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The Solar Ocean Energy Liaison

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OTEC OUTRANKS NUCLEAR, OIL, COAL, AND NATURAL GAS
IN NEW NET ENERGY ANALYSIS

Economically. Both short and long range, with payoff from 4.7 to 6.2 years. When producing electrical power, an associated amount of energy is expended. The cost of finding, extracting, processing, transporting, and delivering energy too often goes unconsidered.

YOU'RE SAYING SOLAR OCEAN ENERGY/OTEC IS MOST ECONOMIC?

No. Hydroelectric and geothermal rank higher. All of these energy forms are inexpensive to deliver, simply because the total process is less costly than nuclear, oil, coal, and so on.

A realistic evaluation and comparison of energy sources must include all auxiliary costs to arrive at an overall net energy analysis. These recent studies provide sobering reality in a muddled energy picture.

This analysis is detailed in the January 1980 issue of Mechanical Engineering, published by ASME, portions of which are reproduced below with the permission of the publisher. The article, “OTEC—A Comprehensive Energy Analysis”, is co-authored by T. C. G. Carlson and W. P. Goss, both of the University of Massachusetts in Amherst. It is thorough.

Net Energy Analysis (NER) is the only way energy should be considered, since it encompasses the total costs of bringing energy to the user, including all ancillary costs. These would include, for example, the costs of locating and determining the magnitude and quality of a natural resource, its extraction from its natural domain, its transportation both before and after processing, and the costs of financing and maintenance of the machinery and other equipment needed for these operations. These factors are outlined in Table 1 in this issue.

Any other means of comparing current energy sources with their alternatives is folly.

Standing in the way of this objectivity are two principal factors: (1) resistance to change, an unfortunate human trait based primarily on fear of the unknown and lack of imagination, and (2) maintenance of the status quo due to vested interests involving chiefly political power and money.

As difficult as these factors may be to overcome, this new study provides a major tool for overcoming them. [Editor’s note: H. T. Odum pioneered NER. For reference see the proceedings of the National Science Foundation/Stanford Workshop on Net Energy Analysis, held at Stanford University in August 1975.]

OTEC Power in New England

The study goes a step farther than the earlier method developed by the Oregon Report (see Table 1) and Lockheed, which carried out a net energy analysis of a single 160 MW OTEC plant, while the Carlson/Goss report looks at multiple plants. Further, the new study investigates the capability of a system of OTEC plants to deliver electrical power on demand for New England through a hydrogen link, with hydrogen being produced on board OTEC plants. The hydrogen would power fuel cells through an already-existing piping system in New England.

While generally focusing on usage in New England, the study applies unbiased and thorough analysis of all energy systems, with references amply provided for further examination.

Carlson and Goss’s article shows that both a single-baseload OTEC power plant and OTEC hydrogen-storage systems are strong net energy producers compared to other electrical—energy conversion systems. Only hydropower and geothermal energy rank higher based on their net energy ratios—due, of course, to the ease of power generation from these sources of minimal geographic distribution.

The dynamic energy analysis of the OTEC system indicates energy payoff times from 4.7 to 6.2 years, and on-line (fully operational) times of 17 to 35 years, depending on assumed building schedules.

Objective, realistic analyses such as the Carlson/Goss study clearly indicate the attractiveness of OTEC power. However, (continued on Page 3)
JUNE OCEAN ENERGY CONFERENCE EXPECTS LARGE ATTENDANCE

Cousteau To Be Keynote Speaker

Early indications are that the 7th Ocean Energy Conference, which will be held at the Shoreham Hotel in Washington DC, June 2nd through 5th, may reach a thousand attendees. The Conference is sponsored by the Ocean Systems Branch of the US Department of Energy and twenty other organizations. Gibbs and Cox Incorporated is organizing the meeting.

Captain Jacques-Yves Cousteau has accepted an invitation to appear as keynote speaker. Cousteau himself and the Cousteau Society have repeatedly advocated the rapid implementation of ocean-energy and OTEC technology (see the December 1979 issue of OE), often chiding the Carter Administration and DOE for moving too slowly in that pursuit.

