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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)
This Supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, for $4.00. For copies mailed to addresses outside the United States, add $2.50 per copy for handling and postage.
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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The development of the conceptual design of high (1000 kW, 18 mph mean wind speed site) and low (100 kW, 12 mph site) power wind generator systems to be integrated into a standard electric utility is discussed. Analyses leading to the selection of the rotor and tower design are outlined. The 1000 kW system selected for further development utilizes an all composite rotor blade design and a steel shell tower. The projected energy cost is 3.5 cents/kW hr. Results of optimization of the rated power, site wind speed, and rated wind speed parameters are summarized. C K D
**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
A76-19022 * A study of efficiency in low resistivity silicon solar cells P M Dunbar and J R Hauer (North Carolina State University, Raleigh, N C) Solid-State Electronics, vol 19, Feb 1976, p 95-102 22 refs NASA-supported research

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)


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. Cost expectations and other factors influencing the rate of introduction of solar energy are discussed.

C K D

A76-19039 # 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 275-284 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 Mahduri (Deutsche Philips GmbH, Forschungs laboratorium, 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 Mircia (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 (Caracterisation physique des cellules solaires au silicium par l'étude des réponses spectrales) E Fabre and M Maurer (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 Sailes (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 now 12.5 per cent (it was 9 per cent during the last few years). A cost analysis is carried out (Author).

Minerals for solar cells (Les matériaux pour photopiles solaires) M Rodor (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/CdS heterojunction cells and GaAs cells (Author).


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).


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 (Author).

What can we expect from geothermal energy (Que pouvons-nous attendre de l'énergie géothermique) J Goguel (Bureau de Recherches Geologiques et Minieres, 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 (Author).


The solution considered is based on the production of neutrons by fusion. The neutrons can be used in a reaction with lithium to obtain hydrogen. 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 (Author).

High-temperature solar heat sources for spacecraft (Solnechnye vysokotemperaturnye istochniki tepla dla kosmicheskikh apparatov) V A Grikhes, 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 (Author).

Multiscale aerial and orbital techniques for management of coal-mined lands F J Wobber (IBM Corp, Gathersburg, 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 planning 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).

Mixed metal vapor phase matching for third-harmonic generation D M Bloom, J F Young, and S E Harris (Stanford University, Stanford, Calif J 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).


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 (Author).
A76-19595 Get ready for the great debate on transportation R W Simpson (MIT, Cambridge, Mass.) Aeronautics and Astronautics, vol 14, Feb 1976, p 3845 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

A76-19598 Short-range transports to save fuel G Cornning and P Sampath (Maryland, University, College Park, Md.) Aeronautics and Astronautics, 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% 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


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 CO2 lasers. The problem of hydrogen radiation damage of reactor walls is considered

A76-19918 The basic technical characteristics of the demonstration tokamak fusion reactor /ths T-20 device/ (Osnovnye tekhnicheskie karakteristiki demonstratsionnogo termiodernogo reaktora-tokamaka /ustanovka T-20/) V A Glukhikh, N A Monazont, and G F Kurakov Akademiya Nauk SSSR, Izvestiya, 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


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

A76-20008 A general review of closed-cycle gas turbines using fossil, nuclear and solar energy K Bammert (Hanover, Technische Universitat, Hanover, West Germany) Munich, Verlag Karl Thiemng (Thiemng 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 Oberhauser hybrid power plant. The components of a gas turbine plant are defined, i.e., 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

A76-20111 Solar power stations in space R Ockert and G Wirths Dormer-Post (English Edition), no 3 1975, p 1822

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 Rnth (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

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 10 refs

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

A76-20072 Hydrogen problems in energy related technology J P Hirth (Ohio State University, Columbus, Ohio) and H E 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 environment embrittlement is given along with important research areas in prospect. In particular, the model of hydrogen entry distinguishes hydrogen stress cracking (HSC) and hydrogen embrittlement. The degraded mechanical property differentiates HSC and loss in tensile ductility, and the mode of fracture 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

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 10 refs

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

**A76-20524**  
The history, current status, and future prospects of wind power generation by wind-activated power plants is surveyed. Vaned 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 electronic generating plants in isolated areas and locations and in developing countries, and associated problems, are discussed.

**A76-20559**  
The paper proposes a new approach to plasma heating by the radiation of electric discharge CO2 lasers by which synchronous spherical irradiation of a target by single-cascade CO2-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.

**A76-20566**  
Current approaches in the solar energy program of the Energy Research and Development Administration are outlined. It is predicted that 25% of total U.S. 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 $5000 per peak kilowatt is anticipated. Additional technologies under exploration include fuels from biomass, ocean thermal conversion, and solar thermal conversion.

**A76-20567**  
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.

**A76-20716**  
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.

**A76-20780**  
This paper describes the mathematical modeling of the ac polyphase commutator generator by means of Park's equations. For constant, 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.

**A76-20838**  
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.

**Author**


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 small equal streams are equal, the exchanger becomes very simple, and lends itself to direct optimization of heat exchanger size. Several sample optimization calculations are shown. (Author)


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 this 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 the solar system to a design 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)


Three flat plate solar collectors were simultaneously tested for over six months as a water trickle collector, a typical collector with double glazing, and as 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)


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. (C. K. D.)


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 Thermolin 66 fluid to 590 K. The energy is stored in a high temperature storage unit for use by a turbogenerator. The Thermolin fluid is returned from the turbine to storage at 460 K. It is rejected, from the 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. (C. K. D.)


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 and possible advantages of the photochemical solar energy system. The lower cost and lighter weight, 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 high initial cost of the working fluid, and possible deterioration of the energy storage capacity with time. (Author)


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)


A76-21141 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 transit, and group rapid transit systems with very short or fraction-second headway capabilities are examined. The specific weight of wells and walks 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 solar silicon 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 x 10 to the 23rd power per cm cuber. 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-carrying 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 superflywheel, and electric power generation (Stockage d'energie - Etude de faisabilite d'une experience de captation, de stockage par accumulation cinetique et de restitutioin d'energie electrique d'origine solaire) B Tatry (Centre National d'Etudes Spatiales, Division Systemes de Stabilisation et Piloteage, Toulouse, France) L'Aeronautique et I'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


Silicon photovoltaic cells with differences in depth of the n(+)-p junction, structure of the rear contact, and transversity 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


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


A method of obtaining reliability estimates, using quantitative indicators 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 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.

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.

A76-21472 Preparation and properties of InP/Cds solar cells

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.

