ENERGY POLICY MODELING: UNITED STATES AND CANADIAN EXPERIENCES

Volume I

Specialized Energy Policy Models

Editors

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*These volumes are affectionately dedicated
to our mothers, Ruth Rosner Schwartz
and Mary Moser Ziemba.*

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FOREWORD

Alex Cowie

As the twentieth century draws to a close, one of our greatest problems is the availability of energy. One way to study the energy problem is to resolve it into four areas: energy demand, energy sources, transportation of energy from sources to demand centers, and the optimal allocation of energy forms to demands. Each of these areas is extremely complex by itself. When efforts are made to tie them together, for example, to produce a National Policy, the complexities are compounded.

Another way to study the energy problem, because of its political and social consequences, is to resolve it into geographical areas. Individual provinces of Canada or states of the United States will have their concerns about energy within their geographical boundaries. As producer, consumer, or both, each wants to ensure an energy development program which will work to the maximum benefit of its citizens. Similarly, countries endeavor to protect their citizens and undertake energy policies that will assure either a continuation of the existing quality of life or — particularly in the case of “Third World” countries — a marked improvement in quality of life. These competing and conflicting goals call for a study which encompasses the whole world. Again, complexity is piled upon complexity. If the problem is not yet sufficiently complex, there is an equally complex question of the effect of energy production and use on the ecology.

The only way problems of this complexity can be brought within the capability of the human mind is by modeling. Global models, linear programming models, and econometric models are some of the tools required in any attempt to solve or even gain understanding of the energy problem. Models which capture the complex interactions involved, coupled with the calculating capability of computers, offer the best hope for solutions.

The study of complex problems by modeling describes the work of Operational Research. It was natural, therefore, that the 1978 Canadian Energy Policy Modeling Conference should be held in tandem with the 1978 National Conference of CORS, the Canadian Operational Research Society. Many of the conference speakers, panelists, and session chairman are also members of O.R. Societies. Operational Researchers are among the leaders in energy-related studies. These grounds alone justify CORS endorsing both the conference itself and this publication of its proceedings. However, in a larger sense, CORS is greatly concerned about any problem that faces mankind. We will always endorse undertakings, such as the 1978 Canadian Energy Policy Modeling Conference, which bring together outstanding people to communicate on the "state of the art" in the resolution of important problems and issues. Conferences like these focus public attention on problems and permit cross-pollination of ideas which promotes speedier resolution of problems.

It is a pleasure on behalf of CORS to endorse these two proceedings volumes and commend them to all who are concerned about the problem of energy availability.

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PREFACE

During the period following World War II the major industrialized nations built economies that utilized and were highly dependent upon cheap and readily available energy supplies. The primary energy sources were various fossil fuels, in particular oil and natural gas that were used to produce gasoline, home heating oil, electricity from oil fired burners and myriad of other products. Oil and natural gas were in plentiful supply with much domestic production in North America and vast reserves in the OPEC (Organization of Petroleum Exporting Countries) nations. The marginal costs of production in many countries were almost negligible (about 20¢ per barrel in Saudi Arabia) and supplies virtually inexhaustible, or so it seemed. There was a decline in the real price of energy of about 30 percent over a twenty-five year period. Then, suddenly in 1973–1974, through a sequence of quick actions, the members of OPEC increased the price of oil by about 500 percent (\$2.20 to \$11.50). The Arab members of OPEC, namely OAPEC, saw the availability of their oil as an important political weapon. In the fall of 1973 they announced a boycott against the United States, Holland, and other nations thought to be sympathetic to the Israeli point of view in their

continuing struggle with their Arab neighbors. The boycott took many forms, and lasted until the spring of 1974. It caused much dislocation in the economies of North America, Europe, Japan, and other countries. The simultaneous price rise and fear of shortages led to a period known as "the energy crisis" or "the energy-environmental crisis" or "the oil crisis." It was apparent that many economic, operations research, and scientific studies could aid in the solution and understanding of this crisis. Many energy modeling groups were formed to analyze energy-related problems from regional and economy-wide perspectives. The suddenly felt need for sound government action to alleviate the economic shock caused by these dislocations has led to increased use of quantitative modeling techniques by various government agencies. Never before has operations research and econometrics played such an important role in the preparation and execution of government actions as in the wake of the 1973-1974 energy crisis. In the ensuing four years, analyses of a multitude of energy problems were undertaken and the field of energy policy modeling became one of the fastest growing industries in the industrialized world. This has led to numerous sessions at economics, operations research, and other conferences as well as specialized conferences on various energy topics. The "Canadian Energy Policy Modeling Conference," held in North Vancouver, May 18-20, 1978, was organized to assess the state of the art in energy modeling in North America. A major aim of the conference was to determine the extent to which energy modeling had and could make a contribution to the energy policy decision-making process. The participants and speakers at the conference were a balanced mixture of industry, government, and academics from the United States and Canada.

