NASA SP-7043(08)

ENERGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

FEBRUARY 1976

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7043(08)

ENERGY

A Continuing Bibliography

With Indexes

Issue 8

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 October 1 through December 31, 1975 in

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

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(08)) lists 397 reports, journal articles, and other documents announced between October 1, 1975 and December 31, 1975 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.

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TABLE OF CONTENTS

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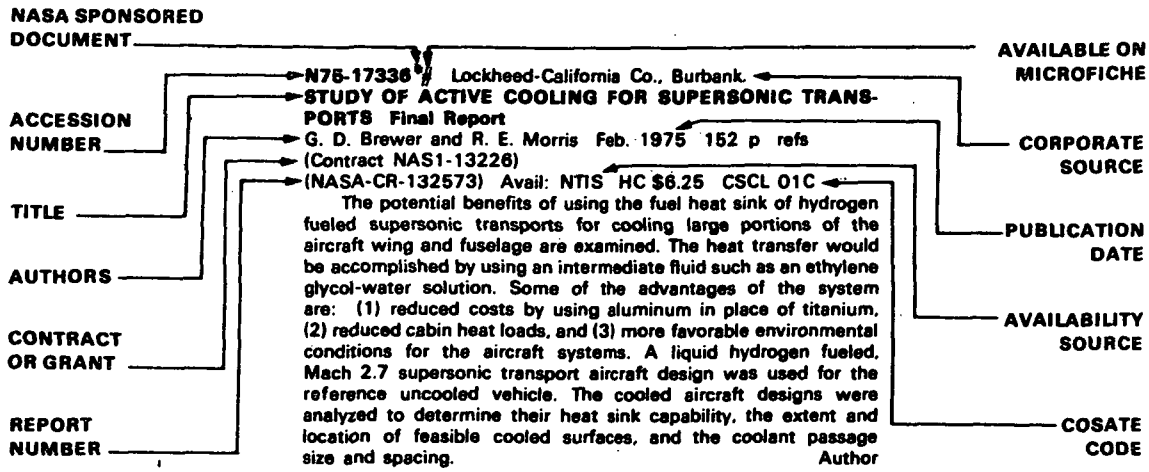

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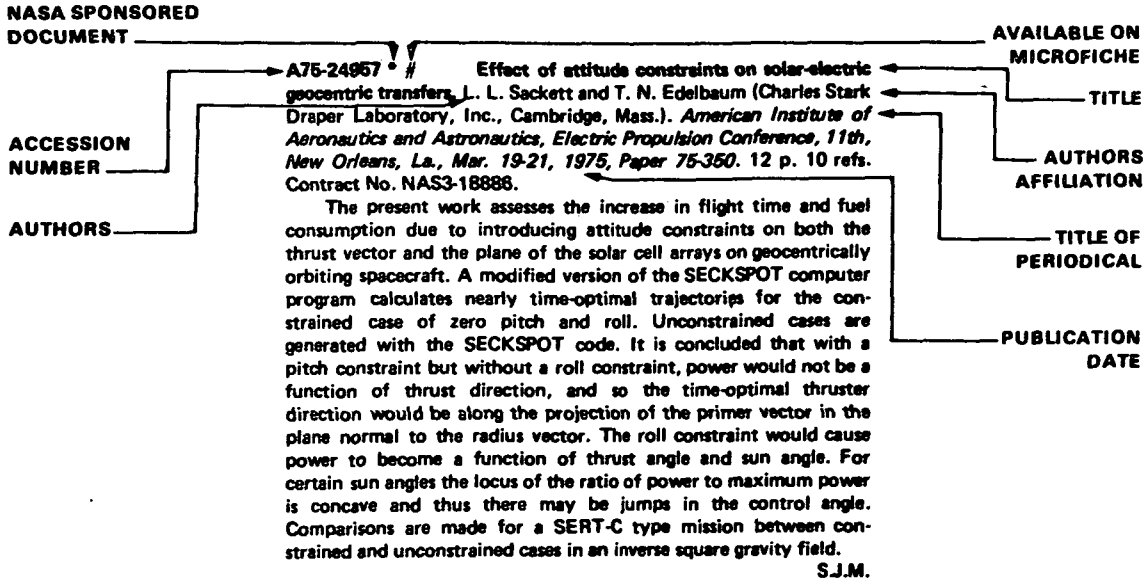

A Listing of Energy Bibliographies Contained in This Publication:

ENERGY

A Continuing Bibliography (Issue 8)

FEBRUARY 1976

IAA ENTRIES

A75-38863 **Can hydrogen transmission replace electricity.** P. J. Hampson, A. B. Hart, B. Jones (Central Electricity Generating Board, Research Laboratories, Leatherhead, Surrey, England), D. T. Swift-Hook (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England), J. J. Syrett, and J. K. Wright (Central Electricity Generating Board, London, England). *CEGB Research*, May 1975, p. 4-11.

A careful consideration of the nationwide use of hydrogen created with nuclear power is given, and it is concluded that such use does not appear competitive with the use of nuclear electricity at this time. Savings would only accrue in the area of transmission and distribution costs, and even then only if the system were used over very large distances. Thermochemical methods of generating hydrogen directly from reactor heat have not yet been successful, and therefore electrolysis would have to be the means of producing the gas; thus production would not cost less than production of electricity. Possible interest may be expressed in the aviation and chemical industrial fields, however, as fossil fuel prices continue to rise. S.J.M.

A75-38864 ***Storing electrical energy on a large scale.*** G. C. Gardner, A. B. Hart (Central Electricity Generating Board, Research Laboratories, Leatherhead, Surrey, England), R. D. Moffitt (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England), and J. K. Wright (Central Electricity Generating Board, London, England). *CEGB Research*, May 1975, p. 12-20.

Various means of storing the surplus energy to be produced by nuclear power plants later this century are reviewed. Pumped-water storage, compressed-air storage, superconducting magnetic storage, flywheel storage, battery storage, electrolysis storage, and heat storage are discussed. It is shown that there are definite economic advantages to be gained from large-scale storage systems, in their enabling nuclear power plants to be run more continuously at a uniform level. This advantage will increase as the proportion of nuclear-generated energy increases. The most long-term economically appealing of the above storage systems are electrochemical, compressed-air, and heat storage. S.J.M.

A75-38865 **The potential of natural energy sources.** J. D. Denton, R. Glanville, B. J. Gliddon, R. C. Hotchkiss, E. M. Hughes, D. T. Swift-Hook (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England), P. L. Harrison (Central Electricity Generating Board, Research Laboratories, Leatherhead, Surrey, England), and J. K. Wright (Central Electricity Generating Board, London, England). *CEGB Research*, May 1975, p. 28-40.

The general technology and application potential of solar power, wind power, wave power, tidal power, and geothermal power in the U.K. are evaluated. Emphasis is on wave power, since this energy source seems to be the most practical for the country. Cost is the prohibitive factor in the solar area, except for solar domestic water heating, which appears quite feasible. Wind power presents difficulties in the economic and load factor realms. Two two-basin tidal systems for use in the Bristol Channel are considered, but their prohibitive construction costs, variability from neap to spring tides and variability in times of high and low tides, and detrimental environmental effects tend to bar its application. Geothermal gradients in Britain are generally too low for practical, efficient power generation. S.J.M.

A75-38868 # **Airborne windmills - Energy source for communication aerostats.** M. S. Manalis (California, University, Santa Barbara, Calif.). *American Institute of Aeronautics and Astronautics, Lighter Than Air Technology Conference, Snowmass, Colo., July 15-17, 1975, Paper 75-923.* 19 p. 12 refs.

Practical systems are described which will enable the placing of an aerogenerator on communication aerostats. These tethered aerostats are high-altitude platforms for wide-area telecommunication and broadcast functions. The purpose of this effort is to investigate the use of airborne windmills to increase the operational availability of the aerostat system. Preliminary calculations indicate that useful amounts of power could be generated economically without increasing the weight of the aerostat and without appreciably changing its angular position. (Author)

A75-38956 **Thick semiconductor films for photothermal solar energy conversion.** R. E. Hahn and B. O. Seraphin (Arizona, University, Tucson, Ariz.). *(American Vacuum Society, Conference on Structure/Property Relationships in Thick Films and Bulk Coatings, 2nd, San Francisco, Calif., Feb. 10-12, 1975.) Journal of Vacuum Science and Technology*, vol. 12, July-Aug. 1975, p. 905-908. 12 refs. NSF Grant No. GI-36731X.

Efficient and economical photothermal conversion of solar energy requires the use of spectrally selective surfaces for collection and retention of incident solar flux. This spectral selectivity can be obtained from an absorber-reflector tandem by overcoating an opaque metal film having high infrared reflectance with a thick film of semiconductor having an appropriate band gap. The practical implementation of this design using films of silver and silicon on a variety of substrate materials is described. The spectral reflectance of coated samples has been measured at temperatures up to 500 C. The solar absorptance increases with temperature, while the thermal emittance typically increases by 2%-4% at 500 C. (Author)

A75-38958 **Polycrystalline silicon layers for solar cells.** T. L. Chu (Southern Methodist University, Dallas, Tex.). *(American Vacuum Society, Conference on Structure/Property Relationships in Thick Films and Bulk Coatings, 2nd, San Francisco, Calif., Feb. 10-12, 1975.) Journal of Vacuum Science and Technology*, vol. 12, July-Aug. 1975, p. 912-915. 16 refs. NSF Grant No. GI-38981.

The substrate requirements for silicon deposition and the techniques for chemical-vapor deposition of silicon films are reviewed. In particular, the technique for the deposition of silicon layers by thermal decomposition of silane is described. The techniques used in assessing the structural properties, the dopant concentration and distibution, and the thickness uniformity of the deposited silicon layer are examined. The deposition of polycrystalline silicon layers containing a shallow p-n junction on steel, graphite, and metallurgical-grade silicon substrates is discussed. Silicon deposited on metallurgical-grade silicon is found to be epitaxial with respect to the substrate, with conversion efficiencies up to 2.5%. S.D.

A75-39018 # **The fuel scene and its impact on the economics of airline operations.** R. H. Whitby (British Airways, London, England) and E. J. Pope. In: Anglo-American Aeronautical Con-

ference, 14th, Los Angeles, Calif., August 4-7, 1975, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1975. 8 p.

The paper discusses the development and consequences of recent increases in the price of fuel and shows how they may influence airline planning and aircraft design. The airlines' short-term methods of dealing with price increases are discussed. Possible changes in aircraft design are noted, with particular reference to the competitive effect of limiting cruise speed. The use of the more exotic fuels is unlikely, at least for civil aviation. S.D.

A75-39132 # **Hydrazine as a fuel for a fuel cell (L'hydrazine en tant que combustible de pile à combustible).** B. Verger and N. Chillier Duchatel (Société Générale de Constructions Electriques et Mécaniques ALSTHOM, Paris, France). In: Properties of hydrazine and its applications as an energy source; International Conference, Poitiers, France, October 22-25, 1974, Proceedings. Paris, Centre National d'Etudes Spatiales, 1974, p. 233-243. In French.

A new design for a hydrazine-hydrogen peroxide battery is described. Because of its strong reducing ability, hydrazine is an excellent reactant for high-performance electrochemical cells. By using certain catalysts of varying composition, the production of ammonia and hydrogen (parasitic reactions) can be minimized. Each element of the modular cell consists of a flat-sheet-shaped container, the sides of which are wave-shaped, filled with electrolyte plus reductant and electrolyte plus oxidant, which are separated from each other by a semipermeable membrane; the container is bounded on the inside by a catalyst and on the outside by an electrode on each side. S.J.M.

A75-39134 # **Hydrazine gas generation for pressure gas feed systems.** J. Schaper (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). In: Properties of hydrazine and its applications as an energy source; International Conference, Poitiers, France, October 22-25, 1974, Proceedings. Paris, Centre National d'Etudes Spatiales, 1974, p. 267-279.

The use of hydrazine technology in pressure gas feed systems for flight vehicles is examined. Pressure gas feeding with and without medium separation is discussed. In the first case, a pressure gas feed system operating on a hydrazine basis consists of a pressure gas tank with a reducing valve for pressurization of the hydrazine tank; the gas generation unit is placed downstream of the tank. In the second case, possible reactions between propellant and hydrazine decomposition gases are discussed. As compared to a conventional pressure gas system, hydrazine technology ensures a design of less volume and weight, which is of paramount importance in spacecraft engineering. S.D.

A75-39196 **An overview of solar energy applications.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). In: NEREM 74; Northeast Electronics Research and Engineering Meeting, Boston, Mass., October 28-31, 1974, Record. Part 1. Newton, Mass., Institute of Electrical and Electronics Engineers, Inc., 1974, p. 45-50.

The paper reviews briefly some of the main approaches under study and development for harnessing the sun's energy. This includes solar heating and cooling systems, renewable gas and oil fuels, solar heat engine power plants, wind energy, ocean thermal gradients, direct energy conversion using solar cells, and solar energy conversion in space for use on earth. It is pointed out that although a solar heating and cooling system is still more expensive to install than a fossil fuel system, the total costs during the operational life of the two systems are expected to be comparable in view of the spiralling prices of fossil fuels. P.T.H.

A75-39197 **MHD power generation.** R. J. Rosa (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: NEREM 74; Northeast Electronics Research and Engineering Meeting, Boston, Mass., October 28-31, 1974, Record. Part 1. Newton, Mass., Institute of Electrical and Electronics Engineers, Inc., 1974, p. 51-53.

The basic principles of MHD power generation are briefly reviewed and the prospects for development of MHD power plants on a commercial basis are examined. While basic technical questions appear to have been resolved, the prooftesting and accumulation of large-scale engineering experience required for developing a MHD plant has only begun in the U.S.A. To move MHD power generation through the pilot and demonstration stages, broad-based support by government and industry is required. P.T.H.

A75-39198 **Batteries and fuel cells in the electrical generating industry.** J. H. B. George (Arthur D. Little, Inc., Cambridge, Mass.). In: NEREM 74; Northeast Electronics Research and Engineering Meeting, Boston, Mass., October 28-31, 1974, Record. Part 1. Newton, Mass., Institute of Electrical and Electronics Engineers, Inc., 1974, p. 57-59.

The paper shows that batteries and fuel cells have quite significant prospects of becoming integral components of the electrical utility generating system within the next one or two decades. The most prospective use of batteries is in load-leveling systems, to store electrical power generated during off-peak periods, and feed it back into the utility network during periods of above-average demand. The fuel cell will be used for both decentralized generation and load levelling. P.T.H.

A75-39333 **Lasers for fusion.** M. McGeogh (Imperial College of Science and Technology, London, England). *New Scientist*, vol. 67, July 24, 1975, p. 205-207.

The search for the 'Brand-X' laser for better fusion is reviewed. The requirement is for a gas laser of at least 10% efficiency easily scaled up to energies of about 10 kilojoules, and operating at a wavelength of about 0.4 micrometers. An increase in the efficiency will reduce the cost of such a laser. In order to have good energy storage, a transition with a small corss-section of between 10 to the minus 19th power and 10 to the minus 20th power sq cm should be chosen. The class of quasimolecular system (based on xenon, krypton and argon) offer advantages for energy storage in their low cross-section for stimulated emission. Other lasers discussed included iodine laser, neodymium laser and the carbon dioxide laser. M.G.

A75-39335 * **Trace elements by instrumental neutron activation analysis for pollution monitoring.** D. W. Sheibley (NASA, Lewis Research Center, Cleveland, Ohio). In: Trace elements in fuel. Research sponsored by the American Chemical Society. Washington, D.C., American Chemical Society (Advances in Chemistry Series, No. 141), 1975, p. 98-117. 11 refs.

Methods and technology were developed to analyze 1000 samples/yr of coal and other pollution-related samples. The complete trace element analysis of 20-24 samples/wk averaged 3-3.5 man-hours/sample. The computerized data reduction scheme could identify and report data on as many as 56 elements. In addition to coal, samples of fly ash, bottom ash, crude oil, fuel oil, residual oil, gasoline, jet fuel, kerosene, filtered air particulates, ore, stack scrubber water, clam tissue, crab shells, river sediment and water, and corn were analyzed. Precision of the method was plus or minus 25% based on all elements reported in coal and other sample matrices. Overall accuracy was estimated at 50%. (Author)

A75-39349 # **Available energy conversion and utilization in the United States.** G. M. Reistad (Oregon State University, Corvallis, Ore.). *(American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-21, 1974, Paper 74-WA/Pwr-1.) ASME, Transactions, Series A - Journal of Engineering for Power*, vol. 97, July 1975, p. 429-434. 30 refs.

The effectiveness (basic thermodynamic performance) of various energy-consuming systems and sectors of society is examined, based on 1970 consumption data. Effectiveness is distinguished from

efficiency, which is not a valid comparative measure. Effectiveness takes into account the internal irreversibility losses of a system, and is based on availability; efficiency is based on energy. Energy effectiveness for the utility, residential, transportation, and industrial sectors is investigated. S.J.M.

A75-39385 # Generation of power from the wind. E. W. Hewson (Oregon State University, Corvallis, Ore.). *American Meteorological Society, Bulletin,* vol. 56, July 1975, p. 660-675. 24 refs.

There is vast energy available in the earth's winds for man's use. It is conservatively estimated that the wind power available to man is the equivalent of the output of 1000 typical fossil fueled or nuclear power plants of 1000 megawatts (MW) capacity each. By contrast, the water power potential of the earth is only one-tenth as large. Large wind generators have been built and used during the past 50 years. Research on wind power sites in the mountainous coastal and valley areas of the Pacific Northwest is being conducted. Terrain modification, aerogenerator 'farms', special duty installations, environmental impacts, land use, and net energy costs are all taken into consideration. It is concluded that wind power shows promise of supplying substantial amounts of supplementary electrical energy and that the development of this wind power potential should proceed with the federal government taking a lead role. (Author)

A75-39403 Photogalvanic cells. W. D. K. Clark and J. A. Eckert (Exxon Research and Engineering Co., Linden, N.J.). *(International Solar Energy Society, Annual Meeting, Fort Collins, Colo., Aug. 21-23, 1974.) Solar Energy,* vol. 17, July 1975, p. 147-150. 10 refs. NSF-supported research.

The theory for photogalvanic cells is presented showing that they are electrochemical cells which are recharged with light. A description of a photogalvanic cell based on the iron-thionine system is given in which the power conversion efficiency for absorbed monochromatic light is 1.5 per cent. (Author)

A75-39405 Semi-transparent solar collector window systems. N. Fuschillo. *Solar Energy,* vol. 17, July 1975, p. 159-165. 29 refs.

A new window system is proposed which acts as an efficient solar energy collector by absorption of as much of the solar heat as possible with a 20 per cent light transmission. The arrangement is such that winter sunlight heating and summer sunlight cooling are performed by convective flow, whereas on dull warm or cold days or nights the window system is converted into a thermally insulated thermopane window economical in fuel for both artificial heating and cooling. Permanent and retractable systems are described. It is shown that retractable systems have lower cost and life-time but are more flexible in performance, and that a variety of practical solar absorber and reflector coatings exists which allow implementation of semi-transparent solar collector systems giving a 75 per cent utilization of the total solar energy for space heating or ventilation. S.D.

A75-39406 Year round performance studies on a built-in storage type solar water heater at Jodhpur, India. H. P. Garg (Central Arid Zone Research Institute, Jodhpur, India). *Solar Energy,* vol. 17, July 1975, p. 167-172. 17 refs.

An improved solar water heater (capacity 90l) made up of a 112 x 80 x 10 cm rectangular tank which performs the dual function of absorbing heat and storing the heated water has been designed and a prototype tested in Jodhpur. The performance tests carried out at the Central Arid Zone Research Institute, Jodhpur, indicate an efficiency factor reaching as high as 70 per cent. The year-round performance tests show that this heater can supply 90l of water at a mean temperature of 50 to 60 C in winter and 60 to 75 C in summer (measured at 4:00 p.m.). The performance tests also indicate that sufficient hot water can be obtained in the early morning if the heater is covered with an insulation blanket overnight or if the hot water is stored in an insulated tank. A performance equation for this type of heater, where the inputs are the solar intensity, ambient air temperature and geometry and material specifications of the heater, has also been developed. With this performance equation the optimum gap depth, i.e. the distance between upper and lower plate of the heater, has been found to be 10.0 cm. (Author)

A75-39407 Radiation cooling of structures with infrared transparent wind screens. T. E. Johnson (MIT, Cambridge, Mass.). *Solar Energy,* vol. 17, July 1975, p. 173-178. 9 refs. NSF Grant No. GI-41306.

Energy conserving radiation cooling schemes for dwellings in high humidity climates have usually failed due to the deleterious effect of the wind. In this paper the cooling mechanisms at work in wind conditions are examined. A radiator system using an i.r. transparent wind screen that doubles as the structural envelope is proposed and supporting experimental results are presented. A one family dwelling built with these radiation panels can carry 50 per cent of the 24 hr cooling load. Worst case conditions give radiator coefficients of performance twice that of existing appliances. (Author)

A75-39409 Cooling with the sun's heat - Design considerations and test data for a Rankine Cycle prototype. D. Prigmore and R. Barber (Barber-Nichols Engineering Co., Denver, Colo.). *Solar Energy,* vol. 17, July 1975, p. 185-192.

The development of a demonstration package supplying residential cooling and/or electricity via a solar-heated Rankine Cycle is discussed. The 3-ton air conditioning, 1-kW electric system employs a solar collector to warm flowing water which provides input heat to a low temperature organic (R-113) Rankine Cycle. Expansion through a high speed (approximately 50,000 rpm) turbine-speed reducer drives an available R-12 refrigeration compressor and 3600 rpm motor-generator. The design point solar collector water temperature is 215 F, providing an R-113 temperature at the turbine inlet of 200 F. With a water-cooled R-113 condenser purveying a condensing temperature of 95 F and a turbine efficiency design goal of 80%, Rankine Cycle efficiency (turbine shaft power divided by heat input to the working fluid) is 11.5%. An 85% efficient R-12 compressor yields an overall coefficient of performance (COP) goal of 0.71. The project is jointly funded by Honeywell, Inc., and the National Science Foundation. (Author)

A75-39410 Solar absorption air conditioning alternatives. P. J. Wilbur and C. E. Mitchell (Colorado State University, Fort Collins, Colo.). *Solar Energy,* vol. 17, July 1975, p. 193-199. 8 refs. NSF-supported research.

The relative advantages of a single-stage, lithium bromide-water absorption air conditioner heated from a flat-plate solar collector are compared theoretically to those for an ammonia-water system, and the lithium bromide system is selected as the preferred one. Double-stage absorption systems with their improved performance are described and are shown theoretically to require generator temperatures that are too great to make them attractive for use with flat-plate collectors. Dual, series-connected systems which require no cooling tower for heat rejection are shown by analysis to have a low coefficient of performance. System utilizing refrigerant storage and a heat rejection buffer between a cooling tower and the absorber and condenser are discussed along with the computer simulation describing them. They are shown to require smaller cooling towers than conventional units. Operation with an air heat exchanger rather than the cooling tower in such a system is shown to yield acceptable system performance with a small reduction in the fraction of the cooling load which can be met with solar energy. (Author)

A75-39412 Effect of diffusion on concentration profiles in a solar pond. N. Chepurniy and S. B. Savage (McGill University, Montreal, Canada). *Solar Energy,* vol. 17, July 1975, p. 203-205. 11 refs.

The evolution of density gradients with time in salt-containing solar ponds from initial stepwise (discontinuous) state to asymptotic uniform state is mathematically investigated. Various numbers of initial gradiated salt solution layers are considered. The time for the

top surface of the pond to reach one-half the concentration at mid-level increases with decreasing number of initial layers and with increasing pond depth. S.J.M.

A75-39925 **The economics of coal-based synthetic gas.** O. Hammond and M. B. Zimmerman (MIT, Cambridge, Mass.). *Technology Review,* vol. 77, July-Aug. 1975, p. 42-51. 6 refs.

An attempt is made to show that for space heating applications at least one alternative, the heat pump, will have a lower real cost than the gasification of coal. The physical and chemical characteristics of coal are considered along with the thermodynamics of coal gasification and the cost of coal-based synthetics. An evaluation of high-B.t.u. gasification is conducted, taking into account the synthetic gas and the utilization techniques. It is concluded that present gasification technologies already at the development stage offer little promise. G.R.

A75-40176 **Energy - Engineering - Environment; Proceedings of the Seventh Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 9, 10, 1974.** Conference sponsored by the Oklahoma State University. Stillwater, Oklahoma State University, 1975. 374 p. $10.00.

Various topics concerning waste utilization and disposal, new concepts in electric energy generation and storage, nuclear energy conversion, and fuel resources technology are discussed. Papers presented include gaseous fuel nuclear reactor research, high-level radioactive waste management, effects of external fouling on dry cooling tower performance, economics of solar and wind energy systems for large-scale power generation, thermodynamic considerations in the use of gasified coal as a fuel for power conversion systems, and shale from oil shale economically.

S.J.M.

A75-40177 * # **Gaseous fuel nuclear reactor research.** F. C. Schwenk and K. Thom (NASA, Washington, D.C.). In: Energy - Engineering - Environment; Proceedings of the Seventh Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 9, 10, 1974. Stillwater, Oklahoma State University, 1975, p. 3-1 to 3-36. 33 refs.

Gaseous-fuel nuclear reactors are described; their distinguishing feature is the use of fissile fuels in a gaseous or plasma state, thereby breaking the barrier of temperature imposed by solid-fuel elements. This property creates a reactor heat source that may be able to heat the propellant of a rocket engine to 10,000 or 20,000 K. At this temperature level, gas-core reactors would provide the breakthrough in propulsion needed to open the entire solar system to manned and unmanned spacecraft. The possibility of fuel recycling makes possible efficiencies of up to 65% and nuclear safety at reduced cost, as well as high-thrust propulsion capabilities with specific impulse up to 5000 sec. S.J.M.

A75-40179 # **Prospects for electrolytic hydrogen for chemical/industrial plants.** L. J. Nuttall (General Electric Co., Lynn, Mass.). In: Energy - Engineering - Environment; Proceedings of the Seventh Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 9, 10, 1974. Stillwater, Oklahoma State University, 1975, p. 13-1 to 13-22.

Characteristics of the solid polymer electrolyte water electrolysis cell and the general economics of electrolytically obtained hydrogen are discussed. Advantages of the new design over the conventional liquid KOH electrolyte include long life, operation at high (exceeding 2000 amps/sq ft) current densities, high efficiency, lack of performance degradation with time, ability to withstand high differential pressures, and impossibility of electrolyte carryover into the generated gases. Near-term viability is expected in many chemical and industrial applications, with technology potential becoming competitive for the rest of society over a longer period. S.J.M.

A75-40181 # **The utilization of ocean energy for electrical energy generation.** S. A. Sebo (Ohio State University, Columbus, Ohio). In: - Energy - Engineering - Environment; Proceedings of the Seventh Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 9, 10, 1974. Stillwater, Oklahoma State University, 1975, p. 15-1 to 15-22. 21 refs. Research supported by the Westinghouse Educational Foundation.

Factors involved in the implementation of wave energy converters, ocean current energy converters, tidal energy converters, and ocean thermal energy converters are discussed. Emphasis is on tidal and solar (thermal) technologies, since these technologies are the closest of the above to realization. In addition, brief comments are made on the use of sea water as a raw material (i.e., a source of thorium and uranium for atomic fission, as well as a source of hydrogen and deuterium for atomic fusion). S.J.M.

A75-40182 # **Shale from oil shale economically.** H. E. McCarthy (Garrett Research and Development Co., Inc., Los Angeles, Calif.). In: Energy - Engineering - Environment; Proceedings of the Seventh Annual Frontiers of Power Technology Conference, Stillwater, Okla., October 9, 10, 1974. Stillwater, Oklahoma State University, 1975, p. 16-1 to 16-16.

A new in situ processing concept for the production of shale oil from oil shale is described. In this plan, known as the Garrett process, a rubble pile is formed under the ground by mining into the area under the oil shale or in the oil shale; then a combustion procedure is begun at the top of the pile and retorting is initiated. Air is forced down through the top and is circulated back up to the top. The recycled gas and air are mixed to control the amount of oxygen, which in turn controls the maximum temperature achieved. Oil is then produced at one level, condensed and drained out at the bottom. S.J.M.

A75-40297 **Solar climate control - Evaluating the commercial possibilities.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *ASTM Standardization News,* vol. 3, Aug. 1975, p. 8-12.

A general review of the feasibility of domestic solar water and space heating systems is presented. Cost considerations, commercial considerations, the solar climate control market, the emergence of a solar climate control industry, and the federal role are evaluated. It is concluded that nurtured development of the solar energy industry at a steady rate will have advantageous repercussions on the international as well as national environmental, economic, and cultural levels. S.J.M.

A75-40298 **Solar energy powered systems - History and current status.** R. C. Jordan (Minnesota, University, Minneapolis, Minn.). *ASTM Standardization News,* vol. 3, Aug. 1975, p. 13-18, 46, 47. 13 refs.

A general review of the development of solar energy technology and a description of its current aspects is presented. Early attempts at solar energy conversion were concerned with direct production of mechanical power, in competition of with that obtained from fossil fuels; present technology deals most effectively with low-temperature heating of liquids and gases. Photovoltaic and thermal system principles are explained; emphasis is on hybrid distributed-heliostatic systems supplemented by conventional power sources. S.J.M.

A75-40299 **Laboratory based activities in solar energy at the National Bureau of Standards.** J. E. Hill (National Bureau of Standards, Center for Building Technology, Boulder, Colo.). *ASTM Standardization News,* vol. 3, Aug. 1975, p. 20, 21, 24-28. 28 refs. ERDA-supported research.

A75-40300 **Evaluation of focusing solar energy collectors.** F. Kreith (Colorado, University, Boulder, Colo.). *ASTM Standardization News,* vol. 3, Aug. 1975, p. 30-38. 31 refs.

An introductory presentation is made concerning means of evaluating the performance of focusing solar energy collectors, with

emphasis on common features among different focusing collectors. Term definitions, the advantages of focusing collectors over flat-plate collectors methods of concentration, an illustrative example, and an economic evaluation criterion are discussed. It is concluded that the key information necessary to evaluate a collector is its efficiency, defined as the ratio of the useful energy delivered at the working fluid to the total solar radiant energy incident on the aperture. S.J.M.

A75-40502 * Design of short haul aircraft for fuel conservation. M. K. Bowden, H. S. Sweet (Lockheed-Georgia Co., Marietta, Ga.), and M. H. Waters (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn., May 6-8, 1975, Paper 750587.* 16 p. 6 refs.

Current jet fuel prices of twice the 1972 level have significantly changed the characteristics of airplane design for best economy. The results of a contract with the NASA Ames Advanced Concepts and Missions Division confirmed the economic desirability of lower design cruise speeds and higher aspect-ratio wings compared to designs developed in the by-gone era of low fuel price. Evaluation of potential fuel conservation for short-haul aircraft showed that an interaction of airfoil technology and desirable engine characteristics is important: the supercritical airfoil permits higher aspect ratio wings with lower sweep; these, in turn, lower the cruise thrust requirements so that engines with higher bypass ratios are better matched in terms of lapse rate; lower cruise speeds (which are also better for fuel and operating cost economy) push the desired bypass ratio up further. Thus, if fuel prices remain high, or rise further, striking reductions in community noise level can be achieved as a fallout in development of a 1980s airplane and engine. Analyses are presented of developmental trends in the design of short-haul aircraft with lower cruise speeds and higher aspect-ratio wings, and the effects on fuel consumption of design field length, powered lift concepts, and turboprop as well as turbofan propulsion are discussed. (Author)

A75-40521 Future hydrogen fueled commercial transports. A. J. K. Carline (General Dynamics Corp., St. Louis, Mo.). *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn., May 6-8, 1975, Paper 750615.* 12 p. 6 refs.

An examination is conducted of the problems inherent in the design of future subsonic liquid hydrogen fueled transports. Attention is also given to the economic aspects of subsonic commercial transports which use liquid hydrogen as fuel. It is found that such transports are very competitive with equivalent jet fueled aircraft. It is pointed out that all economical data are very dependent on the relative price of liquid hydrogen and jet fuel. G.R.

A75-40614 The Florida Solar Energy Center. W. B. Phillips (Florida State University, Tallahassee; Florida Solar Energy Center, Port Canaveral, Fla.). In: Technology today for tomorrow; Proceedings of the Twelfth Space Congress, Cocoa Beach, Fla., April 9-11, 1975. Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1975, p. 5-1 to 5-4.

The Florida Solar Energy Center is designed to serve as a central facility for solar energy activities of the state's nine public universities, as well as private institutions which choose to participate. Activities of the Center will include research, development, information dissemination, and demonstration projects. The Center will include Divisions of Research, Development, Tests and Standards, Education, Information, and Technical Assistance. The site consists of 20 acres on the water at Port Canaveral and adjacent to the Kennedy Space Center. Four existing buildings including an auditorium, laboratories, offices, a library, TV studios, and classrooms will be used for the initial operations of the Center. (Author)

A75-40617 * Energy survey - What can R&D do by 1985. S. L. Copps (NASA, Office of Energy Programs, Systems Analysis Div., Washington, D.C.). In: Technology today for tomorrow; Proceedings of the Twelfth Space Congress, Cocoa Beach, Fla., April 9-11, 1975. Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1975, p. 5-19 to 5-27. 8 refs.

Research and development in the field of energy is generally recognized as requiring long lead times before the results are felt. Near term relief from foreign oil dependence will be achieved by reducing energy consumption through conservation and by increasing domestic energy supply through expanded exploration and drilling for oil and natural gas, and by increased coal production. This paper describes the results of an informal survey performed by NASA within its own agency to determine if any research and development activities might be an exception to the general rule of long lead times and thus have significant impact by 1985 on oil and natural gas consumption. (Author)

A75-40618 * Data monitoring and information availability - A key to solar energy utilization. A. J. Kemp (IBM Corp., Huntsville, Ala.). In: Technology today for tomorrow; Proceedings of the Twelfth Space Congress, Cocoa Beach, Fla., April 9-11, 1975. Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1975, p. 5-29 to 5-36. NASA-supported research.

Widespread use of solar energy heating and cooling systems is dependent upon their price competitiveness with other systems in the marketplace. There are indications that the degree of accuracy of existing solar insolation data is such that systems must be oversized by 50 percent. Refinement of the solar insolation data could result in a substantial cost reduction of solar heating and cooling systems making these units more competitive with conventional systems. This paper describes a system, the Sunfall Monitor, that provides this capability. The system monitors and records on tape in computer-compatible format the values of the direct and total solar irradiance. Provisions are also incorporated for evaluation of solar cell, collector and absorber material samples. Concepts and discussions for application of the device in relationship to research/development and the solar energy heating and cooling acts conclude the paper. (Author)

A75-40688 Generation schemes for wind power plants. T. S. Jaya Devaiah (Wisconsin, University, Milwaukee, Wis.) and R. T. Smith (Southwest Research Institute, San Antonio, Tex.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-11, July 1975, p. 543-550. 14 refs. NSF-supported research.

This paper reviews various electric generation schemes for wind energy conversion suitable for interconnection with a power grid. The schemes can be generally classified as constant speed constant frequency (CSCF) and variable speed constant frequency (VSCF) systems. Historically, only CSCF systems have been used for large power generation in wind power plants. However, with the advent of power electronics and the availability of solid state devices capable of handling large amounts of power, VSCF systems are becoming competitive. Various schemes under each classification are discussed and compared. It is stressed, however, that the optimum choice of the generating scheme is not decided by considering the generator alone. The optimum choice is one which minimizes the cost of energy generated by the wind power plant. (Author)

A75-41072 # Statistical relation between heat transfer from a closed area and meteorological parameters during the use of a solar refrigerating plant (Statisticheskaia sviaz' mezhdu teplootvodom iz pomeshcheniia i meteorologicheskimi vekichinami pri ispol'zovanii solnechnoi kholodil'noi ustanovki). A. Rakhmanov, A. Kakabaev, M. Goshdzhanov (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR), and M. Golaev. *Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk,* no. 2, 1975, p. 27-31. 5 refs. In Russian.

A75-41125 Efficient use of energy. *Physics Today,* vol. 28, Aug. 1975, p. 23-27, 29, 32, 33. 17 refs.

A brief summary is given of a recent report on the contributions

physics can make to improving the efficiency of present-day energy-consuming devices. The discussion concentrates on the technical aspects of energy use. Three categories of end-use are examined: the house, the automobile, and industrial processes based on chemical and physical changes of state. S.J.M.

A75-41178 # **Cooling a light industrial building in Puerto Rico using solar energy.** H.-C. Yu and R. P. Hankins, Jr. (Hankins and Anderson, Inc., Richmond, Va.). *American Institute of Aeronautics and Astronautics and American Astronautical Society, Solar Energy for Earth Conference, Los Angeles, Calif., Apr. 21-24, 1975, AIAA Paper 75-612.* 24 p.

A75-41425 **A resonant point absorber of ocean-wave power.** K. Budar and J. Falnes (Norges Tekniske Hogskole, Trondheim, Norway). *Nature*, vol. 256, Aug. 7, 1975, p. 478, 479. 5 refs.

A system for absorbing and utilizing the energy carried by ocean waves is discussed. The 'point absorber' considered is a system in which the horizontal extent is much smaller than one wavelength. The point absorber is optimized for efficient energy conversion. The resonant characteristic frequency of the system is at all times tuned to the characteristic frequency of the wave. G.R.

A75-41433 **Fusion power by magnetic confinement - Plans and the associated need for nuclear engineers.** R. L. Hirsch and D. S. Beard (ERDA, Div. of Controlled Thermonuclear Research, Washington, D.C.). *Nuclear Technology*, vol. 27, Sept. 1975, p. 84-91. 8 refs.