A76-21769 Theoretical analysis of graded-band-gap gallium-aluminum arsenide/gallium arsenide p-Ga1-xAlxAs/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-Ga1-xAlxAs/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 AM0 (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.

A76-21877 Theoretical performance of vertical axis wind turbines

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 compared for some examples and applied to estimate the economic feasibility of a turbine of 10 megawatt rating.

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

A76-21931 Waste heat utilization through the use of heat pipes

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.

A76-21960 Power turbines for Ocean Thermal Energy Conversion systems
L L Ambs (Massachusetts, University, Amherst, Mass.) and R J Veeneema, Jr American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov 30-Dec 4, 1975, Paper 75-WA/OCE 11 p 9 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 is used for general 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.

A76-21969 A theory of concentrators of solar energy on a central receiver for electric power generation
M Riaz (Minneapolis, 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 and 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 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, TRACES. 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 8 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 designs 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 Rolls 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 G I-43936

Two types of linear segmented 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 Alcnone (Sandia Laborat ories, 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 Boso (Dow Chemical Co, Midland, Mich ) and N V Suryanarayana (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

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 insulation 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, percent 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 Edendurn (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, $1.50, non members, $3.00


During 1972 and 1973 the U.S. Geological Survey (U.S.G.S.) 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 U.S.G.S. 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).


Attention is given to the temperature patterns determined with the aid of the measured data. Some tentative generalizations regarding the Long Valley geothermal system


The audiromagnetotelluric (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 818,600 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).


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 by-products were determined to be: suspension gasification - 57, fluidized-bed gasification - 66%, fluidized-steam-iron process - 62%. 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.


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, (8) related topics (control and regulation devices, wind measuring devices, blade design and rotors, wind tunnel simulation, aero-dynamics). Cross-referencing is aided by indexes of author, corporate sources, titles, and keywords.


The subjects considered are related to fossil fuels, nuclear energy, and alternate energy sources. Attention is given to solar thermal conversion power plant design 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.

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 A76-22698


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 geographical 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) G R A76-22697


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) G R A76-22698


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) G R A76-22700


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. (Author) G R A76-22701


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) G R A76-23057


The economic potential for 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) G R A76-22698


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) G R A76-23131

Unconventional energy converters (Unkonventionelle Energiewandler). E F Schmidt Berlin, Elsner-Verlag, 1975 179p 208 refs $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...
**A76-23598** Future prospects. T Van Duzer (California, University, Berkeley, Calif.) In Applied superconductivity Volume 2.


Current and future trends in the development of applications of superconducting magnets and Josephson effects 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.


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/Cu2S cells, polysilicon cells, and Schottky barrier photovoltaics.

**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 Weltfrauforschung. Contract No GW-RVII V67/74-P-7B 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, photovoltaic 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.


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.

**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 zukunftige 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 use of electrochemical power systems are examined, taking into account applications related to the storage of energy and 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, hydroxone systems, zinc chloride systems, zinc-air systems, and various types of fuel cells.

**A76-24748** Tokamaks (Les tokamaks) J-P Poite 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/cm² 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.


Models of extragalactic double radio sources are analyzed in which the components are excited and gravitationally bound 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
A76-24820

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

A76-24844 # Operation of a thin silicon solar cell with illumination from two sides (Rabota tokogo kremeniovoj fotoprovodnogo oksydatora pri osveshhenii ego s dvukh storon) N M Bordina, T M Golowner, V V Zadde, A K Zaitseva, and V I Strel'tsova (Vsesoiuznyi Nauchno-issledovatel'skiy Institut Istochnikov Toka, Moscow, USSR) Geliotekhnika, no 6, 1975, p 12 19

In Russian

The paper studies the spectral distribution of the collection


Drilling and search techniques used in the exploitation of offshore 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.

F G M


Advantages of the heat pipe for a transfer of heat energy include its virtually noiseless passive operation, the absence of maintenance requirements, and cleanliness 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

A76-24843 # Degradation of the characteristics of the thin-film photovoltaic cell Cu/S-CdS (Degradatsiya karakteristik tokoplenochnogo fotoval'stsioghelementa Cu/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/S-CdS for use in solar cells are reported. The base layer - CdS was deposited by a gas-transport technique in a flow of H2 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

A76-24945 # Solar cells from gallium arsenide obtained by ion bombardment (Solnechnye elementy iz arsenida gallia, poluchennye ionnoi bombardirovkoi) A A Gavrilov, G A, Kachurn, and L S Smirnov (Akademna 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 dopant depth of the p-n junction. The small dopant 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 (90 to 95% 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 (Raschitatel'skoye meto dopredeleniya formy i razmerov obrazovatelei pri osveshchenii s dvukh storon) V T Chkhoev, la T Shermazanian, and V V Arutuman 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 (Kontsentritruushchee spektrirovaniye zerkal'nykh sistem SES - Vliyanie geometricheskikh faktorov) D I Tepliakov and R R Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skiy Energeticheskiy 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 central receiver 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 poluprovodnykh fotoval'stsioghelementov iz razmerov otrazhaushchei poverkhnosti) A V Vartanian, la T Shermaostanian, and V V Arutuman 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
A76-25539 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 these are worthwhile 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)

A76-25534 Flow of fluids through porous, anisotropic, composite media with sources and sinks - Application to fuel cells
S Sreen (Kennebec Copper Corp, Lexington, Mass I and D Gidaspow (Institute of Gas Technology, Chicago, III) Energy Conversion, vol 15, no 3-4, 1976, p 113-120 16 refs


(Paragraph continues)
The advantages and shortcomings of introducing an additive in the form of aqueous solutions of K2CO3 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 K2CO3 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 0.8 mm. Experimental results are presented regarding measurement of the electroconductance and temperature of the injection. The electroconductance 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 Hurst (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 thermo-dynamic 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 units of peak power production. (Author)

A76-25650 Modern gas turbines for low Btu gas fuel operation R J Palmer and M R Burgess (Turboodyne 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 17-11 to 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 bulk electricity at a loadcenter 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 Zeiger and M Funk (Harold I. Zeiger 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 17-6 to 317-6-11 refs The 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 are 0.89, 0.82, 0.71, and 0.91, respectively. Note 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 bank, information and literature bank which is being established for Kentucky's energy development program. The 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 and the various 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 (U S 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 P11-10 IP11 In response to national problems brought about by the energy crisis a report was submitted to the President of the U.S. 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.

