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# **ENERGY**

**A CONTINUING BIBLIOGRAPHY**

**WITH INDEXES**

**JULY 1976**

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

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# ENERGY

## A Continuing Bibliography

### With Indexes

### Issue 10

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from April 1 through June 30, 1976 in

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



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# INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(10)) lists 426 reports, journal articles, and other documents announced between April 1, 1976 and June 30, 1976 in *Scientific and Technical Aerospace Reports* (STAR) or in *International Aerospace Abstracts* (IAA). The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

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

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

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

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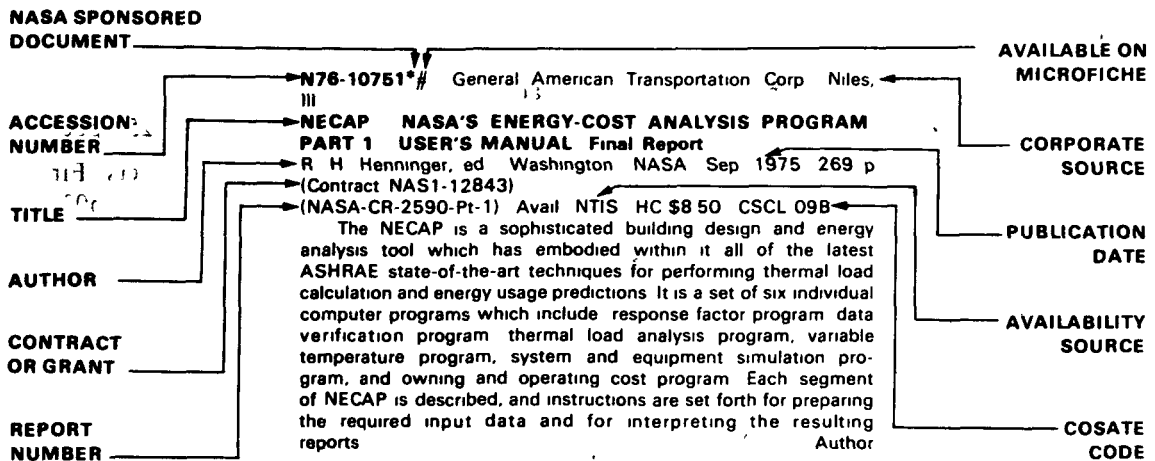
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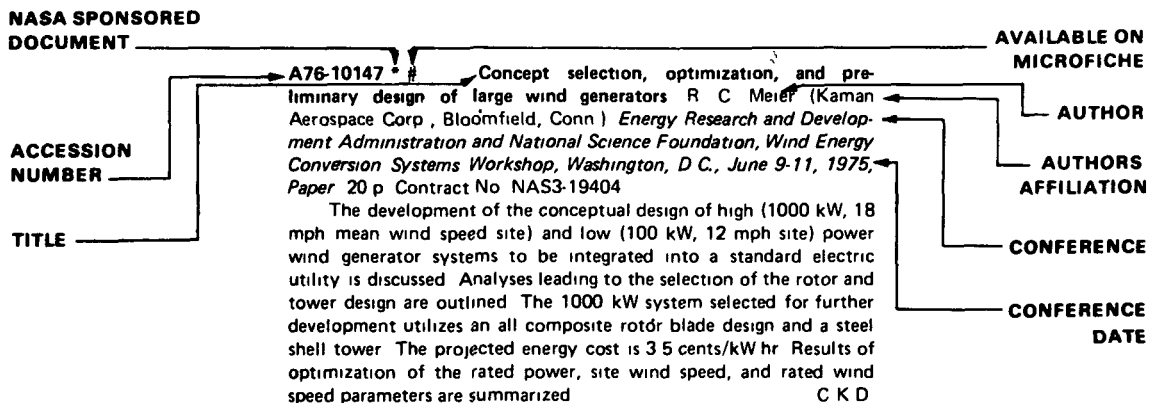
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## TYPICAL CITATION AND ABSTRACT FROM STAR



## TYPICAL CITATION AND ABSTRACT FROM IAA



## A Listing of Energy Bibliographies Contained In This Publication:

- 1 Wind energy utilization A bibliography with abstracts - Cumulative volume 1944/1974  
---Book A76-22496 p0053
- 2 Wind energy utilization A bibliography with abstracts, cumulative volume 1944/1974  
N76-13589 p0009
- 3 Bibliography of selected abstracts of documents related to energy conservation through  
telecommunications N76-16632 p0071
- 4 Heat Pipe Technology A bibliography with abstracts N76-18372 p0074
- 5 Heat Pipe Technology A bibliography with abstracts N76-18373 p0074
- 6 Heat Pipe Technology A bibliography with abstracts N76-20406 p0082
- 7 Heat Pipe Technology A bibliography with abstracts N76-20407 p0082
- 8 Hydrogen energy A bibliography with abstracts Annual supplement, 1974  
N76-20625 p0082
9. Quarterly literature review of hydrogen energy A bibliography with abstracts First  
quarter, 1975 N76-20626 p0082
10. Quarterly literature review of hydrogen energy A bibliography with abstracts Second  
quarter, 1975 N76-20627 p0082
- 11 Quarterly literature review of hydrogen energy A bibliography with abstracts Third  
quarter, 1975 N76-20628 p0083
12. Heat pipe technology A bibliography with abstracts N76-21423 p0089

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## IAA ENTRIES

**A76-19022 \*** A study of efficiency in low resistivity silicon solar cells P M Dunbar and J R Hauser (North Carolina State University, Raleigh, NC) *Solid-State Electronics*, vol 19, Feb 1976, p 95-102 22 refs NASA-supported research

A general device-analysis program has been utilized to study the efficiency of silicon solar cells. The analysis is applied to specific geometries of both n(+) p and n(+) p-p(+) solar cells, and involves a numerical solution of the basic transport and continuity equations. This approach allows solutions that are free of typical limiting assumptions involved in solving the device equations as well as solutions relating to lifetime, mobility variations, and diffused-region profiles. The analysis includes available empirical information on diffusion length, mobility, and lifetime as a function of doping, as well as a Gaussian profile for the diffused region. Results are presented which illustrate the limitations of efficiency as a function of doping. It is found that the maximum efficiencies for both types of cell converge at lower resistivities to around 16% with air-mass-zero radiation and a single-layer absorbing-SiO antireflecting film. It is also found that the minority-carrier lifetime, both in the n(+) surface and p-type bulk regions, presents serious limitations to conversion efficiency, particularly in the low-resistivity cells.

(Author)

**A76-19092 #** Future energy demand and the role of solar energy T Thalhammer (Philips Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) *Acta Electronica*, vol 18, Oct 1975, p 267-273 22 refs

It is estimated that by 1985 thermal solar installations must be cost competitive with 0.75 cents/kWh for primary fuel energy. Assuming an efficiency of 35% and a discounted cash flow of 15%, the estimated allowable cost for the total solar plant installation is \$24/sq m. A total annual solar energy supply of about 10 trillion kWh (13% of projected OECD requirements) is predicted by the year 2000. In the light of these figures, a survey of methods for the conversion of solar energy into various other forms of energy is presented, and possible means of improving the efficiencies of the methods are considered. Cost expectations and other factors influencing the rate of introduction of solar energy are discussed.

C K D

**A76-19093 #** Solar radiation (Le rayonnement solaire) F Desvignes (Societe Anonyme d'Etudes et Realisations Nucleaires, Limeil-Brevannes, Val-de-Marne, France) *Acta Electronica*, vol 18, Oct 1975, p 275-294 16 refs In French

This paper summarizes those solar radiation characteristics which are related to solar energy utilization. A short description of the radiation which reaches the upper atmosphere is given. The geometrical consequences of earth rotation, related to spin axis tilt with respect to the eclipse plane, and ground based collector inclination are examined. After a review of atmospheric optical properties - absorption, scattering - the characteristics of the daylight

radiation which is received at the ground are examined. Statistical information needed for the sizing of solar power installations is described. The paper concludes with the analysis of various problems related to the simulation of solar radiation and the measurement of energy conversion efficiency.

(Author)

**A76-19094 #** Photothermal conversion E Kauer, R Kersten, and F Mahdjuri (Deutsche Philips GmbH, Forschungslaboratorium, Aachen, West Germany) *Acta Electronica*, vol 18, Oct 1975, p 295-304 22 refs

This paper is introduced by a short survey on global power fluxes and the principal processes involved in photothermal conversion. The temperatures which can be produced by this method range from ambient to 4000 K. The main part of the paper deals with low temperatures up to 150 C. The efficiencies of various types of flat plate collectors in relation to their heat losses, transmission, absorption, working temperatures, and weather conditions are analyzed. It is shown how medium (150-600 C) and high temperatures (greater than 600 C) can be obtained by various types of optical focusing systems which increase the radiation density. A short description of some experimental solar power plants is given.

(Author)

**A76-19096 #** Simulation of silicon solar cells and comparison with experimental results (Simulation de cellules solaires au silicium et comparaison avec des resultats experimentaux) J Michel and A Mircea (Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, Val-de-Marne, France) *Acta Electronica*, vol 18, Oct 1975, p 311-330 22 refs In French

A detailed description of the physical mathematical model developed for computer simulation of the operation of photovoltaic cells is given. This program is particularly flexible and implies little working cost. Its use in analyzing the effect of numerous parameters on the conversion output of silicon cells with an n-p and n-p-p structure is described. It is shown that it is possible to achieve better conversion outputs with thin cells (50 to 100 micrometers) than with cells of the usual thickness (300 micrometers).

(Author)

**A76-19097 #** Physical characterization of silicon solar cells by a study of spectral responses (Caractérisation physique des cellules solaires au silicium par l'étude des réponses spectrales) E Fabre and M Mautref (Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, Val-de-Marne, France) *Acta Electronica*, vol 18, Oct 1975, p 331-338 18 refs In French

Spectral response measurements are shown to be a useful tool for assessing solar cells. Data is acquired on minority carrier diffusion length and on the entrance window of the cell, i.e., on the main parameters which govern the overall conversion efficiency. Trap saturation phenomena which lead to an improvement of the apparent minority carrier diffusion length are measured. An electrolytic cell is used to study the influence of different parameters which can affect the short-circuit current and to establish the best solar cell fabrication process.

(Author)

**A76-19098 #** Industrial development of silicon solar cells (L'évolution industrielle des cellules solaires au silicium) Y Salles (La Radiotechnique Compelec, Caen, France) *Acta Electronica*, vol 18, Oct 1975, p 339-343 5 refs In French

Silicon solar cells were first developed and manufactured for space applications. Following a cost reduction due to technological progress, the use of the solar cells has greatly increased. This paper describes the evolution of different technological steps in manufacturing solar cells and panels for terrestrial applications. The conversion efficiency of the cells in the BPX 47 A panel is now 12.5 per cent (it was 9 per cent during the last few years). A cost analysis is carried out. (Author)

**A76-19099 #** Materials for solar cells (Les matériaux pour photopiles solaires) M. Rodot (CNRS, Laboratoire de Physique des Solides, Meudon, Hauts de Seine, France) *Acta Electronica*, vol 18, Oct 1975, p 345-358. 45 refs. In French.

Materials problems associated with solar cells are studied. The electronic properties of Si, III-V and II-VI compounds are reviewed, with special attention to the effect of doping on recombination and to point defects. The discussion lays emphasis on three types of cells: silicon cells, CdS-Cu<sub>2</sub>S heterojunction cells and GaAs cells. (Author)

**A76-19162** Epitaxial solar cells on silicon EFG 'ribbon' substrates. H. Kressel, R. V. D'Aiello, and P. H. Robinson (RCA Laboratories, Princeton, N.J.) *Applied Physics Letters*, vol 28, Feb 1, 1976, p 157-159. 7 refs. NSF-supported research.

Epitaxial solar-cell structures grown on polycrystalline silicon 'ribbon' substrates (prepared by the edge-defined-growth process) are compared with devices made by direct diffusion into similar material. Efficiency values of 10% (AM-1) have been achieved by the epitaxial structures, which are substantially higher than achieved by diffusion. The improvement is shown to result mainly from the lower saturation-current density of the epitaxial junctions. (Author)

**A76-19270** Energy Volume 2 - Non-nuclear energy technologies. S. S. Penner and L. Icerman (California, University, La Jolla, Calif.) Reading, Mass., Addison-Wesley Publishing Co., Inc., 1975. 704 p. 302 refs. \$19.50.

Oil recovery from tar sands and oil shale is considered along with questions related to the availability and the use of coal, the hydrogen economy, energy-storage systems, techniques for direct energy conversion, and aspects of solar-energy utilization. Attention is also given to energy from windmills, tidal and wave energy utilization, hydroelectric power generation, hydrothermal energy sources and their utilization, geothermal energy from dry wells, and questions related to electrical power production, transmission, and distribution. (G.R.)

**A76-19398** What can we expect from geothermal energy (Que pouvons-nous attendre de l'énergie géothermique) J. Goguel (Bureau de Recherches Géologiques et Minières, Paris, France) *Palais de la Découverte, Revue*, vol 4, Jan 1976, p 21-34. In French.

A historical review is given of the utilization of geothermal energy. Geothermal electric power generation on New Zealand is discussed. The energy crisis of the 1970s is considered, with emphasis on the role of the United Nations, and the distribution of geothermal sources in the southwest United States. A distinction is made between low energy and high energy geothermal sources. A discussion of the origin and applications of such sources is included. (B.J.)

**A76-19400** The energy crisis and a potential laser-fusion solution. K. M. Siegel (KMS Fusion, Inc., Ann Arbor, Mich.) *Journal of Applied Science and Engineering, Section A - Electrical Power and Information Systems*, vol 1, Apr 1975, p 3-18.

The solution considered is based on the production of neutrons by fusion. The neutrons can be used in a reaction with lithium to obtain heat. They can also be employed in processes designed to supply hydrogen which can be used directly as fuel or as a basic material for obtaining other chemical substances. Studies conducted to prove the feasibility of this solution are discussed. For reasons of fuel compatibility with existing systems it would be advisable, for the more immediate future, to use as fuel methane obtained from

hydrogen in preference to hydrogen itself. An approach based on laser fusion for producing neutrons would make it possible to install appropriate equipment at the substation level. A description is given of a systematic investigation of the possibilities to achieve economic fusion with laser systems, taking into account the successful production of thermonuclear neutrons and economic mass production techniques developed for the required pellets. (G.R.)

**A76-19446 #** High-temperature solar heat sources for spacecraft (Solnechnye vysokotemperaturnye istochniki tepla dlia kosmicheskikh apparatov) V. A. Grilikhes, V. M. Matveev, and V. P. Poluektov (Moscow, Izdatel'stvo Mashinostroenie, 1975). 248 p. 208 refs. In Russian.

The development of high temperature solar heat sources to serve as energy sources for a variety of space applications is discussed. The systems considered consist of a concentrator for solar radiant energy, a receiver for the concentrated radiation, and a heat accumulator. The theoretical basis for the design of the system components is presented, and the characteristics of heat exchange in the receiver and accumulator are analyzed. The selection of design and operational parameters for power systems based on a solar heat source is discussed. (C.K.D.)

**A76-19583** Multiscale aerial and orbital techniques for management of coal-mined lands. F. J. Wobber (IBM Corp., Gaithersburg, Md.), O. R. Russell, and D. J. Deely (Earth Satellite Corp., Bethesda, Md.) *Photogrammetria*, vol 31, Oct 1975, p 117-133. 10 refs.

The expansion of surface coal mining to meet the world's energy needs must include preplanning for environmental protection and the monitoring of reclamation progress. Due to the rapid changes in rates of mining, grading, and revegetating mined lands, the flexibility provided by satellite and multilevel aircraft inventory and monitoring systems is required. LANDSAT 1 imagery and small-scale color infrared aerial photography have unique advantages for performing a rapid regional inventory of disturbances in coal-mining areas, and have immediate cost benefits for regulatory agencies and the mining industry. Large scale photography is needed for comprehensive studies of acid mine drainage, and other mining related water quality control problems. A systematic analysis of nearly 50 mined-land features versus various scales of imagery has been tabulated for ease of reference by those involved in mined land studies. (Author)

**A76-19591 \*** Mixed metal vapor phase matching for third-harmonic generation. D. M. Bloom, J. F. Young, and S. E. Harris (Stanford University, Stanford, Calif.) *Applied Physics Letters*, vol 27, Oct 1, 1975, p 390-392. Research supported by the University of California and AEC, Grant No. NGL 05 020 103.

Phase matching for frequency tripling of 1.06 microns is demonstrated in a homogeneous mixture of sodium and magnesium vapor. The ratio of Mg to Na vapor pressures required for phase matching is 2:1. This ratio is about 1/75 of that required to phase match Na with Xe. (Author)

**A76-19593 \* #** Improving aircraft energy efficiency. F. P. Povinelli, J. M. Klineberg, and J. J. Kramer (NASA, Office of Aeronautics and Space Technology, Aircraft Energy Efficiency Office, Washington, D.C.) *Astronautics and Aeronautics*, vol 14, Feb 1976, p 18-31.

Investigations conducted by a NASA task force concerning the development of aeronautical fuel conservation technology are considered. The task force estimated the fuel savings potential, prospects for implementation in the civil air-transport fleet, and the impact of the technology on air-transport fuel use. Propulsion advances are related to existing engines in the fleet, to new production of current engine types, and to new engine designs. Studies aimed at the evolutionary improvement of aerodynamic design and a laminar flow control program are discussed and possibilities concerning the use of composite structural materials are examined. (G.R.)

**A76-19595 #** Get ready for the great debate on transportation R W Simpson (MIT, Cambridge, Mass) *Astronautics and Aeronautics*, vol 14, Feb 1976, p 38-45 9 refs

Three bills, which have been proposed by the Department of Transportation (DOT), advocate programs to 'deregulate' rail, trucking, and air transportation. Current transportation policies, which exist for about forty years, are critically examined, taking into account the representation of air transportation within DOT policy making. Attention is given to the pronounced rise in the standard prices for air transportation, problems of overcapacity, and questions related to a review of the objectives of the Airways/Airports Trust Fund and its operations. G R

**A76-19598 #** Short-range transports to save fuel G Corning and P Sampath (Maryland, University, College Park, Md) *Astronautics and Aeronautics*, vol 14, Feb 1976, p 62-64. Research supported by the University of Maryland.

An investigation was conducted concerning the possibilities to save fuel by using an aircraft designed specifically for the 500-mi range. It was found that 7.5% or more fuel could be saved by using such an aircraft in place of a 737-200. It is pointed out that the smaller operating weight of the 500-mi aircraft would also result in lower direct operating costs. G R

**A76-19917 #** Laser thermonuclear fusion in the energetics of the future (Lazernyi termoiadernyi sintez v energetike budushchego) N G Basov, V B Rozanov, and N M Sobolevskii *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Nov Dec 1975, p 3-17 37 refs. In Russian.

The paper gives a review of the current state of theory and experimentation in the field of laser fusion. The theoretical principles of the fusion reaction involving the laser implosion of a deuterium-tritium pellet are discussed. A scheme is presented for the energy cycle of a laser fusion reactor, where continuously repeated microexplosions would be the source of useful energy. The feasibility of using different types of lasers for the fusion is considered among those discussed are neodymium lasers, and CO<sub>2</sub> lasers. The problem of neutron radiation damage of reactor walls is considered. B J

**A76-19918 #** The basic technical characteristics of the demonstration tokamak fusion reactor /the T-20 device/ (Osnovnye tekhnicheskie kharakteristiki demonstratsionnogo termoiadernogo reaktora-tokamaka (ustanovka T-20)) V A Glukhikh, N A Monoszon, and G F Churakov *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Nov Dec 1975, p 18-27. In Russian.

The tokamak reactor T-20 is designed for controlled fusion in deuterium-tritium plasma. It will be used for the investigation of physical processes in thermonuclear plasmas, and for preliminary research directed towards the development of operational fusion reactors. The vacuum system, the plasma heating system, the system for injecting neutral beams are discussed in detail. Lists containing the basic physical parameters of the reactor, and the basic technical reactor design data are included, along with reactor structural design diagrams. B J

**A76-19919 #** Some questions associated with hybrid thermonuclear reactors (Nekotorye voprosy gibrnidnykh termoiadernykh reaktorov) I N Golovin, G E Shatalov, and B N Kolbasov *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Nov Dec 1975, p 28-34. In Russian.

The feasibility of using the controlled fusion reaction involving deuterium and tritium as an energy source is examined. The possibility of combining a fusion reactor with a fission reactor is discussed. The production of tritium and that of plutonium in such hybrid reactors is considered. Cost comparisons are made for hybrid tokamak reactors and ordinary fusion and fission reactors. The benefits to be derived from the use of subcritical hybrid reactors are enumerated, and the question of how such reactors differ from those with an electronuclear technique for producing plutonium is dealt with. Detailed tables are presented for the cost analyses. B J

**A76-20072** Hydrogen problems in energy related technology J P Hirth (Ohio State University, Columbus, Ohio) and H H Johnson (Cornell University, Ithaca, N Y) *Corrosion*, vol 32, Jan 1976, p 3-15 94 refs. Grant No DAHC15-71 C-0253, Contract No N00014-75-C-0541.

The paper is concerned with the phenomenological classification of hydrogen degradation phenomena in metals, with particular emphasis on problems related to hydrogen energy systems and geothermal energy systems. A state-of-the-art summary of materials capabilities with respect to hydrogen exposure is presented, along with important research areas in prospect. In particular, the mode of hydrogen entry distinguishes hydrogen stress cracking (HSC) and hydrogen environment embrittlement. The degraded mechanical property differentiates HSC and loss in tensile ductility, and the mode of failure discriminates HSC and microperforation by high-pressure hydrogen. Fundamental issues in hydrogen embrittlement are examined. Standardization and validation of tests used to study hydrogen embrittlement and hydrogen attack phenomena are discussed. S D

**A76-20098** A general review of closed-cycle gas turbines using fossil, nuclear and solar energy K Bammert (Hannover, Technische Universität, Hanover, West Germany) Munich, Verlag Karl Thieme (Thieme Taschenbucher Volume 57), 1975 93 p 117 refs \$5.00.

Aspects of thermodynamics are considered along with existing plants, the limits of the conventional closed-cycle gas turbines, the selection of the pressure ratio, and the Oberhausen helium power plant. The components of a gas turbine plant are examined, taking into account the machine group, the heat exchanger, the coolers, and the gas heater. A description of nuclear gas turbines is presented, giving attention to the cycle diagram, turbosets, heat exchange equipment, new turboset concepts, and the lubricating oil and seal gas system. A conventionally arranged nuclear power plant is discussed along with a semi-integrated nuclear power plant and an integrated nuclear power plant. G R

**A76-20111 #** Solar power stations in space R Ockert and G Wirths *Dornier-Post* (English Edition), no 34, 1975, p 18-22.

Basic features of several design concepts for a solar power station to be located in a geostationary orbit are discussed, including a solar thermal power station (Patha et al., 1974), the satellite solar power station (SSPS) proposed by Glaser (1974), and the modular solar energy satellite (MOSES) proposed by Ruth (1974). Technical obstacles in the development of a design combining features of the SSPS and the MOSES are described. The system, incorporating a simple layout of longitudinally placed solar surfaces and concentration reflectors at an angle to them, is based on modular construction. The collector modules are covered with solar cells attached to rolls of fiberglass-reinforced kapton sheets. The micro waves generated by a crossed field amplifier are transmitted by a phased-array antenna. A major developmental obstacle is the presently inadequate lifetimes of the gimbal mounted gyroscopes and ion thrusters comprising the suggested attitude control system. A further problem is the requirement of a second-generation reusable transport with larger payload compartment than that of the Space Shuttle together with a reusable high power stage with electric engines and high specific impulse. The proposed system has a mass of roughly 30,000 tons and an expected output of about 5000 MW. C K D

**A76-20150 \* #** Effect of fuel properties on performance of a single aircraft turbojet combustor H F Butze and R C Ehlers (NASA, Lewis Research Center, Cleveland, Ohio) *Combustion Institute, Fall Meeting, Palo Alto, Calif., Oct 20, 21, 1975, Paper 15 p 10 refs*.

The performance of a single-can JT8D combustor was investigated with a number of fuels exhibiting wide variations in chemical composition and volatility. Performance parameters investigated were combustion efficiency, emissions of CO, unburned

hydrocarbons and NO<sub>x</sub>, as well as liner temperatures and smoke. At the simulated idle condition no significant differences in performance were observed. At cruise, liner temperatures and smoke increased sharply with decreasing hydrogen content of the fuel. No significant differences were observed in the performance of an oil shale derived JP-5 and a petroleum based Jet A fuel except for emissions of NO<sub>x</sub> which were higher with the oil shale JP-5. The difference is attributed to the higher concentration of fuel-bound nitrogen in the oil shale JP-5. (Author)

**A76-20524** Wind power machines receiving fresh wind (Les éoliennes sont-elles dans le vent) F Segurier *La Recherche*, vol 7, Feb 1976, p 184-187. In French

The history, current status, and future prospects of power generation by wind activated power plants is surveyed. Varied wind power devices similar to those used in ancient Sumer are still in use in Iran today, while European windmills have shifted in function from flour milling to water pumping. The devices are most feasible in isolated locations where dispersed energy sources are needed, but require efficient storage equipment because of the unreliable and varying wind input. Antenna type wind pickup designs lie dormant, but turning vane and turbine blade models are still of interest. An induction type rotating wind motor generating electric power is described. The outlook for practical and economic wind power electric generating plants in isolated areas and locations in developing countries, and associated problems, are discussed. Combinations with solar, batteries and power storage by lead batteries show some promise. R D V

**A76-20559** # A possible application of electric discharge CO<sub>2</sub> lasers for laser thermonuclear fusion (Ob odnoi vozmozhnosti primeneniya elektroionizatsionnykh CO<sub>2</sub> lazerev dlia tselei LTS) N G Basov, I A Berezhnoi, V A Boiko, V A Danilychev, V D Zvorykin, V V Ignat'ev, I V Kholin, and A Iu Chugunov *Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol 1, Dec 26, 1975, p 1105-1108. 5 refs. In Russian

The paper proposes a new approach to plasma heating by the radiation of electric discharge CO<sub>2</sub> lasers by which synchronous spherical irradiation of a target by single-cascade CO<sub>2</sub>-lasers of large aperture is accomplished by using the target as one of the resonator mirrors. In an experiment using one laser, a 300-J, 100 nsec pulse at 10% efficiency was obtained. For synchronous operation of many lasers, as would be required during real heating of a fusion target, a feedback arrangement could be used. Under real conditions, however, with targets of the order of about 1 cm, cavity length will have to range from 30 to 100 m, whereas in the present experiment, the cavity measured only 13.5 m in length. P T H

**A76-20566** # Review of current R & D program approaches to solar conversion D A Beattie (ERDA, Washington, D C) *International Energy Engineering Congress, Chicago, III, Nov 4, 5, 1975, Paper 10 p*

Current approaches in the solar energy program of the Energy Research and Development Administration are outlined. It is predicted that 25% of total US energy requirements will be provided by solar energy applications by the year 2020. A program is underway to demonstrate solar heating on a large scale by the end of 1977 and combined solar heating and cooling by the end of 1979. Both agricultural (crop drying, heat for greenhouses and animal shelters) and industrial applications are under investigation. An experimental 100 kW wind energy conversion system has been constructed, and the design of a second generation 100 kW system and of a first generation megawatt system has been initiated. Development programs in photovoltaic energy conversion are directed towards improvements in silicon cell technology, alternative materials, and power conditioning devices to permit tie-ins with power grids. A production of 500 MW per year by 1985 with an array price below \$500 per peak kilowatt is anticipated. Additional technologies under exploration include fuels from biomass, ocean thermal conversion, and solar thermal conversion. C K D

**A76-20567** # A technical, economic and environmental assessment of utilizing solar energy for heating/cooling and energy conversion R Romancheck (Pennsylvania Power and Light Co., Allentown, Pa.) *International Energy Engineering Congress, Chicago, III, Nov 4, 5, 1975, Paper 9 p*

**A76-20650** Solar cells H J Hovel (IBM Thomas J Watson Research Center, Yorktown Heights NY) New York, Academic Press, Inc (Semiconductors and Semimetals Volume 11), 1975 274 p 295 refs \$14.50

The present work is a general reference source in the field of photovoltaics, with special emphasis on heterojunction and Schottky barrier cells, thin film devices, and polycrystalline devices. An introductory description of solar cells is given along with most important material and device parameters. Featured topics include the process of photocurrent generation and the spectral response, the electrical behavior of a solar cell in the dark, the efficiencies of Si, GaAs, and CdS solar cells under various conditions, the effects of thickness on solar cell behavior, and the effects of grain boundaries in polycrystalline films. An introduction is presented to Schottky barrier, heterojunction, vertical multijunction, and grating solar cells. Radiation effects on cells exposed to the space environment are discussed, and device behavior under various temperature and intensity environments is described. Also discussed is solar cell technology, including crystal growth, diffusion, ion implantation, antireflective coatings, and ohmic contacts. S D

**A76-20716** # Geometrical aspects of the troposkien as applied to the Darrieus vertical-axis wind turbine B F Blackwell and G E Reis (Sandia Laboratories, Albuquerque, N Mex.) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D C, Sept 17-19, 1975, Paper 75-DET-42* 5 p Members, \$1.00, nonmembers, \$3.00

The equations derived to define a troposkien (the shape a completely flexible cable assumes when it is spun at a constant angular velocity about a vertical axis to which its two ends are attached) are described. The implications of the solutions on the design of a vertical axis wind turbine are discussed for cases where gravity is neglected. (Author)

**A76-20780** Analysis of polyphase commutator generator for wind-power applications R T Smith (Southwest Research Institute, San Antonio, Tex.) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES 12, Jan 1976, p 39-41

This paper describes the mathematical modeling of the ac polyphase commutator generator by means of Park's equations. For clarity, a two-phase, balanced-operation machine is analyzed. Equations of performance are developed in terms of familiar parameters. The machine is shown to have attractive characteristics for variable-speed constant frequency power generation, with possible application to wind-power systems. (Author)

**A76-20838** Model of solar-cell array for terrestrial use D Biran and M S Eriicki (Technion - Israel Institute of Technology, Haifa, Israel) *Solar Energy*, vol 17, no 6, 1975, p 325-329

On the basis of solar radiation data, a computer method for the analysis of a terrestrial solar conversion system consisting of solar cell arrays, batteries, overcharge protection, and voltage, current and frequency-control devices has been developed. The method yields the cost-optimized solution for a specified location and any given load. The data in the memory may be adapted for any location on the basis of local climatic data, including the monthly averages of the sun's inclination, the average and minimum daily radiation, the daily sunshine period, and monthly temperature averages. Three types of systems are taken into account: slant angle set for year-round operation according to the 'worst' month, slant angle re-set according to the 'worst' month in each season, and slant angle re-set monthly. The required charging voltage, array area, and battery capacity are obtained together with the optimum slant angle, working cycle, and battery configuration. C K D

**A76-20839** Selection of design parameters for closed-circuit forced-circulation solar heating systems B J Brinkworth (University College, Cardiff, Wales) *Solar Energy*, vol 17, no 6, 1975, p 331-333

**A76-20840** Heat exchanger penalties in double-loop solar water heating systems. F de Winter (Atlas Corp., Santa Clara, Calif) *Solar Energy*, vol 17, no 6, 1975, p 335-337 5 refs

In many solar water heating systems, it may prove desirable to use a double-loop system with a heat exchanger between the flat-plate collector and the water storage tank. This approach, using a second fluid which does not freeze in service and which does not lead to corrosion of metals, may be the most convenient way to avoid freezing or corrosion problems in the collector. Because of the heat exchanger, the collector is, however, forced to operate at a higher temperature with a corresponding performance penalty. A heat exchanger factor has been developed, which makes it possible to determine the collection performance penalty in a straightforward manner. When the heat exchanger is of the counterflow type and is operated so that the mass flowrate-specific heat products of the two streams are equal, the expression becomes very simple, and lends itself to direct optimization of heat exchanger size. Several sample optimization calculations are shown. (Author)

**A76-20841** Financial incentives for the adoption of solar energy design - Peak-load pricing of back-up systems. S L Feldman (Clark University, Worcester, Mass.) and B Anderson (Total Environmental Action, Harrisville, N H) *Solar Energy*, vol 17, no 6, 1975, p 339-343 16 refs

Most solar energy systems for the space conditioning of buildings require a full sized back-up system for long periods of cloudy weather. If gas or electricity is a source of energy for that back-up system, not only does the building owner have to provide both a solar energy system and a back-up system, but the utility company has to build and maintain full sized facilities to provide for the demand by the back-up system during peak load conditions. One method to limit capacity design of utilities is to design a peak-load pricing scheme which would tend to flatten the utilities' load curve. The scheme could also provide incentives for the installation of solar energy design that would use electricity or gas as back-up systems during off-peak hours only. Indeed, the success of the diffusion of solar energy construction into widespread usage may depend upon such financial incentives to the consumer. (Author)

**A76-20842** Experimental performance of three solar collectors. R L San Martin (New Mexico State University, Las Cruces, N Mex) and G J Fjeld (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug 1974*) *Solar Energy*, vol 17, no 6, 1975, p 345-349 11 refs

Three flat plate solar collectors were simultaneously tested for over six months: a water trickle collector, a typical collector with double glazing, and a thermal trap collector. The thermal trap collector employs a transparent solid (methyl methacrylate) adjacent to the fluid cooled collector plate. It is found that by the use of this transparent solid, which has a high transmittance of short wavelengths combined with a low transmittance of long wavelengths and a small thermal conductivity, high temperatures can be achieved. The comparative collector tests were performed for a variety of operational conditions. The collector efficiencies were experimentally determined, and analysis of the collector losses was accomplished. The thermal trap collector was found to have a higher operational efficiency than the other collector types and is capable of collecting solar energy for a longer period of time each day. At operating temperatures above 145 F, the thermal trap collector is more than twice as efficient as the water trickle collector. (Author)

**A76-20843** Cost of paraboloidal collectors for solar to thermal electric conversion. W W Shaner (Colorado State University, Fort Collins, Colo.) and H S. Wilson (Westinghouse Manufacturing Development Laboratory, Pittsburgh, Pa.) (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug*

*1974*) *Solar Energy*, vol 17, no 6, 1975, p 351-358 6 refs NSF-supported research

Preliminary cost estimates for the large-scale production and installation of paraboloidal solar collectors have been obtained. The design parameters incorporated in the optimization model used include aperture width, reflectivity, rim angle, contour error, and tracking error. The input data were derived from known technologies most suitable for the production of such collectors. The cost of materials is shown to be the largest contribution to overall manufacturing costs, while field costs (installation, pipe supports, foundations, etc.) account for almost half of the total costs. Cost functions developed for reflectors of varying aperture widths and rim angles indicate that module size influences the overall costs more strongly than either the choice of shell materials or the method of manufacture. Cost-performance relationships for reflectivity are presented. (Author)

**A76-20844** A status report on the Sandia Laboratories solar total energy program. R P Stromberg (Sandia Laboratories, Albuquerque, N Mex.) (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug 1974*) *Solar Energy*, vol 17, no 6, 1975, p 359-366 ERDA-supported research

The solar community concept is a system designed to minimize the use of fossil fuel energy by optimum use of energy from solar collectors. Energy is collected at high temperature, stored in a thermal reservoir, and used to produce electricity. The thermal energy remaining after electricity production is either stored or distributed immediately for heating, air conditioning, hot water or process heat. A test bed designed for operation with loads approximately equivalent to 12-15 homes is under construction. Preliminary results of an analysis of a proposed one-thousand-home solar community system using the total energy computer program are presented. The system incorporates 150-9-15 by 15-25 m focusing collectors mounted in a N-S orientation which heat Therminol 66 fluid to 590 K. The energy is stored in a high temperature storage unit for use by a turbogenerator. The Therminol fluid is returned from the turbine to storage at 460 K, heat is rejected from the turbine condenser at 380 K to a low-temperature water storage system, from which water is distributed to individual homes. A collector test installation, consisting of a fluid loop system for supplying controlled temperatures and rates of flow to a collecting device, and an instrumentation trailer to process data are described. (Author)

**A76-20845** The design requirements for a viable photochemical solar heating and cooling system. S G Talbert, D H Frieling, J A Eibling, and R A Nathan (Battelle Columbus Laboratories, Columbus, Ohio) (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug 1974*) *Solar Energy*, vol 17, no 6, 1975, p 367-372 10 refs

The results of a systems analysis and economic study of a photochemical solar energy system are presented and compared with a conventional hot-water solar energy system. Conversion efficiency, energy storage capacity, and life-cycle costs are the primary bases of comparison. The paper indicates the requirements to make a photochemical solar energy system technically and economically feasible and identifies potential advantages of the photochemical solar energy system: i.e., lower cost and lighter weight collector, cloudy-day effectiveness, smaller storage tank, storage at room temperature and uniform energy levels in the stored fluid, both winter and summer. Two possible problem areas have been identified for a photochemical system: anticipated higher initial cost of the working fluid, and possible deterioration of the energy storage capacity with time. (Author)

**A76-20846** Passive freeze protection for solar collectors. L W Bickle (L W Bickle and Associates, Albuquerque, N. Mex.) *Solar Energy*, vol 17, no 6, 1975, p. 373, 374.

Freeze damage is an important practical problem for water type solar collectors. In the past, electric resistance heaters, drain systems,



and separate ethylene glycol-water collection loops have commonly been used to prevent freezing. These techniques are effective but involve active components such as controls, heaters, valves, solenoids, pumps, heat exchangers, etc., that increase costs, degrade reliability and/or reduce overall efficiency. This note describes a simple passive concept that can be used to protect water-type solar collectors from freeze damage. Briefly, the water is allowed to freeze. As it freezes, however, it expands against a compliant region, and thus, the expansion does not damage the system. (Author)

**A76-21041** Experimental study of heat transfer in the channel of an open-cycle magnetohydrodynamic generator V V Kirillov, E P Reshetov, and V D Semenov (Akademii Nauk SSSR, Nauchno Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 13, May-June 1975, p 634-643) *High Temperature*, vol 13, May-June 1975, p 573-580 12 refs Translation

**A76-21141** Bringing logic to urban transportation innovation D Brand *Technology Review*, vol 78, Jan 1976, p 38-45

Logical performance specifications are worked out for future urban transportation systems. Stages in the impact of massive use of private automobiles in congested urban areas are delineated, and dislocations in central business districts of cities are focused upon as a difficult problem. The limitations of fixed-schedule fixed route public transportation are examined, and dual mode (partly automated) transportation, personal rapid transport, and group rapid transit systems with very short or fraction-second headway capabilities are examined. The specific weight of walks and waits in gaining access to the primary system, and the acceptance attitudes of potential users, are considered critical, and the real choices opted by frustrated potential users are examined with attention to sociological aspects. The question of real cost savings attainable via any of these systems is scrutinized. R D V

**A76-21145** Resistivity dependence of silicon solar cell efficiency and its enhancement using a heavily doped back contact region M A Green (New South Wales, University, Kensington, Australia) *IEEE Transactions on Electron Devices*, vol ED-23, Jan 1976, p 11-16 20 refs

For the normal solar-cell geometry, there is an upper limit to the cell conversion efficiency for each value of the silicon-substrate resistivity. This limit cannot be exceeded regardless of possible improvements in material lifetime properties. It peaks for a value of substrate resistivity of about 0.1 ohm cm for p-type substrates, corresponding to an acceptor concentration of 7 by 10 to the 23rd power per cu meter. The limit can be exceeded if the cell structure is modified. A high-low junction incorporated near the ohmic back contact to a suitably designed device not only improves the current-collecting properties for a given cell thickness, but also increases the ultimate conversion efficiency. (Author)

**A76-21173** Energy storage - Feasibility study of an experiment involving solar energy collection, its storage by a super-flywheel, and electric power generation (Stockage d'énergie - Etude de faisabilité d'une expérience de captation, de stockage par accumulation cinétique et de restitution d'énergie électrique d'origine solaire) B Taty (Centre National d'Etudes Spatiales, Division Systèmes de Stabilisation et Pilotage, Toulouse, France) *L'Aéronautique et l'Astronautique*, no. 56, 1976, p 46-51 In French

A system for collecting and storing solar energy and for converting it into electric power continuously 24 hours a day and all year round is described. The energy is collected by means of solar panels which are oriented towards the direction of the sun at noon. The energy is stored by means of a superflywheel (kinetic accumulator) which is mounted on magnetic or roller bearings and includes a reversible electric motor. It is shown that it may be feasible to

develop a solar energy system furnishing 1 kW of power with a solar panel with a surface area of 20 sq m and with a flywheel whose rotor weighs 100 to 300 kg. B J

**A76-21204** Effect of constructional parameters on the temperature characteristics of silicon photoconverters V G Doroshenko and E S Russkikh (*Geliotekhnika*, no 3-4, 1975, p 5-11) *Applied Solar Energy*, vol 11, no 3-4, 1975, p 3-7 5 refs Translation

Silicon photoelectric cells with differences in depth of the n(+)-p junction, structure of the rear contact, and translucency of the operational surface are investigated over a range of 100-400 K. Short circuit current and power are determined along with open-circuit voltage, and spectral sensitivity. Discrepancies in the results of earlier studies appear to be due to structural differences in the models used. Reduced depth of the junction, the use of multi-layered rear contacts on cells with allowed bases, highly transparent operational surfaces, and deposition of a protective covering to lower equilibrium temperature will increase the efficiency of solar cells. C K D

**A76-21208** Approximate solar-energy concentrator consisting of wedge-shaped facets of constant transverse curvature A Sh Sharafi, G Ia Umarov, and A Abduazizov (Akademii Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkentskii Gosudarstvennyi Universitet, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 3-4, 1975, p 35-38) *Applied Solar Energy*, vol 11, no 3-4, 1975, p 28-31 Translation

**A76-21209** Application of chemically reacting working bodies in a solar gas-turbine system V V Chikovani, M S Dzitzoiev, and G I Krylov (*Geliotekhnika*, no 3-4, 1975, p 80-87) *Applied Solar Energy*, vol 11, no 3-4, 1975, p 63-69 5 refs Translation

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

**A76-21210** Reliability of solar energy-supply systems R B Saleeva (Tashkentskii Institut Svyazi, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 3-4, 1975, p 119-124) *Applied Solar Energy*, vol 11, no 3-4, 1975, p 96-100 Translation

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

**A76-21470** The depletion layer collection efficiency for p-n junction, Schottky diode, and surface insulator solar cells M A Green (New South Wales, University, Kensington, Australia) *Journal of Applied Physics*, vol 47, Feb 1976, p 547-554 24 refs Research supported by the Radio Research Board of Australia

The collection efficiency for carriers optically generated in the depletion region of photovoltaic solar cells is analyzed. For p-n junction devices, it is shown that virtually all these carriers are collected provided the minority carrier diffusion lengths are larger than the width of the depletion layer, and that a reasonable percentage will be collected even when the diffusion lengths are much smaller than this. For Schottky diode devices, the collection efficiency for carriers optically generated near the metal-semiconductor interface is shown to be small and to depend critically

upon the exact model of the contact used. As a consequence the spectral response of Schottky diodes at short wavelengths is shown to contain considerable information regarding the physics of the metal-semiconductor contact. New surface insulator devices are shown to have a short-wavelength response superior to that of Schottky diodes. (Author)

**A76-21471** High-voltage vertical multijunction solar cell. R. J. Soukup (Iowa, University, Iowa City, Iowa). *Journal of Applied Physics*, vol. 47, Feb. 1976, p. 555-559. 13 refs.

