

UMR-MEC Conference on Energy

26 Apr 1974

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Recommended Citation

Ulrikson, G. U.; Guthrie, M. P.; Caton, G. M.; and McDuffie, H. F., "An Environmental and Energy Information System" (1974). *UMR-MEC Conference on Energy*. 41.

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AN ENVIRONMENTAL AND ENERGY INFORMATION SYSTEM*

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ABSTRACT

The Environmental Information System Office (EISO) at Oak Ridge National Laboratory (ORNL) provides information support for researchers and administrators involved with energy and environmental policy and progress. Multiple EISO activities for various governmental agencies have resulted in establishment of compatible data bases concerned with energy and environmental information, methods for effectively developing these, development and computer display of numerical data summaries, and reports evaluating published information. Direction is provided by continuing dialogue between users and information system staff.

INTRODUCTION

Our nation is striving to minimize environmental insults and potential hazards to human health while at the same time using advanced technologies for energy generation. Funding agencies, program managers, research administrators, and researchers need the best available information to make accurate, comprehensive decisions. Information analysis centers and systems organized to meet the needs of these groups can make valuable contributions to legislative decisions and research program direction.

To be relevant and effective, an information system must be designed for the user and must remain service-oriented throughout its existence. At Oak Ridge National Laboratory we have created an Environmental and Energy Information System which provides the information services listed in Table 1. These types of information have been determined after many man-years of effort. In the following sections we discuss these various services and how we fulfill them.

Table 1. Environmental and Energy Information Services

Bibliographic Information
Directory of Researchers and Institutions
Inventories of Current and Proposed Research
Factual Information Files
Numerical Data Files
Assessment of Information

BIBLIOGRAPHIC INFORMATION

In recent years the emphasis of energy and environmental research has changed from small disciplinary research projects in which researchers were aware of the current state-of-the-art of a given project. Today researchers of many disciplines, including engineering, physical, biological, and social sciences, are concerned with ecological, physical, chemical, and economic information in relation to the applied energy programs being developed.

Many available bibliographic services are oriented toward disciplinary objectives, e.g., *Chemical Abstracts*,¹ *Biological Abstracts*,² *Engineering Abstracts*,³ *Physics Abstracts*,⁴ *Metals Abstracts*,⁵ and *Statistical Abstracts*.⁶ In gathering bibliographic information for a given request or building an interdisciplinary information base such as energy, an information system can begin by using the large computer readable data bases produced by bibliographic services. The repackaging of this information rather than building new data bases is economical and expedient. If a proper search and retrieval

strategy for each request is followed by the information specialist, much valuable information can be obtained.

For collecting the maximum relevant information, we suggest the following plan (see Fig 1). The information specialist converses with the requester to get an understanding of specific needs of the user and then searches the available data bases for a reference list as a subset for that request. The number of references dropped for an interdisciplinary project varies according to the data bases searched and the keywording of those data bases. The list of journals from this bibliographic search provides the information specialist with a list of "core" journals in which authors are publishing relevant material. The most recent of these journals are often manually searched. The authors cited in this search can become an "expert" directory data base. By using *Science Citation Index*,⁷ one can find who cited the paper listed in the original search and how many times, the authors' listing in this index journal provides a comprehensive bibliographic service. With this listing a specific project-oriented bibliographic data base can be constructed with individual subfiles. Documents can be purchased for users, special libraries constructed, bibliographies produced,⁹⁻¹² and specific searches accomplished.

An example of an interdisciplinary service is *NSF-RANN Energy Abstracts*,⁸ a monthly journal which the Environmental Information System Office (EISO) of Oak Ridge National Laboratory (ORNL) began publishing in January 1973. Its primary purpose is to disseminate as rapidly and widely as possible the published results of research on energy. Each citation contains the title, author, corporate author and address, sponsor, publication description and date, abstract, availability, and price. Indexes by author, corporate author, keywords, and permuted words of the title are issued semiannually. Beginning with the January 1974 issue, the citations in each issue are grouped by subject category to facilitate rapid scanning of fields of interest.

The subject coverage of *NSF-RANN Energy Abstracts* includes energy and electric power and development, conservation, supply and demand, economics, and environmental effects, all energy sources, including unconventional sources such as solar, tidal, and waste products; electric power generation and transmission, energy storage; and energy demand and consumption, including all consuming sectors.

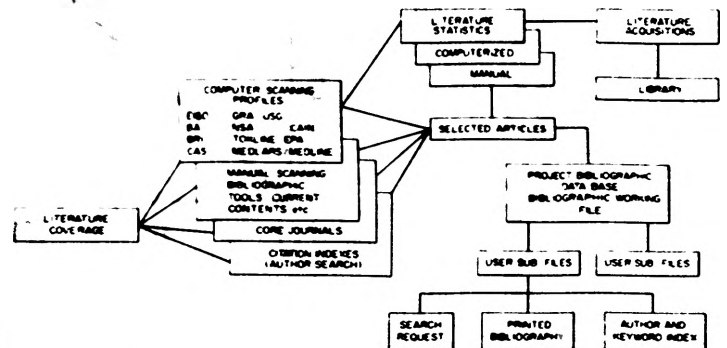


Fig 1 Search and retrieval strategy of bibliographic information.