A76-26047 Problems of the environment, energy, and natural resources: The international aspect (Problemy okruzhayushchey sredy, energii i prirodnykh resursov Mezhdunarodnyj aspekt) K V Ananiev 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


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


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


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


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 nonperturbative optical diagnostic probes currently under development for combustion measurements purposes (Author).


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


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 lasering, energy storage enhancements up to 15 (at a peak field of 20 kilogaus) 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).
The 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 boiler cost of electricity for a shallow solar pond system is $6 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.

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.

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 journal and annual variations caused by the rotation and orbital motion of the earth.

The shallow solar pond energy conversion system is presented as a potentially important use of shallow solar ponds. It can provide process hot water, up to the boiling point, for industrial and commercial purposes. A shallow solar pond could provide hot water for space heating, air conditioning, and hot water needs for a community of homes.

Solar space heating at high altitude conditions are described and results of field trials on a solar space heating device at an altitude of 3.5 km and under sub-zero ambient conditions are documented. 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.

Energy-storage requirements reduced in coupled wind-solar generating systems 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, solar energy biological conversion, water storage of solar energy and space applications.

Methodological aspects of reliability analysis of large-scale power systems are discussed, including the importance of reliability in power systems. 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 journal and annual variations caused by the rotation and orbital motion of the earth.

Reliability aspects of the system are assessed. Optimal synthesis and optimization are examined, along with the calculation of system reliability by supply system employing two heat sources simultaneously are.

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.


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.


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. 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 design of heat-supply systems are discussed.


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.


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.


The principal methodological problems of system analysis and optimization are formulated, and the directions of future scientific and engineering research are indicated.


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.


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 at a steady state 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 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.


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, and the development of new engines with

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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.

A76-27123

Geothermal energy E R Berman
Park Ridge, N J., Noyes Data Corp
(Chemical Technology Review, No 4), 1975
p 348 s $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 domes, feasibility studies for three areas of the U.S., and a number of proposed research projects.

A76-27125

Coal conversion technology I Howard Smith
and G J Werner (Millimeter Coal Pty., Ltd, Brisbane, Australia)
Park Ridge, N J., Noyes Data Corp
(Chemical Technology Review, No 68), 1976
p 155 s 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 hydrogenation. 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, electrofueldic gasification, liquid phase methanation, and two-state fluidized gasification.

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.)

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.

A76-27136

Thin-film conducting microgrids as transparent heat mirrors J C C Fan, F J Bachner, and R A Murphy (MIT, Lexington, Mass.)

A transparent heat mirror for solar-energy applications has been fabricated by chemically etching a Sn-doped In203 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.

A76-27145

Solar absorption and emittance properties of several solar coatings R B Petit and R R Sowell (Sandia
Solar absorptance (α) and total hemispherical emittance (τ) for two potential solar selective coating systems are reported. The first coating system 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 α values above 0.99, all have high τ values due to the high emittance of the silicone binder. The second system is a number of high-performance, black, coated superconducting magnets from the University of Massachusetts and Carnegie-Mellon University. The coatings show no decrease in solar absorptance at angles of incidence up to 75° from normal.


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, depends 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.

A76-27899 Superconducting magnets in the world of energy, especially in fusion power P Komarek (Karlsruhe University, 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 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. The use of pulsed superconducting windings in tokamaks and the use of “Yin Yang” or baseball coil configurations in mirror confinement devices is examined. The application of superconducting energy storage for load leveling in the grid and for pulsed operation fusion magnets is examined. The reliability and availability aspects of superconducting energy technology are considered.

A76-27884 Wind power D M Simmons Park Ridge, N J, Noyes Data Corp (Energy Technology Review, No 8, 1975 316 p 31 refs $24

The state-of-the-art of wind conversion and storage systems 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. Commerically available wind power equipment and wind machine designs are described.

A76-27800 R-32 energy storage propulsion system C H Weinstein (Air Research 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.

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 environmentally optimal for passenger cars. Southern California’s fuel industry of the distant future is discussed.


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 descriptive data for 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.

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.


The increased search for alternative energy sources has lead 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.

A76-27971 Effect of national transportation/energy policy on regional transportation phenomena J E Floiry, M A
Most regional transportation modeling studies have focused on macrolevel 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.

A76-28028 * # Photovoltaic Test and Demonstration Project A F Foresti, H W Brandhorst, Jr, and J N Deyo (NASA, Lewis Research Center, Cleveland, Ohio) Centre National d’Études Spatiales and Centre National de la Recherche Scientifique, Internationale 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 characteristics 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.


A review of recent 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 wind power systems. The economies of wind power is considered as are international research and development programs concerning wind power.


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. Photo graphs 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.

A76-28229 # Review of development in West-Germany U Hutter (Stuttgart, Universität, 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 Honnelf, by the Ventimotor GmbH in Weimar and the Allgäuer Werke in Uihingen. In 1931 and 1932 Honnelf 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 Allgäuer 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.

A76-28230 # Optimum design concept for wind electric converters U Hutter (Stuttgart, Universität, 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 maximum power intercepted 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.


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.

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 equationsthe 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.

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 Teknik Utveckling, 1976, p 237, 239 to 258 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 characteristicsthe 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 Teknik Utveckling, 1976, p 263 to 299 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 flexing modes, which were elastic cantilever bending for hingeless rotor blades and rigid body rotation for teetering rotor blades. The MOSTAB 65 computer code was used to calculate aerodynamic and mechanical loads. The teetering rotor has substantial advantages over the hingeless rotor with respect to wind stresses, fatigue life, and tower loading. The hingeless rotor analyzed does not appear to be structurally stable during overloads. (Author)


Wind-powered generator designs studied were used 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. (Author)

A76-28236 # Advanced vertical axis rotor concepts O Ljungstrom (Styrelsen for Teknik Utveckling, Stockholm, Sweden) In Advanced wind energy systems, Proceedings of the Workshop, Stockholm, Sweden, August 29, 30, 1974 Volume 1 Stockholm, Styrelsen for Teknik Utveckling, 1976, p 31 to 34 4 refs

New vertical axis rotor concepts for wind powered 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 easy pitch change to be arranged more easily than for the curved cattenary blades of the phi type. Other concepts mentioned include aerodynamic design scaling effects, and the integration of power cables in the structural support system. (Author)

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 Teknik Utveckling, 1976, p 35 to 318 4 refs

Various design aspects of high-speed vertical axis wind machines for power generation are considered. These include aerodynamic design, structural design and rotor blades. Blade supports, optimization aspects, 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 suggested as a general height to diameter ratio of 1.5, the use of two or three blades designed predominantly to have a low solidity, and the blades will be braced to the central column, and the solidity will be about 0.2 to allow for a blade zero lift/drag coefficient of 0.01, and power will be taken off just above or just below the lower rotor bearing. (Author)

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 Teknik Utveckling, 1976, p 319 to 322 4 refs

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 e.g. winds do 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. (Author)

A76-28240 # Wind-powered aquaduct 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 Teknik Utveckling, 1976, p 43 to 410 8 refs

An aquaduct 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 electric 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.