A75-41434 **Environmental aspects of fusion reactors.** F. E. Coffman and J. M. Williams (ERDA, Div. of Controlled Thermonuclear Research, Washington, D.C.). *Nuclear Technology*, vol. 27, Sept. 1975, p. 174-181. 12 refs.

Potential environmental impacts of commercial fusion reactors are discussed and compared with those of fission reactors. It is shown that the environmental impact of fusion reactors will be quite small, with the main contribution coming from thermal discharges. Some attractive safety and environmental characteristics of fusion reactors are described, including an effectively infinite low-cost fuel supply, their inherent incapacity for nuclear runaways, the absence of fission products, flexibility in selecting structural materials, and the absence of special fuels such as U-235 and Pu-239 which could be diverted for purposes of nuclear blackmail. F.G.M.

A75-41530 **Determination of some thermophysical properties of pebble-type solar heat accumulators.** G. Ia. Umarov, R. R. Avezov, S. O. Khatamov, and M. Sharipova (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 1, 1975, p. 38-41.) *Applied Solar Energy,* vol. 11, no. 1-2, 1975, p. 29-31. 7 refs. Translation.

A75-41533 **Comprehensive utilization of a solar installation.** R. B. Salieva (Tashkentskii Institut Sviazi, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 1, 1975, p. 65-71.) *Applied Solar Energy,* vol. 11, no. 1-2, 1975, p. 50-54. Translation.

The present work proposes a method for complex utilization of a solar power plant in pasture regions where underground springs are the only water source. The plant operates alternately in furnishing power to well pumps and in replenishing its storage cells. Algorithms for optimal control of the plant are given. P.T.H.

A75-41534 **Use of solar heat pumps for heating and air conditioning - A brief survey.** O. L. Shvaleva, R. A. Zakhidov, and R. R. Avezov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 1, 1975, p. 72-79.) *Applied Solar Energy,* vol. 11, no. 1-2, 1975, p. 55-60. 31 refs. Translation.

The present work discusses the use of heat pumps of different types for alternate heating of rooms and water during winter and cooling during summer. The main characteristics of some commercial, industrial, and scientific heat pumps available are summarized. The use of heat pumps in conjunction with hot-box type solar power plants is discussed briefly. P.T.H.

A75-41538 **Operation of photoconverters under conditions of strong illumination.** A. M. Vasil'ev, V. M. Evdokimov, A. P. Landsman, and A. F. Milovanov (Vsesoiuzinyi Nauchno-Issledovatel'skii Institut Istochnikov Toka; Moskovskii Energeticheskii Institut, Moscow, USSR). *(Geliotekhnika,* no. 2, 1975, p. 18-24.) *Applied Solar Energy,* vol. 11, no. 1-2, 1975, p. 72-77. 6 refs. Translation.

The parameters of illuminated photoelectric converters are studied experimentally. It is shown that the observed dependence of carrier lifetime on the illumination intensity leads to a more pronounced dependence of the photocurrent and the photo-emf. Illumination-induced changes of the p-n junction boundary conditions lead at superhigh intensities to saturation of the photo-emf. V.P.

A75-41540 **Calculation of the radiant energy field for a biparaboloidal radiation furnace with a carbon arc.** G. Ia. Umarov, R. A. Zakhidov, and Iu. B. Sokolova (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 2, 1975, p. 35-42.) *Applied Solar Energy,* vol. 11, no. 1-2, 1975, p. 86-92. 5 refs. Translation.

Large-area solar energy concentrators are prepared by joining a number of film surfaces. The mechanical and optical properties of the concentrators change with the increase in film thickness at the joints. This makes it necessary to study the surface configurations of concentrators with joints of various type and to determine their influence on the concentrator characteristics. Analytical solutions are obtained to the linear problems of determining the deformed shape of a circular specular reflecting membrane with a diametral seam, and the deflections of a tread under a running load that represents the reaction of the thread on a loaded membrane. V.P.

A75-41541 **Investigation of the effect of boiler design and finite thermal response of solar water heaters on efficiency.** R. R. Avezov and F. Soatov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 2, 1975, p. 69-72.) *Applied Solar Energy,* vol. 11, no. 1-2, 1975, p. 115-117. Translation.

The analysis is carried out for metallic and sand-type solar water heaters and for two specific positions of the sun. The geometrical dimensions and the mechanical and heat-engineering indexes are tabulated. The analysis shows that, all other conditions being equal, the efficiency of metallic water heaters is greater by a factor of 2.2. V.P.

A75-41547 **Computation of water temperature at the mouth of a geothermal well.** G. D. Polizo (Odesskii Politekhnicheskii Institut, Odessa, Ukrainian SSR) and V. A. Kurishko (Krymneftegazrazvedka Trust, USSR). *(Energetika,* no. 4, 1974, p. 92-96.) *Heat Transfer - Soviet Research,* vol. 7, Mar.-Apr. 1975, p. 145-150. 6 refs. Translation.

A method is described for determining the temperature of water at the mouth of a geothermal well intended as a heat source, based on approximating the unsteady heat and mass transfer in the well by a quasi-steady process. A nomogram is given for determining the water temperature at the well mouth. (Author)

A75-41608 **Sunlight to electricity: Prospects for solar energy conversion by photovoltaics.** J. A. Merrigan. Cambridge, Mass., MIT Press, 1975. 172 p. 153 refs. $12.95.

Aspects of energy demand and supply in the U.S. to the year 2000 are examined. Solar energy as a resource is considered along with the principles of photovoltaic energy conversion and the state-of-the-art in photovoltaic conversion technology. Attention is given to silicon cells, cadmium sulfide, cuprous sulfide, cadmium telluride, the possibilities for technological advancement and cost reduction, and questions related to the storage of electrical energy. Economic considerations in the development of photovoltaic energy conversion are discussed, taking into account the demand for electricity, its supply, costs, and the markets for photovoltaic energy conversion. G.R.

A75-41669 * # **Design and testing of an energy flywheel for an Integrated Power/Attitude Control System /IPACS/.** J. E. Notti and A. Cormack, III (Rockwell International Corp., Space Div., Downey, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass., Aug. 20-22, 1975, Paper 75-1107.* 9 p. Contract No. NAS1-13008.

This paper summarizes the design of a prototype flywheel energy storage assembly developed to evaluate the spacecraft Integrated Power and Attitude Control System (IPACS) concept. In the IPACS application, the flywheel assembly is used for kinetic electrical energy storage as well as conventional angular momentum control. The kinetic energy storage function dictates high rotational speeds which require new approaches to the design of the major components: rotors, motor-generators, bearing systems, and electronics. The paper includes a general description of a NASA-contracted prototype assembly, a discussion of major component design characteristics, and the presentation of preliminary test results as compared with analytical predictions. The test data were obtained from preliminary tests of the NASA prototype assembly as well as from a Rockwell prototype test unit. (Author)

A75-41698 * # **Fuel conservation possibilities for terminal area compatible transport aircraft.** G. W. Hanks (Boeing Commercial Airplane Co., Seattle, Wash.) and A. R. Heath, Jr. (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug. 4-7, 1975, Paper 75-1036.* 14 p. 7 refs. Contract No. NAS1-12018.

Design characteristics that would reduce mission fuel consumption and improve terminal-area operations for advanced transports are discussed. Sensitivity studies of the effects of cruise speed, wing geometry, propulsion cycle, operational procedures, and payload on fuel usage are presented and utilized to arrive at a conceptual configuration which offers mission fuel savings as well as desirable operational characteristics in the terminal area. Technical and economic evaluation is provided in the form of a comparison of the resulting configuration with transports reflecting the current level of technology. The research and technology programs required to realize potential benefits are described. (Author)

A75-41768 **Thermokinetics of a flat solar collector of constant heat capacity (Thermocinétique d'un insolateur plan de capacité calorifique constante).** J. Fléchon, R. Wertwijn, and A. Diallo (Nancy I, Université, Nancy, France; Ecole Normale Supérieure, Bamako, Mali). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol. 281, no. 1, July 7, 1975, p. 9-12. In French.

This paper examines the evolution with time of the temperature of a flat collector subjected to constant-power solar radiation normal to its surface. Two theories (one approximate, the other more involved) enable defining the instantaneous temperature of the collector by writing a corrected exponential law. The energy yield of the collector is calculated, and a comparison with experimental results confirms the predictions. S.J.M.

A75-42166 **Enhancement of Schottky solar cell efficiency above its semiempirical limit.** M. A. Green (New South Wales, University, Kensington, Australia). *Applied Physics Letters,* vol. 27, Sept. 1, 1975, p. 287, 288. 6 refs. Research supported by the Radio Research Board of Australia.

Geometries are described for increasing the efficiency of Schottky solar cells above the theoretical limits recently calculated. The ultimate conversion efficiencies for the new cells are the same as for p-n junction devices. With present technology, improvements of over 50% above the old limits are possible. (Author)

A75-42276 **Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975.** Symposium-Course sponsored by the University of Miami. Edited by T. N. Veziroglu (Miami, University, Coral Gables, Fla.). Coral Gables, Fla., University of Miami, 1975. 309 p. $45.

The papers report fundamental information about and latest developments in the field of hydrogen energy and research into hydrogen as an important nonfossil fuel. Topics include solar-tower thermochemical energy cycles, thermochemical production of hydrogen, photoproduction of hydrogen by microbial and biochemical processes, energy transmission systems, hydrogen energy vs electrical energy, liquid hydrogen as an aviation fuel, automotive hydrogen engines, naval applications of hydrogen energy, and the economics of hydrogen energy systems. F.G.M.

A75-42277 # **Solar tower thermo-chemical energy cycles.** A. F. Hildebrandt (Houston, University, Houston, Tex.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S1-3 to S1-15. 23 refs.

Solar energy systems incorporating a central receiver, or solar tower, are briefly assessed. It is shown that the most promising method of energy conversion in such systems is the conventional steam cycle. The layout of a typical central receiver is outlined, its efficiency is estimated, and the available power at the receiver is evaluated analytically taking into account radiation and other losses. It is found that the heat produced is competitive with present fuel oil costs. Other thermodynamic solar-fuel cycles are considered, including water to hydrogen, methane-water to hydrogen-carbon monoxide, and organic waste to oil or gas. The minimal environmental impact of solar energy is noted. F.G.M.

A75-42279 # **Photoproduction of hydrogen via microbial and biochemical processes.** A. Mitsui (Miami, University, Miami, Fla.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S2-31 to S2-48. 68 refs. Research supported by the Gulf Oil Foundation.

The utilization of solar energy for the bioproduction of hydrogen gas is reviewed. Two approaches are discussed in relation to efforts being made to increase the efficiency of hydrogen bioproduction. The approaches investigate microbial processes in intact cell systems and biochemical processes for utlization in a cell-free system. (Author)

A75-42280 # **Research opportunities in cryogenic hydrogen-energy systems.** J. Hord (National Bureau of Standards, Institute for Basic Standards, Boulder, Colo.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S3-11 to S3-23. 36 refs.

As liquid hydrogen pervades the commercial fuel market, new and improved products and technologies will be needed. To meet these demands appropriate research and development must be performed on hydrogen fuel systems. Candidate markets for cryogenic hydrogen-energy systems are reviewed and discussed, and associated research and development needs are outlined herein. A wide variety of cryogenic research and development opportunities exist. (Author)

A75-42281 # **Will hydrogen transmission replace electricity.** P. J. Hampson, A. B. Hart, B. Jones (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England), D. T. Swift-Hook (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England), J. J. Syrett, and J. K. Wright (Central Electricity Generating Board, Research Dept., London, England). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S3-25 to S3-43. 15 refs.

It has been suggested that hydrogen, produced using nuclear power, could supplant electricity as the major way in which nuclear energy would be distributed and used. This paper compares the economics of transmitting and distributing nuclear energy as hydrogen and electricity. It is shown that if hydrogen is produced by electrolysis, it would be more expensive to deliver nuclear energy in this way than as electricity. Furthermore, since electricity is a higher grade source of energy than chemical fuel, its average usefulness per unit of energy delivered is higher. Whilst there are special areas where there may be a market for hydrogen generated from nuclear energy as fossil fuels become scarce, there does not seem to be an economic case for an all-embracing hydrogen economy. (Author)

A75-42282 # **Aviation usage of liquid hydrogen fuel - Prospects and problems.** G. D. Brewer (Lockheed-California Co., Burbank, Calif.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S4-3 to S4-37. 11 refs.

If worldwide air transportation is to continue to grow as forecast, a fuel must be found to supplant petroleum-based kerosene (Jet A). The new fuel must be available universally without hazard of control by cartel, and must meet fundamental requirements of economics, safety, performance and environmental considerations. Hydrogen is found to provide this potential. The results of studies performed to investigate the feasibility, practicability, and potential advantages/disadvantages of using liquid hydrogen as fuel in both subsonic and supersonic commercial transport aircraft for initial operation in the 1990-2000 time period are discussed. A program to develop needed technologies and to resolve questions such as how to introduce the new fuel into commercial service with least trauma is outlined. (Author)

A75-42283 # **An energy utility company's view of hydrogen energy.** J. M. Burger (Public Service Electric and Gas Co., Newark, N.J.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S4-39 to S4-63. 14 refs.

Several areas where the use of hydrogen has been of recent interest to electric and gas utilities are briefly examined. These are electrical peak-leveling systems with hydrogen as a storable medium, the production of hydrogen as a marketable product in either limited or large quantities, and the use of hydrogen for energy transmission. The relationship of these applications to utility operations is discussed generally and some numerical estimates on costs are given. Some research and development needs implied by cost considerations are indicated. (Author)

A75-42284 # **Automotive hydrogen engines, and onboard storage methods.** W. D. Van Vorst and J. G. Finegold (California, University, Los Angeles, Calif.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S4-65 to S4-90. 31 refs.

A75-42285 # **Economics of hydrogen energy systems.** K. C. Hoffman (Brookhaven National Laboratory, Upton, N.Y.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S5-3 to S5-16. AEC-sponsored research.

An economic analysis of hydrogen energy systems is conducted. The analysis is performed by partitioning the national energy system into electrical and nonelectrical energy forms and considering the efficacy of hydrogen relative to electricity in specific end uses on the basis of the ratio of electrical-energy units needed to substitute for one hydrogen-energy unit. A possible partition range for the energy system is plotted together with typical efficacy ratios. An anticipated course is considered for incorporating hydrogen fuel into the energy system. The cost and efficiency are evaluated of various processes for the production, transport, and storage of hydrogen. It is found that hydrogen systems are generally less efficient than electrical systems except for the thermochemical production system, which can be competitive with electricity if 50% production efficiency can be attained. F.G.M.

A75-42286 # **A technology assessment of the hydrogen economy concept.** E. M. Dickson, J. W. Ryan, and M. H. Smulyan (Stanford Research Institute, Menlo Park, Calif.). In: Hydrogen energy fundamentals; Proceedings of the Symposium-Course, Miami Beach, Fla., March 3-5, 1975. Coral Gables, Fla., University of Miami, 1975, p. S5-19 to S5-39. NSF-sponsored research.

A75-42531 **Massive production of hydrogen by a thermo-electrochemical method.** J. O. Bockris (Flinders University, Adelaide, Australia). *Energy Conversion*, vol. 14, July 1975, p. 81-85. 25 refs.

Electrolytic hydrogen is thought to be too expensive. The suggestion that cyclical chemical methods of producing hydrogen (driven by heat) would lower its price compared with the electrolytic product is improbable. The best way to use heat to produce hydrogen is to raise the temperature of an electrochemical cell containing a solid electrolyte to about 1000 C. About 47 per cent of the energy needed to obtain hydrogen would then arise from the heat source. A reduction in ionic resistance of stable solid electrolyte membranes by about one order of magnitude would be necessary. With various alternative schemes assuming present and near-future costs, the price of thermo-electrochemical hydrogen is then between $1.87 and $3.55 per 1,000,000 BTU (1974 dollars). (Author)

A75-42532 **High intensity wind belts as massive energy sources.** J. O. Bockris (Flinders University, Adelaide, Australia). *Energy Conversion*, vol. 14, July 1975, p. 87-91. 26 refs.

Calculation of the year-average energy available from wind generators involves a factor which relates the cube of the mean annual wind (A) to the mean of the cubes of the instantaneous wind velocities (B). B/A is 2.7. The practical equation for electricity obtained after conversion to hydrogen, passage, and reconversion to electricity, yields a power of 5MW per 100-m radius rotor in a location where the mean annual wind is 30 kph. The practicality of wind rotors of 100 m or equivalent radius needs proving. Designs are proposed. Electrolysis of seawater evolves chlorine and its reconversion to oxygen is not a difficulty, but an extra cost. Hydrogen transfer up to 4000 km would be economic. The concept of large sea-borne rotors in high velocity wind belts with long distance hydrogen transmission offers a more readily attainable (and more environmentally acceptable) prospect than atomic or solar possibilities. (Author)

A75-42533 **Fuel as an agricultural crop.** J. Levitt (Institute of Soils and Water, Bet Dagan, Israel). *Energy Conversion*, vol. 14, July 1975, p. 93-96. 7 refs.

An immediately available method is described for converting the unharvested part of a crop into fuel to replace fossil fuel. In the form of charcoal, it could supply all the energy needed for raising, harvesting and marketing the crop, plus a considerable surplus. The ultimate aim should be to supply all the energy needs of agriculture from the photosynthetically produced by-products of crops. The fuel shortage today is widely recognized to be a political problem, a

business problem, an engineering problem, but few people recognize it as an agricultural problem. There are two reasons for agriculturists to become involved in the fuel problem: (1) modern agriculture consumes tremendous quantities of fuel, and (2) fuel can be produced as an agricultural crop. (Author)

A75-42973 # **Getting at the big facts in transportation.** D. Christensen and M. Pikarsky. *Astronautics and Aeronautics,* vol. 13, Sept. 1975, p. 46-53. 27 refs.

An analysis is conducted of the relative amount of petroleum consumed by private automobiles and public transportation. It is pointed out that transportation consumes over 50% of the nation's oil and that the driver-alone vehicle in the trip to and from work burns over 50% of that large share of energy. An investigation shows that public transportation is more efficient than the private car. Approaches for reducing oil consumption are discussed, taking into account an expansion of the public transit system. G.R.

A75-43459 **An Al p-silicon MOS photovoltaic cell.** E. J. Charlson and J. C. Lien (Missouri, University, Columbia, Mo.). *Journal of Applied Physics,* vol. 46, Sept. 1975, p. 3982-3987. 27 refs.

A MOS photovoltaic diode, consisting of Al on p-type silicon with a thin interfacial layer of SiO_2, has been found to have good conversion efficiency for solar radiation. Measurements of capacitance versus voltage, current versus voltage, and photocurrent per absorbed photon indicate a most probable surface barrier height of 0.85 eV, approximately twice as large as that for the normal Al p-silicon diode. A single-layer antireflection coating of silicon monoxide or zinc sulfide was found to increase the short-circuit current by approximately 50%. Double-layer coatings of zinc sulfide over silicon monoxide gave nearly the same increase with a shift of the maximum diode response to the near-infrared. Absolute light-conversion efficiencies of 8% at one sunlight level were obtained with short-circuit current densities as high as 26.5 mA/sq cm. (Author)

A75-43510 **Solar energy conversion by water photodissociation.** V. Balzani, L. Moggi, M. F. Manfrin, F. Bolletta (Bologna, Università, Bologna, Italy), and M. Gleria (CNR, Laboratorio de Fotochimica e Radiazioni d'Alta Energia, Bologna, Italy). *Science,* vol. 189, Sept. 12, 1975, p. 852-856. 25 refs. Research supported by the Consiglio Nazionale delle Recerche of Italy and NSF.

Some aspects of the photochemical conversion of solar energy by simple nonbiological systems are discussed. The basic concepts of direct and catalyzed photodissociation of water are outlined. Water dissociation in closed-cycle processes based on endothermic photochemical reactions offers a potential solution to the problem of solar energy conversion. It is shown that transition metal commplexes whose excited state chemistry is extremely rich are in principle suitable catalysts for cycles of this type. The most significant cycles are those involving metal hydrido complexes or binuclear complexes in which the two metal atoms are bound into a macrocyclic ligand. S.D.

A75-43860 # **Influence of the geometrical development of the cathode surface on the specific power of a thermionic converter with surface ionization (O vliianii geometricheskogo razvitiia poverkhnosti katoda na udel'nuiu moshchnost' termoemissionnogo preobrazovatelia s poverkhnostnoi ionizatsiei).** Iu. A. Dunaev, V. I. Babanin, A. S. Mustafaev, V. I. Sitnov, and A. Ia. Ender (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *Zhurnal Tekhnicheskoi Fiziki,* vol. 45, July 1975, p. 1486-1489. 9 refs. In Russian.

A75-43881 # **Thermal performance analysis of the stationary reflector/tracking absorber /SRTA/ solar concentrator.** J. F. Kreider (Environmental Consulting Services, Inc., Boulder, Colo.). *(American Society of Mechanical Engineers, Paper 75-HT-FFF,* 1975.) *ASME, Transactions, Series C - Journal of Heat Transfer,* vol. 97, Aug. 1975, p. 451-456. 11 refs.

The performance of a novel solar energy concentrating system consisting of a fixed, concave spherical mirror and a sun-tracking, cylindrical absorber is analyzed in detail. The effects of mirror reflectance, concentration ratio, heat transfer fluid flow rate, radiative surface properties, incidence angle, an evacuated absorber envelope, and insolation level upon thermal performance of the concentrator are studied by means of a mathematical model. The results of the study show that high-temperature heat energy can be collected efficiently over a wide range of useful operating conditions. The analysis indicates that mirror surface reflectance is the single most important of the principal governing parameters in determining system performance. Efficiency always increases with concentration ratio although the rate of increase is quite small for concentration ratios above 50. High fluid flow rate (i.e., lower operating temperature), an evacuated envelope, or a highly selective surface can enhance performance under some conditions. (Author)

A75-43976 **Cryogenic Engineering Conference, Georgia Institute of Technology, Atlanta, Ga., August 8-10, 1973, Proceedings.** Conference supported by the National Bureau of Standards, National Science Foundation, et al. Edited by K. D. Timmerhaus (Colorado, University, Boulder, Colo.; National Science Foundation, Engineering Div., Washington, D.C.). New York, Plenum Press (Advances in Cryogenic Engineering. Volume 19), 1974. 538 p. $32.50.

A75-43977 # **Cryogenic H2 and national energy needs.** J. Hord (National Bureau of Standards, Cryogenics Div., Boulder, Colo.). In: Cryogenic Engineering Conference, Atlanta, Ga., August 8-10, 1973, Proceedings. New York, Plenum Press, 1974, p. 1-11. 81 refs.

National energy needs and resources are considered, taking into account as potential long-term abundant energy sources breeder fission reactors, fusion reactors, and solar power. Only solar power emerges as an abundant nonpolluting energy source with minimal threat to man. Energy storage problems could be solved by producing molecular hydrogen as a synthetic fuel. Cryogenic hydrogen is attractive as a transportation fuel, has certain potential advantages in hydrogen-electric utility systems, and is unexcelled in performance as an aerospace fuel. Aspects regarding the production of cryogenic hydrogen are discussed along with questions of liquefaction, storage, transmission, applications in utilities, applications in transportation, and uses in aerospace applications. G.R.

A75-43978 # **The economics of liquid hydrogen supply for air transportation.** J. E. Johnson (Union Carbide Corp., New York, N.Y.). In: Cryogenic Engineering Conference, Atlanta, Ga., August 8-10, 1973, Proceedings. New York, Plenum Press, 1974, p. 12-22. 8 refs.

Studies reported by Hallet (1968) have shown that large-scale projects can produce liquid hydrogen at prices that could make this fuel competitive if appropriate load factors and low-cost energy sources are available. An investigation is conducted concerning the prospects for an early application of liquid hydrogen which could substantially contribute toward easing the fuel shortage. Near-term benefits of liquid hydrogen would be greatest in aircraft operation. An analysis of the economics of liquid hydrogen takes into account a conversion of coal to hydrogen and a conversion of fission energy to hydrogen. It is concluded that a liquid hydrogen aviation fuel capability offers the best domestic alternate fuel strategy to counter overpricing and overdependence on imported hydrocarbon liquid fuel for air transportation. G.R.

A75-43979 # **Cryogenic engineering and fusion power.** C. E. Taylor (California, University, Livermore, Calif.). In: Cryogenic Engineering Conference, Atlanta, Ga., August 8-10, 1973, Proceedings. New York, Plenum Press, 1974, p. 28-34. 11 refs. AEC-sponsored research.

In order to reduce the consumption of power for the magnets of a fusion power plant to acceptable proportions, it is necessary that fusion reactors must use either cryogenically cooled or superconducting coils. The cryogenic aspects of reactor design are discussed. It is found that the most difficult cryogenic engineering problems of fusion reactors are mainly those caused by the large size of the superconducting magnets. Major approaches to fusion power are considered. G.R.

A75-44005 # **Solar cells for power generation on communication satellites.** M. P. R. Panicker, M. J. Nair, and M. K. Mukherjee (Indian Space Research Organization, Vikram Sarabhai Space Centre, Trivandrum, India). *(Institution of Engineers /India/, Seminar on Modern Trends in Communication Electronics, Hyderabad, India, Apr. 21, 1974.) Institution of Engineers (India), Journal, Electronics and Telecommunication Engineering Division,* vol. 55, Apr. 1975, p. 68, 69; Discussion, p. 69.

The different types of power systems that could be used on a satellite are described briefly and the effects of each system are mentioned. Solar cells with chemical batteries being the most optimum combination at present, the advantages of thin film cadmium sulphide (CdS) cells are described. The construction details of a CdS cell with the problems encountered while processing such a cell are also mentioned. Power-to-weight ratio of CdS thin film cells is found to be the most advantageous feature for their application in satellites. (Author)

A75-44736 **Plasma physics and controlled nuclear fusion research 1974; Proceedings of the Fifth International Conference, Tokyo, Japan, November 11-15, 1974. Volumes 1 & 2.** Vienna, International Atomic Energy Agency, 1975. Vol. 1, 724 p.; vol. 2, 791 p. In English, Russian, and French. Price of volume 1, $44; volume 2, $47.

Various studies on the tokamak experiment, open confinement systems, low-beta toroidal systems, fusion reactor design problems, and inertial confinement are presented. Specific objects of the analyses include research on a tokamak with an axisymmetric divertor and impurity problems in tokamak devices, the effect of corrugation of the longitudinal magnetic field on the ion component of plasma in tokamaks, neutral beam injection experiments in Ormak, a study of the hot electron plasma in the minimum magnetic configuration B Circe, kink instabilities for shaped tokamaks in toroidal geometry, excitation of ion cyclotron harmonic waves by injection of a 10-keV ion beam into a plasma, the ion velocity distribution in a toroidal plasma with large Larmor radii, the effect of random density fluctuations on parametric interactions in a plasma, laser-plasma experiments relevant to laser-produced implosions, and gas-blanket studies in toroidal arcs. S.J.M.

A75-44751 **Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Parts A & B.** Conference sponsored by NSF, ARPA, and University of Miami. Edited by T. N. Veziroglu (Miami, University, Coral Gables, Fla.). New York, Plenum Press, 1975. Pt. A, 714 p.; pt. B, 718 p. Price of two parts, $95.

The papers report on current world-wide efforts toward a universal hydrogen-energy economy with emphasis on solar, thermochemical, and thermal production of hydrogen. Topics include primary energy sources, hydrogen storage and transmission, hydrogen production using nuclear and geothermal energy, metal hydride storage, large-scale production of hydrogen from water, hydrogen automotive and aviation fuel and engine systems, hydrogen-fueled gas-dyanic lasers, and environmental impacts of a hydrogen economy.

F.G.M.

A75-44752 # **Is massive solar energy conversion a practical prospect.** J. O. Bockris (South Australia, Flinders University, Adelaide, Australia). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974, Part A. New York, Plenum Press, 1975, p. 9-34. 44 refs.

Prospective methods of conversion of solar energy to electricity are related to the photovoltaic method, the photogalvanic method, photothermic methods, photosynthesis, the optical concentrator-boiler method, the utilization of winds, and the use of ocean thermal gradients. The selection of materials in photovoltaics is considered. The principle of operation of photothermic methods and the problems which have to be solved to develop a feasible process are also discussed. Attention is given to the type of technology needed for lowering costs in photovoltaic conversion, the practicality of cadmium sulfide, and questions of solar-hydrogen economy. It is pointed out that a solar-hydrogen economy could probably be built on either the solar concentrator or the ocean-thermal gradient. G.R.

A75-44753 # **A tower-top point focus solar energy collector.** A. F. Hildebrandt and L. L. Vant-Hull (Houston, University, Houston, Tex.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 35-44. 10 refs. NSF Grant No. GI-39456.

Temperatures above 1000 C appear possible with a large segmented Fresnel mirror consisting of independent hydraulically or electrically steered heliostats constructed of flat mirrors. In order that the redirected solar radiation from a square mile be intercepted, a central receiver must be elevated well above the mirror field on a tower of about 450 meters height. A square-mile collector would produce heat at a peak rate of 500 MWT (megawatts thermal) in the winter and 700 MWT in the summer. (Author)

A75-44754 # **Reliability of low cost Cu2S/CdS solar cells for large scale conversion of solar to electrical energy.** L. D. Partain and M. M. Sayed (Delaware, University, Newark, Del.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 45-55. 12 refs. NSF-supported research.

Basic procedures of cell construction are briefly examined. It is pointed out that the manufacturing process is adaptable to automation leading to a low-cost production of the cell. The conduction of accelerated life tests is discussed and the nature of the cell degradation processes is considered. It is concluded that the production of high efficiency, low cost Cu2S/CdS solar cells for large scale conversion of solar to electrical energy appears to be technically and economically feasible. G.R.

A75-44755 # **Geothermal energy as a resource in a hydrogen energy economy.** F. Maslan and T. J. Gordon. In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A.. New York, Plenum Press, 1975, p. 57-85. 32 refs. NSF Grant No. C-836.

The major characteristics of the development of geothermal energy are examined. The location of geothermal resources and their geology, a description of a typical geothermal power plant, relevant environmental considerations, technologically feasible levels of geothermal energy resources development in the United States, and the combination of geothermal energy with the hydrogen energy economy are discussed. The forecast of technical feasibility is based on a careful review of a methodological sequence to be utilizable in the 1985-2000 time interval. S.J.M.

A75-44756 # **The effect of atmospheric turbulence on windmill performance.** T. E. Base (Western Ontario, University, London, Canada). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A.. New York, Plenum Press, 1975, p. 87-105. 22 refs.

Theoretical and experimental studies have been made to determine the effects of free-stream turbulence structure on the performance of a simple airscrew windmill. A modified blade-

element method was developed to predict the fluctuating life forces on the rotor blades, and computed vortex models of turbulence were used to represent the fluctuating velocity field. Eventually, the computer program will enable large-rotor-diameter windmill performance studies to be conducted and comparisons to be made with small test rotors. (Author)

A75-44757 # **Nuclear water splitting and high temperature reactors.** H. Barnert and R. Schulten (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 115-128. 7 refs.

The economic and organizational aspects of nuclear hydrogen production are discussed. The political and financial importance of energy independence is stressed, and the relatively low cost of nuclear fuel and reactor operation is pointed out. Environmental effects are investigated and found to be minimal. The superiority of hydrogen to alternative energy carriers, such as electricity, is demonstrated. S.J.M.

A75-44758 # **High-temperature nuclear reactors as an energy source for hydrogen production.** J. D. Balcomb and L. A. Booth (California, University, Los Alamos, N. Mex.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 129-136. AEC-sponsored research.

Application of current high-temperature reactor technology to hydrogen production is reviewed. The requirements and problems of matching a thermochemical hydrogen-production cycle to a nuclear heat source are discussed. Possibilities for extending the temperature of reactors upward are outlined. The major engineering problem is identified as the development of a high-temperature process heat exchanger separating the nuclear heat source from the chemical process. (Author)

A75-44759 # **Hydrogen production with a high-temperature gas-cooled reactor /HTGR/.** R. N. Quade and A. T. McMain (General Atomic Co., San Diego, Calif.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 137-154.

Use of the HTGR (high-temperature gas-cooled reactor) as a major supplier of electric energy has been established. However, the total market for energy forms other than electricity is large and represents a new potential use for nuclear reactors. Of the many ways an HTGR can be applied to a chemical process to produce hydrogen, two are discussed in detail. One is for steam hydrocarbon reforming, which might be considered a thermochemical open-cycle process; the other is water-splitting, a thermochemical closed-cycle process. (Author)

A75-44760 # **Hydrogen production from decomposition of water by means of nuclear reactor heat.** S. Dorner and C. Keller (Gesellschaft für Kernforschung mbH, Karlsruhe, West Germany). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 155-166. 20 refs.

A closed-cycle process is described for the production of hydrogen from water by means of nuclear heat. The following steps are needed: dissolution of a metal, preferably Ag, in hydrohalogenic acids; transformation of the silver halide into silver and oxygen by means of alkaline hydroxides; splitting the alkaline halide into the basic and acid components by a chemical reaction or by electrolysis. A critical discussion, however, shows that it cannot be determined at present whether this process can be realized in practice. (Author)

A75-44761 # **Aqueous homogeneous reactor for hydrogen production.** W. Kerr and D. P. Majumdar (Michigan, University, Ann Arbor, Mich.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 167-181. 14 refs.

Hydrogen production by radiolysis of water in aqueous reactors is described. Three reactor designs are considered, and the essential features of each are described. The use of thermal neutron leakage into an aqueous blanket surrounding the main power-generating part of the reactor is treated. The potential of a low-power reactor for production of hydrogen is evaluated. The design of a system to extract the hydrogen generated by the fission fragments and other charged particles is considered. (Author)

A75-44762 # **Wind capture and diversion through pneumatic energy recovery with large capacity aerogenerators.** P. E. Coulter (Florida International University, Miami, Fla.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 183-196.

An investigation of a novel design approach to capturing and containing wind in a useable energy form in a 1.5- to 2.5-megawatt power range. Rotor blade, air entrainment and transmission, and tower design are graphically described. Methods of energy conversion and output reliability are discussed, followed by concluding remarks concerning research and development needs relative to anticipated application of the large-capacity aerogenerator. (Author)

A75-44763 # **Sea thermal power as a hydrogen and methanol generator.** J. H. Anderson (Sea Solar Power, Inc., York, Pa.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 197-207.

Arguments are presented in favor of sea thermal power as a viable, inexpensive source of energy for the production of fuels such as hydrogen and methanol. The basic principles of operation of a sea thermal power plant and the economics of sea thermal power plant technology are considered in detail. Ocean thermal power plants can be constructed more rapidly than nuclear plants or fossil plants, and operating costs should also be lower. S.J.M.

A75-44764 # **Ocean based solar-to-hydrogen energy conversion macro system.** W. J. D. Escher (Escher Technology Associates, St. Johns, Mich.) and J. A. Hanson (Oceanic Institute, Waimalano, Hawaii). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 209-229. 11 refs.

Mechanized ocean thermal power production of hydrogen fuel is investigated. Hydrogen's natural advantages of transportability and storability are the basis for the choice of this energy carrier over electricity. World production of fossil fuels is expected to peak between 2030 and 2080, at which time reliable and economic nonfossil-based energy supplies will be available. Ocean basing of large-scale 'central' solar energy conversion facilities (as opposed to conventional desert locations) offers significant advantages: virtually unlimited collection area, enormous thermal sink, immediate source of feedstock water, excellent logistics, low-friction bearing surface, and availability of ocean thermal gradient mode. Ocean basing also offers several coproduction possibilities, particularly that of open sea mariculture. S.J.M.

A75-44765 # **Thermochemical water cracking using solar heat.** C. J. Swet (Johns Hopkins University, Silver Spring, Md.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 231-242. 9 refs.

Direct solar radiation is shown to be a potentially superior source of energy for the thermochemical production of hydrogen from water, especially in a regionally self-sufficient hydrogen economy. Its impact on chemical-cycle selection, conversion efficiency, operating mode, plant siting, plant capacity, and product cost is compared with that of a nuclear heat source. Conceptual designs and development goals are suggested. (Author)

A75-44766 # **Photolysis of water as a solar energy conversion process - An assessment.** S. N. Paleocrassas (Tri-State College, Angola, Ind.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 243-253. 14 refs.

One of the less conventional solar-energy conversion methods is the photocatalytic decomposition of H2O to generate H2 and O2 directly. This paper presents an assessment of photolysis of water by sunlight. Calculations are used to establish efficiency upper limits for this type of energy-conversion method using three different photocatalysts: compound salts, compound semiconductors, and photosynthetic dyes. The efficiencies were estimated to be 3 percent, 28 percent, and 7 percent, respectively. (Author)

A75-44767 # **The technology and economies of hydrogen production from fusion reactors.** J. Powell, F. J. Salzano, and W. A. Sevian (Brookhaven National Laboratory, Upton, N.Y.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 255-277. 16 refs.

The technology, economics, and environmental effects of producing synthetic fuels (H2 gas, H2 liquid, and methanol) based on fusion (CTR) reactors are assessed. Four United States energy systems (2020 A.D.) with different degrees of CTR implementation are compared: in System A, no CTR input is assumed; in System B, CTRs replace 50 percent of nuclear-fission electricity; in System C, CTRs supply all electrical demand, produce synthetic fuels to replace all oil and gas imports, and eliminate strip mining; and in System D, CTRs supply all electrical demand and virtually all fuel demand. CTR reactor costs are analyzed in detail for a range of containment parameters, reactor outputs, and first well loadings for DT and catalyzed DD fuel cycles. (Author)

A75-44769 # **An economic perspective on hydrogen fuel.** J. E. Johnson (Union Carbide Corp., New York, N.Y.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975. p. 299-308.