DIRECTORY OF RESEARCHERS AND INSTITUTIONS

A second important need of researchers is a directory of people and places involved in pertinent areas of research. The EISO computerized directory lists approximately 20,000 persons by name, address, telephone number, and various types of identifying labels and keywords. This directory is used to maintain distribution lists and to locate researchers and administrators. More specialized subsets can be prepared and used to maintain and publish directories for

*Work supported by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

specific programs such as the NSF-RANN Trace Contaminants Directory¹³ Once these data bases are constructed, they can be used for searching geographic locations by zip code or area telephone number and experts by professional or research interest

INVENTORIES OF CURRENT AND PROPOSED RESEARCH

Comprehensive data files listing current research projects in detail can be prepared An example of this is the *Inventory of Current Energy Research and Development*,¹⁴ which is a compilation of 4,907 descriptions of energy-related research and development projects conducted or sponsored in the US since 1971 It is an expanded and updated version of the March 1972 *Inventory of Energy Research*¹⁵

The scope of research projects for the current inventory is broad, including. (1) all types of energy sources - fossil fuels, nuclear, hydroelectric, solar, geothermal, tidal, wind, wood, plant, animal materials, and waste products, (2) electric power - generation, transmission, distribution, and storage, (3) energy uses - residential, commercial, industrial, transportation, agricultural, and specialized applications, and (4) health and ecological effects Subcategories under appropriate headings include exploration, mining, processing, resources and reserves studies, information on any basic or applied research, engineering development, economics, environmental effects, policy, regulatory, and legislative studies relevant to the above subjects

The description of each research project lists, if available, the following information: the title of the project, the research institution and address, the investigator(s), the funding organization, the duration of the project, the amount of funding by years, a brief summary of the research together with a list of pertinent publications, and the state in which the research is performed (Fig 2) Several summary tables of funding and a number of indexes are also provided One table gives the total funds provided by each type of sponsor for each subject category, a second gives for each state the number of projects and the total funding, a third gives the total funds allocated to different types of research facility, the fourth

table gives the total number of projects and total funds for each subject category Five indexes are given on research facility, sponsor, investigator, location of research, and permuted words of the title This information is stored in a computer file which permits easy updating and rearranging of the information Selected subsets of the energy file can be obtained

Another of our computerized and subsequently published files is the *NSF RANN Trace Contaminants Abstracts*,¹⁶ a bimonthly abstract journal in which research results are reported by the grantees in the NSF RANN Trace Contaminants Program The abstracts are accompanied by an informal newsletter containing brief program notes This abstract journal facilitates the exchange of information among the grantees and others interested in this area of environmental concern

Other examples of information bases containing such information include *Office of Coal Research Annual Report 1972*,¹⁷ *CRC Air Pollution Research Advisory Committee Status Report*,¹⁸ *Survey of Research - Projects Reported by Electric Utility Systems in the United States*,¹⁹ and *Abstracts of FY 1973 RANN Awards - Energy Research and Technology*²⁰

FACTUAL INFORMATION FILES

In addition to building comprehensive bibliographic files, it is becoming important for information centers to answer questions For example, factual information about a chemical substance released from energy generating stations and processes is necessary in order to assess the effects of that chemical on the environment Many factual information files exist today, however, many of these have been produced with a single objective There are desk top reference books such as the Chemical Rubber Publishing Company's *Handbook of Chemistry and Physics*²¹ for chemical and physical data and *Biology Data Book*²² for biological data Another published work of this type is the Public Health Service Publication 149, Volumes I - V,²³ on carcinogenicity of chemicals

The necessity for establishing data files, particularly in the area of toxic materials, has been recognized by such groups as the United Nations Advisory Committee on the Application of Science and Technology to Development, the Scientific Committee on Problems of the Environment of the International Council of Scientific Unions, and the United Nations Conference on the Human Environment

The Environmental Information System Office of ORNL is demonstrating the feasibility of factual data systems and is using the efforts of its individual information center units to construct various interlocking data files that show promise of conversion to a large integrated file For example, the Environmental Mutagen Information Center (EMIC) could extract and publish data concerning the potential mutagenicity and teratogenicity of compounds encountered in the mining and refining of fossil fuels

The Biomedical Sciences Section (BMS) of EISO is extracting toxicologically related information for the Toxicology Information Program of National Library of Medicine This information could be used to discern real and potential biologic effects resulting from energy generation

The Toxic Materials Information Center (TMIC) is determining the feasibility of reducing scientific and technical data pertaining to the sources, transport, and fate of trace contaminants in the environment These data would be machine-stored in their reduced form and could be printed out in tabular form

The combination of these specialized files makes a comprehensive data file from which valuable information could be gleaned, such as the impact of energy-related chemicals or substances in the environment In providing information to users, quick and easy access to the computer file and also the versatility of searching on various "fields" or "subject headings" are important

NUMERICAL DATA FILES

The last type of information capability, needed mainly by researchers but also by decision makers is numerical data bases With the growing concern for better land use planning new energy sources, environmental impact of power plant construction, economic growth and development, and man-made changes in our environment, there is a need for detailed numerical data that can be merged with all other types of information for final assessment.