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, and the molten salt thermal storage system. 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.


Results of economic studies of storage systems for energy generated from 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.

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 economy 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.

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 power needs. 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.

A76-28245 # Wind-turbine mechanical to electrical conversion systems R T Smith and T S J Deviaah (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 CSCF systems have a slightly higher energy output than comparable VSCF 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 CSCF 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 CSCF systems. A two generator scheme is suggested to alleviate the problem of low generator efficiency at light loads.

A76-28246 # 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 6-15 to 6-17, 6-19 to 6-22

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 constitute 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 installed 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.

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 aero
dynamic 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.

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 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 7-25 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. 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.

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 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 greater 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.

A76-28397 Hydrogen sorption in LaNi5. O Boser (North
American Philips Corp., Briarcliff Manor, N. Y.) Journal of the

A76-28398 Hydrogen production from water by thermo-
chemical 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 is being studied for water via
electrolysis, direct thermal cracking, or chemical reactions. The
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, giving the degree
of completeness of the chemical reactions, and cost and efficiency
problems. Some 72 thermochemical cycles are tabulated with
relevant data.

A76-28477 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
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.

A76-28508 Method for the hydrodynamic and thermal
calculation of circulating systems. G N Kononenko In Methods for
the mathematical modeling of technical problems Kiev, Izdatel'stvo Instytutu 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. Electrodynamic (electrical) calculation is used to
model the hydrodynamic and thermal process in a circulating system
for extracting heat from a massif 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

A76-28508

67
used to solve systems of equations for plane-radial flow and for
unsteady convection

Some methods for constructing thermal and hydrodynamic fields in systems for heat extraction from the earth (O nekotorykh metodakh postroenii teplovykh i gidrodinamicheskikh polev v sistemakh izvlechenia tepla zemli) G N Kononenko and E V Ismokhina 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 (rheoelectrical) 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.

Some elements of the theory of the search for useful minerals (Elementy teorii poiska poleznykh iskopaemykh) V A Voronin 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 (e.g., 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.
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 and 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.

Author

N76-16227#: Battelle Columbus Labs Ohio
STUDY OF THE ENERGY AND FUEL-USE PATTERNS IN THE NONFERROUS METALS INDUSTRIES
(Contract DO-14-01-0001-1658) (PB-245194/5 FEA/Et-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 is 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 industries which may be critical to the needs of Project Independence.

Author

N76-16240#: British Steel Corp Sheffield (England) Information Services
THE DEVELOPMENT AND TESTING OF A NOVEL HIGH TEMPERATURE CERAMIC RECUPERATOR
(PB-245089/1 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 1300°C 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.

Author

N76-16243#: Dynatech R/D Co Cambridge Mass
R G Kipset S E Sadek L C Anderson and D L Wise 31 Jan 1975 167 p
(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 M I T; (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.

Author

N76-16244#: Exxon Research and Engineering Co Linden N J 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
(Contract DAAD05-73-C-0559) (AD-A014847) 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

N76-16508 Pennsylvania State Univ University Park
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 oils.

**SULFUR CONTENT OF CRUDE OILS**

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 live goals of the project are to restore public lands which have been surface mined, to demonstrate that surface-mined land can be restored in ways that preserve or enhance the environment, to provide immediate employment, to improve secondary employment opportunities, and to enhance the long-term economic prospects of reclaimed areas through construction of such land-utilization features as public forests, grazing lands, swamps, parks, recreation, and tourism opportunities. This may make possible improvements in national coal production.

**PROJECT PROPOSAL FOR SURFACE-MINED LAND ENHANCEMENT (SMILE)**

**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 236 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 of 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.

**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 U.S. 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 U.S. and foreign crude oil production during 1971 by sulfur content. The objective was to classify the 1971 crude oil production from U.S. and foreign fields, where crude oil analyses were available according to sulfur content.

**N76-16612**

National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala

**THERMOELECTRIC POWER SYSTEM**


**THESUS**

Turan Gonen 1975 336 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 and cooling was examined. A computerized electric energy model was developed for the electric power industry to simulate the many complex factors that influence the optimal allocation of various fuel-mixes over a period of several years where the subject systems are placed. 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.

**N76-16617**

Kansas Univ, Lawrence

**WIND/SOLAR ENERGY INVESTIGATION, A FEASIBILITY STUDY**

Ph D Thesis 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 and cooling was examined. A computerized electric energy model was developed for the electric power industry to simulate the many complex factors that influence the optimal allocation of various fuel-mixes over a period of several years where the subject systems are placed. 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.

**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

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 a 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.
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.

N76-16621# National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex
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)
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 are the International Energy Agency, and its viability and related legislation are considered.

N76-16626# Committee on Interstate and Foreign Commerce (U.S. House)
Statistics concerning energy production and consumption are presented. Data are included for energy sources, electric utilities, nuclear power, and basic resources for the U.S. and the world.

N76-16627# Joint Committee on Atomic Energy (U.S. Congress)
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 and capital equipment are discussed and compared to budgets of previous years.

N76-16628# Committee on Government Operations (U.S. House)
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.

N76-16630# Portland Cement Association, Skokie III
ENERGY CONSERVATION POTENTIAL IN THE CEMENT INDUSTRY Jun 1975 344 p refs (Contract Dl-14-01-0001-185B) (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 and development and demonstration support. It discusses basic materials processes used in manufacturing new technology available and the controlling economics.

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 and plus load profile calculation and system simulation is given.

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/D 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.

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.

N76-16634# Ohio State Univ Columbus Engineering Experiment Station
HEAT TRANSFER MODELS AND ENERGY NEEDS FOR RESIDENTIAL HOMES C. F. Sepsy, R. S. Blencett, 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


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.

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-670) (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.

N76-16641 Colorado Univ Boulder DEMAND AND ANALYSIS SOLAR HEATING AND COOLING OF BUILDINGS PHASE I REPORT SOLAR WATER HEATING IN SOUTH FLORIDA 1923 - 1974 Jerome E Scott Ronald W Melcher and Donald M Sciglimpagha 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. The 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.

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.

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-245064/7 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.