The vertical multijunction solar cell with covering lens is a photovoltaic device which promises efficiencies greater than that predicted under ideal conditions for any other structure. The mathematical analysis presented here illustrates this statement. In addition the structure described here is capable of a high-voltage output for small solar cell dimensions, a feature which makes this device attractive for many applications where other designs are impractical. The analysis predicts the output short circuit current, open-circuit voltage, maximum power, and an efficiency of 21% for a silicon homojunction solar cell. (Author)

**A76-21472** Preparation and properties of InP/CdS solar cells. J. L. Shay, S. Wagner (Bell Telephone Laboratories, Inc., Holmdel, N.J.), K. J. Bachmann, and E. Buehler (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Journal of Applied Physics*, vol. 47, Feb. 1976, p. 614-618. 16 refs.

The preparation and properties of the recently reported InP/CdS single-crystal solar cells having a solar power conversion efficiency of 12.5% is described. A process for increasing the efficiency of these and inadvertently inferior cells to 14% is outlined. The ultimate efficiency achievable with InP/CdS using state-of-the-art liquid-encapsulated Czochralski p-type InP substrates is calculated to be 17.2% for AM2 conditions and 14.0% for AM0 conditions. (Author)

**A76-21769** Theoretical analysis of graded-band-gap gallium-aluminum arsenide/gallium arsenide p-Ga<sub>1-x</sub>Al<sub>x</sub>/As/p-GaAs/n-GaAs solar cells. M. Konagai and K. Takahashi (Tokyo Institute of Technology, Tokyo, Japan). *Solid-State Electronics*, vol. 19, Mar. 1976, p. 259-264. 17 refs.

Graded-band-gap p-Ga<sub>1-x</sub>Al<sub>x</sub>/As/p-GaAs/n-GaAs solar cell structures are analyzed as a function of the drift field in the surface layer and thickness of the p-GaAs layer. Such cells allow conversion efficiencies higher than conventional GaAs cells due to the reduction of the surface recombination effect. The p-type GaAs is preferable, because the electron diffusion length is several times larger than the hole diffusion length. The optimum thickness of the p-GaAs layer is calculated for AMO (6000 K blackbody radiation) and with typical parameters assumed. The efficiency strongly depends on the drift field E, and the maximum energy conversion efficiency approaches 20% at -3000 V/cm. (Author)

**A76-21877** # Theoretical performance of vertical axis wind turbines. E. E. Lapin (Aerospace Corp., El Segundo, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 4, 1975, Paper 75-WA/Ener-1* 11 p. 8 refs. Members, \$1.50, nonmembers, \$3.00.

An elementary theory is developed for the power extraction capability of a vertical axis wind turbine comprising a number of blades which operate either at fixed or at continuously variable incidence. The performance according to that theory is computed for some examples and applied to estimate the economic feasibility of a turbine of 10 megawatt rating. (Author)

**A76-21927** # Preliminary analysis of heat pipe heat exchangers for heat recovery. J. O. Amode (Amahdu Bello University, Zaria, Nigeria) and K. T. Feldman (New Mexico, University, Albuquerque, N. Mex.). *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 4, 1975, Paper*

*75-WA/HT-36* 11 p. 11 refs. Members, \$1.50, nonmembers, \$3.00. Research supported by the University of New Mexico.

A preliminary analysis of fin tube heat pipe heat exchangers for air-to-air heat recovery was conducted. The analysis uses conventional heat exchanger design techniques and a new heat pipe design technique which includes probabilistic design of artery wick heat pipes. The heat transfer capability of the heat pipes may be matched with that of the finned tubes in order to optimize the heat exchanger performance. The results predicted by the heat pipe heat exchanger analysis program are compared to one set of experimental data available in the literature, and relatively good agreement was obtained. Heat pipe heat exchangers may be used as recuperators in heating and ventilating systems, in gas turbines, in steam power plants and in various process industry applications. (Author)

**A76-21931** # Waste heat utilization through the use of heat pipes. A. Basulis and M. Plost (Hughes Aircraft Co., Electron Dynamics Div., Torrance, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 4, 1975, Paper 75-WA/HT-48* 6 p. 7 refs. Members, \$1.50, nonmember, \$3.00.

The basic heat pipe consists of a closed container which has in its interior a capillary wick structure that contains a vaporizable fluid. Heat between a heat input section and a heat output section of the pipe is transferred by means of an evaporation-condensation cycle. A number of heat pipes which are currently used in life tests are listed in a table, taking into account pipes with operational temperatures in the range from 45 to 650 C. Examples are discussed to illustrate the employment of heat pipes in the beneficial utilization of waste heat. Attention is given to process control applications, plume control in sulfur scrubbers, and the improvement of thermodynamic efficiency of gas turbines through heat recovery. G. R.

**A76-21960** # Power turbines for Ocean Thermal Energy Conversions systems. L. L. Ambis (Massachusetts, University, Amherst, Mass.) and R. J. Veenema, Jr. *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 4, 1975, Paper 75-WA/OCE 11* 9 p. 8 refs. Members, \$1.50, nonmembers, \$3.00.

The design procedure used to evaluate possible power turbine configurations for Ocean Thermal Energy Conversion (OTEC) systems based on a closed Rankine Cycle power plant with propane, ammonia, or R12/31 as working fluids is described. A procedure incorporating pitch diameter analysis and a design computer program are used for general axial flow turbine analysis, yielding turbine geometry and total to static turbine efficiency predictions. Resulting designs are subjected to off-design analysis. Results obtained for a turbine with a 35 Mw output for a Gulf Stream site are presented. The off-design behavior of propane is more favorable to cycle operation than that of ammonia, a large design diameter for these outputs is the major drawback of R12/31, which would require smaller turbines than the other working fluids. C. K. D.

**A76-21969** # A theory of concentrators of solar energy on a central receiver for electric power generation. M. Riaz (Minnesota, University, Minneapolis, Minn.). *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 4, 1975, Paper 75-WA/Sol-1* 9 p. 5 refs. Members, \$1.50, nonmembers, \$3.00. NSF Grant No. GI-41019.

The modeling of the performance of large-area solar concentrators for central receiver power plants is formulated using a continuum field representation of ideal heliostat arrays that accounts for two governing factors: the law of reflection of light rays imposes steering constraints on mirror orientations, the proximity of mirrors creates shadow effects by blocking the incident and/or reflected solar radiation. The results of a steering analysis which develops the space-time characteristics of heliostats and of a shadow analysis which determines the local effectiveness of mirrors in reflecting solar energy to a central point are combined to obtain in closed analytical

form the global characteristics of circular concentrators. These characteristics which appear as time profiles for mirror orientations, for effective concentration areas (i.e., reflected solar flux), and for concentration ratios, establish theoretical limits of performance against which actual or realistic solar power systems can be compared and assessed (Author)

**A76-21971 # Computer modeling of heat pumps and the simulation of solar-heat pump systems** T L Freeman, W A Beckman, J W Mitchell, and J A Duffie (Wisconsin, University, Madison, Wis.) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-3* 16 p 19 refs Members, \$1 50, nonmembers, \$3 00 NSF Grant No GI-34029, ERDA Grant No 2588

A generalized digital computer model of a residential size heat pump is described. The modeling strategy is to 'design' or 'size' the four major components in the vapor compression cycle to yield any desired design condition performance. Once the system has been defined, the program is able to compute a 'performance map' of heat added and heat rejected at all possible combinations of inlet flow-stream conditions. The model is applied to the thermal performance simulation of several different solar-heat pump heating and cooling systems using the modular simulation program, TRNSYS. Performance of 'in-line' heat-pump boosted solar systems which use solar energy storage as the heat source are compared to 'parallel' systems where the heat pump acts only as an auxiliary and ambient air provides the source. A simplified economic analysis shows that the parallel system is the more cost effective configuration (Author)

**A76-21972 # Simulation of a small solar-power station** M H Cobble and P R Smith (New Mexico State University, Las Cruces, N Mex.) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-4*, 8 p 6 refs Members, \$1 50, nonmembers, \$3 00 NSF Grant No. OIP-74-08333

A numerical model for simulating a solar electric generating plant has been developed which is capable of simulating the tracking solar collector, the solar boiler, the prime mover, and the electrical generator. Various methods of energy storage, such as heat storage in a liquid, gravitational potential, etc., can be treated. The model is time-dependent and the solar radiation and atmospheric conditions are generated within the simulation program as a function of time. An example of the use of the model is presented and consists of a simulation of a 1 KW electric generator driven by an open cycle gas turbine. Solar energy is supplied to the turbine by a tracking cylindrical parabolic concentrator (Author)

**A76-21973 # Evaporator design for sea solar power cycles** A S Woodhull (United Engineers and Constructors, Inc., Philadelphia, Pa.) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-5* 12 p 11 refs Members, \$1 50, nonmembers, \$3 00 Research supported by TRW, Inc., NSF Grant No C-958

In a closed ocean thermal power system, the operating conditions for evaporator and condenser are small temperature differences, high flow rates and low water-side pressure drop in order to minimize parasitic losses. Tube and shell cross-flow heat exchangers were investigated for this study using ammonia as the working fluid. These choices were dictated by the present development status of shell and-tube heat exchangers and the favorable thermodynamic properties of ammonia. A stringent overall working fluid pressure drop limitation, imposed by system constraints, was met by designing the evaporator with acceptable pressure drop by varying baffle spacing. Quality of the two-phase mixture was determined to be the most important design parameter. The significant result of this study is that a forced convection ammonia evaporator can be designed to meet the overall system requirement of pressure drops, flow rates and duty, with present technology and analytical procedures (Author)

**A76-21974 # Construction and evaluation of linear segmented solar concentrators** P Desai, J R Williams, A M Lindsey (Georgia Institute of Technology, Atlanta, Ga.), and J Rollins *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-6* 8 p Members, \$1 50, nonmembers, \$3 00 NSF Grant No GI 43936

Two types of linear faceted collectors suitable to satisfy energy needs in the intermediate temperature range between 100 C and 300 C are examined. These are the segmented plane solar concentrator (SPSC) and the faceted fixed mirror concentrator (FFMC). A comparative performance evaluation of the SPSC for several receiver configurations is presented. Calculated heat flux onto the heat exchanger is compared with measurements obtained by scanning a broad spectral response detector across the focal plane in terms of the concentrator efficiency of the FFMC (Author)

**A76-21975 # Low cost solar augmented heat pump system for residential heating and cooling** J M Alcone (Sandia Laboratories, Albuquerque, N Mex.) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-7* 15 p 8 refs Members, \$1 50, nonmembers, \$3 00

The analysis and design of a low cost solar collector/heat storage system configured to take advantage of the characteristics of conventional air-to-air heat pumps is presented. The dynamical interaction of the various system components is examined and the resulting design constraints are given. The system, as proposed, eliminates the collector costs associated with conventional solar systems while requiring an increase of 50% in the volume required for thermal storage (Author)

**A76-21976 # Solar assisted heat pump system - A parametric study for space heating of a characteristic house in Madison, Wisconsin** R C Bosio (Dow Chemical Co., Midland, Mich.) and N V Suryanaryana (Michigan Technological University, Houghton, Mich.) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-8* 15 p 12 refs Members, \$1 50, nonmembers, \$3 00

**A76-21977 # Cost optimization of solar heating of buildings in northern regions** G J E Willcutt, Jr., B D Hunn (California, University, Los Alamos, N Mex.), and T B McSweeney (Combustion Engineering Power Systems, Windsor, Conn.) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-9* 13 p 9 refs Members, \$1 50, nonmembers, \$3 00

A detailed computer model is developed to simulate the performance, on an hourly basis, and to optimize the cost of solar heated buildings in northern regions characterized by cold and/or cloudy climate. The original version of this model was applied to 1971 Ottawa weather data and the details have been reported elsewhere. The present model includes improvements in the original model and extends its application to five Canadian cities (Vancouver, B C, Edmonton, Alta, Winnipeg, Man, Ottawa, Ont, and Fredericton, N B) for the years 1970 and 1971. For each simulated year the system cost is optimized as a function of collector size for representative values of the other system parameters (storage size, number of glazings, etc.). Annual combined solar/conventional system costs are determined with collector cost and conventional fuel cost as parameters. Comparison is made between the effects of the amount of insolation received, cloud cover, and severity of the heating demand on system performance and cost (Author)

**A76-21978 # Simulation of solar heated buildings** P R Smith (New Mexico State University, Las Cruces, N Mex.) and B P Gupta *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/Sol-10* 7 p 5 refs Members, \$1 50, nonmembers, \$3 00

A simulation of solar heated buildings was developed in order to aid the design of such buildings now under construction on the campus of New Mexico State University. The time dependent energy

equations for the various elements of the heating system, the solar collectors, the heat storage tank, the auxiliary heating unit, and the building itself were solved by a fourth order Runge-Kutta integration scheme on the digital computer. The simulation is fairly general in that it allows treatment of buildings of any size and solar collectors of any design. Further, different wall cross-sections, percents of window area to wall area, insulations, roof cross-sections, etc can all be examined. Ambient temperature can be introduced from weather bureau data as a function of time, either in tabular form from weather bureau data or it can be internally generated. As an example of the utility of the simulation, results are presented for the operation of the New Mexico State University Solar House. (Author)

**A76-21979 #** A solar heating system for a northern New Mexico adobe house. M W Edenburn (Sandia Laboratories, Albuquerque, N Mex) and F C Wessling, Jr (New Mexico University, Albuquerque, N Mex) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex, Nov 30-Dec 4, 1975, Paper 75-WA/Sol-11* 9 p 7 refs. Members, \$150, non members, \$300

**A76-22111** Geothermal investigations of the U.S. Geological Survey in Long Valley, California, 1972-1973. L J P Muffler (U.S. Geological Survey, Menlo Park, Calif) and D L Williams (U.S. Geological Survey, Denver, Colo) *Journal of Geophysical Research*, vol 81, Feb 10, 1976, p 721-724 45 refs

During 1972 and 1973 the U.S. Geological Survey (USGS) conducted detailed geological, geophysical, hydrological, and geochemical investigations in Long Valley, California, as part of a new geothermal research program. The goal of these investigations was to understand a typical hot water geothermal system, thus providing a basis for extrapolation to other hot water areas and for regional exploration and assessment of geothermal resources. Although the USGS investigations have thoroughly characterized the surface expression and geophysical signatures of the Long Valley geothermal system, our understanding of the geothermal system at depth is incomplete. The available data allow us to make only a crude estimate of 350-700 MW cent for the electric power generation potential. Refinement of this estimate must await exploration of the area by deep drill holes. (Author)

**A76-22112** The near-surface hydrothermal regime of Long Valley caldera. A H Lachenbruch, M L Sorey, J H Sass (U.S. Geological Survey, Menlo Park, Calif), and R E Lewis (U.S. Geological Survey, Garden Grove, Calif) *Journal of Geophysical Research*, vol 81, Feb 10, 1976, p 763-768 10 refs

Temperature in 29 holes drilled to depths up to 30 m and in 7 deeper holes (up to 300 m) within the caldera have been measured in connection with a study of the thermal state of the Long Valley geothermal area. A number of thermal conductivity measurements were undertaken to obtain rough estimates of conductive heat flow. Attention is given to the temperature patterns determined with the aid of the measured data and some tentative generalizations regarding the Long Valley geothermal system. G R

**A76-22113** Geothermal setting and simple heat conduction models for the Long Valley caldera. A H Lachenbruch, J H Sass, R J Munroe, and T H Moses, Jr (U.S. Geological Survey, Menlo Park, Calif) *Journal of Geophysical Research*, vol 81, Feb 10, 1976, p 769-784 49 refs

**A76-22114** Convective heat flow from hot springs in the Long Valley caldera, Mono County, California. M L Sorey (U.S. Geological Survey, Water Resources Div, Menlo Park, Calif) and R E Lewis (U.S. Geological Survey, Water Resources Div, Laguna Niguel, Calif) *Journal of Geophysical Research*, vol 81, Feb 10, 1976, p 785-791 23 refs

**A76-22115** Audiomagnetotelluric sounding as a reconnaissance exploration technique in Long Valley, California. D B Hoover, F C Frischknecht, and C L Tippens (U.S. Geological

Survey, Denver, Colo) *Journal of Geophysical Research*, vol 81, Feb 10, 1976, p 801-809 11 refs

An audiomagnetotelluric (AMT) sounding system developed by the U.S. Geological Survey appears to be an effective technique for reconnaissance exploration to detect shallow resistivity anomalies associated with geothermal reservoirs. The equipment operates within the frequency range of 8-18,600 Hz by using nine logarithmically spaced narrow band filters. The technique has been evaluated in Long Valley, California, where the results from dc resistivity and time domain electromagnetic surveys were available for control. The AMT method outlines two linear zones of low resistivity that correlate well with known hot springs in the area. Generally, good agreement was obtained with the results of other electrical methods. (Author)

**A76-22313 \*** The manufacture of hydrogen from coal. C L Tsaros, J L Arora, and K B Burnham (Institute of Gas Technology, Chicago, Ill) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751095* 25 p. NASA-sponsored research

The conversion of coal to hydrogen is studied from the viewpoint of overall plant efficiency for three different processes: suspension gasification, fluidized bed gasification, and fluidized steam-iron process. The basic principles of these processes are reviewed, and total energy requirements are estimated and complete energy balances are made for each process, on the assumption that each model plant is self-contained, with no power imported. Overall plant efficiencies for conversion of coal to major gaseous products plus byproducts were determined to be: suspension gasification - 57.0%, fluidized-bed gasification - 66.4%, fluidized steam-iron process - 62.6%. Similar results are presented for methane liquefaction from coal using a process design based on hydrogasification, and it is found that conversion of coal to pipeline methane is much more efficient and less expensive than hydrogen conversion if a portion of the coal is converted to synthesis gas and this gas is used to hydrogenate more coal to methane. P T H

**A76-22496 \* #** Wind energy utilization. A bibliography with abstracts - Cumulative volume 1944/1974. Research sponsored by NSF, ERDA, and NASA. Albuquerque, University of New Mexico, 1975 484 p

Bibliography, up to 1974 inclusive, of articles and books on utilization of wind power in energy generation. Worldwide literature is surveyed, and short abstracts are provided in many cases. The citations are grouped by subject: (1) general, (2) utilization, (3) wind power plants, (4) wind power generators (rural, synchronous, remote station), (5) wind machines (motors, pumps, turbines, windmills, home-built), (6) wind data and properties, (7) energy storage, and (8) related topics (control and regulation devices, wind measuring devices, blade design and rotors, wind tunnel simulation, aerodynamics). Cross-referencing is aided by indexes of authors, corporate sources, titles, and keywords. R D V

**A76-22695** Greater Los Angeles Area Energy Symposium, 1st, Los Angeles, Calif, April 3, 1975, Proceedings. Symposium sponsored by the American Nuclear Society and Los Angeles Council of Engineers and Scientists. North Hollywood, Calif, Western Periodicals Co (Los Angeles Council of Engineers and Scientists Proceedings Series Volume 1), 1975 230 p \$25

The subjects considered are related to fossil fuels, nuclear energy, and alternate energy sources. Attention is given to a solar thermal conversion power plant siting analysis, the economic potential for wind energy conversion, tidal and wave power, and geothermal power. A number of advanced concepts are also considered, taking into account questions of technology transfer and the energy problem, a solar energy storage system, the use of hydrogen-rich automotive fuels, clean fuels from municipal solid waste, and regional power distribution via power relay satellite. G R

**A76-22696** Coal conversion - An overview of status and potential. J. B. O'Hara (Ralph M Parsons Co., Pasadena, Calif.) In Greater Los Angeles Area Energy Symposium, 1st, Los Angeles, Calif., April 3, 1975, Proceedings North Hollywood, Calif., Western Periodicals Co., 1975, p 47-57. 5 refs

The coal conversion considered involves the transformation of coal from its solid form to a liquid, gaseous, or low-ash solid product which will meet environmental protection standards. The energy requirements of the State of California in relation to available energy sources are examined. It is found that a use of coal conversion products represents one of several approaches to obtain needed supplies of 'clean' energy at an economically acceptable price. The available coal reserves in the western U.S. are considered along with details concerning the U.S. coal conversion development program. Various coal conversion processes are discussed, giving attention to gasification and liquefaction procedures. G R

**A76-22697** Solar thermal conversion power plant siting analysis. W. A. Kammer (Aerospace Corp., Energy and Resources Div., El Segundo, Calif.) In Greater Los Angeles Area Energy Symposium, 1st, Los Angeles, Calif., April 3, 1975, Proceedings North Hollywood, Calif., Western Periodicals Co., 1975, p 104-111 NSF supported research

This paper highlights the results of an extensive, but preliminary, siting analysis for large solar thermal conversion power plants accomplished in support of the Solar Thermal Mission Analysis Study. Based on sunshine hours and insolation data, the geographic boundaries of the analysis were established as the southwestern United States. Land areas were eliminated as unsuitable in the analysis by the sequential application of individual technical and institutional exclusion criteria at two levels of severity: most stringent and least stringent. If adequate cooling can be provided, the potentially suitable area that was identified consistent with the most stringent exclusion criteria would support the generation of electrical energy adequate to meet the projected southwestern United States demand in the year 2000. The potential exists, if the least stringent criteria are used, for providing about eight times the region's electrical energy demands. (Author)

**A76-22698** The economic potential for wind energy conversion. M. Dubey and U. Coty (Lockheed-California Co., Burbank, Calif.) In Greater Los Angeles Area Energy Symposium, 1st, Los Angeles, Calif., April 3, 1975, Proceedings North Hollywood, Calif., Western Periodicals Co., 1975, p 112-121. 6 refs

Wind-energy conversion is an attractive alternative to the conversion of fossil fuel for our future energy needs. The problem is to prove the concept is economically competitive with conventional systems, compatible with the user's applications, and acceptable to the public. To explore these questions, an approach is suggested which may succeed in defining the potential market and thus portend the birth of a new giant industry. (Author)

**A76-22699** Solar energy storage systems. A. G. Hammett. In Greater Los Angeles Area Energy Symposium, 1st, Los Angeles, Calif., April 3, 1975, Proceedings North Hollywood, Calif., Western Periodicals Co., 1975, p 159-164.

Energy storage methods and materials are reviewed. A simple heat pump storage concept is described which is based on the capability of storing relatively large amounts of energy using latent heat resulting from the phase change of certain materials. Heat is obtained from the sun during the daytime and distributed at night. With a lithium chloride/water mixture, it is shown that 83% of the solar input is available for space heating during the daytime (regenerative cycle) and 97% is available during night time (heat pump cycle). In effect, the heat from the sun that is available for space heating is doubled. (Author)

**A76-22700** Some considerations involving hydrogen-rich automotive fuels. S. Lampert and G. A. Hoffman (Southern California University, Los Angeles, Calif.) In Greater Los Angeles

Area Energy Symposium, 1st, Los Angeles, Calif., April 3, 1975, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1975, p 165-181. 19 refs

The investigation is concerned with problems related to the gradual depletion of the world's fossil reserves. Societal demands for portable energy are examined and fossil, thermal, and electrolytic resources for producing future automotive energy are considered. A study is conducted regarding automotive-fuel costs for the next 50 years, taking into account cost benefits and questions related to distribution and storage. A description is given of the renewable sources for transportation fuels beyond the fossil era, giving attention to economic factors, aspects of energy storage, a methane production system, and land use planning factors. It appears that the least-cost system would include solar thermal collectors with on-site closed cycle hydrogen thermochemical converters and the flow of hydrogen and carbon compounds to methane reactors. G R

**A76-22701** Regional power distribution via Power Relay Satellite. K. A. Ehricke (Rockwell International Corp., El Segundo, Calif.) In Greater Los Angeles Area Energy Symposium, 1st, Los Angeles, Calif., April 3, 1975, Proceedings North Hollywood, Calif., Western Periodicals Co., 1975, p 204-209.

Energy transmission via space link offers an attractive solution to many problems where oceans and difficult terrains must be crossed, where territories of several nations must be traversed or where economic and ecological considerations mitigate against large land allocations for right-of-way. Electric energy, generated at a primary source location, is fed into a large antenna system where it is converted to microwave energy and shaped into a beam. The beam is focused on a Power Relay Satellite in stationary orbit and reflected to a distant receiving station near load centers, reconverted to electricity and distributed locally. The system and its performance are described. The required technology on earth and in orbit, prospective availability, environmental impact and cost are reviewed. The economy of the concept in the framework of the overall energy development and in comparison to other energy transmission systems is discussed. (Author)

**A76-23057** Sensitivity of the power density of a surface-ionization thermionic converter to increases of the cathode surface area by surface relief. Iu. A. Dunaev, V. I. Babanin, A. S. Mustafae, 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) *Soviet Physics - Technical Physics*, vol 20, no 7, 1976, p 938-940. 9 refs. Translation

**A76-23113 \*** An impact analysis of a micro wind system. R. P. Zimmer, S. L. Robinette, R. M. Mason, and W. A. Schaffer (Georgia Institute of Technology, Atlanta, Ga.) In Modeling and simulation. Volume 6 - Proceedings of the Sixth Annual Pittsburgh Conference, Pittsburgh, Pa., April 24, 25, 1975. Part 1. Pittsburgh, Pa., Instrument Society of America, 1975, p 127-131. 10 refs. Contract No. NAS3 17827.

A process for the recovery of steel mill stack dust has been developed and is being used to recover secondary metals by a small company in Georgia. The process is energy intensive and wind generators were studied as a means of supplying energy for part of the recovery process. Some of the results of this study will be presented. (Author)

**A76-23166** Unconventional energy converters (Unkonventionelle Energiewandler). E. F. Schmidt. Berlin, Elitera-Verlag, 1975. 179 p. 208 refs. In German. \$22.60.

Aspects of unconventional energy conversion are considered, taking into account an analysis of energy technology, the systematics of unconventional energy conversion, thermodynamic and electric foundations, and questions concerning the changing of electrical energy from one form into another. Approaches for the conversion of chemical energy into electrical energy are examined, giving

attention to the thermodynamic and electrochemical principles of fuel cell operation, fuel cell technology, battery technology for fuel-cell power systems, and an evaluation of fuel cell applications from a systems point of view Photovoltaic solar energy converter cells are discussed along with thermoelectric devices, thermionic energy converters, and magnetohydrodynamic power generation

G R.

**A76-23598** Future prospects. T Van Duzer (California, University, Berkeley, Calif.) In Applied superconductivity Volume 2. New York, Academic Press, Inc., 1975, p 641-671 63 refs

Current and future trends in the development of applications of superconducting magnets and Josephson devices are discussed The state of development of devices in a number of categories is reviewed Among the applications considered are RF signal processing and transmission, computer components and systems, energy conversion and power transmission, transportation, and medical instrumentation The use of Josephson devices in establishing standard units of voltage, temperature, frequency, and current is described

C K D

**A76-23661** Application of thin films to solar energy utilization. D M Mattox (Sandia Laboratories, Albuquerque, N Mex.) (American Vacuum Society, National Symposium, 22nd, Philadelphia, Pa., Oct 28-31, 1975) Journal of Vacuum Science and Technology, vol 13, Jan-Feb 1976, p 127-134. 94 refs ERDA-supported research

The paper describes the basic properties and state-of-the-art of thin films and coatings in two basic types of solar energy applications (1) thermal control of structures, requiring reflecting or partially reflecting coatings and antireflection coatings to control incident solar radiation or to retain thermal energy, (2) photothermal conversion, where solar energy is converted to low-grade heat using reflector films, antireflection coatings, and selective solar absorbed coatings, (3) photothermal/electrical conversion, where solar energy is concentrated and converted to high-grade heat, and (4) photovoltaic conversion, where solar energy is converted directly into electrical energy by using semiconductor films and junctions, transparent conductors, antireflection coatings, and metal electrode films Selective solar absorbers described include interference films, Mie scattering films, electrodeposited coatings, and vacuum deposited films Photovoltaic junction materials characterized include p-n junction photovoltaics, CdS/Cu<sub>2</sub>S cells, polysilicon cells, and Schottky barrier photovoltaics

P T H

**A76-23722** Considerations regarding the feasibility and technology of solar energy satellites and energy transfer satellites (Betrachtungen zur Durchfuhrbarkeit und Technologie von Sonnenenergie-Satelliten und Energieubertragungs-Satelliten). Research supported by the Gesellschaft fur Weltraumforschung, Contract No GfW-RV11 V67/74-PZ-BB 74 Backnang, West Germany, AEG-Telefunken, 1975 89 p In German

A study conducted for the Minister of Research and Technology of West Germany is presented in an abbreviated form The study is based partly on an evaluation of already existing data and partly on comprehensive new investigations Previous studies considered are related to a satellite nuclear power station, orbital solar/thermal power generation, photoelectric solar-energy satellites, and a power relay satellite Problems concerning an implementation of power satellites are examined and a description of the main components of the investigated systems is presented Transportation problems related to the establishment of the satellite stations are also discussed along with questions of orbit selection, economic considerations, and the results of studies regarding the feasibility of the considered power systems for Europe

G R

**A76-24044** Miles of coatings for solar applications D B McKenney (Helio Associates, Inc., Tucson, Ariz.) In Optical coatings Applications and utilization, Proceedings of the Seminar,

San Diego, Calif., August 19, 20, 1974 Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p 191-197

Photothermal conversion methods and applications currently under consideration are reviewed Economic and technological demands placed on optical coatings for concentrating and nonconcentrating solar collectors are discussed Future requirements are compared with 1973 production, emphasizing the need for improved mass production techniques and lower cost per unit area

C K D.

**A76-24264** Directions of research related to batteries and fuel cells with regard to the future supply of energy (Forschungsrichtungen bei Batterien und Brennstoffzellen im Hinblick auf die zukunfftige Energieversorgung). H Binder and G Sandstede (Battelle Institut, Frankfurt am Main, West Germany) Chemie-Ingenieur Technik, vol 47, no 2, 1975, p 51 56 55 refs In German

The advantages of a use of electrochemical power systems are examined, taking into account applications related to the storage of energy and a use for the propulsion of vehicles The various types of electrochemical power systems are considered along with their current status of development Attention is given to lead-acid batteries, nickel cadmium systems, zinc-nickel oxide systems, lithium-sulfur systems, lithium-chlorine systems, chromium-chromate systems, sodium sulfur systems, calcium fluoride systems, hydroquinone systems, zinc-chlorine systems, zinc-air systems, iron-air systems, and various types of fuel cells

G R

**A76-24269** Energy recovery turbines (Les turbines de récupération d'énergie) A Verneau (Societe Bertin et Cie., Plaisir, Yvelines, France) Entropie, vol 11, no 66, 1975, p 10-19 In French

The paper examines the general design principles of expansion turbines and illustrates their use for energy recovery and heat removal in such industrial processes as (1) catalytic cracking, (2) gas scrubbing, and (3) recovering condensable fractions of natural gas Characteristic curves for expansion turbines are shown, and the performance of radial and axial type turbines is compared Applications of expansion turbines for low-power generators and autonomous microgenerators are discussed

P T H

**A76-24748** Tokamaks (Les tokamaks) J-P Poffe La Recherche, vol 7, Mar 1976, p 226 235 15 refs In French

Progress in the development of tokamaks is outlined, with special attention given to the apparatus at the Centre d'Etudes Nucleaires at Fontenay-aux-Roses The plasma current reaches 0.4 MA, the ion temperature, 1.2 keV, and the electron temperature, 2-3 keV The confinement time of the plasma energy for mean densities of 51 trillion/cu cm is between 0.025 and 0.030 sec Different means of heating the plasma, including Ohmic heating and injection of high-energy atoms into the plasma, are discussed together with methods of maintaining the plasma temperature Mechanisms of energy loss from the plasma are described, and safety factors are considered Current and future research and development programs are discussed, and the specifications of major tokamaks currently in use or in the planning stages are presented

C K D

**A76-24780** Confinement of extragalactic radio sources by massive objects P S Callahan (Oxford University, Oxford, England) Royal Astronomical Society, Monthly Notices, vol 174, Mar 1976, p 587-599 25 refs

Models of extragalactic double radio sources are analyzed in which the components are excited and gravitationally contained by a massive object acting on the diffuse cold matter distributed throughout each component The energy requirements, time scales, and observational constraints for a uniform radio component confined by one or more massive objects are investigated, and nonuniform components are briefly considered It is found that only models in which the thermal gas and magnetic field are rather

uniform are consistent with observation. Some difficulties with the gravitational-confinement model are discussed, including the energy requirement, the streaming and Rayleigh-Taylor instabilities, and gravitational instability. Several observational tests of the present model are proposed. F G M

**A76-24820** Offshore oil Technology - and emotion K O Emery (Woods Hole Oceanographic Institution, Woods Hole, Mass.) *Technology Review*, vol 78, Feb 1976, p 30-37

Drilling and search techniques used in the exploitation of off-shore oil reserves are discussed. An overview is given of major government policy statements regarding the use of the outer continental shelf for oil production. The risk of detrimental effects on the environment caused by oil spills from off-shore drilling or damage to benthic animals is considered. C K D

**A76-24821** Oil spills and offshore petroleum R J Stewart (MIT, Cambridge, Mass.) *Technology Review*, vol 78, Feb 1976, p 46-59 7 refs

The number and size of oil spills associated with off-shore production and with tanker transport of imported oil are compared, and the risk of oil spills in off-shore operations utilizing deep-water production technology and improved spill prevention technology is examined. In the past, off-shore production contributed about four times as many spills over 1000 gallons as did importation. A sharp increase in the incidence of spills is noted in oil fields more than 15 years old. The movement of New England, Mid-Atlantic, and Gulf of Alaska oil spills is analyzed. C K D

**A76-24834** The heat pipe - Hot new way to save energy R B Aronson *Machine Design*, vol 48, Mar 11, 1976, p 52-56

Advantages of the heat pipe for a transfer of heat energy include its virtually noiseless operation, the absence of maintenance requirements, and cleanness of operation. The heat pipe is used for cooling and for heating applications. It is also employed for objectives of temperature equalization. Factors which have to be considered in connection with the employment of a heat pipe for a certain application are examined, taking into account questions of temperature range and heat load. Attention is given to various types of heat pipes and to recent advances in heat pipe technology. G R

**A76-24943** # Degradation of the characteristics of the thin-film photovoltaic cell Cu/x/S-CdS (Degradatsiia kharakteristik tonkoplenochnogo fotovol'taicheskogo elementa Cu/x/S-CdS) Kh T Akramov, G Ia Umarov, and T M Razykov (Tashkentskii Gosudarstvennyi Universitet, Tashkent, Uzbek SSR) *Geliotekhnika*, no 6, 1975, p 8-11 7 refs In Russian

Results of experimental investigations of the performance of the thin-film heterojunction Cu/x/S-CdS for use in solar cells are reported. The base layer - CdS - was deposited by a gas-transport technique in a flow of H<sub>2</sub> on a molybdenum substrate. The p-layer of copper sulfide was obtained by immersing the CdS layer into an aqueous solution containing positive copper ions. The I-V, C-V, spectral and load characteristics of the thin film specimens, prepared with and without heat treatment, and with an energy conversion efficiency of about 3%, were tested under close to solar radiation conditions in the course of 4000 hours. B J

**A76-24944** # Operation of a thin silicon solar cell with illumination from two sides (Rabota tonkogo kremnievogo fotopreobrazovatelya pri osveshchenii ego s dvukh storon) N M Bordina, T M Golovner, V V Zadde, A K Zaitseva, A P Landsman, and V I Strel'tsova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) *Geliotekhnika*, no 6, 1975, p 12-19 In Russian

The paper studies the spectral distribution of the collection

coefficient of a silicon solar cell illuminated at different times from the front and back sides. The dependence of the short-circuit current on cell-thickness is calculated during illumination from each of the two sides separately. It is shown that reduction in cell-thickness with the simultaneous elimination of carrier recombination on the back side does not worsen the volt-ampere characteristics of the cell during illumination from the front side and simultaneously increases the short-circuit current and the energy conversion efficiency during illumination from the back side. B J

**A76-24945** # Solar cells from gallium arsenide obtained by ion bombardment (Solnechnye elementy iz arsenida gallia, poluchennye ionnoi bombardirovkoii) A A Gavrilov, G A. Kachurin, and L S Smirnov (Akademiia Nauk SSSR, Institut Fiziki Poluprovodnikov, Novosibirsk, USSR) *Geliotekhnika*, no 6, 1975, p 20-24 8 refs In Russian

The characteristics of gallium arsenide solar cells, obtained by the implantation of cadmium and zinc ions into the n-region were studied. During implantation of cadmium ions, increased losses were observed from the cells due to the high layer-resistance of the p-region and to the near-surface recombination of generated carriers. The high recombinational losses are linked to the incomplete annealing of defects and to the small doping depth of the p-n junction. The small doping depth is conditioned by the relatively small diffusion coefficient of the cadmium and the trapping of the additive in the dislocated layer. The implantation of zinc ions led to the increase of the conductivity of the p-layer and to the displacement of the region of the p-n junction further from the irradiated surface due to the high diffusion coefficient. As a result solar cells are obtained with characteristics analogous to those of diffusion junctions and with a high energy conversion efficiency (9.0 to 9.5% without the use of brightening filters). B J

**A76-24948** # Graph-analytical method for the determination of the shape and dimensions of the reflecting surface of a heliostat (Grafo-analiticheskiy metod opredeleniia formy i razmerov otrazhaushchei poverkhnosti geliostat) A V Vartanian, Ia T Shermazanian, and V V Arutunian *Geliotekhnika*, no 6, 1975, p 36-45 7 refs In Russian

The paper proposes a graph-analytical method for determining the shape and dimensions of the reflecting surface of a solar-array heliostat for a configuration with an arbitrary optical design and a heliostat on an arbitrary mounting. The heliostat, on an altazimuthal mounting, of a high-temperature solar array with a 10 m diameter collector is considered as an example. B J

**A76-24949** # Collecting capacity of solar-array mirror systems - The effect of geometrical factors (Kontsentrirovushchaya sposobnost' zerkal'nykh sistem SES - Vliianie geometricheskikh faktorov) D I Tepliakov and R R Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) *Geliotekhnika*, no 6, 1975, p 46-58 13 refs In Russian

The dependence of the collecting capacity of the mirror systems of paraboloid solar arrays on the geometry of the central receiver is investigated. The dependence of the mean collecting capacity of the array on the angular aperture of the collector is plotted for the cases of planar, conical, cylindrical, and spherical receivers. B J

**A76-24950** # Fabrication and investigation of foam-film faceted collectors (Izgotovlenie i issledovanie penoplenochnykh fatsetnykh kontsentratorov) O Iu Sobirov, A M Gafurov, S N Vil'kova, and R A Zakhidov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no 6, 1975, p 64-68 In Russian

The paper describes a 3-meter foam-film faceted solar collector consisting of 7 parabolic reflectors each with a diameter of 95 cm, a coverage angle of 34 degrees, and a focal distance of 158 cm. A metallized PTFE film was used in the fabrication of the foam-film facets to be employed as reflecting surfaces. The film was subjected to forming at 170 C which eliminated residual stress and gave it a shape close to paraboloidal. The film was fixed with three layers of

epoxy resin to preserve this shape. A system for tracking the visible image of the sun while rotating about the azimuthal and zenithal axes was used to measure the opto-energetic characteristics of the collector. B.J.

**A76-25120** Application of granular semiconductors to photothermal conversion of solar energy. J. I. Gittleman (RCA Laboratories, Princeton, N.J.) *Applied Physics Letters*, vol 28, Apr 1, 1976, p 370, 371. 14 refs. Contract No. F44620-75-C-0057.

A solar absorber involving dispersion of semiconductor grains in an insulator of low dielectric constant is proposed. A granular semiconductor film is formed by cosputtering a semiconductor and an insulator with which it is immiscible. Such a material is structurally similar to granular metals (dispersion of metal particles in insulators). If the mixing does not reduce the extinction coefficient beyond a tolerance value, the absorbance of the granular semiconductor will be high and its reflectance will be low. Calculations based on Maxwell Garnett theory show that due to its lower reflectivity for wavelengths less than 1.5 microns, the material is about 60% more efficient than silicon in converting solar energy to heat. Results are presented on reflectivity measurements for Ge-Al<sub>2</sub>O<sub>3</sub> films on aluminum. Converter performance approaching the ideal can be obtained provided the discussed materials problems are solved. S.D.

**A76-25224** Gasification gases of coke, coal, benzol, and petroleum and cracking products of natural gas with air-water vapor mixtures (Vergasungs- bzw Spaltgase von Koks, Kohle, Benzol, Erdol bzw Erdgas mit Luft-Wasserdampf-Gemischen). E. Schwarz-Bergkamp (Montanistische Hochschule, Leoben, Austria). *High Temperatures - High Pressures*, vol 7, no 4, 1975, p 457-465. 7 refs. In German.

Because of their importance in research and technology, the equilibrium data for the chemical reactions of gasification of carbonaceous raw materials with mixtures of air and steam are compiled in synoptic diagrams in which hydrogen and carbon monoxide contents are represented as isotherms between 500 and 1000 C. The diagrams allow direct evaluation of the composition with a precision of 0.2%, corresponding to the precision of interpolation between the isotherms and between the data for the selected raw materials. To enable calculation of the contents of CH<sub>4</sub>, CO, H<sub>2</sub>O, and N<sub>2</sub> (as residue) equilibrium constants are tabulated over the quoted temperature range. (Author)

**A76-25391** The conversion of energy in chemical reactions. L. Riekert (Karlsruhe, Universität, Karlsruhe, West Germany). *Energy Conversion*, vol. 15, no 3-4, 1976, p 81-84. 10 refs.

Energy conversion and its efficiency in chemical processes can be treated in the same consistent way as energy conversion in power plants or other devices. For this purpose the energy potentially available as shaft work from all material entities entering or leaving a process has to be evaluated. The available energy will always depend on the properties of the environment, the environment being a source or sink of materials in exactly the same sense as it is a source or sink of heat. (Author)

**A76-25392** Becquerel effect solar cell. W. W. Anderson (Lockheed Research Laboratories, Palo Alto, Calif.) and Y. G. Chai (Ohio State University, Columbus, Ohio). *Energy Conversion*, vol 15, no 3-4, 1976, p 85-94. 34 refs. NSF Grant No. AER 74-13292.