The success of last year’s 6th Ocean Thermal Energy Conversion Conference demonstrated that both the need for ocean energy systems and the technology necessary to proceed exist. This year’s Conference, with the theme “Ocean Energy—A Time For Action”, will address a wider spectrum of ocean-energy technology, including OTEC, waves, currents, and salinity gradients. The Conference goal is to summarize the current national and international status of ocean-energy technology development and reach a definitive position on proceeding from small-scale experiments to commercialization as quickly as possible with risk acceptable to both the Government and private industry.

The technical program will include 70 papers, a workshop summarizing the Conference, and a half-day executive seminar reviewing the entire ocean-energy question. An expanded exhibits program of ocean-energy products and services will also be presented. Those readers interested in a detailed program, registration, or exhibit information may write to the 7th Ocean Energy Conference, Gibbs and Cox Incorporated, 2341 Jefferson Davis Highway, Suite 1020, Century Building, Arlington, Virginia 22202.

COMMERCE DEPARTMENT RELEASES STUDY OF US OCEAN MANAGEMENT

Both Congress and the Executive Branch should develop and implement a national ocean philosophy, including broad general operating principles, according to a study released in mid-March by the US Department of Commerce.

The study, entitled Ocean Management: Seeking a New Perspective, was commissioned by the Assistant Secretary for Policy in 1978 and performed by the Traverse Group of Ann Arbor, Michigan. Copies are available from the Superintendent of Documents, US Government Printing Office, Washington DC 20402. Order by title and specify Stock Number 003-000-0055-7.

RECENT PUBLICATIONS AVAILABLE

- Renewable Energy Sources for the World’s Poor: A Review of Current International Development Assistance Programs, by John Ashworth of the Solar Energy Research Institute’s Policy Analysis Branch, Golden, Colorado, provides information on more than 30 Third World renewable energy projects that are large, innovative, or indicative of future large-scale assistance programs. Copies are available as SERI/TR-51-195 for $6 paper copy or $3 microfiche from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.
- Concurrent Studies of Enhanced Heat Transfer and Materials for Ocean Thermal Heat Exchangers, Semi-Annual Progress Report, March 1st Through August 31st, 1978, by Carnegie-Mellon University, Pittsburgh, Pennsylvania (93 pages), is available as C00-2641-7 for $6 paper copy or $3 microfiche from NTIS (see address above).
- Comparative Study of Working Fluids for OTEC Power Plants, by E.N. Ganic and J. Wu of the University of Illinois at Chicago Circle, Chicago, Illinois (48 pages), is available as ANL/OTEC-TM-1 for $4.50 paper copy or $3 microfiche from NTIS (see address above).
- OTEC Thermal Resource Report for the Ivory Coast, by W. A. Wolff of Ocean Data Systems Incorporated, Monterey, California (36 pages), is available as HCP/T2898-01/1 for $4.50 paper copy or $3 microfiche from NTIS (see address above).

AOO TO HONOR BREAUX

The American Oceanic Organization (AOO) will honor Congressman John Breaux of Louisiana on April 24th. Long an advocate of oceanic affairs, Breaux will be the guest of honor at the AOO’s Eleventh Annual Neptune Awards Dinner in the Capitol Ballroom at Bolling Air Force Base, Washington DC.

RESEARCH SHIP TO VISIT CHINA

NOAA’s 303-foot ship Oceanographer left in late March for a 20,000-mile research odyssey that will include a historic visit to China—making it the first US Government ship to visit China for research purposes in over 30 years. The Chinese phase of the trip will aid Chinese efforts to assess human impacts on their marine environment.

SCHLESINGER JOINS LEHMAN BROS.

Former Energy Secretary James Schlesinger has joined the Wall Street firm of Lehman Bros., Kuhn, Loeb, Inc. as a consultant. The firm has been a subcontractor to Fairchild in the past on projects involving OTEC. Schlesinger continues as a senior fellow at the Center for Strategic International Studies at Georgetown University, Washington DC.
Figure 1 shows the interaction of various energy losses or energy costs as related to the energy resource itself. The net energy flow, $N_{E}$, in this figure is the energy flow, $D$, minus the feedback or internal subsidies flow, $I_{S}$, needed to extract and upgrade the resource energy flow, $E$. When producing energy forms, such as electrical power, there is an associated amount of energy that is expended in its production. If energy delivered to the consumer is considered to be a form of goods and services, it will also have an amount of energy expenditure associated with it.