The economic aspects of the production of different energy carriers are reviewed. Synthetic kerosene, hydrogen, methane, ammonia, and methanol are considered as energy media. Two major factors are discussed: (1) the capital investment required to provide the facilities to convert fuel to energy; and (2) the total resources consumed in accomplishing a given task efficiently. Various applications of these forms of energy are investigated, including domestic heating, automotive applications, air transportation, and electricity generation. S.J.M.

A75-44770 # **The utilization of solar energy for hydrogen production by cell-free system of photosynthetic organisms.** A. Mitsui (Miami, University, Miami, Fla.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A.
New York, Plenum Press, 1975, p. 309-316. 11 refs.

The production of hydrogen by a cell-free system of photosynthetic organisms is discussed. This represents a potential source of energy that does not exploit traditional energy resources but utilizes available solar radiation. Screening of tropical and subtropical marine photosynthetic bacteria and algae which exhibit a high activity for the photoproduction of hydrogen is also proposed. (Author)

A75-44771 * # **An analysis of hydrogen production via closed-cycle schemes.** R. E. Chao (Puerto Rico, University, Mayaguez, P.R.) and K. E. Cox (New Mexico, University, Albuquerque, N. Mex.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 317-330. 12 refs. Grant No. NGT-44-005-114.

A thermodynamic analysis and state-of-the-art review of three basic schemes for production of hydrogen from water: electrolysis, thermal water-splitting, and multi-step thermochemical closed cycles is presented. Criteria for work-saving thermochemical closed-cycle processes are established, and several schemes are reviewed in light of such criteria. An economic analysis is also presented in the context of energy costs. (Author)

A75-44772 # **Hydrogen as energy storage element.** L. W. Zelby (Oklahoma, University, Norman, Okla.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A.
New York, Plenum Press, 1975, p. 339-343. 6 refs.

A wind power system for the residential sector, based on a minimum wind velocity of 10 km/h (the average wind speed in about half of the continental United States) and using hydrogen as its energy storage medium, is proposed. This system is advantageous in that it is self-contained and employs off-the-shelf components. The estimated cost of the system, including installation, is about $5000; at current rates, this figure could be amortized in about 10 years. The windmill drives a generator which operates an electrolysis plant to produce the hydrogen. A storage battery is included in the design for temporary overloads. S.J.M.

A75-44773 # **On methods for the large-scale production of hydrogen from water.** J. O. Bockris (South Australia, Flinders University, Adelaide, Australia). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 371-403. 37 refs.

The thermodynamic and kinetic aspects of the electrochemical production of hydrogen from water are examined, taking into account the advantage of higher operational temperatures and approaches for reducing the overpotential. The hydrogen production costs for classical electrolysis cells could be significantly reduced with the aid of an emerging technology. The development of high temperature electrolysis is discussed along with methods of low-potential electrolysis utilizing thermal assistance. The electrolysis of HI, cuprous chloride, and ferrous and ferric chloride is considered. Attention is given to anode depolarization, photo-electrochemical methods, photosynthesis, and plasma torch photolysis. It is concluded that light-oriented methods of going directly to hydrogen appear to be very promising and deserve wide-ranging support. G.R.

A75-44774 # **Electrolytic hydrogen generators.** J. B. Laskin (Teledyne, Inc., Timonium, Md.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 405-415.

The use of three types of electrolytic hydrogen generators is detailed. In all of the systems, water is dissociated in a module made of multiple electrolysis cells connected electrically in series. In each cell, the anode and cathode are separated by a gas-impermeable porous matrix electrolyte frame. Electrolyte is circulated through the module to replace dissociated water and remove waste heat. The types of generators differ primarily in their size: the smallest weighs 80 pounds and measures 26 in. by 14 in. by 10 in., the intermediate system is 33 by 74 by 64 inches and generates hydrogen at 17 cents/100 SCF, and the largest unit produces hydrogen at 14 cents/100 SCF while taking up 260 sq ft of floor space. S.J.M.

A75-44775 # **Electrolysis of sea water.** L. O. Williams (Martin Marietta Aerospace, Denver, Colo.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A.
New York, Plenum Press, 1975, p. 417-424. 6 refs.

Preliminary results of direct electrolysis of natural sea water for hydrogen production purposes are presented. These results are obtained to determine whether hydrogen and oxygen can be evolved from sea water in a relatively pure form, along with the electrical parameters necessary for this evolution. Major conclusions are that hydrogen can be produced from sea water by direct electrolysis, that

chlorine production predominates over oxygen at the anode, that oxygen can be evolved at the anode together with chlorine at current densities of 90 mA per sq cm, and changes at the cathode give rise to insoluble precipitates on the cathode and in the surrounding sea water. Factors hindering large-scale hydrogen production by electrolysis of sea water are discussed. S.D.

A75-44776 * # Hydrogen generation through static-feed water electrolysis. F. C. Jensen and F. H. Schubert (Life Systems, Inc., Cleveland, Ohio). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 425-439. NASA-supported research.

A static-feed water electrolysis system (SFWES), developed under NASA sponsorship, is presented for potential applicability to terrestrial hydrogen production. The SFWES concept uses (1) an alkaline electrolyte to minimize power requirements and materials-compatibility problems, (2) a method where the electrolyte is retained in a thin porous matrix eliminating bulk electrolyte, and (3) a static water-feed mechanism to prevent electrode and electrolyte contamination and to promote system simplicity. (Author)

A75-44777 # Hydrogen generation by solid-polymer electrolyte water electrolysis. L. J. Nuttall, A. P. Fickett, and W. A. Titterington (General Electric Co., Lynn, Mass.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 441-455.

A water electrolysis technology based on a solid-polymer electrolyte (SPE) concept is presented for applicability to large-scale hydrogen production in a future energy system. High cell-current density operation is selected for the application, and supporting cell test-performance data are presented. The inherent system advantages of the acid SPE electrolysis technology are explained. System performance predictions are made through the year 2000 along with plant-capital and operating-cost projections. (Author)

A75-44778 * # Evaluation of multi-step thermochemical processes for the production of hydrogen from water. J. E. Funk, W. L. Conger, and R. H. Carty (Kentucky, University, Lexington, Ky.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 457-469. 12 refs. Grant No. NGR-18-001-086.

A75-44779 # Considerations on iron-chloride-oxygen reactions in relation to thermochemical water-splitting. G. De Beni (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 471-482. 10 refs.

A75-44780 # Thermochemical hydrogen production research at Lawrence Livermore Laboratory. R. G. Hickman, O. H. Krikorian, and W. J. Ramsey (California, University, Livermore, Calif.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 483-498. 25 refs. AEC-sponsored research.

Three novel closed-cycle processes for the thermochemical production of hydrogen from water are under study at the Lawrence Livermore Laboratory. The first cycle is based upon selenium and its compounds, the second on mercury, and the third on methane and methanol. None of these cycles involves halogens, and reaction temperatures are limited to 700 C. Although still in the conceptual stages, some preliminary experiments have been conducted on the first two processes, with the main effort on the first process. (Author)

A75-44781 # Analysis of thermochemical water-splitting cycles. J. B. Pangborn and J. C. Sharer (Illinois Institute of Technology, Chicago, Ill.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 499-515. 9 refs.

A brief description is given of a research program concerned with the derivation, evaluation, and experimental investigation of closed-cycle chemical reaction sequences for splitting water into hydrogen and oxygen. Thermodynamics and water-splitting efficiencies are considered and efficiency calculations for thermochemical cycles are discussed. The evaluation procedure outlined makes it possible to obtain realistic estimates of potentially achievable energy efficiencies for the conversion of heat to hydrogen by splitting water. The most efficient process examined accepts heat at 925 C and cannot exceed about 61 per cent energy efficiency. G.R.

A75-44782 # A search for thermochemical water-splitting cycles. J. L. Russell, Jr. and J. T. Porter (General Atomic Co., San Diego, Calif.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 517-529.

A description is given of an exhaustive computer-aided search for water-splitting cycles. SPLIT, a family of computer programs, has been written with the objective to perform a search for few-step, thermodynamically permissible, water-splitting cycles. The computer procedure for writing a reaction between two compounds is discussed along with questions concerning the thermodynamic evaluation and the search procedure in the case of two-step, three-step, and four-step cycles. G.R.

A75-44783 # Low thermal flux glass-fiber/metal vessels for LH2 storage systems. C. A. Hall and D. E. Spond (Martin Marietta Aerospace, Denver, Colo.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 561-574.

Composite tanks and tubes have been developed that consist of thin metal liners overwrapped with glass-fibers. Because the glass-fiber is a very good thermal insulator and the thin metal liner has a small cross-sectional area, the longitudinal heat conductivity is considerably reduced when compared to an all-metal design. The composite overwrapped tanks and tubes are also damage resistant and lightweight. Fabrication techniques and the use of composites to help solve the problems associated with the development of LH2 power transportation vehicles are discussed. (Author)

A75-44784 # An engineering-scale energy storage reservoir of iron titanium hydride. G. Strickland, J. J. Reilly, and R. H. Wiswall, Jr. (Brookhaven National Laboratory, Upton, N.Y.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part A. New York, Plenum Press, 1975, p. 611-620. Research supported by the Public Service Electric and Gas Company of New Jersey and AEC.

A hydrogen reservoir containing 14 lb of H2 in the form of 893 lb of granular iron titanium hydride was constructed and tested. The reservoir will be used by Public Service Electric and Gas Company of New Jersey to study the feasibility of storing off-peak electrical energy through the use of a water electrolyzer, a hydride reservoir and a fuel cell stack. The internal functional components of the stainless steel vessel consist of a barrier in the form of porous metal tubes, and heat exchanger tubes. Details of construction, preparation of the hydride, and performance tests made at BNL are described. (Author)

A75-44787 # Engine performance with gasoline and hydrogen - A comparative study. J. B. Finegold and W. D. Van Vorst

(California, University, Los Angeles, Calif.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B.
New York, Plenum Press, 1975, p. 685-696. 10 refs. Research supported by the U.S. Department of Transportation.

An experimental investigation of the performance of an internal combustion engine using hydrogen instead of gasoline has been carried out. The minimal modifications necessary for operation based on hydrogen are discussed. Operation with hydrogen resulted in an increase in brake thermal efficiency of 25 to 100 percent over that obtained with gasoline, while oxides-of-nitrogen emissions were reduced 90 to 97 percent. Some form of charge dilution is essential when operating with hydrogen at high power output, and the spark plug gap should be set significantly narrower. (Author)

A75-44789 # **Backfire control techniques for hydrogen-fueled internal combustion engines.** F. E. Lynch (Billing Energy Research Corp., Provo, Utah). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 717-726. 12 refs.

The commonly cited causes of backfires, such as hot spots caused by preignition, are inadequate to explain backfires under many circumstances. A viable hypothesis is formed through consideration of high-temperature particulate matter in the residual cylinder gases. Various methods for controlling backfires are surveyed from the viewpoint of thermal explosion theory. Some novel engine constructions, which are effective in suppressing backfires, are offered in support of a residual gas-quenching technique. (Author)

A75-44791 * # **Hydrogen for the subsonic transport.** P. F. Korycinski and D. B. Snow (NASA, Langley Research Center, Hampton, Va.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 819-838. 12 refs.

Relations between air travel and fuel requirements are examined. Alternate fuels considered in connection with problems related to a diminishing supply of petroleum include synthetic jet fuel, methane, and hydrogen. A cruise flight of a subsonic aircraft on a hydrogen-fueled jet engine was demonstrated in 1957. However, more development work is required to provide a sound engineering base for a complete air transportation system using hydrogen as fuel. Aircraft designs for alternate fuels are discussed, giving attention to hydrogen-related technology already available and new developments which are needed. G.R.

A75-44792 # **Liquid hydrogen as a fuel for future commercial aircraft.** R. D. Lessard (United Aircraft Research Laboratories, East Hartford, Conn.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 839-857. 28 refs.

A realistic cost is established for liquid hydrogen delivered to the aircraft, and the question is evaluated of whether liquid hydrogen at this cost level would be competitive with conventional aircraft fuels. It is found that the least expensive commercial method for producing hydrogen is coal gasification. However, barring any major unforeseeable increases in the price of crude oil obtained from petroleum or derived from coal or oil shale, it does not appear that liquid hydrogen produced by any of the present or proposed processes could supplant conventional aircraft fuel in commercial aircraft before the year 2000. (Author)

A75-44794 # **Utilization of hydrogen as an appliance fuel.** J. C. Sharer and J. B. Pangborn (Illinois Institute of Technology, Chicago, Ill.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 875-887. 5 refs. Research sponsored by the Southern California Gas Co.

This paper treats some aspects of utilizing hydrogen as an appliance fuel. Catalytic combustion techniques, attainable efficiencies, burner exhaust emissions, and the advantages and disadvantages of using hydrogen to fuel appliances are discussed. (Author)

A75-44795 # **Surface electronic properties and the search for new hydrogen oxidation catalysts.** G. E. Laramore, J. E. Houston, and R. L. Park (Sandia Laboratories, Albuquerque, N. Mex.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 889-899. 28 refs. AEC-supported research.

The development of cheap substitutes for the 'noble' metals as oxidation catalysts provides alternatives to direct combustion in the utilization of hydrogen as an energy source. Current likely candidates are the transition-metal carbides which have many of the desirable properties of the 'noble' metals with respect to hydrogen oxidation and hydrogenolysis. In an attempt to understand this phenomenon and to systematize the search for new catalytic materials, the surface electronic properties of tungsten, tungsten carbide, and platinum are measured and compared. (Author)

A75-44796 # **Hydrogen as an energy carrier.** R. G. Murray (Oklahoma State University, Stillwater, Okla.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B.
New York, Plenum Press, 1975, p. 901-914. 7 refs.

The physical and chemical properties of hydrogen make it a nearly optimum fuel. The only serious drawback to hydrogen as a fuel is its low energy density on a volume basis. Hydrogen-utilization devices are examined, taking into account hydrogen-air combustors, a water-modified hydrogen-oxygen burner for providing steam, air-breathing gas turbines, rocket engines, the hydrogen-oxygen fuel cell, and reciprocating engines. An investigation shows that the overall feasibility for usage of hydrogen both as a fuel and a chemical by future society is quite favorable. G.R.

A75-44797 # **On the role of hydrogen in electric energy storage.** F. J. Salzano, E. A. Cherniavsky, R. J. Isler, and K. C. Hoffman (Brookhaven National Laboratory, Upton, N.Y.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 915-932. 23 refs.

The general requirements for electric utility energy storage devices are discussed and a description is given of a specific type of storage concept involving the production of hydrogen, the storage of the hydrogen, and the reconversion of the hydrogen to electricity during periods of peak demand. It is found that under conditions of a cheap abundant supply of oil hydrogen storage electric peaking plants or any other storage device more expensive than pumped storage are not competitive with the gas turbine for electric peaking applications. Hydrogen storage peaking plants are, however, an economic alternative for peaking applications when the oil supply is constrained. G.R.

A75-44798 # **Hydrogen-energy storage for electrical utility systems.** C. J. Kippenhan and R. C. Corlett (Washington, University, Seattle, Wash.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 933-947. 14 refs.

A purely electrical system is considered in the investigation, taking into account a system in which electric energy only is available to produce hydrogen. It is assumed that the only end

product will be useful electrical energy at some later time. A system outline is presented and questions concerning the theory and the technology of water electrolysis are discussed. Hydrogen storage and associated problems are considered along with the approaches available to recover the electrical energy by a hydrogen recombination process. The capital costs of a hydrogen-energy system are found to be comparable to those involved in an expansion of base-load capacity. G.R.

A75-44799 # An economic study of electrical peaking alternatives. W. R. Parrish (National Bureau of Standards, Boulder, Colo.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 949-968. 30 refs.

Results are given of a feasibility study of alternatives for producing peak power. Fuel cells, batteries, and superconducting magnetic storage are considered as well as gas turbines and pumped storage. The fuels considered are hydrogen from coal or electrolysis, synthetic natural gas, and methanol. Fuel storage alternatives include liquid, compressed gas, and (for hydrogen) metallic hydride. (Author)

A75-44800 # An MHD energy storage system comprising a heavy-water producing electrolysis plant and a H2/O2/CSOH MHD generator/steam turbine combination to provide a means of transferring nuclear reactor energy from the base-load regime into the intermediate-load and peaking regimes. S. J. Townsend and W. W. Koziak (SJT Consultants, Ltd., Thornhill, Ontario, Canada). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 983-989.

A75-44801 # Air Force experience in the use of liquid hydrogen as an aircraft fuel. B. C. Dunnam (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 991-1010.

The Air Force began to show interest in liquid hydrogen as an aircraft fuel in about 1943. The use of hydrogen appeared particularly attractive in connection with studies concerning the development of a high altitude reconnaissance aircraft in the 1954-1958 time period. Investigations and development work leading to the construction of test engines operating with liquid hydrogen are discussed, taking into account related studies concerned with the production, storing, handling, and transportation of hydrogen fuel. During the time from 1963 to 1967 a pilot plant for producing hydrogen slurry, a mixture of solid and liquid, was developed. Other investigations reported were related to a study of the use of liquid hydrogen for the C-5A aircraft and for vehicles with velocities exceeding Mach 5. G.R.

A75-44805 # Hydrogen distribution profiling. R. A. Langley, S. T. Picraux, and F. L. Vook (Sandia Laboratories, Albuquerque, N. Mex.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1089-1103. 8 refs. AEC-supported research.

A technique using nuclear microanalysis has been developed to determine deuterium concentration versus depth profiles in the near-surface regions of solids. The technique uses an incident He-3 beam and detects the nuclear reaction products from the reaction He-3(d,p) He-4, as well as the Rutherford-scattered He-3 from atoms of the solid. By energy analysis of the He-4 recoils, the deuterium concentration-depth profile can be determined. Details and results of the technique are presented for ErD2. Using the same reaction the lattice location of D-2 in single crystals can be determined. The technique utilizes deuterium implantation followed by analysis with a channeled He-3 beam. Results are presented for D-2 in tungsten. (Author)

A75-44806 # Future United States demand patterns and the use of hydrogen. L. T. Blank (Texas, University, El Paso, Tex.) and R. K. Riley (Missouri, University, Rolla, Mo.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1105-1122. 20 refs.

The future energy demands under the concepts of saturation and conservation are forecast for the common use areas. Details of conservation efforts in each area are given. Convertibility to hydrogen is estimated for each use area based on conservative demand projections. The estimates are made for the energy demand which is readily convertible and possibly convertible to the use of hydrogen fuel. (Author)

A75-44807 # Social and environmental context of the hydrogen economy. J. D. Salmon (Virginia Polytechnic Institute and State University, Blacksburg, Va.) and J. G. Witwer (Oklahoma, University, Norman, Okla.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1123-1135. 11 refs.

A hydrogen-energy study conducted in 1973 at the Johnson Space Center utilized interdisciplinary teams to identify social-level impacts of the hydrogen economy. This paper presents some of the findings and some extensions of that work. A matrix evaluation scheme was used so that informed judgment could be directed to the social impacts of hydrogen by combining social and technical considerations. These results provide background for some implementation scenarios. (Author)

A75-44808 # Environmental impact of a suitable nuclear power reactor used to provide a process heat system to synthesize fuels. J. A. Richardson (Burns and Roe, Inc., Oradell, N.J.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1137-1156. 9 refs.

Nuclear power reactors could produce electricity and provide hydrogen and oxygen with the aid of a water-electrolysis procedure. The regulatory requirements for nuclear power reactors are examined and the effects of a typical 1100 MWE nuclear power reactor on the environment are investigated. Attention is given to the radioactive wastes produced, the boiling reactor, solid waste, liquids, and gases. Conditions in the case of a pressurized water reactor are also investigated. Problems related to the transportation of radioactive waste are discussed along with the environmental impact of the required cooling operations. G.R.

A75-44809 # How might the hydrogen economy affect our resources and environment. H. J. Plass, Jr. (Miami, University, Coral Gables, Fla.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1157-1176. 9 refs.

Several systems for the production, distribution and utilization of hydrogen are compared with corresponding systems not using hydrogen, but having the same energy resource base. For the systems being compared, estimates are made of rates of consumption of energy resources, and of the forms and extent of environmental damage resulting from the use of the particular system. Except for solar energy, the resource depletion rates and environmental costs of hydrogen systems are greater than those of their non-hydrogen counterparts. (Author)

A75-44810 # The energy crises. F. Schulman (Fred Schulman Associates, Silver Spring, Md.). In: Hydrogen energy;

Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1181-1192. 7 refs.

The energy crises facing America involve complex technical, environmental, political, financial, tax, and diplomatic aspects. This paper covers some of these interrelationships as they relate to (1) the nature of the oil crisis and how the U.S. got into it; (2) the Arab oil weapon and its effects on the U.S.; (3) what can be done about it, both short and long term; (4) effects on foreign relations; and (5) the Soviet role in this complex situation. Determined action can overcome current and future energy crises. (Author)

A75-44811 # **Hydrogen - Mechanisms and strategies of market penetration.** A. S. Manne and C. Marchetti (International Institute for Applied Systems Analysis, Laxenburg, Austria). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1193-1208.

A description is given of a model for quantifying the benefits of a use of hydrogen in the energy sector. A model for optimizing the level and the structure of the research effort is also presented. A series of sensitivity analyses are conducted. In all cases, even with the most pessimistic assumptions concerning a nongrowing, slow-learning society, the prospective benefits appear high. Compared with these benefits, the costs of exploratory research are low enough to justify the support of parallel projects during the next five years. G.R.

A75-44812 # **Technical problems facing the hydrogen economy.** D. P. Gregory (Illinois Institute of Technology, Chicago, Ill.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1209-1217.

Problems affecting a use of hydrogen as fuel are related to a price which has to be competitive to that of other fuels, questions regarding the compatibility of hydrogen with appliances and burners, aspects of hydrogen availability, and the characteristics of the conversion procedure. An investigation is conducted regarding the nuclear energy capacity available for hydrogen production. A national program is proposed for creating a basis for a hydrogen economy. Recommended program objectives include a reduction in the cost of hydrogen by electrolysis, the production of cheap hydrogen from coal to provide an incentive for the use of hydrogen as a fuel, and the demonstration of hydrogen utilization in industrial burners and domestic appliances. G.R.

A75-44813 # **The hydrogen economy and the law.** T. C. Cady (West Virginia University, Morgantown, W. Va.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1219-1238. 36 refs.

The characteristics of the energy law are examined, taking into account property concepts and ownership, aspects of eminent domain and condemnation, the regulation of the American energy system, and questions of federal preemption as a developing trend in energy law. The environmental law is also considered along with international law problems. Attention is given to questions pertaining to law and jurisdiction with regard to plants located in the area of the territorial sea, the contiguous zone, the continental shelf, and the high seas. G.R.

A75-44814 # **An engineering assessment of the hydrogen economy.** J. O. Mingle, N. D. Eckhoff (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.), L. A. Rash (Beach Aircraft Corp., Wichita, Kan.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1239-1249. 12 refs.

An assessment is made of the feasibility of meeting production and storage requirements for a hydrogen economy encompassing the East Coast of the United States. The timing of engineering facilities sufficient to insure adequate hydrogen production and distribution is shown to be critical. The manpower requirements are shown to place an extreme burden on the projected engineering resources. (Author)

A75-44815 # **Ultimate energy, the ultimate fuel, and the hydrogen link in the electrical energy system.** C. M. Summers. In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1251-1264.

This paper considers some of the long-range potential solutions for the energy dilemma. An estimate is given for the ultimate energy we can tolerate in the United States; the ultimate source of energy is discussed; hydrogen is suggested as the ultimate fuel and as an important link in our electrical energy system; and some thoughts are given regarding national and state energy objectives. (Author)

A75-44816 # **Sources and methods for methanol production.** T. B. Reed (MIT, Cambridge, Mass.) and R. M. Lerner (MIT, Lexington, Mass.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1265-1278. 9 refs.

Methanol and methyl fuel promise to be useful clean fuels for internal combustion engines and other liquid fuel applications. The various sources for synthesis of methanol are surveyed, and methods of synthesis are discussed. Various factors affecting production and use economics are listed and production cost from coal, lignin, waste and wood are estimated. (Author)

A75-44817 # **The nuclear electric economy.** P. N. Ross (Westinghouse Electric Corp., East Pittsburgh, Pa.). In: Hydrogen energy; Proceedings of the Hydrogen Economy Miami Energy Conference, Miami Beach, Fla., March 18-20, 1974. Part B. New York, Plenum Press, 1975, p. 1287-1307.

Figures on current and projected use of energy resources and on rate of depletion of oil, natural gas, and coal reserves are given, and developments in energy-conserving technology such as heat pumps, temperature amplifiers, and improved electrochemical batteries are discussed. An energy budget is outlined for the year 2000 with a shift of emphasis from direct use of natural energy resources to their use in electricity generation. The bulk of energy needs are to be met by generation of electricity from coal and uranium. C.K.D.

A75-45060 # **A technique for calibrating photometric curves obtained in solar concentrator tests (Metodika tarirovki fotometricheskikh krivykh, poluchennykh pri solnechnykh ispytaniiakh kontsentratorov).** E. V. Tver'ianovich, V. V. Madaev, Ia. T. Shermazanian, and A. V. Vartanian (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 3-4, 1975, p. 15-19. In Russian.

A75-45061 # **Investigation of a solar concentrator with hexahedral glass facets (Issledovanie solnechnogo kontsentratora s shestigrannymi stekliannymi fatsetami).** A. K. Alimov, D. N. Alavutdinov, and A. Abduazizov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 3-4, 1975, p. 20-22. 5 refs. In Russian.

A75-45062 # **A nearly perfect solar energy concentrator made up of tapered mirror facets with constant transverse curvature (Priblizhennyi kontsentrator solnechnoi energii, sostoiashchii iz zerkal'nykh klinovidnykh fatsetov s postoiannoi poperechnoi kriviznoi).** A. Sh. Sharafi, G. Ia. Umarov, and A. Abduazizov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut; Tashkentskii Gosudarstvennyi Universitet, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 3-4, 1975, p. 35-38. In Russian.

A75-45063 # **Effectiveness of using chemically reacting working media in a solar gas-turbine installation (Ob effektivnosti**

primeneniia khimicheski reagiruiushchikh rabochikh tel v solnechnoi gazoturbinnoi ustanovke). V. V. Chikovani, M. S. Dzitoev, and G. I. Krylov. *Geliotekhnika,* no. 3-4, 1975, p. 80-87. 5 refs. In Russian.

A thermodynamic method for analyzing the cycles of solar gas-turbine installations is developed on the basis of the fundamental laws of thermodynamics of systems of variable composition. The thermodynamic analysis shows that the cycle efficiency of solar gas-turbine installations employing a chemically reacting working fluid is appreciably higher than that of the classical Brayton cycle, particularly at low permissible temperatures of the working fluid in front of the turbine. V.P.

A75-45064 # Estimates of the reliability of energy-supply systems employing solar energy (Ob otsenkakh nadezhnosti sistem energosnabzheniia pri ispol'zovanii energii solntsa). R. B. Salieva (Tashkentskii Institut Sviazi, Tashkent, Uzbek SSR). *Geliotekhnika,* no. 3-4, 1975, p. 119-124. In Russian.

A method of obtaining reliability estimates, using quantitative indices is demonstrated by the example of the power supply of a relay line station equipped with solar cells, electrical accumulators, and diesel generator units. Causes of failure in the power supply from solar cells are analyzed. V.P.

A75-45386 Ion-beam implosion of fusion targets. M. J. Clauser (Sandia Laboratories, Albuquerque, N. Mex.). *Physical Review Letters,* vol. 35, Sept. 29, 1975, p. 848-851. 14 refs.

The performance of ion-beam-irradiated fusion targets consisting of a high-density spherical shell containing DT gas has been calculated. Breakeven with 10-MeV protons irradiating 1-2-mm-diam targets can be produced with a beam current around 10 MA. Results for various target sizes and other beam particles and voltages are also discussed. (Author)

A75-45508 Solar energy - An overview. J. M. Cherne (TRW Systems, Redondo Beach, Calif.). *(American Vacuum Society, Symposium on Films for Solar Energy, Yorktown Heights, N.Y., May 21, 1975.) Journal of Vacuum Science and Technology,* vol. 12, Sept.-Oct. 1975, p. 975-983.

A survey of the potential of solar energy as a viable alternative for fossil fuels is presented. The present status of the six classes of solar energy conversion systems - (1) heating and cooling of buildings, (2) solar-thermal electric power, (3) photovoltaic power, (4) ocean thermal-gradient power, (5) bioconversion, and (6) wind energy conversion - is discussed and projections of energy costs are presented for each of these areas of development. (Author)

A75-45509 Outlook for Si photovoltaic devices for terrestrial solar-energy utilization. M. Wolf (Pennsylvania, University, Philadelphia, Pa.). *(American Vacuum Society, Symposium on Films for Solar Energy, Yorktown Heights, N.Y., May 21, 1975.) Journal of Vacuum Science and Technology,* vol. 12, Sept.-Oct. 1975, p. 984-999. 22 refs.

The feasibility of silicon solar cells for large scale energy conversion is examined. In this context the availability of silicon and the cost of fabrication of devices are discussed. It is proposed that a complete rethinking of solar array processing is necessary to achieve large reduction in production costs. (Author)

A75-45511 Principles and applications of selective solar coatings. J. Jurisson, R. E. Peterson, and H. Y. B. Mar (Honeywell Systems and Research Center, Minneapolis, Minn.). *(American Vacuum Society, Symposium on Films for Solar Energy, Yorktown Heights, N.Y., May 21, 1975.) Journal of Vacuum Science and Technology,* vol. 12, Sept.-Oct. 1975, p. 1010-1015. 7 refs. NSF Contract No. C-957.

Several ways that selective coatings can be used to enhance the performance of solar energy collection systems are reviewed. Coatings discussed include vacuum-deposited, electroplated, and paint-type selective solar absorber coatings and vacuum-deposited and chemically etched antireflection and infrared reflecting coatings for glass. The optical and physical requirements for the coatings, as well as their effectiveness at increasing solar collector performance, are discussed. (Author)

A75-45512 Optical coatings for collection and conservation of solar energy. J. H. Apfel (Optical Coating Laboratory, Inc., Santa Rosa, Calif.). *(American Vacuum Society, Symposium on Films for Solar Energy, Yorktown Heights, N.Y., May 21, 1975.) Journal of Vacuum Science and Technology,* vol. 12, Sept.-Oct. 1975, p. 1016-1022.

An optical coating applied to a surface can cause radiation incident on the surface to be divided into transmission, reflection, and absorption in a prescribed manner. Thus, coatings affect the control of radiation and enhance the collection, conversion, and conservation of solar energy. (Author)

A75-45513 Solar-energy materials preparation techniques. D. M. Mattox (Sandia Laboratories, Albuquerque, N. Mex.). *(American Vacuum Society, Symposium on Films for Solar Energy, Yorktown Heights, N.Y., May 21, 1975.) Journal of Vacuum Science and Technology,* vol. 12, Sept.-Oct. 1975, p. 1023-1031. 90 refs. ERDA-supported research.

The application of materials to the thermal control of structures, photothermal/electrical conversion, and photovoltaic conversion are reviewed. Applications include solar and infrared reflectors, optical filters, transparent conductors, bulk semiconductor materials, semiconductor films, and selective solar absorbers. The use of thin films in many conservation and photothermal applications is presently economical, but the economics of photothermal/electrical and photovoltaic conversion is still being investigated. The means of obtaining selective solar absorbers which have a high solar absorptance and low IR emittance are discussed, and specific data on an electrodeposited black-chrome selective absorber is presented. It is shown that solar-electric generating plants must be constructed at a cost of about $50/sq m to be competitive with other electrical generating plants, and that a meaningful impact on the electrical energy economy will require a fabrication rate of greater than 50 square miles per year. (Author)

A75-45514 Solar-energy conversion at high solar intensities. C. E. Backus (Arizona State University, Tempe, Ariz.). *(American Vacuum Society, Symposium on Films for Solar Energy, Yorktown Heights, N.Y., May 21, 1975.) Journal of Vacuum Science and Technology,* vol. 12, Sept.-Oct. 1975, p. 1032-1041. 22 refs.

The concentration of sunlight offers distinct advantages for solar-electrical generation either by thermal conversion or by photovoltaics. A large variety of concentration techniques are available with concentration ratios of 1-1000. Concentration is required for thermal conversion systems to attain the high temperatures needed for efficiencies in the desired range of about 25%-35%. The projected costs for some of the solar thermal systems (especially the central receiver and the fixed mirror) indicate that they could be economically competitive in the southwestern states. The southwest may be required for these high-concentration systems to overcome the main disadvantage of concentration, which is the use of the direct component of sunlight only. Other concerns of high-intensity systems are in tracking requirements, reflective surface accuracy, and material lifetimes of both the reflecting and absorbing components. (Author)

A75-45647 # A potassium topping cycle for public utility power plants. W. F. Zimmerman, G. C. Wesling, and R. J. Rossbach (General Electric Co., Evendale, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1235.* 12 p. 44 refs.

A potassium topping cycle power plant proposed for utility power is an excellent example of the effective use of prior space program development efforts. During the 1960's the government sponsored the development of nuclear powered Rankine cycle systems for the generation of power in space. Over 10,000 hours of potassium vapor turbine operation were accumulated in superalloy

systems operating in an air environment. Much additional effort and supporting technology were developed in areas which were required to support the development of metal vapor turbine space power systems. It has been suggested that the technology be used to increase the operating temperature and, thus, the thermal efficiency of utility power plants. A recent study of such systems indicates electric power can be generated at higher efficiency with controlled thermal and air pollution and with considerable conservation in coal and water resources. (Author)

A75-45648 # **MHD electrical power generation from fossil fuels.** K. E. Tempelmeyer (Tennessee, University, Tullahoma, Tenn.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1236.* 11 p. 8 refs.

The generation in electrical power by magnetohydrodynamic (MHD) techniques was pioneered in the U.S. in the early 1960's. At present, the major activities are underway in the U.S.S.R., the U.S., and Japan. Each of these countries now have large scale active programs for MHD central plant power generation using different fossil fuels. The effort in the Soviet Union centers about the use of natural gas; coal-fired systems are being investigated in the U.S. while Japan uses oil. All of these efforts are directed toward the development of open-cycle systems but the development problems are different because of the different types of fuel being used. This paper will review the status of these various problems and outline the prospects for their solutions. (Author)

A75-45649 # **Electrochemical heat engines for direct electric power generation and energy storage.** G. R. B. Elliott, W. J. Trela, and G. E. Dials (California, University, Los Alamos, N. Mex.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1237.* 8 p. 7 refs. ERDA-supported research.

Batteries can be operated in heat engine cycles analogous to the cycles of usual mechanical heat engines but without the mechanical motion of pistons, turbines, etc. These electrochemical cycles can be used for direct generation of electric power and for storage of energy. The Los Alamos Scientific Laboratory is in the initial stages of development of such engines which can accept heat in the temperature range of 1700-900 K, then drop the temperature to the range 800-600 K while doing useful electrochemical work. These systems offer promise as topping cycles for steam turbines, and they also could be used for mine-mouth generation of electric power following in situ gasification of coal - here the rejected heat from the generation can be used in endothermic processes underground. Such processes include preliminary drying of the coal bed, frequently a necessary step in in situ gasification, as well as coal pyrolysis to produce a substitute feedstock for petroleum refineries of the future, plus gasification itself. (Author)

A75-45651 # **Solar residential electrification with high performance heat engines.** R. M. Salter (Rand Corp., Santa Monica, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1239.* 12 p. 45 refs.

Application of high-performance closed-cycle heat engines to solar energy conversion for residences and other buildings is considered. Stirling and recuperated Brayton cycles are investigated with the former favored due to commonality in construction with conventional small Otto cycle engines. Typical top temperatures of these cycles is near best compromise between thermodynamic efficiency vs solar collection efficiency. The overall system includes an array of sun-following paraboloidal collectors connected by sodium heat pipes. Both heat and electrical buffering, control problems, accoutrements (such as heat pumps), other heat sources, and other electrical sources are examined. Analogous conversion of furnace fuel energy into electricity is considered. (Author)

A75-45656 * # **Propulsion technology needs for advanced space transportation systems.** J. W. Gregory (NASA, Lewis Research Center, Rocket Systems Branch, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1246.* 21 p. 16 refs.

Plans have been formulated for chemical propulsion technology programs to meet the needs of advanced space transportation systems during the two decades from 1980 to the year 2000. The many possible vehicle applications have been reviewed and cataloged to isolate the common threads of primary propulsion technology that will satisfy near term requirements in the first decade and at the same time establish the technology groundwork for various potential far term applications in the second decade. Two thrust classes of primary propulsion engines are apparent: (1) 5,000 to 30,000 pounds thrust for upper stages and space maneuvering; (2) large booster engines of over 250,000 pounds thrust. Six major classes of propulsion systems and the important subdivisions of each class have been identified. The relative importance of each class is discussed in terms of the number of potential applications, the likelihood of that application materializing, and the criticality of the technology needed. Specific technology programs are described and scheduled to fulfill the anticipated primary propulsion technology requirements of the period. (Author)

A75-45659 # **Consideration of ultra-high temperature nuclear heat sources for MHD conversion systems.** R. R. Holman, J. M. Tobin, and W. E. Young (Westinghouse Electric Corp., Pittsburgh, Pa.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1258.* 6 p. 7 refs.

The nuclear technology reactors developed and tested in the Nuclear Engine Rocket Vehicle Application (NERVA) program operated with fuel exit gas temperatures in excess of 2600 K. This experience provided a significant ultra-high temperature technology base and design insight for commercial power applications. Design approaches to accommodate fission product retention and other key prevailing requirements are examined in view of the basic overriding functional requirements, and some interesting reconsiderations are suggested. Predicted overall system performance potentials for a 2000 K MHD conversion system and reactor parameter requirements are compared and related to existing technology status. Needed verification and development efforts are suggested. A reconsideration of basic design approaches is suggested that could open the door for immediate development of ultrahigh temperature nuclear heat sources for advanced energy systems. (Author)

A75-45661 # **Application of nuclear rocket technology to light weight nuclear propulsion and commercial nuclear process heat systems.** G. H. Farbman and R. E. Thompson (Westinghouse Astronuclear Laboratory, Pittsburgh, Pa.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1261.* 12 p.