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.

N76-16648 Mitre Corp McLean Va STRATEGIC IMPLICATIONS OF SOLAR ENERGY FOR EMPLOYMENT OF SHEET METAL WORKERS H W Block G R Murray J D McConnell and J C Snipes Jun 1975 116 p Sponsored by Sheet Metal Workers International Assoc Washington D C (PB-245670/5) Avail NTIS HC $5.50 CSCL 13A

The present situation and the future outlook for 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.


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.

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 effects 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 SCVs. The 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
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 review 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
Washington 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
(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 Cong 1st Sess No 29 10 and 12 Jun 1975
(GLS-62-322) 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.

J M S

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. DelVitte
Aug 1975 111 p
refs
(AF Prog 2102)

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.

Author

N76-17650* Army Construction Engineering Research Lab Champaign III
TECHNICAL EVALUATION STUDY ENERGY-RECOVERY SOLID WASTE INCINERATION TO NAVAL STATION, MYAPORT, FLORIDA
S. A. Hathaway and H. G. Rigo
Feb 1975 60 p
refs

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.

Author

N76-17652* Army Construction Engineering Research Lab Champaign III
TECHNICAL EVALUATION STUDY SOLID WASTE HEAT RECLAMATION AT NAVAL AIR TEST CENTER PATUXENT, MARYLAND
H. G. Rigo and G. E. Ondrayer
Nov 1974 46 p
refs

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 the current method of solid waste disposal 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.

Author
Techniques for conserving energy in urban passenger transport are described. A systems approach for evaluating these simultaneously in order to formulate area-wide 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.

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

The costs and benefits of energy conservation and environmental regulations are discussed in terms of strengthening or relaxing the present standards. Factors considered include inflationary and recessionary effects impact of environmental regulations on domestic energy resources, 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

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 the high cruise efficiency provides savings in trip 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 some forces are analyzed of change in the way the industry works, and desirable or undesirable that are likely to affect the way the industry does business, its efficiency or ineffectiveness 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. This 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, and parts manufacturing industries.

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

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

Author

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-DR-14833B 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, cryogenic cooling, 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, cryogenic cooling, electrical and electronic equipment cooling.

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-DR-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 of solar collectors, cooling engines, electrohydrodynamic phenomena and vapor laser oxens.

Author

N76-18460# National Aeronautics and Space Administration Pasadena Office Calif
HYDROGEN-RICH GAS GENERATOR Patent Application

A process and apparatus are described for producing hydrogen-rich gas from liquid hydrocarbon and air. The proposed gas generator is portable and produces a hydrogen-rich gas. The process includes 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

Author
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 reductions 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. 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


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**


The impact of 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**


For abstract see N76-18644.


**SOVIET PAPERS PRESENTED AT THE 1975 EINDHOVEN MEETING OF THERMIOMIC CONVERSION SPECIALISTS**


**THERMOEMISSION ENERGY CONVERTER WITH IMPULSE IONIZATION**


Several problems of operating the thermoelectric 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**


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. Author

**N76-18655** Jet Propulsion Lab, Calif. Inst. of Tech., Pasadena

**FUTURE HYDROGEN USE**


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 systems. Needs for hydrogen are reviewed. Author

**N76-18656** Jet Propulsion Lab, Calif. Inst. of Tech., Pasadena

**SUPPLY OPTIONS**


C.SCL 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. Author

**N76-18657** Jet Propulsion Lab, Calif. Inst. of Tech., Pasadena

**TECHNOLOGY ISSUES**


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**


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
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.

HYDROGEN PRODUCTION

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.

FACTORS AFFECTING THE BROADENED USE OF HYDROGEN
C England J E Chinvella T Fujita R E Jeffe D Lawson and R Manvi 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.

EUROPEAN ACTIVITIES IN THE HYDROGEN ENERGY FIELD
J E Chinvella 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.

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.

THERMOCHEMICAL CYCLES
J E Funk (Kentucky Univ Lexington) M A Soliman (Kentucky Univ Lexington) R H Caputo (Kentucky Univ Lexington) R Manvi, R Caputo and T Fujita 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.

PRODUCTION COST METHODS AND DATA
R E Jeffe and T Fujita In its Hydrogen Tomorrow Dec 1975 10 p refs 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 discussed. Cost data are given for various methods of hydrogen production. The cost matrix procedure is briefly discussed.

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.

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), and James H Swisher (ERDA Livermore Calif). In JPL Hydrogen Tomorrow Dec 1975 10 p

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.

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)

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.

EVALUATION OF CONVENTIONAL POWER SYSTEMS
Kirk R Smith John Weyant and John P Holdren Jul 1975 184 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.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Lewis Research Center Cleveland Ohio

76
PRELIMINARY ASSESSMENT OF SYSTEMS FOR DERIVING LIQUID AND GASEOUS FUELS FROM WASTE OR GROWN ORGANICS

Robert W Graham Thane W Reynolds and Yih-Yun Hsu
Washington Feb 1976 42 p refs (NASA-TN-D 8185 E-8463) Avail NTIS HC $4.00 CSCL 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

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 the extent of 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

The mount is characterized by a rigidly supported collector dish and oppositely extended and portions normally related to the midportion of the axe and received in spaced journals. The longitudinal axis of symmetry for the midportion of the axe is coincident with a seasonal axis while the axes of the journals are coincident with a diurnal axis parallel to the earth's polar axis. 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 axe 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

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 photooxidation reactor in the presence of an insoluble photooxidation 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 generated 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 photooxidation catalyst is a bifunctional reagent catalyst including a transition metal salt such as manganese oxidize 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

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

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 and integrated utility systems for communities. Efficiency of energy use in industry, energy conservation and the environment, and electric power system measurements are discussed.

D M L

N76-18683# Committee on Commerce (U S Senate) ENERGY LABELING AND DISCLOSURE

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 and integrated utility systems for communities. Efficiency of energy use in industry, energy conservation and the environment, and electric power system measurements are discussed.

J M S

Aug 1975 40 p (PB-245216/7 FEA/G-75/487) Avail NTIS HC $4.00 CSCL 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 generation units including megawatt capacities and both primary and alternative fuel types.

GRA
THE FUTURE ENVIRONMENT US AND WORLD TRENDS

That it can be completed within six months and that several terms say 30 years. Preliminary work on the pilot model indicates what the country can achieve in physical terms over the long interactions within and across the sectors of the economy. The general objective of the model is to determine, in the face of the changing energy picture, including a detailed energy sector. The model, the proceedings and details are described in the work.