An energy conversion system is defined as a flow of a basic energy resource through various stages until its end use by man. A most important portion of this analysis is to define the various stages through which an energy resource must flow, but it is more important to account for the energy input into each of these stages necessary to deliver the resource. Each of the stages have direct energy deliveries to them, such as domestic oil, natural gas, and delivered electricity generated from coal, nuclear fission, and other resources. In addition, there is also indirect energy needed to produce various goods and services for the construction and maintenance of the system. There are seven general stages to be considered in an energy conversion system, as outlined in the Oregon Report (Energy Study, Interim Report 26 July 1-974, Oregon Office of Energy Research and Planning, Salem, Oregon, July 1974). These are shown in Table 1.

It should be noted that in any energy analysis being performed on a particular energy-conversion system, all of the stages may not be present, or some may be combined.

**Energy Analysis**

(continued from Page 1)

due primarily to political constraints and the large economic commitment to nuclear power, a great deal of education and aggressiveness by the OTEC community remains necessary.

We commend the authors of this study for their highly useful work. Readers interested in the complete report may contact the American Society of Mechanical Engineers at 345 East 47th Street, New York, New York 10017.

### Table 1: Seven Stages of an Energy Conversion System

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td>Basic research and development, sifting and exploration of the resource.</td>
</tr>
<tr>
<td>Extraction</td>
<td>Construction, maintenance, and operation of the equipment necessary to extract the resource.</td>
</tr>
<tr>
<td>Transport I</td>
<td>Transportation energies expended prior to final refinement of the energy resource into a usable product.</td>
</tr>
<tr>
<td>Processing</td>
<td>Construction, materials, and energies necessary to convert raw energy resource to a usable product.</td>
</tr>
<tr>
<td>Transport II</td>
<td>Post-processing transportation of the resource to the distribution or conversion station.</td>
</tr>
<tr>
<td>Conversion</td>
<td>Conversion of thermal, potential, or kinetic energy into an alternate form of energy.</td>
</tr>
<tr>
<td>Distribution</td>
<td>Distribution of the energy form to the consumer after processing or conversion.</td>
</tr>
</tbody>
</table>

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**US Government Procurement Invitations and Contract Awards**

Listed below are contract awards and procurement invitations related to OTEC in particular and ocean resources in general culled from the Commerce Business Daily. This is not to be construed, however, as a complete list.

- **Feb 1:** Engineering Services to Model the Dynamic Behavior of Undersea Cables By Means of a Computer Program That Uses Efficient Finite Difference Methods: Negotiations will be conducted with SRI International, Menlo Park, California. David W. Taylor Naval Ship Research and Development Center, Bethesda, Maryland 20084, Attention Timothy Frazier, Code 5321.1, Telephone (202) 227-1077.

- **Feb 14:** Potential for Ocean Thermal Energy Conversion as a Renewable Energy Source for Developing Nations: RFP 1751-000321 issued for services to perform a research project. The estimated level of effort is two professional man years by personnel having expertise in energy analysis. Due April 15th, 1980. Department of State, Supply and Transportation Division, PO Box 9244, Rosslyn Station, Arlington, Virginia 22209, Attention Mr. Robert J. Day, Jr.

**Feb 15:** Technology Scenario for the Year 2005: The objective of this study is to develop a series of scenarios representing the technologies for the year 2005 so that the Coast Guard can evaluate the potential utility and effectiveness of different technologies in a future environment. The RFP will be issued around February 28th. RFP DTCG23-80-R-20011. Contracting Office (G-FCP-2/TP64), US Coast Guard, Washington DC 20593.

Feb 20: Investigation of Rechargeability and Intrinsic Reactivity of Lithium Electrodes in Electrolytic Solutions: Negotiations are to be conducted with EIC Corporation, 55 Chapel Street, Newton, Massachusetts 02158.

Feb 20: Research for Assessing the Research and Development Status of Selected Projects Within the Navy's Ocean and Atmospheric Sciences Program: Negotiations are to be conducted with Planning Systems Incorporated, Suite 600, 7900 Westpark Drive, McLean, Virginia 22102.