A75-45663 # **Terrestrial and space applications of the migma controlled fusion concept.** R. Ho. *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1263.* 6 p. 16 refs.

Approaches for the heating of ions with the aid of colliding beam technology are considered and a description is given of the self colliding beam technology and the migma principle. The utilization of the described principle for fusion reactions is discussed. In an analysis of migma space propulsion applications it was found that migma propulsion compares favorably with hypothetical fission or solar powered spacecraft. Terrestrial dd migma applications offer also a number of advantages. G.R.

A75-45814 * **Report on studies of space to earth microwave power transmission systems.** A. Edwards, Jr. (Raytheon Advanced Development Laboratory, Sudbury, Mass.) and R. M. Schuh (NASA, Lewis Research Center, Space Flight Systems Study Office, Cleveland, Ohio). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper 75-005.* 38 p. 13 refs. Contract No. NAS3-17835.

The studies reported include a preliminary analysis, conceptual design, technical and economic evaluation, and planning for a technology development, a ground demonstration, and an orbital test program. The concept investigated involves a transmitting antenna in geosynchronous orbit which beams microwave power to a ground antenna where it is rectified to DC power. The amplitron and the klystron are considered as devices for converting DC power to RF power at microwave frequencies. G.R.

A75-45819 **Deployable Symphonie solar generator.** H. H. Schultz (Société Européenne de Propulsion Vernon, Eure, France) and J.-C. Vermalle (Société Nationale Industrielle Aérospatiale, Cannes, France). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper 75-009.* 13 p.

The developmental history of the Symphonie satellite solar generator is reviewed. Design restraints on the solar generator, original concepts and feasibility studies, general characteristics of the chosen design solution, development tests, qualification tests, tests on a modified launch vehicle, and verification tests are discussed. A brief description of the Symphonie telecommunications satellite as a whole precedes the discussion. S.J.M.

A75-45822 # **Thrust vector control by magnetic field.** M. Shepshelovich and Y. Manheimer-Timnat (Technion - Israel Institute of Technology, Haifa, Israel). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper 75-027.* 29 p. 7 refs.

Possibilities are discussed for the practical application of a magnetic field to the problem of thrust control and vectoring of an MHD-generator rocket engine. Two alternative techniques are considered: the introduction of 'magnetic nozzles' and the use of thermal choking. The performance of these techniques is compared analytically, and it is shown that thermal choking is more advantageous since it requires a smaller current density. Possible designs for both systems are considered, and effective thrust vectoring with solid propellants is examined. F.G.M.

A75-45829 **Economic analysis of space-based electric power generation and transmission systems.** E. J. Greenblat (ECON, Inc., Princeton, N.J.). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper 75-006.* 18 p.

An economic evaluation is conducted of a space solar power station (SSPS) project considered by an American aerospace corporation. Underlying economic considerations for determining the 'cost' of electricity to users from a given power plant are discussed. An economic analysis of the initial program plan is considered along with an analysis of technology choices and the potential economic benefits of an SSPS. On the basis of the reported evaluation it is concluded that the SSPS concept can be regarded as potentially economically viable. G.R.

A75-45875 # **Storage of energy in kinetic batteries for an earth resources satellite (Stockage d'énergie sur batteries cinétiques pour un satellite de ressources terrestres).** J. P. Passani. *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper ST-75-09.* 39 p. 10 refs. In French.

A plan for the storage of energy (e.g., solar energy) in a rotating flywheel is proposed. This design is especially useful for energy storage in satellites. The gyroscopic effect of the flywheel is shown to have no significant effect on the pilot-ability of the satellite. A comparison with battery-powered systems shows that satellite lifetimes are increased, satellite weights are decreased, and power supply-based satellite actuation possibilities are increased with the flywheel as compared to the Ni-Cd cells. Computer management of these systems will provide a great deal of adaptability to different energy demand patterns. S.J.M.

A75-45885 # **Space and energy - Some legal problems (Espace et énergie - Quelques problèmes juridiques).** A. W. Stoebner. *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper.* 15 p. In French.

Three areas of possible conflict between terrestrial and space use of energy are examined. The first area is economic evaluation of the earth by spatial means. The second concerns harnessing solar energy. Evaluation and exploitation of extraterrestrial environments and resources constitute the third category. In the first area are included meteorology, telecommunications, and remote sensing; the second category deals mainly with the installation of very large energy-converting and transmitting space stations; and the third centers around the right of a nation with advanced technology to appropriate extraterrestrial resources to the exclusion of underdeveloped countries. S.J.M.

A75-45893 # **The utilization of space as a source of energy for the earth.** S. Estradé (Barcelona, Polytechnic University, Barcelona; PROMAR S.A., Spain). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper.* 21 p. 6 refs.

A study of energy sources outside the earth is conducted in connection with the desirability to obtain a clean and practically inexhaustible source of energy for terrestrial and space applications. Attention is given to orbital helioelectric plants, the earth's magnetic field and the Van Allen radiation belts, energy in inter-stellar matter, cosmo-driven plants, the utilization of the moon, and problems of energy transportation. Juridical considerations regarding the utilization of energy from space are discussed. Stimuli for accelerating space energy research are considered along with questions related to the rivalry between states. G.R.

A75-45903 # **The satellite solar power station - A step toward the industrial use of space.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper 75-003.* 27 p. 12 refs.

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

A75-45920 **Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, University of Delaware, Newark, Del., August 18-22, 1975, Record.** Conference sponsored by IEEE, AIChE, ANS, SAE, ACS, AIAA, ASME, International Solar Energy Society, American Power Conference, and Electrochemical Society. New York, Institute of Electrical and Electronics Engineers,

Inc., 1975. 1557 p. $50.

The topics considered are related to solar buildings, fuel cells, liquid metal fast breeder reactors, energy storage and components, automotive engines, solar heating and cooling, urban systems, nuclear power systems, and thermionic energy conversion. Attention is also given to photovoltaic conversion, lithium batteries, topping cycles, unique engines, a review of U.S. government and foreign energy programs, molten salt/solid electrolyte batteries, synthetic liquid fuels from coal and oil shale, energy conservation, thermoelectric systems, solar utilization, aqueous batteries, alternative fuels, isotope power systems, Stirling cycle engines, wind systems, space solar systems, Brayton cycle systems, hydrogen, biomedical power, space and remote power systems, and heat pipe applications. G.R.

A75-45921 **Technical and economic evaluation of solar heating and cooling of buildings.** R. O. Turbyfill and A. D. Cohen (General Electric Co., King of Prussia, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1-6. NSF Grant No. C-855.

Aspects of weather data development for the evaluation are considered, taking into account the division of the country into separate solar climate regions and business economic areas. A system of seventeen building models representing the various categories of buildings was selected. The reference buildings were used as a basis for the reported evaluation studies. It was found that solar heating and cooling is technically feasible now, and with the advent of mass production in hardware could become economically viable in the early 1980s. Significant savings in fossil fuels would occur by the end of the century. G.R.

A75-45922 **Solar One, two years experience.** K. W. Böer, J. H. Higgins, and J. K. O'Connor (Delaware, University, Newark, Del.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 7-13. 9 refs. Research supported by the Delmarva Power and Light Co., Pennsylvania Power and Light Co., Atlantic City Electric Co., Baltimore Gas and Electric Co., Tampa Electric, Ohio Edison, Southern California Edison, and American Public Power Association.

The Delaware Solar One laboratory has been in operation for approximately two years and results of its solar thermal and electrical system are reported. It could provide substantially in excess of 50% solar heat and shows the feasibility to provide up to 15 kwh per clear summer day of its electric energy needs from CdS/Cu2S solar cells of approximately 4% conversion efficiency (620 sq ft roof coverage is simulated). These encapsulated cells have shown no degradation. Highly efficient solar collectors are developed with air as the heat transport fluid. The thermal storage uses heat of fusion and has maintained an acceptable storage capacity throughout its operation. An analysis summary is presented with key data points of the system. (Author)

A75-45923 **Operational experience - Solar heating a Boston school.** J. E. Notestein (General Electric Co., King of Prussia, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 14-18. 7 refs.

The solar heating system considered consists of a solar collector array, a thermal energy storage tank, two air heating coils, two pumps, two heat recovery/dump heat exchangers, various motorized valves, piping, instrumentation, and control devices. On the basis of an evaluation of the operational experience with this heating system it is concluded that solar heating is effective and feasible in the Boston area. A solar heating system should provide over 2/3 of the heating requirements. G.R.

A75-45924 **A large mechanical contracting corporation solar heats its own offices.** T. A. King, E. F. Nerf, Jr. (Mueller Associates, Inc., Baltimore, Md.), and W. A. Touchard, Jr. (Poole and Kent Co., Baltimore, Md.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 19-22.

The considered solar heating system provides a minimum of 50 per cent of the heating requirements of a 1500 square foot building. Commercially available equipment is used. The collector system employs water as the working fluid. Problems of freeze protection are considered along with details concerning the heat storage arrangements and the space heating system. Questions concerning the cost effectiveness of the solar heating system are investigated, taking into account costs for competitive heating systems and the importance of a reduction in the price of solar collectors. G.R.

A75-45925 **The nation's first private industrial solar heating system - General Electric's Valley Forge Space Center.** W. J. Haggerty (General Electric Co., Valley Forge, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 23-28.

The solar heating system collector array is installed on a portion of the roof of the building. The solar collectors face southward with a tilt of 45 degrees from the vertical. The array consists of 203 flat plate collectors with a surface area of 4872 square feet. Aspects of system design are discussed along with structural details, the collector array, the mechanical components, and the control system. Instrumentation is provided to analyze system performance, obtain data on specific system components, evaluate variations in collector configuration, and obtain detailed solar collector performance data. G.R.

A75-45926 **Solar heating and cooling of Army buildings.** W. R. Terrill, A. Kirpich (General Electric Co., King of Prussia, Pa.), and D. C. Hittle (U.S. Army, Construction Engineering Research Laboratory, Champaign, Ill.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 29-37.

The U.S. Army initiated a study program to evaluate the potential application of solar energy for the heating and cooling of Army buildings. The program includes the definition of the preliminary design of a solar heating system to be retrofitted into an existing building. A system concept is also to be defined for a combined solar heating and cooling system for an incorporation into a new building. Details of the study program are discussed, taking into account the characteristics of the selected buildings, the analysis methods, and details regarding the preliminary design of the considered systems. G.R.

A75-45927 **An integrated solar heated and cooled mobile home.** S. L. Macklis and S. A. Haas (General Electric Co., Valley Forge, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 38-42.

The primary goal of the considered program was to use the solar energy data and technology base available from existing solar installations to demonstrate the feasibility of mobile home heating and cooling using solar energy. Major accomplishments of the first phase of the program include an overall system study of a solar heating and cooling system designed specifically for use with a mobile home. The solar collector system is discussed along with the heating and cooling system, the control system, and aspects of instrumentation and data acquisition. A preliminary economic analysis is also conducted. G.R.

A75-45929 **The economic incentive for introducing electric storage devices into the national energy system.** C. Braun, E. A.

Cherniavsky, and F. J. Salzano (Brookhaven National Laboratory, Upton, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 82-90. 10 refs. ERDA-sponsored research.

Requirements for electric utility energy storage devices are related to the variations in the demand for electricity on a daily, weekly, and seasonal basis. No specific device is identified in the reported study and a 'black box' storage device having a characteristic efficiency and cost is considered. It is pointed out that a significant analysis must take the entire electric utility system into account. This condition is satisfied by the linear programming model which is discussed. The model encompasses the entire energy system including all alternative resources and both electric and nonelectric demands. A break-even capital cost study for electric storage devices is described. G.R.

A75-45930 Energy storage by flywheels. R. I. Fullman (GE Research and Development Center, Schenectady, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 91-100. 45 refs.

The purpose of this report is to estimate the best performance and cost effectiveness that are likely to be attainable in the storage of energy by flywheels. Its emphasis is on identifying safe design values for the properties of candidate rotor materials, and on the relationship of these properties to the rotor's maximum energy storage density. Approximate allowance is made for the weight, volume, and cost of components other than the rotor itself, but no attempt is made to provide an independent assessment of requirements for bearings, seals, vacuum pumps, etc. Some areas for further development are suggested, and applications are identified in which flywheel energy storage is most likely to be useful. (Author)

A75-45931 Energy storage by high-pressure, moderate-temperature electrolytic techniques. H. J. Allison and W. L. Hughes (Oklahoma State University, Stillwater, Okla.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 104-110. 7 refs. NSF Grant No. GI-39457.

General design constraints for energy storage systems are considered along with basic information related to the hydrogen-oxygen electrolytic reaction. Advantages of high-pressure and elevated temperature operation are examined. Conventional high-pressure, moderate temperature hydrogen-oxygen electrolysis cells consist essentially of parallel plate electrodes separated by a solution of an electrolyte, usually KOH. Certain problems with these cells and approaches to overcome the difficulties are discussed. A description is given of an electrolysis system which was designed to minimize the considered problems. The system can operate at a maximum pressure of 3000 psi and a maximum temperature of 400 F. G.R.

A75-45932 Thermal energy storage. M. Telkes (Delaware, University, Newark, Del.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 111-115. 14 refs.

Various thermal storage materials are compared and their theoretical and actual performance limitations are summarized. Solid/liquid phase change reactions (heat of fusion materials, or heat sinks) are described, especially in solar heating applications. Inexpensive materials are available that are nontoxic, noncorrosive and nonflammable. The problems of supercooling, or of unwanted labile crystal forms can be controlled by heterogeneous nucleating materials or devices. Results are presented with sodium thiosulfate pentahydrate melting around 49 C (120 F). Its heat of fusion is 50 kcal/kg (90 Btu/lb); its volumetric heat storage capacity is 9,300 Btu/cu ft. Estimated cost of the material for the storage of one million Btu is $770, additional cost of containers increases this to about $1,500 per million Btu. The result of heat transfer tests are reported as obtained in a calorimetric device. This material has been used in Solar-One, the experimental solar building at the University of Delaware. (Author)

A75-45933 Application of rocket engine technology to energy. A. D. Lucci and D. R. Hodson (Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 116-124.

A description is given of a compact steam generator (CSG) designed for peak shaving for a large utility. It supplies a nominal steam load of 132,000 lb/hr at 330 psia and 600 F, and burns natural or propane gas with oxygen giving a nonpolluting exhaust. It is pointed out that the concept stems principally from the technology developed for rocket engine thrust chambers. Liquid fuel and oxidizer are introduced into a combustion chamber where they are burned at elevated pressure. A general physical description of the CSG system installation is provided. Attention is given to questions of equipment design and system operation. G.R.

A75-45934 Advanced heat transfer methods for geothermal power applications. L. Awerbuch and S. C. May (Bechtel, Inc., San Francisco, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 125-130. 5 refs.

A binary cycle for the extraction of geothermal energy is considered. Heat from the fluid of a geothermal well is transferred to a secondary fluid. The secondary fluid is heated to a supercritical condition and expanded through a turbine to generate electricity. Studies concerning the heat exchanger requirements for a 10-MW (net) electrical power generating plant were conducted. Other considerations being equal, the cost of the heat transfer equipment can be minimized by utilizing high overall heat transfer coefficients. Attention is given to the advantages obtained by employing the overall heat transfer coefficients of various heat transfer methods in preheaters, evaporators, and condensers. G.R.

A75-45936 Solar heat pump comfort heating systems. T. A. V. Cassel (Bechtel, Inc., San Francisco, Calif.), H. G. Lorsch (Franklin Institute Research Laboratories, Philadelphia, Pa.), and N. Lior (Pennsylvania, University, Philadelphia, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 162-170. 25 refs. NSF Grant No. GI-29729.

This paper is addressed to the development of an advanced and energy-efficient heating system which integrates solar energy collectors, a thermal energy storage device, a vapor compression heat pump, an auxiliary heat source, controls, and a residence. Using simulation programs written in interactive APL computer language, two proposed solar heat pump systems were modeled for a 1500 square foot Philadelphia, Pennsylvania residence, and were compared to models of direct solar and conventional heating systems over an entire heating season. Comparisons were made on three criteria: resource energy utilization efficiency, effect on electric utilities, and consumer investment incentives. (Author)

A75-45937 Optimum properties of working fluids for solar powered heat pumps. L. I. Stiel, R. A. Allen, and K. P. Murphy (Allied Chemical Corp., Specialty Chemicals Div., Buffalo, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 171-177. 7 refs. NSF-supported research.

In this study, the effect of the thermodynamic properties of the working fluid on the performance of a solar powered heat pump has been analyzed. The system consists of a vapor compression cooling or heating cycle combined with a Rankine power cycle. Values of the input fluid properties which result in optimum efficiencies have been determined for upper temperatures of 180 and 300 F. Cycle and overall efficiencies have also been calculated for approximately 20 halocarbons and other substances. The fluids are classified by boiling points, and the results are tabulated for operation both in cooling and heating modes. Plots are also presented indicating the variation of the efficiencies with cycle parameters. (Author)

A75-45938 Study on parameter variations for solar powered lithium bromide absorption cooling. W. Bessler and C. N. Shen (Rensselaer Polytechnic Institute, Troy, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 178-185. 6 refs.

The investigation reported is concerned with the use of solar energy for powering an absorption-cycle refrigeration system for the cooling of buildings. The cooling system considered employs a lithium bromide water solution. Questions of system operation were studied with the aid of a mathematical model. The computerized simulation procedure was used in connection with realistic solar heat supply and cooling load data. The solution of the problem-system model is discussed, taking into account initial conditions, aspects of concentration and flow, questions of storage and mixing, and the cooling performance. Problems of systems control are also explored. It is concluded that the concept of latent heat storage, as investigated, appears to provide a feasible approach for the cooling of buildings. G.R.

A75-45939 Design and operation of a solar-powered turbocompressor air-conditioning and heating system. F. R. Biancardi, M. D. Meader, W. A. Blecher, and J. B. Hall (United Technologies Research Center, East Hartford, Conn.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 186-194. 18 refs. ERDA-supported research.

The turbocompressor Rankine-cycle system concept for solar-powered heating and cooling utilizes a single working fluid and a common condenser for both the power and cooling loops. Hot fluid from the solar collector/storage system is used to vaporize a working fluid in the vapor generator of the power loop. The vapor is expanded through a turbine which produces mechanical power to drive a compressor. Questions of cycle selection are discussed along with the characteristics of ejector systems, mechanical expander-compressor systems, single-fluid systems, dual-fluid systems, and problems of working fluid selection. G.R.

A75-45940 Development of a 540-sq-ft prototype faceted fixed mirror solar concentrator. J. R. Williams (Georgia Institute of Technology, Atlanta, Ga.) and S. F. Hutchins (Scientific Atlanta, Inc., Doraville, Ga.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 195-201. 8 refs. NSF Grant No. GI-43936.

A new type of solar collector has been assembled and tested at Georgia Tech which promises to provide heat at about the same cost as commercially available flat-plate collectors, but at a much higher temperature. The higher temperature permits higher COP air conditioning and heat pump operation, with a resulting decrease in the collector area required and lower air conditioning equipment costs as compared with systems using flat plate collectors. In addition, this focusing collector can supply low-grade steam and other industrial process heat at temperatures to several hundred degrees Centigrade. Using air as the heat-transfer medium, collection temperatures in excess of 400 C have already been achieved using the 540-sq-ft FFMC at Georgia Tech. These Data indicate that an average collection efficiency of at least 50% at the design temperature of 260 C should be achieved using an improved heat exchanger currently under construction. (Author)

A75-45941 A computer program to determine the optimum configuration of solar assisted building heating and cooling systems based upon life-cycle cost. D. R. Fairbanks (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 202-209. 5 refs.

A75-45942 Solid polymer electrolysis fuel cell status report. L. J. Nuttall (General Electric Co., Aircraft Equipment Div., Wilmington, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 210-217.

The electrolyte used in current solid polymer electrolyte (SPE) fuel cells is a thin (10 mil) sheet of a perfluoro linear polymer to which sulfonic acid radicals have been chemically linked. Ionic conductivity results from the mobility of hydrated hydrogen ions. The SPE fuel cells, which were first used operationally in the Gemini spacecraft, have been improved in recently completed fuel cell technology programs. Enhanced performance and reduced manufacturing costs make the solid polymer electrolyte fuel cell an attractive candidate for many ground power applications in addition to its continued use in the aerospace field. G.R.

A75-45943 Phosphoric acid fuel cell stack development. S. G. Abens, B. S. Baker, R. DiPasquale, and I. Michalko (Energy Research Corp., Danbury, Conn.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 218-221. Grant No. DAAK02-74-C-0367.

It is pointed out that most fuel cell systems are currently probably not economically feasible because of the way components are manufactured. A description is given of techniques which have been developed to reduce the costs of fuel cell manufacture, taking into account the production of three key fuel cell components. Attention is given to the manufacture of the electrodes, the acid fuel cell matrix, and the bipolar plates. G.R.

A75-45944 1.5 and 3KW indirect methanol-air fuel cell power plants. S. S. Kurpit (U.S. Army, Mobility Equipment Research and Development Center, Fort Belvoir, Va.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 222-228.

A 1.5KW methanol-air fuel cell power plant was completed and tested during the early part of 1974. The power plant consists of two major subsystems. The fuel conditioning subsystem converts the aqueous methanol feed to hydrogen, and the fuel cell subsystem converts the hydrogen to electrical power. The fuel cell subsystem consists of a phosphoric acid electrolyte cell stack. The phosphoric acid electrolyte is contained in a soft porous phenolic resin mat between the electrodes. The success encountered with this unit provided the basis for a decision to design, fabricate, and evaluate a 3KW power plant. G.R.

A75-45946 The EPA-Van - A clean energy system for the home. S. J. Bunas (U.S. Environmental Protection Agency, Control Systems Laboratory, Research Triangle Park, N.C.), M. F. Collins, and P. L. Terry (Engelhard Minerals and Chemicals Corp., East Newark, N.J.). In: Energy 10; Annual Intersociety Energy Con-

version and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 241-246. 5 refs.

In the design of the EPA-Van system three approaches were combined for reducing air pollution and conserving energy. These approaches are related to better home construction, the use of solar energy, and a utilization of new, low-polluting devices such as fuel cells and catalytic appliances. Heavy insulated walls, floors, and ceiling are to be employed in the construction of the home. The solar energy system includes a collector mounted on the roof. A solution of ethylene glycol and water is heated as it circulates in tubes. The solar energy system is integrated with an electrically driven heat pump. G.R.

A75-45947 **The annual cycle energy system.** H. C. Fischer. In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 251-259. Research sponsored by the U.S. Department of Housing and Urban Development and Federal Energy Administration.

The annual cycle energy system (ACES) obtains heat by freezing water during the heating season. A one-direction heat pump is used to deliver the heat to the building. The ice is used to provide air conditioning during the summer. The cycle is repeated each year and the only major energy expenses are related to the cost of operating the heat pump during the winter. Questions concerning the provision of hot water are discussed along with problems regarding the ice freezing coils. Attention is also given to ice bin requirements, ice bin structures, the heat leakage into an ice bin, the application of ACES to large central systems, and economic considerations. G.R.

A75-45948 **Design study for a coal-fueled closed cycle gas turbine system for MIUS applications.** A. P. Fraas, R. S. Holcomb, M. E. Lackey, and J. J. Tudor (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 260-268. 10 refs. Research sponsored by the U.S. Department of Housing and Urban Development.

The general requirements of a modular integrated utility system (MIUS) are examined. Probably the most notable differences when compared to central station applications are related to the low power output and the need for semiunattended operation. System design conditions are presented in a table and the development of a conceptual design is discussed. A description of a furnace design is provided, taking into account questions of fabrication and accessibility, the economizer, aspects of tube differential thermal expansion and thermal stress, bed pulsation, tube vibration problems, and the furnace casing construction. Questions of system design are also considered, giving attention to the turbine-generator unit, ducting between the furnace and the gas turbine, and the coal feed system. G.R.

A75-45949 * **Application of fuel cells with heat recovery for integrated utility systems.** V. Shields (NASA, Johnson Space Center, Houston, Tex.) and J. M. King, Jr. (United Technologies Corp., Power Systems Div., Windsor, Conn.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 278-281.

This paper presents the results of a study of fuel cell powerplants with heat recovery for use in an integrated utility system. Such a design provides for a low pollution, noise-free, highly efficient integrated utility. Use of the waste heat from the fuel cell powerplant in an integrated utility system for the village center complex of a new community results in a reduction in resource consumption of 42 percent compared to conventional methods. In addition, the system has the potential of operating on fuels produced from waste materials (pyrolysis and digester gases); this would provide further reduction in energy consumption. (Author)

A75-45950 **Parametric study for a pyrolytic system for production of fuels from agricultural and forestry wastes.** J. W. Tatom, A. R. Colcord, J. A. Knight, L. W. Elston, P. H. Har-Oz (Georgia Institute of Technology, Atlanta, Ga.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 282-289. U.S. Environmental Protection Agency Contract No. 68-02-1485.

A75-45951 * **The UF6 Breeder - A solution to the problems of nuclear power.** J. R. Williams, J. D. Clement, and J. A. Rust (Georgia Institute of Technology, Atlanta, Ga.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 308-313. 28 refs. Grants No. NsG-7067; No. NsG-1168.

One of the major advantages of uranium hexafluoride reactors for power generation is the simplified fuel reprocessing scheme which the gaseous fuel makes possible. Critical experiments related to the development of the reactors for electric power generation are discussed along with UF6 breeder reactor studies. Previous energy conversion studies are reported, taking into account gas turbine power plants, thermionic conversion, and MHD conversion. Thermodynamic cycle analyses show that high efficiencies can be achieved using UF6 as the working fluid for Rankine or Brayton cycles without requiring excessive temperatures. G.R.

A75-45953 **Thermal power conversion systems for fusion plants.** P. H. Sager, Jr. (General Atomic Co., San Diego, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 320-328. 27 refs.

The utilization of the energy provided by a fusion reactor would involve the extraction of thermal energy from the reactor blanket and the conversion of this heat into usable electrical energy. Coolants which have been considered include water, liquid metals, gases, and molten salts. The merits of several types of gases and liquid metals are considered. Various types of power conversion systems are compared, taking into account thermal efficiency, system complexity, inherent safety, development requirements, projected availability, projected reliability, projected specific capital cost, and improvement potential. G.R.

A75-45954 **The growth of thermionic energy conversion.** G. N. Hatsopoulos and F. N. Huffman (Thermo Electron Corp., Waltham, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 342-350. 36 refs.

A thermionic energy converter converts heat into electricity without an employment of moving parts. Thermionic conversion can be used with either fossil fuel, solar energy, or nuclear energy sources. The basic principles of thermionic energy conversion are examined, taking into account a hydropower analogy, the space charge problem, and the barrier index. The evolution of thermionic technology is considered. Prospects of thermionic conversion methods for the future are discussed, giving attention to performance improvements and applications. G.R.

A75-45955 * **The ERDA thermionic program.** G. A. Newby (ERDA, Space Nuclear Systems Div., Washington, D.C.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 351-355. NASA-ERDA-sponsored research.

A rationale for increased Federal support of thermionic research is considered and the objectives and milestones of the thermionic

program of the U.S. Energy Research and Development Administration (ERDA) are examined. The ERDA program is to provide very high specific power systems needed for planned future NASA nuclear electric propulsion missions. Another objective is the enhancement of the overall thermal conversion efficiency of the present utility power plants from approximately 35% to 50% or more. Attention is given to key problem areas, taking into account inadequate analytical tools, the reduction of the plasma arc-drop losses, aspects of hot shell materials development, and the coordination of the participating groups programmatic activities. G.R.

A75-45956 * NASA thermionic converter research and technology program. J. G. Lundholm (NASA, Office of Aeronautics and Space Technology, Research Div., Washington, D.C.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 356-360.

This paper describes the NASA/ERDA research and technology program that was initiated in mid-FY 1974 with the objective of doubling the efficiency of thermionic power conversion with decreased emitter temperature. Also discussed are the potential uses of thermionic power conversion systems. Emphasis in this paper is placed on potential space applications, especially nuclear-electric propulsion (NEP). Possible development schedules are shown that would allow NEP systems to be ready for use in the 1990 time period for missions to the outer planets. (Author)

A75-45957 * Electrodes for thermionic energy conversion. F. Rufeh, A. H. Sommer, and F. N. Huffman (Thermo Electron Corp., Waltham, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 361-366. 5 refs. NASA-supported research; Contract No. AT(11-1)-3056.

Problems concerning an application of thermionic energy conversion methods are related to the high heat source temperatures currently required for practical power densities and efficiencies. A description is given of advances made in the development of improved emitter and collector surfaces as a basis for the reduction of operating temperatures. The controlled addition of oxygen has resulted in a considerable improvement of emitter performance. Improvements in converter performance have been obtained by a reduction of the collector work function. Attention is given to fundamental studies, simulated converter environment tests, and variable spacing converter experiments. G.R.

A75-45960 Collector work function improvements and the development of low temperature thermionic converters. M. v. Bradke and R. Henne (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt Institut für Energiewandlung und Elektrische Antriebe, Stuttgart, West Germany). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 382-386. 16 refs.

A new technique for measuring the work functions of solar thermal collectors in a vapor atmosphere where a dynamic equilibrium exists between adsorption and desorption has been applied to collectors in Ba or Cs vapors. The most significant results were obtained with Cs adsorption on oxidized electrode surfaces. On oxidized tungsten, for instance, a stable surface with a minimum work function value of about 1.05 eV (lower than for pure tungsten) was produced. Thus 1.2 eV should be the work function of a Mo-collector in operating, low-temperature, low-pressure Cs-diodes by means of the saturated-back emission. S.J.M.

A75-45961 CdS/Cu2S solar cells, their potential and limitations. K. W. Böer, H. C. Hadley, Jr., J. E. Phillips, and A. Rothwarf (Delaware, University, Newark, Del.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 387-391. NSF Grant No. AER-72-03489.

A review is given of typical CdS/Cu2S solar cells, the physics of the cell operation and possible limiting factors. Indications are given for the potential of these cells in respect to possible conversion efficiencies (in excess of 15%), life expectancies (in excess of 20 years), and production yields (in excess of 90%, within a 1% efficiency band). (Author)

A75-45962 Design considerations in Schottky solar cells. W. A. Anderson, A. E. Delahoy, and S. M. Vernon (Rutgers University, New Brunswick, N.J.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 400-403. *11 refs. Research sponsored by Exxon Corp., Rutgers* University, and NSF.

Schottky solar cells have been fabricated using Cr Schottky metal on p-type silicon. AMI sunlight efficiency of 6-9.5% has been measured on cells 1-3 sq cm in area. Computer studies predict a quantum efficiency of 0.71 for the Schottky cell, which compares well to experimental data from 0.35 to 1.1 microns. Increased temperature decreases open circuit voltage by 2.5 mV/C and fill factor by 0.4%/C similar to previously published data on p-n silicon cells. Performance degradation with temperature cycling to 120 C has not been detected. Proper contact design and a 20 ohm/sheet Schottky metal sheet resistance produce a 0.21 ohm total resistance for a 4-finger cell. (Author)

A75-45963 Concentrated photovoltaic power generation systems. J. P. Spratt and R. F. Schwarz (GE Space Sciences Laboratory, King of Prussia, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 404-412. 8 refs.

It is shown theoretically that concentration of sunlight reduces the cost of terrestrial photovoltaic power conversion systems, as long as cell series resistance can be substantially reduced below present levels. Heterojunctions are in principle suitable for achieving this lowered resistance; a new type of heterojunction has been proposed which will be capable of reducing the resistance by a factor of 10 or more. The adoption of such a device could result in a thousandfold increase in energy concentration and a corresponding decrease in the cost of the photovoltaic conversion systems. S.J.M.

A75-45964 The practical lithium/poly-carbonmonofluoride battery system. M. Fukuda and T. Iijima (Matsushita Electric Industrial Co., Ltd., Central Research Laboratories, Kadoma, Osaka, Japan). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 413-417. 9 refs.

Lithium/poly-carbonmonofluoride cells of both cylindrical and button types have been developed for practical applications. These cells have energy densities about five times as high as those of conventional carbon-zinc batteries. By the use of an improved LiBf4/B.L + THF electrolyte, high discharge performance can be obtained at very low temperatures (0 C). Cell potentials for these devices are in the 3-volt range. They have the additional advantages of flat discharge characteristics, long shelf life, and ease of manufacture. S.J.M.

A75-45972 Topping cycle applications of thermionic conversion. F. N. Huffman, T. O. P. Speidel, and J. P. Davis (Thermo Electron Corp., Waltham, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Insti-

tute of Electrical and Electronics Engineers, Inc., 1975, p. 496-502. 11 refs. Contract No. AT(11-1)-3056.

Increased efficiency of electric power plants can be expected to come primarily from topping Rankine cycles with advanced conversion systems which utilize the thermodynamic availability between the heat source temperature and the conventional utilization temperature. Thermionic converters are an attractive topping possibility since they are static and modular, and have the potential of high efficiency. Studies of incorporating thermionic converters to top fossil fuel power plants have been initiated with the goal of minimum perturbation to conventional systems. Placement of the converters on the water wall, superheater and reheater gives a projected plant efficiency of 46 percent (compared to a base plant efficiency of 36 percent). The reject heat from the thermionic converters can also be coupled to the steam generating components via air convection. This arrangement simplifies many practical problems. Initial studies indicate that efficiencies of over 50 percent are possible with this arrangement. (Author)

A75-45973 * Thermionic topping of electric power plants. E. J. Britt, G. O. Fitzpatrick, and N. S. Rasor (Rasor Associates, Inc., Sunnyvale, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 503-512. 17 refs. ERDA-NASA-sponsored research.

The most likely use of thermionic conversion is in the form of a topping cycle combined with a steam-turbogenerator plant. A specific reference system is chosen in which the thermionic topping cycle occurs in thermionic heat exchangers referred to as large, modular thermionic units to which heat is transferred from a separate heat source and which reject their heat to a conventional steam turboelectric system. Results of analysis show that the performance and cost criteria for practical thermionic topping of large electric power plants are well within the reach of demonstrated and foreseeable converter capabilities. Thermionic topping has many significant advantages over unconventional cycles proposed for topping applications, including level of demonstrated and projected performance and lifetime, development time, and design simplicity. S.D.

A75-45974 Conceptual design and economics of an MHD pilot plant. P. D. Bergman, J. I. Joubert, D. Bienstock (ERDA, Pittsburgh Energy Research Center, Pittsburgh, Pa.), and K. D. Plants (ERDA, Pittsburgh Energy Research Center, Pittsburgh, Pa.; U.S. Bureau of Mines, Morgantown, W. Va.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 513-523. 46 refs.

Cycle analyses and preliminary cost estimates are presented for two proposed design configurations of a 300 MWT coal-burning, open-cycle magnetohydrodynamic pilot plant. Cycle efficiencies ranged from 43 to 46% with a basic pilot plant cost of $98 to $114 million. A directly fired design option is recommended as the preferred path to pursue, because it is completely coal-based, and avoids the large-scale utilization of scarce and expensive clean liquid and gaseous fuels for power generation. Related topics including the use of oxygen enrichment, provision for a back-up system, and pilot plant scale-up are discussed. (Author)

A75-45977 High-efficiency electrochemical plant. M. S. S. Hsu, W. E. Morrow, Jr., and J. B. Goodenough (MIT, Lexington, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 555-563. 24 refs. USAF-sponsored research.

Preliminary engineering analysis indicates that high-temperature (1200-1500 K) electrolysis of water and recombination of the products in a medium-temperature (530 K) fuel cell can achieve a practical efficiency exceeding 50% at an acceptable cost. A solid electrolyte is chosen for the electrolytic cell. The Bacon fuel cell, which offers high efficiency and automatic replenishing of water vapor into the cycle, is presently a unique choice in realizing a high-efficiency electrochemical cycle. Both high-temperature, gas-cooled reactors and conventional combustion processes were taken as heat sources. Unconventional heat sources such as concentrated solar energy can also be used. A regenerative counterflow heat exchanger and a waste-heat power plant serve as the essential energy-conserving devices. An important feature of this cycle is the flexibility of operation that can be achieved by adding hydrogen storage. Switching among power-generating, load-averaging, and hydrogen-generating modes can then be done by simple gas-flow valves. (Author)

A75-45978 Study of an electrofluidic generator. R. Pape (Illinois Institute of Technology, Chicago, Ill.), S. Hong, and S. L. Soo (Illinois, University, Urbana, Ill.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 564-568. 15 refs. NSF-supported research.

An electrofluidic generator combines an electrofluidynamic (EFD) generator and a fluidic oscillator to produce power from the kinetic energy of a gas. Based on an original disclosure of Pape, the study shows feasibility of an electrofluidic generator to produce ac at high voltage. Since an ac power source is readily transmitted and integrated to an existing power system, the electrofluidic generator makes possible large-scale power generation via EFD. The electrofluidic system can convert energy efficiently at moderate temperatures from nuclear or chemical sources. A most immediate application is for utilizing the fines of coal produced by automated mining and hoisting system to produce low-cost electric power without the need for water. (Author)

A75-45979 Dielectric power conversion. J. E. Drummond (Maxwell Laboratories, Inc., San Diego, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 569-575. 8 refs.