N76-19001# Committee on Interior and Insular Affairs (U S Senate)
OUTER CONTINENTAL SHELF MANAGEMENT ACT OF 1975

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

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
DESIGN OF A FORCE-FREE INDUCTIVE STORAGE COIL
O K Mawardi Apr 1975 11 p refs (Contract W-7405-eng-36) (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 detailed 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.

N76-19546# Midwest Research Inst. Kansas City Mo
BASE LINE FORECASTS OR RESOURCE RECOVERY, 1972 TO 1990 Final Report

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 1980, 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).

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 computer simulation 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 phase volumetric concentrations and two-phase pressure gradient are included in the design technique.

N76-19562# Joint Economic Committee (U.S. Congress)
POTENTIAL HEATING OIL SHORTAGES

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.

N76-19565# Oak Ridge National Lab. Tenn
ASSESSMENT OF INDUSTRIAL ENERGY OPTIONS BASED ON COAL AND NUCLEAR SYSTEMS

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 fossil 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-MWt) 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.

N76-19566# Federal Energy Administration Washington D.C.

Energy use by the federal government during the third quarter of the Fiscal Year 1975 (Jan-Mar) for 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 the energy used 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.

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/A/N-75-080C Vol-3 SAN-1089-T1-P3) Avail NTIS HC $7.50 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 evaluated 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.

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/A/N-75-080D Vol-4 SAN-1089-T1-P4) Avail NTIS HC $4.50 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 biocide 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.
solely by analyses required for the successful design and construction of ocean thermal energy conversion plants

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 CSCL 05A

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 implications. Withheld from gasoline marketing by major firms in the Pacific Northwest occurring in late 1973 control of interstate 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 the Alaska pipeline.

N76-19572# Wisconsin Dept of Transportation Madison
PROCEEDINGS THE ROLE OF THE US RAILROADS IN MEETING THE NATION'S ENERGY REQUIREMENTS
(Contract DOT-FR-4 3015)
(PB-245565/7) Avail NTIS HC $5 00 CSCL 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.

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 Phillips 10 Jul 1975 244 p refs.
(Grants NSF GI-44210 NSF/ISR-75-22988-000)
(PB-246141/6 NSF/RA/N-75-078) Avail NTIS HC $8 00 CSCL 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 on zoning ordinances and building codes and social acceptance research on the acceptability of solar heating.

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 SO144093)
(PB-245759/6 BM-OFR-B0-75) Avail NTIS HC $7 50 CSCL 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.

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 FE/A-D/75 590) Avail NTIS HC $5 50 CSCL 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.

N76-19578# Federal Power Commission Fort Worth Tex
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
Sep 1975 46 p refs
(PB-245570/7) Avail NTIS HC $4 00 CSCL 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.

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-44220)
(PB-245392/6 NSF/RA/N 75 0761 Avail NTIS HC $4 00 CSCL 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.

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 5 c 1143)
(PB-245609/3) Avail NTIS HC $6 00 CSCL 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

80
N76-19583j 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
(IP-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

N76-19589j 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 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

N76-19592j Texas Governors 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-24351/4 NSF/RJ-73-245) Avail NTIS HC $5.75 CSCL 10A
The technology is assessed of solid waste conversion for application to the needs of Texas. The production rate of solid wastes in the municipal agricultural and industrial sectors of the state is summarized. 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

N76-19616j 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

N76-19617j Systems Technology Corp., Dayton, Ohio
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: hydrosposal fiber recovery and glass and aluminum recovery. This report presents the data for the hydrosposal and fiber recovery systems only GRA

N76-20027j Committee on Science and Technology (U S House)
ERDA AUTHORIZATION, PART 5, 1976 AND TRANSITION PERIOD
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 F O S

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

N76-20030j Committee on Science and Technology (U S House)
ERDA AUTHORIZATION, 1976 AND TRANSITION PERIOD OVERVIEW
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 programs Y J A

N76-20371j Battelle Columbus Labs. Ohio
ENERGY USE PATTERNS IN MACHINERY AND NOMETALLURGICAL AND NONMETALLURGICAL MINERAL PROCESSING PHASE 5 ENERGY DATA END FLOWSHEETS, INTERMEDIATE 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 comminable raw materials transportation and
fuels and electrical energy

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-146820) Avail NTIS for foreign requesters only
Domestic orders Univ of New Mexico Tech Application Center
Albuquerque HC available by subscription only $48.00 CSCL
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 CSCL
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

N76-20407# Los Alamos Scientific Lab N Mex
LASER SYSTEMS FOR HIGH PEAK-POWER APPLICA-
TIONS C Fenstermacher 1975 9 p refs Presented at the Seminar
on Opt Methods in Energy Conversion Rochester NY 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 require-
ments 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 NASA

N76-20505# Transportation Systems Center Cambridge Mass
AUTOMOTIVE ENERGY EFFICIENCY PROGRAM
Harvey 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
CSCL 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 govern-
ment industry and university investigators Papers and illustrat-
jed lectures presented at the conference are included

N76-20550* Raymond Technical Facilities Inc New York
CONCEPT ANALYSIS, OFFSHORE BREAKWATER-OIL
STORAGE SYSTEM Joseph Perano and Tomasz Plodowski Apr 1975 67 p refs
(Contract DACW72-73-C-0005) (AD-A01348 CERC-MP-4-75) Avail NTIS CSCL 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-
oll 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

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-243535/4 FEA/G-75/518) Avail NTIS HC $4.50 CSCL
81B

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

N76-20625* New Mexico Univ Albuquerque Technology
Application Center
HYDROGEN ENERGY A BIBLIOGRAPHY WITH AB-
STRACTS ANNUAL SUPPLEMENT, 1974
Mar 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 CSCL 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

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 CSCL
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 transmission
distribution and storage and safety

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 HC $50.00 CSCL
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 CSCL 108
For abstract see N76-20626

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

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 CSCL 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 costs 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

N76-20632# A Research 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 CSCL 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 dessicant type air conditioner offers many significant advantages As a result limited efforts were expended toward the optimization of such a system

N76-20634# National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Md
MECHANICAL CAPACITOR James A. Kirk, Philip A Studer and Harold E. Washington Mar 1976 61 p refs (NASA-TN-D-8185 G-7639) Avail NTIS HC $4.50 CSCL 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 As a result long life and near zero rundown losses are projected A 7-kWh 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

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

N76-20636# Committee on Commerce (U S Senate)
INDUSTRY EFFORTS IN ENERGY CONSERVATION Washington GPO 1974 280 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

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

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 A part by Calif State Assembly and Rockefeller Foundation (B-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 and uses of energy in California are discussed. Several energy state policy response which is harmonious with national interests. 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 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 Nakung. Dec 1975. 48 p. (R-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 AIR DETERIORATION VOLUME 1 EXECUTIVE SUMMARY


This report evaluates the impact of proposed Senate House 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. 