Feb 21: Midwest Grant Program for Small-Scale, Energy-Related Appropriated Technology: Energy-related appropriated technology is small in scale and decentralized, utilizing local materials, labor, and ingenuity. It makes maximum use of renewable resources and does not require a large financial investment. Examples include bio-mass for energy (passive, thermal, photovoltaic), wind energy, energy education, energy conservation, recycling, energy use in appliances, agriculture, buildings, and transportation, and other small-scale locally-useful approaches. In other words, it is technology "appropriate" to local cultural, economic, and social conditions. Projects must be in one or more of the following categories: (a) Idea Development, that is, the development of a new idea or a new application of an old idea. (b) Device Development: Includes any one or combination of the following efforts to evaluate the feasibility and practicality of proposed solutions to specify community-level energy problems: studies, investigation, hardware development, experimental tests, or operational tests. The project must be directed toward the production or improvement of a useful product, but does not include manufacturing and production engineering. (c) Demonstration: the testing of a system or technique under operational conditions to show that commercial application is technically, economically, and environmentally feasible. Those eligible to submit applications are individuals, local non-profit organizations and institutions, state and local agencies, Indian tribes, and small businesses residing or doing business in Illinois, Indiana, Michigan, Minnesota, Ohio, or Wisconsin. Proposed projects must be performed in one of the listed states. Program Announcement DE-PA-02-80-R-510195. Due date April 23rd, 1980.


Feb 21: Environmental Modeling for the Upper Ocean: Negotiations are to be conducted with Science Applications Incorporated, McLean, Virginia 22102.


Feb 25: Feasibility Studies for Alternative Fuels Production: To provide incentive and support for feasibility studies leading to the construction and operation of commercial-scale alternative-fuel production facilities. As stated in the PL 96-126, the Department of Interior and Related Agencies Appropriation for Fiscal Year 1980, $100 million is set aside for these efforts, with individual grant awards not to exceed $4 million in Government support. Organizations that requested to be placed on the Presolicitation Conference mailing list, in response to the CBD announcement of January 11th, 1980, need not submit another request. Firms desiring a copy of Solicitation DE-PA-01-80-RA-50185 must submit a request in writing. The solicitation will be issued on or about February 25th, 1980. Firms are specifically advised that telephone requests for this solicitation will not be honored. US Department of Energy, Office of Procurement Operations, Attention Document Control Specialist, PO Box 2500, Washington DC 20003.

Feb 26: Renewable Energy Technology Project: Assist the Government of Lesotho in the implementation of the Renewable Energy Technology Project, which is designed to meet expanding energy demand, primarily among lower income groups, in ways that minimize national requirements for scarce, expensive, or non-renewable energy. The contractor will disseminate a set of renewable energy technologies in rural pilot areas, establish their feasibility, and provide the basis for their dissemination nationwide. Interested qualified sources should submit written requests for RFP 90653. Telephone requests will not be honored. Issue date will be on or about March 17th, 1980, with the closing date 45 days thereafter. Agency for International Development, Regional Operations Division, Office of Contract Management, Africa Branch, Attention Stephen Dean, Washington DC 20523.


Feb 27: Research on Upper Ocean Forecasting Models: Contract N00014-80-C-0076, January 28th, 1980, for $1,387,000, awarded to Florida State University, Tallahassee, Florida 32306.

Feb 27: Further Oceanic Studies: Contract N00014-79-C-C-0004, January 28th, 1980, for $450,410, awarded to Oregon State University, Corvallis, Oregon 97331.

Feb 28: Research Studies Into the Use of Nitrol Heat Engines (NHE) for Production of Electrical Power: The water and power resources service intends to contract for research studies to determine the technical and economic feasibility of using large-scale NHE's to generate electrical power from the thermoclines of lakes. The study and evaluation will be conducted in phases. At the completion of each phase, data on efficiencies, power output, cost of energy, capital cost, plus operation and maintenance cost will be used to determine justification for proceeding with each succeeding phase which may ultimately result in the fabrication of a prototype unit. A request for proposals will be issued on or about March 20th, 1980. Accompanying this request should be a statement of the firm's background and qualifications. Water and Power Resources Service, Attention Mr. Steve Wilson, Code 810, PO Box 25007, Denver, Colorado 80225.