The physical processes involved in the conversion of radiant energy to electrical and/or chemical energy in a semiconductor-electrolyte cell are described. These processes are then related to the problem of solar energy conversion and the desirable characteristics of such a cell are defined and potential efficiency of the device is shown to be comparable to that of a p-n junction solar cell. Preliminary measurements on a CdS cell gave 4.6 per cent external conversion efficiency for monochromatic excitation at an incident

power density of 0.4 mW/sq cm. When known internal device loss mechanisms were accounted for, a calculated 25 per cent conversion efficiency at the semiconductor electrode was obtained for the same monochromatic excitation. Electrode corrosion is shown to be the main obstacle to use of the Becquerel photovoltaic effect in a practical energy conversion device. Noncorrosive electrode reactions and charge exchange processes are known and may be of use. (Author)

**A76-25393** Review of candidate batteries for electric vehicles. S. Gross (Boeing Aerospace Co., Seattle, Wash.). *Energy Conversion*, vol 15, no 3-4, 1976, p 95-112. 206 refs.

Short summaries are presented of most of the battery systems that can be considered for electric vehicles. Many little known systems are included, some with little or no experimental background, and thus are worth considering for future research. Electric vehicle battery requirements are postulated, and based on these requirements the battery candidates are evaluated for their near-term and long-term prospects. (Author)

**A76-25394** Flow of fluids through porous, anisotropic, composite media with sources and sinks - Application to fuel cells. S. S. Sareen (Kennecott Copper Corp., Lexington, Mass.) and D. Gidaspow (Institute of Gas Technology, Chicago, Ill.). *Energy Conversion*, vol 15, no 3-4, 1976, p 113-120. 16 refs.

**A76-25396** The performance of electrogasdynamic expanders with slightly conducting walls. D. Wadlow and P. J. Musgrove (Reading, University, Reading, Berks., England). *Energy Conversion*, vol. 15, no 3-4, 1976, p 127-135. 7 refs. Science Research Council Grant No. B/SR/9898, Grant No. AF-AFOSR-74-2647.

In electrogasdynamic (EGD) devices the radial movement of charge carriers to insulating duct walls can produce high parasitic electric fields and greatly degrade the overall performance. In principle these parasitic fields may be reduced by constructing the EGD ducts from slightly conducting materials, but there is then a power loss due to current flow through the wall. This paper examines the effect of particle deposition velocity, wall resistivity, load resistance and aspect ratio, as well as fluid friction and gas density, on this resistive wall power loss and on the overall performance of EGD devices. Given suitable and realistic values of the relevant parameters, isentropic efficiencies in excess of 85 per cent are predicted at pressures of the order 10-40 atmospheres. (Author)

**A76-25398** Design and performance of a turbine suitable for an aerogenerator. O. Igra. *Energy Conversion*, vol 15, no 3-4, 1976, p. 143-151. 17 refs.

As a part of a large project aimed at finding the optimal configuration for an aerogenerator to exploit wind power, an investigation was launched to find a simple and reliable way to design a turbine to operate in a shrouded aerogenerator. To check the reliability of the proposed model for the turbine design, two turbines were built and tested. The tests covered a wide range of inlet and angular velocities and were conducted for several numbers of blades. The results of these tests clearly demonstrate that the proposed design scheme can be used with confidence for the design of a turbine that is intended to work inside an aerogenerator shroud. (Author)

**A76-25536 #** Introduction of an ionizable additive in the form of an aqueous solution of K<sub>2</sub>CO<sub>3</sub> of high temperature and concentration (Vvod ioniziruiushchiesia prisadki v vide vodnogo rastvora K<sub>2</sub>CO<sub>3</sub> vysokoi temperatury i konsentratsii). M. A. Styrikovich, A. V. Zagorodnikh, V. E. Kartun, I. L. Mostinskiy, R. S. Nekhoroshev, V. R. Pesochin, E. G. Smirnova, and V. I. Stepanov (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplotfizika Vysokikh Temperatur*, vol 13, Nov-Dec 1975, p 1261-1266. 5 refs. In Russian.



The advantages and shortcomings of introducing an additive in the form of aqueous solutions of  $K_2CO_3$  of 50 and 75% concentration into the combustion chamber of an open-cycle MHD facility are discussed. A system is proposed for producing and introducing an aqueous solution of  $K_2CO_3$  with a concentration of 73 plus or minus 1 at % at 360 C into the combustion chamber of a MHD facility of the type U-02. Other concentrations considered are 50 at % at 20 C and 50 at % at 270 C. The solutions are atomized in the combustion chamber by means of a pneumatic injector with a nozzle diameter of 0.5 mm. Experimental results are presented regarding measurement of the conductance of combustion products along the length of the combustion chamber, its dependence on temperature, pressure, and concentration of the solution introduced. The limits of normal regimes for the operation of the evaporator are determined. S D

**A76-25613**      **Transportation energy conservation policies**  
E Hirst (Oak Ridge National Laboratory, Oak Ridge, Tenn) *Science*, vol 192, Apr 2, 1976, p 15-20 19 refs

Using models based on energy consumption data for the 1960s, the energy savings for 1980 and 1985 as the result of four possible transportation policies are estimated. The analysis indicates that policies directly affecting automobile ownership and use (fuel economy standards and increased gasoline taxes) are shown to be much more effective than policies designed to increase the use of energy-efficient means of transportation (carpools and mass transit). The energy efficiencies of different urban and intercity transit systems are evaluated. C K D

**A76-25790 #**      **Cycle analysis of air-storage power plants.** K W. Li and N R Duckwitz (North Dakota State University, Fargo, N Dak) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, New Orleans, La., Mar 21-25, 1976, Paper 76-GT-41* 9 p 9 refs. Members, \$1 50, nonmembers, \$3 00

Underground air storage and gas turbines are combined to form an air-storage power plant for peak power generation. This generating system will lower the peak power generation cost at the time when the fuel price is high. The paper is intended to present thermodynamic analysis of various cycle arrangements. The air storage is of constant pressure type. In the paper, the parameters affecting the system performance characteristics are identified and studied. Also included are the effects of intercoolers and recuperators. The storage volume is predicted in terms of unit peaking power production.

(Author)

**A76-25850 #**      **Modern gas turbines for low Btu gas fuel operation.** R J Palmer and M R Burgess (Turbodyne Corp, St Cloud, Minn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, New Orleans, La., Mar 21-25, 1976, Paper 76-GT-117* 7 p. Members, \$1 50, nonmembers, \$3 00

A brief review of gas-turbine experience in operation on low-Btu gas is presented. The applicability of this experience to combustion technology associated with current generation turbines is discussed. The integration of a currently available turbine design into possible synthetic fuel systems is presented as an available alternative in generation-system planning. (Author)

**A76-25929**      **A net energy analysis of the use of Northern Great Plains surface mined coal in load center power plants.** T Ballentine (Florida, University, Gainesville, Fla) In *International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings Volume 1*

New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 1 17-1 to 7 17-1 15 refs

A net energy systems analysis is performed with the aid of energy systems diagrams to obtain an objective appraisal of the utility of surface-mined coal from the Northern Great Plains as an energy source for the United States. The theory and methodology of

energy systems analysis are described with emphasis on energy quality, the proper use of energy, and constraints imposed on coal developments in the Northern Great Plains, particularly inflation. The net energy ratio associated with the use of this coal for electrical-power generation at load centers is determined. It is concluded that (1) the present coal may become rapidly uncompetitive both energetically and economically with increasing distance of the load center from the mines, (2) one-third of the energy costs involved in mining and delivering the raw coal is represented by the diesel fuel required for these operations, and (3) the net energy ratio associated with bulk electricity at a load-center coal-fired power plant is 8 66 units of yield per unit of energy investment, as compared with a ratio of 30 1 for imported oil prior to 1973. F G M

**A76-25934**      **Power vs. pollution - A numerical approach.** H I Zeligler and M Funk (Harold I Zeligler Chemical and Environmental Consultants, Spring Valley, N Y) In *International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings Volume 1*  
New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 1 17-6 to 3 17-6 11 refs

A technique is proposed for the quantitative determination of the extent of environmental pollution resulting from the inefficiencies of different energy-transformation processes. In applying this technique, the amount of pollution energy is expressed by a pollution coefficient, defined as the total energy transformed less the useful energy. Pollution coefficients are calculated for petroleum combustion in an internal combustion engine, coal combustion in a steam-turbine electrical generator, and electrical-power generation by nuclear fission and nuclear fusion. The results obtained - 0 89, 0 82, 0 71, and 0 91, respectively - show that nuclear fission produces the least amount of pollution energy (71% of the energy transformed). Noting that even this low level will still lead to dangerous pollution of the environment, it is concluded that the only long-term solution to the world's energy-pollution problem is the use of solar energy. F G M

**A76-25960**      **The role of environmental data banks in energy resource development.** J E Jones and G E Smith (Kentucky, University, Lexington, Ky) In *International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings Volume 2*  
New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 1 25-6 to 5 25-6 13 refs

The paper presents a rationale for the implementation of an environmental data, information and literature bank which is being established for Kentucky's energy development program. Main concern of the bank is the environmental, social, and economic aspects of producing clean solid, liquid and gaseous fuels from coal. The data bank promotes information exchange between other related governmental and private projects and the energy development community. An overview of coal conversion - the potential magnitude of the industry, the environmental considerations, and the general types of information resources of environmental assessment - is presented. P T H

**A76-26007**      **Future energy development and related environmental monitoring.** S J Gage and G J D'Alessio (US Environmental Protection Agency, Office of Energy Minerals and Industry, Washington, D C) In *International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings Volume 2*  
New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 5 PIII-10 PIII

In response to national problems brought about by the energy crisis a report was submitted to the President of the US in December 1973. The report emphasized the need for an environmental assessment of new energy technologies. The report identified also objectives related to environmental monitoring and to associated monitoring methods. In connection with the resulting environmental research and development program, it is the objective of the Western

Energy/Environment Monitoring Study to provide current baseline information on air, water, and land quality in the Western U S Questions concerning the planning and the implementation of the monitoring study are discussed and attention is given to future energy-related monitoring needs  
G R

**A76-26047 #** **Problems of the environment, energy, and natural resources: The international aspect (Problemy okruzhaiushchei sredy, energii i prirodnikh resursov Mezhdunarodnyy aspekt)** K V Ananichev Moscow, Izdatel'stvo Progress, 1975 168 p 230 refs In Russian

The nature and extent of the environmental crisis is examined The environmental impact of urbanization and cultivation of large areas of land is considered The distribution of fuel and mineral resources is analyzed A comparative study is made of environmental problems confronting the U S S R. and the U S A Current programs of international cooperation on environmental issues are described, and specific targets for further collaborative efforts are discussed  
C K D

**A76-26067** **Optical methods in energy conversion; Proceedings of the Seminar, Rochester, N Y., June 23-25, 1975** Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers Edited by M Lubin Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings Volume 61), 1975 128 p \$32

Prospects for fossil, fission, and fusion power production in connection with the energy problem are considered along with optical focusing criteria for laser fusion, tunable lasers for isotope separation, optical diagnostics of combustion processes, fast X-ray shutters, and laser systems for high peak-power applications Attention is also given to neodymium glass lasers, design criteria for high power laser systems, the magnetic enhancement of laser amplifier energy storage capability, pulsed HF laser oscillator-amplifier experiments, and the focusing optics for high peak-power laser fusion systems  
G R

**A76-26068** **The energy problem - Prospects for fossil, fission, and fusion power production** L M Goldman (Rochester, University, Rochester, N Y) In *Optical methods in energy conversion, Proceedings of the Seminar, Rochester, N Y, June 23-25, 1975* Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p 2-8 6 refs

An investigation is conducted concerning the approaches which can be used to satisfy the future energy requirements of the U S The exhaustion of petroleum and gas supplies makes it necessary to replace these fuels The approaches considered include an increased use of coal An employment of shale oil is still somewhat problematical because of costs and environmental considerations A solution of the energy problem by the utilization of nuclear fission depends partly upon the willingness to accept certain risks A successful breeder reactor system would not be fuel limited for many hundreds of years The feasibility of controlled nuclear fusion has still to be demonstrated There are also a number of difficulties regarding the use of solar energy  
G R

**A76-26069** **Some basic energy and economic considerations for a laser ignited fusion reactor** R E Kinsinger (Rochester, University, Rochester, GE Research and Development Center, Schenectady, N Y) and E B Goldman (Rochester, University, Rochester, N Y) In *Optical methods in energy conversion, Proceedings of the Seminar, Rochester, N Y, June 23-25, 1975*

Palos Verdes Estates, Calif., Society of Photo Optical Instrumentation Engineers, 1975, p 16-24 15 refs

An investigation is conducted regarding the energy gain from thermonuclear fusion reactions in a properly prepared plasma sphere

A reactor energy balance is also studied It is concluded that the applicability of current published compression schemes for homogeneous targets to central station power production appears doubtful Economic factors are also examined A reduction of over three orders of magnitude in laser system cost appears necessary for an economic laser-fusion central station power plant The prospects of laser induced fusion could possibly be enhanced by an employment of fission-fusion hybrid schemes or the use of more sophisticated target designs  
G R

**A76-26071** **Optical diagnostics of combustion processes** M Lapp (General Electric Co, Schenectady, N Y) In *Optical methods in energy conversion, Proceedings of the Seminar, Rochester, N Y, June 23-25, 1975* Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p 42-50 22 refs

New measurement techniques for the study of combustion processes are currently receiving widespread attention because of their potential utility for combustion modeling Such modeling promises to offer many benefits for the design of advanced power sources with high efficiency and low pollutant emissions Here, we very briefly discuss several classes of optical methods for the measurement of combustion system properties We then describe in more detail the measurement of temperature, density, and composition by Raman scattering, and velocity by laser Doppler velocimetry, as examples of nonperturbing optical diagnostic probes currently under development for combustion measurements purposes (Author)

**A76-26074** **Neodymium glass lasers - A status report.** J M McMahon (U S Navy, Naval Research Laboratory, Washington, D C) In *Optical methods in energy conversion, Proceedings of the Seminar, Rochester, N Y, June 23-25, 1975*

Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p 64-67 10 refs ERDA-supported research

Attention is given to aspects of power amplification, energy storage/gain considerations, and power density limitations The most fundamental limit to pulse intensity is related to the avalanche ionization of any material in the beam Difficulties concerning the self-focusing effect, however, have limited achievable intensities to the range from 1 to 10 GW per sq cm Investigations concerned with an enhancement of pulse intensity are discussed It appears that the ultimate limit for neodymium glass lasers would be in the range from 5 to 10 TW per beam at overall efficiencies of the order of 0.1%  
G R

**A76-26076** **Magnetic enhancement of laser amplifier energy storage capability** J W Birkeland, P W Schreiber, and E D Beard (USAF, Aerospace Research Laboratories, Wright-Patterson AFB, Ohio) In *Optical methods in energy conversion, Proceedings of the Seminar, Rochester, N Y, June 23-25, 1975*

Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p 73-80 7 refs

This paper describes an experimental and theoretical investigation of the efficacy of an axial inhomogeneous magnetic field in increasing the ratio of stored energy to peak small signal amplification in a laser system based on the 2P1/2-2P3/2 atomic iodine transition The experiments were conducted with a photo-dissociative C3F7I-iodine laser oscillator placed in the fringing field of a solenoid By studying the variation with magnetic field of the time-integrated dissociative flux at the onset of lasing, energy storage enhancements up to 15 (at a peak field of 20 kilogauss) were inferred The results are compared with theoretical calculations of the phenomena which include the hyperfine structure of the transition The dynamic behavior and extraction efficiency of a master oscillator/power amplifier configuration utilizing this technique for increasing the maximum obtainable output energy per pulse are also discussed (Author)

**A76-26143** The shallow solar pond energy conversion system W C Dickinson, A F Clark, J A Day, and L F Wouters (California, University, Livermore, Calif.) (*International Solar Energy Society, Annual Meeting, Fort Collins, Colo., Aug 21-23, 1974*) *Solar Energy*, vol 18, no 1, 1976, p 3-10 8 refs ERDA-sponsored research

The concept of a shallow solar pond energy conversion system is presented as an effective way to produce large-scale electric power from solar energy. Water is used both for heat collection and heat storage. Inexpensive layers of weatherable transparent plastic over the water suppress heat loss to the environment. The hot water is stored in an insulated reservoir at night. The stored hot water heats a thermodynamic fluid, probably Freon 11, which drives a turbine and an electric generator. A 10 MWe plant built in the southwest would require a total area of about 2 sq km and could provide power for a community or a manufacturing process. The estimated busbar cost of electricity for a shallow solar pond system is 56 mills/kWh. This cost could be reduced with the development of improved and cheaper plastics and more efficient turbines. Another potentially important use of shallow solar ponds is to provide process hot water, up to the boiling point, for industrial and commercial purposes. Also, a shallow solar pond could provide hot water for the space heating, air conditioning and hot water needs of a community of homes.

(Author)

**A76-26144** The effect of heat loss on solar heating systems R T Nash and J W Williamson (Vanderbilt University, Nashville, Tenn.) (*International Solar Energy Society, Annual Meeting, Fort Collins, Colo., Aug 21-23, 1974*) *Solar Energy*, vol 18, no 1, 1976, p 11-20 14 refs

The effect of structural heat losses on the performance of a solar heating system is examined from the technical and economic points of view. A pictorial method is used to visualize the relationships between the dominant physical factors: the structural heat loss coefficient, the collecting area of the solar collector, the incident solar flux and the external temperature. The economic factors which contribute to the total cost of heating a dwelling are discussed. A method for identifying cost effective combinations of solar energy gain, structural energy loss and thermal energy storage is developed. The requirements for residential heating throughout the United States are considered.

B J

**A76-26146** Solar thermal power system based on optical transmission L L Vant Hull and A F Hildebrandt (Houston, University, Houston, Tex.) (*International Solar Energy Society, Annual Meeting, Fort Collins, Colo., Aug 21-23, 1974*) *Solar Energy*, vol 18, no 1, 1976, p 31-39 15 refs NSF-supported research

In the solar tower concept, a multiplicity of mass produced heliostats reflect sunlight to an elevated central receiver where it is absorbed as heat and transported to the ground. This paper presents the results of an NSF/RANN funded study of the technical and economic feasibility of this approach for powering a 10-500 MW electrical generator. A computer model of the collector system is described and results illustrative of the high performance of the system are presented. Detailed heliostat design studies have shown a silvered float glass mirror supported on a welded steel grid and guided in elevation and azimuth by a receiver oriented optical sensor and feedback circuit can be mass produced economically. Conceptual designs of the tower and receiver show them to be a minor cost component. With careful attention to thermal cycle fatigue, the receiver will present only a minor technical risk. The cost of electricity in the intermediate load range is competitive with the upper range of fossil fuel costs.

(Author)

**A76-26147** Solar space heating at high altitude conditions J P Gupta and R K Chopra (Defence Laboratory, Jodhpur, India) *Solar Energy*, vol 18, no 1, 1976, p 51-57 15 refs

Results of field trials on a solar space heating device at an altitude of 3.5 km and under sub-zero ambient conditions, down to

-17 C are presented. The equipment does not require auxiliary power. It is based on automatic thermosiphon circulation of anti-freeze solution and subsequent radiant heating of living space. The equipment has been tried on a living room of dimensions 3.75 x 2.40 x 2.40 m and results are compared with those for kerosene and electrically-heated control rooms. A solar collector area of 6.5 sq m provides heat equivalent to 17 kWh of electricity or 7 liters of kerosene per day. Apart from economic advantage the device avoids air pollution and fire hazards.

(Author)

**A76-26150** New potentialities for international co-operation in the field of solar energy and its applications B H Chatel (United Nations, Office for Science and Technology, New York, N Y.) (*International Solar Energy Society, Annual Meeting, Fort Collins, Colo., Aug 21-23, 1974*) *Solar Energy*, vol 18, no 1, 1976, p 69-71

The paper reviews the role of United Nations' agencies in the field of solar energy. Developments in the period 1950-1970 are touched upon, with particular attention paid to the 'arid zones' program sponsored by UNESCO and the international conference in Rome in 1961 on solar, wind and geothermal energy. The educational, research, information-dissemination, and technical assistance activities of UNESCO in the field of solar energy in the 1970s are discussed, with emphasis on the international conference 'Sun in the Service of Mankind' in Paris in 1973. The role of the United Nations Environment Program (UNEP) and that of the Advisory Committee on the Application of Science and Technology to Development (ACAST) are considered. Research and development topics are classified in six categories: improvement of small solar devices, heating and cooling of buildings, production of bulk electric power, solar energy biological conversion, water storage of solar energy and space applications.

B J

**A76-26151** Energy-storage requirements reduced in coupled wind-solar generating systems J W Andrews (Long Island University, Southampton, N Y.) *Solar Energy*, vol 18, no 1, 1976, p 73, 74

A Monte Carlo computer model has simulated the operation of a system of combined solar and wind powered generators, using varying proportions of wind and solar power on different runs, to test whether the combination of the generators would result in a reduction in the needed capacity for energy storage. The basic data which results from each year's run of the model is the minimum energy-storage capacity needed to meet demand at all times during the year's operation. This will vary from run to run since random changes in sunlight intensity and wind velocity due to changes in the weather are superimposed on the diurnal and annual variations caused by the rotation and orbital motion of the earth.

B J

**A76-26320 #** Methodological aspects of reliability analysis of large-scale power systems (Metodicheskie voprosy issledovaniia nadezhnosti bol'shikh sistem energetiki) Iu N Rudenko (Akademiia Nauk SSSR, Energeticheskii Institut, Irkutsk, USSR) *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Jan-Feb 1976, p 7-17, Discussion, p 17-24 19 refs In Russian

The problem of ensuring reliable large scale electric-power, gas, fuel, coal, heat, and water supply for cities and industrial centers is examined. The possibility of developing a general methodological approach to the stability analysis of specialized power systems is discussed, and the current status of methods used in reliability analysis is briefly reviewed. The principal problems involved in ensuring reliability of large scale power supply systems are formulated, and scientific and engineering work in this field is noted.

V P

**A76-26321 #** Reliability aspects of electric power systems (Problemy nadezhnosti elektroenergeticheskikh sistem) I A Aleksandrov, Iu N Rudenko (Akademiia Nauk SSSR, Energeticheskii Institut, Irkutsk, USSR), V A Venikov, V V Mogirev, S A Sovolov, and V D Shlimovich *Akademiia Nauk SSSR, Izvestiia*,

*Energetika i Transport*, Jan-Feb 1976, p 38-45, Discussion, p 45-55 12 refs In Russian

Problems are formulated which have to be solved in theoretical and methodological studies concerning the reliability of power supply systems. The reliability criteria currently used at various stages of designing electric power systems are analyzed, along with methods of obtaining optimal solutions. Some scientific and engineering aspects of the problems under consideration are examined

V P

**A76-26322 # Reliability and redundancy problem for an integrated gas supply system (Problema nadezhnosti i rezervirovaniia edinoi gazosnabzhaushchei sistemy)** A I Garliauskas, S V Gerchikov, N I Il'kevich, and Iu A Kuznetsov *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Jan-Feb 1976, p 96-106, Discussion, p 106-108 18 refs In Russian

Some aspects of analyzing the reliability of a gas supply system that covers an enormous territory and incorporates gas extraction, storage, and transport facilities (pipeline) are examined, along with the importance of this problem in optimal planning and design. Means of improving system reliability and achieving redundancy of the system elements by providing auxiliary gas sources are examined. The principal methodological problems of system analysis and optimization are formulated, and the directions of future scientific and engineering research are indicated

V P

**A76-26323 # Reliability aspects of a crude oil supply system (Voprosy nadezhnosti sistemy neftesnabzheniia)** V L Berezin, K E Rashchepkin, and E M Iasin *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Jan-Feb 1976, p 128-138, Discussion, p 139-145 16 refs In Russian

The structure and characteristics of a large-scale integrated oil supply system are discussed, and the basic problems involved in providing reliable system operation are formulated. Criteria for use in reliability planning and design are given, and methods of establishing criteria are outlined. Particular attention is given to the solution of reliability problems under geographically and climatically difficult conditions. The directions of studies aimed at improving the reliability of the supply system and its elements are noted

V P

**A76-26324 # Reliability problem of heat-supply systems with hot redundancy (O probleme nadezhnosti sistem teplosnabzheniia s nagruzhennym rezervirovaniem)** V Ia Khasilev, A P Merenkov, B M Kaganovich, and N A Vinogradov *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Jan-Feb 1976, p 146-153, Discussion, p 154-160 10 refs In Russian

The reliability and other operational characteristics of a heat-supply system employing two heat sources simultaneously are examined, along with the calculation of system reliability by methods of reliability theory. Problems arising from the fact that the use of a second heat source improves reliability (at a diminished heat supply in case of breakdowns) but at the same time increases the probability of element malfunction are studied, and the overall effectiveness of the system is assessed. Optimal synthesis and optimal designing of heat-supply systems are discussed

V.P

**A76-26449 Energy The solar-hydrogen alternative** J O Bockris (South Australia, Flinders University, Adelaide, Australia) New York, Halsted Press, 1975 381 p 579 refs \$27.50

Characteristics, consequences, and implementation of a hydrogen economy are considered and an investigation is conducted regarding the time available for the research, development, and building of a new energy base. Attention is given to coal as a source of hydrogen, sources of abundant clean energy, basic concepts of solar energy, the approach to a technology using solar energy, methods for the transmission of energy over long distances, the large scale production of hydrogen fuel from water, the storage of massive amounts of energy, safety aspects, materials aspects of a hydrogen economy, modes of transduction and usage of hydrogen, and some consequences of the availability of massive quantities of hydrogen and oxygen. Aspects of hydrogen-fueled transportation are discussed along with environmental effects and alternative economies

G R

**A76-26498 Net energy analysis - An economic assessment** D A Huettnner (Oklahoma, University, Norman, Okla.) *Science*, vol 192, Apr 9, 1976, p 101-104 20 refs

The assumptions and concepts of net energy analysis are outlined, and the conclusions drawn from net energy analyses are compared with those obtained by economic analysis. Net energy is defined as the amount of energy remaining for consumer use after the energy costs of finding, producing, upgrading, and delivering the energy have been paid. All inputs have an energy measure to account for their total value. When a resource is exhausted, the energy required to synthesize a substitute is included. It is shown that economic analysis and net energy analysis yield identical results if inputs are priced according to their energy content alone, however, the assumption that energy is the ultimate limiting factor would lead to distortions in the allocations of income, investments, and natural resources if net energy analysis were used on a long-term basis. The possibility of the development or discovery of new, quasi inexhaustible energy sources also undermines the utility of net energy analysis

C K D

**A76-26633 Power sources 5, Research and development in non-mechanical electrical power sources, Proceedings of the Ninth International Symposium, Brighton, Sussex, England, September 17-19, 1974** Symposium sponsored by the Joint Services Electrical Power Sources Committee of England. Edited by D H Collins. London, Academic Press, Inc (London), Ltd, 1975 752 p \$39.20

Theoretical analyses, design studies, and test results are presented for a wide variety of power sources not featuring rotating machinery. Electrochemical batteries, solar cells, thermoelectric generators, and thermomechanical generators are reported on. Topics covered include a zinc-bromine storage battery for electric vehicles, fast charging of sealed nickel-cadmium batteries, the air electrode at low temperatures, a sixty-minute thermal battery, lithium/poly-carbon monofluoride cylindrical type batteries, and some experimental thermomechanical generators based on the Stirling principle

P T H

**A76-26645 The thermo-mechanical generator** E Cooke-Yarborough, E Franklin, J Geisow, R Howlett, and C West (Atomic Energy Research Establishment, Electronics and Applied Physics Div, Harwell, Berks, England) In *Power sources 5, Research and development in non-mechanical electrical power sources, Proceedings of the Ninth International Symposium, Brighton, Sussex, England, September 17-19, 1974*

London, Academic Press, Inc (London), Ltd, 1975, p 643-648, Discussion, p 648, 649 8 refs

Research work on thermomechanical generators based on the Stirling engine is briefly summarized. One propane-heated engine is mentioned which on a 3-day fuel consumption run consumed 22 g of fuel per hour and delivered 31.75 W ac continuously, corresponding to an overall efficiency of 10%. Such a machine would require less than a quarter of the fuel required by a typical propane-heated thermoelectric generator delivering the same power. Another machine was equipped with a nuclear radiation shield to make it suitable for heating with a strontium 90 radio-isotope heat source. Tests with the shield electrically heated show that with 180 W thermal in the radiation shield, 18 W ac at 80 Hz can be obtained at the output of the alternator. Consequently, it could be expected to obtain twice as much electrical power from a given radio isotope source as from the same source incorporated in a thermoelectric generator

P T H

**A76-26670 Propulsion systems (Triebwerksanlagen)** W Alvermann (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Antriebssysteme, Braunschweig, West Germany) *VDI-Z*, vol 118, no 6, Mar 1976, p 287-291 41 refs In German

The current status of development of aircraft engines is examined, taking into account a search for new fuels, economic demands for aircraft engines, the development of new engines with

more favorable environmental characteristics, plans for the development of an acceptable engine for supersonic aircraft, and general studies concerned with the enhancement of the operational efficiency of the engine. Attention is given to current and future jet engines, turbine engines for helicopters, piston engines, and ramjet engines. G R

**A76-26689 Tungsten trioxide as a photoanode for a photoelectrochemical cell /PEC/** G Hodes, D Cahen, and J Manassen (Weizmann Institute of Science, Rehovot, Israel) *Nature*, vol 260, Mar 25, 1976, p 312, 313

The paper addresses the problem of finding a semiconductor electrode for a PEC with an optical band gap small enough to allow it to absorb a reasonably large portion of the solar spectrum, at the same time being stable to photocorrosion. It is shown that WO<sub>3</sub> meets these requirements although it is not very efficient at solar wavelengths. WO<sub>3</sub> electrodes were prepared either by heating tungsten to form a layer of yellow WO<sub>3</sub>, or by spraying ammonium tungstate on conducting glass and heating at 500 C to decompose the tungstate. Volt-ampere curves are plotted for a WO<sub>3</sub> photoanode in the dark and in illumination approximating sunlight. The spectral response of the photocurrent of a WO<sub>3</sub> electrode on conducting glass is compared with that of polycrystalline TiO<sub>2</sub> (up to now the only photoanode material). B J

**A76-26703 Solar energy collection using beam waveguides.** J C Daly (National Institute for Higher Education, Limerick, Ireland) *Applied Optics*, vol 15, Apr 1976, p 855, 856 7 refs

Beam waveguides can be used for the transmission of large quantities of solar energy for use in thermal processes. Mirror reflectivities limit solar energy propagation over waveguides to about 10 km. High energy collimated beams can be produced by an array of sun-tracking heliostats and an array of smaller mirrors mounted on a tower. Calculations indicate that collimated solar beams 10 m in diameter and carrying 4.8 MW are feasible. C K D

**A76-26719 Transparent heat mirrors for solar-energy applications** J C C Fan and F J Bachner (MIT, Lexington, Mass.) *Applied Optics*, vol 15, Apr 1976, p 1012-1017 8 refs USAF-sponsored research

Transparent heat-mirror films, which transmit solar radiation but reflect IR thermal radiation, have potentially important applications in solar/thermal/electric conversion, solar heating, solar photovoltaic conversion, and window insulation. RF sputtering was used to prepare two types of films: TiO<sub>2</sub>/Ag/TiO<sub>2</sub> and Sn-doped In<sub>2</sub>O<sub>3</sub>. To characterize the properties of heat-mirror films for solar energy collection, two parameters are defined: the effective solar absorptivity and the effective IR emissivity. For the Sn-doped In<sub>2</sub>O<sub>3</sub> films, the ratio of the effective values is comparable to the ratio of the values reported for the leading selective absorbers. Even higher values of the effective ratio are obtained for the TiO<sub>2</sub>/Ag/TiO<sub>2</sub> films. (Author)

**A76-26846 # Liquefied natural gas, in France and throughout the world (Le gaz naturel liquéfié, en France et dans le monde)** P Asselineau (Gaz de France, Paris, France) *Palais de la Découverte, Revue*, vol 4, Apr 1976, p 27-44 In French

The thermodynamic and physical properties of liquefied natural gas, consisting primarily of methane, are outlined. The processes involved in liquefaction, storage, transport, and regasification are discussed. Capacities and locations of major production plants and their terminals are summarized, and experimental programs investigating the use of liquefied natural gas as fuel for internal combustion engines are described. C K D

**A76-27122 Electrical machines with superconductors III - Turbogenerators** G Bogner and D Kullmann (Siemens AG, Forschungslaboratorien, Erlangen, West Germany) *Siemens Forschungs- und Entwicklungsberichte*, vol 5, no 1, 1976, p 10-16 13 refs. Research supported by the Bundesministerium für Forschung und Technologie

A description is given of the basic concept of a superconducting generator and a summary of the state of the art in this field is provided. After an analysis of the limitations of conventional turbogenerators, it is concluded that the output limits of conventional machines might possibly be reached within 15 or 20 years. The basic construction of superconducting generators is considered. In such generators only the rotating excitation winding uses superconducting components. Attention is given to the rotor with the helium cooling system, the armature winding, and the methods used for the screening of the relatively large stray fields. The electrical operating characteristics of the generator are also discussed. G R

**A76-27123 Geothermal energy** E R Berman (Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No 4), 1975 348 p \$24

The use of geothermal energy as an alternate resource is considered, taking into account system characteristics, costs, environmental impact, advantages and disadvantages, recent exploration techniques, research and development in the U.S., and a survey of major geothermal installations. Soviet geothermal research and development is discussed along with dry geothermal reservoirs, the use of nuclear explosives in the plowshare concept, a study of geothermal resources of California, the methods of energy recovery from hot brine deposits, feasibility studies for three areas of the U.S., and a number of proposed research projects. G R

**A76-27125 Coal conversion technology I** Howard Smith and G J Werner (Millmerran Coal Pty., Ltd., Brisbane, Australia) Park Ridge, N.J., Noyes Data Corp. (Chemical Technology Review, No 66), 1976 153 p 155 refs \$24

Coal conversion processes for the production of solid, liquid, and gaseous products are considered, taking into account catalytic coal liquefaction, the clean coke process, the extractive-coking process, the Fischer-Tropsch synthesis, Garrett's coal pyrolysis, gas extraction, the hydro-cracking process, and intermediate hydro generation. High BTU coal gasification processes are discussed and a description is given of low and medium BTU coal gasification processes. Attention is given to the air products recycle process, electric arc gasification, electrofluidic gasification, liquid phase methanation, and two-state fluidized gasification. G R

**A76-27132 Characteristics of a water absorber in front of a silicon solar cell** T I Chappell and R M White (California, University, Berkeley, Calif.) *Applied Physics Letters*, vol 28, Apr 15, 1976, p 422, 423 13 refs NSF Grant No ENG 73-08300A01

In a system for converting sunlight to both electric power and heat, a selective absorber between the sun and a semiconductor solar cell may provide a substantial thermal output without seriously reducing the electrical output. Calculations for water in front of a typical silicon solar cell show, for example, that a water layer 1-cm thick absorbs 16.3% of the incident energy (chiefly photons having energies below the energy gap of silicon), while reducing the electric power output only from 13.8% to 13.1%. Experimental results confirm this finding. (Author)

**A76-27136 Thin-film conducting microgrids as transparent heat mirrors** J C C Fan, F J Bachner, and R A Murphy (MIT, Lexington, Mass.) *Applied Physics Letters*, vol 28, Apr 15, 1976, p 440-442 9 refs USAF-sponsored research

A transparent heat mirror for solar-energy applications has been fabricated by chemically etching a Sn-doped In<sub>2</sub>O<sub>3</sub> film to form a transparent conducting microgrid. For square openings 2.5 microns on a side, separated by lines 0.6 micron wide, the solar transmission increases from 0.8 for the original continuous film to 0.9 for the microgrid. Although 65% of the area of the film is removed by etching, the infrared reflectivity decreases by only 9%, from 0.91 to 0.83. A smaller decrease in infrared reflectivity may be possible if materials with higher optical conductivity are used. (Author)

**A76-27145 Solar absorptance and emittance properties of several solar coatings** R B Petit and R R Sowell (Sandia

Laboratories, Albuquerque, N Mex ) *Journal of Vacuum Science and Technology*, vol 13, Mar Apr 1976, p 596-602 26 refs ERDA-supported research

Solar absorptance ( $\alpha_s$ ) and total hemispherical emittance ( $\epsilon_{th}$ ) properties of two potential solar selective coating systems are reported. The first coating system studied is a semiconductor-pigmented paint which consists of a high-temperature silicone binder mixed with small particles of Ge, Si, or PbS. Although most of the paints have  $\alpha_s$  values above 0.90, all have high  $\epsilon_{th}$  values due to the high emittance of the silicone binder. The second system studied is electroplated films of 'black nickel' and a proprietary 'black chrome'. Increasing the plating time initially increases both  $\alpha_s$  and  $\epsilon_{th}$ , however, for long plating times, there is no improvement in  $\alpha_s$ , while  $\epsilon_{th}$  continues to increase. By increasing the surface roughness of nickel-plated substrates, the solar absorptance can be increased while maintaining approximately the same total hemispherical emittance. The coatings show minor decreases in solar absorptance at angles of incidence up to 75 deg from normal. (Author)

**A76-27698** Oil from beneath Britain's seas. P Kent (Natural Environment Research Council, London, England) *Contemporary Physics*, vol 17, Mar 1976, p 169-172

This paper summarizes the exploration, engineering and environmental problems involved in the discovery and development of North Sea oil. The discovery of the oil and gas fields, with a notably high success ratio, depended on the development of highly sophisticated methods of seismic survey and data analysis. The subsequent engineering operations have involved technology well beyond previous practice as regards the use of equipment, the water depth and a highly adverse environment. (Author)

**A76-27699** Superconducting magnets in the world of energy, especially in fusion power. P Komarek (Karlsruhe, Universität, Gesellschaft für Kernforschung mbH, Karlsruhe, West Germany) *Cryogenics*, vol 16, Mar 1976, p 131-142 62 refs

A review is presented concerning the prospects of utilizing superconducting magnets in various fields of the new energy technology. It is supposed that only two industrial applications of the magnets are feasible in the near future: in MHD generators, where the magnet is to be of a dipole type with warm aperture and in homopolar machines where the magnet is to be a solenoid. The use of a superconducting rotating dipole or quadrupole winding in synchronous machines is also considered. The utilization of superconducting magnets in fusion reactors is considered touching upon the use of pulsed superconducting windings in tokamaks and the use of 'Yin Yang' or baseball coil configurations in mirror confinement devices. The applications of superconducting energy storage for load levelling in the grid and for pulsed operation fusion magnets is examined. The reliability and availability aspects of superconducting energy technology are considered. B J

**A76-27784** Wind power. D M Simmons Park Ridge, N J, Noyes Data Corp (Energy Technology Review, No 6), 1975 316 p 31 refs \$24

The state-of-the-art of wind conversion and storage system and wind machine design is reviewed. The properties of wind, based on the results of numerous wind studies, are discussed together with method of wind measurement and the selection of sites for wind power systems. Wind power research and development in the United States, Canada, the USSR, Germany, Denmark, France, Great Britain, Sweden, and several African and Asian countries is summarized. Commercially available wind power equipment and wind machine designs are described. C K D

**A76-27800 #** R-32 energy storage propulsion system. C H Weinstein (AirResearch Manufacturing Co., Torrance, Calif.) In *Transpo L A Economic leverage for tomorrow*, Proceedings of the Fourth Annual Symposium, Los Angeles, Calif., November 12, 1975

North Hollywood, Calif., Western Periodicals Co., 1975, p 303-313

The described approach can be used to reduce energy consumption for transit cars. Energy is saved during car braking by storing the kinetic energy of the moving car in a flywheel rather than losing it through heat by dynamic or friction braking. The stored energy is then utilized for subsequent car acceleration. The energy storage system considered has been installed on two New York City Transit Authority R 32 subway cars for an evaluation of its suitability. G R

**A76-27801 #** Economic fueling of L.A. transportation in the post-fossil era. G A Hoffman (Southern California, University, Los Angeles, Calif.) In *Transpo L A Economic leverage for tomorrow*, Proceedings of the Fourth Annual Symposium, Los Angeles, Calif., November 12, 1975. North Hollywood, Calif., Western Periodicals Co., 1975, p 314-320

An investigation is conducted regarding the distant-future options open to Southern California for energizing its vehicles from local permanently renewable resources. The electrification of the four busways converging into downtown L A is considered along with the utilization of solar energy and the synthesis of automotive fuels. In a study of the suitability of various nonfossil fuels it is concluded that octane-rich gasoline like fuels could prove economically optimal for passenger cars. Southern California's fuel industry of the distant future is discussed. G R

**A76-27896** Solar energy for heating and cooling of buildings. A R Patton Park Ridge, N J, Noyes Data Corp (Energy Technology Review, No 7), 1975 337 p 65 refs \$24

Components for solar heating and cooling systems are considered, taking into account collectors, heat storage, and heating and air conditioning equipment. A chronology of experimental systems is given and descriptions of experimental systems are provided. Simulated systems are discussed along with feasibility studies for large scale applications, and studies conducted by General Electric, Westinghouse, and TRW. A review is given of a project involving the first integrated system for the heating and cooling of a building by the use of solar energy. A section on available solar hardware has been included. G R

**A76-27897** Thermal energy from the sea. A W Hagen Park Ridge, N J, Noyes Data Corp (Energy Technology Review, No 8, Ocean Technology Review, No 5), 1975 156 p 17 refs \$24

The thermodynamic basis for the production of sea thermal power is briefly outlined, and an overview is given of projected costs. Site and systems analysis for solar sea power plants (SSPP's) is discussed, and technical, environmental, and economic problems associated with different aspects of sea thermal power production are summarized. Several possible SSPP designs are described. A design concept developed at the University of Massachusetts is based on a closed Rankine power cycle utilizing propane as the working fluid. A similar concept developed at Carnegie-Mellon University uses ammonia as the working fluid. C K D

**A76-27900 \* #** Design, economic and system considerations of large wind-driven generators. G E Jorgensen, M Lotker (Northeast Utilities Service Co., Hartford, Conn.), R C Meier, and D Brierley (Kaman Aerospace Corp., Bloomfield, Conn.) *Institute of Electrical and Electronics Engineers, Winter Power Meeting, New York, N Y, Jan 25-30, 1976, Paper 9 p* Contract No NAS3-19404