Author

N76-20641# Solarcorp Rockville Md

DEVELOPMENT OF A HIGH EFFICIENCY THIN SILICON SOLAR CELL Quarterly Report


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 (graph is 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-transmitance 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 13 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

ENERGY BALANCE FOR THE WASHINGTON METROPOLITAN AREA FOR 1973 Final Report


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 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 the 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. 

Author

N76-20645# California State Div of Oil and Gas, Sacramento

PROCEEDINGS OF THE WORKSHOP ON ENVIRONMENTAL ASPECTS OF GEOTHERMAL RESOURCES DEVELOPMENT


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, Environmental Impact Evaluation and Land Use, Socio-Economic Impact. A chairman's summary problems and recommended approaches to solution are presented in each area. 

Author

N76-20646# Dow Chemical Co, Midland, Mich

EVALUATION OF NEW ENERGY SOURCES FOR PROCESS HEAT Final Report


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 quantities 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. 


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 2,044 bills totaling 84

Author
1107 pages and are a compilation of legislative achievement vetoed and unsigned bills. Legislation is organized by category.

### N76-20650# National Conference of State Legislatures, Washington, D.C.
**ENERGY: THE STATES’ RESPONSE TO ENERGY LEGISLATION JANUARY - JULY, VOLUME 2**
R. G. Jones and Joette Pelster

(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 incentives resource development/mineral extraction management emergency powers/responses energy/environment and miscellaneous.

### N76-20651# International Research and Technology Corp, Arlington, Va.
M. O’Farrell and R. W. Roig

(Contract DI-14-01-0001-1866)

(PB-246392/3 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.

### N76-20652# International Research and Technology Corp, Arlington, Va.
M. O’Farrell and R. N. Mudry and R. W. Roig

(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, and industry surveys.

### 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.

### 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.

### N76-20658# Illinois Univ Urbana Dept of Civil Engineering
**BIOLICAL CONVERSION OF ORGANIC REFUSE TO METHANE**

Semianual Progress Report, 1 Jul - 31 Dec 1974

John T Pfeffer and Jon C Lieberman

(Grant NSF GI-39181)

(PB-245795/0 UI/U-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.

### N76-20659# Kentucky Univ Lexington Inst for Mining and Minerals Research
**METHANOL PRODUCTION FROM COAL, SECTION 1**

David A Conner and Gene Plock

(Contract NSF C-958)

(PB-246201/8 IMMR-1-PD-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 top 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.

N76-20660 Parsons Brinckerhoff Quade and Douglas New York

ASSURED ENERGY RECEP TIVITY STUDY Final Report 6 Jun 1975 61 p Sponsored by Transit Develop Corp (PB-246244/4 TDC-AER-75-1) Avail NTIS HC $4 50 CSCL 108

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 re-distributed. 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.

N76-20661 General Electric Co Ene Pa

ASSURED ENERGY RECEP TIVITY 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 108

Two methods for enhancing the receptivity of a transit system third rail power supply are examined for trains exploying 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 notchting 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.

N76-20662 Transit Development Corp Washington D C

ASSURED ENERGY RECEP TIVITY, 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 108

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 analyses 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.

N76-20663 Stanford Research Inst Menlo Park, Calif


(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 CO2 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.

N76-20665 Exxon Research and Engineering Co Linden, N J

EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES COAL TREATMENT SECTION MEYERS PROCESS Final Report E M Magge Sep 1975 46 p refs (Contract EPA-68-02-0629) (PB-246311/5 EPA-650/2-74-009-N) Avail NTIS HC $4 00 CSCL 08I

The report discusses the Myers 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 sulfide. The quantities of solid iron 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.

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 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 Recovering Panel from the Environmental Impact Panel and from the Economics Panel.

N76-20667 Boston Univ Mass Dept of Chemistry


Totally-illuminated multi-thin-layer (TI-TL) iron-thionine (Fe(TH)-) photolytic cells were constructed with SnO2 and mSnO2 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 Sn02/Fe TH- cells were sealed by enclosure and decline in output with time identified as due to leaching of tin from the SnO2 electrode. Reverse-bias experiments indicated that output of the TI-TL Sn02/Fe TH- cell is not limited by electrode...
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 FE/A/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.

A BRIEF ANALYSIS OF THE IMPACT OF ENVIRONMENTAL ISSUES ON THE NATURAL GAS INDUSTRY

5 Feb 1975. 14 p. refs (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 the 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.

A COMPARISON OF TWO NATURAL GAS FORECASTING MODELS: TERA AND MACAVOY-PINDYCK

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A BRIEF ANALYSIS OF THE IMPACT OF ENVIRONMENTAL ISSUES ON THE NATURAL GAS INDUSTRY

5 Feb 1975. 14 p. refs (PB-246209/1. FEA-EATR-75-3. FEA/B-75/645) Avail NTIS HC $3.50 CSCL 21D

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CONSERVATION IN INDUSTRY Final Report, Apr - Jun 1975
John T Reding and Burchard P Shepherd Sep 1975 44 p refs
(Contract EPA-68-02-1235)
(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.

N76-20689f 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.

N76-20690f 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
(IPB-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 Administrator'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.

N76-20691f Southern California Gas Co Los Angeles
SAGE SOLAR ASSISTED GAS ENERGY
1975 16 p Sponsored by NSF Prepaerd in cooperation with
Calif Inst of Tech Pasadena
(IPB-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.

N76-20692f 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 around a set of 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.

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 Wilsee Jr and Ralph B DAgostino Jul 1975 212 p refs Available NTIS HC $50 00 CSCL 10A

The effects of the energy conservation tax program on baseline fuel prices and 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.

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 AFPR 9789) Available 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.

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 75/847) Available NTIS HC $5 00 CSCL 10A

The effects of the energy conservation tax program on baseline fuel prices and 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.

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 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.

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

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 2, 0 2 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.