If two changes can be wrought in the way thermal energy is converted to electrical energy in capacitors, the efficiency of dielectric power conversion (DPC) could be increased by three orders of magnitude becoming a new resource for development of total power conversion systems. The needed changes are (1) replacement of arbitrary thermal cycles by a large-scale Carnot cycle using electrical charge as the working fluid, and (2) replacement of the single cell dielectric power converter by a stack of such cells separated by thermal switches through which heat cascades. Means of effecting these changes are discussed. Details of 60 Hz operation of a single DPC from a steady heat source are given showing electrical power output density of 5 watts per gram of dielectric. The limiting efficiency of cascaded dielectric converters (CDC) is shown to be about 47%. A combined system using a CDC as a bottoming cycle for a gas turbine might achieve 57%. The R & D needed to bring these partly tested principles to engineering and economic reality are discussed. (Author)

A75-45980 The selection and use of energy storage for solar thermal electric application. J. E. Raetz, C. R. Easton, and R. J. Holl (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 576-582. NSF-supported research.

This study summarizes research work done in establishing economic guidelines for candidate energy storage systems (thermal and electrical) and identifies economically attractive concepts. A

procedure is proposed for assessing the impact of various energy impact concepts in terms of their influence on plant economics. It is shown that the use of thermal storage can reduce the annual cost of electricity produced by a solar plant, provided an inexpensive method is adopted. In this respect, a thermal storage system using an intermediate heat transfer fluid is functionally outlined. It is found that in addition to merely storing thermal energy for deferred operation, the described system can be used to minimize many of the undesirable transients that would otherwise be imposed on the turbine. Improvement in plant efficiency by means of thermal storage concepts using elevated temperature (over 600 F) and two-temperature storage did not offset the added costs related to the higher-temperature fluid and extra equipment. S.D.

A75-45981 **Solar-heated-air turbine generating systems.** P. O. Jarvinen (MIT, Lexington, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 583-592. 8 refs. Research sponsored by the Massachusetts Institute of Technology and U.S. Air Force.

The feasibility of large-scale solar electrical power generation using open-cycle heated air turbines in conjunction with a tower-mounted, pressurized, central receiver/heliostat system is investigated. Such a system requires no cooling towers and may be sited away from cooling water supplies. A regenerative open cycle/solar gas turbine approach is chosen since it offers higher overall thermal efficiency than a simple cycle and because peak efficiency is achieved at a pressure ratio of about 4 to 1, which minimizes design considerations of the pressurized receiver. The feasibility of the heated air receiver is demonstrated and structural design, heat transfer and efficiency aspects of a windowless cavity receiver which provides 1800 F heated air are discussed. It is concluded that a central receiver solar thermal heated air gas turbine power plant is feasible and that future efforts should be directed at the development of the most effective receiver possible in order to minimize heliostat collector field area and system cost. (Author)

A75-45982 **The design of a solar cavity steam generator for electrical power generation.** T. Tracy and T. Howerton (Martin Marietta Aerospace, Denver, Colo.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 593-600. NSF Grant No. AER-74-07570.

The preliminary design, principles of operation, and performance analysis of a 100,000-kWe solar power plant are presented. The power generation station is surrounded by eight mirror fields, with a tower-mounted-cavity steam generator at the south end of each field. Control concepts and effects of thermal cycling on component design are discussed. A model of the cavity, compatible with the French solar test facility capability of 1000 kWt, is designed and analyzed in detail. Major conclusions are that a solar cavity radiation receiver with a thermal efficiency (heat into steam/solar energy into cavity) of more than 95% can be designed without using a window in the aperture, and that thermal computer programs developed for space programs are highly valuable tools in the design and analysis of solar power plants. S.D.

A75-45984 **Ground based solar energy technology advances.** G. R. Woodcock and D. L. Gregory (Boeing Aerospace Co., Seattle, Wash.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 607-612.

Competitive busbar output costs for intermediate or base-load solar power plants can be achieved only when the costs of the concentrating heliostats is below $4.00 per square foot of reflecting area. In addition, the heliostats must resist various weather factors and have a long relatively maintenance-free life. A concept is derived for a 'weather-decoupled' heliostat fabricated primarily from tensioned plastic films. The plastic-film enclosure (dome) over the reflector reduces the heliostat efficiency; however, this is easily compensated by increasing the total heliostat area. Other system effects do not appear to have a significant impact, leading to an overall cost advantage for this type of heliostat. (Author)

A75-45992 **Industrial process heat from solar energy.** J. A. Day, A. F. Clark, W. C. Dickinson, and A. Iantuono (California, University, Livermore, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 750-758. 7 refs. ERDA-sponsored research.

The paper is concerned with the analysis and design of a shallow solar-pond water heating facility intended to provide hot water to a uranium leaching operation. The discussion covers the pond description and alternatives, pond performance equations, and parameter variations as to mass flow rate, total mass, water depth, batch versus continuous-flow mode of operation, and some other relevant characteristics. The payoff derived by selecting a combination solar-fossil-fuel system over an all fossil-fuel system is examined along with the effects of system variation on system costs. Major conclusions are that it is most cost effective to heat all of the water used daily to some intermediate temperature as opposed to heating part of it to 140 F, that hot water storage is cost effective, that the daily heat collected is insensitive to flow rate for a daily fixed mass of water required, and that filling and emptying times are at sunrise and 3 hr before sunset, + or - 1/2 hr. S.D.

A75-45993 **Continuous duty solar energy system concepts.** R. Ramakumar (Oklahoma State University, Stillwater, Okla.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 759-764. 26 refs. NSF Grant No. GI-39457.

The concepts underlying the design of two continuous-duty solar energy systems for the near and distant future are outlined. In the system proposed for near-term future, solar heat and wind energy are used as inputs, with the outputs being in electrical, thermal, and fuel forms; solar thermal collectors and concentrators are employed to convert solar energy directly into heat for steam production purposes. The system proposed for long-term future is an enlarged version of the near-future system, with additional inputs in the form of sunlight and ocean thermal gradients. Technical aspects of these systems are discussed in terms of solar thermal conversion, field-modulated generator system, aeroturbines and supporting structures, electrolysis and energy storage, aphodid burner, solar sea power plant, photovoltaic conversion, and manufacture of synthetic fuels. Some economic aspects of important units are discussed. Estimates of generation costs indicate that the proposed systems show promise of being competitive in the coming decades. S.D.

A75-45994 **Water-splitting system synthesized by photochemical and thermoelectric utilizations of solar energy.** T. Ohta, S. Asakura, M. Yamaguchi, and N. Kamiya (Yokohama National University, Yokohama, Japan). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 772-778.

A hybrid system is proposed for hydrogen production from water on the basis of solar light and thermal energy. The system consists of a photochemical reactor, an electrolyzer, and a thermoelectric generator. Hydrogen production is made possible by the combination of a glass cell for photochemical reactions and a light-focusing apparatus for the thermoelectric generator. Photochemical reaction is carried out using a mixture of Fe(2+) and molecular iodine, which is transparent to the red light used for heating the 32 thermocouples used in the system. It is shown that

the wide wavelength range of solar light can be utilized to decompose water with a total efficiency within the range 30-35%. S.D.

A75-45995 **New dimensions in water heating in the Northwest - A study of solar energy utilization.** P. M. Soot, W. R. Goldbach (Pacific Power and Light Co., Inc., Portland, Ore.), and C. B. Winn (Colorado State University, Fort Collins, Colo.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 779-785. 7 refs.

A75-45996 **Solar sea power plants /SSPP/.** A. M. Strauss (Cincinnati, University, Cincinnati, Ohio). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 786-795. 61 refs.

The current state of knowledge about the design and construction of demonstration solar sea power plants (SSPP) is reviewed. Open-cycle and closed-cycle SSPP design concepts are discussed. Consideration of structural strength, corrosion resistance, manufacturing and assembly difficulties, initial cost and maintenance suggests that concrete is the best choice for SSPP construction at any ocean depth above the thermocline. The characteristics of Nitinol engine powered SSPP are examined. It is shown that SSPP is a cost-effective nonpolluting system associated with a highly efficient mariculture economy. Recommendations are set forth as to the choice of siting, materials, the Nitinol SSPP, the Claude cycle SSPP, the closed-cycle SSPP, working fluids, turbines, cold water, and mooring and anchoring. S.D.

A75-45997 **Nickel-hydrogen secondary battery.** M. Klein (Energy Research Corp., Danbury, Conn.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 803-806.

The nickel-hydrogen secondary battery system has attracted interest due to its potential long cycle life and insensitivity to overcharge and reversal. Over the past three years a number of design approaches have been studied and experimental data has been generated on both components and lightweight cells. The single cylindrical cell with stacked disk electrodes has emerged in the most favored approach. Two size cells are now available and are being subjected to test and evaluation by a number of organizations. The cells are a 20 ampere-hour size, 2-1/2-inch diameter cylinder and a 50 ampere-hour size 3-1/2-inch diameter. This paper presents the ERC advanced single cell designs and experimental test results on both components and complete cells under a variety of test conditions. (Author)

A75-45998 **Nickel-hydrogen as an alternative to lead-acid and nickel-cadmium systems in non-space applications.** L. E. Miller (Eagle-Picher Industries, Inc., Electronics Div., Joplin, Mo.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 807-810.

A low cost, nickel-hydrogen battery design concept is proposed. System cost reduction is achieved through utilization of the multiple cell per single battery pressure vessel concept, standardization of components, ease of manufacture and an inherent system design versatility with an ability to meet varied user requirements with only minor modifications. Utilizing current hermetically-sealed, aerospace nickel-cadmium systems as a cost comparison, it is projected that the proposed design concept will reduce nickel-hydrogen system cost from approximately 25% greater to approximately 50% less than current sealed nickel-cadmium system cost. (Author)

A75-45999 **Redox thermogalvanic cells for direct energy conversion.** B. W. Burrows (Battelle, Geneva, Switzerland). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 821-827. 24 refs.

The behavior of nonisothermal galvanic cells has been investigated under conditions of current drain in order to assess their feasibility as devices for the direct conversion of heat into electricity. The cells were based on the ferrous-ferric redox couple with inert Pt electrodes in aqueous supporting electrolyte. It was found that a steady-state power output could be maintained indefinitely as long as a temperature differential remained fixed. The maximum power outputs were, however, limited to values less than 0.05mW per sq cm for temperature differentials of 50 C. The power outputs were limited to these low values by the nature of the potential losses in the thermogalvanic cells, which were found to be principally due to mass-transfer or concentration polarization. (Author)

A75-46000 **Energy from agriculture.** J. A. Alich, Jr. and R. E. Inman (Stanford Research Institute, Menlo Park, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 834-841.

The feasibility and overall energy yield of biomass energy production are assessed. Candidates for cultivable species are tabulated and include sunflower, sorghum, corn, sugarcane, poplar, eucalyptus, and tropical rainforest complex. Energy consumption in running an energy plantation is estimated by individual operation (field tasks, irrigation, farm chemical manufacture, farm machinery manufacture, etc.); it comes to about 24.5 million Btu per acre-year, as compared to 450 million Btu per acre-year total yield. Thus the operation of these plantations appears feasible. The main problem would probably be water supply, since areas (such as the southwest) with enough sunlight for prolific plant growth have a concomitant lack of rainfall. S.J.M.

A75-46001 **The economics of the production of liquid fuel and fertilizer by the fixation of atmospheric carbon and nitrogen using nuclear power.** S. Baron (Burns and Roe, Inc., Oradell, N.J.) and M. Steinberg (Brookhaven National Laboratory, Upton, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 842-848. 20 refs.

A75-46006 ***Nuclear heat source for cryogenic refrigerators* in space.** B. Raab, A. Schock, and W. G. King (Fairchild Space and Electronics Corp., Germantown, Md.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 894-900. 5 refs. ERDA-supported research.

To supply the heat input required by space-borne cryogenic refrigerators, a possible design for a reliable Pu-238 radioisotope heat source, based on state-of-the-art technology, is described. The isotope heat source, which makes use of existing fuel elements, would replace electrical heaters powered by solar panels and batteries, without requiring redesign of the refrigerators. The heat source contains all necessary safety features, and also a simple thermal control system to permit refrigerator shut-down for indefinite duration. A system for thermal interfacing with the spacecraft, the booster, and ground support is also described. The isotope heaters are compared with solar-electric heaters for the same application, and found to result in very significant weight and size savings. (Author)

A75-46009 **Harnessing wind power in developing countries.** R. Ramakumar (Oklahoma State University, Stillwater, Okla.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 966-973. 19 refs.

This paper discusses the possibilities of harnessing wind power in developing countries to mitigate the burdens imposed by high price of imported fuel and to augment their total energy supply. Special emphasis is given to the use of variable-speed constant-frequency field modulated generator systems to tap wind energy in constant frequency ac form for use in conjunction with conventional utility systems and with isolated conventional generating units. Estimated competitive cost limits are worked out for wind energy systems in comparison with conventional fuel burning systems and with utility supplied electrical energy for pumping water for irrigation and for household electricity in the Arab Republic of Egypt and in the Republic of India. (Author)

A75-46010 **Wind and solar thermal combinations for space heating.** J. G. McGowan, W. E. Heronemus, and G. Darkazalli (Massachusetts, University, Amherst, Mass.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 974-980. 18 refs.

This paper presents the results of an analytical study that was carried out to model and to determine the feasibility of a residential heating system for the Northeastern section of the United States, designed to be powered or augmented by a wind generator system. In addition to windpowered electrical resistance heating systems (with and without thermal energy storage), the possibility of combining these systems with a flat plate solar collector is investigated. In addition to the detailed analytical results, a description of an experimental system, built on the University of Massachusetts campus, is presented. (Author)

A75-46012 **Tornado-type wind energy system.** J. T. Yen (Grumman Aerospace Corp., Bethpage, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 987-994. 9 refs.

A multimegawatt wind power system design is proposed, featuring a closed-bottom tower and a flywheel. Experimental data on scaled-down models are tabulated and compared with conventional wind turbines. Wind energy is directed by vertical vanes to form a vortex within the tower. This vortex creates a low-pressure core directly above a horizontal turbine located at the throat of an inlet that is open at the bottom. S.J.M.

A75-46013 **Efficient thermo-mechanical generation of electricity from the heat of radioisotopes.** E. H. Cooke-Yarborough and F. W. Yeats (Atomic Energy Research Establishment, Harwell, Oxon, England). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1003-1011. 8 refs.

A prototype radioisotope-powered thermoelectric generator is described, and preliminary results obtained with it are reported. These results, together with those obtained from higher-powered nonisotopic thermoelectric generators, are employed to calculate the characteristics and performance of thermomechanical radioisotope generators capable of using strontium-90 from nuclear waste. The best performance predicted is a coupling efficiency of 9%, with a growth potential up to 11% at 800 C. S.J.M.

A75-46014 **A 100 watt Stirling electric generator for solar or solid fuel heat sources.** W. T. Beale and C. F. Rankin, Jr. (Sunpower, Inc., Athens, Ohio). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1020-1022. 6 refs.

A75-46015 **A comparison of the COMSAT violet and non-reflective cells.** J. F. Allison, R. A. Arndt, and A. Meulenberg (COMSAT Laboratories, Clarksburg, Md.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1038-1040. 6 refs. Research sponsored by the Communications Satellite Corp.

Properties of a new solar cell, known as the nonreflective cell, are described and compared to characteristics of the violet cell and the conventional cell. The nonreflective cell has much lower reflectance, higher current-voltage characteristics, higher short-circuit current, and better wavelength response than previous cells. Its peak power output is 85 mW, corresponding to an efficiency of 15.6 percent, and it produces 21 mW/sq cm under AMO illumination. S.J.M.

A75-46016 * **SEPS solar array design and technology evaluation.** R. V. Elms, Jr. (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) and L. E. Young (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1041-1047. Contract No. NAS8-30315.

The technology developments required and a preliminary design of a lightweight 25 kW solar array for the solar electric propulsion stage (SEPS) have been defined. The requirements for a 65 W/Kg SEPS solar array system requires significant component weight reductions over present state-of-the-art flexible solar arrays in both electrical and structural-mechanical designs. A requirement for operation from 0.3 au to 6.0 au presents a wide range of temperature environments as well as severe combined thermal/vacuum/UV radiation environments. Additional requirements are capability for partial array retraction operation, and capability for full retraction and automatic preloading for survival of the Shuttle reentry environment. An assessment of current lightweight flexible solar array technology is made against the SEPS solar array requirements and new technology requirements are defined. A preliminary design and the operating characteristics of a flat-fold solar array system meeting the SEPS requirements is presented. A full-width, 10-ft-tall functional array model, including representative welded electrical modules and a model astromast, was fabricated and tested. (Author)

A75-46017 * **The ATS-6 power system - An optimized design for maximum power source utilization.** T. A. LaVigna (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1048-1055. 7 refs.

The modified power system design adopted for the ATS-6 satellite is described. This design featured a shunt-boost configuration to provide direct power from the solar array to the loads for maximum efficiency. In addition, shunt power dissipators were used, not only as a means of power system regulation, but also for thermal control. A brief description of the spacecraft and of the initial series regulator power system design (which was unable to meet mission requirements) precede the discussion. The shunt boost system provides excellent utilization of array power with an 8 to 10% increase in efficiency over the original configuration; good array-battery static and dynamic load sharing; excellent flexibility in accommodating mission requirements; and low electromagnetic interference. S.J.M.

A75-46018 **Orbital solar energy technology advances.** G. R. Woodcock and D. L. Gregory (Boeing Aerospace Co., Kent, Wash.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1057-1064. 5 refs.

Power satellites to generate electricity for use on earth will become feasible if economical solutions to five primary technical problems can be found: massive transportation from the earth to a low assembly orbit, assembly operations in that orbit, powersat transportation to the high assembly orbit, efficient power generation, and an efficient, environmentally acceptable power transmission system. We baseline a '1990 technology' total powersat system which provides a preliminary solution to these problems. This system employs solar concentration and thermal engines for power generation. Low orbit transportation is accomplished with a vertical takeoff/vertical land single stage to orbit freighter. High orbit transportation uses electric power generated by the powersat modules themselves to operate electric thrusters. Ground and orbital facilities to support powersat production are described. The effects of gravity gradients on powersat assembly and transportation are discussed. Potential technology advances for advanced powersats are identified. (Author)

A75-46019 * Space power application of the all purpose mini-Brayton rotating unit /mini-BRU/. R. D. Gable and H. J. Lloyd (AiResearch Manufacturing Co., Phoenix, Ariz.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1071-1076. Contract No. NAS3-18517.

The design of and results of tests on the mini-Brayton rotating unit (mini-BRU) are presented. Results demonstrate the flat performance trends of the mini-BRU system. The system is 'all-purpose'; it is essentially a closed Brayton cycle engine. A power spectrum comprised between 2.1 and 1.4 kWe and recuperator sizes of 106 or 75 lbs are envisioned for the final in-use configuration. S.J.M.

A75-46022 Hydrogen production by electrolysis - Present and future. A. J. Konopka and D. P. Gregory (Institute of Gas Technology, Chicago, Ill.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1184-1193. 23 refs. Contract No. N00014-67-A-0202-0046.

This paper surveys present and future predicted electrolysis systems in terms of three criteria: energy efficiency, which is related to the cell's operating voltage; capital cost of the plant, which is related to cell hydrogen production rate; and lifetime and maintenance requirements, which involve construction materials and operating conditions. Factors affecting electrolyzer design include operating parameters, electrodes, and diaphragms or cell separators. The current state-of-the-art is reviewed as regards tank electrolyzers and filter-press electrolyzers. S.J.M.

A75-46023 Hydrogen production by water electrolysis - Methods for approaching ideal efficiencies. G. Kissel, S. Srinivasan (Brookhaven National Laboratory, Dept. of Applied Science, Upton, N.Y.), M. H. Miles (Middle Tennessee State University, Murfreesboro, Tenn), and P. W. T. Lu. In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1194-1198. 6 refs. ERDA-sponsored research.

Investigations were carried to determine the nature and extent of correlations between various properties of electrolytic hydrogen production cells. Studies centered on (1) a comparison of cell potential and current density in acid and alkaline water electrolysis cells; (2) the effect of increasing temperature on the performance of these cells; (3) the effect of temperature on hydrogen and oxygen overpotentials at nickel electrodes in concentrated potassium hydroxide electrolytes; and (4) an evaluation of separator materials, to replace asbestos, for carrying out the electrolysis of water in alkaline solution at temperatures in the 150 C range. Maximizing surface area by impregnating noble metal catalyst particles in solid polymer electrolytes resulted in a considerable reduction of activation overpotential. Cell potential decreased from 2.05 to 1.7 V in the alkaline cell and from 2.35 to 2.05 V in the acid cell as the temperature was increased from 25 to 82 C. S.J.M.

A75-46024 Electrical generation by wind power. R. T. Smith (Southwest Research Institute, San Antonio, Tex.) and T. S. Jayadev (Wisconsin, University, Milwaukee, Wis.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1246-1250. 12 refs. NSF Grant No. GZ-2932.

Various proposed schemes for wind-powered generation of electricity are reviewed. These schemes are classified as either constant-speed, constant-frequency (CSCF) or variable-speed, constant-frequency (VSCF). Included in the first category are synchronous generators and induction generators; the second group contains ac commutator generators, ac-dc-ac links, and field-modulated generators with subsequent demodulation. Optimum selection of a generating scheme should be based on suitability for interconnection with the power grid and minimization of energy generation cost. S.J.M.

A75-46025 * Electrical generating equipment and electric utility requirements for high-power wind generator systems. P. J. Romanelli (General Electric Co., Valley Forge, Pa.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1251-1257. 10 refs. Contract No. NAS3-19403.

A75-46026 Wind power system optimization. M. C. Smith (Michigan State University, East Lansing, Mich.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1258-1263. Research supported by the Michigan State University.

It is shown that wind power system optimization can be achieved by consideration of the four quantities of average annual energy extracted, wind statistics, efficiency of conversion of wind energy to shaft rotation energy and the cost characteristics of the wind interaction elements (blades), the electric generator and the remaining system components. The problem reduces to the determination of two dimensionless parameters as a function of the wind statistics. These parameters determine the optimum blade diameter and the generator size. Example wind statistics and an example optimization problem are given. (Author)

A75-46027 * Comparison and evaluation of nuclear power plant options for geosynchronous power stations. J. R. Williams (Georgia Institute of Technology, Atlanta, Ga.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1264-1274. 49 refs. Grant No. NGR-11-002-181.

The suitability of eleven types of nuclear fission reactors in combination with five potential energy conversion systems for use in geosynchronous power plants is evaluated. Gas turbine, potassium Rankine liquid metal MHD, and thermionic energy conversion systems are considered. The existing technology of reactors in near-term, intermediate-term, and long-term classes is discussed, together with modifications for use in large-scale power production in space. Unless the temperature is high enough for MHD, reactors which heat gases are generally more suitable for use with gas turbines. Those which heat liquid metals will be more useful for potassium Rankine or liquid metal MHD conversion systems. C.K.D.

A75-46028 * Design and test of a flywheel energy storage unit for spacecraft application. A. Cormack, III, J. E. Notti, Jr., and

M. L. Ruiz (Rockwell International Corp., Downey, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1275-1280. Research supported by the Rockwell Independent Research and Development Funds; Contract No. NAS1-13008.

This paper summarizes the design and test of a development flywheel energy storage device intended for spacecraft application. The flywheel unit is the prototype for the rotating assembly portion of an Integrated Power and Attitude Control System (IPACS). The paper includes a general description of the flywheel unit; specific design characteristics for the rotor and bearings, motor-generators, and electronics; an efficiency analysis; and test results for a research unit. (Author)

A75-46034 High efficiency power conversion cycles using hydrogen compressed by absorption on metal hydrides. J. R. Powell, F. J. Salzano, W.-S. Yu, and J. S. Milau (Brookhaven National Laboratory, Upton, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1339-1347. 10 refs.

A new power conversion cycle is analyzed which uses H2 gas as a working fluid in a regenerative closed Brayton cycle. In the proposed cycle, H2 is compressed by cyclic absorption/desorption on a metal hydride bed instead of being mechanically compressed. Two thermal inputs are used: a low temperature input supplied by low grade solar geothermal heat, which operates the hydride compressor, and a high temperature heat input supplied by a nuclear reactor or fossil combustor. Almost all of the high temperature heat input can be converted to electricity using current fossil or reactor technology. Approximately 3 KW (th) of low grade heat input is required per KW (e) output. Besides conserving scarce nuclear and fossil resources, the proposed cycle should result in reduced capital costs for electric generation plants, as well as substantially lower total electric generation costs. Where low grade heat sources are available, existing power plants can be retro-fitted with the proposed cycle, which would increase output by a factor of 2 or more. (Author)

A75-46035 Hydrogen sponge heat pump. S. Wolf (U.S. Navy, Naval Underwater Systems Center, Newport, R.I.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1348-1351.

A heat pump with potentially higher performance and higher heat output temperatures than conventional cycles is described. Heat is transferred by the exothermic adsorption on and endothermic desorption from a lanthanum pentanickel sponge, with periodic flow reversal when saturation occurs. The pressure at which transfer takes place is a function of sponge temperature, with a relativly low (100 psi) pressure differential necessary to obtain a useful temperature differential (55 C). Substantial cost reductions are demonstrated in comparison with equivalent oil fired furnace heating systems. Coefficients of performance for a Carnot Cycle system, an F-12 Freon heat pump system and the hydrogen sponge heat pump system for real and reversible adiabatic compressors are calculated, and advantages up to 23% in favor of the hydrogen sponge system are shown. C.K.D.

A75-46036 The rate limiting processes for the sorption of hydrogen in LaNi5. O. Boser and D. Lehrfeld (North American Philips Laboratories, Briarcliff Manor, N.Y.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1363-1369. 10 refs. Contract No. F33615-73-C-3003.

A hydrogen-compressor module based on the sorption of hydrogen in LaNi5 is described, and the rate limiting process is determined for the sorption of hydrogen in the same material. The most significant features of the compressor are outlined together with its working cycle, and results are reported for tests of the heat-up and desorption input-heat requirements of the LaNi5 module. The sorption-rate measurements indicate that 80% of a charge of hydrogen will be absorbed in about 11 sec at room temperature and in about 1.5 sec at 90 C. F.G.M.

A75-46037 A technology assessment of the hydrogen economy concept. E. M. Dickson, J. W. Ryan, and M. H. Smulyan (Stanford Research Institute, Menlo Park, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1370-1379. NSF-sponsored research.

The building block concept referring to economic scale considerations is described and the natural building blocks for hydrogen production, conversion, distribution, and demand are examined as a basis for the evaluation of important factors concerning a hydrogen economy. The relative economics of hydrogen are discussed along with important noneconomic conditions affecting the evolution of a hydrogen economy. It is concluded that for a variety of reasons the transition process toward an electric/hydrogen economy, if it is to take place, will probably be slow. G.R.

A75-46038 A detailed analysis of the hydriding characteristics of LaNi5. C. E. Lundin and F. E. Lynch (Denver, University, Denver, Colo.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1380-1385. 20 refs. Contract No. F44620-74-C-0020.

The storage of hydrogen constitutes one major problem which has to be solved for an application of hydrogen gas as an alternative to fossil fuels. The use of metal alloy absorbers for storing hydrogen is currently being studied. The investigation reported is concerned with the properties of LaNi5 which is considered for the storage of hydrogen in the form of metal hydrides. Attention is given to the pressure-temperature-composition relationships, the thermodynamic properties deduced therefrom, the phase equilibria, the hysteresis effects, and the kinetics of desorption. G.R.

A75-46040 Evaluation of solar-assisted Rankine cycle concept for the cooling of buildings. H. M. Curran and M. Miller (Hittman Associates, Inc., Columbia, Md.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1391-1398. NSF Grant No. C-858.

A75-46041 Heat pipe thermal recovery units. M. A. Ruch (Q-dot Corp., Dallas, Tex.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1507-1510.

The heat pipe is an evaporation/condensation device which can transfer large quantities of heat with very small temperature differences. A multiplicity of heat pipes arranged as a counterflow heat exchanger between two airstreams finds useful applications in thermal energy recovery. Three general classes of applications can be identified: (1) using energy recovered from process exhaust to regenerate the process, (2) using energy from process exhaust to heat comfort make-up air during the winter months, and (3) using comfort exhaust to preheat comfort make-up air during the winter months and/or precool comfort make-up air during the summer months. Installations of each class are described. (Author)

A75-46042 High temperature heat pipes for energy conservation. A. Basiulis and J. H. Johnson (Hughes Aircraft Co.,

Electron Dynamics Div., Torrance, Calif.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1511-1515. 5 refs.

The characteristics of different heat recovery systems are examined, taking into account regenerator types, shell and tube heat exchangers, a secondary fluid heat exchanger, a plate-fin heat exchanger, and a heat pipe heat exchanger. Heat exchangers for high temperature energy recovery are evaluated. It is found that the heat pipe unit potentially offers better heat transfer, lower pressure drop, lower maintenance cost, and possibly lower installation cost. High temperature heat pipe materials are discussed. For the temperature range from 800 to 1800 F, heat pipe working fluids are available and only reliable envelope materials are needed. G.R.

A75-46043 **Heat pipe applications development in Europe.** O. Brost and W. D. Münzel (Stuttgart, Universität, Stuttgart, West Germany). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1516-1527. 27 refs.

Heat pipes for the cryogenic temperature range are considered along with low temperature heat pipes, heat pipes in the mid-temperature range, and heat pipes in the high temperature range. A description of structures for high performance heat pipes is presented. The characteristics of isothermal spaces obtained by the use of simple heat pipes are examined, taking into account isothermal inserts, isothermal furnaces, and thermal conductivity and heat flux measurements using heat pipes. Problems of heat flux transformation and temperature controlled heat pipes are also discussed. G.R.

A75-46044 **Laser application of heat pipe technology in energy related programs.** R. J. Carbone (California, University, Los Alamos, N. Mex.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1528-1532. 13 refs.

It is pointed out that the unique characteristics of uniform density, small temperature gradient, thermal stability, and high thermal conduction in a heat pipe may provide the only means to accomplish undistorted beam transmission required for the optical and near ultraviolet spectral output in certain laser applications. The operating conditions for vapor-vapor or vapor-gas mixtures are discussed along with questions regarding the selected optical application of the heat pipe. A potential laser medium that could be useful for laser fusion or isotope separation is molecular mercury. G.R.

A75-46045 **Application of heat pipes to solar collectors.** W. B. Bienert, D. S. Trimmer, and D. A. Wolf (Dynatherm Corp., Cockeysville, Md.). In: Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1533-1539. 11 refs. ERDA-NSF-sponsored research.

A description is given of a development program concerned with heat pipe applications in the case of solar-to-thermal energy conversion concepts. Highly reflecting parabolic trough-like mirrors are used to concentrate the solar flux on a coated heat pipe. Heat pipe requirements are examined and aspects regarding the selection of a working fluid are investigated. Questions of hydrodynamics and heat transfer are considered. A study is conducted of the feasibility and merit of incorporating heat pipes into flat plate solar collectors. G.R.

A75-46548 **Availability and propulsion.** J. M. Clarke (Noel Penny Turbines, Inc., England) and J. H. Horlock (Salford University, Salford, Lancs., England). *Journal of Mechanical Engineering Science*, vol. 17, Aug. 1975, p. 223-232. 9 refs.

The first and second laws applied to steady-flow systems are expressed in forms which emphasize the distinction between energy, which is conserved, and available energy, which is depleted in real processes. These forms are applied to propulsive systems using, as a velocity datum, the propulsion unit itself and, alternatively, the atmosphere at rest. The maximum thrust power obtainable from the combustion of the fuel is shown to be dependent on the composition, state and velocity of the fuel and also on the composition and state of the environment in which the unit works. An illustrative calculation of the losses in a turbojet engine in flight reveals that in this case 16.64 per cent of the fuel's available energy is obtained as thrust power, 54.25 per cent is rejected by the exhaust, 2.33 per cent is dissipated by aerodynamic losses and the remainder (26.78 per cent) is lost by combustion. Available-energy calculations are seen as providing a consistent framework within which losses can be compared within machines, between machines of different types for the same job and with perfection in the form of the completely reversible machine. (Author)

A75-46721 * **Technique for producing 'good' GaAs solar cells using poor-quality substrates.** H. J. Hovel and J. M. Wooddall (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *Applied Physics Letters*, vol. 27, Oct. 15, 1975, p. 447-449. 7 refs. NASA-supported research.

Relatively good GaAs solar cells can be made from poor-quality substrates by making the junction deep (greater than 1 micron) instead of shallow and by 'leaching' both the pGaAs and nGaAs regions during the growth process. AM0 efficiencies of 14.7% (19% AM1) have been obtained from substrates with starting substrate diffusion lengths of 0.6 micron. (Author)

A75-46951 **Indium tin oxide-coated silicon as a selective absorber.** R. B. Goldner and H. M. Haskal (Tufts, University, Medford, Mass.). *Applied Optics*, vol. 14, Oct. 1975, p. 2328, 2329. 7 refs.

It is shown that by coating a silicon solar absorber with a thin indium tin oxide (ITO) layer, its selectivity is considerably increased. The thin coating acts as both an antireflection coating for solar radiation and as a reflector for thermal infrared radiation. The antireflecting property can be attributed to the fact that the refractivity of the coating closely index-matches silicon and vacuum over much of the solar spectrum; while the infrared reflecting property, to the high concentration of free carriers and their high optical mobility. Spectral reflectance results are presented for two ITO-coated silicon samples and for uncoated silicon. B.J.

A75-47081 # **Liquid hydrogen - Future aircraft fuel: Background, payoff, and cryogenic engineering challenge.** W. J. D. Escher (*Escher Technology Associates, St. Johns, Mich.*). In: *Advances in* cryogenic engineering. Volume 20. New York, Plenum Press, 1975, p. 70-81. 10 refs.

The paper reviews past experience with hydrogen aircraft and engines and examines the issue of the potential technical impact of liquid hydrogen fuel on future commercial aircraft design. The engineering aspects of liquid hydrogen compared to conventional hydrocarbon aircraft fuel are studied, and several conceptual designs created by the aircraft industry which reflect approaches for integrating hydrogen fuel into the aircraft are presented. The liquid hydrogen tank will tend to be larger, more expensive, and heavier than that for conventional fuel, but these disadvantages are expected to be outweighed by hydrogen's superior ability as a fuel. Hydrogen provides a potential for much higher 'space heating rates', which suggests the opportunity to considerably shorten engine combustor lengths and, important from the NOx formation standpoint, associated dwell times. P.T.H.

A75-47495 **Liquid hydrogen - Fuel of the future.** R. Jensen (Lockheed-California Co., Burbank, Calif.). *Society of Allied*

Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1065. 43 p. 18 refs.

Liquid hydrogen is compared to petroleum-based fuels for propulsion of various types of vehicles. For supersonic aircraft, a lighter, less costly design can be achieved through the use of this cryogenic fuel. Takeoff weight can be reduced by more than 40%, operational empty weight and cost by more than 20%. For subsonic, medium-range aircraft, takeoff and operational weights can be reduced by 20% and 10%, respectively. A brief review of the methods used to produce this fuel of the future leads to an outline of the ways in which our needs may be met. For the near term, LH2 can be manufactured from coal or lignite. In the not-too-distant future, nuclear power or solar collectors can generate large quantities of hydrogen by electrolysis or by thermochemical splitting of water. A comparison of relative hazards shows that LH2 is actually safer to use than petroleum fuels. (Author)

A75-47509 Weight contribution to fuel conservation for terminal area compatible aircraft. G. W. Hanks (Boeing Co., Seattle, Wash.). *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1091.* 25 p. 6 refs.

The contribution to reductions in fuel consumption by potential weight characteristics of advanced aircraft are considered, and trades between weight reduction versus increased aerodynamic and operating efficiency are discussed. Direct reductions in fuel use may be obtained by application of advanced technology in structure and airfoils, proper engine choice, and revised environmental control features. Weight penalties involved in wing planform optimization are countered by increased aerodynamic efficiency. Results of studies of an M = 0.80, 200 passenger, 5556 km design incorporating advanced structure, airfoils, and propulsion show 21.6% reductions in operational empty weight and takeoff gross weight as compared to a conventional design. Features for reduction of congestion and emissions offer fuel reduction potential; noise reduction devices carry weight and fuel-use penalties. Implementation of the described fuel reduction approaches will yield an estimated 25% reduction in fuel consumption. C.K.D.

A75-47511 # Solar-thermal electric power generation using a system of distributed parabolic trough collectors. J. W. Ramsey (Honeywell Systems and Research Center, Minneapolis, Minn.), E. M. Sparrow, and E. R. G. Eckert (Minnesota, University, Minneapolis, Minn.). *ASME, AIChE, CSChE, and CSME, Heat Transfer Conference, San Francisco, Calif., Aug. 11-13, 1975, AIChE Paper 12.* 35 p. 5 refs.

The paper describes a solar-thermal collection and transport system for electric power generation. The system employs water as the working fluid; steam at 60 bars pressure and 276 C is generated locally by distributed parabolic solar collectors. A transfer loop conveys the steam to a central site at which the power plant is situated. The design of the collector and the operating characteristics of three transfer loop configurations are described. Results of experiments performed at a desert test site using a scale model of a solar collector module are presented. The data establish the efficiency of the collector both in the absence of heat losses and under normal operating conditions. The findings of life tests being performed on samples of candidate solar reflector surfaces are reported. (Author)

A75-47512 # High temperature air preheaters for open cycle MHD energy conversion systems. F. A. Hals, R. E. Gannon, F. E. Becker, and H. Steinle (Avco Everett Research Laboratory, Inc., Everett, Mass.). *ASME, AIChE, CSChE, and CSME, Heat Transfer Conference, San Francisco, Calif., Aug. 11-13, 1975, AIChE Paper 16.* 59 p. 34 refs. Research supported by the Electric Power Research Institute, Baltimore Gas and Electric Co., Boston Edison Co., Consolidated Edison Company of New York, NEGEA Service Corp., New England Power Co., Northeast Utilities Service Co., Avco Corp., and ERDA.