The increased search for alternative energy sources has led to renewed interest and studies of large wind-driven generators. This paper presents the results and considerations of such an investigation. The paper emphasizes the concept selection of wind-driven generators, system optimization, control system design, safety aspects, economic viability on electric utility systems and potential electric system interfacing problems. (Author)

**A76-27971** Effect of national transportation/energy policy on regional transportation phenomena. J E Flory, M A

Pearce, P J Hunter, and N J Mosman (California, University, Davis, Calif) *Simulation*, vol 26, Apr 1976, p 105-110 50 refs NSF Grant No GI-27

Most regional transportation modeling studies have focused on microlevel phenomena operating within the region In contrast, the model presented in this paper utilizes a hierarchical causality approach to examine the impact of higher level (i.e., national) policies on macrolevel regional transportation characteristics Specifically, the individual and joint effects of national trends in gasoline price, transit funding, and fuel economy of automobiles are examined with respect to their influence on two Sacramento regional variables transit usage and transportation fuel consumption The authors conclude that given the uncertain future of causal forces that are beyond the region's control (e.g., gasoline price), a macrolevel analysis may be a more judicious use of limited transportation planning resources (Author)

**A76-28028 \* # Photovoltaic Test and Demonstration Project** A F Forestieri, H W Brandhorst, Jr., and J N Deyo (NASA, Lewis Research Center, Cleveland, Ohio) *Centre National d'Etudes Spatiales and Centre National de la Recherche Scientifique, International Conference on Solar Electricity, Toulouse, France, Mar 1-5, 1976, Paper 5 p*

The Photovoltaic Test and Demonstration Project was initiated by NASA in June, 1975, to develop economically feasible photovoltaic power systems suitable for a variety of terrestrial applications Objectives include the determination of operating characteristic and lifetimes of a variety of solar cell systems and components and development of methodology and techniques for accurate measurements of solar cell and array performance and diagnostic measurements for solar power systems Initial work will be concerned with residential applications, with testing of the first prototype system scheduled for June, 1976 An outdoor 10 kW array for testing solar power systems is under construction C K D

**A76-28226 Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volumes 1 & 2** Workshop sponsored by the Styrelsen for Teknisk Utveckling and Swedish State Power Board Edited by O Ljungstrom (Styrelsen for Teknisk Utveckling, Stockholm, Sweden) Stockholm, Styrelsen for Teknisk Utveckling, 1976 Vol 1, 220 p, vol 2, 216 p

A review of important past developments in the field of wind energy systems is presented Advanced horizontal axis rotor concepts for wind machines are studied in detail together with advanced vertical axis rotor concepts Wind energy conversion and storage are discussed with consideration of storage via electrolysis using high pressure hydrogen, pumped hydro-storage, air storage concepts and the use of synchronous flux generators and dc generator/thyristor converter in wind power systems The economics of wind power is considered as are international research and development programs concerning wind power B J

**A76-28227 # French contribution to wind power development - By EDF 1958-1966** R Bonnefille (Electricite de France, Chatou, Yvelines, France) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1* Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 1-17 to 1-22

**A76-28228 # Review of the UK wind power programme 1948-1960** A H Stodhart (Electrical Research Association, Leatherhead, Surrey, England) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1* Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 1 23 to 1 34 21 refs

The UK wind power program consisted of three parts (1) the wind survey and site selection program covering over 100 different sites in the UK and including suitable instrumentation for wind survey purposes, (2) the development of prototype machines, and (3)

the establishment of testing programs for these machines Photographs are presented of five windpowered generators the 10 kW prototype installed at Cranfield, the 25 kW machine on the Isle of Man, and three 100 kW machines on Costa Hill, at St Albans and on the Isle of Man An appendix is included providing a list of Electrical Research Association published reports on wind power generation B J

**A76-28229 # Review of development in West-Germany** U Hutter (Stuttgart, Universitat, Stuttgart, West Germany) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1* Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 1 51 to 1-72 6 refs

The paper reviews work done in the field of windpowered generators in Germany from the 1920s through the 1950s Examples are taken from work done by Hermann Honnef, by the Ventimotor GmbH in Weimar and the Allgaier Werke in Utingen In 1931 and 1932 Honnef published the results of his studies on the outlay of a multirotor windpowered generator system with a total rated power of almost 60 megawatts The height of the tower was 250 m and it was planned to support three individual rotor systems of 160 m each The system was a gearless one using large ring generators The Ventimotor GmbH project in the 1940s consisted of a 50 kW ac unit with a rotor diameter of 18 m, a rotor rated speed of 4 5 m/s and an elevation of the rotor axis of 22 m above the ground In the early 1950s Allgaier-Werke developed a standard unit with a pitch controlled 3- and later a 2-blade high tip speed ratio rotor The machine, including in one block rotor hub, gear, generator and an automatic positioning system was adjusted to a tubular tower B J

**A76-28230 # Optimum design concept for windelectric converters** U Hutter (Stuttgart, Universitat, Stuttgart, West Germany) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1* Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 2-3 to 2-23 6 refs

The optimal design criteria of windpowered generators relate to four parameter groups (1) the outlay of the rotor blades, (2) the correlation of the rated power output, the magnitude of the disk area swept by the rotor and wind velocity statistics, (3) the parameters of energy conversion, and (4) the absolute values of the magnitude of individual units and the relative magnitude of system components such as tower height in relation to rotor diameter Graphs are plotted for the optimal lift/drag ratio of rotor airfoils and for the optimal power coefficients versus rotor blade tip speed The effect of power disk load on energy quality is calculated B J

**A76-28231 # The NOAH wind energy concept** W Schonball In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1* Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 2-25 to 2-30

The NOAH wind rotor system (a 70 kW double-rotor wind generator concept) is described The system consists of the following two contra-rotating propellers each with 5 blades of fixed pitch (the generator is integrated with the propeller system), a multipole generator without power transmitting couplings and with the field and the poles directly connected to the propellers, with the EM field of the generator used as a braking system, an electronic regulating system controlling the rotor speed and modulating the power output to ac or dc as necessary, a wind-operated directional system which keeps the main rotor head in the wind and which is also used as a security device to turn the main rotors away from the wind when speeds exceed the rated maximum B J

**A76-28232 # Aerodynamic design of horizontal axis wind generators** O Holme (Saab Scania AB, Linkoping, Sweden) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1* Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 2 31 to 2 35

A blade element vortex theory taking account of the finite number of blades (a propeller theory) is used to perform the aerodynamic design of windpowered generators and to calculate their aerodynamic loads and performance. A complete system of equations for the torque and drag coefficient of the blade element of a windmill at a given pitch angle and speed ratio is calculated on the basis of velocity, force and geometrical relations for the blade element. Corresponding coefficients for the complete windmill are obtained by integrating over the blade radius and the method is extended to cover the effects of wind shear, oblique flow and pitch and yaw oscillations. The maximum power coefficient at a given speed ratio and a given number of blades is used as a windmill optimization criterion. B J

**A76-28233 #** Some marketing and technical considerations of wind power. P B S Lissaman (AeroVironment, Inc., Pasadena, Calif.) In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 2 37, 2 39 to 2-58. 7 refs.

A brief review of the wind power market situation is given. Three viable windmill classes are identified, in the power ranges of 0.1, 1, and 1,000 kW. Judging by the public response, and some very preliminary market surveys, the demand for the two smaller units appears attractive for private venture capital. Some common characteristics of potential purchasers for the 1 to 5 kW systems are identified. A basic aerodynamic performance analysis for the crosswind type rotor is outlined, showing that it is intrinsically less efficient aerodynamically than the wind axis (propeller) rotor. A greatly simplified structural comparison is made, also showing the crosswind type to be comparable but slightly less efficient structurally than the propeller type. It is stressed that this tentative conclusion is based on an incomplete technical analysis and ignores other considerations, such as total cost or esthetics. (Author)

**A76-28234 \* #** Structural analysis of wind turbine rotors for NSF-NASA Mod-0 wind power system. D A Spera (NASA, Lewis Research Center, Cleveland, Ohio). In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 2 63 to 2-99. 7 refs.

Preliminary estimates are presented of vibratory loads and stresses in hingeless and teetering rotors for the proposed NSF NASA Mod-0 wind power system. Preliminary blade design utilizes a tapered tubular aluminum spar which supports nonstructural aluminum ribs and skin and is joined to the rotor hub by a steel shank tube. Stresses in the shank of the blade are calculated for static, rated, and overload operating conditions. Blade vibrations were limited to the fundamental flapping modes, which were elastic cantilever bending for hingeless rotor blades and rigid body rotation for teetering rotor blades. The MOSTAB C computer code was used to calculate aerodynamic and mechanical loads. The teetering rotor has substantial advantages over the hingeless rotor with respect to shank stresses, fatigue life, and tower loading. The hingeless rotor analyzed does not appear to be structurally stable during overloads. (Author)

**A76-28235 #** Reduction of wind powered generator cost by use of a one bladed rotor. R R Pruyne and W Wiesner (Boeing Vertol Co., Philadelphia, Pa.) In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 2-101, 2 103 to 2 131.

Windpowered generator designs studied were sized for an output power of 1000 kW. The one blade design seems to have significant design and cost advantages (a 30% reduction) over two or more bladed rotors. The one-bladed design has the potential of reducing acquisition cost to \$680 per available kW if the unit is located in a region with mean surface winds of 15 mph. Using the one bladed concept, it is possible to halve the minimum solidity of the rotor, to greatly simplify the rotor hub and to reduce blade costs almost in

half. Vibratory loads of the one bladed rotor appear to be compatible with a 30 year design life. B J

**A76-28236 #** Advanced vertical axis rotor concepts. O Ljungstrom (Styrelsen for Teknisk Utveckling, Stockholm, Sweden). In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 3-1 to 3 4.

New vertical axis rotor concepts for windpowered generators are reviewed. The concepts include the freedom of arranging the blades in different ways in delta-rotor, Y-rotor and phi-rotor layouts. The straight-bladed concepts (delta and Y) have the advantage of allowing cyclic pitch change to be arranged more easily than for the curved catenary blades of the phi type. Other concepts mentioned include aerodynamic design scaling effects, and the integration of power cables in the structural support system. B J

**A76-28237 #** A high speed vertical axis wind machine. P South (National Aeronautical Establishment, Ottawa, Canada). In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 3 5 to 3 18.

Various design aspects of high-speed vertical axis wind machines for power generation are considered. These include aerodynamic structural design of rotor blades, blade supports, optimization aspects, the role of blade number and blade manufacturing. A phi type rotor system is considered. Graphs are plotted for power output versus tip speed ratio for single and three blade rotors and rotor drag is plotted versus speed ratio along with measured power versus wind speed ratio. The calculated power is plotted versus wind speed ratio and the aerodynamic normal force distribution for zero bending moment is examined. An optimal configuration with the following characteristics is proposed: a rotor height to diameter ratio of 1.5, the use of two or three blades designed predominantly as tensile members, the blades would be braced to the central column, the solidity would be about 0.2 to allow for a blade zero lift/drag coefficient of 0.01, and power would be taken off just above or just below the lower rotor bearing. B J

**A76-28238 #** Low velocity panemones. A W Sleeswyk (Groningen, Rijksuniversiteit, Groningen, Netherlands). In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 3-19 to 3 22.

Panemones ('all winds' in Greek) are wind turbines with vertical axis rotors that operate equally well regardless of wind direction at any given instant. The device should in principle operate under conditions when gicing does not occur at circumferential velocities exceeding the wind velocity. The possibility of scaling up the rotor diameter without adversely affecting the angular velocity of the electric generator that may be coupled to the wind turbine led to the building of an open air test stand for low velocity panemones at the University of Groningen. The maximum dimensions of the test rotors were 3 m in diameter and 2 m in height. The power, approximately 2 kW, was dissipated by means of eddy current coupling. The load was adjusted to maintain a preset angular velocity and the torque was measured by means of a full-bridge strain gage torque meter. B J

**A76-28240 #** Wind-powered aqueduct systems. F R Eldridge (Mitre Corp., McLean, Va.) In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974. Volume 1. Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 4 3 to 4 10. 8 refs.

An aqueduct system that would use large-scale wind-driven units to provide power for the pumping of water from the main reservoir to auxiliary reservoirs of the system is considered. The preliminary design study of this system would include a comparison of the following alternatives: the direct mechanical pumping of water, the



direct power generation by wind-turbine units and the use of this power to operate water pumps, the use of wind units to pump water from an auxiliary reservoir below a hydroelectric dam back into the main reservoir and the use of hydroelectric power to operate the electrical pumps of the aqueduct system, the feasibility of reducing the number of wind units required by interconnection with a public utility network or by the use of some means of energy storage. The aqueduct system of the Canadian River Project for furnishing supplementary water to cities in the Texas panhandle is thought to be an ideal system on which to perform initial proof-of-concept experiments on the use of wind units. B J

**A76-28241 # Survey of Oklahoma State University work in energy storage, variable speed constant frequency generators and wind generating systems** W L Hughes, J D Parker, H J Allison, R G Ramakumar, and D D Lingelbach (Oklahoma State University, Stillwater, Okla.) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 5-3 to 5-62 85 refs Contract No F33657-72-C-0645

An overview is presented of technical and economic aspects of the development of wind power systems. Techniques under investigation as possible means of storing and converting wind energy are discussed, with special attention given to high pressure fuel cells, high pressure electrolysis systems, and the aphodid burner turbine generator. An economic analysis shows that wind energy systems operating in parallel with conventional power lines could significantly reduce fuel costs by pumping electricity directly when available into electric transmission line grids. On the basis of projected fuel and energy cost and consumption data, the long term cost of wind power systems is compared with that of systems based on fossil fuels. Different types of electric generators under consideration for use with wind systems are described, and the design of wind turbines and coupling systems is discussed. C K D

**A76-28242 # Some wind-energy storage options** F R Eldridge (Mitre Corp., McLean, Va.) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 5-63 to 5-65

Results of economic studies of storage systems for energy generated from the wind are summarized. These fall into the categories of electrochemical energy storage systems (batteries or systems that store hydrogen generated by electrolysis), thermal energy storage systems, kinetic energy systems (fly-wheels or superconducting electromagnetic systems), and potential energy systems (pumped hydro-systems or compressed air systems). The minimum economic sizes for utility applications, estimated capital costs per unit, estimated unit lifetimes, dispersed storage capabilities, and estimated turn around efficiencies are given. C K D

**A76-28243 # High pressure hydrogen by electrolysis - The provision of a viable energy economy for isolated communities and its potential application on a larger scale** I Harris and D Highgate (Cranfield Institute of Technology, Cranfield, Beds., England) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 5-67 to 5-75

The possibility of utilizing hydrogen and oxygen produced by electrolysis to meet the energy requirements of isolated communities and to supplement the energy requirements of the UK when increasing fuel costs lead to greater dependence on intermittently available energy sources (wind, solar, geothermal, etc.) is examined. Development of high pressure electrolyzers similar to those currently used in submarine life support systems is suggested. Such systems eliminate the need for subsequent handling and compression of the gas and can be produced on a small scale without significant reductions in efficiency. Preliminary analysis indicates that an electrolyzer capable of absorbing power at the rate of 25 to 100 KW would be required to meet the energy needs of a typical isolated community. A significant increase in efficiency could be obtained by developing an electrolyzer capable of operation in reverse as a fuel cell when needed. C K D

**A76-28244 # Air storage power** L Norberg (Stal Laval Turbin AB, Finspang, Sweden) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 5-81 to 5-89

A compressed air system which acts both as a storage and as an active power producing scheme is proposed as a means of storing energy produced by a nuclear power system to provide peak as needed to meet night time consumption. The air storage method is applied to a gas turbine electric system. When operated as a normal turbine, 2/3 of the shaft output goes to the compressor, and the remaining 1/3 is the net electric output. The compressor and turbine may be operated separately in conjunction with the electric generator/motor drive. When excess power is available the generator is used as a motor compressing air, using electric power equal to 2/3 the rated turbine power. When energy is required, the compressed air is discharged through the turbine. The storage cavern pressure is balanced by a water column. Costs of air storage systems are competitive with hydro systems requiring the construction of artificial storage chambers. C K D

**A76-28245 # Wind-turbine mechanical to electrical conversion systems** R T Smith and T S J Devaiah (Southwest Research Institute, San Antonio, Tex.) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 5-95, 5-97 to 5-114 5 refs

The electrical energy output of Variable-Speed, Constant-Frequency (VSCF) and Constant-Speed, Constant-Frequency (CSCF) electric generation schemes for wind power plants in a power grid is analyzed on the basis of power duration curves. A sample calculation shows that VSCF systems have a slightly higher energy output than comparable CSCF systems. In both systems the output is primarily dependent on the generator efficiency. A VSCF system with no power control but with an excessively large generator generates less energy than a VSCF system with power control and relatively small generator. VSCF systems require a large capital outlay for generators but obviate the elaborate pitch controls characteristic of CFCS systems. A two generator scheme is suggested to alleviate the problem of low generator efficiency at light loads. C K D

**A76-28246 # Today's economy of the 200 kW experimental Gedser windmill** M Johansson (Danske Elvaerkess Forenings Ulredningsafdeling, Lyngby, Denmark) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 6-15 to 6-17, 6-19 to 6-22

**A76-28247 # Wind energy - Cost effectiveness is the key** C D McCarthy and G Rosen (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 6-29 to 6-35

It has been determined that \$400 (1974 dollars) per rated kilowatt capacity would be a competitive cost for a wind energy conversion system producing electricity, assuming a thirty year lifetime for the system. The cost of installation is assumed to contribute 30% of the total cost, leaving a selling price target of about \$280/kW for the complete system. A rotor using variable pitch blades plus its control system accounts for about 25% of the uninstalled system cost. An allowable cost target of \$42 per rated kilowatt is suggested for rotor blades, which represent 60% of the rotor cost. Ten-year projections of candidate blade materials are given. C K D

**A76-28248 # Wind energy research at the National Research Council of Canada** R J Templin (National Aeronautical Establishment, Ottawa, Canada) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2 Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 7-3 to 7-15

The Canadian National Research Council has developed a

curved blade high-speed vertical axis wind turbine with high aerodynamic efficiency. An aerodynamic theory has been developed (Templin, 1974) to analyse the effects of various design variables of this device. The induced velocity is assumed constant throughout the swept volume. The theory takes the correct curved blade shape into account and allows for arbitrary non-linear airfoil characteristics, which may be varied along the length of the blades. Theoretical values of the power and overall rotor drag coefficients are in good agreement with wind tunnel measurements. Theoretical results indicate that beyond a value of  $NC/R$  of about 0.2 there is no aerodynamic advantage to be gained by increasing the blade area. An analysis of the mutual interaction of large arrays of wind turbines has led to the assumption that the practical availability of wind energy over large areas is limited to that which can be obtained with turbine arrays having a total swept area not more than 1/1000 of the surface area. Two research programs undertaken with the cooperation of Canadian industries are outlined. C K D

**A76-28249 #** Possibilities for wind energy utilization in the Netherlands. P van Staveren (Centrale Organisatie TNO, Delft, Netherlands) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2, Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 7-17 to 7-23

**A76-28250 \* #** The U.S.-NSF/NASA wind energy conversion systems /WECS/ program. L V Divone (National Science Foundation, Washington, D C) and J M Savino (NASA, Lewis Research Center, Cleveland, Ohio) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2, Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 7-25 to 7-33

The five-year research and development plan of the NSF/NASA Wind Energy Conversion Systems (WECS) program is outlined. The program includes mission studies to determine energy use patterns and requirements and define specific applications for wind energy systems, wind energy resource assessment and development, and development of cost-effective components and subsystems. The program is also directed towards the development of energy storage systems to make wind-powered systems firm power sources where appropriate. A 100 kW experimental wind generator (Model Zero) is being designed as a flexible test bed for a variety of system components. Designs will be developed for units in the 50 to 200 kW and 500 to 3000 kW size ranges. C K D

**A76-28251 #** The Swedish wind energy R&D program proposal for three years 1975-77. O Ljungstrom (Styrelsen for Teknisk Utveckling, Stockholm, Sweden) In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2, Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 7-35 to 7-38

**A76-28252 #** DC-generator and thyristor converter is a good alternative to AC-synchronous - for large wind generators. B Sodergard In *Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974* Volume 2, Stockholm, Styrelsen for Teknisk Utveckling, 1976, p 9-7, 9-9 to 9-20

The performance of a large AC-synchronous generator is compared with that of a DC generator and thyristor in a wind power system. The DC equipment provides good attenuation of gust transients and is capable of giving full voltage output at as low as 40% of the normal full speed. The acceleration time for a wind rotor at rest at low wind velocities is shorter for the DC generator than for the AC equipment. Sample calculations carried out for a 230 kW wind generator show that the annual energy output with a DC-equipped system is 8% higher than that of the AC system. C K D

**A76-28397** Hydrogen sorption in LaNi<sub>5</sub>. O Boser (North American Philips Corp., Briarcliff Manor, N J) *Journal of the*

*Less-Common Metals*, vol 46, Apr 1976, p 91-99 19 refs

To determine the sorption rates of hydrogen in LaNi<sub>5</sub> a set-up was designed that allowed the measurement of both the absorption and desorption rate in the two-phase region. A charge chamber was charged (evacuated) with a small amount of hydrogen, a valve was opened to the sample, hydrogen was absorbed (given off) until the plateau pressure was reached. The resulting pressure changes could be fitted to a straight line by plotting the reciprocal pressure versus time. The measured sorption rates are independent of pressure (up to 5 atm) and independent of the sense of sorption (ab- or desorption). If the sorption rates are plotted logarithmically versus 1/T, the activation energy for sorption can be determined as 7.6 kcal/mol H<sub>2</sub>. This value agrees closely with the formation energy of the LaNi<sub>5</sub> hydride and thus leads to the conclusion that the phase transformation is the rate controlling process for sorption. (Author)

**A76-28398** Hydrogen production from water by thermochemical cycles. C E Bamberger and D M Richardson (Oak Ridge National Laboratory, Oak Ridge, Tenn.) *Cryogenics*, vol 16, Apr 1976, p 197-208 67 refs ERDA-sponsored research

The article focuses on the production of hydrogen from water via thermochemical cycles (series of chemical reactions at different temperatures with thermal energy transformed into chemical energy), to provide a practical and efficient source of hydrogen as an energy source. Hydrogen production from water via electrolysis, direct thermal cracking, or chemical reactions are discussed briefly. Primary sources of energy for the thermochemical cycles under consideration are examined. Restrictions on the types of useful thermochemical cycles are considered. A literature review is presented for the thermochemical cycles developed to date, the degree of completeness of the chemical reactions, and cost and efficiency problems. Some 72 thermochemical cycles are tabulated with relevant data. R D V

**A76-28478** The status of the satellite solar power station. P E Glaser (Arthur D Little, Inc., Cambridge, Mass.) In *Future space activities, Proceedings of the Thirteenth Goddard Memorial Symposium, Washington, D C, April 11, 1975* Tarzana, Calif., American Astronautical Society, 1976, p 81-102 7 refs.

The option of 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. Consideration is given to cost projections, resource use, and economic comparisons. Environmental issues, including the impact of waste heat release, space vehicle exhaust, noise pollution, and location of antenna sites are listed. Biological effects and radio-frequency interference are explored. The time frame for accomplishing the operational system is outlined. (Author)

**A76-28508 #** Method for the hydrodynamic and thermal calculation of circulating systems (O metodike gidrodinamicheskikh i teplovyykh raschetov tsirkulyatsionnykh sistem) G N Kononenko In *Methods for the mathematical modeling of technical problems* Kiev, Izdanie Instituta Matematiki AN USSR, 1975, p 120-126 5 refs In Russian

The problem of heat transfer in fissured rocks becomes important in the extraction of geothermal resources from the upper earth crust. Electro-analog (rheoelectrical) simulation is used to model the hydrodynamic and thermal process in a circulating system for extracting heat from a mass of fissured rocks. The temperature distribution in the system is studied and an equation for the conservation of thermal energy is solved. The analog simulation is

used to solve systems of equations for plane-radial flow and for unsteady convection B J

**A76 28509 #** Some methods for constructing thermal and hydrodynamic fields in systems for heat extraction from the earth (O nekotorykh metodakh postroeniia teplovykh i gidrodinamicheskikh polei v sistemakh izvlecheniia tepla zemli) G N Kononenko and E V Timokhina In Methods for the mathematical modeling of technical problems Kiev, Izdanie Instituta Matematiki AN USSR, 1975, p 127-133 In Russian

The paper investigates a circulating system for the extraction of geothermal energy from massifs of fissured rocks from the upper earth crust The system consists of boiler, pumps, heat exchanger, purifiers and a heat transmission line and operates on a fluid filtration principle The EGDA integrator for the electro-analog (rheological) simulation of dynamic processes is used to model the convective heat and mass transfer in the combined heat extraction-fissured rock system in order to obtain the heat extraction coefficient of the circulating system B.J.

**A76 28691 #** Some elements of the theory of the search for useful minerals (Elementy teorii poiska poleznykh iskopaemykh) Iu A Voinin In Some problems of computational and applied mathematics Novosibirsk, Izdatel'stvo Nauka, 1975, p 281-291 In Russian

The paper attempts to develop a theory of the search for useful minerals (eg, fossil fuels) whose purpose would be the more effective application of new complex physical-chemical search techniques, the development of mathematical-economic search models and the utilization of automatic control systems for search tasks It is shown that the search can be constructed on the basis of the relation between minerals whose direct detection would entail large costs and indicator minerals which could be detected without large costs A 'probe property' matrix is used to classify geological bodies The matrix contains identification and description grids indicating minuteness, correctness and content of description B J

## STAR ENTRIES

**N76-16173\*#** National Aeronautics and Space Administration  
Marshall Space Flight Center Huntsville Ala  
**NUCLEAR ENERGY WASTE-SPACE TRANSPORTATION  
AND REMOVAL**

R E Burns Dec 1975 87 p refs  
(NASA-TM-X-64973) Avail NTIS HC \$5 00 CSCL 21C

A method for utilizing the decay heat of actinide wastes to power an electric thrust vehicle is proposed. The vehicle launched by shuttle to earth orbit and to earth escape by a tug obtains electrical power from the actinide waste heat by thermionic converters. The heavy gamma ray and neutron shielding which is necessary as a safety feature is removed in orbit and returned to earth for reuse. The problems associated with safety are dealt with in depth. A method for eliminating fission wastes via chemical propulsion is briefly discussed. Author

**N76-16226#** British Steel Corp Sheffield (England) Information Services

**THE EFFECT OF RAW MATERIALS FOR STEELMAKING  
ON ENERGY REQUIREMENTS**

D I T Williams and D S Thornton Aug 1975 22 p  
(PB-245058/3 CAPL-SM/A/14/75) Avail NTIS HC \$3 50  
CSCL 11F

The value of raw materials used in steelmaking is influenced by the impurities present, the grade of steel made and the steelmaking process employed. It is important that the maximum benefits are derived from the available raw materials for considerations of both economics and conservation of resources. The major factors affecting the energy requirements of the process routes are examined in an attempt to highlight where maximum benefits can be achieved. The presence of contaminants adhering to iron and scrap can increase the thermal requirements by significant amounts, thereby adding to the fuel costs in steelmaking. GRA

**N76-16227#** Battelle Columbus Labs Ohio  
**STUDY OF THE ENERGY AND FUEL-USE PATTERNS IN  
THE NONFERROUS METALS INDUSTRIES**

E H Hall, E S Bartlett, F H Buttner, H N Conkle, D C Drennen et al 31 Dec 1974 356 p refs  
(Contract DI-14-01-0001-1658)  
(PB-245194/6 FEA/EI-1658) Avail NTIS HC \$10 50 CSCL 11F

The patterns of energy use in 10 SICs within the nonferrous metals industries are covered. Total energy use broken down by fuel type is estimated for each of the 10 industries and for major processes within each industry. A review of each industry is presented with respect to the potential for fuel switching, opportunities for short-term conservation, sources of fuels and energy supply levels of fuel stocks, key constraints on industry operations and industry products which may be critical to the needs of Project Independence. GRA

**N76-16240#** British Steel Corp Sheffield (England) Information Services

**THE DEVELOPMENT AND TESTING OF A NOVEL HIGH  
TEMPERATURE CERAMIC RECUPERATOR**

W R Laws, W R Laws, H R McChesney, D A Winkworth and E Morris Aug 1975 21 p refs  
(PB-245059/1 CEL/CE/14/75) Avail NTIS HC \$3 50 CSCL 13A

Energy consumption in a large integrated steelworks is described. Large quantities of energy are lost in the form of high-temperature thermal effluents, even from plants where waste heat recovery is already practiced. A short survey of traditional designs of ceramic and metallic recuperators highlights performance limitations of existing plant. The development of a new design of ceramic recuperator for operating with waste gas temperatures of up to 1300C is described. The development program is briefly mentioned, referring to theoretical computer model studies and the testing of components. The design of a prototype ceramic recuperator for an oil-fired soaking pit is described and preliminary results given. Potential applications are discussed. GRA

**N76-16243#** Dynatech R/D Co Cambridge Mass  
**FUEL GAS PRODUCTION FROM SOLID WASTE Final  
Report, 28 Jun 1973 - 31 Dec 1974**

R G Kispert, S E Sadek, L C Anderson and D L Wise  
31 Jan 1975 167 p refs  
(Contract NSF C 827)  
(PB-245083/1 Dynatech-1258 NSF/RA/N-74/268) Avail  
NTIS HC \$6 75 CSCL 21D

Six major program tasks are discussed: (1) preliminary engineering analysis and economic evaluation of a full-scale fuel gas from solid waste facility; (2) pilot plant design, procurement and initial operation; (3) supporting laboratory experiments and studies at the University of Massachusetts and MIT; (4) confirmation of the economic model for the full-scale fuel gas from solid waste facility; (5) evaluation and specification of a proof-of-concept pilot plant; and (6) application of the computer model to full-scale plant studies. GRA

**N76-16244#** Exxon Research and Engineering Co Linden NJ  
Government Research Lab

**FUTURE SYNTHETIC FUELS: A SCIENTIFIC AND TECHNICAL  
APPLICATIONS FORECAST Final Report**

William F Taylor and Homer T Hall Sep 1975 152 p refs  
(Contract DAAD05-73 C-0559)  
(AD-A014947) Avail NTIS CSCL 21/4

This STAF reviews the broad problem of the impact on the U.S. Army of the use of synthetic fuels (defined as a non-petroleum derived fuel) over the time period of 1975 to 2000. The STAF is divided into three basic parts. The first part involves a forecast of which synthetic fuels will have a major impact in the time period under study. In the second part of the STAF, those alternate fuels identified as the most feasible synthetic fuels in the future were subjected to detailed analyses. The third part of the STAF consists of the identification of a number of areas which appear to offer promise for fruitful R and D in the synthetic fuel area.

Author (GRA)

**N76-16508** Pennsylvania State Univ University Park  
**THE TRADEOFF BETWEEN ENERGY AND THE ENVIRONMENT:  
THE CASE OF CRUDE OIL SUPPLIES FOR  
CALIFORNIA Ph D Thesis**

Donald W Barnett 1975 319 p  
Avail Univ Microfilms Order No 76-1337

A methodology is developed using linear programming as an analytical tool that ranks various energy sources in terms of their social desirability when environment as well as production costs are considered. The model is confined to the petroleum resources that do or could supply the California market. A comprehensive cost analysis is undertaken for each fuel. The objective is to minimize the cost of supplying the California market subject to resource, sulfur and oil spill constraints. The model is designed so the effect of the different combinations of demand, cost, sulfur content and oil spill levels can be studied. The social desirability of an oil source is indicated by two criteria.

whether the source is included in the optimal solution and the size of the associated shadow price. The larger the shadow price, the greater the desirability of obtaining an increase in production of that resource. The solutions generated by the model indicated that the environmental tradeoffs can be surprisingly large, and that foreign oils can be economically and environmentally inferior to certain domestic offshore oils. Dissert Abstr

**N76-16609#** Federal Energy Administration Washington D C Office of Coal  
**PROJECT PROPOSAL FOR SURFACE-MINED LAND ENHANCEMENT (SMILE)**  
 Arthur M Hughes and David R Maneval (Appalachian Regional Comm) 29 Jan 1975 71 p refs  
 (PB-245567/3 FEA/G-75/586) Avail NTIS HC \$4 50 CSCL 081

A program is outlined to reclaim 6 000 acres of the worst strip-mined land on public property in 5 states Pennsylvania Ohio Maryland Kentucky and Alabama. The five basic goals of the project are: restore public lands which have been surface mined, demonstrate that surface-mined land can be restored in ways that preserve or enhance the environment, provide immediate employment, improve secondary employment opportunities and long-term economic prospects of reclaimed areas through construction of such land-utilization features as public forests, grazing lands, farm lands, parks, recreation and tourism opportunities. make possible improvements in national coal production. GRA

**N76-16610#** Barry (Theodore) and Associates, Los Angeles, Calif  
**OPERATIONS STUDY OF SELECTED SURFACE COAL MINING SYSTEMS IN THE UNITED STATES Final Open File Report**  
 Feb 1975 236 p  
 (Contract BM-So-141048)  
 (PB-245085/6 BM-OFR-72-75) Avail NTIS HC \$8 00 CSCL 081

Selected surface coal mining systems in the United States are discussed. The potential production and economic capacity of the systems is assessed. One mine was selected from each of the major coal fields: midwestern, eastern, northwestern, and southwestern. Following the documentation of each operation and development of a comprehensive production and cost data base, an analysis was conducted to identify production inefficiencies and to develop short-term and long-term improvements that would increase the mines productivity or reduce costs. GRA

**N76-16611#** Bureau of Mines Dallas Tex Mineral Supply Field Office  
**SULFUR CONTENT OF CRUDE OILS**  
 M Carrales Jr and R W Martin Aug 1975 66 p refs  
 (PB-245192/0 BM-IC-8676) Avail NTIS HC \$4 50 CSCL 21D

Information is presented pertaining to the sulfur content of crude oil produced during 1971 in the United States and in some foreign countries. These data are presented for fields in 26 States that accounted for about 76 percent of the US oil production during 1971 and for fields in 24 foreign countries that accounted for about 64 percent of the total oil produced from these countries during the same year. The tabular data include the following items: geographical area or foreign country, field name, sulfur content, analysis number, geologic formation, geologic age, depth of formation, and 1971 oil production. Summary tables show the classification of US and foreign crude oil production during 1971 by sulfur content. The objective was to classify the 1971 crude oil production from US and foreign fields where crude oil analyses were available according to sulfur content. GRA

**N76-16612\*** National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala

**THERMOELECTRIC POWER SYSTEM Patent**  
 Ambrose W Byrd, inventor (to NASA) Issued 6 Jan 1976  
 5 p Filed 19 Mar 1974 Supersedes N74-18726 (12 - 10 p 1128)  
 (NASA-Case-MFS-22002 1, US-Patent-3,931,532  
 US-Patent-Appl-SN-452769, US-Patent-Class-310-4,  
 US-Patent-Class-136-202, US-Patent-Class-136-210,  
 US-Patent-Class-165-105) Avail US Patent Office CSCL 10A

A thermoelectric power system is described which is particularly adaptable for use in outer space. A nuclear reactor heats a working fluid which in turn supplies heat to a plurality of thermoelectric generators spaced about a ring shaped support. A first heat pipe is employed to couple heat between the hot fluid and hot junction of the thermoelectric element of each generator, and a second heat pipe couples heat away from the cold junction of each thermoelectric element. Each of the second heat pipes are elongated flexible units adapted to be folded upon launch and thereafter extended in space to provide a substantial area for the radiation of heat to be discharged. Official Gazette of the US Patent Office

**N76-16615** Iowa State Univ of Science and Technology Ames  
**US ELECTRICAL ENERGY DILEMMA AND AN ENERGY MODEL FOR THE ELECTRICAL UTILITIES OF IOWA Ph D Thesis**  
 Turan Gonen 1975 336 p  
 Avail Univ Microfilms Order No 76-1841

Energy sources were examined, energy supply and demand were projected to the year 2000, various US energy forecasts were compared, and some energy related issues were discussed in relation to these forecasts. A computerized electric energy cost model was developed for the electric power industry to minimize the cost of energy used for electric generation by optimum allocation of various fuel-mixes over a period of n years where the energy is subject to a large number of physical and environmental constraints. The results showed that the computerized model is a promising tool in long range power systems planning. It was demonstrated that there can be considerable savings to the companies and to the consumer, if the companies act as a united group to meet their customers' electrical energy demand in an optimum fashion. Dissert Abstr

**N76-16617** Kansas Univ Lawrence  
**WIND/SOLAR ENERGY INVESTIGATION, A FEASIBILITY STUDY Ph D Thesis**  
 George Hazen Stickney 1975 489 p  
 Avail Univ Microfilms Order No 76-1311

The question of utilizing the wind and sun to provide the energy required by an average home for space heating, air conditioning, and a hot water supply was considered. Energy requirements were compared with the daily availability of wind and solar energy and the storage needed to reconcile the two was determined. Preliminary design procedures are shown for wind and solar energy collection and systems storage. Initial design procedures are also shown for an accompanying heating and cooling system. Although wind and solar energy are free, non-depleting and non-polluting, the high initial cost of the required hardware causes them to be economically noncompetitive with more conventional fuels. Specifically, this system was estimated to have an annual cost in 1975 of around 2 1/2 times that of a home heated by natural gas and about 13 percent higher than an all electric home. However, this cost was estimated to drop by at least one third by 1985. Dissert Abstr

**N76-16620\*#** National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio  
**STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY PROTOTYPE MODERATELY CONCENTRATING GROOVED COLLECTORS**  
 Jan 1976 13 p refs  
 (NASA-TM-X-71863 E-8626) Avail NTIS HC \$3 50 CSCL 10A

Prototypes of moderately concentrating grooved collectors were tested with a solar simulator for varying inlet temperature flux level and incident angle. Collector performance is correlated in terms of inlet temperature and flux level. Author

**N76-16621\***# National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex  
**PYROLYSIS SYSTEM AND PROCESS** Patent Application Shang-I Cheng, inventor (to NASA) (Cooper Union) Filed 30 Dec 1975 16 p Sponsored by NASA  
(NASA-Case-MSC-12669-1 US-Patent-Appl-SN-645503) Avail NTIS HC \$3 50 CSCL 10B

A pyrolysis system and process for recovering energy from solid waste and other feedstocks containing hydrocarbons such as coal asphalt naphtha cheap crude oils, etc is described. The process is comprised of the following steps continuously feeding the feedstock into a pyrolyzer for pyrolysis and gasification continuously circulating a hot heat transfer agent through the pyrolyzer for promoting pyrolysis and gasification by direct contact with the feedstock and removing the pyrolysis gases from the pyrolyzer for further energy treatment and use. NASA

**N76-16625**# Committee on International Relations (U S House)  
**US INTERNATIONAL ENERGY POLICY**  
Washington GPO 1975 193 p refs Hearing before Subcomm on Intern Resources Food and Energy of Comm on Intern Relations, 94th Congr 1st Sess 1 May 1975  
(GPO-53-813) Avail Subcomm on Intern Resources Food and Energy

The direction of the U S International energy policy is discussed in the aftermath of the failure of the preliminary conference in Paris to produce agreement among oil consuming countries oil producing countries and non-oil-producing countries on the agenda for a major international conference. The issues discussed at the conference the International Energy Agency and its viability and related legislation are considered. J M S

**N76-16626**# Committee on Interstate and Foreign Commerce (U S House)  
**BASIC ENERGY DATA AND GLOSSARY OF TERMS**  
Washington GPO Jun 1975 225 p refs Rept by Comm on Interstate and Foreign Commerce 94th Congr 1st Sess Jun 1975  
(GPO-53-220) Avail US Capitol House Document Room

Statistics concerning energy production and consumption are presented. Data are included for energy sources electric utilities nuclear power energy consumption resource development prices and basic resources for the U S and the world. F O S

**N76-16627**# Joint Committee on Atomic Energy (U S Congress)  
**AUTHORIZING APPROPRIATIONS FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION FOR FISCAL YEAR 1976 AND FOR THE TRANSITION QUARTERLY ENDING 30 SEPTEMBER, 1976**  
Washington GPO 1975 58 p Rept to accompany S 598 94th Congr 1st Sess 21 Apr 1975  
(S-Rept-94-104 GPO-38-006) Avail US Capitol Senate Document Room

The fiscal budget is outlined for the following (1) fission power reactor development and safety engineering (2) space nuclear systems (3) development of isotopes (4) weapons development (5) solar and other energy sources and (6) research facilities. Total operating expenses plant and capital equipment are discussed and compared to budgets of previous years. J R T

**N76-16628**# Committee on Government Operations (U S House)  
**FEDERAL INVOLVEMENT IN THE DEVELOPMENT OF EASTERN OIL AND GAS SHALE**  
Washington GPO 1975 65 p Hearings before a subcomm of Comm on Govt Operations 94th Congr 1st Sess 8 May 1975  
(GPO-54-728) Avail Comm on Govt Operations

Testimony is provided on development of the eastern oil shale which extends from Texas through the Middle West and East into western New York State. The nonpolluting nature of the energy sources and the advanced technology needed to develop it are discussed. J M S

**N76-16630**# Portland Cement Association, Skokie Ill  
**ENERGY CONSERVATION POTENTIAL IN THE CEMENT INDUSTRY**  
Jun 1975 344 p refs  
(Contract DI-14-01-0001-1858)  
(PB-245159/9 FEA/D-75/400) Avail NTIS HC \$10 00 CSCL 10A

Detailed background data are given which are needed to establish energy conservation objectives which are reasonable for the industry to assess the potential for energy conservation within the industry and to establish the probable impacts of certain levels and types of federal research development and demonstration support. It discusses basic materials processes used in manufacturing new technology available and the controlling economics. GRA

**N76-16631**# Ohio State Univ Columbus Engineering Experiment Station  
**THERMAL RESPONSE AND MODEL OF HEATING AND COOLING EQUIPMENT FOR RESIDENTIAL HOMES**  
C F Sepsy J M Salvadore and M F McBride Jun 1975 82 p refs Sponsored by Electric Power Research Inst  
(PB-244991/6 EPRI-137-2) Avail NTIS HC \$5 00 CSCL 10A

A mathematical model was constructed which can simulate the building thermal load and energy consumption component of a two-story residential dwelling. A floating temperature analysis plus load profile calculation and system simulation is given. GRA

**N76-16632**# Office of Telecommunications Washington D C  
**BIBLIOGRAPHY OF SELECTED ABSTRACTS OF DOCUMENTS RELATED TO ENERGY CONSERVATION THROUGH TELECOMMUNICATIONS**  
Charles E Lathey and Joseph R Bewick Aug 1975 77 p  
(COM-75-11367/0 OT-SP-75-5) Avail NTIS HC \$5 00 CSCL 10A