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-1466401) Available NTIS for foreign requestors 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.
WATER dissociation energies to reduce the photon energy required to catalytically reduced when these molecules are in intimate contact when using photodissociation for the generation of hydrogen is discussed. The problems limiting the efficiency of photodissociation include laser induced chemistry developments in photovoltaics including modification of the Schottky barrier devices and generation of high voltage emf by 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
CSCL 20E
Ultraviolet irradiation of the n-type semiconductor TiO2 crystal electrode of an aqueous electrochemical cell evolves O2 at the TiO2 electrode and H2 at the Pt electrode. The gases are typically evolved in a 2:1 (H2:O2) 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 TiO2. The wavelength response of the TiO2 and the correlation of product yield and current are reported. The results support the claim that TiO2 is a true photoassistance agent for the electrolysis of water. Minimum optical efficiencies of the order of 1 percent can be achieved by the production of H2.

N76-21508* Princeton Univ N J
PHOTOCATALYTIC GENERATION OF HYDROGEN FROM WATER
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.

N76-21509* Jet Propulsion Lab Calif Inst of Tech Pasadena
PHOTOVOLTAIC CONVERSION OF LASER ENERGY
(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 AMO5 solar cell are briefly considered.

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 propulsion 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 CO2 laser technology and compatibility with photovoltaic power conversion devices.

N76-21519* Rasor Associates Inc Sunnyvale Calif
THERMO ELECTRONIC LASER ENERGY CONVERSION
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.

N76-21524* Stanford Univ Calif Applied Physics Dept
INITIAL EXPERIMENTS WITH A LASER DRIVEN STIRLING ENGINE
CSCL 20E
Operation of a Beale free piston Stirling engine with a 40-W CO2 laser is described. Advantages of such a system include closed-cycle operation long life inexpensive construction and size scalability to 100 MW.

N76-21687# 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 081
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 I of this final report provides final reserve and productive capacity estimates. Volume II provides summaries of engineering analyses of major domestic oil and gas fields.

N76-21870# Illinois Univ Champaign Center for Advanced Computation

RESERVE AND RESOURCE ESTIMATION. APPENDIX D
Final Report
Michael Reber Shao Lee Soo and James Stukel May 1975
72 p refs
(Grant NSF GI-35821)
(PB-248063/0 CAC-163-App-D NSF/RA/N-75-037D) Avail
N75 HS $4.50 CSCL 086
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

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

N76-21679*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
CLOSED CYCLE MHD POWER GENERATION EXPERIMENTAL UTILIZATION WITH A HELIUM-CESIUM WORKING FLUID IN THE NASA LEWIS FACILITY
(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 1 100 V/m were obtained in the tests with 17 electrodes

N76-21680*# Committee on Aeronautical and Space Sciences (U S Senate)
SOLAR POWER FROM SATELLITES
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 these satellites are also discussed

N76-21683*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
LARGE EXPERIMENTAL WIND TURBINES WHERE WE ARE NOW
(NASA-TM-X-71890 E-8674) Avail NTIS HC $4.00 CSCL 10B
Several large wind turbine projects have been initiated by NASA-Lews as part of the ERDA wind energy program The projects consist of progressively larger 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

N76-21684# Committee on Science and Technology (U S House)
ENERGY FACTS. 2
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

N76-21685# 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
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.

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 lifestyle changes that are difficult to accomplish. Furthermore, many of the conservation actions cited as instant solutions to the energy crisis are those which would either require 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.

**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 (e.g., 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.

**Energy Conservation in the Energy Industry**

In its ECASTAR Energy Conserv Sep 1975 11 p

CSCL 108

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 include 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.

**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 would be needed to produce these additional requirements. Also, the indirect requirements would create more jobs.

**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) and 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.
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 and 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.

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 drives a synchronous alternator that generates its maximum output of 100 kW of electrical power in a 25 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.
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.

N76-21720# Mitr Corp McLean Va

ENERGY RESOURCES FOR THE YEAR 2000 AND BEYOND, WITH SCENARIOS FOR THE YEAR 2000 AND THE YEAR 2100


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.

N76-21721# Air Force Systems Command Wright-Patterson AFB Ohio

NEW DEVELOPMENTS IN THE AREA OF MAGNETOHYDRODYNAMIC CURRENT GENERATORS

P K Fritzer 17 Apr 1975 21 p refers Transl into ENGLISH from Elektrotech Maschinenbau (Berlin) v 91 no 3 Mar 1974 p 127-129 (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-velocity for stabilizing a channel flow and heat transfer Results of the investigation are summarized.

J M S

N76-21724# Minnesota Univ Minneapolis Dept of Management Sciences

REIS PHASE 2 REPORT 1 AN OVERVIEW OF THE REIS SYSTEM Draft Report

Norman L Cherwany J David Naumann and Ronald D Vissness 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 i.e 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.

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 Fred and W C Wolenhauer Nov 1975 50 p refs Sponsored by Elec Power Res Inst (PB-247526-9 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 models are evaluated The Soviet delegation expressed a strong interest in a formal inclusion of EPRI in the U S-U S S R 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 U S S R in September The report describing these meetings and giving the EPRI delegation's
summary evaluation and recommendation is given together with a summary of the meeting jointly drafted by the U S and USSR participants.

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 Locketz Apr 1975 40 p ref (Grant NSF GI-043890)
(PB-247756/O 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 indices 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 Dw
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 081
This report is concerned primarily with forecasting energy requirements for taconite and iron mining in Minnesota until 2000 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 DC 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 impact, socioeconomic impact, environmental impact, 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 DC 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-75-619336) 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 as 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 DC 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-NS-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 and cooling and supplying domestic hot water could be obtained from the sun. This report deals with the design and construction of the retrofit system. It consists of 45 sq m (485 sq ft) of double-glazed flat-plate solar collector. 5.7 cu m (11.500 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 35°F 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 30% 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 150°F. This indicated that the maximum brine temperature should be kept at 150°F 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/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 60°C of dewatering of the fermentor residue by vacuum filtration and of pretreatment of the residue by a hot- caustic process. Treatment requirements for the centrate filtrate produced by dewatering of the residue are presented.   GRA

N76-21734#   ICF Inc Washington DC
SHORT-TERM COAL FORECAST, 1975 - 1980 Final Report
or gasify coal or coke with air and steam. Dissemination of the pilot-scale activities by industry on fast fluidized beds and objectives of this project are a high priority national need. The specific projections of 1975-1980 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 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 are provided for bituminous coal and lignite production, consumption, and end-of-year stocks for 1975 through 1980.

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.

The costs derived from installing, operating, and maintaining the transmission and distribution system have historically comprised about 2/3 of the total costs of producing and delivering 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.

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.

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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.

The purpose of the statement is to describe and analyze the environmental and energy impacts that would result from 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.
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