The paper studies the use of refractory type regenerative preheaters which have been under development for reaching preheat temperatures from 2000-3000 F or higher. There are two types of high temperature air preheaters: one type classified as directly fired, utilizes the heat energy in the MHD generator exhaust gas for preheating of the combustion air; the other type classified as indirectly fired utilizes a separate fuel as the heat source. Design criteria and operating characteristics of both of these two types of high temperature preheaters for MHD power systems are reviewed. The status in the air preheater development work is summarized which includes results from experimental preheater operation and from corrosion studies of candidate refractory materials for use in preheaters. (Author)

A75-47525 # Direct contact heat exchangers in geothermal power production. I. Sheinbaum (Ben Holt Co., Pasadena, Calif.). *ASME, AIChE, CSChE, and CSME, Heat Transfer Conference, San Francisco, Calif., Aug. 11-13, 1975, ASME Paper 75-HT-52.* 10 p. 21 refs. Members, $1.00; nonmembers, $3.00.

The direct contact cycle can be advantageously utilized in the production of power from liquid dominated geothermal resources. The heat from the geothermal resource is transferred to a selected working fluid by direct countercurrent contact in a vertical perforated trayed tower. The direct contactor is divided into three heat transfer zones where heat is extracted from the hot water by liquid-liquid contact, mixed phase boiling and vapor liquid contact. A procedure is presented for optimizing the cycle, sizing the direct contactor and evaluating the number of cross temperature contacts and tray efficiencies in each of the heat transfer zones. The relationship between heat transfer and mass transfer is indicated for the perforated trayed tower. (Author)

A75-47526 # Moderately concentrating flat-plate solar energy collectors. R. B. Bannerot and J. R. Howell (Houston, University, Houston, Tex.). *ASME, AIChE, CSChE, and CSME, Heat Transfer Conference, San Francisco, Calif., Aug. 11-13, 1975, ASME Paper 75-HT-54.* 11 p. 19 refs. Members, $1.00; nonmembers, $3.00. NSF Grant No. GI-41003.

The radiative characteristics of a family of solar collectors consisting of East-West aligned trapezoidal grooves with reflecting walls are determined. Optimal designs based on one-reflection maximum concentration of direct insolation are analyzed for seasonal variations in noon-time solar incidence. The effect of off-design performance is examined. Comparison of such collectors with other high-performance collectors is made. It is concluded that geometrical modification will produce behavior improvement of the same order as that produced by a very good spectrally selective surface. Choice would be determined by relative cost and durability. Combining the geometrical effect with a spectrally selective surface in a simple collector model yields noon-time efficiencies on the order of fifty percent with the absorber plate temperature 93 C above ambient. (Author)

A75-47527 # The role of heat transfer in solving geothermal energy problems to accelerate its effective application. E. F. Wehlage (International Society for Geothermal Engineering, Whittier, Calif.). *ASME, AIChE, CSChE, and CSME, Heat Transfer Conference, San Francisco, Calif., Aug. 11-13, 1975, ASME Paper 75-HT-57.* 12 p. 20 refs. Members, $1.00; nonmembers, $3.00.

Heat exchange equipment difficulties now make a formidable barrier to future geothermal use. Both binary cycle units and refrigeration systems look dependent on the resolution of existing difficulties in heat transfer systems for geothermal service. (Author)

A75-47798 * # Preliminary results of the large experimental wind turbine phase of the national wind energy program. R. L. Thomas and J. E. Sholes (NASA, Lewis Research Center, Cleveland, Ohio). *Oklahoma State University, Frontiers of Technology Conference, Stillwater, Okla., Oct. 1, 2, 1975, Paper.* 13 p. 5 refs.

A major phase of the wind energy program is the development of reliable wind turbines for supplying cost-competitive electrical

energy. This paper discusses the preliminary results of two projects in this phase of the program. First an experimental 100 kW wind turbine design and its status are reviewed. Also discussed are the results of two parallel design studies for determining the configurations and power levels for wind turbines with minimum energy costs. These studies show wind energy costs of 7 to 1.5 c/kWH for wind turbines produced in quantities of 100 to 1000 a year and located at sites having average winds of 12 to 18 mph. (Author)

A75-47802 * # **Plans and status of the NASA-Lewis Research Center wind energy project.** R. Thomas, R. Puthoff, J. Savino, and W. Johnson (NASA, Lewis Research Center, Cleveland, Ohio). *Institute of Electrical and Electronics Engineers and American Society of Mechanical Engineers, Joint Power Conference, Portland, Ore., Sept. 28-Oct. 1, 1975, Paper.* 30 p. 8 refs.

This report describes that portion of the national five-year wind energy program that is being managed by the NASA-Lewis Research Center for the ERDA. The Lewis Research Center's Wind Power Office, its organization and plans and status are briefly described. The three major elements of the wind energy project at Lewis are the experimental 100 kW wind-turbine generator; the first generation industry-built and user-operated wind turbine generators; and the supporting research and technology tasks which are each briefly described. (Author)

A75-47803 * # **The NASA-Lewis/ERDA Solar Heating and Cooling Technology Program.** J. P. Couch and H. S. Bloomfield (NASA, Lewis Research Center, Cleveland, Ohio). *International Solar Energy Society and American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Workshop on the Use of Solar Energy for the Cooling of Buildings, Los Angeles, Calif., Aug. 4-6, 1975, Paper.* 14 p. 20 refs.

The NASA Lewis Research Center plans to carry out a major role in the ERDA Solar Heating and Cooling Program. This role would be to create and test the enabling technology for future solar heating, cooling, and combined heating/cooling systems. The major objectives of the project are to achieve reduction in solar energy system costs, while maintaining adequate performance, reliability, life, and maintenance characteristics. The project approach is to move progressively through component, subsystem, and then system technology advancement phases in parallel with continuing manufacturing cost assessment studies. This approach will be accomplished principally by contract with industry to develop advanced components and subsystems. This advanced hardware will be tested to establish 'technology readiness' both under controlled laboratory conditions and under real sun conditions. (Author)

A75-47804 * # **Initial comparisons of solar collector performance data obtained out-of doors and with a solar simulator.** R. W. Vernon (NASA, Lewis Research Center, Cleveland, Ohio). *International Solar Energy Society, Meeting, Los Angeles, Calif., July 28-Aug. 1, 1975, Paper.* 14 p. 9 refs.

A facility was constructed to evaluate solar collector performance outdoors for conditions that would be encountered by collectors if they were incorporated in a solar heating/cooling system. In addition to obtaining initial collector performance data, the outdoor facility will enable collector durability and degradation rates to be evaluated for operating periods of several months. The data obtained from the outdoor tests were compared to collector performance predicted on the basis of results obtained with a solar simulator. The performance measured outdoors was less than the predicted performance. (Author)

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STAR ENTRIES

N75-28503# National Academy of Sciences - National Research Council, Washington, D.C.
NATIONAL MATERIALS POLICY
Jan. 1975 216 p refs Proc. of a Joint Meeting of the Natl. Acad. of Sci-Natl. Acad. of Eng., Washington, D. C., 25-26 Oct. 1973.
(Contracts NSF C-310; DI-BM-SO-133081)
(PB-240941/5; ISBN-0-309-02247-9) Avail: NTIS MF $2.25; HC Natl. Acad. of Sci., Washington, D. C. CSCL 05D

A broad range of issues and strategies dealing with national policy on materials to complement present energy and environmental programs is covered. Information on the size of materials reserves, more efficient recovery of nonrenewable resources, and the creative use of wastes and pollutants to extend the useful life of materials is discussed. Recommendations on further university and industry contributions to materials science and engineering, and on priorities for research and development are given. GRA

N75-28508# Electric Power Research Inst., Palo Alto, Calif.
URANIUM RESOURCES TO MEET LONG TERM URANIUM REQUIREMENTS
Nov. 1974 123 p refs
(PB-239515/0; EPRI-SR-5) Avail: NTIS HC $5.25 CSCL 08G

Comparison between uranium requirements and uranium resources, the uncertainty concerning the size of the nation's uranium resources, and the future levels of uranium consumption are discussed. Published AEC uranium statistics form the basis for all of the quantitative uranium resources analysis. The United States is essentially unexplored for uranium and much more information is necessary to adequately assess the uranium potential of the country. GRA

N75-28514# Bureau of Mines, Washington, D.C.
A SUMMARY OF SIGNIFICANT RESULTS IN MINING METALLURGY AND ENERGY, BUREAU OF MINES RESEARCH 1974
Mar. 1975 138 p
(PB-241084/2; BM-SP-1-75) Avail: NTIS MF $2.25; SOD HC CSCL 08I

Research projects in the minerals and fossil fuels fields are summarized. Topics covered include: technology to increase the percentage of recovery of oil, coal, natural gas, copper, and other mineral products; the economics of recycling scrap metals, efficient utilization of virgin metals and minerals by extending their mormal lifespan; and industrial uses for the wastes of mineral processing that costitute unsightly dumps and contribute to air, water, and land pollution. GRA

N75-28516 British Library Lending Div., Boston Spa (England).
SOVIET ENERGY POTENTIAL
M. Pervukhin [1974] 3 p Transl. into ENGLISH from Moskovskaya Pravda (Moscow), 21 Apr. 1974
(BLL-M-23413-(5828.4F)) Avail: British Library Lending Div., Boston Spa, Engl.: 1 BLL photocopy coupon

Various energy resources and their utilization in the U.S.S.R. are outlined. Coal, oil, gas, hydropower and atomic power are discussed. D.M.L.

N75-28517 AEG-Telefunken, Backnang (West Germany).
ANALYSIS OF TECHNOLOGICAL DEVELOPMENT PROBLEMS POSED BY USE OF ORBITAL SYSTEMS FOR ENERGY CONVERSION AND TRANSFER IN AND FROM SPACE Final Report [ANALYSE DER TECHNOLOGISCHEN ENTWICKLUNGSPROBLEME FUER DEN EINSATZ ORBITALER SYSTEME ZUR ENERGIEERZEUGUNG IM BZW. DER ENERGIEUEBERTRAGUNG AUS DEM WELTRAUM]
May 1975 502 p refs In GERMAN Prepared jointly with Dornier System and Tech. Univ. Berlin
(Contract RV-1/1-V-67/74-PZ-BB-74)
Avail: Issuing Activity

Current American and European concepts of a solar satellite power station with associated technological problem areas was studied. Solar arrays, liquid gallium as a collecting contact, amplitrons and phased array earth antennas for microwave transmission and reception, respectively, and associated technological and theoretical implications, as well as typical spacecraft optimization problems are considered in detail. ESRO

N75-28518*# Little (Arthur D.), Inc., Cambridge, Mass.
FEASIBILITY STUDY OF SOLAR ENERGY UTILIZATION IN MODULAR INTEGRATED UTILITY SYSTEMS Final Report
30 Jun. 1975 187 p refs
(Contract NAS9-14524)
(NASA-CR-141929; ADL-78036) Avail: NTIS HC $7.00 CSCL 10A

The feasibility and benefits were evaluated of solar thermal energy systems on Integrated Utility Systems. The effort included the identification of potential system concepts, evaluation of hardware status, and performance of weighted system evaluations to select promising system concepts deserving of further study. Author

N75-28519*# National Aeronautics and Space Administration. Pasadena Office, Calif.
LOW COST SOLAR ENERGY COLLECTION SYSTEM Patent Application
Charles G. Miller (JPL) and James B. Stephens, inventors (to NASA) (JPL) Filed 24 Jul. 1975 57 p
(Contract NAS7-100)
(NASA-Case-NPO-13579-1; NASA-Case-NPO-13580-1; US-Patent-Appl-SN-598969) Avail: NTIS HC $4.25 CSCL 10A

A fixed, linear, ground-based primary reflector is described which has an extended curved-sawtooth contoured surface covered with a metallized polymeric reflecting material; it reflects solar energy to a movably supported collector that is kept at the concentrated line focus of the reflector primary. The primary flector was constructed by a process utilizing freeway paving machinery. The solar energy absorber is preferably a fluid-transporting pipe. Efficient utilization leading to high temperatures from the reflected solar energy was obtained by cylindrical shaped secondary reflectors that direct off-angle energy to the absorber pipe. Refocusing secondary reflectors which cause a series of discrete spots of highly concentrated solar energy to fall on the fluid-transporting pipe were used to obtain higher temperature levels. A seriatim arrangement of cylindrical secondary reflector stages and spot-forming reflector stages produces a high temperature solar energy collection system of greater efficiency. NASA

N75-28522# Army War Coll., Carlisle Barracks, Pa.
TECHNOLOGICAL FEASIBILITY OF ALTERNATIVE ENERGY SOURCES
Maurice L. Zweigle 28 Oct. 1974 30 p refs
(AD-A005549) Avail: NTIS CSCL 05/3

The U.S. energy shortage is discussed. The technology of coal gasification or liquefication, shale oil from oil shale, and geothermal energy recovery is presented in sufficient detail to show feasibility of these as energy source alternatives to petroleum crude. Technical trade publications data show that essentially all necessary process technology is known, although important improvements are possible, and have been proved at pilot plant scale. Conversion of coal to energy offers the best opportunity

for rapid development as a broad, in-house U.S. energy source. The other two should be developed as time and funds are available. GRA

N75-28524# Stanford Univ., Calif.
WORKSHOP ON FUNDAMENTAL RESEARCH IN HOMOGENEOUS CATALYSIS AS RELATED TO US ENERGY PROBLEMS Final Report
James P. Collman, Jack Halpern, Jack Norton, and James Roth 6 Dec. 1974 43 p Workshop held at Stanford, Calif., 4-6 Dec. 1974
(Grant NSF MPS-04210)
(PB-240177/6) Avail: NTIS HC $3.75 CSCL 07D

Opportunities for the solution of energy problems by homogeneous catalysts were discussed along with recommendations for fundamental research that could accelerate these solutions. The following areas of research were recognized: (1) the homogeneous catalytic activation of saturated hydrocarbons; (2) selective oxidation of organic substances and the activation of oxygen; (3) the reduction of carbon monoxide, especially by hydrogen; (4) studies on multi-metal catalyst systems; (5) production of high energy substances; and (6) catalytic complexes involving unusual metal environments. GRA

N75-28527# National Center for Energy Management and Power, Philadelphia, Pa.
INTEGRATED SOLAR POWERED CLIMATE CONDITIONING SYSTEMS Semiannual Progress Report, 1 Jan. - 30 Jun. 1974
Jesse C. Denton Jul. 1974 67 p refs
(Grant NSF GI-29729)
(PB-239759/4; NSF/RANN/SE/GI-29729/PR-74-2; NSF/RA/N-74-152(4)) Avail: NTIS HC $4.25 CSCL 10B

Performance comparisons were made between direct solar heating, solar powered vapor compression and gas absorption heat pumps, electric resistance heating, and combustion furnace heating. Seasonal resource energy consumption for a Philadelphia single family residence was used as the measure of comparison. The attitudes of prospective purchasers toward using solar heating in their new homes were surveyed. Financial institutions were polled to determine whether they would grant additional loans on buildings equipped with solar heating systems in view of the expected operating cost savings. Government agencies were contacted to elicit plans for encouraging such loans. GRA

N75-28528# Mitre Corp., McLean, Va.
TRANSPORTATION ENERGY CONSERVATION: A PROGRAM PLAN OF POLICY-ORIENTED RESEARCH Final Report
Willard E. Fraize, Michael Lenard, and John Lieb Jan. 1975 77 p refs
(Contract FEA-C-04-50065-00)
(PB-240734/4; MTR-6843) Avail: NTIS HC $4.75 CSCL 10A

Transportation's role in energy conservation is reviewed. The Office of Transportation Research proposed research program to explore transportation energy use and alternative government policies related to transportation energy conservation is described. Project descriptions include estimated cost, suggested scheduling, priority designation, interrelationships with other projects and programs, and detailed task descriptions. GRA

N75-28529# Little (Arthur D.), Inc., Cambridge, Mass.
AN OVERVIEW OF ALTERNATIVE ENERGY SOURCES FOR LDCS
7 Aug. 1974 372 p refs
(Contract AID/TA/C-1089)
(PB-239465/8; ADL-C-77105) Avail: NTIS MF $10.00 CSCL 10A

An overview of alternative energy sources is presented which could be of significant value to lesser developed countries in adjusting to the impact of sharply higher world market prices of petroleum. It presents a highly condensed review of non-conventional energy technologies, together with some limited commentary on the relevance of the more conventional technologies in new lesser developed country economic settings. It also provides a summary on a country-by-country basis of the current economic posture and energy resources array. GRA

N75-28530# Industrial Research Inst., Inc., New York.
INSTITUTIONAL AND LEGAL CONSTRAINTS TO COOPERATIVE ENERGY RESEARCH AND DEVELOPMENT Final Report
Mar. 1975 174 p
(Contract DOC-4-35596)
(PB-240929/0; CTAB-75-2) Avail: NTIS HC $6.25 CSCL 10A

Guidelines are provided for the design and operation of research and development consortia with a minimum risk of antitrust challenge. A platform is given for a government-industry dialog on the need for and the barriers to cooperative research and development. The results of a survey of Industrial Research Institute member companies which identifies industry's perceptions of the barriers to cooperative research and development ventures and describes eight illustrative case histories is presented. GRA

N75-28536# Wisconsin Univ., Madison. Inst. for Environmental Studies.
GLASS RECYCLING AND REUSE
Harold R. Samtur Mar. 1974 106 p refs
(Grant NSF GI-29731)
(PB-239674/5; IES-17; NSF/RA/E-74-015) Avail: NTIS HC $5.25 CSCL 13B

Methods are surveyed for recycling and/or reusing post-consumer glass products to determine which methods are most favorable. The following topics are included: the properties of glass, glass manufacture; analyses of alternatives to direct disposal of glass products; reuse of waste glass for glass manufacture; techniques for the separation of glass from municipal refuse; the development of degradable glass containers; returnable containers; and energy consumption for each of the major components of the glass cycle. GRA

N75-28539# National Science Foundation, Washington, D.C. Div. of Advanced Energy Research and Technology.
PROCEEDINGS OF THE CONFERENCE ON ENERGY CONSERVATION IN COMMERCIAL, RESIDENTIAL AND INDUSTRIAL BUILDINGS
7 May 1974 340 p refs Conf. held at Columbus, Ohio, 5-7 May 1974; Sponsored by Ohio State Univ., Am. Soc. of Heating, Refrigerating and Air-conditioning Engr., Inc., and the Assoc. of Phys. Plant Admin. of Univ. and Coll.
(PB-240306/1; NSF/RA/N-74-123) Avail: NTIS HC $9.50 CSCL 10A

Topics discussed are as follows: (1) Current energy conservation test projects, (2) energy conservation methods and associated problems in industry; (3) problems of energy conservation in existing buildings; (4) energy conservation methods in buildings; (5) computer programs and system simulations; (6) future changes in codes and buildings; and (7) possible research projects in energy conservation in the future GRA

N75-28543# Minnesota Univ., Minneapolis.
RESEARCH APPLIED TO SOLAR THERMAL SYSTEMS Semiannual Progress Report, 1 Jan. - 31 Jun. 1974
E. M. Sparrow, J. W. Ramsey, and G. K. Wehner Jul. 1974 189 p refs Prepared in Cooperation with Dynatherm Corp. and Honeywell, Inc., Minneapolis
(Grant NSF GI-34871)
(PB-241089/2; NSF/RANN/SE/GI-34871/PR-74-2; NSF/RA/N-74-147; SAPR-4) Avail: NTIS MF $7.00 CSCL 10B

Experiments of a scale model trough collector were performed at a desert test site. Absorbed solar energy was measured both for east/west and north/south orientations. The collector was found to absorb up to 61.5 percent of the available solar flux.

Continuing life tests of candidate solar concentrator surfaces indicated that certain surfaces showed no degradation in reflectance. Solar absorber coating/substrate structures have been devised for high temperature operation and a technique developed for enhancing coating life expectancy in air. Cost characteristics of three transfer loop systems were determined and the most cost effective one was identified. GRA

N75-28544# Minnesota Univ., Minneapolis.
RESEARCH APPLIED TO SOLAR THERMAL POWER SYSTEMS Semiannual Report, 1 Jul. - 31 Dec. 1974
E. M. Sparrow, J. W. Ramsey, and G. K. Wehner Jan. 1975 112 p refs Prepared in cooperation with Dynatherm, Corp., Cockeysville, Md. and Honeywell, Inc., Minneapolis, Minn.
(Grant NSF GI-34871)
(PB-241090/0; NSF/RANN/SE/GI-34871/PR-74-4; NSF/RA/N-75-015; SAR-5) Avail: NTIS HC $5.25 CSCL 10B

Experiments were conducted on the scalemodel parabolic trough collector module at a desert test site. Collector performance was measured for absorber tube operation over a range of temperature from 210 to 300C. Auger electron spectroscopy studies of the diffusion phenomena in various solar absorber coatings were continued. An experimental model of a solar boiler/heat exchanger was designed. Measurements were made of the thermal conductivity of a candidate pipeline insulation. A computer program was written and applied for determining the heat transfer characteristics of phase-change heat storage media Preliminary data runs were made for a single-phase heat storage system. GRA

N75-28545# Delaware Univ., Newark. Inst. of Energy Conversion.
DIRECT SOLAR ENERGY CONVERSION FOR LARGE SCALE TERRESTIAL USE Annual Report, 1 Jan. - 31 Dec. 1974
K. W. Boer Jan. 1975 170 p refs
(Grant NSF GI-34872)
(PB-241007/4; NSF/RANN/SE/GI-34872/PR-74-4; NSF/RA/N-75-013) Avail: NTIS HC $6.25 CSCL 10B

Major aspects of the development of the Cu2S/CdS solar cell are presented. Results are reported in the following areas: (1) production of cells of conversion efficiency of 5% (2) Auger, Rutherford backscattering, and energy dispersive X-ray analysis; grain boundary and diffusion length studies; and Cu2S synthesis; (3) diode analysis, spectral response, solar simulation, response uniformity, and junction capacitance; (4) life tests; and (5) diode and light generated currents and the heterojunction model. GRA

N75-28546# Federal Power Commission, Washington, D.C. Office of Energy Systems.
MEASURE FOR REDUCING ENERGY CONSUMPTION FOR HOMEOWNERS AND RENTERS
25 Mar. 1975 24 p
(PB-240472/1) Avail: NTIS HC $3.25 CSCL 10A

A comprehensive set of measures is described that can lead to a large reduction in the quantity of fuel consumed by the typical residence. It is indicated that the savings given are not additive, since most energy conservation measures interact with one another. In addition, for the two most important areas of space heating and hot water heating, estimates of energy saved for the various options are given for different regions of the country. GRA

N75-28548# Bureau of Mines, Laramie, Wyo. Energy Research Center.
PRODUCING SNG BY HYDROGASIFYING IN SITU CRUDE SHALE OIL Report of Investigations, 1975
Lawrence K. Barker Feb. 1975 43 p refs
(PB-240841/7; BM-RI-8011) Avail: NTIS HC $3.75 CSCL 08I

The effect of temperature and pressure on the yield and composition of gas which could be obtained from an in situ crude shale oil is determined along with the effect extended operating times would have on gasification. Tests were also made to determine the temperature at which 90 volume-percent of the ethane was converted to methane and whether or not a cobalt-molybdate-on-alumina catalyst plays a significant part in conversion of light hydrocarbons. Both in situ crude shale oil and liquefied petroleum gas were used as feedstocks. Temperatures of 800 degrees to 1,400 degrees F, pressures of 500, 1,000, and 1,5000 psig, and operating times of 19 to 67 hours were used. A cobalt-molybdate-on-alumina catalyst was used for the catalyst experiments. GRA

N75-28551# American Bar Foundation, Chicago, Ill.
PROCEEDINGS OF A WORKSHOP ON SOLAR ENERGY AND THE LAW Interim Report
William A. Thomas 1975 34 p Conference held at Arlington, Va., 10 Feb. 1975
(Grant NSF APR74-21034)
(PB-241051/2; NSF/RA/S-75-004) Avail: NTIS HC $3.75 CSCL 10A

Topic areas discussed include: restrictions on building design and materials; access to sunlight; fiscal impediments and inducements; zoning; transferable development rights; and innovative land use laws. GRA

N75-28552# Little (Arthur D.), Inc., Cambridge, Mass.
THE BENEFITS/COSTS OF TERTIARY OIL RECOVERY Final Report
Dec. 1974 51 p
(Contract DI-BM-JO-155010)
(PB-240463/0; ADL-C-77591; BM-OFR-4-75) Avail: NTIS HC $4.25 CSCL 08I

The benefits of a secondary/tertiary research and development program were considered: (1) savings realized as a result of having cheaper supplementary oil available from tertiary recovery than would be otherwise available under uncertain alternative futures; (2) savings resulting from applying tertiary methods to stripper wells that would otherwise be closed and require more expensive reentry costs at a later time; (3) an alternative view of the benefits of tertiary recovery being equal to the full balance of payments value/barrel of recovered reserves, recovered at an earlier time; (4) value as emergency stockpile; and (5) insurance and portfolio values. GRA

N75-28964# National Planning Association, Washington, D.C.
DEMAND FOR SCIENTIFIC AND TECHNICAL MANPOWER IN ENERGY-RELATED INDUSTRIES: UNITED STATES 1970-1985 Final report
Ivars Gutmanis, Rita A. McBrayer, Richard P. Mckenna, and Richard Kotz Oct. 1974 249 p refs
(Grant NSF GR-32464)
(PB-240865) Avail: NTIS HC $7.50 CSCL 05I

Requirements for scientists and engineers in the domestic projection of energy in 1985 are reported. Estimates are included only for the following selected industries: electric power generation, transmission and distribution, petroleum and natural gas extraction, and petroleum refining, natural gas production, transmission, and distribution, coal mining; nuclear power production and radioactive waste disposal; manufacture of selected producers durable equipment for electric companies; and energy-related construction. GRA

N75-28967 Texas Univ., Arlington.
APPLICATION OF FAST SPARSE-MATRIX TECHNIQUES AND AN ENERGY ESTIMATION MODEL FOR LARGE TRANSPORATION NETWORKS Ph.D. Thesis
Howard Alanson Smolleck 1975 280 p
Avail: Univ. Microfilms Order No. 75-14488

A near-optimal path assignment problem and the development of a model for rapidly estimating the total amount of energy consumed daily by automotive vehicles operating within a large metropolitan area is presented. The development of electric circuit models for large transportation networks and their applications was studied. An algorithm for network alterations and peculiarities

was investigated, and computational techniques for checking and correcting ill-conditioned highway network data were developed. A method for subdividing the highway network into primary and secondary subsystems, in a manner analogous to that used in the solution of electric power-flow problems, was formulated in order to increase solution speed and accuracy. A model for estimating the total vehicular energy consumption within a highway network based upon path assignments is shown.
Dissert. Abstr.

N75-29012* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE LONG TERM ENERGY PROBLEM AND AERONAUTICS
Richard A. Rudey *In its* NASA/Univ. Conf. on Aeron. 1975 p 183-210 refs
CSCL 10B

The projected increase in energy consumption by transportation in general and civil aviation in particular is directly opposed to the dwindling supplies of natural petroleum crude oil currently used to produce aircraft fuels. This fact dictates the need to develop even more energy conservative aircraft and propulsion systems than are currently available and to explore the potential of alternative fuels to replace the current petroleum derived hydrocarbons. Advances in technology are described in the areas of improved component efficiency, aircraft and engine integration, control systems, and advanced lightweight materials that are needed to maximize performance and minimize fuel usage. Also, improved turbofan and unconventional engine cycles which can provide significant fuel usage reductions are described. These advancements must be accomplished within expected environmental constraints such as noise and pollution limits. Alternative fuels derived from oil shale and coal are described, and the possible technological advancements needed to use these fuels in aircraft engines are discussed and evaluated with relation to potential differences in fuel characteristics. Author

N75-29269# Illinois Univ., Urbana. Center for Advanced Computation.
ENERGY INTENSITY OF BARGE AND RAIL FREIGHT HAULING
May 1974 18 p refs
(Grant NSF GI-35179)
(PB-240012/5; UIUC-CAC-DN-74-127; NSF/RA/N-74-166) Avail: NTIS HC $3.25 CSCL 21D

Results of an energy comparison per ton mile of competing rail freight vs. inland barge freight, including the effects of circuitry and the use of probable competing rail lines instead of national average rail data are presented. GRA

N75-29270# Webb Inst. of Naval Architecture, Glen Cove, N.Y.
FUEL CONSERVATION IN SHIP OPERATIONS
Robert Zubaly Jan. 1975 46 p
(Contract MA-2-4214)
(COM-75-10466/1; NMRC-KP-133) Avail: NTIS HC $3.75 CSCL 21D

A study of ways to reduce fuel consumption by both short-term and long-term changes in operational practices has been made, using two typical North Atlantic container fleets as models. Fuel saving strategies are evaluated, all involving reductions in ship speed. GRA

N75-29271# Little (Arthur D.), Inc., Cambridge, Mass.
TECHNOLOGY AND CURRENT PRACTICES FOR PROCESSING, TRANSFERRING AND STORING LIQUEFIED NATURAL GAS Final Report
D. Allan, S. Atallah, E. Drake, R. Hinckley, and S. Mathias Dec. 1974 205 p
(Contract DOT-OS-40171)
(PB-241048/8; ADL-C-76971) Avail: NTIS HC $7.25 CSCL 21D

Current state-of-the-art safety information related to the design, location, construction, operation and maintenance of facilities required for liquefaction, transfer, storage, and revaporization of natural gas is assembled and summarized. A detailed review of codes, standards and practices pertaining to LNG installations is presented along with an evaluation of present trends in LNG safety requirements. LNG safety research programs completed or in progress are described and key research results summarized. A methodology for quantitative assessment of risks associated with LNG facilities is outlined. GRA

N75-29546# Bureau of Mines, Twin Cities, Minn. Twin Cities Mining Research Center.
EXTRACTING MINERALS FROM GEOTHERMAL BRINES: A LITERATURE STUDY Information Circular, 1974
Rolland L. Blake Dec. 1974 30 p refs
(PB-240681/7; BM-IC-8638) Avail: NTIS HC $3.75 CSCL 08I

The Bureau of Mines is concerned with extracting minerals from residual geothermal brines after their heat content and some demineralized water have been recovered. The potential of the domestic geothermal mineral resources, is examined along with the technical problems involved. Possible effects on the environment from reservoir fluid withdrawal and reinjection are outlined. GRA

N75-29546*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE 100 kW EXPERIMENTAL WIND TURBINE GENERATOR PROJECT
Richard L. Puthoff and Paul Sirocky 1975 19 p refs Presented at the Wind Energy Workshop, Washington, D. C., 9-11 Jun. 1975; sponsored by ERDA
(NASA-TM-X-71758; E-8403) Avail: NTIS HC $3.25 CSCL 10A

The Energy Research and Development Administration and the NASA Lewis Research Center engaged jointly in a Wind Energy Program which included the design and erection of a 100 kW wind turbine generator. This test machine consists of a rotor turbine, transmission, shaft, alternator, and tower. The rotor, measuring 125 feet in diameter and consisting of two variable pitch blades, operates at 40 rpm and generates 100 kW of electrical power at a wind velocity of 18 mph. The entire assembly is placed on top of a tower 100 feet above ground level. The machine was scheduled to be ready for operation in August, 1975. Author

N75-29548*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR ENERGY POWER SYSTEM Patent Application
Billy K. Davis, inventor (to NASA) Filed 21 Mar. 1975 17 p (NASA-Case-MFS-21628-2; US-Patent-Appl-SN-561020) Avail: NTIS HC $3.25 CSCL 10A

A solar energy vapor (Freon) powered system for generating electrical energy for outer space application is described. Features of the system include: storage of the heat s absorbed from the sun by a thermal capacitor in which a mass of Pyrone liquifies when heat is applied and then solidifies to provide a heat output; an efficient solar boiler which uses an anodized titanium surface and a combination of shaped boiler tubes and complimentary reflectors; and a unique arrangement of heat recovery devices. The system provides efficiency in conversion of solar radiation into a heated work medium and in the generation of power from that medium. NASA

N75-29550# Booz-Allen and Hamilton, Inc., Bethesda, Md.
ALTERNATIVE STRATEGIES FOR OPTIMIZING ENERGY SUPPLY, DISTRIBUTION, AND CONSUMPTION SYSTEMS ON NAVAL BASES. VOLUME 3: ASSESSMENT OF TOTAL ENERGY SYSTEM APPLICATIONS AT NAVAL FACILITIES Final Report, Feb. - Nov. 1974
D. Kennedy, D. Wulfinghoff, and R. Shaw 20 Nov. 1974 146 p refs
(Contract N62399-73-C-0029)
(AD-A003590; CEL-CR-75.003-Vol-3) Avail: NTIS CSCL 10/2

The key topics investigated and discussed are: advanced research in Total Energy Systems; opportunities for heat recovery from prime movers at naval facilities; and feasibility of using in-port steaming to provide power for naval shore facilities. GRA

N75-29552# Colorado Springs Dept. of Public Utilities, Colo.
ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEM IN A SUBURBAN DEVELOPMENT SETTING Semiannual Report, 1 Jul. - 31 Dec. 1974
James D. Phillips 10 Jan. 1975 108 p refs
(Grant NSF GI-44210)
(PB-240784/9; NSF/RA/G-74-028) Avail: NTIS HC $5.25 CSCL 10A

The development is discussed of a solar-heated residence project in Colorado Springs, Colorado. The house and the heating system are described and the status of related information-gathering activities in areas affecting solar heating systems, such as legal, social acceptance, and economic considerations is reported. Outlines of the technical research being conducted, news clippings, and an analysis of the questionnaires completed by persons visiting the house in July, 1974, are included. GRA

N75-29553# Commerce Technical Advisory Board, Washington, D.C.
REVIEW OF PROJECT INDEPENDENCE BLUEPRINT: PANEL SUBCOMMITTEE REPORTS ON FEA-INTERAGENCY TASK FORCES
1975 308 p
(COM-75-10500/7) Avail: NTIS HC $9.25 CSCL 10B

Data, assumptions, and background information used to develop Project Independence Blueprint are discussed. Topic areas covered include: energy demand/conservation; coal; oil; natural gas; nuclear energy; future energy sources; oil shale; transportation; water and environment; human resources; finance; and materials, equipment, and construction. GRA

N75-29555# Solar, San Diego, Calif.
SOLAR 10 kW TURBOALTERNATOR SILENT POWER PROGRAM Final Report, Jan. - Oct. 1974
Jerry S. Todd Nov. 1974 175 p refs
(Contract DAAK02-71-C-0311)
(AD-A006549; ER-2497) Avail: NTIS CSCL 10/2

The report covers effort to design, fabricate and test an enclosure for the 10 kW turboalternator inaudible at 100 meters in a quiet environment. The report includes past effort, present design criteria, acoustical performance and operational capability. The enclosure did meet design intent, but was overweight. GRA

N75-29558# Army War Coll., Carlisle Barracks, Pa.
OIL AND US POLICY
Robert L. Day 15 Dec. 1974 33 p refs Revised
(AD-A006473; MIRM-74-11-Rev) Avail: NTIS CSCL 05/4

The paper analyzes the rapidly growing demand for energy by the industrialized nations of the world, and the growing importance of Middle East oil. Today, Western Europe and Japan are heavily dependent on Middle East oil, and with U.S. oil production at or near peak capacity, the United States must now also look to the Middle East for ever-increasing amounts of oil--at least through 1985. Russian influence in the international oil market, financial impact of increased imports, the changing role of the international oil companies and available alternatives are discussed. U.S. vulnerability to possible short-term supply interruptions and to longer term shortfalls are projected, and remedial measures discussed. GRA

N75-29559# Reynolds, Smith and Hills, Jacksonville, Fla.
ENERGY CONSERVATION STUDY OF VETERANS ADMINISTRATION HOSPITALS. STAGE 1: BASE LINE SURVEY Final Report
Feb. 1974 122 p refs
(Contract V-594P-454)
(PB-241095/9) Avail: NTIS HC $4.25 HC also available from NTIS $22.00/set of 4 reports as PB-241094-SET CSCL 10A

A base line survey is presented that identifies and unifies all elements of energy consumption and establishes significant energy parameters at three V.A. hospitals. GRA

N75-29560# Reynolds, Smith and Hills, Jacksonville, Fla.
ENERGY CONSERVATION STUDY OF VETERANS ADMINISTRATION HOSPITALS. STAGE 2: OPERATIONAL STUDY Final Report
Feb. 1974 58 p
(Contract V-594P-454)
(PB-241096/7) Avail: NTIS HC $5.25 HC available from NTIS $22.00/set of 4 reports as PB-241094-SET CSCL 10A

The programming specifications are presented for a computer-based energy data reporting system to measure and compare management of energy usage for all V.A. hospitals. GRA

N75-29561# Reynolds, Smith and Hills, Jacksonville, Fla.
ENERGY CONSERVATION STUDY OF VETERANS ADMINISTRATION HOSPITALS. STAGE 3: HOSPITAL ENERGY CONTROL SYSTEM Final Report
Feb. 1974 92 p refs
(Contract V-594P-454)
(PB-241097/5) Avail: NTIS HC $4.75 HC also available from NTIS $20.00/set of 4 reports as PB-241094-SET CSCL 10A

The philosophy, the design, the mathematical details and sample results of the Hospital Energy Control System, a computerized reporting system for monitoring both energy consumption and its conservation, at all V.A. hospitals are presented. A method is included of self-scoring for use by the hospital staff in objectively determining the severity of their own correctional problems. These self-evaluating check lists provide a means of determining each hospital's existing state of thermal integrity and the needed motivation for energy conservation. Author

N75-29562# Reynolds, Smith and Hills, Jacksonville, Fla.
ENERGY CONSERVATION STUDY OF VETERANS ADMINISTRATION HOSPITALS. STAGE 4: BASIC DETAIL DATA FOR STAGE 1, 2, AND 3 Final Report
Feb. 1974 594 p
(Contract V-594P-454)
(PB-241098/3) Avail: NTIS HC $9.50 HC also available from NTIS $20.00/set of 4 reports as PB-241094-SET CSCL 10A

For abstract, see N75-29561.

