical power plants. These concepts are in addition to the Tokamak and mirror concepts which are presently receiving the bulk of the U.S. R and D effort. The concept characterizations were assembled by means of workshops and are presented in two sets of summaries. Part A is a concise executive summary written in nontechnical

language and suitable for reading by executives who do not require a discussion of scientific details. A longer, more technical summary is presented in Part B. Part C deals specifically with the use of advanced fuel cycles (those that avoid the breeding of tritium and the materials damage by 14 MeV neutrons) and gives an illustration of a possible technique for achieving neutronless fusion energy. ERA

N78-21957*# National Aeronautics and Space Administration, Washington, D. C.

NOVEL SILICON CRYSTALS AND METHOD FOR THEIR PREPARATION

B. Authier Sep. 1977 12 p Transl. into ENGLISH from West German Preliminary Patent Specification 25-08-803, 9 Sep. 1976 10 p Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original doc. prep. by Wacker-Chemitronic Ges. fuer Elektronik-Grundstoffe mbH, Burghausen (West Ger.)

(Contract NASw-2791)

(NASA-TM-75195) Avail: NTIS HC A02/MF A01 CSCL 20B

Plate shaped silicon crystals and their preparation by pouring a silicon melt into a suitable mold and then allowing it to solidify in a temperature gradient were investigated. The production of energy by direct conversion of solar energy into electrical energy by means of solar cells takes on increasing importance. While this type of energy production is already the prevailing form today in the realm of satellite technology, its terrestrial application has thus far encountered strict limitations owing to the high price of such solar cells. Of the greatest interest in this connection are silicon cells. A substantial reduction in the semiconductor material costs and the costs involved in the further processing to make solar cells are prerequisites for a rational market growth for solar energy. Author

N78-21980# National Academy of Sciences - National Research Council, Washington, D. C. Ocean Sciences Board.

THE QUALITY OF NOAA'S OCEAN RESEARCH AND DEVELOPMENT PROGRAM: AN EVALUATION

1977 149 p

(PB-277095/6; NOAA-78020801)

Avail: NTIS

HC A07/MF A01 CSCL 05A

The quality, vitality, and health of the ocean research and development conducted by the National Oceanic and Atmospheric Administration (NOAA) in comparison with others in the ocean science community is discussed. The ocean R&D carried out within all the major line components is intended in part to meet statutory responsibilities which cover a broad range, including fisheries, ocean dumping and marine protection, disasters and the environment, some marine mammals, coastal zone management, mapping and charting, energy, and ocean technology. Individual reports on each component summarize their strengths and weaknesses. Recommendations for improvement are delineated. GRA

N78-21986# California Univ., Livermore. Lawrence Livermore Lab.

DECISION MAKING WITH INTERACTIVE ACCESS TO INTEGRATED ADMINISTRATIVE AND TECHNOLOGICAL DATA BASES. AN ILLUSTRATED CONCEPTUAL OVERVIEW

Viktor E. Hampel 14 Sep. 1977 64 p refs Presented at ERDA/AESOP 17th Conf., Boston, 13-15 Sep. 1977 Submitted for publication

(Contract W-7405-eng-48)

(UCRL-80353; Conf-770937-3)

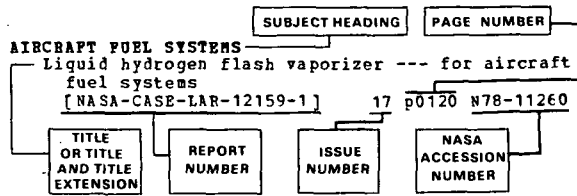
Avail: NTIS

HC A04/MF A01

A computer based Integrated Information System intended to support the ongoing research and development work in the energy storage area of energy research and to permit comparative decision making by computer and cost/risk/benefit analyses is described. Bibliographic and numeric reference materials on batteries employing aqueous and high temperature electrolytes, molten salt energy storage, alloys and fiber composites of flywheels, and for hydrogen-based energy storage compounds, and evaluation criteria on the performance of energy storage systems are compiled in the data base and are accessible interactively from remote terminals. Features of the system include accessibility over computer networks and by dial-up over telephone lines and conferencing and electronic mail delivery with a VOTRAX voice synthesizer. ERA

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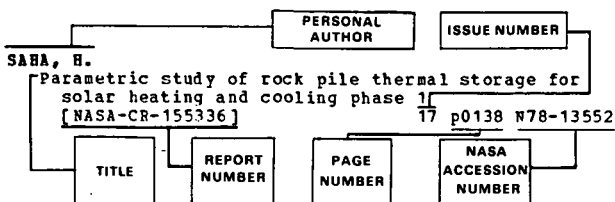
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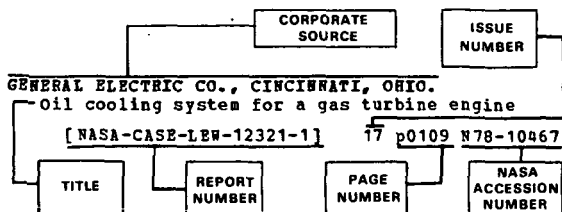
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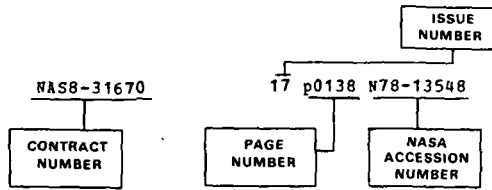
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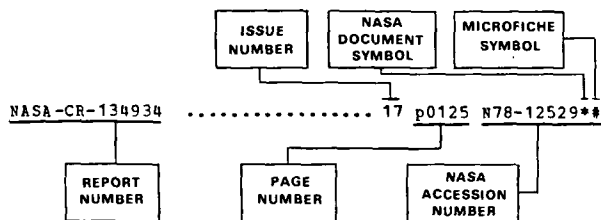
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