(170)
 SOURCE NUMBER: F0011 P0011
 TITLE

DESCRIPTION: CATEGORICAL & LEGISLATION
 (170)

(170)
 TITLE: Environmental Report for Manufacture of
 High-Purity Gas from Coal
 SOURCE NUMBER: Environmental Coal Co
 DESCRIPTION: The objective of the project is the
 development of a process for producing
 carbonable liquid products from coal; primary
 emphasis is on the utilization of high
 sulfur marine source coals The present
 effort is an extension of development work on
 the Concol Synthetic Fuel Process from earlier
 R&D completed in the period 1963-1970
 Primary emphasis is the present four-stage
 process to be developed in cooperation with the
 process previously demonstrated in a 30 T/20
 pilot plant

PERFORMER: Office of Coal Research, 200 S
 Report No. 10 (Contract No. 01-0001-100)
 Report Number: 10 through 6
 LOCATION: Pennsylvania

(170)
 TITLE: Manufacture of Pipelines Gas via the CO₂
 Synthesis Process
 SOURCE NUMBER: Environmental Coal Co
 DESCRIPTION: The objective of the project is the
 development of a novel process for the
 conversion of pipeline quality gas from
 marine source coals In this process, the
 carbonable liquid of synthesis is captured by
 the carbon dioxide with oxygen as oxidant
 regeneration of the carbon dioxide using
 air is carried out in a separate vessel The
 process is run in a 30 T/20 pilot plant
 stage or liquid CO₂ is used as oxidant
 Gas and CO₂ is used in a laboratory
 scale-up process to be carried out in a
 30 T/20 pilot plant Report No. 10 through 6
 Report Number: 10 through 6
 Report Number: 10 through 6
 Report Number: 10 through 6

(170)
 TITLE: Production of Carbonable Liquid Fuels from
 Coal
 SOURCE NUMBER: Environmental Coal Co
 DESCRIPTION: The objective of the project is the
 development of a process for producing
 carbonable liquid products from coal; primary
 emphasis is on the utilization of high
 sulfur marine source coals The present
 effort is an extension of development work on
 the Concol Synthetic Fuel Process from earlier
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 Primary emphasis is the present four-stage
 process to be developed in cooperation with the
 process previously demonstrated in a 30 T/20
 pilot plant
 PERFORMER: Office of Coal Research, 200 S
 Report No. 10 (Contract No. 01-0001-100)
 Report Number: 10 through 6
 Report Number: 10 through 6
 Report Number: 10 through 6

(170)
 TITLE: Production of Clean High Temperature
 Gas from Coal
 SOURCE NUMBER: Environmental Coal Co
 DESCRIPTION: The objective of the project is the
 development of a process for producing
 carbonable liquid products from coal; primary
 emphasis is on the utilization of high
 sulfur marine source coals The present
 effort is an extension of development work on
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 PERFORMER: Office of Coal Research, 200 S
 Report No. 10 (Contract No. 01-0001-100)
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 R&D completed in the period 1963-1970
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 process previously demonstrated in a 30 T/20
 pilot plant
 PERFORMER: Office of Coal Research, 200 S
 Report No. 10 (Contract No. 01-0001-100)
 Report Number: 10 through 6
 Report Number: 10 through 6

Fig 2 Example of research project information.

Information system scientists can play a major role by knowing where files are located, the content of the data files, the means of accessing the data, and the shortcomings and strong points of the data in relation to the needs of the requester. Information scientists can work closely with the people they serve to minimize the lag between a perceived need for information and the actual delivery of that information.

We commonly use several types of numerical bases in support of impact and assessment studies at ORNL. Examples of these are 1970 U.S. Census Data and Statistical Abstracts produced by U.S. Department of Commerce, Bureau of Census; Current Fisheries Statistics, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, produced in cooperation with the states; Earth Resources Technology Satellite Data, NASA; and water quality and flow data, U.S. Geological Survey.

Information systems can now locate and subset these data for specific problems. ORNL routinely uses the census data for electrical power plant impact analysis. We hope that in the future there may be a common system in which environmental numerical data bases can be accessed according to regions of specific interest.

ASSESSMENT OF INFORMATION

The information gathered in the files just described is often passed on to the requester for evaluation. However, information systems can play a significant role in the evaluation of data and the subsequent preparation of reviews and state-of-the-art documents. Senior information scientists with academic specialties in the area under review can unify the efforts of the more generally oriented information center staff with those of the highly specialized research participants or university professors to produce extremely useful and accurate state-of-the-art documents.

CONCLUSIONS

An example of information system support for researchers and administrators involved with energy and environmental policy and progress, EISO is necessarily service-oriented to user needs. Multiple EISO activities for varied government agencies have resulted in the establishment of compatible data bases concerned with energy and environmental information. The establishment of data bases, methods for effectively developing and exploiting them, development and computer display of numerical data summaries, and reports evaluating published information are actively being pursued. Direction is provided by continuing dialogue between users and information system staff.

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