A collection of documents related to the use of telecommunications as a potential for conserving energy is given. Each document is abstracted authors are listed date of publication and information provided that will give the reader necessary information to obtain the document if desired. GRA

**N76-16633**# Metropolitan Washington Council of Governments D C  
**ENERGY INFORMATION RESOURCES MAINTAINED BY THE METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS** Final Report  
T Markle R Haas and M Fraser May 1975 85 p  
(PB-245248/0) Avail NTIS HC \$5 00 CSCL 05B

The current capability is described of Council of Government's Metropolitan Energy Information Center. Approximately 500 documents are listed by major subject codes. Unit operations performed on materials received by the Center are described and the Center's public access procedures and operations philosophy are reviewed. GRA

**N76-16634**# Ohio State Univ Columbus Engineering Experiment Station  
**HEAT TRANSFER MODELS AND ENERGY NEEDS FOR RESIDENTIAL HOMES**  
C F Sepsy R S Blancett and M F McBride Jun 1975 116 p refs  
(PB-244992/4 EPRI-137-3) Avail NTIS HC \$5 50 CSCL 10A

The results of the development and field validation of algorithms to simulate heating and cooling loads and energy requirements for a split-level and a ranch-style test house are discussed. The report includes (1) a description of the test sites (2) a description of the instrumentation and data acquisition

system used to collect data at the test sites (3) a discussion of the algorithms developed and used to determine heating and cooling loads and energy requirements and (4) comparisons of simulated versus measured test site space temperatures and cooling energy requirements GRA

**N76-16635#** North Carolina State Univ Raleigh Dept of Mechanical and Aerospace Engineering  
**RESEARCH ON SOLAR ENERGY STORAGE SUBSYSTEMS UTILIZING THE LATENT HEAT OF PHASE CHANGE OF PARAFFIN HYDROCARBONS FOR THE HEATING AND COOLING OF BUILDINGS** Semiannual Report  
 J A Bailey J C Mulligan C K Liao and S I Guceri 1975 75 p refs Sponsored by NSF  
 (PB-244872/8 NSF/RA/N-75-075) Avail NTIS HC \$4 50 CSCL 13A

An analytical and experimental research program designed to assess the potential of a solar energy storage subsystem (thermal capacitor) using the latent heat of fusion of paraffin hydrocarbons for the heating and cooling of buildings is described. An idealized model of a flat plate thermal capacitor based on uniaxial heat conduction with a change of phase and an absence of natural convection in the phase change material is assumed. An analysis of the model using the asymptotic expansion and Goodman techniques for the melting (freezing) process is conducted. The analyses are used to generate data concerning the variation with time of the capacitor fluid outlet temperature and internal temperature distribution for various capacitor inlet temperatures mass flow rates latent heats of fusion effective thermal conductivities and capacitor sizes. An experimental system consisting of a prototype thermal capacitor fluid flow control unit and hydraulic system for the generation of performance data is described GRA

**N76-16636#** Honeywell Inc Minneapolis Minn Systems and Research Center  
**SOLAR HEATING PROOF-OF-CONCEPT EXPERIMENT FOR A PUBLIC SCHOOL BUILDING** Final Report  
 6 Nov 1974 89 p refs  
 (Contract NSF C-870)  
 (PB-245008/8 Rept-41434-FR NSF/RA/N-74-119) Avail NTIS HC \$5 00 CSCL 13A

A 5000-square-foot solar energy system to supplement the heating and hot water requirements of North View Junior High School in suburban Minneapolis is discussed. The report discusses in detail the collector design system design system operation and system performance GRA

**N76-16641#** Colorado Univ Boulder  
**DEMAND ANALYSIS SOLAR HEATING AND COOLING OF BUILDINGS. PHASE 1 REPORT SOLAR WATER HEATING IN SOUTH FLORIDA 1923 - 1974**  
 Jerome E Scott Ronald W Melicher and Donald M Sciglimpaglia  
 Dec 1974 179 p refs  
 (Grant NSF GI-42508)  
 (PB-245322/3 NSF/RA/N-74-190) Avail NTIS HC \$7 50 CSCL 13A

Two specific areas of research are discussed. The first is an assessment of the solar water heater industry in South Florida. This section documents the historical development of the industry and provides an analysis of its future potential. The second investigates the attitudes and expectations of important lending institutions toward the use of solar energy for space heating and cooling of single family residences GRA

**N76-16642#** Delaware Valley Regional Planning Commission Philadelphia Pa  
**POTENTIAL FOR CONVERSION TO COAL AS A FUEL BY MAJOR FUEL USERS IN THE PENNSYLVANIA COUNTIES OF BUCKS, CHESTER DELAWARE, MONTGOMERY AND PHILADELPHIA** Final Report  
 Charles R Roxin and Michael Tinkleman Dec 1974 71 p refs  
 (Grant HUD-CPA PA 1054)  
 (PB-244946/0 DVRPC-74-14 TR-15) Avail NTIS HC \$4 50 CSCL 21D

Major fuel users in the Pennsylvania counties of Bucks Chester Delaware Montgomery and Philadelphia are identified. Their present fuel use is discussed and the potential for their conversion from oil and gas to coal as fuel is briefly assessed. Impacts on air quality and freight rail needs are also reviewed. Finally the attitudes of these industries toward conversion is discussed particularly in reference to local reaction to national issues and policies GRA

**N76-16644#** Naval Weapons Center China Lake Calif  
**A PROGRAM TO EVALUATE AND DEMONSTRATE CONSERVATION OF FOSSIL FUEL ENERGY FOR SINGLE-FAMILY DWELLINGS**  
 Jun 1975 75 p Sponsored by FEA  
 (PB-245064/1 FEA/D-75/529) Avail NTIS HC \$4 50 CSCL 13A

A program is outlined which will demonstrate reduction in the United States fossil-fuel energy usage particularly residential shopping and commuting. Goals include combining more efficient energy use with low-energy structures to demonstrate that fuel consumption in single-family dwellings can be cut at least in half, reducing fuel consumption further and where solar flux is adequate replacing use of fossil fuels in the single-family home with high temperature solar energy and demonstrating a solar-powered thermal-storage car for short trips GRA

**N76-16645#** Bechtel Corp San Francisco Calif  
**ELECTRIC POWER GENERATION USING GEOTHERMAL BRINE RESOURCES FOR A PROOF-OF-CONCEPT FACILITY**  
 Frank A Comprelli May 1975 175 p refs  
 (Grant NSF AER-74-19931)  
 (PB-245264/7 NSF/RA/N-75-049) Avail NTIS HC \$6 75 CSCL 10B

The technical environmental and economic feasibility is examined of using hot brine resources for electric power production and other industrial applications. Site selection energy conversion process evaluation conceptual design implementation plan and schedule and capital cost estimate are discussed GRA

**N76-16648#** Mitre Corp McLean Va  
**STRATEGIC IMPLICATIONS OF SOLAR ENERGY FOR EMPLOYMENT OF SHEET METAL WORKERS**  
 H W Brock G R Murray J D McConnell and J C Snipes  
 Jun 1975 116 p Sponsored by Sheet Metal Workers International Assoc Washington DC  
 (PB-245670/5) Avail NTIS HC \$5 50 CSCL 13A

The present situation and the future outlook for energy in the United States is reviewed. Solar and other energy related technological developments are discussed along with probable impacts of solar energy on sheet metal works. Strategic alternatives for the sheet metal Union are identified GRA

**N76-16650#** Federal Energy Administration Washington DC  
 Office of Energy Conservation and Environment  
**LIGHTING AND THERMAL OPERATIONS ENERGY MANAGEMENT ACTION PROGRAM FOR COMMERCIAL-PUBLIC-INDUSTRIAL BUILDINGS**  
 Nov 1974 59 p  
 (PB-245047/6 FEA/D-74/136) Avail NTIS HC \$4 50 CSCL 13A

Desirable targets for lighting and thermal operations are discussed including guidelines for illumination levels efficiency in lighting and operating cooling and heating systems. Energy savings in selected buildings in areas of illumination thermostat setting building occupancy and fan operation are given GRA

**N76-17101\*#** Lockheed-California Co Burbank  
**MINIMUM ENERGY, LIQUID HYDROGEN SUPERSONIC CRUISE VEHICLE STUDY** Final Report, 21 Apr - 17 Oct 1975  
 G D Brewer and R E Morris Oct 1975 178 p refs

(Contract NAS2-8781)  
(NASA-CR-137776 LR-27347) Avail NTIS HC \$7 50 CSCL  
O1C

The potential was examined of hydrogen-fueled supersonic vehicles designed for cruise at Mach 2.7 and at Mach 2.2. The aerodynamic weight and propulsion characteristics of a previously established design of a LH2 fueled Mach 2.7 supersonic cruise vehicle (SCV) were critically reviewed and updated. The design of a Mach 2.2 SCV was established on a corresponding basis. These baseline designs were then studied to determine the potential of minimizing energy expenditure in performing their design mission and to explore the effect of fuel price and noise restriction on their design and operating performance. The baseline designs of LH2 fueled aircraft were then compared with equivalent designs of jet A (conventional hydrocarbon) fueled SCV's. Use of liquid hydrogen for fuel for the subject aircraft provides significant advantages in performance cost noise pollution sonic boom and energy utilization. Author

**N76-17299\*#** National Aeronautics and Space Administration  
Lewis Research Center Cleveland Ohio  
**HIGH EFFICIENCY SILICON SOLAR CELL REVIEW**  
Michael P Godlewski ed Washington Dec 1975 235 p  
refs Meeting held at Cleveland 14-15 Nov 1974  
(NASA-TM-X-3326 E-8425) Avail NTIS CSCL 10A

An overview is presented of the current research and development efforts to improve the performance of the silicon solar cell. The 24 papers presented reviewed experimental and analytic modeling work which emphasizes the improvement of conversion efficiency and the reduction of manufacturing costs. A summary is given of the round-table discussion in which the near- and far-term directions of future efficiency improvements were discussed. Author

**N76-17641\*#** National Aeronautics and Space Administration  
Lewis Research Center Cleveland Ohio  
**ELECTROLYTIC HYDROGEN PRODUCTION AN ANALYSIS  
AND REVIEW**  
John Evangelista B Phillips and L Gordon Dec 1975 70 p  
refs  
(NASA-TM-X-71856 E-8602) Avail NTIS HC \$4 50 CSCL  
10A

The thermodynamics of water electrolysis cells is presented followed by a review of current and future technology of commercial cells. The irreversibilities involved are analyzed and the resulting equations assembled into a computer simulation model of electrolysis cell efficiency. The model is tested by comparing predictions based on the model to actual commercial cell performance and a parametric investigation of operating conditions is performed. Finally the simulation model is applied to a study of electrolysis cell dynamics through consideration of an ideal pulsed electrolyzer. Author

**N76-17643\*#** National Aeronautics and Space Administration  
Lewis Research Center Cleveland, Ohio  
**STANDARDIZED PERFORMANCE TESTS OF COLLECTORS  
OF SOLAR THERMAL ENERGY A SELECTIVELY COATED,  
STEEL COLLECTOR WITH ONE TRANSPARENT COVER**  
Jan 1976 7 p ref  
(NASA-TM-X-71870 E-8641) Avail NTIS HC \$3 50 CSCL  
10A

Basic test results are presented of a flat-plate solar collector whose performance was determined in solar simulator. The collector was tested over ranges of inlet temperatures fluxes and coolant flow rates. Collector efficiency was correlated in terms of inlet temperature and flux level. Author

**N76-17644#** Committee on Science and Technology (U S  
House)  
**HYDROGEN**  
Washington GPO 1975 1369 p refs Hearings before Subcomm  
on Energy Res Develop and Demonstration of Comm on Sci

and Technol 94th Congr 1st Sess No 29 10 and 12 Jun  
1975  
(GPO-62-332) Avail Subcomm on Energy Res Develop and  
Demonstration

The production and utilization of hydrogen as a source of energy are considered in terms of their effects on the energy economy of the future. Factors discussed include environmental hazards cleanliness of hydrogen combustion compatibility with existing industrial infrastructure and safety and cost considerations. JMS

**N76-17649#** Air Force Weapons Lab Kirtland AFB N Mex  
**ALTERNATIVE ENERGY SOURCES FOR UNITED STATES  
AIR FORCE INSTALLATIONS Final Report, Jul 1974 - Jun  
1975**

Michael D DeWitte Aug 1975 111 p refs  
(AF Proj 2102)  
(AD-A014858 AFWL-TR-75-193) Avail NTIS CSCL 10/1

This report is concerned with the consumption and cost of facilities-related energy both present and future at Air Force installations and it presents a basic assessment of the potential of alternative energy sources. In particular solar wind and geothermal energy resources are investigated. GRA

**N76-17650#** Army Construction Engineering Research Lab  
Champaign Ill  
**TECHNICAL EVALUATION STUDY ENERGY-RECOVERY  
SOLID WASTE INCINERATION TO NAVAL STATION,  
MAYPORT, FLORIDA**  
S A Hathaway and H G Rigo Feb 1975 60 p refs  
(AD-A015615 CERL-TR-E-51) Avail NTIS CSCL 21/4

This study was undertaken to assess the feasibility of energy-recovery incineration of solid waste at Naval Station Mayport Florida. It was found that use of solid waste as a fuel for steam generation at Naval Station Mayport is technically and economically feasible and environmentally compatible. The recommended system employs a clean-fuel fired basket-grate incinerator in series with an energy-recovery train consisting of an afterburner and boiler. The afterburner fires fuel reclaimed at an on-station bilge and fuel tank waste oil treatment facility. Refuse-derived fuel (RDF) is fired one shift five days per week with the auxiliary burner assuming the load during nights and weekends. Production of 22 700 pounds of steam/hour can be achieved. The benefit-to-cost ratio of this system is 8:1. Through implementation of this system a net fuel savings of 345 800 gallons/yr can be achieved excluding the amount of the reclaimed oil used. Design criteria are provided. GRA

**N76-17652#** Army Construction Engineering Research Lab  
Champaign Ill  
**TECHNICAL EVALUATION STUDY SOLID WASTE HEAT  
RECLAMATION AT NAVAL AIR TEST CENTER PATUXENT,  
MARYLAND**

H G Rigo and G E Quindry Nov 1974 46 p refs  
(AD-A015613 CERL-TR-E-60) Avail NTIS CSCL 13/2

This study was initiated to evaluate the solid waste disposal system at Naval Air Test Center Patuxent MD and to ascertain the feasibility of solid waste heat reclamation at the base. The solid waste stream was analyzed applicable standards were evaluated and the cost and performance characteristics of current solid waste heat reclamation units were reviewed. Recommendations were based on consideration of the facility benefit to cost ratio. It was found that continuing the current method of solid waste disposal on an on-base landfill operation would be economically and environmentally sound. New solid waste collection equipment and altered procedures at the landfill site were recommended to substantially improve the economics and life expectancy of the on-base refuse management system. GRA

**N76-17655#** Pennsylvania State Univ University Park  
**ENERGY CONSERVATION THROUGH URBAN TRANSPORTATION  
PLANNING Final Report**  
Mar 1975 186 p refs  
(PB-245214/2 PTI-7515) Avail NTIS HC \$7 50 CSCL 10A



Techniques for conserving energy in urban passenger transport are described. A systems approach for evaluating these simultaneously in order to formulate areawide passenger transportation energy policy is presented. It consists of a simple computer technique for estimating the conservation value of various schemes. The program is also of value in assessing the energy impact of individual energy conserving programs. Because only local planners are familiar with the economic environmental and political constraint on policy and programs, the tool is intended for use in urban regions. It is however written in general terms and as such if used in all urban areas in the U.S. could offer realistic national estimates of urban passenger transportation energy requirements in the short term. GRA

**N76-18000#** Joint Economic Committee (U.S. Congress)  
**THE ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS**

Washington: GPO, 1974. 230 p. refs. Hearings pursuant to S. Con. Res. 93 before Joint Economic Comm., 93d Cong., 2d Sess., 19 21-22 Nov. 1974. (GPO-51-795) Avail. SOD. HC \$2.15

The costs and benefits of energy conservation and environmental regulations are discussed in terms of strengthening, maintaining, or relaxing the present standards. Factors considered include inflationary and recessionary effects, impact of environmental regulations on domestic energy resources, environmental damage caused by the development of energy fuels, effect of pollution control regulations on energy fuel development and the consumption of energy, interaction of environmental regulations with the development of western coal, offshore oil, and nuclear energy, and the relationship of energy conservation, pollution control, and increased quality of economic growth. J. M. S.

**N76-18087\*#** National Aeronautics and Space Administration  
 Ames Research Center, Moffett Field, Calif.  
**BENEFITS OF VTOL AIRCRAFT IN OFFSHORE PETROLEUM LOGISTICS SUPPORT**

Darrell E. Wilcox and Michael D. Shovlin. Dec. 1975. 69 p. refs. (NASA-TM-X-73098, A-6360) Avail. NTIS. HC \$4.50. CSCL 01C

The mission suitability and potential economic benefits of advanced VTOL aircraft were investigated for logistics support of petroleum operations in the North Sea and the Gulf of Mexico. Concepts such as the tilt rotor and lift/cruise fan are promising for future operations beyond 150 miles offshore, where their high cruise efficiency provides savings in trip time, fuel consumption, and capital investment. Depending upon mission requirements, the aircraft operating costs are reduced by as much as 20 percent to 50 percent from those of current helicopters. Author

**N76-18089#** Stanford Research Inst., Arlington, Va.  
**THE ECONOMIC IMPACT OF ENERGY SHORTAGES ON COMMERCIAL AIR TRANSPORTATION AND AVIATION MANUFACTURE VOLUME 1 IMPACT ANALYSIS Final Report**

J. E. Gorham, D. Gross, and J. C. Snipes. Jun. 1975. 259 p. refs. 2 Vol. (Contract FEA-C-03-50033-00) (PB-246271/1, FEA/B-75/588-Vol-1) Avail. NTIS. HC \$9.00. CSCL 05C

The impact is evaluated of the energy shortage on commercial air transportation and its related manufacturing industries. As a result, the forces are analyzed of change at work in the air transportation industry relating to the energy crisis, both desirable and undesirable, that are likely to affect the way the industry does business, its efficiency, or inefficiency in the use of fuel, the impact of continued fuel price increases, and the ability of the industry to use the most fuel-efficient aircraft presently or prospectively available. The cumulative impact is considered of

these factors affecting air transportation on the need for number of and timing of requirements for new aircraft in order to assess the secondary impact on the aircraft engines, and parts manufacturing industries. GRA

**N76-18090#** Stanford Research Inst., Arlington, Va.  
**THE ECONOMIC IMPACT OF ENERGY SHORTAGES ON COMMERCIAL AIR TRANSPORTATION AND AVIATION MANUFACTURE VOLUME 2 AVIATION INDUSTRIES PROFILES AND ENERGY USAGE CHARACTERISTICS Final Report**

J. E. Gorham, D. Gross, and J. C. Snipes. Jun. 1975. 284 p. refs. 2 Vol. (Contract FEA-C-03-50033-00) (PB-246272/9, FEA/B-75/589-Vol-2) Avail. NTIS. HC \$9.25. CSCL 05C

The results are summarized of the economic impact of energy shortages on commercial air transportation and aviation manufacture. GRA

**N76-18372\*+** New Mexico Univ., Albuquerque. Tech. Application Center.  
**HEAT PIPE TECHNOLOGY A BIBLIOGRAPHY WITH ABSTRACTS Annual Supplement, 1974**

1974. 133 p. Sponsored in part by NASA. (NASA-CR-146328, TAC-HP-74-102) Avail. NTIS. Univ. of New Mexico Tech. Application Center. HC \$20.00. CSCL 20M

This bibliography lists 149 references with abstracts and 47 patents dealing with applications of heat pipe technology. Topics covered include heat exchangers for heat recovery, electrical and electronic equipment cooling, temperature control of spacecraft, cryosurgery, cryogenic cooling, nuclear reactor heat transfer, solar collectors, laser mirror cooling, laser vapor cavities, cooling of permafrost, snow melting, thermal diodes, variable conductance, artery gas venting, and venting and gravity assisted pipes. Author

**N76-18373\*+** New Mexico Univ., Albuquerque. Tech. Application Center.  
**HEAT PIPE TECHNOLOGY A BIBLIOGRAPHY WITH ABSTRACTS Annual Supplement, 1973**

1973. 222 p. Sponsored in part by NASA. (NASA-CR-146329, TAC-HP-73-101) Avail. NTIS. Univ. of New Mexico Tech. Application Center. HC \$15.00. CSCL 20M

This bibliography lists 229 references with abstracts and 94 patents dealing with applications of heat pipe technology. Topics covered include heat exchangers for heating and air conditioning, electronics cooling, temperature control of spacecraft, heat transfer in thermoelectric power generators, heat transfer in nuclear reactors, measurement of thermophysical properties, solar collectors, cooling engines, electrohydrodynamic phenomena, and vapor laser ovens. Author

**N76-18460\*#** National Aeronautics and Space Administration  
 Pasadena Office, Calif.

**HYDROGEN-RICH GAS GENERATOR Patent Application**  
 John Houseman (JPL) and Donald J. Cerni, inventors (to NASA) (JPL) Filed 10 Jul. 1974. 27 p. Sponsored by NASA. (NASA-Case-NPO-13560, NASA-Case-NPO-13561-1, US-Patent-Appl-SN-487156) Avail. NTIS. HC \$4.00. CSCL 13F

A process and apparatus are described for producing hydrogen-rich gas from liquid hydrocarbon and air. The proposed gas generator is portable and produces soot-free hydrogen-rich gas preventing clogging of the carburetor of the internal combustion engine using the product gas. The use of water or steam in the process is eliminated. NASA

**N76-18638** Pennsylvania Univ., Philadelphia.  
**ALLOCATION MODELS FOR ENERGY PLANNING Ph.D. Thesis**

Reynaldo Sanchez Mariano. 1975. 239 p. Avail. Univ. Microfilms. Order No. 76-3196

The problem of shortages of varying time duration originating from the electrical energy sector is investigated. Two different time frameworks are used to characterize the incidence of an electricity shortage: a periodic shortage occurring only for a few hours during the day at times of peak load and a sustained shortage which is severe enough to result in permanent reduction of supply. The periodic shortage problem is approached by using a priority-weighting method. Energy users are first classified into different industry groups. Then, by pairwise comparisons of users according to various criteria, an overall measure of importance of each industry in relation to the others is expressed on a ratio scale between 0 and 1, is derived. A linear programming model is developed to study the problem of a sustained shortage. A short-term framework is assumed and the state of technology is taken as constant. The magnitude of the shortage and constraints on the model were introduced as parameters to derive alternative allocation plans under various conditions. Dissert Abstr

**N76-18640\*** New Mexico Univ Albuquerque Tech Application Center

**NEW MEXICO ENERGY RESEARCH RESOURCE REGISTRY RESEARCHERS AND FACILITIES Cumulative Volume through 30 June 1975**

30 Jun 1975 550 p Sponsored in part by NASA (NASA-CR-146330 TAC-ERR-75-800) Avail Univ of New Mexico Tech Application Center HC \$20.00 CSCL 05A

Human resources and facilities in New Mexico available for application to energy research and development are listed. Information regarding individuals with expertise in the environmental, socio-economic, legal, and management and planning areas of the energy effort is included, as well as those scientists, engineers, and technicians involved directly in energy research and development. Author

**N76-18644#** Select Committee on Small Business (U S House) **SMALL BUSINESS AND THE ENERGY SHORTAGE. VOLUME 1**

Washington GPO 1973 568 p refs Hearings before Subcomm on Special Small Business Problems of Permanent Select Comm on Small Business 93d Congr 1st Sess 22 May 6 21 and 27 Jun 10 and 17 Jul 5 Jul 1973 (GPO-99-720) Avail Subcomm on Special Small Business Problems

The impact on small business of the growing energy problems and the measures needed to solve this problem are examined. Factors considered include allocations, the extent of petroleum supplies, both domestic and of foreign origin, and forecasts of future supply and demand. Emphasis is placed on ways of reducing consumption. J M S

**N76-18645#** Select Committee on Small Business (U S House) **SMALL BUSINESS AND THE ENERGY SHORTAGE. VOLUME 2**

Washington GPO 1974 278 p refs Hearings before Subcomm on Special Small Business Problems of Permanent Select Comm on Small Business 93d Congr 2d Sess 9 Oct 15 Nov 1973 8 Mar 1974 (GPO-40-890) Avail Subcomm on Special Small Business Problems

For abstract see N76-18644

**N76-18646#** Joint Publications Research Service Arlington Va

**SOVIET PAPERS PRESENTED AT THE 1975 EINDHOVEN MEETING OF THERMIONIC CONVERSION SPECIALISTS** 20 Jan 1976 94 p refs Transl into ENGLISH of Soviet papers from Dutch conf Conf Held at Eindhoven Holland 1-3 Sep 1975 (JPRS-66621) Avail NTIS HC \$5.00

Papers on thermionic energy conversion systems and techniques are summarized

**N76-18650** Joint Publications Research Service Arlington Va **THERMOEMISSION ENERGY CONVERTER WITH IMPULSE IONIZATION**

V A Zherebtsov *In its* Soviet Papers Presented at the 1975 Eindhoven Meeting of Thermionic Conversion Specialists (JPRS-66621) 20 Jan 1976 p 48-60 refs Transl into ENGLISH of Soviet papers from Dutch conf

Several problems of operating the thermoemission energy converters with impulse ionization are reported. Emphasis was placed on the working portion of the cycle - plasma breakdown. The question of how effective ionizing impulses with different polarity are was discussed. Author

**N76-18654\*#** Jet Propulsion Lab Calif Inst of Tech Pasadena **HYDROGEN TOMORROW DEMANDS AND TECHNOLOGY REQUIREMENTS**

Dec 1975 244 p refs (Contract NAS7-100) (NASA-CR-146416 JPL-5040-1) Avail NTIS HC \$8.00 CSCL 21D

National needs for hydrogen are projected and the technologies of production, handling, and utilization are evaluated. Research and technology activities required to meet the projected needs are determined.

**N76-18655\*** Jet Propulsion Lab Calif Inst of Tech Pasadena **FUTURE HYDROGEN USE**

*In its* Hydrogen Tomorrow Dec 1975 6 p refs

CSCL 10B

The use of hydrogen is related to energy consumption because hydrogen is primarily used as a feedstock in petroleum processing and in the manufacture of ammonia, methanol, and other chemicals. National energy scenarios are selected as a basis for projecting how much hydrogen will be required for established uses and how these quantities might be affected by new energy system uses for hydrogen. Author

**N76-18656\*** Jet Propulsion Lab Calif Inst of Tech Pasadena **SUPPLY OPTIONS**

*In its* Hydrogen Tomorrow Dec 1975 8 p

CSCL 10B

The use of captive hydrogen (produced and consumed on site) and merchant hydrogen (externally supplied) is considered. A low-merchant-captive ratio market and a high-merchant-captive ratio market are described and compared. J M S

**N76-18657\*** Jet Propulsion Lab Calif Inst of Tech Pasadena **TECHNOLOGY ISSUES**

*In its* Hydrogen Tomorrow Dec 1975 6 p refs

CSCL 10B

Factors affecting the use of hydrogen are discussed. These include efficiency, economics, and environmental effects. Emphasis is placed on the state of development of the technologies of hydrogen production, handling, and use. The needs and deficiencies in the present technologies and the ability to meet these needs effectively are considered in detail. Author

**N76-18658\*** Jet Propulsion Lab Calif Inst of Tech Pasadena **CONCLUSIONS**

*In its* Hydrogen Tomorrow Dec 1975 3 p

CSCL 10B

Conclusions are presented according to general areas of technology with some specific examples of research and technology needs identified. These conclusions provide a base for the future development of detailed program plans and identify research needs that are not being given attention or are not being supported at a sufficient level. Emphasis is placed on hydrogen production and use. Author

**N76-18659\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**HYDROGEN UTILIZATION AND ALTERNATIVES**  
 R Manvi R Caputo and T Fujita *In its Hydrogen Tomorrow*  
 Dec 1975 47 p refs  
 CSCL 10B

The historical uses of hydrogen are described along with potential new uses which could develop as a result of the diminishing supply of conventional fossil fuels such as natural gas. A perspective view of hydrogen both as a chemical feedstock and as a fuel is necessary to understand its relationship to the overall national energy projections. These projections which show energy usage in terms of use sectors forms of energy and sources of energy do not specifically identify hydrogen as a component of the energy system. By superimposing the traditional roles upon the new opportunities for hydrogen on the energy projections the role of hydrogen and future projections is developed within the context of the national energy projections. Use supply and other factors affecting application are interrelated and are discussed. Author

**N76-18660\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**HYDROGEN PRODUCTION**  
 C England J E Chirivella T Fujita R E Jeffe D Lawson  
 and R Manvi *In its Hydrogen Tomorrow* Dec 1975 25 p  
 refs  
 CSCL 10B

The state of hydrogen production technology is evaluated. Specific areas discussed include hydrogen production fossil fuels coal gasification processes electrolysis of water thermochemical production of hydrogen production of hydrogen by solar energy and biological production of hydrogen. Supply options are considered along with costs of hydrogen production. J M S

**N76-18661\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**FACTORS AFFECTING THE BROADENED USE OF HYDROGEN**  
*In its Hydrogen Tomorrow* Dec 1975 21 p refs

CSCL 10B

The future role of hydrogen is considered. Specific factors discussed include storage, transmission and distribution problems, materials compatibility and safety environmental and social implications of increased hydrogen usage and the economics related to expanding hydrogen use. Author

**N76-18662\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**EUROPEAN ACTIVITIES IN THE HYDROGEN ENERGY FIELD**  
 J E Chirivella *In its Hydrogen Tomorrow* Dec 1975 3 p  
 refs  
 CSCL 10B

Research activities in the hydrogen energy field in the European community are reviewed. Countries included in the discussion are Austria Belgium England Federal Republic of Germany and Italy. Author

**N76-18663\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**HYDROGEN USES**  
 R Manvi *In its Hydrogen Tomorrow* Dec 1975 8 p refs

CSCL 10B

Brief descriptions are given of some of the present and future uses of hydrogen. Industrial synthesis process uses and applications to other sectors of the national economy are also considered. Author

**N76-18664\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**THERMOCHEMICAL CYCLES**  
 J E Funk (Kentucky Univ Lexington) M A Soliman (Kentucky Univ Lexington) R H Carty (Kentucky Univ Lexington) W L Conger (Kentucky Univ Lexington) K E Cox (Kentucky Univ Lexington) and D Lawson *In its Hydrogen Tomorrow* Dec 1975 15 p refs  
 CSCL 10B

The thermochemical production of hydrogen is described along with the HYDRGN computer program which attempts to rate

the various thermochemical cycles. Specific thermochemical cycles discussed include iron sulfur cycle iron chloride cycle and hybrid sulfuric acid cycle. J M S

**N76-18665\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**PRODUCTION COST METHODS AND DATA**  
 R E Jeffe and T Fujita *In its Hydrogen Tomorrow* Dec 1975 10 p  
 CSCL 10B

The general gas cost equation for utility financing is presented. Modifications and assumptions made in order to apply the cost equation to hydrogen production are described. Cost data are given for various methods of hydrogen production. The cost matrix procedure is briefly discussed. J M S

**N76-18666\*** National Aeronautics and Space Administration  
 Lewis Research Center Cleveland Ohio  
**CRYOGENIC STORAGE**  
 R L DeWitt *In JPL Hydrogen Tomorrow* Dec 1975 11 p  
 refs  
 CSCL 10B

Types of storage techniques available are described in terms of their present as well as future potential for liquid hydrogen storage. Examples are given and areas for further technology development are defined. J M S

**N76-18667\*** National Aeronautics and Space Administration  
 Lewis Research Center Cleveland Ohio  
**MATERIALS CONSIDERATIONS**  
 Hugh R Gray Howard G Nelson (NASA Ames Research Center) Robert E Johnson (NASA Lyndon B Johnson Space Center) Bryan McPherson (NASA Marshall Space Flight Center) Frank S Howard (NASA John F Kennedy Space Center Cocoa Beach Fla) and James H Swisher (ERDA Livermore Calif) *In JPL Hydrogen Tomorrow* Dec 1975 10 p

CSCL 10B

Materials problems are examined that may be encountered within a hydrogen energy system. Emphasis is placed on hydrogen embrittlement corrosion oxidation and erosion. Other factors discussed include degradation of mechanical properties of structural alloys system reliability and maintenance costs. Author

**N76-18668\*** Denver Research Inst Colo  
**HYDROGEN, SOCIO-ENVIRONMENTAL IMPACT**  
 John S Gilmore William E Matthews and Mary K Duff *In JPL Hydrogen Tomorrow* Dec 1975 43 p refs

(Contract JPL-954155)

CSCL 10B

The concept and logic flow of a hydrogen technology assessment are described along with a specific procedure for such an assessment. The development of hydrogen technology is discussed. Factors considered in the development and use of hydrogen include stimulus of societal needs and technological innovations economic factors and social and environmental effects. J M S

**N76-18675\*#** California Univ Berkeley  
**EVALUATION OF CONVENTIONAL POWER SYSTEMS**  
 Kirk R Smith John Weyant and John P Holdren Jul 1975 194 p refs Prepared for JPL  
 (Contracts NAS7-100 JPL-954071)  
 (NASA-CR-146344 ERG-75-5) Avail NTIS HC \$7.50 CSCL 10B

The technical economic and environmental characteristics of (thermal nonsolar) electric power plants are reviewed. The fuel cycle from extraction of new fuel to final waste management is included. Emphasis is placed on the fossil fuel and nuclear technologies. Author

**N76-18677\*#** National Aeronautics and Space Administration  
 Lewis Research Center Cleveland Ohio

**PRELIMINARY ASSESSMENT OF SYSTEMS FOR DERIVING LIQUID AND GASEOUS FUELS FROM WASTE OR GROWN ORGANICS**

Robert W Graham Thaine W Reynolds and Yih-Yun Hsu  
Washington Feb 1976 42 p refs  
(NASA-TN-D 8165 E-8463) Avail NTIS HC \$4 00 CSCI 10A

The overall feasibility of the chemical conversion of waste or grown organic matter to fuel is examined from the technical economic and social viewpoints The energy contribution from a system that uses waste and grown organic feedstocks is estimated as 4 to 12 percent of our current energy consumption Estimates of today's market prices for these fuels are included Economic and social issues are as important as technology in determining the feasibility of such a proposal An orderly program of development and demonstration is recommended to provide reliable data for an assessment of the viability of the proposal Author

**N76-18678\*# Jet Propulsion Lab Calif Inst of Tech Pasadena PROJECT PLAN HYDROGEN ENERGY SYSTEMS TECHNOLOGY PHASE 1 HYDROGEN ENERGY SYSTEMS TECHNOLOGY STUDY**

30 Oct 1974 25 p refs Sponsored by NASA  
(NASA-CR-146424 JPL-1200-194) Avail NTIS HC \$3 50 CSCI 10B

An overview of the potential need for hydrogen as a source of energy in the future was presented in order to identify and define the technology requirements for the most promising approaches to meet that need The following study objectives were discussed (1) determination of the future demand for hydrogen based on current trends and anticipated new uses (2) identification of the critical research and technology advances required to meet this need considering to the extent possible raw material limitations economics and environmental effects and (3) definition and recommendation of the scope and space of a National Hydrogen Energy Systems Technology Program and outline of a Program Development Plan Author

**N76-18679\*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala A MOUNT FOR CONTINUOUSLY ORIENTING A COLLECTOR DISH IN A SYSTEM ADAPTED TO PERFORM BOTH DIURNAL AND SEASONAL SOLAR TRACKING Patent Application**

Lott W Brantley and Billy D Lawson inventors (to NASA) Filed 29 Jan 1976 12 p  
(NASA-Case-MFS 23267-1 US-Patent-Appl-SN 653422) Avail NTIS HC \$3 50 CSCI 131

The mount is characterized by a rigid angulated axle having a linear midportion supporting a collector dish and oppositely extended end portions normally related to the midportion of the axle and received in spaced journals The longitudinal axis of symmetry for the midportion of the axle is coincident with a seasonal axis while the axes of the journals are coincident with a diurnal axis paralleling the earth's polar axis Drive means are provided for periodically displacing the axle about the diurnal axis at a substantially constant rate while other drive means are provided for periodically indexing the dish through 1 deg about the seasonal axis once during each of the earth's successive rotations about its polar axis The position of the dish relative to the axle is thus varied for accommodating seasonal tracking as changes in the angle of inclination of the polar axis occur

NASA

**N76-18680\*# National Aeronautics and Space Administration Pasadena Office Calif SOLAR PHOTOLYSIS OF WATER Patent Application**

Porter R Ryason inventor (to NASA) (JPL) Filed 13 Feb 1976 14 p  
(Contract NAS7-100)

(NASA-Case-NPO-13675-1 US-Patent-Appl-SN-658132) Avail NTIS HC \$3 50 CSCI 21D

Hydrogen is produced by the solar photolysis of water in a photooxidation vessel in the presence of a water soluble

photooxidizable reagent and an insoluble hydrogen recombination catalyst Simultaneously oxygen is produced in a photoreduction reactor in the presence of an insoluble photoreduction reagent catalyst When spent the solution from the first reactor is fed into the second reactor A reaction occurs in the dark in which the redox reagents are regenerated and the regenerated photooxidation reagent solution is recycled to the first reactor The photooxidation reagent is preferably a europium salt and the associated hydrogen recombination catalyst is a material such as platinum supported on glass beads The photoreduction catalyst is a bifunctional reagent catalyst including a transition metal salt such as manganese oxychloride covalently bonded to the surface of a high area support such as glass fibers together with a hydroxyl or chlorohydroxyl decomposition catalyst of high area NASA

**N76-18681# Joint Committee on Internal Revenue Taxation (U S Congress)**

**ANALYSIS OF ENERGY SUPPLY, CONSERVATION AND CONVERSION Automotive**

Washington GPO 1975 22 p Prepared for the Comm on Finance HR 6860 and possible alternatives 22 Jul 1975 (GPO-55-802) Avail Joint Comm on Internal Revenue Taxation

Legislation providing tax incentives designed to reduce the consumption of fuel by automobiles and other vehicles is discussed D M L

**N76-18682# Joint Committee on Internal Revenue Taxation (U S Congress)**

**ANALYSIS OF ENERGY SUPPLY, CONSERVATION, AND CONVERSION Business Use Tax, Tax Treatment of Railroads, Home Insulation, etc**

Washington GPO 1975 18 p Prepared for the Comm on Finance HR 6860 and possible alternatives 22 Jul 1975 (GPO-55-800) Avail Joint Comm on Internal Revenue Taxation

Legislation which provides tax incentives designed to encourage various methods of energy conservation is discussed Rail transportation space heating air conditioning materials recycling and offshore drilling are among the areas affected

D M L

**N76-18683# Committee on Commerce (U S Senate)**

**ENERGY LABELING AND DISCLOSURE**

Washington GPO 1975 217 p refs Hearings on S 349 before Comm on Commerce 94th Congr 1st Sess 24-25 Feb 1975

(GPO-51-440) Avail Comm on Commerce

Energy conservation is considered in terms of energy costs of consumer products and systems A system of disclosing the estimated annual operating cost for major household appliances central air-conditioning and heating systems and automobiles is proposed along with energy conservation measures in building codes Specific topics discussed include computer techniques for estimating the energy requirements of homes office buildings schools and hospitals energy labeling of household appliances integrated utility systems for communities efficiency of energy use in industry energy conservation and the environment and electric power system measurements J M S

**N76-18685# ICF Inc Washington D C**

**DEMAND FOR COAL FOR ELECTRICITY GENERATION 1975 - 1984 Final Report**

Aug 1975 40 p  
(PB-245216/7 FEA/G-75/487) Avail NTIS HC \$4 00 CSCI 10B

Data submitted by the Regional Electric Councils are compiled and related to the status of their respective Bulk Power Supply Programs to the Federal Power Commission These data include projections of annual net generation requirements and scheduled generating capacity additions by primary fuel type through 1984 as well as detailed information on individual existing generating units including megawatt capacities and both primary and alternative fuel types GRA

**N76-18686#** Cornell Univ, Ithaca, NY Dept of Operations Research

**ON MATHEMATICS IN ENERGY RESEARCH**

William F Lucas Sep 1975 18 p refs  
(Contract N00014-67-A-0077-0014, Grant NSF MPS-75-02024)  
(AD-A016654, TR-273) Avail NTIS CSCL 12/2

This report contains comments on the papers presented at the SIMS Research Applications Conference on Energy at Alta, Utah on July 7-11, 1975, plus remarks on some types of mathematical models and new methodologies which may prove useful in such research GRA

**N76-18688#** National Maritime Research Center, Kings Point, NY

**ALTERNATE ENERGY SOURCES FOR MARINE POWER PLANTS**

Jose Femenia (Webb Inst of Naval Architecture, Glen Cove, N Y) Sep 1975 22 p refs  
(COM-75-11474/4, NMRD-KP-144) Avail NTIS HC \$3 50  
CSCL 21D

This report discussed the size of ship power plants and other factors governing the suitability of different types of fuel for marine use It then considers various alternatives to traditional fuels derived from crude petroleum Types of fuel considered are other liquid hydrocarbon fuels, both natural and synthetic, hydrocarbon fuels in solid liquid/solid, and gaseous forms, non-hydrocarbon fuels and solar and wind energy GRA

**N76-18691#** Naval Academy, Annapolis, Md  
**OCEAN THERMAL ENERGY CONVERSION: A MODEL APPROACH**

Thomas W Frey 22 May 1975 88 p refs  
(AD-A015954, USNA-TSPR-66) Avail NTIS CSCL 10/2

An Ocean Thermal Energy conversion model was successfully built and it has demonstrated the feasibility of power generation from small temperature differences similar to those existing in the tropical oceans Seventy watts of electrical power were generated at a pressure difference of 32 psi corresponding to an 11 F internal temperature differential The model, the proceedings and details are described in the work GRA

**N76-18693#** Stanford Univ Calif Systems Optimization Lab

**FORMULATING A PILOT MODEL FOR ENERGY IN RELATION TO THE NATIONAL ECONOMY**

George B Dantzig Apr 1975 22 p  
(Contracts N00014-75-C-0865 N00014-75-C-0267,  
AT(O4-3)-326-PA-18 Grant NSF MPS-71-03341-A03  
NR Proj O47-143 NR Proj O47-064)  
(AD-A016184 SOL-75-10) Avail NTIS CSCL 10/1

This dynamic linear-programming model on a pilot scale is an attempt to describe in physical terms many of the technological interactions within and across the sectors of the economy including a detailed energy sector The general objective of the model is to determine, in the face of the changing energy picture, what the country can achieve in physical terms over the long term say 30 years Preliminary work on the pilot model indicates that it can be completed within six months and that several useful scenarios can be run during the ensuing six months GRA

