

material, by and large, is commendable. Chapters 4 and 5, reactivity measurements in thermal and fast systems, respectively, are also excellently written. The coverage of pertinent material is rather complete. Chapter 4 contains 50 pages and 46 references and Chap. 5 contains 47 pages and 50 references.

Despite the negative remarks made earlier, the book is a good addition to one's library in the area of measurement and analysis of reactivity coefficients.

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## Energy Needs and the Environment

<i>Editors</i>	Robert L. Seale and Raymond A. Sierka
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<i>Reviewer</i>	V. Lawrence Parsegian

As far as subject matter is concerned, it would be difficult to pick one that is more appropriate to the times than is suggested by the title of this volume.

The work emerged from a symposium on "Energy, the Environment, and Education" that convened in the Spring of 1971 at the University of Arizona. One cannot help noting how much the energy situation has changed in the intervening period. The substantive materials begin with "Energy Resources for Power Production" in which M. King Hubbert reproduces many graphs and data that were in his 1969 book *Resources*

*and Man*. His emphasis is on fossil fuels, and it is interesting that after casual introduction to "solar power" a footnote adds that there is more interest now in that energy resource.

There follows a good discussion by A. J. Haagen-Smit of the pollutants that endanger the "Air Resources" of California. Victor A. Koelzer and Richard C. Tucker discuss water management problems connected with steam-electric generation, without going much outside the fences surrounding the power plant. F. A. McCrackin of the Southern California Edison Co. discusses the rapid growth of central station energy requirements, with some fear of what's ahead. R. C. Amero delves into "Transportation Energy Requirements" with analysis of fuels and engine types and their trends. An interesting item he includes is the cost (as given by H. R. Lindon) for transporting energy, in cents per million Btu over 100 mile distances: The cost is 0.6 for oil pipeline, 1.5 for gas, and 10.0 for extra-high-voltage electric lines (500 kV). The implications of this for increased use of coal through gasification or fluidization are obvious.

The next three chapters delve briefly into emissions from power plants and their control: A. L. Plumley on fossil fuel emissions, William J. Moroz on waste heat control, and D. G. Daniels and J. R. Eliason on "Thermal Emissions Control." J. G. Terrill, Jr., and W. D. Fletcher present the radiation emissions from present day pressurized water reactors and from the Dresden-I boiling water plant. There is a brief chapter on "Future Reactor Systems" by Harry Lawroski.

Albert W. DeAgazio discusses processing of spent nuclear fuels for recovery of the uranium and plutonium and for control and storage of fission products. His conclusion that "The technology is largely available at the present time to solve the problems that are yet in the future" is not too well based, in the face of questions he himself leaves unanswered. John R. Trotter's estimates of radiation levels that can be expected to accumulate by the year 2000 would be more convincing if I could find what nuclear power levels were in mind in his projections for the future. J. E. Norco discusses the implications and specifications of the Clean Air Act of 1967 and its 1970

Amendments—specifications that many people will want to postpone in favor of getting energy from any source.

T. M. Morong and J. L. Shapiro carefully and with candor describe the Navajo Project for building a huge coal-fired generating station near Page, Arizona. Sponsored by four utilities, the Los Angeles Department of Water and Power, and the U.S. Bureau of Reclamation, the project aims to meet the "challenge of environmental acceptability," even in this region of limited water supply. We can only wish them well and wait to see the results around 1976 when there will be so many other people after the same limited water resources.

There follows a description by Ernest S. Starkman and Roger B. Sperling of how the University of California is supporting the State's air pollution research. The volume ends with a chapter titled "National Goals" by J. Frederick Weinhold of what used to be the Office of Science and Technology. As one might readily guess, there were no clear national goals at the time.

Although the volume contains much useful information of the kind environmentalists should have at their disposal before they posture against new power plants, I am not sure that its reading would (or should) calm their fears. The book lacks clear focus on issues that are substantive to the topic, and lacks even more a philosophic and engineering overview. One can take little comfort from statements such as Lawroski's "The technology for fast breeder reactor systems is essentially at hand . . ." against current realization that we are billions of dollars and two decades away from having such systems available for power use.

Perhaps the inadequacies of the volume had their cause in the organization of the symposium. One gets the idea that each speaker was permitted to say his piece and to leave for home, even when his subject required concerted effort and argument to put into perspective. Since I am about to participate in a symposium that has similar theme and publication plans, the fear is in me that we may do no better.

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