N75-29570# Colorado Springs Dept. of Public Utilities, Colo. Dept. of Public Utilities.
ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEM IN A SUBURBAN DEVELOPMENT SETTING Monthly Report
James D. Phillips 10 Nov. 1974 38 p
(Grant NSF GI-44210)
(PB-240553/8; NSF/RA/G-74-018) Avail: NTIS HC $3.75 CSCL 13A

Briefly discussed are problems and costs relating to a solar house heating system that is on automatic control. GRA

N75-29587# Chicago Univ., Ill. Center for Urban Studies.
ENVIRONMENTAL REGULATIONS AND ENERGY FOR HOME HEATING
Alan S. Cohen, John L. Gardner, and Gideon Fishelson 1974 12 p Prepared in cooperation with Argonne Natl. Lab., Ill.
(Grants NSF AG-352; NSF GI-32989A2)
(PB-240699/9; NSF/RA/E-74-027) Avail: NTIS HC $3.25 CSCL 21D

This report considers the effects of residential fuel policies on: (1) costs to tenants, landlords, coal distributors and others affected by the regulation, (2) price of fuels, (3) human health and material property, and (4) air quality. The policies compared are: (1) no restrictions, (2) a low sulfur law banning the use of fuels having more than a one percent sulfur content, (3) a coal ban, still allowing oil with no more than a one percent sulfur

content, and (4) a complete ban on the use of coal and oil. Implications for national energy and environmental policies are discussed. GRA

N75-29596# Exxon Research and Engineering Co., Linden, N.J.
EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES: GASIFICATION. SECTION 1: CO2 ACCEPTOR PROCESS Final Report
C. E. Jashing and E. M. Magee Dec. 1974 68 p refs
(Contract EPA-68-02-0629)
(PB-241141/1; EPA-650/2-74-009D) Avail: NTIS HC $4.25 CSCL 07A

Results are given of a review of the CO2 Acceptor Coal Gasification Process from the standpoint of its effect on the environment. The quantities of solid, liquid, and gaseous effluents are estimated, where possible, as well as the thermal efficiency of the process. For the purpose of reducing environmental impact, a number of possible process modifications or alternatives are proposed and new technology needs are pointed out. GRA

N75-29597# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning Standards.
REPORT TO CONGRESS ON CONTROL OF SULFUR OXIDES
Feb. 1975 68 p refs
(PB-241021/5; EPA-450/1-75-001; APTIC-75097) Avail: NTIS HC $4.25 CSCL 13B

The compliance status of existing coal-fired steam electric power plants is discussed along with alternative methods for compliance with applicable emission regulations. Compliance alternatives include the use of low-sulfur coal, physical coal desulfurization, flue-gas desulfurization, coal gasification, fluidized-bed boilers, supplementary control systems, and energy recovery from solid waste. A review is presented showing the current status of existing coal-fired plants in terms of the sulfur content of coal purchased during the first half of 1974, the involvement of power companies in litigation challenging the applicable regulations, and the programs for achieving compliance with sulfur regulations in State Implementation Plans. GRA

N75-29952# Mathematics and Computation Lab., McLean, Va.
THE MCL-THUROW MODEL SUPPLEMENT Final Report
Patricia R. Devine Feb. 1975 117 p
(PB-241113/0; GSA/OP/MCL-TR-96) Avail: NTIS HC $5.25 CSCL 05C

Changes and additions to the model, notably the updating to a 1972 model and the extension of the Personal Consumption Expenditures submodel are reported. A new module in the Contingency Impact Analysis System is also described. GRA

N75-29953# Little (Arthur D.), Inc., Cambridge, Mass.
ECONOMIC IMPACT OF SHORTAGES ON THE FERTILIZER INDUSTRY Final Report
Jan. 1975 259 p
(Contract FEA-C-50068-00)
(PB-240418/4; ADLC-77382; FEA/EI-50068) Avail: NTIS HC $8.50 CSCL 07A

Information is provided on the basic structure, characteristic, and problems of the fertilizer industry. Particular emphasis is placed on fuel use and substitutability as well as the impact of fertilizer on farm production. GRA

N75-30331# GCA Corp., Bedford, Mass. Technology Div.
WASTE AUTOMOTIVE LUBRICATING OIL REUSE AS A FUEL Socioeconomic Environmental Studies Series.
Steven Chansky, James Carroll, Benjamin Kincannon, James Sahagian, and Norman Surprenant Sep. 1974 218 p
(Contract EPA-68-01-1859)
(PB-241357/3; EPA-600/5-74-032) Avail: NTIS; SOD HC CSCL 21D

This study evaluates the technical, economic, and environmental feasibility of automotive waste oil reuse as a fuel. The supply and potential marketability of waste oil fuel is considered in relationship to existing and projected fossil fuel usage in the United States. Its use will alleviate a serious waste oil disposal problem. The physical and chemical properties of waste oil are presented and serve as the basis for subsequent assessment of waste oil usage options: the use of untreated waste oil as a blended fuel oil or as a supplement to coal combustion and the use of waste oil following treatment to alleviate technical and environmental impacts. Various treatment methods are discussed and their cost and effectiveness assessed. The reduction of environmental impacts by the use of particulate emission control system and industrial utilization of fuel and control equipment are discussed. GRA

N75-30438*# Duke Univ., Durham, N.C. Dept. of Electrical Engineering.
DESIGN OF ENERGY STORAGE REACTORS FOR dc-TO-dc CONVERTERS Ph.D. Thesis
De Yu Chen 18 Aug. 1975 188 p refs
(Grant NGL-34-001-001)
(NASA-CR-143327) Avail: NTIS HC $7.00 CSCL 09C

Two methodical approaches to the design of energy-storage reactors for a group of widely used dc-to-dc converters are presented. One of these approaches is based on a steady-state time-domain analysis of piecewise-linearized circuit models of the converters, while the other approach is based on an analysis of the same circuit models, but from an energy point of view. The design procedure developed from the first approach includes a search through a stored data file of magnetic core characteristics and results in a list of usable reactor designs which meet a particular converter's requirements. Because of the complexity of this procedure, a digital computer usually is used to implement the design algorithm. The second approach, based on a study of the storage and transfer of energy in the magnetic reactors, leads to a straightforward design procedure which can be implemented with hand calculations. An equation to determine the lower-bound volume of workable cores for given converter design specifications is derived. Using this computer lower-bound volume, a comparative evaluation of various converter configurations is presented. Author

N75-30524* National Aeronautics and Space Administration. Pasadena Office, Calif.
ELECTRIC POWER GENERATION SYSTEM DIRECTORY FROM LASER POWER Patent
Katsunori Shimada, inventor (to NASA) (JPL) Issued 12 Aug. 1975 7 p Filed 27 Mar. 1974 Supersedes N74-19702 (12 - 11, p 1250) Sponsored by NASA
(NASA-Case-NPO-13308-1; US-Patent-3,899,696; US-Patent-Appl-SN-455165; US-Patent-Class-310-4; US-Patent-Class-331-DIG.1) Avail: US Patent Office CSCL 20E

A pool of liquid cesium is spaced apart from a collector in an enclosed vessel. A laser beam is directed to the liquid cesium pool. The beam is focused to provide sufficient laser power density at the liquid cesium surface to vaporize some of the liquid cesium and ionize the vaporized cesium, and thereby form cesium ions and free electrons. The work function of the collector is different from that of cesium. When the work function is higher, the formed ions are attracted to the collector, and the electrons are attracted by the liquid cesium. Electrons and ions are attracted by the collector and liquid cesium respectively when the work function of the collector is less than that of cesium. Thus, a potential difference is generated by the liquid cesium pool and the collector, sufficient to apply electric power to a load.
Official Gazette of the U.S. Patent Office

N75-30646# Federal Power Commission, Washington, D.C.
NATURAL GAS ACT, 1 MARCH 1974
1 Mar. 1974 58 p
Avail: SOD HC $0.70

Legislation is presented which regulates the transportation of natural gas in interstate commerce, the sale in interstate commerce of natural gas for resale for ultimate public consumption, and the natural gas companies engaged in such transportation or sale. J.M.S.

N75-30648# *Joint Publications Research Service, Arlington, Va.*
SCIENTIFIC RESEARCH IN POWER ENGINEERING
V. M. Fil'kov and A. A. Troitskiy 8 Aug. 1975 22 p refs Transl. into ENGLISH from Teploenerg (Moscow), no. 5, 1975 p 8-11
(JPRS-65422) Avail: NTIS HC $3.25
Data are reported on scientific research of the U.S. and U.S.S.R. in the power engineering field. Author

N75-30649*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID-METAL BINARY CYCLES FOR STATIONARY POWER
Martin Gutstein, Edward R. Furman, and George M. Kaplan Washington Aug. 1975 33 p refs
(NASA-TN-D-7955; E-8023) Avail: NTIS HC $3.75 CSCL 10A
The use of topping cycles to increase electric power plant efficiency is discussed, with particular attention to mercury and alkali metal Rankine cycle systems that could be considered for topping cycle applications. An overview of this technology, possible system applications, the required development, and possible problem areas is presented. Author

N75-30659# Energy and Environmental Analysis, Inc., Arlington, Va.
PROJECTED REGIONAL ENERGY AVAILABILITY IN 1985 Final Report, 1 Jul. 1974 - 15 Jan. 1975
15 Jan. 1975 100 p
(Contract DAAK02-75-C-0080; DA Proj. 4A7-62719-A-886) (AD-A008938) Avail: NTIS CSCL 10/1
Fixed Army facility energy requirements, in the context of national and regional energy trends through 1985, are evaluated. The national energy outlook in terms of the availability and price of various sources of energy is discussed. Demand and price forecasts are made for each energy source for each of nine census regions. Fixed Army Facility energy demands are forecasted within the nine regions by type of energy required. GRA

N75-30660# Office of the Chief of Engineers (Army), Washington, D.C. Studies Group.
ARMY INSTALLATION ENERGY REQUIREMENTS IN CONUS Final Report
Jan. 1975 147 p refs
(AD-A008951) Avail: NTIS CSCL 10/1
This report displays data relevant to current (FY 73) energy consumption and gives estimates of projected 1990 energy requirements at 75 Army installations in the Continental U.S. The current (FY 73) consumption of electrical energy is characterized by 10 energy regions and by type of installation. The totals for fuel consumption are presented by region, type of fuel, and size of boiler and heating plants. Future electrical energy requirements for troop installations were estimated based on projected populations combined with FY 73 per capita consumption at each installation. Estimates for other installations were based on an estimated or assumed activity level. This study estimates a 7.2% increase in electrical energy requirements by 1990 and a 3.4% reduction in fuel requirements. GRA

N75-30665# National Academy of Sciences - National Research Council, Washington, D.C.
MATERIALS TECHNOLOGY IN THE NEAR-TERM ENERGY PROGRAM
Dec. 1974 129 p refs
(Grant NSF C-310)
(PB-240942/3; ISBN-0-309-02322) Avail: NTIS HC $5.75 CSCL 10B
Materials research and development is reported that could affect energy supply and demand during the period prior to 1985. Assessed are major energy programs that can have significant impact within the time frame, including coal gasification and liquefaction, oil shale, high temperature gas turbines, and the use of critical elements. The capital investment estimates and the impact of materials technology in each are discussed. Other energy programs are also discussed, including nuclear power reactors, energy storage, and geothermal, nuclear, and solar energy sources. GRA

N75-30667# Minnesota Univ., Minneapolis. Dept. of Management Sciences.
REGIONAL IMPACTS OF ALTERNATIVE ENERGY ALLOCATION STRATEGIES
Wilbur R. Maki and Peter C. Knobloch 1 May 1974 27 p refs Presented at 6th Ann. Meeting of the Mid-Continent Regional Sci. Assoc., Urbana, Ill., 5-6 Apr. 1974
(PB-241125/4; MEA/RIAE-74/8) Avail: NTIS HC $3.75 CSCL 05B
The impacts are considered of the energy crisis and its shortages on the energy management decision process, and the specific gainers and losers of allocation strategies, with tradeoffs in costs of having or not having energy information. Input/output models are discussed, as are industrial/household-use data for operational decision making; energy stocks and flow, facility locations with their impacts, as well as data collection and analysis as they relate to industrial growth and employment and to services and materials, are reviewed. Economic tradeoffs of individual allocation criteria are estimated. The input/output framework is used to achieve consistency in the total set of economic variables in the economic information for energy planning. GRA

N75-30668# National Academy of Sciences - National Research Council, Washington, D.C. Building Research Advisory Board.
SOLAR HEATING/COOLING OF BUILDINGS: CURRENT BUILDING COMMUNITY PROJECTS Interim Report
1974 47 p
(Contract NSF C-310)
(PB-241117/1) Avail: NTIS HC $3.75 CSCL 13A
Brief descriptions of 21 projects involving the use of solar energy for heating and cooling buildings are presented. GRA

N75-30944# Minnesota Univ., Minneapolis. Dept. of Management Sciences.
A REGIONAL ENERGY INFORMATION SYSTEM FOR MINNESOTA: A PRELIMINARY DESIGN
Norman L. Chervany, J. David Naumann, Ralph Krishnan, Daniel Quillin, and John Schmitt Jan. 1975 135 p Sponsored by Minnesota Energy Agency, St. Paul
(PB-241124/7; MEA/REIS-7502) Avail: NTIS HC $5.75 CSCL 05B
A state's (Minnesota's) energy system, with its socio-economic plans that take energy constraints into consideration, is reviewed for policy makers. Four types of data, (1) energy supply/distribution/consumption data, (2) demographic data, (3) economic data, and (4) engineering data are found to be needed to support the short run energy allocation problems and long run energy planning problems. Preliminary design of a regional energy information system in this report. The system is designed to collect, store, and report the supply/distribution/consumption data. This data category was focused on primarily. Timely, valid data on energy supply, distribution, and consumption are technically feasible to obtain. GRA

N75-30945# Minnesota Univ., Minneapolis. Dept. of Management Sciences.
MASTER PLAN FOR REIS IMPLEMENTATION Final Report
Peter C. Knobloch Aug. 1974 52 p Sponsored by Minnesota Energy Agency, St. Paul
(PB-241126/2; MEA/REIS/WP-7408) Avail: NTIS HC $4.25 CSCL 05B
Implementation requirements of the regional energy informa-

tion system (REIS) and provision of a brief cost/benefit analysis of the proposed system is discussed. Divided into four sectors (problems, requirements, the present system, and the proposed implementation of REIS), the development of a demonstration data base, its implementation and that of the regional input-output model as a tool for decision makers are subjects of the report. The accounting subsystem and energy flow network model are two main components; the need to identify specific problems, to gather information on source, energy type, location, use, time with cross classification, the structure of REIS with parameter subsystem, and a description of the study area (N.E. Minnesota) are included. GRA

N75-30946# Minnesota Univ., Minneapolis. Dept. of Management Sciences.
DESIGN CONSIDERATIONS FOR A COMPREHENSIVE REGIONAL ENERGY INFORMATION SYSTEM
J. D. Naumann, P. C. Knobloch, and N. L. Chervany 1 Jul. 1974 35 p Sponsored by Minnesota Energy Agency, St. Paul (PB-241123/9; MEA/REIS/WP-7401) Avail: NTIS HC $3.75 CSCL 05B

The regional energy information systems (REIS) concerns itself with decision making on substate, state, and regional levels in emergencies, for tactical decisions, and long-range strategic policies by both government and industry. Effective access to energy information is critical, and REIS is designed to provide a standardized data base with design goals, constraints, parameters, and schedules. The REIS system is being developed; many states, the FEA, and other agencies are developing energy information systems. Shareability of data must be sought, and both technical and procedural requirements for this are discussed, and a plan for action is presented. GRA

N75-30948# National Bureau of Standards, Washington, D.C.
NATIONAL BUREAU OF STANDARDS ANNUAL REPORT: FISCAL YEAR 1974 Final Report
Dick Franzen, ed. Mar. 1975 36 p Supersedes NBS-SP-397 (COM-75-10465/3; NBS-SP-418; NBS-SP-397) Avail: NTIS MF $2.25; SOD HC as C13.10:418 CSCL 05B

The document described how resources were utilized during fiscal year 1974 and highlights major achievements. Brief discussions are included of accomplishments within major program areas. The report serves as (1) an annual account of NBS activities and (2) promotional information about NBS. The table of contents includes: standards for daily living; expanding measurement capabilities; toward solving the energy problem; improving man's environment; striving for safer products; aiding health care; advancing computer technology; public interests; government projects; industry cooperation; and information services. GRA

N75-31074* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FUEL-CONSERVATIVE ENGINE TECHNOLOGY
James F. Dugan, Jr., John E. McAulay, Thaine W. Reynolds, and William C. Strack *In its* Aeron. Propulsion 1975 p 157-190

CSCL 21E

Aircraft fuel consumption is discussed in terms of its efficient use, and the conversion of energy from sources other than petroleum. Topics discussed include: fuel from coal and oil shale, hydrogen deficiency of alternate sources, alternate fuels evaluation program, and future engines. F.O.S.

N75-31165 AEG-Telefunken, Hamburg (West Germany). Dept. of Space Technology and New Technologies.
SOLAR GENERATOR AND POWER SYSTEMS FOR COMMUNICATION SATELLITES
Rainer Hehnen and Joachim Rath *In* ESRO European Capabilities for Space Appl. 1975 14 p

State of the art and development activities on solar generators are discussed. Power conditioning and power storage equipment, including onboard equipment and electrical ground support equipment, are also considered. ESRO

N75-31285# Politecnico di Torino (Italy). Ist. di Macchine e Motori per Aeromobili.
CONTRIBUTION TO THE IMPROVEMENT OF THE REGULATING PROCESS OF IGNITION CONTROLLED ENGINES [CONTRIBUTO AL MIGLIORAMENTO DELLA CARATTERISTICA DI REGOLAZIONE DEI MOTORI AD ACCENSIONE COMANDATA]
Enrico Antonelli and Guido Colasurdo Jul. 1974 50 p refs In ITALIAN
(Publ-165) Avail: NTIS HC $3.75

A search for new methods of automobile fuel saving was carried out using a device to anticipate the closing of the aspiration valve. The corresponding mechanical set up is detailed and the method for determining the closure law is discussed by means of a specific fluid dynamic model: the equations are numerically solved. Special care is devoted to boundary values at cylinder level, valve level, and ducts, and to initial conditions and main engine characteristics. For velocities between 1000 and 6000 rpm the net theoretical saving is of the order of a few percent. ESRO

N75-31341 Texas Univ., Austin.
AN ASSESSMENT OF THE APPLICABILITY OF HIGH VOLTAGE AC CIRCUIT BREAKERS TO INDUCTIVE ENERGY STORAGE Ph.D. Thesis
Robert Bruce McCann 1975 147 p
Avail: Univ. Microfilms Order No. 75-16707

High voltage ac circuit breakers are attractive candidates for the current interrupter in Inductive Energy Storage (IES) systems with energy transfer times of 0.5 to 50 ms. The various types of high voltage circuit breakers are considered, and vacuum circuit breakers are selected as the most desirable for IES applications. In designing the IES circuits, it is assumed that the circuit breakers must be operated within the appropriate 60 Hz ratings. Two IES systems are considered as examples: a fusion feasibility experiment based on a staged theta pinch; and the turbulent heating of a proposed Tokamak fusion feasibility device. An optimization model is developed which considers economic as well as engineering factors in determining the conditions under which ac circuit breakers are applicable to IES. For inductive loads it is found that energy delivery times as short as about 1.0 ms are practical while for resistive loads this might be extended to 500 microns. In either case, the energy transfer time should not be less than twenty times greater than the circuit breaker dionization time. Dissert. Abstr.

N75-31556# Committee on Commerce (U. S. Senate).
OIL AND GAS DEVELOPMENT AND COASTAL ZONE MANAGEMENT
Washington GPO 1974 454 p refs Hearings before Natl. Ocean Policy Study of Comm. on Commerce, 93d Congr., 2d Sess., 23-25 Apr., 2 May and 22 May 1974
(GPO-37-347) Avail: Comm. on Commerce

Oil and gas extraction on the outer continental shelf is discussed along with the environmental, economic and social impact upon the coastal zone. Topics discussed include land and natural resources, oil drilling and exploration, nuclear power plants and oil leasing. M.J.S.

N75-31562# Massachusetts Inst. of Tech., Cambridge. Sea Grant Project Office.
THE OCS (OUTER CONTINENTAL SHELF) PETROLEUM PIE Final Report
J. W. Devanney 28 Feb. 1975 132 p refs
(Grant NOAA-NG-43-72)
(COM-75-10599/9; MITSG-75-10; NOAA-75041105) Avail: NTIS HC $5.75 CSCL 08I

This report analyzes a range of alternatives for managing Outer Continental Shelf (OCS) petroleum from the point of view of national income, public income, and developer income. The economic value of the resource is reviewed, and estimates of unit resource costs obtained for a range of find sizes, water depths and design wave heights. The basic result is that the economic rent associated with yet-to-be-discovered OCS

petroleum could easily be in the hundreds of billions of dollars. Management alternatives examined include work obligation permitting, bonus bidding, royalty bidding, profits bidding, and public exploratory drilling followed by bonus bidding. Special emphasis is given the latter option and the ramifications and problems of this system examined in some detail. GRA

N75-31566# Select Committee on Small Business (U. S. House).
ENERGY DATA REQUIREMENTS OF THE FEDERAL GOVERNMENT. PART 4: PROPANE AND CRUDE OIL; CONFLICTS OF INTEREST
Washington GPO 1974 507 p refs Hearings before Subcomm. on Activities of Regulatory Agencies of Permanent Select Comm. on Small Business, 93d Congr., 2d Sess., 24-26 Sep.; 2-3 Oct. 1974
(GPO-41-639) Avail: Subcomm. on Activities of Regulatory Agencies

Energy data on which Federal government energy policy in the propane and crude oil allocation program is based are examined. Factors discussed include: lack of data and economic analysis and the existence of a potential conflict of interest. Economic justifications underlying the propane and crude oil allocation regulations are examined. It is recommended that all conflicts of interest be investigated and that the existing conflict of interest statutes be vigorously enforced. J.M.S.

N75-31567# Committee on Science and Astronautics (U. S. House).
SOLAR ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1974
Washington GPO 1974 384 p refs Hearings on H.R. 15612 before Subcomm. on Energy of Comm. on Sci. and Astronaut., 93d Congr., 2d Sess., No. 42, 30 Jul. and 2 Aug. 1974
(GPO-39-827) Avail: Subcomm. on Energy

Hearings were held before the Subcommittee on Energy of the Committee on Science and Astronautics of the U.S. House of Representatives on July 30 and August 2, 1974 to discuss H.R. 15612, a bill on solar energy research, development, and demonstration. The objective of this bill is to further the conduct of research, development, and demonstrations in solar energy technologies, to establish a solar energy coordination and management project, to amend the National Science Foundation Act of 1950 and the National Aeronautics and Space Act of 1958, to provide for scientific and technical training in solar energy, to establish a Solar Energy Research Institute, to provide for the development of suitable incentives to assure the rapid commercial utilization of solar energy, and for other purposes. Author

N75-31568*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR COLLECTOR PERFORMANCE EVALUATION WITH THE NASA-LEWIS SOLAR SIMULATOR-RESULTS FOR AN ALL-GLASS-EVACUATED-TUBLAR SELECTIVELY-COATED COLLECTOR WITH A DIFFUSE REFLECTOR
Frederick Simon Apr. 1975 30 p refs
(NASA-TM-X-71695; E-8289) Avail: NTIS HC $3.75 CSCL 10A

A solar collector was tested in a solar simulator for inlet temperatures of temperatures of 70 to 200 F, flux levels of 230 and rate of 7 lb/(hr)(sq. ft), and incident angles of 0 deg, 33 deg, and 52 deg. Test results plotted in a form suggested by analysis indicate a very low heat loss coefficient. The collector shows excellent performance on an all-day performance basis, and also for conditions corresponding to temperatures required in solar Rankine systems and/or for low flux level radiation. Author

N75-31570*# Old Dominion Univ., Norfolk, Va. School of Engineering.
INVESTIGATION OF CURRENT UNIVERSITY RESEARCH CONCERNING ENERGY CONVERSION AND CONSERVATION IN SMALL SINGLE-FAMILY DWELLINGS Final Technical Report, 7 Apr. - 7 Aug. 1975
G. R. Grossman and A. S. Roberts, Jr. 7 Aug. 1975 87 p refs
(Grant NsG-1172)
(NASA-CR-143430; TR-75-T11) Avail: NTIS HC $4.75 CSCL 10A

An investigation was made of university research concerning energy conversion and conservation techniques which may be applied in small single-family residences. Information was accumulated through published papers, progress reports, telephone conversations, and personal interviews. A synopsis of each pertinent investigation is given. Finally, a discussion of the synopses is presented and recommendations are made concerning the applicability of concepts for the design and construction of NASA-Langley Research Center's proposed Technology Utilization House in Hampton, Virginia. Author

N75-31571*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
BENEFIT-COST METHODOLOGY STUDY WITH EXAMPLE APPLICATION OF THE USE OF WIND GENERATORS Final Report
R. P. Zimmer, C. G. Justus, R. M. Mason, S. L. Robinette, P. G. Sassone, and W. A. Schaffer Jul. 1975 411 p refs
(Contract NAS3-17827)
(NASA-CR-134864; A-1645) Avail: NTIS HC $10.50 CSCL 10A

An example application for cost-benefit methodology is presented for the use of wind generators. The approach adopted for the example application consisted of the following activities: (1) surveying of the available wind data and wind power system information, (2) developing models which quantitatively described wind distributions, wind power systems, and cost-benefit differences between conventional systems and wind power systems, and (3) applying the cost-benefit methodology to compare a conventional electrical energy generation system with systems which included wind power generators. Wind speed distribution data were obtained from sites throughout the contiguous United States and were used to compute plant factor contours shown on an annual and seasonal basis. Plant factor values (ratio of average output power to rated power) are found to be as high as 0.6 (on an annual average basis) in portions of the central U. S. and in sections of the New England coastal area. Two types of wind power systems were selected for the application of the cost-benefit methodology. A cost-benefit model was designed and implemented on a computer to establish a practical tool for studying the relative costs and benefits of wind power systems under a variety of conditions and to efficiently and effectively perform associated sensitivity analyses. Author

N75-31573*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TECHNOLOGY SURVEY OF ELECTRICAL POWER GENERATION AND DISTRIBUTION FOR MIUS APPLICATION
William L. Gill and Tony E. Redding Jul. 1975 72 p refs
(NASA-TM-X-58127; JSC-08661) Avail: NTIS HC $4.25 CSCL 10B

Candidate electrical generation power systems for the modular integrated utility systems (MIUS) program are described. Literature surveys were conducted to cover both conventional and exotic generators. Heat-recovery equipment associated with conventional power systems and supporting equipment are also discussed. Typical ranges of operating conditions and generating efficiencies are described. Power distribution is discussed briefly. Those systems that appear to be applicable to MIUS have been indicated, and the criteria for equipment selection are discussed. Author

N75-31575# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
SELECTED TOPICS ON HYDROGEN FUEL Final Report
W. R. Parrish, R. O. Voth, J. G. Hust, T. M. Flynn, and J. Hord May 1975 215 p refs
(COM-75-10619/5; NBS-SP-419) Avail: NTIS MF $2.25; SOD HC as C13.10:419 CSCL 21D

A summary report on selected hydrogen-fuel topics is given. These data were prepared to identify cost and technical barriers to the commercial use of hydrogen fuel and to generate reference data for policy-planning, decision-making and design. Cryogenic

hydrogen fuel technology is emphasized in the economic and systems analyses. Research and development needs within selected areas of NBS competence are identified and future research plans are outlined. GRA

N75-31579# Oceanic Foundation, Waimanalo, Hawaii.
SEAWARD EXTENSION OF URBAN SYSTEMS: THE FEASIBILITY OF OFFSHORE COAL-FIRED ELECTRICAL POWER GENERATION
Isao Roy Yumori Jan. 1975 125 p
(Grant NOAA-04-3-158-29)
(COM-75-10592/4; UNIHI-SEAGRANT-CR-75-02; TR-7; NOAA-75041807) Avail: NTIS HC $5.25 CSCL 10B

With dwindling supplies and escalating costs of petroleum, coal appears to offer the most attractive near-term energy resource, particularly for stationary electrical power generation. This report explores three configurations of offshore coal-fired electrical power plants in the 500 Mw capacity range and chooses a pylon moored barge configuration for more detailed study. Ocean siting is technically feasible and, since certain ocean siting economic advantages (assembly line production and inexpensive fuel delivery, and the obviated need for site preparation and cooling towers) can balance the increased costs of marine structures and underwater cables, it can be economically attractive as well. GRA

N75-31580# Defense Documentation Center, Alexandria, Va.
ENERGY CONVERSION Report Bibliography, Aug. 1973 - Nov. 1974
Apr. 1975 145 p refs
(AD-A009600; DDC-TAS-75-6) Avail: NTIS CSCL 10/1

This bibliography presents a brief scattering of abstracts of DOD research reports concerned with energy conversion GRA

N75-31581# Illinois Univ., Urbana. Water Resources Center.
PROCEEDINGS OF THE WORKSHOP ON RESEARCH NEEDS RELATED TO WATER FOR ENERGY
Glenn E. Stout Nov. 1974 299 p refs Workshop held at Indianapolis, 20-22 Oct. 1974
(Contract DI-14-31-0001-4271)
(PB-241346/6; UILU-WRC-74-0093; W75-07089; OWRT-X-147(4271)(1)) Avail: NTIS HC $8.75 CSCL 10A

Development of large scale energy conversion facilities and their impact on water resources in the Ohio River, Great Lakes and Upper Mississippi River basins was studied at an interdisciplinary workshop. Within limits determined by available water resources and minimization of environmental impact, participants identified areas in which research will be needed if energy conversion facilities are developed. Coal gasification and liquefaction received special emphasis. Included are two papers on coal conversion processes and related water requirements, nine papers with commentaries related to main topic and reports of discussion groups which identify research needs and rank them in importance. GRA

N75-31582# Federal Energy Administration, Washington, D.C. Office of Energy Data Policy.
SOLAR ENERGY PROJECTS OF THE FEDERAL GOVERNMENT
Howard L. Magnus Jan. 1975 133 p refs
(PB-241620/4; FEA/C-75/247) Avail: NTIS HC $6.25 CSCL 10A

This report identifies 171 solar energy projects administered by 14 different Federal agencies between July 1973 and January 1975. Solar categories included are: heating and cooling of buildings; wind energy conversion; solar thermal conversion; ocean thermal conversion; photovoltaic electric power systems; and bioconversion to fuels. An introductory chapter provides an overview and analysis of the Federal effort in solar energy and categorizes projects by agency, the amount of funding, and the major program areas. Appendices provide brief summaries of each of the 171 projects. GRA

N75-31610# Pennsylvania State Univ., University Park. Center for the Study of Environmental Policy.
FINANCIAL INCENTIVES AND POLLUTION CONTROL: A CASE STUDY
Terry A. Ferrar, Alan B. Brownstein, John D. Simpson, and Sally Streiter Apr. 1975 59 p refs
(Contract EPA-68-01-2250)
(PB-241479/5; EPA-600/5-75-007) Avail: NTIS HC $4.25 CSCL 13B

Confronted with shortages of low-sulfur content residual fuel oil, several air pollution control authorities in the northeastern states were forced to relax air quality standards during the winters of 1972-73 and 1973-74. The authorities did so by granting variances to their sulfur-content standards for residual fuel oil. The characteristics of these variances provide the social test-tube or this analysis. The report examines alternative policies such as direct regulation, fuel-oil surcharges, emission taxes and quantity control. GRA

N75-31910# *Institut Franco-Allemand de Recherches, St. Louis (France).*
PROGRESS OF ISL RESEARCH ON ENERGY CONVERSION IN FERROELECTRIC CERAMICS OF THE TYPE Pb(ZrLxTix) O3 [ETAT ACTUEL DES RECHERCHES A L'ISL SUR LES PROBLEMES DE CONVERSION D'ENERGIE A L'AIDE DE CERAMIQUES FERROLECTRIQUES DU TYPE Pb(ZrL-xTix) O3]
F. Bauer 22 Oct. 1974 8 p refs In FRENCH Presented at the Reunion Franc. de Ferroelectricite, Nantes, France, 27 Sep. 1974
(ISL-29/74) Avail: NTIS HC $3.25

Adiabatic depolarization of prepolarized ferroelectric ceramics by a plane shockwave was studied. The shock wave at the interface of a missile has a velocity of 200 m/s and the ceramic has an intensity of 20 kbar and lasts a few microseconds. The electric energy liberated by a 10 mm diameter and 0.5 mm thickness Pb(Zr 0.965 TiO.035)(03+1percent Nb205) disk attained 4500 V after 100 ns and decreased thereafter while pressure remains on a plateau value. Phase transitions or nonlinear piezoelectric behavior are hypothesized. ESRO

N75-31918# Committee on Labor and Public Welfare (U. S. Senate).
EFFECTS OF THE ENERGY CRISIS ON EMPLOYMENT DISLOCATION, 1974
Washington GPO 1974 101 p Hearing before Subcomm. on Labor of Comm. on Labor and Public Welfare, 93d Congr., 2d Sess., 12 Feb. 1974
(GPO-35-761) Avail: Subcomm. on Labor

The impact of the energy crisis on the state of New Jersey is discussed. Testimony is provided on the impact of the energy crisis on the state of New Jersey. Topics discussed include: unemployment due to plant closings and inability to get to work; public and private transportation; price of gasoline and oil; and necessity of conservation. J.M.S.

N75-31953# Committee on Interior and Insular Affairs (U. S. House).
PROVIDING FOR A NATIONAL FUELS AND ENERGY CONSERVATION POLICY, ESTABLISHING AN OFFICE OF ENERGY CONSERVATION IN THE DEPARTMENT OF THE INTERIOR, AND FOR OTHER PURPOSES
Haley Washington GPO 10 Dec. 1974 12 p Rept. to accompany H. R. 11343 presented by the Comm. on Interior and Insular Affairs, 93d Congr., 2d Sess., 10 Dec. 1974
(H-Rept-93-1546; GPO-38-006) Avail: US Capitol, House Document Room

Amended provisions of the bill for a national fuels and energy conservation policy are presented. The bill provides for the establishment of an energy conservation program to regulate the national rate of growth in energy use and a Council on Energy Policy. Major elements of the program are described and analyzed. J.M.S.

N75-31954# Committee on Public Works (U. S. Senate).
THE NEED FOR A NATIONAL MATERIALS POLICY, PART 1
Washington GPO 1974 463 p refs Hearings before Panel on Materials Policy of Subcomm. on Environ. Pollution of Comm. on Public Works, 93d Congr., 2d Sess., 11-13 Jun. 1974
(GPO-39-885) Avail: Subcomm. on Environ. Pollution

Testimony is provided on policy issues related to the creation of a national materials recovery policy. Emphasis is placed on disposal of hazardous wastes, such as, toxic chemical, biological, and radioactive wastes, waste utilization and the relationship of the Federal government with State and local governing bodies in solid waste management and resource recovery. Other topics discussed include: waste reduction, recycling, environment protection, and resource and energy conservation. J.M.S.

N75-31955# Committee on Public Works (U. S. Senate).
THE NEED FOR A NATIONAL MATERIALS POLICY, PART 2
Washington GPO 1974 786 p refs Hearings on S. 3560, S. 3549, S. 1086, S. 3277, and S. 3954 before Panel on Materials Policy of Subcomm. on Environ. Pollution of Comm. on Public Works, 93d Congr., 2d Sess., 9-11 Jul. and 15-16 Jul. 1974
(GPO-40-687) Avail: Subcomm. on Environ. Pollution

Legislative proposals that attempt to deal with the solid waste management and resource recovery problem facing American cities are reviewed. Waste management and utilization is discussed in terms of energy conversion, conservation, and recovery. Factors discussed include: waste reduction, recycling, pyrolysis, compositing, improved waste disposal techniques, efficient use of natural resources, and materials recovery. J.M.S.

N75-31956# Committee on Public Works (U. S. Senate).
THE NEED FOR A NATIONAL MATERIALS POLICY, PART 3
Washington GPO 1974 992 p refs Hearings on S. 3560, S. 3549, S. 1086, S. 3277, and S. 3954 before Panel on Materials Policy of Subcomm. on Environ. Pollution of Comm. on Public Works, 93d Congr., 2d Sess., 17-18 Jul. 1974
(GPO-40-687) Avail: Subcomm. on Environ. Pollution

Testimony is given by the private sector on recommendations for solid waste disposal and utilization legislation. Factors discussed include: materials recovery, marketing of by-products; recycling, hazardous wastes disposal, and increased use of recovered materials by the Federal government. J.M.S.