**N76-18969\*#** Forecasting International Ltd Arlington Va  
**THE FUTURE ENVIRONMENT US AND WORLD TRENDS**

Kathryn H Humes and Harold S Becker (Futures Group) 15 Jul 1975 779 p refs  
(Contracts NAS5-20732 NAS5-20734)  
(NASA-CR-144728) Avail NTIS HC \$18 75 CSCL 05K

The impact of rapidly developing technology and industrialization on human society and environments is considered

**N76-18971\*** Forecasting International Ltd Arlington Va  
**ENERGY AND OTHER NON-RENEWABLE RESOURCES**

*In its* The Future Environment 15 Jul 1975 4 p refs

**CSCL 10B**

Anticipated U S demands for non-renewable energy and mineral resources exceed domestic supplies essential for economic growth For the long term changes necessary in the energy supply and demand gap, new technologies and substitute materials as well as legislation and socio-economic strategies are elaborated GG

**N76-18972\*** Forecasting International Ltd, Arlington, Va  
**FUTURE US ENERGY DEMANDS BASED UPON TRADITIONAL CONSUMPTION PATTERNS LEAD TO REQUIREMENTS WHICH SIGNIFICANTLY EXCEED DOMESTIC SUPPLY**

*In its* The Future Environment 15 Jul 1975 39 p refs

**CSCL 10B**

Energy consumption in the United States has risen in response to both increasing population and to increasing levels of affluence Depletion of domestic energy reserves requires consumption modulation, production of fossil fuels, more efficient conversion techniques, and large scale transitions to non-fossil fuel energy sources Widening disparity between the wealthy and poor nations of the world contributes to trends that increase the likelihood of group action by the lesser developed countries to achieve political and economic goals The formation of anticartel cartels is envisioned GG

**N76-19001#** Committee on Interior and Insular Affairs (U S Senate)

**OUTER CONTINENTAL SHELF MANAGEMENT ACT OF 1975**

Washington GPO 17 Jul 1975 119 p ref Rept to accompany S 521 94th Congr, 1st Sess 17 Jul 1975

(S-Rept-94-284) Avail US Capitol Senate Document Room

Outer continental shelf (OCS) management legislation is described which would (1) establish policy guidelines (2) require a 5-year leasing program (3) give the coastal states an increased role in Federal OCS decisions (4) provide Federal compensation to coastal states adversely affected by OCS development (5) improve safety requirements (6) establish unlimited absolute liability for oil spill damage with payments from a liability fund (7) provide for a two-step decision process to separate exploration from development and production and (8) authorize new leasing systems and require their use on an experimental basis Author

**N76-19004#** Committee on Interstate and Foreign Commerce (U S House)

**ENERGY CONSERVATION AND OIL POLICY ACT OF 1975**

Washington GPO 1975 325 p refs Rept together with minority supplemental and additional views to accompany H R 7014 94th Congr 1st Sess 9 Jul 1975

(H-Rept-94-340 GPO-57-006) Avail US Capitol House Document Room

A bill is proposed which is directed to the attainment of the collective goals of increasing domestic supply conserving and managing energy demand and establishing standby programs for minimizing the nation's vulnerability to major interruptions in the supply of petroleum imports The bill would apply price controls to the entirety of domestic crude oil production in an attempt to restore elements of reason to a marketplace whose mechanisms are made to counteract the influence of cartel pricing and to insulate the economy at least in part from further sharp inflationary increases in petroleum prices The bill would also establish regulatory programs to bring about measured savings in consumption of energy by improving the efficiency of products and cars Targeted goals for bettering industrial efficiencies are provided And a gasoline savings program is established which makes use of allocation and supply controls to prevent growth in gasoline consumption over the next three years and where practicable to reduce existing demand levels by an additional 2 to 4 percent The bill's main provisions are discussed in detail Author

**N76-19347#** Los Alamos Scientific Lab., N Mex  
**DESIGN OF A FORCE-FREE INDUCTIVE STORAGE COIL**  
 O K Mawardi Apr 1975 11 p refs  
 (Contract W-7405-eng-38)  
 (LA-5953-MS) Avail NTIS HC \$4 00

Force free coils are considered for various applications as energy storage devices. A novel energy storage system consisting of both toroidal and poloidal coils is developed. In this system, the Lorentz forces on the two coils are in opposition and can be made to cancel by having the proper ratio of ampereturns in the two coils. A general discussion of force free coil design is given, and the toroidal-poloidal coil system is described. The materials costs of magnets constructed with this and other geometries are compared. The conclusions are that conductor cost of this system lies between those of solenoids and toroids, and that the costs of structural material may be considerably less than either of these simpler coils. Author (NSA)

**N76-19545#** Midwest Research Inst., Kansas City Mo  
**BASE LINE FORECASTS OR RESOURCE RECOVERY, 1972 TO 1990 Final Report**  
 Gary R Nuss, William E Franklin, David Hahlin, William Park and Michael Urie Mar 1975 386 p refs  
 (Contract EPA-68-01-0793)  
 (PB-245924/6 EPA/530/SW 107C) Avail NTIS HC \$10 75  
 CSCL 13B

An assessment is made of the future of resource recovery from municipal waste for the years 1972 to 1990 based on the assumption there would be no federal legislation to stimulate resource recovery to 1990. Key methods of recovery are examined with emphasis on large-scale system recovery techniques (primary energy/material recovery by SMSA). Data on material collection, recycling centers, and current scrap dealers are also included. The results are summarized by material for the resources studied: glass, ferrous metals, aluminum, plastics, rubber, paper. GRA

**N76-19550** Massachusetts Univ., Amherst  
**DESIGN AND OPTIMIZATION OF THE POWER CYCLE AND THE HEAT EXCHANGERS FOR AN OCEAN THERMAL POWER SYSTEM Ph D Thesis**  
 James William Connell III 1975 295 p  
 Avail Univ Microfilms Order No 76-5275

A comprehensive digital computer design model for a closed Rankine power cycle utilizing the temperature potential of two ocean currents which provide the heat source and heat sink for the power cycle is presented. A simplified plate-fin heat exchanger surface geometry is proposed for use by both the evaporator and condenser. A detailed numerical design technique is presented for the proposed compact exchanger geometry. The evaporator modeling is one-dimensional and employs the empirical results for predicting local values of the working fluid forced convection evaporating heat transfer coefficient. The condenser modeling is also one-dimensional and employs a combination of analytical and empirical technique for predicting local values of the working fluid forced convection condensing heat transfer coefficient. In addition, computational procedures for evaluating local values of the fluid phase volumetric concentrations and two-phase pressure gradient are included in the design technique. Dissert Abstr

**N76-19562#** Joint Economic Committee (U S Congress)  
**POTENTIAL HEATING OIL SHORTAGES**  
 Washington GPO 1973 218 p refs. Hearings before Subcomm on Consumer Economics of Joint Economic Comm. 93d Congr 1st Sess. 18 and 20 Sep 1973  
 (GPO-24-027) Avail SOD HC \$1 65

The possibility of heating oil shortages on a national scale is considered. Emphasis is placed on the outlook for distillate fuels programs concerning priority use of low-sulfur fuels, the propane allocation program, and the operation of the voluntary petroleum allocation program. J M S

**N76-19566#** Oak Ridge National Lab., Tenn  
**ASSESSMENT OF INDUSTRIAL ENERGY OPTIONS BASED ON COAL AND NUCLEAR SYSTEMS**  
 T D Anderson, H I Bowers, R H Bryan, J G Delene, E C Hise, J E Jones, Jr, O H Klepper, S A Reed, and I Spiewak Jul 1975 330 p refs  
 (Contract W-7405-eng-26)  
 (ORNL-4995) Avail NTIS HC \$10 60

Industry consumes about 40 percent of the total primary energy used in the United States. Natural gas and oil, the major industrial fuels, are becoming scarce and expensive, therefore, there is a critical national need to develop alternative sources of industrial energy based on the more plentiful domestic fuels--coal and nuclear. This report gives the results of a comparative assessment of nuclear- and coal-based industrial energy systems which include technical, environmental, economic, and resource aspects of industrial energy supply. The nuclear options examined were large commercial nuclear power plants (light-water reactors or high-temperature gas-cooled reactors) and a small [approximately 300-MW(t)] special purpose pressurized-water reactor for industrial applications. Coal-based systems selected for study were those that appear capable of meeting environmental standards, especially with respect to sulfur dioxide. Author (NSA)

**N76-19566#** Federal Energy Administration, Washington D C  
 Office of Energy Conservation and Environment  
**FEDERAL ENERGY MANAGEMENT PROGRAM, FISCAL YEAR 1975 Quarterly Report, Jan - Mar 1975**  
 Jul 1975 11 p  
 (PB-246314/9, FEA/D-75-516 Paper-30 QR-3) Avail NTIS HC \$3 50 CSCL 21D

Energy use by the federal government during the third quarter of the Fiscal Year 1975 (Jan-Mar 1975) is analyzed. The total amount of energy saved during the first 9 months of FY 75 is 425.4 trillion Btu, which amounts to a total reduction in use of 25.3 percent, which is about 10 percent more than ordered by the President. Energy use is monitored in the 26 Federal departments and agencies that account for about 99 percent of all the energy expended by the federal government. Use is measured in two broad categories: (1) energy used in buildings and facilities, and (2) energy used in operating vehicles and other similar equipment. Data also reflect the types of energy and amounts of each that the government uses. GRA

**N76-19567#** TRW Systems Group, Redondo Beach, Calif  
**OCEAN THERMAL ENERGY CONVERSION RESEARCH ON AN ENGINEERING EVALUATION AND TEST PROGRAM VOLUME 3 BASELINE SYSTEM CONCEPT**  
 Jun 1975 195 p. Previously announced as SAN-1089-T1-P3 (Contract NSF C-958)  
 (PB-246180/4 NSF/RA/N-75-080C Vol-3 SAN-1089-T1-P3) Avail NTIS HC \$7 50 HC also available \$27 00/set of 5 reports as PB-246177-SET CSCL 10A

This volume examines the use of a baseline concept defined here as one which embodies basic system principles with the lowest possible technical risk. System concepts were postulated and ranked with criteria of performance, risk, and cost. The baseline system concept used a binary closed Rankine cycle using ammonia as the working fluid. GRA

**N76-19568#** TRW Systems Group, Redondo Beach, Calif  
**OCEAN THERMAL ENERGY CONVERSION RESEARCH ON AN ENGINEERING EVALUATION AND TEST PROGRAM VOLUME 4 TEST PROGRAM PLAN**  
 Jun 1975 51 p. Previously announced as SAN-1089-T1-P4 (Contract NSF C 958)  
 (PB-246181/2 NSF/RA/N-75 080D-Vol-4 SAN-1089-T1 P4) Avail NTIS HC \$4 50 HC also available \$27 00/set of 5 reports as PB 246177-SET CSCL 10A

An outline is given of an incremental test program whose objectives are twofold: (1) to provide solutions to the critical issues such as biofouling, heat exchanger performance, cold water pipe characteristics including pipe attachment and deployment, and plant interaction with the environment such as disturbance of the thermocline; (2) to provide design data not obtainable

**N76-19571**

solely by analyses required for the successful design and construction of ocean thermal energy conversion plants GRA

**N76-19571#** Federal Trade Commission Washington D C Bureau of Competition

**STAFF REPORT TO THE FEDERAL TRADE COMMISSION ON THE STRUCTURE, CONDUCT AND PERFORMANCE OF THE WESTERN STATES PETROLEUM INDUSTRY**

Sep 1975 158 p  
(PB-245855/2 FTC-7410018) Avail NTIS HC \$6.75 CSDL 05C

Competitive conditions in the energy industries using Western States Petroleum as a model are examined. The report examines the extent of economic concentration in such areas of the market as crude oil production, refining and marketing. It also examines three areas of industry conduct for antitrust implication: Withdrawal from gasoline marketing by major firms in the Pacific Northwest occurring in late 1973; control of intrastate crude oil pipelines in California by major oil firms to the alleged exclusion of independent refiners and producers; and assertions that the major oil firms are holding California crude oil prices down through the exercise of their market power as buyers. An examination was made of the legal issues presented by the question of regulatory jurisdiction over the Alaska pipeline. GRA

**N76-19572# Wisconsin Dept of Transportation Madison PROCEEDINGS THE ROLE OF THE US RAILROADS IN MEETING THE NATION'S ENERGY REQUIREMENTS**

Oct 1974 88 p refs Proc held at Madison Wisc 6-8 May 1974 Prepared in cooperation with Wisc Univ Madison (Contract DOT-FR-4 3015)  
(PB-245565/7) Avail NTIS HC \$5.00 CSDL 10A

The market role of the railroads given present and forecast changes in energy parameters is discussed in terms of meeting the nation's energy requirements. Other topics covered include the posture and responsibility of government, environmental issues and technology, especially the potential for electrification of main lines. GRA

**N76-19575# Colorado Springs Dept of Public Utilities Colo ASSESSMENT OF A SINGLE FAMILY RESIDENCE SOLAR HEATING SYSTEM IN A SUBURBAN DEVELOPMENT SETTING Annual Report, 1 Jul 1974 - 31 Jul 1975**

James D Philips 10 Jul 1975 244 p refs  
(Grants NSF GI-44210 NSF ISR-75-22998-000)  
(PB-246141/6 NSF/RA/N-75-078) Avail NTIS HC \$8.00 CSDL 13A

A gas moratorium in 1973 prompted the city of Colorado Springs to investigate alternate methods for space heating. This investigation led to the conclusion that solar heating could become a viable alternative. A community Project to construct and test a solar heated house. This report is the result of one year's intensive investigation into four areas related to solar heating: technical research on the system's components; economic research; legal research on zoning ordinances and building codes; and social acceptance research on the acceptability of solar heating. GRA

**N76-19576# Battelle Columbus Labs Ohio ENERGY USE PATTERNS IN METALLURGICAL AND NONMETALLIC MINERAL PROCESSING PHASE 4 ENERGY DATA AND FLOWSHEETS, HIGH-PRIORITY COMMODITIES**

27 Jun 1975 192 p refs  
(Contract S0144093)  
(PB-245759/6 BM-OFR-80-75) Avail NTIS HC \$7.50 CSDL 10A

Energy requirements for high-priority primary products are given. These commodities and their appropriate primary products were originally selected for this study because of an expected relatively high total annual energy requirement to produce or because of the large tonnage produced each year. All of these commodities are important basic industrial materials and therefore this detailed energy appraisal is of particular value in assessing

the national pattern of energy consumption. Estimated energy values are included for mining and beneficiation, consumable raw materials, transportation and fuels and electrical energy. GRA

**N76-19577# Stanford Research Inst Menlo Park Calif COMPARISON OF ENERGY CONSUMPTION BETWEEN WEST GERMANY AND THE UNITED STATES Final Report**

Richard L Goen and Ronald K White Jun 1975 112 p refs  
(Contract DI-14-01 0001-1885 SRI Proj EGU-3519)  
(PB-245652/3 FEA/D-75 590) Avail NTIS HC \$5.50 CSDL 10A

The report examines and explains the differences in per capita energy consumption between the United States and West Germany and quantifies the factors involved. West Germany uses only half as much energy per capita as the United States. Energy use per capita for transportation is only one-fourth of that of the United States for residential space heating (climate corrected) only one-half for other residential uses, only one-fourth and for industrial uses 58 percent. The United States uses at least 40 percent more energy for industry in relation to output as West Germany. The total energy use in the United States in relation to national income is about 50 percent greater than in West Germany. This large disparity in energy use between the two countries suggests that continued economic growth and improvement in the standard of living in the United States should be possible without a proportionate increase in energy consumption. GRA

**N76-19578# Federal Power Commission Fort Worth Tex Bureau of Power**

**THE PHASING OUT OF NATURAL GAS AND OIL FOR ELECTRIC POWER GENERATION SOUTHWEST POWER POOL AND ELECTRIC RELIABILITY COUNCIL OF TEXAS PART 1 PRESENT ELECTRIC UTILITY PROGRAM 1975 1984**

Sep 1975 46 p refs  
(PB-245570/7) Avail NTIS HC \$4.00 CSDL 10A

The report covers electric utility plans for phasing out natural gas and oil for electric generation in the Southwest Power Pool and Electric Reliability Council of Texas. These two electric reliability councils cover all or parts of eight states ranging from the western part of Mississippi to the eastern part of New Mexico and stretching from Texas to Kansas and part of Missouri. Because this area is heavily dependent on natural gas as a fuel for electric generation, its use is of major concern and importance in the face of a diminishing natural gas supply. GRA

**N76-19580# Pennsylvania State Univ University Park Dept of Architectural Engineering**

**EVALUATION OF THE SOLAR BUILDING ALBUQUERQUE NEW MEXICO Annual Report 1 Apr - 31 Dec 1974**

Stanley F Gilman 31 Jan 1975 50 p refs  
(Grant NSF GI 43922)  
(PB-245392/6 NSF/RA/N 75 076) Avail NTIS HC \$4.00 CSDL 13A

A procedure was developed for designing solar energy assisted heat pump systems for commercial buildings. A building in Albuquerque, N. M. was instrumented and equipped with a computerized data acquisition system. Various operating modes and operating data are covered. GRA

**N76-19582# Massachusetts Univ Amherst A SURVEY OF THE POSSIBLE USE OF WINDPOWER IN THAILAND AND THE PHILIPPINES**

William E Heronemus Nov 1974 143 p refs  
(Contract AID/ta c 1143)  
(PB 245609/3) Avail NTIS HC \$6.00 CSDL 10A

Use of wind powers by the peasant farmer in Thailand or the Philippines to improve the quality of his life was investigated. It was found that windpower was being used to a very limited extent in Thailand to move water, thus relieving either a backbreaking manual labor task or a very expensive out of

pocket expenditure for fuel for engine driven pumps. No evidence of existing wind pumping could be found in the Philippines GRA

**N76-19583#** Federal Energy Administration Washington D C Oil and Gas Statistics Div

**ENERGY INFORMATION REPORTED TO CONGRESS AS REQUIRED BY PUBLIC LAW 93-319, SECOND QUARTER 1975 Quarterly Report**

1975 197 p

(PB-242760 02) Avail NTIS HC \$10 00 (special price)/MF \$10 00 (special price) HC also available on subscription \$35 00/year domestic \$45 00/year foreign CSCL 10A

Resource development coal natural gas crude oil refined petroleum products nuclear energy and electric power are discussed. Topic areas cover such things as demand reserves consumption and international trade GRA

**N76-19589#** Naval Academy Annapolis Md Environmental Protection Research and Development Team

**COST BENEFIT OF UTILIZING THERMAL STORAGE FOR PEAK COOLING POWER LEVELING**

Bruce H Morgan 19 Sep 1975 21 p refs

(AD-A017297 USNA-EPRD-13) Avail NTIS CSCL 13/1

Calculations indicate that provision for diurnal ice storage reducing peak air conditioning power demand would save money by decreasing the amount and therefore the cost of the electrical generating equipment which must be installed. The thermal storage facility of a solar heating system might be used for this purpose perhaps with chilled water rather than ice GRA

**N76-19592#** Texas Governor's Energy Advisory Council Austin **POTENTIAL FOR SOLID WASTE AS AN ENERGY SOURCE IN TEXAS Final Report**

James E Halligan and William J Huffman Nov 1974 128 p

refs Prepared in cooperation with Texas Tech Univ

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

(PB-243351/4 NSF/RA/N-74-255) Avail NTIS HC \$5 75 CSCL 10A

The technology is assessed for solid waste conversion for application to the needs of Texas. The production rate of solid wastes in the municipal agricultural and industrial sectors of the state is summarized. The research-development and legislative actions required to implement energy recovery from solid wastes and those locations in Texas where such conservation processes would be feasible are recommended GRA

**N76-19616#** TRW Environmental Services Vienna, Virg **IMPLEMENTATION PLAN REVIEW FOR VIRGINIA AS REQUIRED BY THE ENERGY SUPPLY AND ENVIRONMENTAL COORDINATION ACT Final Report**

Feb 1975 57 p refs

(Contract EPA-68-02-1385)

(PB-245833/9 EPA-450/3-75-016) Avail NTIS HC \$4 50 CSCL 13B

Revisions of control regulations for stationary fuel combustion sources which do not interfere with attainment and maintenance of the national ambient air quality standards are presented. The changes would make it possible to alter fuel resource allocations to provide clean fuel savings in a manner consistent with environmental and national energy needs GRA

**N76-19617#** Systems Technology Corp, Dayton, Ohio **A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE WET PROCESSING SYSTEM FOR THE RECOVERY AND DISPOSAL OF MUNICIPAL SOLID WASTE Final Report**

1975 223 p refs

(Contract EPA-68-01-2211)

(PB-245674/7 EPA-530/SW-109c) Avail NTIS HC \$7 75 CSCL 13B

A technical, economic and environmental evaluation is given for a wet pulping process used for the recovery and disposal of

municipal solid waste. The demonstration facility consists of three major systems: hydrazosol fiber recovery and glass and aluminum recovery. This report presents the data for the hydrazosol and fiber recovery systems only GRA

**N76-20027#** Committee on Science and Technology (U S House)

**ERDA AUTHORIZATION, PART 5, 1976 AND TRANSITION PERIOD**

Washington GPO 1975 798 p refs. Hearing before Subcomm on Energy Res Development and Demonstration of Comm on Sci and Technol 94th Congr 1st Sess No 4 25 27 28 Feb 1975

(GPO-50-274) Avail Subcomm on Energy Res Development and Demonstration

The hearings concerning the ERDA budget request for fiscal year 1976 are reported. The role of colleges and universities in research for solar geothermal and systems for conservation of energy are discussed. It is recommended that ERDA organize two programs: a research and technology grant program and university centers to build a knowledge network of energy technology. The energy demand and supply outlook for 1985 energy sources areas of special concern and electric utilities are considered FOS

**N76-20029#** Joint Committee on Atomic Energy (U S Congress) **ATOMIC ENERGY LEGISLATION THROUGH 93RD CONGRESS, 2ND SESSION**

Washington GPO Jul 1975 502 p refs. Prepared by Joint Comm on Atomic Energy 94th Congr 1st Sess Jul 1975 (GPO-49-939) Avail SOD HC \$4 25

Statutes and material pertaining to atomic energy legislation are presented. Topics considered are the Atomic Energy Act of 1954, The Energy Reorganization Act of 1974, the AEC Authorization Acts, International Atomic Energy Agency Participation Act of 1957, Atomic Energy Community Act 1955, Appropriations legislative history of various acts and documents relating to the activation of the Energy Research and Development Administration and Nuclear Regulatory Commission are included JMS

**N76-20030#** Committee on Science and Technology (U S House)

**ERDA AUTHORIZATION, 1976 AND TRANSITION PERIOD OVERVIEW**

Washington GPO 1975 560 p refs. Hearing before Comm on Sci and Technol 94th Congr 1st Sess No 9 6 Feb 1975

(GPO-49 191) Avail Comm on Sci and Technol

The following subjects were discussed: (1) Public Law 93-438, the Energy Reorganization Act of 1974; (2) Examination of the budget of the Energy Research and Development Administration for fiscal year 1976, including a treatment and breakdown of the various research and development projects YJA

**N76-20371#** Battelle Columbus Labs Ohio **ENERGY USE PATTERNS IN METALLURGICAL AND NONMETALLIC MINERAL PROCESSING PHASE 5 ENERGY DATA END FLOWSHEETS, INTERMEDIATE PRIORITY COMMODITIES**

16 Sep 1975 242 p refs

(Contract S0144093)

(PB-246357/8 BM-OFR-96-75) Avail NTIS HC \$8 00 CSCL 08I

These commodities and their appropriate primary products were originally selected for this category either because of an expected fairly high total annual energy requirement to produce or because of the fairly large tonnage produced each year. All of these commodities are important basic industrial materials and therefore this detailed energy appraisal should be of particular value in assessing the national pattern of energy consumption. This study differs from the usual energy analysis



because it includes estimated energy values for mining and beneficiation consumable raw materials transportation and fuels and electrical energy GRA

**N76-20406\*** - New Mexico Univ Albuquerque Technology Application Center

**HEAT PIPE TECHNOLOGY A BIBLIOGRAPHY WITH ABSTRACTS Quarterly Update, 30 Sep 1975**

30 Sep 1975 55 p Sponsored by NASA (NASA-CR-146780) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC available by subscription only \$48 00 CACL 20M

Heat Pipe Technology is a continuing bibliographic summary of research on the subject of the heat pipe This update to Heat Pipe Technology cites references identified during July August and September of 1975 A library containing essentially all of the articles and publications referenced in this update and all the previous volumes has been established Author

**N76-20407\*** + New Mexico Univ Albuquerque Technology Application Center

**HEAT PIPE TECHNOLOGY A BIBLIOGRAPHY WITH ABSTRACTS Quarterly Update 1 Jan - 31 Mar 1975**

31 Mar 1975 62 p Sponsored by NASA (NASA CR-145826) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC available by subscription only \$48 00 CACL 20M

Heat Pipe Technology is a continuing bibliographic summary of research on the subject of the heat pipe This update to Heat Pipe Technology cites references identified during January February and March of 1975 A library containing essentially all of the articles and publications referenced in this update and all the previous volumes has been established Author

**N76-20470# Los Alamos Scientific Lab N Mex LASER SYSTEMS FOR HIGH PEAK-POWER APPLICATIONS**

C Fenstermacher 1975 9 p refs Presented at the Seminar on Opt Methods in Energy Conversion Rochester N Y 23 Jun 1975 (Contract W-7405-eng-36) (LA-UR-75-1757, Conf-750666-2) Avail NTIS HC \$4 00

Large scale programs are under way at major laboratories to study the feasibility of laser-induced fusion The laser requirements for this investigation are formidable and it is estimated that powers in the range of 100 terawatts with total energies of 100 000 to 1 000 000 joules may be needed A major fraction of the effort was directed toward the development of high-energy short-pulse lasers which can meet these requirements The parameters of the CO2 laser system were extensively studied and it appears that the efficiency energy density bandwidth and optical damage limits are compatible with the requirements The scaling laws are also now well understood Based upon these results several large carbon dioxide systems were developed by the Los Alamos Scientific Laboratory NSA

**N76-20505# Transportation Systems Center Cambridge Mass AUTOMOTIVE ENERGY EFFICIENCY PROGRAM**

Harold G Miller Jun 1975 273 p refs Presented at the Contractors Coordination Meeting 15-17 Jan 1975 (PB-245808/1 DOT-TSC-OST-75-31) Avail NTIS HC \$9 00 CACL 13F

The capability of the automotive industry to significantly improve the fuel economy of production vehicles is assessed along with the related socio-economic effects The primary objective of the conference was to report on progress to date and future plans of the Automotive Energy Efficiency Program and to promote the exchange of information between government industry and university investigators Papers and illustrated lectures presented at the conference are included GRA

**N76-20550# Raymond Technical Facilities Inc New York CONCEPT ANALYSIS, OFFSHORE BREAKWATER-OIL STORAGE SYSTEM**

Joseph Peraino and Tomasz Plodowski Apr 1975 67 p refs (Contract DACW72-73-C-0005) (AD-A010348 CERC-MP-4-75) Avail NTIS CACL 13/2

A method of providing a prompt and efficient answer to the fast-growing need for deep-draft berthing facilities along the U S east coast is developed The general concept of large hollow precast floating units towed to the site and sunk into position lends itself particularly to using the hollow interiors as storage space for liquid bulk cargo in large quantities Since the trend for more economical transportation of petroleum products is by use of large deep-draft carriers the combinations breakwater-oil storage system is a possible solution Assumptions were made as to probable site conditions i.e., water depths sea conditions, bottom conditions and a preliminary design developed for the units Various construction procedures were studied and compared from both technical and construction cost aspects GRA

**N76-20617# Federal Energy Administration Washington D C OIL AND GAS RESOURCES, RESERVES, AND PRODUCTIVE CAPACITIES, VOLUME 1 Final Report**

Oct 1975 74 p (PB-246354/5 FEA/G-75/618) Avail NTIS HC \$4 50 CACL 08I

Reserve and productive capacity estimates are given and compared with estimates from other sources A US crude oil productive capacity estimate is provided The procedures used to develop these estimates are evaluated GRA

**N76-20625\*** + New Mexico Univ Albuquerque Technology Application Center

**HYDROGEN ENERGY A BIBLIOGRAPHY WITH ABSTRACTS ANNUAL SUPPLEMENT, 1974**

Mani Natarajan ed 1975 236 p Sponsored by NASA (NASA-CR-146791 TAC-H-74-501) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC \$22 50 CACL 10B

A bibliography with abstracts on research and projections on the subject of hydrogen as a secondary fuel and as an energy carrier is presented References identified during the year 1974 are cited Cross indexes are included Topics covered include production utilization transmission distribution and storage and safety JMS

**N76-20626\*** + New Mexico Univ Albuquerque Technology Application Center

**QUARTERLY LITERATURE REVIEW OF HYDROGEN ENERGY A BIBLIOGRAPHY WITH ABSTRACTS FIRST QUARTER, 1975 Quarterly Update, 31 Mar 1975**

1975 57 p Sponsored by NASA (NASA-CR-146789) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC available by subscription only HC \$48 00 CACL 10B

A continuing bibliographic summary with abstracts of research and projection on the subject of hydrogen as a secondary fuel and as an energy carrier is presented Cross indexes are included Topics covered include production utilization and safety JMS

**N76-20627\*** + New Mexico Univ Albuquerque Technology Application Center

**QUARTERLY LITERATURE REVIEW OF HYDROGEN ENERGY A BIBLIOGRAPHY WITH ABSTRACTS SECOND QUARTER, 1975 Quarterly Update, 30 Jun 1975**

1975 44 p Sponsored by NASA (NASA-CR-146790) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC available by subscription only \$50 00 CACL 10B

For abstract, see N76-20626

**N76-20628\*** + New Mexico Univ Albuquerque Technology Application Center

**QUARTERLY LITERATURE REVIEW OF HYDROGEN ENERGY A BIBLIOGRAPHY WITH ABSTRACTS THIRD QUARTER, 1975 Quarterly Update, 30 Sep 1975**

1976 107 p Sponsored by NASA (NASA-CR-146779 QR-3) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC available by subscription only \$50 00 CSDL 10B

For abstract see N76-20626

**N76-20630#** Committee on Aeronautical and Space Sciences (U S Senate)

**ENERGY-RELATED RESEARCH AND DEVELOPMENT**

Washington GPO Apr 1975 137 p Rept for Comm on Aeron and Space Sci, 94th Congr 1st Sess Apr 1975 (GPO-51-189) Avail SOD-HC \$1 55

An update is presented of the report on energy-related research and development being conducted within the NASA. The various projects in energy research and development are discussed with emphasis on solar and nuclear energy. Possibilities of energy conversion, transmission and storage are presented with views of eventual application to transportation propulsion systems. Priority is given to energy and environment conservation in regard to fuel consumption and inefficient energy systems. Finally relevant space and nuclear research is studied and the solutions to the energy problems is thought to rely heavily on the technology derived from these two sources. L S

**N76-20631\*#** National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

**COMPARATIVE EVALUATION OF PHASE 1 RESULTS FROM THE ENERGY CONVERSION ALTERNATIVES STUDY (ECAS)**

Feb 1976 375 p refs Sponsored in part by ERDA and NSF (NASA-TM-X-71855 E-8596) Avail NTIS HC \$10 50 CSDL 10A

Ten advanced energy conversion systems for central-station based-load electric power generation using coal and coal-derived fuels which were studied by NASA are presented. Various contractors were selected by competitive bidding to study these systems. A comparative evaluation is provided of the contractor results on both a system-by-system and an overall basis. Ground rules specified by NASA such as coal specifications, fuel costs, labor costs, method of cost comparison, escalation and interest during construction, fixed charges, emission standards and environmental conditions are presented. Each system discussion includes the potential advantages of the system, the scope of each contractor's analysis, typical schematics of systems, comparison of cost of electricity and efficiency for each contractor, identification and reconciliation of differences, identification of future improvements and discussion of outside comments. Considerations common to all systems such as materials and furnaces are also discussed. Results of selected in-house analyses are presented in addition to contractor data. The results for all systems are then compared. Author

**N76-20632\*#** AiResearch Mfg Co, Torrance Calif  
**DEVELOPMENT OF A SOLAR-POWERED RESIDENTIAL AIR CONDITIONER Final Summary Report**

28 Nov 1975 146 p (Contract NAS8-30758) (NASA-CR-144234) Avail NTIS HC \$6 00 CSDL 10A

The initial objective of the program was the optimization (in terms of cost and performance) of a Rankine cycle mechanical refrigeration system which utilizes thermal energy from a flat solar collector for air conditioning residential buildings. However feasibility investigations of the adsorption process revealed that a desiccant type air conditioner offers many significant advantages. As a result limited efforts were expended toward the optimization of such a system. D M L

**N76-20634\*#** National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Md

**MECHANICAL CAPACITOR**

James A Kirk Philip A Studer and Harold E Evans Washington Mar 1976 61 p refs (NASA-TN-D-8185 G-7639) Avail NTIS HC \$4 50 CSDL 10C

A new energy storage system (the mechanical capacitor), using a spokeless magnetically levitated composite ring rotor is described and design formulas for sizing the components are presented. This new system is configured around a permanent magnet (flux biased) suspension which has active servo control in the radial direction and passive control in the axial direction. The storage ring is used as a moving rotor and electronic commutation of the stationary armature coils is proposed. There is no mechanical contact with the rotating spokeless ring, therefore long life and near zero rundown losses are projected. A 7-kW h system is sized to demonstrate feasibility. A literature review of flywheel energy storage systems is also presented and general formulas are developed for comparing rotor geometries. Author

**N76-20635#** Bureau of Mines Washington, D C  
**UNITED STATES ENERGY THROUGH THE YEAR 2000, REVISED**

Walter G Dupree, Jr and John S Corsentino Dec 1975 73 p Revised Avail NTIS HC \$4 50

A forecast of future energy consumption and supply is presented. The forecast is based on the evaluation of Bureau of Mines fuels data and the assumption that existing patterns of resource utilization will continue. It is suggested that projected energy resource utilization patterns can be altered to take advantage of the more plentiful indigenous resources. Author

**N76-20636#** Committee on Commerce (U S Senate)  
**INDUSTRY EFFORTS IN ENERGY CONSERVATION**

Washington GPO 1974 290 p refs Prepared for Comm on Commerce 93d Congr, 2d Sess Oct 1974 (GPO-35-814) Avail SOD HC \$3 50

A survey was conducted of the nation's 100 largest industrial corporations to gain information on the measures they have taken to reduce energy waste and to improve the efficiency of energy utilization in their operations. Of those surveyed 87 companies replied. All reported the establishment of some form of energy conservation program. Many indicated that they had initiated energy economy programs even before the seriousness of the energy crisis became widely known. Several of the companies also noted that energy conservation is not only a fulfillment of corporate responsibility but also sound business practice. In some cases overall energy savings of up to 26% were reported. Summaries and selected examples of the various ways industrial executives assemble energy data, coordinate energy policies, and the results of these efforts are presented. This analysis of the responses is divided according to specific areas of corporate energy conservation programs. The full texts of many of the responses are included. Author

**N76-20637#** Committee on Finance (U S Senate)

**FISCAL POLICY AND THE ENERGY CRISIS, PART 4**

Washington GPO 1974 579 p refs Hearings on S 2806 before Subcomm on Energy of Comm on Finance 93d Congr 2d Sess 27-29 Nov 23-25 28 and 29 Jan 1974 (GPO-28-243) Avail SOD HC \$4 45

Testimony and reports regarding energy policy and various energy sources are presented. Nuclear energy, coal, petroleum, solar energy and windpower are discussed. Economic, technological and environmental factors are considered. D M L

**N76-20638#** RAND Corp, Santa Monica Calif  
**ENERGY ALTERNATIVES FOR CALIFORNIA PATHS TO THE FUTURE**

William Ahern, Ronald Doctor, William Harris, Albert Lipson, Deane Morris, and Richard Nehring Dec 1975 331 p refs Sponsored in part by Calif State Assembly and Rockefeller Foundation (GPO-1793-CSA/RF) Avail NTIS HC \$10 00

Major energy issues affecting California were studied

Considerable emphasis was placed on developing a coordinated state policy response which is harmonious with national interests. A description of past and future energy sources is first presented and uses of energy in California are discussed. Several energy supply issues are then addressed. West-East oil movement, offshore oil and gas development, a northern California deepwater port, liquefied natural gas, gas transportation from the North Slope of Alaska, natural gas regulation and allocation policies, electricity generation and the development of alternative energy sources. Energy conservation measures are also examined in the transportation, residential, commercial and industrial sectors. Different scenarios of California's energy future, each of which incorporates a different set of policy actions, are discussed and various institutional alternatives for formulating and implementing state energy policy are examined. Author

**N76-20639#** RAND Corp. Santa Monica Calif  
**ENERGY ALTERNATIVES FOR CALIFORNIA: PATHS TO THE FUTURE, EXECUTIVE SUMMARY**

William Ahern, Ronald Doctor, William Harris, Albert Lipson, Deane Morris, and Richard Nehring. Dec 1975. 44 p. ref. Sponsored in part by Calif. State Assembly and Rockefeller Foundation. (PB-1793/1-CSA/RF) Avail. NTIS HC \$4.00

The major results of a project to identify and analyze energy policy issues facing the State of California are presented. Author

**N76-20640#** Federal Energy Administration, Washington D.C.  
 Office of Environmental Regulations

**AN ANALYSIS OF THE IMPACT ON THE ELECTRIC UTILITY INDUSTRY OF ALTERNATIVE APPROACHES TO SIGNIFICANT DETERIORATION. VOLUME 1. EXECUTIVE SUMMARY**

Oct 1975. 53 p. refs. Prepared in cooperation with EPA, Washington D.C. (PB-246205/9 FEA/D-75/585-Vol 1) Avail. NTIS HC \$4.50 CSCL 10B

This report evaluates the impact of proposed Senate House and EPA regulations regarding significant deterioration of air quality on the electric utility industry. The following issues are evaluated: (1) aggregate impact of significant deterioration requirements on new coal-fired power plants; (2) implications of Class I area designations; (3) impact of alternative Class II increments; (4) implications of stack height limitations; and (5) minimum degree of emission control. GRA

**N76-20641\*#** Solarex Corp., Rockville Md.  
**DEVELOPMENT OF A HIGH EFFICIENCY THIN SILICON SOLAR CELL. Quarterly Report**

Joseph Lindmayer. Mar 1976. 22 p. Prepared for JPL. (Contracts NAS7-100 JPL-954290) (NASA-CR-146770 SX/105/2Q QR-2) Avail. NTIS HC \$3.50 CSCL 10A

One hundred thin (120 microns to 260 microns) silicon-aluminum solar cells were fabricated and tested. Silicon slices were prepared into which an aluminum alloy was evaporated over a range of temperatures and times. Antireflection coatings of tantalum oxide were applied to the cells. Reflectance of the silicon-aluminum interfaces was correlated to alloy temperature (graphs are shown). Optical measurements of the rear surface-internal reflectance of the cells were performed using a Beckman spectrophotometer. An improved gridline pattern was evaluated and stability tests (thermal cycling tests) were performed. Results show that: (1) a high-index, high-transmittance antireflection coating was obtained; (2) the improved metallization of the cells gave a 60 percent rear surface-internal reflectance and the cells displayed excellent fill factors and blue response of the spectrum; (3) an improved gridline pattern (5 micron linewidths compared to 13 micron linewidths) resulted in a 1.3 percent improvement in short circuit currents; and (4) the stability tests showed no change in cell properties. J R T

**N76-20644#** Metropolitan Washington Council of Governments  
 D.C.

**ENERGY BALANCE FOR THE WASHINGTON METROPOLITAN AREA FOR 1973. Final Report**

P. Graham, T. Markle, V. Krouse, and R. Haas. Jun 1975. 48 p. refs.

(Grant HUD-CPA-DC-1011)

(PB-245391/8) Avail. NTIS HC \$4.00 CSCL 21D

A framework of accounts used in the metropolitan energy balance is presented for each of the following headings: resource type, fuel type, method of conversion, energy use, and demand sector. A table by fuel type of non-renewable and renewable primary energy resources used in the metropolitan Washington area is presented. Energy use data are presented in three demand sectors: (1) commercial, industrial, and institutional; (2) residential; and (3) transportation. Energy use data are presented by fuel type and demand sector using the following accounts: space heat, water heat, air conditioning, process, ground passenger transportation, ground freight transportation, and air transportation. A flow chart is presented showing how metropolitan energy resources model is integrated into a metropolitan framework model used for forecasting the effects of alternative metropolitan management strategies over a specified planning period. GRA

**N76-20645#** California State Div. of Oil and Gas, Sacramento  
**PROCEEDINGS OF THE WORKSHOP ON ENVIRONMENTAL ASPECTS OF GEOTHERMAL RESOURCES DEVELOPMENT**

David N. Anderson and Richard G. Bowen. Nov 1974. 115 p. refs. Prepared jointly with Oregon State Dept. of Geol. and Mineral Ind.

(Contract NSF AER-75-06872)

(PB-245209/2 NSF/RA/E-74-071) Avail. NTIS HC \$5.50 CSCL 10A

Environmental degradation related to the use of geothermal resources to produce electricity and directions for research to mitigate these problems are discussed. Six work groups were established: Water Quality, Air Quality, Biological Impact, Hazards, Environmental Impact Evaluation, and Land use and Socio-Economic Impact. A chairman's summary, problems and recommended approaches to solution are presented in each area. GRA

**N76-20646#** Dow Chemical Co., Midland Mich.  
**EVALUATION OF NEW ENERGY SOURCES FOR PROCESS HEAT. Final Report**

G. L. Decker, R. W. Barnes, Robert E. Sampson, and Virginia L. Prentice. Sep 1975. 242 p. refs. Prepared in cooperation with Environmental Research Inst. of Michigan.