These two volumes contain revised and updated versions of the major papers presented at the conference plus edited transcriptions of the panel discussions and several additional papers aimed at particular topics deemed worthy of further study at the conference. These include contributions by: Marcuse on why one would wish to utilize models in a world that is so uncertain; Greenberg on crash mode modeling; and Fuller and Ziemba's survey of twenty major United States and Canadian energy policy models. The coverage is broken down into eight parts, four of which appear in each volume. The first volume is concerned with "specialized" energy policy models, such as those occurring in the study of demand, supply, coal and transportation, and the problems and interactions of energy, environment, and conservation. The second volume is concerned with attempts to mesh supply and demand elements in an integrative fashion. Its major sections are concerned with the process of energy policy modeling, national and regional energy modeling concepts and methods, the Canadian-United

States gas pipeline, and the problems of financing energy development projects. This breakdown is suggestive rather than forming a strict guide to the contents of each volume. Each section is introduced with a survey of topics and related literature that interface with the papers in the section. The introductions are not meant to be definitive surveys, rather they are intended to put the papers in perspective in light of the current literature on energy policy modeling.

All the papers were refereed and they were also edited by Sandra Schwartz and me to minimize inconsistencies of style, form, and content. Thanks are due to the various authors for their contributions to these volumes and their patience and understanding regarding our red penciling of their papers. Since one of our primary goals is to assess the current state of energy modeling, the papers take many forms. Many of the papers describe the development and use of models that have been or are currently in actual use. Others are discussional in nature and are concerned with energy problem areas or model development and use. Several papers describe preliminary work concerned with the development of major energy models and indicate the direction that they expect future work to take. There are of course, many differences as well as similarities and interconnections between the energy problems of Canada and the United States. One of the primary differences borne out by the papers and panel discussions in these volumes is the more widespread use of econometric simulations in Canada and the more integrative optimizing approach of the United States' models. This is partly due to historical precedents and the expense of integrative model construction and the greater availability of large research grants in the United States.

A number of people contributed to the success of the conference and aided in the preparation of these volumes. Jack Mitten and John Roberts initially suggested that I organize a session concerned with "National Energy Policy Models" at the annual general meeting of CORS, held May 15-18, 1978, in North Vancouver. It seemed appropriate to expand this suggested session into a full conference that would begin with the CORS session linking the two conferences. The CORS council has endorsed the conference and these volumes as an activity it wishes to support, and its current president, Alex Cowie, has kindly provided the Foreword to the volumes. Herb Drechsler and Ernest Koenigsberg kindly assisted me in the organization of the conference. Ernest also organized the sessions on coal and transportation and is responsible for Section III of Volume I on this topic. While I was visiting at the Department of Industrial Engineering and Operations Research, University of California, Berkeley, in the winter and spring of 1978, Bill Jewell kindly provided much support and encouragement as well

as several valuable suggestions concerning the conference. The conference was organized as an activity of the Management Science Research Centre, Faculty of Commerce and Business Administration, University of British Columbia. Thanks are due to Peter Larkin, Dean of Graduate Studies, U.B.C., and Peter Lusztig, Dean of the Faculty of Commerce and Business Administration, for their financial contributions to the conference budget. My U.B.C. colleagues Ernst Berndt, Erwin Diewert, John Helliwell, and Peter Nemetz have made a number of very helpful suggestions concerning the preparation of these volumes. Trudy Cameron and Joan Rush have aided us in our research for the volume. Trudy and Dave Fuller did masterful jobs of transcribing the panel discussions into a coherent readable form. Special thanks go to the following individuals who served as referees: E. Balas, G. E. Bennington, E. R. Berndt, T. A. Cameron, T. E. Daniel, W. E. Diewert, J. D. Fuller, M. A. Fuss, D. Granot, H. J. Greenberg, E. D. Griffith, R. C. Grinold, J. Hayward, T. Johnston, B. A. Kalymon, E. Keonigsberg, A. Kydes, A. J. Lichtenberg, W. Marcuse, F. Mathewson, J. M. Mulvey, S. C. Parikh, T. Parson, S. C. Peck, E. R. Peterson, R. A. Preece, J. Rogers, M. Rothman, R. Sahi, A. Shogan, D. G. Waddingham, and G. C. Watkins. Excellent clerical and typing assistance was received from Barbara Blancard, Monica Heinrich, Violet Jung, Jupian Leung, Helen McCann, Lillian McClanaghan, and Mabel Yee. Finally, special thanks go to Sandra Schwartz for joining me as a coeditor of these volumes.

W. T. Ziemba