N75-31957# Committee of Conference (U. S. Congress).
SPECIAL ENERGY RESEARCH AND DEVELOPMENT APPROPRIATION ACT, 1975
Washington GPO 30 Jun. 1974 5 p H. R. 14434 enacted into law by the 93d Congr., 30 Jun. 1974
(Pub-Law-93-322; GPO-38-139) Avail: US Capitol, House Document Room

An act making appropriations for energy research and development activities of certain departments, independent executive agencies, bureaus, offices, and commissions for the fiscal year ending June 30, 1975, and for other purposes is described. Author

N75-31958# Committee on Commerce (U. S. Senate).
OUTER CONTINENTAL SHELF OIL AND GAS LEASING OFF SOUTHERN CALIFORNIA: ANALYSIS OF ISSUES
Washington GPO Nov. 1974 99 p refs Prepared for the Comm. on Commerce pursuant to S. Res. 222, 93d Congr., 2d Sess., 12 Nov. 1974
(GPO-41-659) Avail: SOD HC $1.35

A brief history of the development of Southern California offshore continental shelf (OCS) oil and gas is given along with an outline of the Department of the Interior's OCS leasing procedures. The implications of the Interior's lease sale proposal for the coastal zone of Southern California are examined. Significant issues discussed include: role of coastal states in the Federal decisionmaking as to the siting and location of oil and gas leases; role of coastal zone management in the offshore leasing program; justification, in terms of national energy needs, availability of manpower and materials, and possible alternatives, for leasing the OCS; for nominating areas for lease in Southern California at this time. Findings and recommendations are included. J.M.S.

N75-31959# Committee on Commerce (U. S. Senate).
OUTER CONTINENTAL SHELF OIL AND GAS DEVELOPMENT AND THE COASTAL ZONE
Washington GPO Nov. 1974 206 p refs Rept. pursuant to S. Res. 222 prepared by Comm. on Commerce, 93d Congr., 2d Sess., Nov. 1974
(GPO-39-356) Avail: SOD HC $2.15

Major issues involved in leasing of the outer continental shelf are presented, and improvements in current procedures and practices are recommended. Topics discussed include information needs, exploratory and geological data, environmental and socio-economic impact on the Coastal Zone and on ocean resources, federal management and leasing policies, local control, production and transportation technology, and shortages of drilling rigs, equipment, and manpower. M.J.S.

N75-31960# Committee on Government Operations (U. S. Senate).
TO ESTABLISH AN ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION AND A NUCLEAR ENERGY COMMISSION
Washington GPO 1974 649 p refs Hearings on S. 2744 before Subcomm. on Reorganization, Res., and Intern. Organ. of Comm. on Govt. Operations, 93d Congr., 1st Sess., 4-5 Dec. and 10 Dec. 1973
(GPO-28-963) Avail: SOD HC $4.45

Testimony regarding the formation of the Energy Research and Development Administration and Nuclear Energy Commission is presented. A number of important considerations are discussed, including energy shortages, the necessity for conservation and development of alternative energy sources, various types of available energy resources, environmental protection, agency operations, involvement of private industry, and public safety. D.M.L.

N75-31961# Committee on Commerce (U. S. Senate).
SCIENCE AND TECHNOLOGY APPLICATIONS ACT OF 1974
Washington GPO 1974 65 p refs Joint hearing on S. 2495 amendment no. 1537 before Comm. on Commerce and Comm. on Aeron. and Space Sci., 93d Congr., 2d Sess., 11 Jul. 1974
(GPO-41-407) Avail: Comm. on Commerce

A bill is discussed which recognizes science and technology as a primary national resource, and provides for their efficient utilization in the resolution of current and potential national problems. Some of the problems discussed include: The threat of worldwide famine and the importance of continuing agricultural research and of related technological development in industry as well as in government; the need for new technologies to prevent or reverse the deterioration of our environment; the need to find new sources of energy; the modernization of out transportation systems as an essential part of maintaining a benign environment; the need to advance the science and technology required to provide general access to health care of high quality and to reduce the incidence of disease; the maintenance and improvement of government policies to ensure that American science, technology, and industry continue to flourish. Author

N75-31962# California State Div. of Mass Transportation, Sacramento.
ENERGY USE OF PUBLIC TRANSIT SYSTEMS Final Report
Timothy J. Healy 1 Aug. 1974 64 p refs
(PB-241351/6; DMT-002) Avail: NTIS HC $4.25 CSCL 21D

The amount of energy used by a variety of transit modes operating under different conditions was determined. Projections of energy availability in California through 1985 and 1990 are reviewed and the implications for transportation are discussed.

A short summary of the ways in which vehicles use energy, and an analysis of the resulting implications for energy-limiting or conserving strategies are given. Energy consumption data for a wide variety of vehicles operating in a number of modes are compared in a way that allows the reader (planner) to know relative energy requirements of different systems. GRA

N75-32470# Transportation Systems Center, Cambridge, Mass.
STUDY OF POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. FUEL ECONOMY TEST PROCEDURE PANEL REPORT NO. 6 Special Congressional Report, Jun. - Oct. 1974
Harold G. Miller 10 Jan. 1975 82 p refs Prepared in cooperation with Comm. on Com., Comm. on Interstate and Foreign Com. and EPA, Washington, D. C.
(PB-241776/4; DOT-TSC-OST-75-15) Avail: NTIS HC $4.75; also avail. $29.00/set of 8 reports as PB-241769-SET CSCL 21D

This report presents the test procedures recommended for insuring compliance with fuel economy regulations. Discussions included are: (a) driving variables pertinent to the establishment of a meaningful, reproducible test methodology; (b) test and measurement methods which are applicable to fuel economy certification tests; (c) current test procedures in use by industry and the federal government, and (d) recommendations for a standardized Federal test procedure. GRA

N75-32471# Transportation Systems Center, Cambridge, Mass.
STUDY OF POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. TECHNOLOGY PANEL REPORT NO. 4 Special Congressional Report, Jun. - Oct. 1974
Harold G. Miller 10 Jan. 1975 167 p refs Prepared in cooperation with Comm. on Com., Comm. on Interstate and Foreign Com., and EPA, Washington, D. C.
(PB-241774/9; DOT-TSC-OST-75-13) Avail: NTIS HC $6.25; also avail: $29.00/set of 8 reports as PB-241769-SET CSCL 21D

The authors evaluate individual technologies which could produce improved automobile fuel economy in the areas of vehicle improvement (reduced weight and aerodynamic drag), transmission improvement, engine improvements and reduced performance acceleration. Potential 1980 fuel savings are estimated for each of these technologies. The more promising of these technologies are combined in several different configurations to produce estimates of potential automobile fuel savings possible by 1980. GRA

N75-32587# Joint Economic Committee (U. S. Congress).
ENERGY STATISTICS
Washington GPO 1974 452 p refs Hearings before Subcomm. on Priorities and Economy in Govt. of Joint Economic Comm., 93d Congr., 1st and 2d Sess., 14 and 21 Jan. 1974 2d Sess., 14 and 21 Jan. 1974
(GPO-37-143) Avail: SOD HC $3.85

The hearings to determine the facts on oil production, reserves, inventories, and consumption are reported. Topics discussed include: mandatory oil import control program; oil import question; reserves of crude oil, natural gas liquids, and natural gas. F.O.S.

N75-32590# Lockheed Missiles and Space Co., Palo Alto, Calif.
FULL-SCALE TESTING OF HIGH-VOLTAGE PHOTOCELLS OF FOTOVOLT TYPE AT ELEVATED LIGHT FLUX LEVELS
U. A. Arifov, M. Gaibnazarov, B. N. Dzhalilov, A. I. Kulagin, A. P. Landsman, and D. S. Strebkoi 1974 7 p refs Transl. into ENGLISH from Geliotekhnika, Akad. Nauk Uz. SSR (Tashkent), no. 6, 1974 p 3-9
Avail: NTIS HC $3.25; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Photoelectric batteries were investigated for use in solar power plants operating under high radient flux density at high temperatures. The energy distribution in the focal and out-of-focus planes of a paraboloidal concentrator are presented along with the results of measuring the volt-ampere characteristics at diverse solar ray concentrations. It is shown that a diminution of the spreading and contact resistances of photocells will permit taking off hundreds of times more power in useful load than that for the customary frontal photocells. F.O.S.

N75-32592*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA-LEWIS/ERDA SOLAR HEATING AND COOLING TECHNOLOGY PROGRAM
James P. Couch and Harvey S. Bloomfield 1975 15 p refs Presented at Workshop on the use of Solar Energy for the Cooling of Buildings, Los Angeles, 4-6 Aug. 1975; Cosponsored by Intern. Solar Energy Soc. and the Am. Soc. of Heating, Refrig., and Air-Conditioning Engineers
(NASA-TM-X-71800; E-8478) Avail: NTIS HC $3.25 CSCL 10A

Plans by NASA to carry out a major role in a solar heating and cooling program are presented. This role would be to create and test the enabling technology for future solar heating, cooling, and combined heating/cooling systems. The major objectives of the project are to achieve reduction in solar energy system costs, while maintaining adequate performance, reliability, life, and maintenance characteristics. The project approach is discussed, and will be accomplished principally by contract with industry to develop advanced components and subsystems. Advanced hardware will be tested to establish 'technology readiness' both under controlled laboratory conditions and under real sun conditions. Author

N75-32593*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COST AND SIZE ESTIMATES FOR AN ELECTROCHEMICAL BULK ENERGY STORAGE CONCEPT
Marvin Warshay and Lyle O. Wright 1975 12 p refs Presented at Energy Storage Session of the 148th Meeting of the Electrochemical Soc., Dallas, 5-9 Oct. 1975
(NASA-TM-X-71805; E-8138) Avail: NTIS HC $3.25 CSCL 10C

Preliminary capital cost and size estimates were made for an electrochemical bulk energy storage concept. The electrochemical system considered was an electrically rechargeable flow cell with a redox couple. On the basis of preliminary capital cost estimates, size estimates, and several other important considerations, the redox-flow-cell system emerges as having great promise as a bulk energy storage system for power load leveling. The size of this system would be less than 2 percent of that of a comparable pumped hydroelectric plant. The capital cost of a 10-megawatt, 60- and 85-megawatt-hour redox system is estimated to be $190 to $330 per kilowatt. The other important features of the redox system contributing to its load leveling application are its low adverse environmental impact, its high efficiency, its apparent absence of electrochemically-related cycle life limitations, and its fast response. Author

N75-32594*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY RESULTS OF THE LARGE EXPERIMENTAL WIND TURBINE PHASE OF THE NATIONAL WIND ENERGY PROGRAM
Ronald L. Thomas, Thomas Sholes, and John E. Sholes 1975 25 p refs Presented at Frontiers of Technol. Conf., Stillwater, Oklahoma, 1-2 Oct. 1975; Sponsored by Oklahoma State Univ.
(NASA-TM-X-71796; E-8475) Avail: NTIS HC $3.25 CSCL 10B

The preliminary results of two projects in the development phase of reliable wind turbines designed to supply cost-competitive electrical energy were discussed. An experimental 100 kW wind turbine design and its status are first reviewed. The results of two parallel design studies for determining the configurations and power levels for wind turbines with minimum energy costs are also discussed. These studies predict wind energy costs of 1.5 to 7 cents per kW-h for wind turbines produced in quantities of 100 to 1000 per year and located at sites having average winds of 12 to 18 mph. Author

N75-32595*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INITIAL COMPARISONS OF SOLAR COLLECTOR PERFORMANCE DATA OBTAINED OUT-OF DOORS AND WITH A SOLAR SIMULATOR
Richard W. Vernon 1975 14 p refs Presented at 1975 Intern. Solar Energy Soc. Meeting, Los Angeles, 28 Jul. - 1 Aug. 1975
(NASA-TM-X-71626; E-8472) Avail: NTIS HC $3.25 CSCL 10B

A facility was constructed to evaluate solar collector performance outdoors for conditions that would be encountered by collectors if they were incorporated in a solar heating/cooling system. In addition to obtaining initial collector performance data, the outdoor facility will enable collector durability and degradation rates to be evaluated for operating periods of several months. The data obtained from the outdoor tests were compared to collector performance predicted on the basis of results obtained with a solar simulator. The performance measured outdoors was less than the predicted performance. Author

N75-32596# Naval Academy, Annapolis, Md. Environmental Protection Research and Development Team.
CONVERTING CELLULOSIC WASTE TO FUEL: A LITERATURE REVIEW Interim Report, 1 Jul. 1974 - 1 Feb. 1975
Mark M. Bundy Feb. 1975 23 p refs
(AD-A009400; USNA-EPRD-9) Avail: NTIS CSCL 07/1

Preliminary findings show five processes that will convert discarded cellulosic material into a useable fuel. These processes, virtue of its size and energy density a well-developed hurricane should be able to influence the distribution of trace constituents in the lower stratosphere, at least locally if not on a global basis. The authors describe the results of the first attempt to determine the influence of a hurricane on the vertical profile of aerosol within a 500 mile radius of the center of the storm. Aerosol profiles were obtained over hurricane Gilda in October of 1973. The results show a relatively clean upper troposphere which has been tentatively attributed to a removal process associated with the storm itself. GRA

N75-32598# Naval Postgraduate School, Monterey, Calif.
ELECTRICAL ENERGY ALLOCATIONS AT NAVY AND MARINE CORPS BASES M.S. Thesis
Alexander Shalar Mar. 1975 123 p refs
(AD-A009821) Avail: NTIS CSCL 10/1

Navy and Marine Corps bases in the continental United States derive almost all of their electricity from public utility companies. For this thesis, the conditions of service of select public utility companies in one part of the United States, the West Coast, were investigated. Particular attention was devoted to the utility companies' plans to allocate electricity to their customers if an emergency or a fuel shortage should occur. The second major area investigated was the internal management of electricity within Navy and Marine Corps bases. The load shedding plans of about 80 bases were reviewed, and from these, guidelines were developed for the preparation of an optimal load shedding plan. Also, a unique approach to electrical allocation was developed. The approach is based on the utility theory of economics. GRA

N75-32601# Kell, Alterman, Runstein, and Thomas, Portland, Oreg.
POWER SHORTAGE CONTINGENCY PROGRAM FOR THE PACIFIC NORTHWEST. LEGISLATIVE, REGULATORY AND INSTITUTIONAL ASPECTS
Leon Jourolmon 1975 402 p refs
(PB-241323/5; W75-06977) Avail: NTIS HC $10.50 CSCL 10A

Principles are evaluated which are applied when use of electricity must be rationed either because of critical levels of streamflow or because of slippage of generator schedules, or both. The legal structure controlling the marketing of power throughout the Columbia Basin is examined. GRA

N75-32602# Electric Power Research Inst., Palo Alto, Calif.
EVALUATION OF FIXED BED, LOW BTU COAL GASIFICATION SYSTEMS FOR RETROFITTING POWER PLANTS Interim Report
D. A. Waitzman, H. L. Faucett, E. E. Kindahl, S. V. Tomlinson, and D. E. Nichols Feb. 1975 281 p refs Sponsored by Electric Power Res. Inst., Palo Alto, Calif.
(PB-241672/5; TVA-Bull-Y-91; EPRI-203-1) Avail: NTIS HC $8.75 CSCL 10B

Seven alternative systems are considered: (1) Wellman-Galusha/Benfield System, (2) Wellman-Galusha/Stretford System, (3) Wellman-Galusha/Iron Oxide System, (4) Wellman-Galusha/Iron Oxide/Fines Gasification System, (5) Lurgi/Benfield System, (6) Lurgi/Stretford System, and (7) Lurgi/Iron Oxide System. Conceptual designs and capital and operational cost estimates are provided for six of the systems including associated coal handling, fines removal and sales (or gasification in the Wellman-Galusha/iron oxide/fines gasification system), air compression and boiler modifications. The report estimates the cost of and describes low-Btu, fixed-bed gasification plants that might be operated in the near future on retrofitted power plants, and compares fixed-bed gasification with stack gas cleaning processes. GRA

N75-32603# Bureau of Mines, Pittsburgh, Pa. Pittsburg Mining and Safety Research Center.
IN SITU COMBUSTION OF COAL FOR ENERGY Technical Progress Report
Robert F. Chaiken Nov. 1974 16 p refs Previously announced as N75-11464
(PB-241892/9; BM-TPR-84; N75-11464) Avail: NTIS HC $3.25 CSCL 08I

A concept of efficient thermal energy generation through the in situ combustion of coal, and the on-site conversion of that energy to electricity is discussed and shown to offer distinct advantages in the utilization of our coal reserves. Analysis of data from previous underground coal gasification projects suggest that coal can be efficiently burned underground and that the burning process should be maintainable for time periods sufficient to power a commerical electricity generation plant. A discussion is presented related to the requirements of a 100 megawatt (thermal) demonstration in-situ combustor, and some of the important problem areas that have to be resolved prior to implementation of the concept. GRA

N75-32606# Kellogg (M. W.) Co., Houston, Tex. Research and Engineering Development.
IDENTIFICATION AND CHARACTERIZATION OF THE USE OF MIXED CONVENTIONAL AND WASTE FUELS Final Report
Gopal K. Mathur Feb. 1975 65 p
(Contract EPA-68-02-1308)
(PB-241821/8; EPA-650/2-75-017) Avail: NTIS HC $4.25 CSCL 10A

The major objective of this study was to identify and classify types and properties of mixed fuels presently in use, and types of stationary processes using mixed fuels. Types of fuels presently in use, and types of stationary processes using mixed fuels. Types of mixed fuels include mixed oils; oil and gas; coal and oil; coal and gas; by-product gases and fuels; by-product chemical waste; and mixtures of chemical wastes and conventional fossil fuels. The scope of the task covered industries in the category of utilities, petroleum refineries, petrochemical, chemical processing (excluding fertilizer), glass, cement and textile. A list of manufacturers of mixed fuel burners was developed. GRA

N75-32607# Dow Chemical Co., Freeport, Tex.
ENERGY CONSUMPTION: PAPER, STONE/CLAY/GLASS/CONCRETE, AND FOOD INDUSTRIES Final Report, Aug. 1974 - Mar. 1975
John T. Reding and Burchard P. Shepherd Apr. 1975 60 p refs
(Contract EPA-68-02-1329)
(PB-241926/5; EPA-650/2-75-032-c) Avail: NTIS HC $4.25 CSCL 10A

Energy-intensive steps or operations for commonly used manufacturing processes are examined. Results of the analyses are in the form of energy consumption block diagrams, energy-intensive equipment schematic diagrams, and tables that indicate the causes of energy losses, as well as possible conservation approaches. GRA

N75-32627# Exxon Research and Engineering Co., Linden, N.J.
EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES. LIQUEFACTION: SECTION 2. SRC PROCESS Final Report
C. E. Jahnig Mar. 1975 88 p refs
(Contract EPA-02-0629)
(PB-241792/1; GRU.8DJ.75; EPA-650/2-74-009-f) Avail: NTIS HC $4.75 CSCL 07A

Results are given of a review of the Solvent Refined Coal (SRC) process from the standpoint of its potential for affecting the environment. Estimates are included of the quantities of solid, liquid, and gaseous effluents as well as the thermal efficiency of the process. A number of possible process modifications of alternatives are proposed which could facilitate pollution control or increase thermal efficiency. Technology needs are indicated. GRA

N75-33410# Transportation Systems Center, Cambridge, Mass.
STUDY OF POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. SAFETY IMPLICATIONS PANEL REPORT NO. 2 Special Congressional Report, Jun. - Oct. 1974
Harold G. Miller 10 Jan. 1975 45 p refs Sponsored in part by Committee on Commerce (U.S. Senate), Committee on Interstate and Foreign Commerce (U.S. House), and EPA, Washington, D.C.
(PB-241772/3; DOT-TSC-OST-75-11) Avail: NTIS HC $3.75; also available in a set of 8 reports as PB-241769-SET HC $29.00 CSCL 21D

This report contains four individual analyses related to the safety impact of increased small car usage and automobile weight reductions to improve fuel economy: (1) fuel economy as a function of weight, performance, and driving schedule; (2) traffic control for safety and fuel economy; (3) weight versus safety; and (4) effects of speed limits on fuel economy and safety. GRA

N75-33411# Transportation Systems Center, Cambridge, Mass. 21D
STUDY OF POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT. TRUCK AND BUS PANEL REPORT NO. 7 Special Congressional Report, Jun. - Oct. 1974
Harold G. Miller 10 Jan. 1975 112 p refs Sponsored in part by Committee on Commerce (U.S. Senate), Committee on Interstate and Foreign Commerce (U.S. House), and EPA, Washington D.C.
(PB-241777/2; DOT-TSC-OST-75-16) Avail: NTIS HC $5.25; also available in a set of 8 reports as PB-241769-SET HC $29.00

Special consideration is given to the potential improvement of truck and bus fuel economy implementable by the 1980 production year. Vehicles considered are those with gross vehicle weight ratings of 10,000 pounds or more. GRA

N75-33491# Beychok (Milton R.), Irvine, Calif.
PROCESS AND ENVIRONMENTAL TECHNOLOGY FOR PRODUCING SNG AND LIQUID FUELS Environmental Protection Technology Series
Milton R. Beychok Mar. 1975 152 p
(Contract EPA-68-03-2136)
(PB-242774/8; EPA-660/2-75-011) Avail: NTIS HC $6.25; SOD HC as SN-055-001-01017 CSCL 07A

The process technology and environmental factors involved in the emerging industries for providing new supplemental energy supplies from nonconventional sources are discussed. It includes: (1) the production of substitute natural gas (SNG) from coal, crude oil and naphtha, (2) importing overseas gas supplies in the form of liquefied natural gas (LNG) and as liquid methanol, (3) the regasification of LNG, (4) the production of liquid fuels from oil shale, and (5) the liquefaction of coal to produce clean fuels. The technology of oil and gas processing, heat balances, fuel combustion and stack gases, thermal efficiencies, and water balances is assessed. GRA

N75-33494*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INCORPORATING ENERGY CONSERVATION TECHNIQUES IN THE OPERATION OF EXISTING LeRC R AND D FACILITIES
W. C. Nieberding 1975 20 p Presented at Annual NASA Facilities Conf., Pasadena, Calif., 21-24 Oct. 1975
(NASA-TM-X-71813) Avail: NTIS HC $3.25 CSCL 10B

A general discussion of various methods which can be used to reduce energy consumption is presented. A very brief description of Lewis Research Center facilities is given and the energy reduction methods are discussed relative to them. Some specific examples (ie; automated equipment and data systems) of the implementation of the energy reduction methods are included. Author

N75-33495# Committee on Science and Technology (U. S. House).
SOLAR HEATING AND COOLING DEMONSTRATION ACT OF 1974: OVERSIGHT HEARINGS
Washington NASA 1975 986 p refs Hearings before Subcomm. on Energy Res., Develop. and Demonstration of Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 13, 13-15 May 1975
(GPO-55-414) Avail: Subcomm. on Energy Res., Develop. and Demonstration

Oversight hearings made before the Subcommittee on Energy Research, Development and Demonstration of the Committee on Science and Technology of the U.S. House of Representatives on May 13-15, 1975 were described. These dealt with Public Law 93-409, the Solar Heating and Cooling Demonstration Act of 1974, and included discussions on the following subjects: solar heating, air conditioning, solar energy, electric power, energy consumption, energy costs, energy policy for Florida. Y.J.A.

N75-33498# National Academy of Sciences - National Research Council, Washington, D.C.
SEMINAR ON INDUSTRIAL ENERGY CONSERVATION AND SEMINAR ON SOLAR SPACE HEATING AND COOLING Staff Summary Report
1975 28 p Seminar held at Seoul (Republic of Korea), 13-15 Nov. 1974; sponsored jointly by Rep. of Japan and Natl. Acad. of Sci. - Natl. Res. Council, Washington, D. C.
(Contract AID/CSD-2584)
(PB-241462/1) Avail: NTIS HC $3.75 CSCL 10A

The proceedings of two workshops on energy conservation and solar heating and heating are summarized. Topics discussed include: the technical and economic aspects of energy conservation, and application of industrial energy conservation techniques in terms of effectiveness, cost, and social acceptability. J.M.S.

N75-33499# Michigan Univ., Ann Arbor. Highway Safety Research Inst.
STUDY ON THE EFFECTS OF THE ENERGY CRISIS AND 55 MPH SPEED LIMIT IN MICHIGAN Final Report
James Oday, Daniel J. Minahan, and Dan Golomb Apr. 1975 61 p Prepared in cooperation with Mich. Office of Highway Safety Planning, Lansing
(PB-241843/2; UM-HSRI-SA-75-9) Avail: NTIS HC $4.25 CSCL 13L

The report is a presentation of the findings and conclusions derived from an analysis of Michigan traffic accident data and related data for the periods before, during, and after the peak energy crisis months of 1974. A major objective of this study was to identify the effect of the speed limits imposed as a result of the energy shortage. Some other causative factors relating to traffic crashes also were investigated. The report differs from others in that it seeks to define the cause-effect relationships

specifically within Michigan, rather than nationally. Also by concentrating the study to a single state, it was possible to get more consistent data across several measures--exposure, accident data, speed data--resulting in a more detailed analysis. GRA

N75-33502# Massachusetts Univ., Amherst. Energy Alternatives Program.
HOT WATER HYDRAULICS OF THE GULF STREAM SITED OTGM
Daniel Seluk and Robert H. Kirchhoff Mar. 1975 77 p refs
(Grant NSF GI-34979)
(PB-242151/9; NSF/RANN/SE/GI-34979/TR/75/2; NSF/RA/N-75-027) Avail: NTIS HC $4.75 CSCL 10B

The results are presented of a study to determine if the kinetic energy of the Gulf Stream can be used as a pump for the evaporators in an ocean thermal energy system. The proposed evaporator is of the plate fin heat exchanger type but calculations for the staggered tube type boiler have also been developed. The flow field for both types of evaporators is assumed to be similar to that of a screen submerged in an infinite two dimensional potential flowfield. The problem is then reduced to determining the pressure loss coefficient for each arrangement. Momentum and thermal recovery in the wake of ocean pumped plants are investigated, and graphs are presented to allow the determination of downstream plant spacing. GRA

N75-33503# Dow Chemical Co., Freeport, Tex.
ENERGY CONSUMPTION: THE PRIMARY METALS AND PETROLEUM INDUSTRIES Final Report, Aug. 1974 - Mar. 1975
John T. Reding and Burchard P. Shepherd Apr. 1975 59 p refs
(Contract EPA-68-02-1329)
(PB-241990/1; EPA-650/2-75-032-B) Avail: NTIS HC $4.25 CSCL 10A

Results are reported of a study of energy consumption in the primary metals and petroleum industries. It analyzes energy-intensive steps or operations for commonly used manufacturing processes. Results of the analyses are in the form of energy consumption block diagrams, energy-intensive equipment schematic diagrams and tables that indicate the causes of energy losses, as well as possible conservation approaches. GRA

N75-33504# Stein (Richard G.) and Associates, New York.
RESEARCH DESIGN CONSTRUCTION AND EVALUATION OF A LOW ENERGY UTILIZATION SCHOOL, RESEARCH PHASE 1 Interim Report
Richard G. Stein and Carl Stein 15 Aug. 1974 297 p refs
(Grant NSF GI-39612)
(PB-242217/8; NSF/RA/N-74-117) Avail: NTIS HC $8.75 CSCL 10A

A re-examination of the education determinants that have influenced energy consumption in the past, is presented along with a review of the technical performance of building components. Results indicate that substantial energy savings can be achieved in schools. Since educational buildings represent 7% of the building area in total U.S. construction these savings are considerable. GRA

N75-33505# Mitre Corp., Bedford, Mass.
A SYSTEMS APPROACH TO INNOVATIVE SOLUTIONS TO THE ENERGY PROBLEM Final Report
Phillip R. Vance Dec. 1973 279 p refs
(Grant NSF DI-39519)
(PB-242189/9; NSF/RA/R-73-008; NSF/RD1-8) Avail: NTIS HC $8.75 CSCL 10A

The formation of an institutional mechanism is described whose objectives are to increase the level of non-federal support for energy related research and development, to stimulate the innovation process, and to facilitate the transition of research and development products from laboratory to operational use. Research and development project activities undertaken in cooperation with research directors of the three largest electric utilities, public officials, and university experts in New England are described. The projects cover such topics as fossil fuel switching systems. Operational and pending agreements for cost-sharing by appropriate companies are cited, as are criteria for the measurement of the impact of the efforts undertaken in this experiment in cooperative research and development. GRA

N75-33506# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
PROJECT INDEPENDENCE REPORT: A REVIEW OF US ENERGY NEEDS UP TO 1985
Jerry A. Hausman Apr. 1975 60 p refs
(PB-242142/8; MIT-EL-75-009) Avail: NTIS HC $4.25 CSCL 10A

A review and assessment of the Federal Energy Adminstration's Project Independence Report is undertaken. Special emphasis is placed in the energy mode and its forecast of U.S. energy needs up through 1985. Biases are pointed out and the uncertainty of the final result is emphasized. GRA

N75-33507# Stanford Research Inst., Menlo Park, Calif. Center for the Study of Social Policy.
PLAUSIBILITY OF A RESTRICTED ENERGY USE SCENARIO
Joe E. Armstrong and Willis W. Harman 8 Jan. 1975 211 p refs
(Contract C-5-35546)
(COM-75-10749/0; CSSP-3705-8) Avail: NTIS HC $7.25 CSCL 10A

The consequences are examined of high and modest scenario projections of energy usage in the United States with and without adoption of modest energy conservation measures. The objectives of the overall study are: (1) to establish the plausibility that for a variety of reasons the United States may choose or find itself forced to accept at some point in the future a low or even static growth in energy usage (2) to explore the validity of the use of past trends and inter-element relationships for the economic, social, and technical projections up to and beyond 1990; and (3) to assess the feasibility of key characteristics of a comprehensive energy conservation plan. GRA

N75-33508# Massachusetts Univ., Amherst.
AN ANALYSIS OF THE FLUID MOTION INTO THE CONDENSER INTAKE OF A 400 mW(e) OCEAN THERMAL DIFFERENCE POWER PLANT
Peter A. Mangarella Mar. 1975 27 p refs
(Grant NSF GI-34979)
(PB-242569/2; NSF/RANN/SE/GI-34979/TR/75/3; NSF/RA/N-75-029) Avail: NTIS HC $3.75 CSCL 10B

The report addresses the following questions regarding the operation of an intake device in a complex stratified flow typical of the Gulf Stream: (1) would flow into such an intake create disruption of the thermocline if placed in depths of the order of 300-800 meters thereby withdrawing warm surface waters which would adversely affect the condenser operation, (2) if a finite withdrawal layer is created by such a device, what is the size and configuration of the layer, (3) what is the effect of such a withdrawal layer on the average temperature of the water so withdrawn, and can this average temperature be predicted, and (4) what is the possibility of entraining botton deposits from such an intake device and can some criteria be developed for avoiding scouring. GRA

N75-33509# Hawaii Univ., Honolulu. Dept. of Ocean Engineering.
AN EVALUATION OF OCEANOGRAPHIC AND SOCIOECONOMIC ASPECTS OF A NEARSHORE OCEAN THERMAL ENERGY CONVERSION PILOT PLANT IN SUBTROPICAL HAWAIIAN WATERS Final Report, 1 May 1974 - 31 Jul. 1975
Karl H. Bathen 30 Apr. 1975 312 p refs
(Grant NSF AER74-17521-A01)
(PB-242167/5; NSF/RANN/SE/AER74-17521-A01/FR; NSF/RA/N-75-028) Avail: NTIS HC $9.25 CSCL 10B

Ocean thermal energy conversion (OTEG) proof-of-concept/

pilot plant studies in subtropical waters are discussed. The three-part socio-economic program is concerned with examining the legal aspects of a nearshore OTEC plant. The applicable law, federal interests, licenses and permits, opposing interests, legislative experience and site considerations are considered. An attempt is made to characterize the existing socio-economic conditions in the Kona (Keahole) area by examining the social infrastructure, local population, labor force, income and education, Konal electrical demand, and potential impact of a new power source. An input-output analysis for the Kona area was completed to model and further predict the impact of a new energy source on the economy of Hawaii County. GRA

N75-33511# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
THE FUTURE OF THE US NUCLEAR ENERGY INDUSTRY
Paul L. Joskow and Martin L. Baughman Apr. 1975 59 p refs
(Grant NSF SIA-73-07871-A02)
(PB-242164/2; MIT-EL-75-006; NSF/RA/N-75-033) Avail: NTIS HC $4.25 CSCL 18E

A regional supply-demand-regulatory model of the U.S. electric utility industry is used to evaluate the derived demand for commercial nuclear reactors, raw uranium, and enrichment requirements for the period 1975-1995. The structure of the domestic nuclear energy industry is outlined and the engineering-econometric supply-demand system used for the analyses is described. Conclusions of analysis for alternative assumptions about air quality regulations, peak-load pricing, costs of uranium resources, and future costs of capital to the electric utility industry are included. GRA

N75-33515# RAND Corp., Santa Monica, Calif.
DIRECT AND INDIRECT ENERGY DEMAND MODELS FOR DoD
C. C. Mow Jun. 1974 32 p refs Presented at 33d Military Operations Res. Symp. (MORS), West Point, New York, 25-27 Jun. 1974
(AD-A010968; P-5273) Avail: NTIS

To properly assess the impact of the energy shortage on national security, it is essential to have an insight into how energy is used in support of the military. This report presents some of the results of the energy demand models currently being developed under ARPA sponsorship. Two energy models are described: (1) Direct energy model: A USAF Energy Consumption Projection Model; (2) Indirect energy demand model: Energy Consumption by Industries in Support of National Defense. GRA

N75-33749# National Bureau of Standards, Washington, D.C. Applied Mathematics Div.
THE NBS COMPUTERIZED CARPOOL MATCHING SYSTEM: USER'S GUIDE Final Technical Report
Judith F. Gilsinn and Susan Landau Dec. 1974 65 p
(COM-75-10691/4; NBSIR-74-633) Avail: NTIS HC $4.25 CSCL 13B

The report includes flowcharts, input/output formats, and program listings for the programs, plus details of the manual process for coordinate coding. The matching program produces, for each person desiring it, a list of others residing within a pre-specified distance of him, and is thus applicable to a single work destination having primarily one work schedule. The system is currently operational on the UNIVAC 1108 computer and was run in March of 1974, producing lists for about 950 employees in less than four minutes computer time. Subsequent maintenance of the system will be carried out by the NBS Management and Organization Division. GRA

N75-33931# Center for Naval Analyses, Arlington, Va. Warfare Analysis Group.
THE ECONOMIC IMPACT OF AN INTERRUPTION IN UNITED STATES PETROLEUM IMPORTS: 1975 - 2000
Randall G. Holcombe Nov. 1974 112 p refs
(Contract N00014-68-A-0091)
(AD-A010914; NWAG-Research-Contrib-245) Avail: NTIS CSCL 05/3

The objective of this paper is to estimate the economic impact of a possible interruption in petroleum imports during the period from 1975 to the year 2000. It begins by incorporating the data of the recent oil embargo into an input-output model of the U.S. economy, in order to assess the economic impact of the interruption in imports. The model will be used as a framework for estimating the impact of all sizes of oil import interruptions, from small interruptions to a complete cutoff of imports. Several different scenarios of petroleum supply and demand are developed; indicating the uncertainties in our energy future, but also reflecting the fact that there are many policy options that can be chosen in order to encourage -- and discourage -self-sufficiency in energy. GRA

N75-33932# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
THE ECONOMICS OF THE NATURAL GAS SHORTAGE (1960-1980)
Paul W. MacAvoy and Robert S. Pindyck Sep. 1974 264 p refs
(Grant NSF GI-34936)
(PB-242166/7; MIT-EL-74-011; NSF/RA/N-74-204) Avail: NTIS HC $8.50 CSCL 21D

An econometric policy model of the natural gas industry is described. The structure of the model is given in detail, as is the estimation of the model's equations. The model is then used in a variety of policy simulations to analyze the past and probable future behavior of the natural gas industry under alternative FPC regulatory policies. GRA

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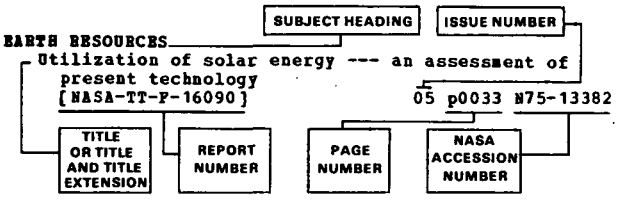

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A

B

C

D

E

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ENERGY CONVERSION EFFICIENCY

ENERGY TECHNOLOGY

F

G

H

J

K

L

M

N

P

R

S

SOLAR ENERGY ABSORBERS

SOLAR ENERGY CONVERSION

SOLAR HEATING

T

U

V

W

Z

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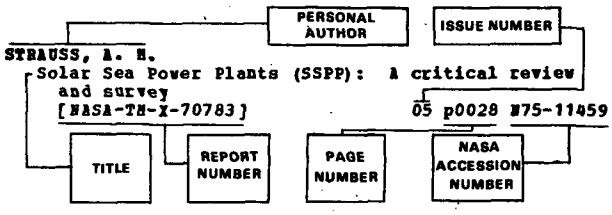

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A

B

C

D

E

F

G

H

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y

Z

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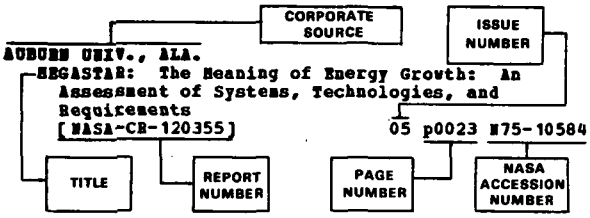

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A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

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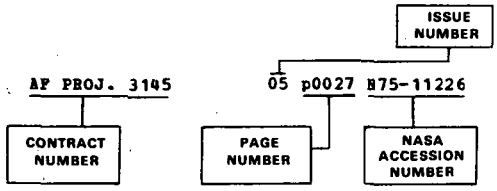

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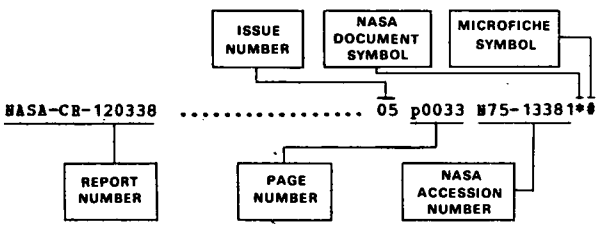

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