(Grant NSF OEP-74-18055) (PB-245604/4 NSF/OEP-74-18055-1) Avail. NTIS CSCL 21D

The technological and economical feasibility is discussed of several alternative energy sources as replacements for oil and gas in the production of industrial process heat. Current industrial fuel usage patterns are described quantitatively and classified into categories relevant to potential replacement by the alternate energy sources. The alternate sources are characterized at their current and near-term expected state of development. For those energy sources having a technological capability to replace industrial oil or gas in significant quantity, the comparative economics of use are evaluated for the present and future points in time. For those sources which are or may become both economically and technologically competitive with oil and gas, primary research and development needs are identified. GRA

**N76-20649#** National Conference of State Legislatures  
 Washington D.C.

**ENERGY: THE STATES' RESPONSE. ENERGY LEGISLATION JANUARY - JULY 1975, VOLUME 1**

R. G. Jones and Joette Pelster. Aug 1975. 517 p. refs.

(Contract DI-14-01-0001-1832)

(PB-246024/4 FEA/E-75/576-Vol-1) Avail. NTIS HC \$12.75 CSCL 05D

This report contains copies of all energy related legislation passed by the 50 State Legislatures during their 1975 sessions. The two volumes of this publication contain 204 bills totalling

1 107 pages and are a compilation of legislative achievement vetoed and unsigned bills Legislation is organized by category GRA

**N76-20650#** National Conference of State Legislatures Washington DC

**ENERGY THE STATES' RESPONSE ENERGY LEGISLATION JANUARY - JULY, VOLUME 2**

R G Jones and Joette Pelster Aug 1975 660 p  
(Contract DI-14-01-0001-1832)  
(PB-246025/1 FEA/E-75/577-Vol-2) Avail NTIS  
HC \$16 25 CSCL 05D

Categories in this volume include resource development/facility siting resource development/revenue resource development/renewable resources resource development/financial incentive resource development/mineral extraction management emergency powers/responses energy/environment and miscellaneous GRA

**N76-20651#** International Research and Technology Corp Arlington Va

**END-USES OF PETROLEUM PRODUCTS IN THE U.S., 1965-1975 VOLUME 1 SOURCES, METHODS AND RESULTS Final Report**

M O Farrell and R W Roig 20 Oct 1975 87 p  
(Contract DI-14-01-0001-1866)  
(PB-246393/3 IRT-391-R-Vol-1 FEA/B-75/656) Avail NTIS  
HC \$5 00 CSCL 21D

The end-uses of distillate oil residual oil aviation jet fuel and ethane plus propane (combined) were reported in terms of fractional shares of use The study employs a multilevel structure of detail comprising major categories of end-use regional uses and detailed categories of end-use in that order Factors taken into consideration include identification by year petroleum product major category of end-use regional area of use and detailed category of end-use Volume 1 provides an analysis of each fuel considered by discussing sources calculations and adjustments and results Other topics included are space heating use manufacturing industry use electric energy generation use and transportation use Data sources for the work included mineral industry surveys census data privately compiled data an IR and T study of the chemical industry and EPA's National Emissions Data System file GRA

**N76-20652#** International Research and Technology Corp Arlington Va

**END-USES OF PETROLEUM PRODUCTS IN THE U.S., 1965-1975 VOLUME 2 TABULATIONS OF RESULTS Final Report**

M O Farrell R N Mudry and R W Roig 20 Oct 1975 166 p  
(Contract DI-14-01-0001-1866)  
(PB-246394/1 IRT-391-R-Vol-2 FEA/B-75/657) Avail NTIS  
HC \$6 75 CSCL 21D

The end-uses of distillate oil residual oil aviation jet fuel and ethane plus propane (combined) were reported in terms of fractional shares of use The study employs a multilevel structure of detail comprising major categories of end-use regional uses and detailed categories of end-use in that order End-use in physical units is obtained by multiplying a control total by a series of factors These factors are identified by year petroleum product, major category of end-use regional area of use and detailed category of end-use Volume 2 provides an analysis of each fuel considered by discussing sources calculations and adjustments and results Other topics included are space heating use manufacturing industry use electric energy generation use and transportation use Data sources for the work included mineral industry surveys census data privately compiled data an IR and T study of the chemical industry and EPA's National Emissions Data System file GRA

**N76-20653#** TRW Systems Group Redondo Beach Calif  
**OCEAN THERMAL ENERGY CONVERSION RESEARCH ON AN ENGINEERING EVALUATION AND TEST PROGRAM VOLUME 1 EXECUTIVE SUMMARY Final Report**

Jun 1975 85 p Previously announced as SAN-1089-T1-P1

(Contract NSF C-958)

(PB-246178/8 NSF/RA/N-75-080A-Vol-1) Avail NTIS  
HC \$5 00 HC also avail \$27 00/set of 5 reports as  
PB-246177-SET CSCL 10A

Subsystems and components specifically warm and cold water circulation subsystems and the heat engine subsystem are evaluated It was determined that Ocean Thermal Energy Conversion (OTEC) systems are technically feasible a working fluid can be used in a closed Rankine cycle driven by the vertical temperature differences available in tropic oceans to produce net electric power GRA

**N76-20654#** TRW Systems Group Redondo Beach Calif  
**OCEAN THERMAL ENERGY CONVERSION RESEARCH ON AN ENGINEERING EVALUATION AND TEST PROGRAM VOLUME 2 EVALUATION OF PRIOR WORK, SUBSYSTEMS AND COMPONENTS**

Jun 1975 160 p refs Previously announced as  
SAN-1089-T1-P2

(Contract NSF C-958)  
(PB-246179/6 NSF/RA/N-75-080B-Vol-2) Avail NTIS  
HC \$6 75 HC also avail \$27 00/set of 5 reports as  
PB-246177-SET CSCL 10A

For abstract see N76-20653

**N76-20655#** TRW Systems Group Redondo Beach Calif  
**OCEAN THERMAL ENERGY CONVERSION RESEARCH ON AN ENGINEERING EVALUATION AND TEST PROGRAM VOLUME 5 APPENDICES**

Jun 1975 346 p refs Previously announced as  
SAN-1089-T1-P5

(Contract NSF C-958)  
(PB-246182/0 NSF/RA/N-75-080E-Vol-5) Avail NTIS  
HC \$10 00 HC also avail \$27 00/set of 5 reports as  
PB-246177-SET CSCL 10A

Twelve topics are outlined They are (1) annotated bibliography for Ocean Thermal Energy Conversion (OTEC) (2) OTEC power plant components and cost item listing (3) OTEC preliminary cycle analysis (4) review of OTEC heat transfer literature and concepts (5) OTEC turbine sizing (6) naval architecture and ocean operations (7) system specification for OTEC power stations (8) comparison of spar buoy semi-submersible and surface vessel hull configuration (9) thermal design of the cold water pipe (10) mooring and positioning (11) heat exchanger analysis and (12) analysis and optimization model description GRA

**N76-20658#** Illinois Univ Urbana Dept of Civil Engineering

**BIOLOGICAL CONVERSION OF ORGANIC REFUSE TO METHANE Semiannual Progress Report, 1 Jul - 31 Dec 1974**

John T Pfeffer and Jon C Liebman Jan 1975 136 p refs  
(Grant NSF GI-39191)

(PB-245795/0 UIIU-ENG-75-2001 NSF/RA/N-75-100) Avail  
NTIS HC \$6 00 CSCL 07A

This report contains the results of an investigation of refuse fermentation at a thermophilic operating temperature of 60 C Results of dewatering of the fermentor residue by vacuum filtration and centrifugation are presented A mathematical simulator of the fermentation process vacuum filtration process shedding and separation process and residue disposal processes were constructed Results from the simulator runs are presented GRA

**N76-20659#** Kentucky Univ Lexington Inst for Mining and Minerals Research

**METHANOL PRODUCTION FROM COAL, SECTION 1**

David A Conner and Gene Plock Aug 1975 39 p refs  
Prepared in cooperation with Speed Scientific school  
(PB-246201/8 IMMR1-PD1-75-Sect-1) Avail NTIS HC  
\$4 00 CSCL 07A

As can be noted in the bibliography many highly competent and well recognized authorities are seriously considering methanol as an energy source of significant magnitude Most of the studies do not emphasize investment capital which even at modest

implementation of the options noted for methanol's future could range from \$10 to \$30 billion. The published work which does include investment and product cost estimates is usually optimistic. In the literature the topical energy spectrum discussed is highly undefined. Policy formulation is in the early stages of development. The feedstock phases of energy supplies are defined. Relations and capital is considered in the high-risk realm. In spite of this technology poses a reasonable potential of resolving these interactions. This potential cost and problem resolution plus the capacity of methanol to supplant a portion of the domestic crude oil leads to the conclusion that the probability of extensive methanol production from coal as an energy source is high. GRA

**N76-20660#** Parsons Brinckerhoff Quade and Douglas New York

**ASSURED ENERGY RECEPTIVITY STUDY Final Report**  
6 Jun 1975 61 p Sponsored by Transit Develop Corp  
(PB-246244/8 TDC-AER-75-1) Avail NTIS HC \$4 50 CSCL 10B

The objective of this study is to compare a conventional chopper-controlled train propulsion system without regeneration with two schemes of regeneration (1) natural receptivity and (2) assured receptivity. A system that employs natural receptivity regeneration converts the kinetic energy of braking trains to electrical energy which is used to power onboard equipment. An assured receptivity regeneration system operates in a manner similar to a natural receptivity system except that the excess electrical energy is stored, dissipated, or redistributed. The objective of this study is to quantify savings achieved in power consumption and cooling capacity by the use of a regenerative braking system and compare them to the added costs of the electrical system for both natural and assured energy receptivity. GRA

**N76-20661#** General Electric Co Erie Pa

**ASSURED ENERGY RECEPTIVITY PROGRAM, PHASE 1**  
Aug 1975 127 p Sponsored by Transit Develop Corp  
(PB-246245/5 TDC-AER-75-2) Avail NTIS HC \$6 00 CSCL 10B

Two methods for enhancing the receptivity of a transit system third rail power supply are examined for trains employing propulsion equipment capable of returning power to the third rail. During periods of heavy traffic accelerating trains will generally be present to absorb the power made available by braking trains. However during periods of light traffic accelerating trains are not likely to be available on the line and other means must be provided to absorb the braking energy. Two methods for providing such a sink are (1) addition of resistor banks on the wayside equipped with notching control to match resistance values and line requirements (2) Addition of dc motor driven flywheel sets on the wayside to absorb the excess braking energy. GRA

**N76-20662#** Transit Development Corp Washington D C  
**ASSURED ENERGY RECEPTIVITY, A PROJECT OVERVIEW**  
**Final Report**

David R Phelps Sep 1975 30 p refs  
(PB-246247/1, TDC/500-75/10) Avail NTIS HC \$4 00 CSCL 10B

The technical feasibility of using wayside resistors and two alternative preliminary designs for the mechanization of this concept was investigated. It was verified that wayside resistors for assured electrical receptivity would have a very beneficial effect on ventilating and air-conditioning apparatus for subway stations and tunnels. However cost-effectiveness analysis showed that in the general case wayside resistors are not cost-effective. Therefore the feasibility of an alternative wayside system utilizing flywheel motor generator sets (based on state-of-the-art apparatus) for energy storage and reuse was investigated. GRA

**N76-20663#** Stanford Research Inst Menlo Park, Calif  
**DIRECT USE OF COAL IN A FUEL CELL FEASIBILITY INVESTIGATION Final Report, 26 Jun 1974 - 28 Feb 1975**

Robert D Weaver Laura Tietz and Daniel Cubicciotti Jun 1975 64 p refs  
(Contract EPA-68-02-1808)

(PB-245917/0 EPA-650/2-75-040) Avail NTIS HC \$4 50 CSCL 07D

The feasibility of using coal to produce electricity directly in a fuel cell that uses molten-carbonate electrolyte a coal anode and an air cathode was studied. The cell voltage, the polarization of the anode, and the nature of the gaseous products formed were investigated. Electrodes made from charred coal yielded open-circuit voltages close to 1 V. At 975 K the activation plus concentration polarization was about 200 mV at current densities of 100 mA per sq cm and larger. At higher temperatures smaller polarizations were observed. The gaseous anode products were primarily CO<sub>2</sub> with some CO. Current efficiencies were somewhat less than 100 percent. The low values were possibly due to losses of anode gases by mechanical means. Coal ash added to the molten electrolyte did not appear to be deleterious to cell operation. Descriptions of possible future engineering systems and thermodynamic limitations are presented. GRA

**N76-20665#** Exxon Research and Engineering Co Linden, NJ  
**EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES COAL TREATMENT SECTION 1 MEYERS PROCESS Final Report**

E M Magee Sep 1975 46 p refs  
(Contract EPA-68-02-0629)  
(PB-246311/5 EPA-650/2-74-009-k) Avail NTIS HC \$4 00 CSCL 08I

The report discusses the Meyers process whereby pyritic sulfur is removed from coal by the action of a solution of ferric sulfate. The coal is not converted and it essentially retains its original heating value. The pyritic sulfur leaves the process as elemental sulfur and iron sulfates. The quantities of solid, liquid, and gaseous effluents are estimated as well as the thermal efficiency of the process. For the purpose of reduced environmental impact a number of possible process modifications or alternatives which could facilitate pollution control or increase thermal efficiency are proposed, and new technology needs noted. GRA

**N76-20666#** California Univ San Diego  
**IDENTIFICATION OF RESEARCH AND DEVELOPMENT PRIORITIES AND OF COSTING PROBLEMS ASSOCIATED WITH IMPLEMENTATION ON IN SITU RECOVERY OF SHAKE OIL**

S S Penner Sep 1974 428 p refs Presented at the UCSD/NSF(RANN) Workshop San Diego Calif 3-7 Sep 1974  
(Contract NSF AER-74-23160)  
(PB-246278/6 NSF/RA/N-75-001) Avail NTIS HC \$11 75 CSCL 08I

A workshop on in situ recovery of shale oil was held at the University of California, San Diego, during September 1974. The purpose of the workshop was to identify the critical problem areas impeding the practical development of in situ shale oil recovery techniques. This report emphasizes the special problems relating to the development of in situ technology and identifies the critical research, development, and costing areas. Included are reports from the Fracture Panel, from the Retorting Panel, from the Environmental Impact Panel, and from the Economics Panel. GRA

**N76-20667#** Boston Univ Mass Dept of Chemistry  
**PHOTOCHEMICAL CONVERSION OF SOLAR ENERGY Semiannual Progress Report, 1 Jan - 30 Jun 1975**

Norman N Lichtin 31 Jul 1975 26 p Prepared in cooperation with Exxon Res and Eng Co  
(Grant NSF AER-72-03597-A03)  
(PB-246156/4 NSF/RANN/SE/A03/75-2, NSF/RA/N-75-088) Avail NTIS HC \$4 00 CSCL 07E

Totally-illuminated multi-thin-layer (TI-MTL) iron-thionine (Fe-TH<sup>+</sup>) photogalvanic cells were constructed with SnO<sub>2</sub> and InSnO<sub>2</sub> respectively as transparent anode and cathode. A 0.7% sunlight engineering efficiency was achieved with a 4-element cell with 81 micrometer electrode separations. Single element TI-TL SnO<sub>2</sub>/Pt Fe-TH<sup>+</sup> cells were sealed by enclosure and decline in output with time identified as due to leaching of tin from the SnO<sub>2</sub> electrode. Reverse-bias experiments indicated that output of the TI-TL SnO<sub>2</sub>/Pt Fe-TH<sup>+</sup> cell is not limited by electrode

activation processes. Studies of dependence of cell output on electrode spacing indicate that bulk back reactions are the principle limiting factors. GRA

**N76-20673#** Federal Energy Administration, Washington, D C  
Office of Quantitative Methods  
**A COMPARISON OF TWO NATURAL GAS FORECASTING MODELS TERA AND MACAVOY-PINDYCK**  
10 Jun 1975 41 p refs  
(PB-246219/0, FEA-EATR-75-15 FEA/B-75/639) Avail  
NTIS HC \$4 00 CSCL 21D

The supply side of two forecasting models of the natural gas industry, the MacAvoy-Pindyck and the TERA, were each simulated under the same wellhead price scenarios, and the factors causing differences in the forecasts identified. The two scenarios were continued. FPC regulation and phased deregulation. The models produce very different forecasts of the level of potential production. The analysis shows the divergence between the forecasts to be attributed primarily to conservative success ratios in the TERA model which are initialized in 1973 at 3.6%, (only 67% of the 1968-72) and the high success ratios in the other model which are initialized in 1972-73 values but rise to 15-20% values by 1980. GRA

**N76-20674#** Federal Energy Administration, Washington, D C  
Office of Quantitative Methods  
**COMPARISON OF FEA FIGURES WITH INTERIOR COMMITTEE STAFF ANALYSIS OF THE PRESIDENT'S ENERGY PROGRAM**  
5 Feb 1975 14 p  
(PB-246209/1, FEA-EATR-75-3, FEA/B-75/645) Avail NTIS  
HC \$3 50 CSCL 21D

Results of an Interior Committee staff study which critiqued President Ford's energy program are compared with FEA figures and the differences in assumptions and methodology of analysis are compared. Both studies agree on the revenues resulting from the program; however, there is substantial disagreement in estimated costs. Major factors supporting the FEA figures are cited and the high estimates in the staff study are attributed to an underestimation of the number of households nationwide, the prediction of windfall profits to natural gas producers, and an overestimation of coal demand and rising coal prices. GRA

**N76-20675#** Massachusetts Inst of Tech Cambridge Dept  
of Mechanical Engineering  
**THERMIC CONTROLS TO REGULATE SOLAR HEAT FLUX INTO BUILDINGS Semiannual Progress Report, 1 Jan - 30 Jun 1975**  
Shawn Buckley 25 Aug 1975 50 p refs  
(Grant NSF GI-43897)  
(PB-246364/4 NSF/RANN/SE/GI-43897/PR-75-2, NSF/RA/N-75-098) Avail NTIS HC \$4 00 CSCL 13A

The purpose of this project was to develop thermic controls for regulating solar heat flux into buildings. Thermics is a control discipline which uses temperature to directly control heat flow. Many independent panels replacing building walls and roof and controlled internally by thermic devices would perform three functions: (1) collect solar energy or dissipate internal heat; (2) control the flow of heat into and out of the panel; and (3) store heat inside the panel. The panel is to save heating costs in winter by absorbing solar energy and save airconditioning costs in summer by dissipating internal heat at night. A primary objective of the panel was to make its installed unit cost approximately that of conventional walls and roofs. Early research indicated that a switchable thermic diode was the most economic thermic control for use in the panel. GRA

**N76-20678#** Resource Planning Associates Inc Cambridge  
Mass  
**A BRIEF ANALYSIS OF THE IMPACT OF ENVIRONMENTAL LAWS OF ENERGY DEMAND AND SUPPLY**  
Henri-Claude Bailly Penny Cushman and Alex Steinbergh Oct  
1974 130 p refs  
(Contract DI-14-01-0001-1628)

(PB-245656/4 RA-74-15 FEA/D-74/568) Avail NTIS  
HC \$6 00 CSCL 10A

Key environmental issues are identified. The energy impact of each of the issues is quantified and the relative importance of the impacts are evaluated. The 10 selected issues considered are classified in two ways: whether they tend to increase the demand or decrease the availability of energy; and at which point in the energy production/consumption cycle they primarily occur. In defining issues, several major Federal environmental laws are reviewed. Two base years and two forecast years are considered--the base years 1968 and 1973, and the forecast years 1975 and 1980. In evaluation of energy impacts, two sets of comparisons is taken into account: the energy impact of each environmental issue was compared with national energy usage in total and by fuel for the relevant two periods, and each issue was compared with nonenvironmental Federal policy impacts. GRA

**N76-20680#** Rutgers Univ New Brunswick, NJ Dept of  
Electrical Engineering  
**SILICON SCHOTTKY PHOTOVOLTAIC DIODES FOR SOLAR ENERGY CONVERSION Quarterly Progress Report, 1 Jun - 30 Sep 1975**

Wayne A Anderson Oct 1975 21 p refs  
(Grant NSF AER-73-03197)  
(PB-246154/9, NSF/RANN/SE/PR-75-3, NSF/RA/N-75-099)  
Avail NTIS HC \$3 50 CSCL 10A

A study has been made of many variables involved in Schottky solar cell fabrication. Cr metal and a thin oxide (5-10 Å) on the silicon are essential for a high open-circuit voltage. A (100) Si orientation is preferred to (111). Substrate resistivities of 0.2 to 2 ohm-cm produce equivalent solar cells. Various surface-preparation methods and heat-treatment techniques have not produced significant performance trends. Heating the vacuum system prior to evaporation has produced a fill factor of up to 0.75 and more consistent metal film resistance values. An apparent tunneling current component was identified through I-V and activation energy plots. Nb<sub>2</sub>O<sub>5</sub> offers improved antireflection properties compared to SiO<sub>2</sub>. Solar cell resistance seems to be controlled by internal effects at the Schottky barrier interface. GRA

**N76-20681#** Chicago Univ Ill Center for Urban Studies  
**ENERGY VERSUS THE ENVIRONMENT THE ISSUES**  
Doris B Holleb and Gary Alexander 1975 35 p Prepared in  
cooperation with Argonne Natl Lab, Ill  
(Grants NSF AG-352 NSF GI-32989)  
(PB-246382/6 NSF/RA/E-75-045) Avail NTIS HC \$4 00  
CSCL 10A

Contents: The supply and costs of petroleum. Alternative energy sources for the future. Correlations between Gross National Product, energy consumption and air pollution. What is energy-related pollution? The importance of conservation measures in dealing with the energy crisis. State and federal impacts of the energy situation. The spatial aspects of pollution. Some perspectives on viewing policy-making and the energy crisis. The effects of the energy crisis on pollution regulation. Dangers of the can-do syndrome. Energy and American values. GRA

**N76-20682#** The Futures Group Glastonbury, Conn  
**A TECHNOLOGY ASSESSMENT OF GEOTHERMAL ENERGY RESOURCE DEVELOPMENT**  
T J Gordon F Maslan and L Deitch 15 Apr 1975 563 p  
refs  
(Contract NSF C-836)  
(PB-246241/4) Avail NTIS HC \$13 50 CSCL 10A

Some potential uses of geothermal energy in the United States are presented along with a systems evaluation and recommendations for future applications. Specific objectives are to: (1) identify potential constraints to the development of geothermal power; (2) determine feasibility; (3) determine its social, political, economic and environmental impacts in the USA; and (4) provide input to the policy process regarding geothermal energy. GRA

**N76-20683#** Harvard Univ Cambridge Mass  
**CONFERENCE ON INTERDEPENDENCE BETWEEN ENERGY AND ECONOMIC GROWTH**

Kenneth Arrow Dale Jorgenson and Alan Manne 1975 59 p  
 Conf held in Cambridge Mass 4-5 Apr 1975 Sponsored in part by NSF  
 (PB-246757/9) Avail NTIS HC \$4 50 CSCL 10A

The conclusions are presented of a conference on the interdependence between energy and economic growth held at Harvard University April 4 and 5 1975 Research areas discussed were end use demand for energy disequilibrium economics and time adjustment substitution and complementary processes between the energy sector and other sectors of the economy  
 GRA

**N76-20684#** Delaware Univ Newark Inst of Energy Conversion  
**DIRECT SOLAR ENERGY CONVERSION FOR LARGE SCALE TERRESTRIAL USE THE CdS/Cu2S HETEROJUNCTION IN STEADY STATE**

K W Boer Oct 1975 71 p refs Previously announced as NSF/RANN/A03/TR-75-6  
 (Grant NSF AER-72-03478)  
 (PB-246710/8 NSF/RANN/AER-72-03478/TR-75-6  
 NSF/RA/N-75-111 NSF/RANN/A03/TR-75-6) Avail NTIS HC \$4 50 CSCL 10B

The physics of the key processes in the CdS/Cu2S solar cell is discussed The electron generation and diffusion is analyzed in Cu2S Collection saturation of electrons from the Cu2S and high-field domains in CdS are proposed to be responsible for current saturation Proper matching of these is necessary to obtain satisfactory collection efficiencies and characteristics Matching is achieved by heat treatment yielding sufficient copper doping in the junction region The boundary conditions at the junction interface are analyzed and provide additional insight into the carrier transport through a heterojunction The current-voltage characteristics with optical excitation are discussed as being substantially different from the diode characteristic in the dark  
 GRA

**N76-20685#** Federal Trade Commission Washington D C  
**STAFF REPORT TO THE FEDERAL TRADE COMMISSION ON FEDERAL ENERGY LAND POLICY EFFICIENCY, REVENUE, AND COMPETITION**

Oct 1975 970 p refs  
 (PB-246663/9 FTC-7510003-FELP) Avail NTIS HC \$23 75 CSCL 10A

Past land disposal policies economic and technological conditions relevant to the choice of a leasing approach and the general direction and effectiveness of policy for each of the following fuel areas are discussed offshore oil and gas onshore oil and gas oil shale coal, uranium and geothermal energy sources  
 GRA

**N76-20686#** National Bureau of Standards Washington D C Center for Building Technology  
**NBSLD, COMPUTER PROGRAM FOR HEATING AND COOLING LOADS IN BUILDINGS Final Report**

Tamami Kusuda 1 Nov 1974 412 p refs Submitted for publication Sponsored in part by Housing and Urban Development  
 (PB-246184/6 NBSIR-74-574) Avail NTIS HC \$11 00 CSCL 13A

A comprehensive computer program called NBSLD the National Bureau of Standards Load Determination program has been developed at NBS to reflect the time change of the many building parameters which are pertinent to accurate estimation of energy usage for heating and cooling Current status of heating and cooling load techniques is reviewed Of general interest are unique features of NBSLD which are not available in existing computer programs A summary of various subroutines of NBSLD is given along with the detailed procedures for them  
 GRA

**N76-20688#** Dow Chemical Co Freeport Tex  
**ENERGY CONSUMPTION FUEL UTILIZATION AND**

**CONSERVATION IN INDUSTRY Final Report, Apr - Jun 1975**

John T Reding and Burchard P Shepherd Sep 1975 44 p refs  
 (Contract EPA-68-02-1329)  
 (PB-246888/2 EPA-650/2-75-032-d) Avail NTIS HC \$4 00 CSCL 10A

Fuel utilization and energy conservation are studied for the six biggest energy consuming industrial groups chemicals primary metals petroleum paper stone/clay/glass/concrete and food Level of heat rejection and short term effects of various conservation measures are covered  
 GRA

**N76-20689#** Resource Planning Associates Inc Cambridge Mass

**ENERGY MANAGEMENT CASE HISTORIES**

Oct 1975 29 p refs  
 (Contract DI-14-01-0001-1895)  
 (PB-246763/7 FEA/D-75/335 FEA/D-CP-1B) Avail NTIS HC \$4 00 CSCL 10A

The experiences of four U S firms are discussed that have found that the financial benefits of an energy conservation program can be substantial and that such programs are good business management practice This study illustrates such case experiences It discusses the way they organized to achieve results how they implemented their energy saving projects and the results of their efforts The analyses go beyond the specific process and business of the company discussed  
 GRA

**N76-20690#** Federal Energy Administration Washington D C  
**NATIONAL PETROLEUM PRODUCT SUPPLY AND DEMAND REVISED BASE CASE FORECAST AND THE PRESIDENT'S PROGRAM FORECAST**

5 Feb 1975 41 p ref  
 (PB-246218/2 FEA-EATR-75-2 FEA/B-75/240) Avail NTIS HC \$4 00 CSCL 10A

Results are presented of implementing the Federal Energy Administration's petroleum supply/demand balance simulation under two sets of assumptions a base case scenario which documents petroleum product supply and demand using a current macroeconomic simulation and updated price and weather data and a policy option scenario which incorporates the particulars of the President's energy program into a base case scenario Appendices present a comparison of alternative forecasts documenting effects of prices and other factors alternative elasticity estimates and factors influencing a determination of imported crude oil prices  
 GRA

**N76-20691#** Southern California Gas Co Los Angeles

**SAGE SOLAR ASSISTED GAS ENERGY**

1975 16 p Sponsored by NSF Prepared in cooperation with Calif Inst of Tech Pasadena  
 (PB-246044/2 NSF/RA/N-75-097) Avail NTIS HC \$3 50 CSCL 13A

SAGE (Solar Assisted Gas Energy) is an evolving system for combining the efficient use of natural gas with solar energy for water and space heating The objectives of SAGE research are to (1) develop an economical and efficient water heating system that draws its energy from the sun and natural gas (2) determine the best means of accelerating the consumer use of the system and (3) enhance conservation of our nation's natural resources This booklet explains the research program illustrates the operation of the SAGE system outlines the history of solar energy and lists SAGE participants  
 GRA

**N76-20692#** Brobeck (William M) and Associates Berkeley Calif

**DEVELOPMENT OF HIGH-DENSITY INERTIAL-ENERGY STORAGE Final Report**

H S Gordon Jul 1975 143 p refs Sponsored by Elec Power Res Inst  
 (PB-245998/0 EPRI-269-1) Avail NTIS HC \$6 00 CSCL 10C

A facility is reported that is capable of testing rotors comprising concentric rings of high strength fiber matrix composite materials to their ultimate strengths and to start a test program addressed to problems of constructing such rotors. The facility has been designed and built which permits spinning rotors of 200 pounds in weight and up to about 38 inches diameter in vacua of one millitorr and less. Two methods of constructing concentric ring rotor systems have been designed, built and tested. Tests have been made of one-and-two-ring plus hub embodiments of these methods to speeds above 15 000 RPM. No insurmountable difficulties have been encountered. GRA

**N76-20693#** Federal Energy Administration Washington D C  
Office of Quantitative Methods  
**IMPACT OF THE PROPOSED ENERGY DEREGULATION/  
TAX PROGRAM ON SELECTED INDUSTRIES**

Apr 1975 80 p refs  
(PB-246207/5 FEA-EATR-75-10 FEA/B 75/647) Avail  
NTIS HC \$5 00 CSCL 10A

The effects of the energy conservation tax program on baseline fuel prices, fuel consumption by major sectors and on selected industries are examined. It was determined that the President's proposals would lead to higher fuel prices in 1975. However, the anticipated impact on energy sensitive industries should be less than the impact of the 1973-74 oil embargo. This is based on the assumption that elasticity of demand would be the major factor in determining absorption of or dollar for dollar pass through of higher fuel costs. Since fuel costs in most industries are small compared to labor and material costs, availability rather than price is the critical factor in the short run. GRA

**N76-20741#** Abcor Inc Cambridge Mass Walden Research  
Div

**IMPACT OF ENERGY SHORTAGE ON AMBIENT SULFUR  
DIOXIDE AND PARTICULATE LEVELS IN METROPOLITAN  
BOSTON AQCR**

Richard D Siegel Peter H Guldberg Kenneth W Wiltsee Jr  
and Ralph B D'Agostino Jul 1975 212 p refs  
(Contract EPA-68-02-1830)  
(PB-246592/0 EPA-450/3-75-068) Avail NTIS HC \$7 75  
CSCL 13B

The present day oil shortage has led to relaxation of some fuel restrictions allowing conversions from oil to coal and thereby increasing emissions of sulfur dioxide and particulates to the atmosphere. The purpose of this project was to evaluate the impact of the energy shortage on ambient sulfur dioxide (SO<sub>2</sub>) and total suspended particulate (TSP) concentrations in a major urban area, metropolitan Boston. A combined approach based on a statistical analysis of measured air quality data, regulatory and emission analysis and diffusion modeling of changes in ambient pollutant concentrations was used to attain this objective. GRA

**N76-20886#** Michigan Univ Ann Arbor Dept of Aerospace  
Engineering

**PERIODIC CONTROL OF VEHICLE CRUISE IMPROVED  
FUEL ECONOMY BY HIGH AND LOW FREQUENCY  
SWITCHING Interim Report**

Elmer G Gilbert Apr 1975 11 p refs  
(Grant AF-AFOSR-2517-73 AF Proj 9769)  
(AD-A015927 AFOSR-75-1337TR) Avail NTIS CSCL 12/1

It is shown that time-dependent periodic control can improve the fuel economy of vehicles in cruise. The time-dependent controls considered are relaxed steady-state (RSS) control, quasi-steady-state (QSS) control and quasi-relaxed steady-state (QRSS) control. Examples are given which show that QRSS control may give better performance than either RSS or QSS control. Properties of optimal cost functions (dependent on the minimum required average speed) are derived. The possibility or impossibility of improved performance through the use of QRSS, QSS and RSS control is investigated in terms of assumptions on the vehicle drag and fuel-consumption functions. GRA

**N76-21033#** Select Committee on Small Business (U S House)  
**ENERGY DATA REQUIREMENTS OF THE FEDERAL  
GOVERNMENT PART 3 FEDERAL OFFSHORE OIL AND  
GAS LEASING POLICIES**

Washington GPO 1974 582 p refs Hearings before Subcomm  
on Activities of Regulatory Agencies of the Permanent Select  
Comm on Small Business 93d Congr 2d Sess 26-27 Mar  
9-11 Apr and 7 May 1974  
(GPO-35-032) Avail Subcomm on Activities of Regulatory  
Agencies

Hearings made before the subcommittee on activities of regulatory agencies of the permanent select committee on small business of the U S House of Representatives during March, April and May 1974 were reported. The subjects discussed included producible shut-in leases, gas supply and reserve estimates, continental shelf lease management, royalty and bonus bidding. Y J A

**N76-21034#** Committee on Appropriations (U S Senate)  
**SPECIAL ENERGY RESEARCH AND DEVELOPMENT  
APPROPRIATIONS FOR FISCAL YEAR 1975**

Washington GPO 1974 890 p refs Hearings on HR 14434  
before Comm on Appropriations 93d Congr 2d Sess 4 Mar  
1974  
(GPO-32-023) Avail Comm on Appropriations

Hearings held before the committee on appropriations of the United States Senate concerning appropriations for energy research and development activities of certain departments, independent executive agencies, bureaus, offices and commissions for FY 1975 were reported. Y J A

**N76-21341\*#** National Aeronautics and Space Administration  
Lewis Research Center Cleveland Ohio  
**SYNTHESIS AND ANALYSIS OF JET FUELS FROM SHALE  
OIL AND COAL SYNCRUDES**

Albert C Antoine and James P Gallagher (Atlantic Richfield  
Co) 1976 32 p refs To be presented at the 82d Natl  
Meeting of the Am Inst of Chem Engr Atlantic City  
29 Aug - 1 Sep 1976  
(NASA-TM-X-73399 E-8722) Avail NTIS HC \$4 00 CSCL  
21D

The technical problems involved in converting a significant portion of a barrel of either a shale oil or coal syncrude into a suitable aviation turbine fuel were studied. TOSCO shale oil, H-Coal and COED coal syncrudes were the starting materials. They were processed by distillation and hydrocracking to produce two levels of yield (20 and 40 weight percent) of material having a distillation range of approximately 422 to 561 K (300 F to 550 F). The full distillation range 311 to 616 K (100 F to 650 F) materials were hydrotreated to meet two sets of specifications (20 and 40 volume percent aromatics, 13.5 and 12.75 weight percent H<sub>2</sub>, 0.2 and 0.5 weight percent S and 0.1 and 0.2 weight percent N). The hydrotreated materials were distilled to meet given end point and volatility requirements. The syntheses were carried out in laboratory and pilot plant equipment scaled to produce thirty-two 0.0757 cu m (2-gal) samples of jet fuel of varying defined specifications. Detailed analyses for physical and chemical properties were made on the crude starting materials and on the products. Author

**N76-21423\*+** New Mexico Univ Albuquerque Technology  
Application Center

**HEAT PIPE TECHNOLOGY A BIBLIOGRAPHY WITH  
ABSTRACTS Quarterly Update, 30 Jun 1975**

30 Jun 1975 66 p Sponsored by NASA  
(NASA-CR-146640) Avail NTIS for foreign requesters only  
Domestic orders Univ of New Mexico Tech Application Center  
Albuquerque Available by subscription only HC \$48 00 CSCL  
20M

A bibliography on heat pipe technology with abstracts of references identified during April, May and June of 1975 was presented. The following subjects were included: (1) general information, reviews, surveys; (2) heat pipe applications; (3) heat pipe theory; (4) design, development and fabrication; (5) testing.



and operation and (6) heat pipe related patents Indices are also included YJA

**N76-21505\*#** National Aeronautics and Space Administration Ames Research Center Moffett Field Calif  
**SECOND NASA CONFERENCE ON LASER ENERGY CONVERSION**

Kenneth W Billman ed Washington 1976 196 p refs  
 Conf held at Moffett Field Calif 27-28 Jan 1975  
 (NASA-SP-395) Avail NTIS HC \$7 00 CSCL 20E

The possible transmission of high power laser beams over long distances and their conversion to thrust electricity or other useful forms of energy is considered Specific topics discussed include laser induced chemistry developments in photovoltaics including modification of the Schottky barrier devices and generation of high voltage emf sby laser radiation of piezoelectric ceramics, the thermo electronic laser energy converter and the laser plasmadynamics converters, harmonic conversion of infrared laser radiation in molecular gases and photon engines

**N76-21507\*** Massachusetts Inst of Tech Cambridge  
**CONVERSION OF LASER ENERGY TO CHEMICAL ENERGY BY THE PHOTOASSISTED ELECTROLYSIS OF WATER**

Mark S Wrighton *In* NASA Ames Res Center 2d NASA Conf on Laser Energy Conversion 1976 p 11-22 refs

CSCL 20E

Ultraviolet irradiation of the n-type semiconductor TiO<sub>2</sub> crystal electrode of an aqueous electrochemical cell evolves O<sub>2</sub> at the TiO<sub>2</sub> electrode and H<sub>2</sub> at the Pt electrode The gases are typically evolved in a 2:1 (H<sub>2</sub>:O<sub>2</sub>) volume ratio The photoassisted reaction seems to require applied voltages but values as low as 0.25 V do allow the photoassisted electrolysis to proceed Prolonged irradiation in either acid or base evolves the gaseous products in amounts which clearly demonstrate that the reaction is catalytic with respect to the TiO<sub>2</sub> The wavelength response of the TiO<sub>2</sub> and the correlation of product yield and current are reported The results support the claim that TiO<sub>2</sub> is a true photoassistance agent for the electrolysis of water Minimum optical storage efficiencies of the order of 1 percent can be achieved by the production of H<sub>2</sub> Author

**N76-21508\*** Princeton Univ NJ  
**PHOTOCATALYTIC GENERATION OF HYDROGEN FROM WATER**

William R Bottoms and Richard B Miles *In* NASA Ames Res Center 2d NASA Conf on Laser Energy Conversion 1976 p 23-37 refs

CSCL 07D

A concept designed to overcome the problems encountered when using photodissociation for the generation of hydrogen is discussed The problems limiting the efficiency of photodissociation of water are the separation of the photolysis products and the high energy photons necessary for the reaction It is shown that the dissociation energy of a large number of molecules is catalytically reduced when these molecules are in intimate contact with the surface of certain metals It is proposed to develop a surface which will take advantage of this catalytic shift in dissociation energies to reduce the photon energy required to produce hydrogen This same catalytic surface can be used to separate the reaction products if it is made so that one of the dissociations products is soluble in the metal and others are not This condition is met by many metal systems such as platinum group metals which have been used commercially to separate hydrogen from other gases and liquids Author

**N76-21509\*** Jet Propulsion Lab Calif Inst of Tech Pasadena  
**PHOTOVOLTAIC CONVERSION OF LASER ENERGY**

Richard J Stirn *In* NASA Ames Res Center 2d NASA Conf on Laser Energy Conversion 1976 p 39-48 refs

(Contract NAS7-100)  
 CSCL 20E

The Schottky barrier photovoltaic converter is suggested as an alternative to the p/n junction photovoltaic devices for the conversion of laser energy to electrical energy The structure current output and voltage output of the Schottky device are summarized The more advanced concepts of the multilayer Schottky barrier cell and the AMOS solar cell are briefly considered JMS

**N76-21515\*** National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio  
**APPLICATION OF HIGH POWER LASERS TO SPACE POWER AND PROPULSION**

Donald L Nored *In* its 2d NASA Conf on Laser Energy Conversion 1976 p 95-108 refs  
 CSCL 20E

The transmission of laser power over long distances for applications such as direct conversion to propulsive thrust or electrical power is considered Factors discussed include problems inherent in transmitting propagating and receiving the laser beam over long ranges high efficiency closed-cycle continuous wave operation advancement of CO<sub>2</sub> laser technology and compatibility with photovoltaic power conversion devices JMS

**N76-21519\*** Rasor Associates Inc Sunnyvale Calif  
**THERMO ELECTRONIC LASER ENERGY CONVERSION**

Lorin K Hansen and Ned S Rasor *In* NASA Ames Res Center 2d NASA Conf on Laser Energy Conversion 1976 p 133-146 refs Sponsored by NASA

CSCL 20E

The thermo electronic laser energy converter (TELEC) is described and compared to the Waymouth converter and the conventional thermionic converter The electrical output characteristics and efficiency of TELEC operation are calculated for a variety of design variables Calculations and results are briefly outlined It is shown that the TELEC concept can potentially convert 25 to 50 percent of incident laser radiation into electric power at high power densities and high waste heat rejection temperatures JMS

**N76-21524\*** Stanford Univ Calif Applied Physics Dept  
**INITIAL EXPERIMENTS WITH A LASER DRIVEN STIRLING ENGINE**

Robert L Byer *In* NASA Ames Res Center 2d NASA Conf on Laser Energy Conversion 1976 p 181-188 refs

CSCL 20E

Operation of a Beale free piston Stirling engine with a 40-W CO<sub>2</sub> laser is described Advantages of such a system include closed-cycle operation long life inexpensive construction and size scalability to 100 MW JMS

**N76-21667#** Federal Energy Administration, Washington D C  
**OIL AND GAS RESOURCES, RESERVES, AND PRODUCTIVE CAPACITIES, VOLUME 2 Final Report**

Oct 1975 160 p  
 (PB-246355/2, FEA/G-75/619-Vol-2) Avail NTIS HC \$6 75  
 CSCL 08I

The Federal Energy Administration Act directs the FEA to prepare a complete and independent analysis of actual oil and gas reserves and resources in the United States and its outer continental shelf Volume 1 of this final report provides final reserve and productive capacity estimates compares these estimates with estimates from other sources projects a US crude oil productive capacity estimate evaluates the procedures used to develop these estimates and recommends procedures to be used for future estimates Volume 2 provides summaries of engineering analyses of major domestic oil and gas fields

GRA

**N76-21670#** Illinois Univ Champaign Center for Advanced Computation

**RESERVE AND RESOURCE ESTIMATION, APPENDIX D****Final Report**

Michael Rieber Shao Lee Soo and James Stukel May 1975  
72 p refs

(Grant NSF G1-35821)

(PB-248063/O CAC-163-App-D NSF/RA/N-75-037D) Avail  
NTIS HC \$4 50 CSCL 08G

Briefly discussed are Illinois and Wyoming coal reserves availability of public land for coal mining National Environmental Policy Act Clean Air Act and Federal Water Pollution Control Act  
GRA

**N76-21676\***+ New Mexico Univ Albuquerque Technology Application Center

**SOLAR THERMAL ENERGY UTILIZATION A BIBLIOGRAPHY WITH ABSTRACTS Semiannual Update, Jul - Dec 1974**

Aug 1975 361 p Sponsored by NASA

(NASA-CR-146804 TAC-ST74-601) Avail NTIS for foreign requesters only Domestic orders Univ of New Mexico Tech Application Center Albuquerque HC \$37 50 CSCL 10A

This bibliography cites and abstracts literature devoted to the practical thermal utilization of solar energy published between 1957 and June 1974 Introductory articles overviews and economic considerations are identified in Section 1 materials on solar and atmospheric radiative property data are abstracted in Sections 2 and 3 respectively Section 4 is devoted to individual components such as collectors flat plates concentrators coolers and thermal storage Thermal characteristics of buildings and of solar heating-cooling systems are covered in Section 5 process heat applications in Section 6, and power generation in Section 7 Access points are provided by a table of contents permuted title index permuted subject index author index and corporate source index  
Author

**N76-21679\***# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

**CLOSED CYCLE MHD POWER GENERATION EXPERIMENTS USING A HELIUM-CESIUM WORKING FLUID IN THE NASA LEWIS FACILITY**

Ronald J Sovie 1976 11 p refs Proposed for presentation at Fifteenth Symp on the Eng Aspects of Magnetohydrodynamics Philadelphia 24-26 May 1976

(NASA-TM-X-71885 E-8660) Avail NTIS HC \$3 50 CSCL 10A

A MHD channel which was previously operated for over 500 hours of thermal operation ten thermal cycles and 200 cesium injection tests was removed from the facility and redesigned The cross sectional dimensions of the channel were reduced to 5 by 16.5 cm to allow operation over a variety of conditions The redesigned channel has been operated for well over 300 hours 10 thermal cycles and 150 cesium injection tests with no problems Experiments have been run at temperatures of 1900-2100 K and Mach numbers from 0.3 to 0.55 in argon and 0.2 in helium The best results to date have been obtained in the helium tests Power outputs of 2.2 kw for tests with 28 electrodes and 2.1 kw for tests with 17 electrodes were realized Power densities of 0.6 MW/cu m and Hall fields of about 1100 V/m were obtained in the tests with 17 electrodes  
Author

**N76-21680\***# Committee on Aeronautical and Space Sciences (U S Senate)

**SOLAR POWER FROM SATELLITES**

Washington GPO 1976 232 p refs Hearings before Subcomm on Aerospace Technol and Natl Needs of Comm on Aeron and Space Sci 94th Congr 2d Sess 19 and 21 Jan 1976 (GPO-66-608) Avail SOD HC \$2 70

Advanced aerospace technology that might supply future sources of energy is considered Emphasis is placed on ways to collect solar power in space with satellites and to beam the power down to earth to supplement other sources of electricity Novel approaches to construction of those satellites are also discussed  
J M S

**N76-21683\***# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

**LARGE EXPERIMENTAL WIND TURBINES WHERE WE ARE NOW**

Ronald L Thomas 1976 32 p refs Presented at 3d Energy Technol Conf/Exposition Washington D C 29-31 Mar 1976 sponsored by Government Inst Inc (NASA-TM-X-71890 E-8674) Avail NTIS HC \$4 00 CSCL 10B

Several large wind turbine projects have been initiated by NASA-Lewis as part of the ERDA wind energy program The projects consist of progressively large wind turbine ranging from 100 kW with a rotor diameter of 125 feet to 1500 kW with rotor diameters of 200 to 300 feet Also included is supporting research and technology for large wind turbines and for lowering the costs and increasing the reliability of the major wind turbine components The results and status of the above projects are briefly discussed in this report In addition, a brief summary and status of the plans for selecting the utility sites for the experimental wind turbines is also discussed  
Author

**N76-21684\***# Committee on Science and Technology (U S House)

**ENERGY FACTS, 2**

Winifred Griffin Smith Washington GPO Aug 1975 542 p refs Presented to Subcomm on Energy Res Develop and Demonstration of the Comm on Sci and Technol 94th Congr 1st Sess, Aug 1975 Prepared by the Library of Congr Congr Res Service

(GPO-53-136) Avail SOD HC \$4 55

Energy Facts 2 contains a comprehensive selection of United States and foreign energy statistics It also includes statistical tables on most common and some unconventional energy sources Care has been taken to select tables that contain the most recent and best organized information available from primary sources The statistical tables and graphs are grouped by resources production consumption and demand, energy and gross national product research and development and other categories  
Author

**N76-21686\***# Auburn Univ Ala School of Engineering **ECASTAR ENERGY CONSERVATION, AN ASSESSMENT OF SYSTEMS, TECHNOLOGIES AND REQUIREMENTS Final Report**

Sep 1975 757 p refs NASA/ASEE Systems Design Summer Faculty Program 1975 Sponsored in part by FEA and ASEE (Grant NGT-01-003-044)

(NASA-CR-146859) Avail NTIS HC \$18 75 CSCL 10B

A methodology for a systems approach display and assessment of the potential for energy conservation actions and the impacts of those actions was presented The U S economy is divided into four sectors energy industry industry, residential/commercial and transportation Each sector is assessed with respect to energy conservation actions and impacts The four sectors are combined and three strategies for energy conservation actions for the combined sectors are assessed The three strategies (national energy conservation, electrification and diversification) represent energy conservation actions for the near term (now to 1985), the mid term (1985 to 2000) and the far term (2000 and beyond) The assessment procedure includes input/output analysis to bridge the flows between the sectors and net economics and net energetics as performance criteria for the conservation actions Targets of opportunity for large net energy net energy savings and the application of technology to achieve these savings are discussed

**N76-21687\*** Auburn Univ Ala **THE POLITICAL ECONOMY OF CONSERVATION**

In its ECASTAR Energy Conserv Sep 1975 10 p

CSCL 10B

A political economic purview of energy conservation in the United States was delineated The concepts of substitution and elasticity are distinguished and further distinctions are made

## N76-21688

between short run price elasticity cross price elasticity, and available fund elasticity An assessment of the role which cost factors can play in conservation is given The structure of the petroleum industry and foreign petroleum resources is discussed Also discussed is the role of government, industry and the consumer with the economic sphere Author

**N76-21688\*** Auburn Univ Ala  
**CONSERVATION TOWARD FIRMER GROUND**  
*In its* ECASTAR Energy Conserv Sep 1975 10 p

### CSCL 10B

The following aspects of energy conservation were discussed conservation history and goals, conservation modes conservation accounting-criteria and a method to overcome obstacles The conservation modes tested fall into one of the following categories reduced energy consumption increased efficiency of energy utilization or substitution of one or more forms of energy for another which is in shorter supply or in some sense thought to be of more value The conservation accounting criteria include net energy reduction economic and technical criteria A method to overcome obstacles includes (approaches such as direct personal impact (life style income security aspiration) an element of crisis large scale involvement of environmental safety and health issues connections to big government big business big politics involvement of known and speculative science and technology appeal to moral and ethical standards the transient nature of opportunities to correct the system Y J A

**N76-21690\*** Auburn Univ Ala  
**CONSERVATION IN THE ENERGY INDUSTRY**  
*In its* ECASTAR Energy Conserv Sep 1975 11 p

### CSCL 10B

The basic energy supply and utilization problems faced by the United States were described Actions which might alleviate the domestic shortfall of petroleum and natural gas are described analyzed and overall impacts are assessed Specific actions included are coal gasification in situ shale oil production improved oil and gas recovery importation of liquid natural gas and deregulation of natural gas prices These actions are weighed against each other as alternate techniques of alleviating or overcoming existing shortfalls Author

**N76-21692\*** Auburn Univ Ala  
**ENERGY CONSERVATION AND THE TRANSPORTATION SECTOR**  
*In its* ECASTAR Energy Conserv Sep 1975 26 p refs

### CSCL 10B

The present status of the energy implications of the transportation systems in the United States was illustrated with primary emphasis on the technologies and methods for achieving a substantial reduction in the associated energy price (approximately 25% of the nation's energy is consumed directly in the operation of these systems) These technologies may be classified as follows (1) improvement of system efficiency (system operations or technological) (2) substitution for scarce energy resources (electrification alternate fuels use of man power recycling) (3) curtailment of end use (managed population growth rate education of citizenry alternatives to personal transportation improved urban planning reduced travel incentives) Examples and illustrations were given Thirty-four actions were chosen on the basis of a preliminary filtering process with the objective of (1) demonstrating a methodological approach to arrive at logical and consistent conservation action packages (2) recommending a viable and supportable specific set of actions Y J A

**N76-21693\*** Auburn Univ Ala  
**ENERGY CONSERVATION AND THE RESIDENTIAL AND COMMERCIAL SECTOR**  
*In its* ECASTAR Energy Conserv Sep 1975 22 p refs

### CSCL 10B

A detailed analysis of energy conservation actions relevant to the residential and commercial sector has led to the conclusion that the potential for savings is great The task will not be easy however since many of the actions require significant life style changes that are difficult to accomplish Furthermore many of the conservation actions cited as instant solutions to the energy crisis are those with only mid to long term potential such as solar energy or heat pumps Three significant conservation approaches are viable adjusting price structure mandating actions and educating consumers The first two appear to be the most feasible But they are not without a price Higher utility bills adversely affect the poor and the elderly on fixed incomes Likewise strict mandatory measures can be quite distasteful But the effect of alternatives such as voluntary savings accomplished through education processes is minimal in a nation without a true conservation ethic Author

**N76-21694\*** Auburn Univ Ala  
**INPUT-OUTPUT ANALYSIS OF SOME SECTOR ACTIONS**  
*In its* ECASTAR Energy Conserv Sep 1975 16 p refs

### CSCL 10B

Selected energy conservation actions previously discussed in depth but separately in the areas of the energy industry the industry sector the transportation sector and the residential and commercial sector were brought together and assessed as a group Particular emphasis was devoted to identifying secondary or indirect impacts and multiple interactions Preliminary results obtained from the ECASTAR energy input-output model suggest that the impacts of energy conservation actions can be grossly misrepresented if secondary impacts are not included in the assessment A methodology which stresses the importance of secondary and multiple interactions permeates the underlying philosophy of this discussion Author

**N76-21695\*** Auburn Univ Ala  
**NATIONAL ENERGY CONSERVATION**  
*In its* ECASTAR Energy Conserv Sep 1975 33 p refs

### CSCL 10B

A set of energy conservation actions that cut across all sectors of the economy were analyzed so that all actions under consideration be analyzed systematically and as a whole The actions considered were as follows (1) roll back the price of newly discovered oil (2) freeze gasoline production for 3 years at 1972 levels (3) mandate automobile mileage improvements (4) require industry to improve energy efficiency (5) require manufacture of household appliances with greater efficiency (6) force conversion of many power plants from gas and oil to coal The results showed that considerable gas and oil would be saved by forcing switches to coal However the large scale switch to coal was shown to require greatly increased outputs from many other industries that in turn require more energy It was estimated that nearly 2.5 quads of additional coal were needed to produce these additional requirements Also the indirect requirements would create more jobs Author

**N76-21696\*** Auburn Univ Ala  
**ELECTRIFICATION**  
*In its* ECASTAR Energy Conserv Sep 1975 25 p refs

### CSCL 10B

Electrification was chosen for an assessment of conservation impact because it is almost the sole consumer of coal and nuclear power and because electrical end use can be made to have higher overall efficiency than many present direct fuel uses The important actions within electrification that were examined are those with the greatest impacts (coal and nuclear) the greatest technological requirements (peak shaving and transmission) and the greatest response from the decision makers (economic health and growth of utilities in an era of increasing energy costs) A list of recommendations relating to the study of electrification was given Author

**N76-21697\*** Auburn Univ Ala  
**DIVERSIFICATION OF ENERGY SOURCES**  
*In its ECASTAR Energy Conserv Sep 1975 15 p refs*

CSCL 10B

The concept of energy source diversification was introduced as a substitution conservation action. The current status and philosophy behind a diversification program is presented in the context of a national energy policy. Advantages/disadvantages (constraints) and methods of implementation for diversification are discussed. The energy source systems for diversification are listed and an example impact assessment is outlined which deals with the water requirements of the specific energy systems.

Author

**N76-21699\*** Auburn Univ Ala  
**ECASTAR SUMMARY AND RECOMMENDATIONS**  
*In its ECASTAR Energy Conserv Sep 1975 13 p*

CSCL 10B

A methodology was presented for a systems approach to energy conservation where conservation was depicted as the result of any action that improves the energy situation of the United States in the present and near future. The relevant constraints and criteria and their application were discussed. Among the most important are the present (capitalistic) structure of the American economy, the lead times necessary for implementation of relevant technologies, and the desire of most policymakers to maintain a reasonable standard of living with a reasonable amount of invulnerability to foreign discretion. The objective of the design group was the assessment of the potential and impact of conservation action in the United States. The U.S. economy was divided into four sectors: energy, industry, residential/commercial, and transportation. Each sector was analyzed for conservation actions and their impacts. The sector analysis was characterized as the system design or construction phase.

Author

**N76-21700\*#** National Aeronautics and Space Administration  
 Lewis Research Center Cleveland Ohio  
**THE COMPUTER SIMULATION OF AUTOMOBILE USE PATTERNS FOR DEFINING BATTERY REQUIREMENTS FOR ELECTRIC CARS**

Harvey J Schwartz 1976 13 p refs. To be presented at the 4th Intern Elec Vehicle Symp Dusseldorf 31 Aug - 2 Sep 1976 sponsored by Intern Union of Producers and Distributors of Elec Energy (NASA-TM-X-71900 E-8689) Avail NTIS HC \$3.50 CSCL 10C

A Monte Carlo simulation process was used to develop the U.S. daily range requirements for an electric vehicle from probability distributions of trip lengths and frequencies and average annual mileage data. The analysis shows that a car in the U.S. with a practical daily range of 82 miles (132 km) can meet the needs of the owner on 95% of the days of the year or at all times other than his long vacation trips. Increasing the range of the vehicle beyond this point will not make it more useful to the owner because it will still not provide intercity transportation. A daily range of 82 miles can be provided by an intermediate battery technology level characterized by an energy density of 30 to 50 watt-hours per pound (66 to 110 W-hr/kg). Candidate batteries in this class are nickel-zinc, nickel-iron, and iron-air. The implication of these results for the research goals of far-term battery systems suggests a shift in emphasis toward lower cost and greater life and away from high energy density.

Author

**N76-21703\*#** National Aeronautics and Space Administration  
 Lewis Research Center Cleveland Ohio  
**FABRICATION AND ASSEMBLY OF THE ERDA/NASA 100 KILOWATT EXPERIMENTAL WIND TURBINE**

Richard L Puthoff Washington Apr 1976 30 p refs (NASA-TM X-3390 E-8663) Avail NTIS HC \$4.00 CSCL 10B

As part of the Energy Research and Development Administration (ERDA) wind-energy program, NASA Lewis Research Center has designed and built an experimental 100-kW wind turbine. The two-bladed turbines drive a synchronous alternator that generates its maximum output of 100 kW of electrical power in a 29-km/hr (18-mph) wind. The design and assembly of the wind turbine were performed at Lewis from components that were procured from industry. The machine was installed atop the tower on September 3, 1975.

Author

**N76-21705#** Brookhaven National Lab Upton NY  
**BROOKHAVEN PROGRAM TO DEVELOP A HELIUM-COOLED POWER TRANSMISSION SYSTEM**  
 E B Forsyth 1975 45 p refs. Presented at Conf on Tech Appl of Superconductivity Alushta USSR 16 Sep 1975. Sponsored by NSF and ERDA (BNL 20444 Conf-750950-1) Avail NTIS HC \$5.25

The particular system under design consists of flexible cables installed in a cryogenic enclosure at room temperature and cooled to the range 6 to 9 K by supercritical helium. Contraction of the cable is accommodated by proper choice of helix angles of the components of the cable. The superconductor is Nb<sub>3</sub>Sn and at the present time the dielectric insulation is still the subject of intensive development. Two good choices appear to be forms of polyethylene and polycarbonate. Sample cables incorporating various dielectrics have been manufactured commercially in lengths of 1500 ft and tested in laboratory cryostats in shorter sections of about 70 ft. A test facility is under construction to evaluate cables and cryogenic components for this type of service. The first refrigerator uses a 350 HP screw compressor and three turbo-expander stages. It is hoped to achieve reliability of a very high order. The first three-phase tests will be conducted at 69 kV, although it appears that 230 to 345 kV is the most likely voltage range for future applications.

Author (NSA)

**N76-21709#** Oak Ridge National Lab Tenn  
**NEUTRON ACTIVATION ANALYSIS APPLIED TO ENERGY AND ENVIRONMENT**

W S Lyon 1975 13 p refs. Presented at Conf of Nucl Power and Appl in Latin Am Mexico City 29 Sep 1975. Sponsored by ERDA (CONF-750928-2) Avail NTIS HC \$4.00

Neutron activation analysis was applied to a number of problems concerned with energy production and the environment. Burning of fossil fuel, the search for new sources of uranium, possible presence of toxic elements in food and water, and water and the relationship of trace elements to cardiovascular disease are some of the problems in which neutron activation was used.

Author (NSA)

**N76-21711#** Energy Research and Development Administration  
 Washington DC Div of Controlled Thermonuclear Research  
**THE 1974 REVIEW OF THE RESEARCH PROGRAM**  
 Jan 1975 168 p refs (ERDA-39) Avail NTIS HC \$5.45

The role of the research program in controlled thermonuclear research, the activities that are contained within the research program, and summaries of the reports prepared by the study groups that analyzed the six activity areas that make up the research program are described. The recommendations by an overview panel are given. The recommendations are based on an analysis of the individual study group reports, consultations with CTR staff and field scientists, and on dependent review of CTR program plans and needs. In some cases the recommendations of the overview panel are identical with study group recommendations and in other cases they are not. Some recommendations by the overview panel take into account factors in information that go beyond that available to the study groups. The five year budget needed to accomplish the recommended research program is discussed.

NSA

**N76-21712#** Energy Research and Development Administration  
 Washington DC Div of Reactor Research and Development

**STATUS OF CENTRAL STATION NUCLEAR POWER REACTORS SIGNIFICANT MILESTONES**

1 Apr 1975 13 p

(ERDA-30(4/75)) Avail NTIS HC \$3 50

Information on U S power reactors is listed concerning the reactor type electrical capacity (MW(e)) manufacturer public announcement date contract award date construction permit and operating license application and issuance dates initial criticality first electrical production fuel power and commercial operation date NSA

**N76-21715#** Oklahoma Univ Norman Science and Public Policy Program

**ENERGY ALTERNATIVES A COMPARATIVE ANALYSIS**

May 1975 706 p refs Sponsored in part by FEA Council on Environ Quality ERDA EPA FPC Dept of the Interior and NSF

(PB-246365/1 FEA/D-75/661) Avail NTIS HC \$18 75 CSCL 10A

This report develops a methodology for systematically identifying assessing and comparing energy alternatives in environmental impact statements (EIS) The report provides descriptions and data on the major energy resource systems in the United States and suggests procedures for using these descriptions and data The study consists of two major parts Part I contains descriptions of the coal oil shale crude oil natural gas tar sands nuclear fission nuclear fusion geothermal energy hydroelectric power organic wastes and solar energy resource systems plus descriptions of electric power generation and energy consumption Each resource system description contains data and information on energy efficiencies environmental residuals and economic costs Part II describes procedures for using the descriptions and data contained in Part I in systematically evaluating and comparing the residuals efficiencies and economic costs of a proposed energy action and its alternatives and suggests procedures for impact analyses GRA

**N76-21718#** Texas Univ Austin Center for Energy Studies  
**ELECTRIC POWER TRANSMISSION AND DISTRIBUTION SYSTEMS COSTS AND THEIR ALLOCATION**

Martin L Baughman and Drew J Bottaro Jul 1975 47 p refs

(Grant NSF SIA-73-07871-A02)

(PB-247189/4 CES-6 NSF/RA/N-75-107) Avail NTIS HC \$4 00 CSCL 10B

Transmission and distribution costs contribute significantly to the total costs of providing electrical service The costs derived from the transmission and distribution (T&D) system have historically comprised about 2/3 the costs of producing and delivering electricity to residential-commercial customers and over 1/3 the total costs supplying electricity to large industrial customers This report (1) estimates the differences in transmission and distribution equipment required to serve industrial and residential-commercial customers and allocates to the above two customer classes the average costs of installing this equipment (2) estimates the costs of operation and maintenance of the transmission and distribution system and allocates these costs to the customer classes and (3) calculates the T&D derived average costs for the two customer classes GRA

**N76-21719#** Electric Power Research Inst Palo Alto Calif Environment and Conservation Div

**SIGNIFICANCE OF ZERO POWER GROWTH IN 1974**

Milton F Searl Sep 1975 22 p refs

(PB-247517/6 EPRI-SR-17) Avail NTIS HC \$3 50 CSCL 10A

For the first time since 1946 the total electricity supply in 1974 did not increase appreciably over the preceding year Two simple historical growth models are used to evaluate the significance of this occurrence One relates total electricity made available to aggregate economic activity (real GNP) and the other relates it to the passage of time In both models electricity supply is highly correlated with the independent variable On the basis of the economic model there is no reason to believe

that the rate of long-term growth of electricity relative to real GNP has declined in fact, the contrary is indicated Use of the other model in which time is the independent variable, leads to exactly opposite conclusions GRA

**N76-21720#** Mitre Corp McLean Va  
**ENERGY RESOURCES FOR THE YEAR 2000 AND BEYOND, WITH SCENARIOS FOR THE YEAR 2000 AND THE YEAR 2100**

Charles A Zraket Mar 1975 55 p refs Presented at Conf on Towards a Plan of Action for Mankind Needs and Resources Paris 9-13 Sep 1974

(PB-247413/8 MTP-401-Rev-2) Avail NTIS HC \$4 50 CSCL 10A

The following topics are discussed current and projected World use of energy resources energy sources and environmental effects two scenarios for the year 2000 and the year 2100 new techniques for energy generation and transmission the transportation sector GRA

**N76-21721#** Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div

**NEW DEVELOPMENTS IN THE AREA OF MAGNETOHYDRODYNAMIC CURRENT GENERATORS**

P K Fritzer 17 Apr 1975 21 p refs Transl into ENGLISH from Elektrotech Maschinenbau (Berlin) v 91 no 3, Mar 1974 p 123-129

(AD-A017803 FTD-HC-23-1105-75) Avail NTIS CSCL 10/2

Multidimensional coupled computations of channel flow are considered Factors discussed include hall effect and cross velocity meaning of the boundary conditions-viscosity for stabilizing a channel flow and heat transfer Results of the investigation are summarized JMS

**N76-21724#** Minnesota Univ Minneapolis Dept of Management Sciences

**REIS PHASE 2 REPORT 1 AN OVERVIEW OF THE REIS SYSTEM Draft Report**

Norman L Chervany J David Naumann and Ronald D Visnes 31 Jul 1975 69 p refs

(PB-248052/3 MEA/REIS-P2-7507) Avail NTIS HC \$4 50 CSCL 05B

The Regional Energy Information System (REIS) is being designed and implemented to collect organize store and report data from the energy supply/distribution/consumption chain in the state of Minnesota This system will contain identification data energy flow data and end use data The REIS system will allow users to have access to the data base in a variety of ways (ie periodic reporting special request reporting direct access/browsing capabilities and the creation of machine readable files) The self-contained language feature of SYSTEM 2000 gives the REIS system the flexibility and evolvability necessary to meet the changing data needs of energy management problems GRA

**N76-21725#** Control Data Corp Palo Alto Calif Structural Engineering Services

**EXPLORATORY DISCUSSIONS CONCERNING A POSSIBLE EPRI/KURCHATOV INSTITUTE JOINT PROGRAM ON FUSION POWER**

C P Ashworth B D Fried and W C Wolkenhauer Nov 1975 50 p refs Sponsored by Elec Power Res Inst (PB-247269-4 EPRI-SR-24) Avail NTIS HC \$4 00 CSCL 18A

Meetings were held between EPRI and a Soviet delegation to discuss fusion power The first meeting took place at EPRI in May 1975 at which the Soviet delegation stated their position as being that the highest priority goal is the development of a hybrid fusion-fission reactor based on a Tokamak The Soviets consider fusion power to be the most realistic approach to the earliest possible implementation of controlled fusion energy production The Soviet delegation expressed a strong interest in a formal inclusion of EPRI in the US-USSR collaborative program in controlled fusion To answer difficult technical and procedural questions in anticipation of a joint venture EPRI met the Soviet delegation in the USSR in September The report describing these meetings and giving the EPRI delegations

summary evaluation and recommendation is given together with a summary of the meeting jointly drafted by the U S and U S S R participants  
GRA

**N76-21726#** Washington Univ St Louis Mo Center for the Biology of Natural Systems  
**THE VULNERABILITY OF CROP PRODUCTION TO ENERGY PROBLEMS**

Barry Commoner Michael Gertler Robert Klepper and William Lockeretz Apr 1975 40 p refs  
(Grant NSF GI-043890)  
(PB-247756/0 CBNS-AE-2 NSF/RA/N-75-164) Avail NTIS HC \$4 00 CSCL 02C

The energy consumed in producing 14 field crops under a variety of conditions is determined The cost of this energy in both 1970 and 1974 is also calculated For each crop the impact of energy price increases is expressed through two indexes involving the increased amount paid for energy to produce one unit of crop In the first index this is compared to the increase in the total direct production cost in the second index, it is compared to the increase in the price received per unit of crop in the same period (1970-1974)  
GRA

**N76-21727#** Minnesota Energy Agency St Paul Research Div

**ENERGY REQUIREMENTS IN MINNESOTA IRON ORE AND TACONITE MINING 1953 - 2000**

Howard Hirsch Aug 1975 38 p refs  
(PB-248055/6 MEA-MINE-7508) Avail NTIS HC \$4 00 CSCL 08I

This report is concerned primarily with forecasting energy requirements for taconite and iron mining in Minnesota until 2 000 and additionally with the role in the industry in the economy of both the State and the three-county Iron Range region of northeastern Minnesota Direct energy inputs in iron mining in 1973 are related to three end-use categories production transportation and overhead activities Over 85 percent of direct energy consumed was for production activities Transportation and overhead accounted for 6 74 and 7 91 percent of direct energy use respectively  
GRA

**N76-21728#** Federal Energy Administration Washington D C Office of Environmental Programs  
**ENERGY INDEPENDENCE ACT OF 1975 AND RELATED TAX PROPOSALS**

Mar 1975 392 p refs  
(PB-247305/6 FEA/D-75/698) Avail NTIS HC \$10 75 CSCL 10A

It describes and analyzes the social economic and environmental impacts that may result from legislative programs It examines the impacts that may result from each individual legislative proposal and from the energy program as a whole Assessments of legislative proposals are organized into five sections description of proposal energy impacts socioeconomic impacts environmental impacts and a presentation of reasonable alternatives to the proposed program and a description of their major environmental impacts  
GRA

**N76-21729#** National Bureau of Standards Washington D C Center for Building Technology  
**ENERGY CONSERVATION POTENTIAL OF MODULAR GAS-FIRED BOILER SYSTEMS Final Report**

G E Kelly and D A Didion Dec 1975 57 p refs  
(PB-247205/8 NBS-BSS-79 LC-75-619338) Avail NTIS HC \$4 50 CSCL 13A

Four of the boilers each having an input rating of 85 000 Btu per hour were arranged so that they could either be operated like a single boiler (i.e. all of the boilers either on or off) or as a modular installation in which the boilers are sequentially fired to match the number in operation with the heating load The fifth boiler had an input rating of 300 000 Btu per hour and was operated as a single boiler installation Efficiency vs heating load curves were obtained for the single boiler installation the four small boilers ran like a single boiler and the modular installation operated with and without water flowing through the idle modules  
GRA

**N76-21730#** National Bureau of Standards Washington D C Center for Building Technology  
**RETROFITTING A RESIDENCE FOR SOLAR HEATING AND COOLING THE DESIGN AND CONSTRUCTION OF THE SYSTEM**

James E Hill and Thomas E Richtmyer Nov 1975 101 p refs  
(PB-247482/3 NBS-TN-892) Avail NTIS HC \$5 50 CSCL 13A

During 1972 and 1973 the National Bureau of Standards conducted controlled laboratory tests on a factory-built four-bedroom house having a floor area of 110 sq m (1200 sq ft) equipped with a conventional gas furnace and central electric air conditioner incorporated into a forced air distribution system During 1974 the house was moved onto the NBS grounds and a solar heating and cooling system was designed to be added to the house Calculations were made to show that more than 75% of the yearly energy needs for heating cooling and supplying domestic hot water could be obtained from the sun This report deals with the design and construction of the retrofitted system It consists of 45 sq m (485 sq ft) of double-glazed flat-plate solar collector 5 7 cu m (1 500 gallons) of water storage and a 10 000 W (3 ton) lithium bromide absorption air cooling unit  
GRA

**N76-21731#** San Diego Gas and Electric Co Calif  
**TEST AND EVALUATION OF A GEOTHERMAL HEAT EXCHANGER Final Report**

G L Lombard Sep 1975 66 p Prepared for Electric Power Res Inst  
(PB-247318/1 EPRI-376-FR) Avail NTIS HC \$4 50 CSCL 13A

A small-scale tube-in-shell heat exchanger with four sections in series was tested with geothermal brine The brine inlet temperature was approximately 355F and contained 14 500 ppm dissolved solids Scale was deposited on the heat exchanger tubes as heat was extracted from the brine and caused the overall heat transfer coefficient to decrease with time Tube materials tested were titanium carbon steel and 90% copper-10% nickel Results indicate that scaling rate is primarily a function of brine velocity and tube material type with some effects of temperature becoming apparent as the temperature approaches 150F This indicated that the minimum brine exit temperature should be kept at 150F or higher and that the maximum practical brine velocity may be around 7 ft/sec in full-scale heat exchanger designs Pressure loss in the brine side of the heat exchanger due to scale build-up was minor Chemical cleaning removed the scale layer  
GRA

**N76-21733#** Illinois Univ Champaign Dept of Civil Engineering  
**BIOLOGICAL CONVERSION OF ORGANIC REFUSE TO METHANE Annual Progress Report 1 Jul 1974 - 30 Jun 1975**

John T Pfeffer and Jon C Liebman Sep 1975 153 p refs  
(Grant NSF GI-39191)  
(PB-247751/1 UILU-ENG-75-2019  
NSF/RANN/SE/GI-39191/PR-75-2  
NSF/RA/N-75-131-75-116) Avail NTIS HC \$6 75 CSCL 21D

Urban solid wastes contain significant quantities of energy that can be reclaimed Biological conversion of the organic refuse to methane by anaerobic fermentation is one mechanism by which this energy can be reclaimed The results are given of an investigation of refuse fermentation at a thermophilic operating temperature of 60C of dewatering of the fermentor residue by vacuum filtration and of pretreatment of the refuse by a hot-caustic process Treatment requirements for the concentrate-filtrate produced by dewatering of the residue are presented  
GRA

**N76-21734#** ICF Inc Washington D C  
**SHORT-TERM COAL FORECAST, 1975 - 1980 Final Report**

Aug 1975 120 p refs  
 (Contract FEA-C-05-50099-00)  
 (PB-247073/0 FEA/G-75/494) Avail NTIS HC \$5 50 CSDL  
 21D

Estimates are provided for bituminous coal and lignite production consumption and end-of-year stocks for 1975 through 1980 The report discusses the approach and data base used to develop the projections of 1975-1980 production consumption and stock levels estimates the price impacts of these projections and discusses the uncertainties and sensitivities inherent in the projections GRA

**N76-21735#** Illinois Univ Champaign Center for Advanced Computation

**THE COAL FUTURE ECONOMIC AND TECHNOLOGICAL ANALYSIS OF INITIATIVES AND INNOVATIONS TO SECURE FUEL SUPPLY INDEPENDENCE APPENDIX B Final Report**

Michael Reiber Shao Lee Soo and James Stukel May 1975 36 p refs  
 (Grant NSF G1-35821)  
 (PB-247679/4 UIUC-CAC-DN-75-163B NSF/RA/N-75-037B)  
 Avail NTIS HC \$4 00 CSDL 18E

Energy costs of mining preparing reprocessing and disposing of fuel for an average 1 000 MWe nuclear power plant are discussed This model plant is assumed to average one boiling water reactor (BWR) and two pressurized water reactors (PWR) The energy cost of materials needed to construct a boiling water reactor plant is also discussed GRA

**N76-21736#** Nevada Bureau of Mines and Geology Reno **EVALUATION OF GEOTHERMAL ACTIVITY IN THE TRUCKEE MEADOWS, WASHOE COUNTY NEVADA**

Richard L Batemen and R Bruce Scheibach 1975 46 p refs  
 Prepared in cooperation with Nevada Univ Reno  
 (Contract DI-14-31-0001-4028)  
 (PB-247297/5 NBMG-25 W76-01683) Avail NTIS  
 HC \$4 00 CSDL 08G

Probable effects of thermal waters on overall ground-water conditions under a pattern of increasing development within the basin are estimated All chemical quality and temperature data for thermal and nonthermal ground waters were assembled and subjected to various forms of analysis Results were used to precisely delineate areas of geothermal occurrence and assess the probable results of induced mixing of poor-quality thermal and good-quality nonthermal ground waters Past and present use of the local geothermal resource were inventoried and evaluated The most frequent present use is for single residence heating employing geothermal wells and simple heat exchange systems GRA

**N76-21737#** Research Triangle Inst Research Triangle Park N C

**RANN UTILIZATION EXPERIENCE CASE STUDY NO 15 NEW TECHNIQUES FOR GASIFYING COAL**

A Squires 1975 31 p refs Prepared in cooperation with City Univ of New York  
 (Grant NSF C-927)  
 (PB-247259/5 NSF/RA/G-75-043) Avail NTIS HC \$4 00  
 also available in complete report and summary PB-247243  
 HC \$13 00 CSDL 07A

Since the use of fuel gas lessens the particulate pollution associated with the combustion of coal improved methods of coal gasification are a high priority national need The specific objectives of this project are to provide a technical basis for pilot scale activities by industry on fast fluidized beds and agglomerating fluidized beds that either react coal with hydrogen or gasify coal or coke with air and steam Dissemination of the research results is discussed GRA

**N76-21738#** University of South Florida Tampa Coll of Engineering

**REPORT ON A WORKSHOP FOR ENERGY CONSERVATION IN SOUTHEAST INDUSTRIAL PLANTS Final Report**

E W Kopp 30 Jun 1975 55 p  
 (Grant NSF ENG-75-03005)

(PB-246651/4 NSF/ENG-75-03005) Avail NTIS HC \$4 50  
 CSDL 10A

The objective was to identify research areas which should lead to a more efficient use of energy in industrial and commercial plant operations The program was designed to define the state-of-the-art of energy use in such industrial facilities by means of case study presentations and descriptions of ongoing research activities having potential for energy conservation in industrial plants Results of the workshop regarding solutions to existing problems and identification of needed research are also reviewed GRA

**N76-21739#** Colorado Univ Boulder Dept of Mechanical Engineering

**TRANSPORT OF MASS AND ENERGY IN POROUS MEDIA DUE TO NATURAL CONVECTION THE GEOTHERMAL BASIN PROBLEM Progress Report**

D R Kasoy 26 Mar 1975 20 p refs  
 (Grant NSF AER-74-03429)  
 (PB-247087/0 CUMER-75-2 NSF/RA/N-75-118 PR-1) Avail  
 NTIS HC \$3 50 CSDL 08G

Geological and geophysical field data are used to develop plausible models of the energy-mass transport systems in geothermal anomalies The basic describing equations for saturated thermally-active elastic porous media are discussed in the context of modelling physical processes occurring in the geothermal environment Progress in code development is considered Calculations for heat and mass transport due to natural convection in model systems are described The importance of using variable fluid properties is emphasized GRA

**N76-21740#** Massachusetts Inst of Tech Cambridge Energy Lab

**ELECTRIC POWER TRANSMISSION AND DISTRIBUTION SYSTEMS COSTS AND THEIR ALLOCATION**

Martin L Baughman and Drew J Bottaro Jul 1975 45 p refs  
 (Grant NSF SIA-73-07871 A02)  
 (PB-247141/5 MIT-EL 75-020) Avail NTIS HC \$4 00 CSDL  
 10B

The costs derived from installing operating and maintaining the transmission and distribution system have historically comprised about 2/3 the total costs of producing and delivering electricity to residential commercial customers and over 1/3 the total costs of supplying electricity to large industrial customers This paper estimates the costs of transmission and distribution for nine regions of the United States for the above two customer classes These costs are detailed for six categories of equipment used in the transmission and distribution system and the contribution to the total cost of each equipment category is determined GRA

**N76-21741#** Little (Arthur D.) Inc Cambridge Mass **ASSESSMENT OF FUELS FOR POWER GENERATION BY ELECTRIC UTILITY FUEL CELLS Final Report**

R P Stickles G C Sweeney P E Mawn and J M Parry Oct 1975 320 p refs Sponsored by Elec Power Res Inst (PB-247216/5 EPRI-318-FR) Avail NTIS HC \$9 75 CSDL  
 10B

The relative cost of fuel supply options for the production and distribution of fuels suitable for fuel cells was assessed including the supply alternatives of hydrogen synthetic gas (hydrogen/carbon monoxide) methanol naphtha and raw energy sources for conversion to product fuels-petroleum natural gas coal and municipal solid waste Comparative economics of fuel cell power systems from raw of primary fuel to electricity were developed based on forecasted energy prices for 1978 1990 The integration of on-site fuel conversion with the fuel cell power sections was considered to utilize waste heat and water from the stack The integration of coal gasifiers with fuel cell plants was also investigated GRA

**N76-21837#** Colorado Univ Boulder Dept of Mechanical Engineering

**FAULTING IN GEOTHERMAL AREAS**

John S Rinehart 11 Sep 1975 40 p refs

(Grant NSF AER-74-03429)

(PB-247071/4 CUMER-75-12 NSF/RA/N-75-128) Avail NTIS HC \$4 00 CSCL 08G

This report describes fault systems that are present in known geothermal areas. It was written primarily to provide an introduction to the subject of the nature and occurrence of faults for nongeologists working in the field of geothermal energy development especially the character of flow of fluids in the basins. GRA

the implementation of the proposed legislation or from alternatives to that legislation. Background on the natural gas shortage, descriptions of proposed legislation concerning natural gas, a description of the natural gas situation, a description of the environment affected and impact methodology, energy and environmental impacts of the proposed legislation concerning natural gas, adverse environmental impacts, short-term uses of the environment and long-term productivity alternatives to proposed natural gas legislation, and commitment of natural gas resources are included. GRA

**N76-22049#** Energy Research and Development Administration Washington D C Div of Controlled Thermonuclear Research

**FUSION POWER BY MAGNETIC CONFINEMENT**

[1975] 24 p

(ERDA-11) Avail NTIS MF \$2 25 SOD HC \$1 20

This report graphically explains the principal aspects of nuclear fusion. It illustrates how thermal energy is used to generate electricity, how energy can be produced from nuclear fusion, how the present research and development program is oriented, and finally how present efforts can lead to commercial nuclear fusion power. Author (NSA)

**N76-22051#** California Univ Livermore Lawrence Livermore Lab

**FUSION POWER THE TRANSITION FROM FUNDAMENTAL SCIENCE TO FUSION REACTOR ENGINEERING**

R F Post 25 Jul 1975 42 p refs Presented at IEEE Eascon Meeting Washington D C 29 Sep 1975 Sponsored by ERDA

(UCRL-77055 Conf-750948-1) Avail NTIS HC \$5 25

The historical development of fusion research is outlined. The basics of fusion power along with fuel cost and advantages of fusion are discussed. Some quantitative requirements for fusion power are described. NSA

**N76-22059#** Los Alamos Scientific Lab N Mex

**LASER FUSION AN OVERVIEW**

K Boyer 1975 19 p refs Presented at 3d Conf on the Laser New York 22 Apr 1975

(Contract W-7405-eng-36)

(LA-UR-75-660 Conf-750460-1) Avail NTIS HC \$4 25

The laser fusion concept is described along with developments in neodymium and carbon dioxide lasers. Fuel design and fabrication are reviewed. Some spin-offs of the laser fusion program are discussed. NSA

**N76-22114#** Scientific Software Corp Denver Colo

**ECONOMIC EVALUATION MANUAL Final Report**

Sep 1975 337 p refs

(Contract DI-14-08-0001-13926)

(PB-247640/6 USGS-CD-75-003) Avail NTIS HC \$10 00 CSCL 05C

The bases for and methods of performing economic evaluations of petroleum and natural gas prospect and producing projects are presented in a wholly tutorial format. GRA

**N76-22118#** Federal Energy Administration Washington D C Office of Environmental Programs

**NATURAL GAS EMERGENCY STANDBY ACT OF 1975 Draft Environmental Impact Statement**

Nov 1975 314 p refs

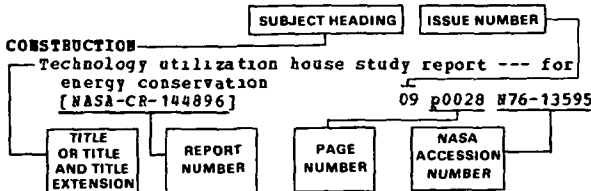
(PB-247306/4 FEA/D-75/573) Avail NTIS HC \$9 75 CSCL 21D

The purpose of the statement is to describe and analyze the environmental and energy impacts that would result from



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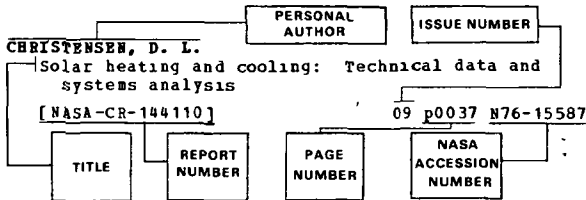
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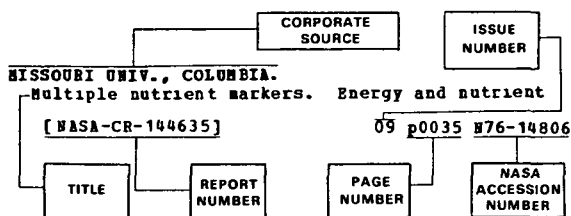
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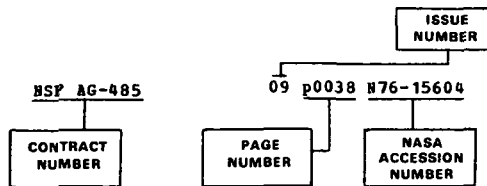
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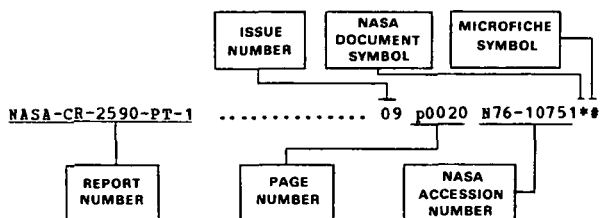


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