

A SYSTEMS APPROACH TO ENERGY PLANNING
IN INDIA

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C E R T I F I C A T E

This is to certify that the thesis entitled, " A SYSTEMS APPROACH TO ENERGY PLANNING IN INDIA" which is being submitted by Mr. E.A.S. Sarma to the Centre for Energy Studies, Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy, is a record of bonafide research work carried out by him. He has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis, which has attained the standard required for a Ph.D. degree of this Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

The objective of this study is to develop a systems approach to energy planning with particular focus on the Indian scene. A number of supply and demand side options including certain foreign trade choices are considered and analysed together. The supply side options include the modal choices in electricity generation, the use of different grades of coal, the availability of crude from different sources, the use of different types of refining facilities, the availability of natural gas both in its free and associated forms and the supply of fuelwood from the low-productivity forest growth that occurs naturally in comparison with high-cost high-productivity fuelwood plantations. The availability of draught animal energy, animal waste and crop residue in relation to the livestock-agriculture sub-system and the traditional use of animal waste as dung cakes and manure in comparison with its alternate use as a source of biogas and slurry are some of the other supply options considered in the study. The use of solar photovoltaic energy is considered as an emerging technology in addition to the implications of a few energy conservation devices/processes. The demand sectors considered in the study include agricultural operations, lift irrigation, transportation, industry, the production of nitrogenous fertilisers and aluminium, cooking and lighting. Foreign trade options are considered in the case of crude and petroleum products on the supply side and fertilisers and aluminium on the demand side.

The quantitative framework of this study is based on a linear programming model with cost optimisation as its objective. The sensitivity of the optimal result is analysed with reference to changes in important assumptions regarding the shadow prices of unskilled labour and foreign exchange, the world market price of oil, the availability of resources and the sectoral goals for the different demand sectors. The model is used further to evaluate new energy technologies such as the use of solar thermal energy for cooking. In addition to analysing the investment alternatives in the energy sector, the model provides a valuable insight into the pricing of different forms of energy on an integrated basis.

The study suggests for the reference year i.e. the year 2000-01, a primary energy supply pattern that places greater emphasis on the development of coal, natural gas and hydro-electricity as compared with the prevailing pattern and the future policy. The study highlights the important inter-relationships that exist among the different sub-systems of energy and suggests the need to consider these interrelationships simultaneously. Further, an integrated framework for the pricing of energy is evolved.

TABLE OF CONTENTS

	Page
CERTIFICATE	... i
ACKNOWLEDGEMENTS	... ii
ABSTRACT	... iii
TABLE OF CONTENTS	... v
LIST OF TABLES	... x
LIST OF FIGURES	... xii
Abbreviations used in the study	... xiii
<u>CHAPTERS</u>	
1 INTRODUCTION	... 1-20
1.1 Background	... 1
1.2 Pattern of Energy Consumption in India	... 2
1.3 Availability of Energy Resources in India	... 6
1.4 Energy Losses	... 10
1.5 Cost of Energy Development	... 10
1.6 Choices Available in the Energy Sector	... 11
1.7 Issues in Energy Planning	... 13
1.8 Objective of the Present Study	... 14
1.9 Methodology of the Study	... 15
1.10 Scope and Limitations of the Study	... 17
1.11 An Overview	... 19
1.12 Contribution to Energy Planning Methodology	... 20
2. A REVIEW OF THE EXISTING LITERATURE ON ENERGY PLANNING	...21-33
2.1 Introduction	... 21
2.2 Traditional Approaches	... 22

2.3	Sectoral Approach to Energy Planning	...	23
2.4	Integrated Energy Planning Studies	...	28
2.5	Summary	...	33
3.	A DESCRIPTION OF THE SYSTEMS MODEL	...	34-69
3.1	Introduction	...	34
3.2	Choices Considered in the Study	...	35
3.3	A Schematic Representation of the Energy Flows	...	36
3.4	A Description of the Linear Programming Model	...	49
3.5	Variable Activities	...	51
3.6	Cost Coefficients	...	52
3.7	Objective Function	...	52
3.8	Constraints	...	52
3.9	Parameters Used in the Constraints	...	53
3.10	Assumptions Made in Formulating the Model	...	54
3.11	Reasons for Imposing Lower/Upper Bounds	...	65
3.12	The Model	...	66
3.13	The Limitations of the Model	...	67
4.	THE DATA FOR THE STUDY	...	70-79
4.1	Introduction	...	70
4.2	The Sources of the Data	...	70
4.3	The Data	...	71
4.4	Capacity Related Parameters	...	71
4.5	Resource Related Parameters	...	72

4.6	Technical Parameters	...	73
4.7	Demand Related Parameters	...	74
4.8	Upper/Lower Bounds	...	74
4.9	Cost Coefficients	...	75
4.10	Limitations of the Data	...	79
5.	INVESTMENT PLANNING IN THE ENERGY SECTOR	...	80-112
5.1	Introduction	...	80
5.2	Results in the Base Case	...	80
5.3	Sensitivity to the Shadow Price of Unskilled Labour	...	91
5.4	Sensitivity to the Shadow Price of Foreign Exchange	...	93
5.5	Sensitivity to the World Market Price of Oil	...	96
5.6	Implications of Reduced Availability of Coal	...	98
5.7	Implications of Increased Availability of Oil and Gas	...	99
5.8	Implications of Reduced Availability of Fuelwood	...	101
5.9	A High Demand Profile and the Energy Supply and Demand Pattern	...	101
5.10	Evaluation of New Energy Technologies	...	105
5.11	Transportation of Coal and Petroleum Products	...	109
5.12	A General Observation	...	111
6.	AN INTEGRATED APPROACH TO ENERGY PRICING	...	113-122
6.1	Introduction	...	113
6.2	The Economic Significance of the Simplex Multiplier	...	113

6.3	The cost of Supply of Coal, lignite and Electricity	...	113
6.4	Petroleum Products	...	115
6.5	Crude Oil	...	117
6.6	Natural Gas	...	118
6.7	Other Forms of Energy	...	119
6.8	The Need for an Integrated Energy Pricing Policy	...	120
7.	CONCLUSIONS AND SUGGESTIONS	...	123-130
7.1	Introduction	...	123
7.2	Investment Planning in the Energy Sector	...	123
7.3	Energy Pricing	...	127
7.4	The Data Base for Energy Planning	...	128
7.5	The Contribution of the Study to the Field of Energy Policy Analysis	...	129
7.6	Suggestions for Further Research	...	130

APPENDICES (CHAPTER 3)

3.1	Code Numbers used in the Model	...	131
3.2	Activities	...	134
3.3	Resource/Capacity Related Parameters	...	138
3.4	Technical Parameters	...	140
3.5	Demand Related Parameters	...	144
3.6	Upper/Lower Bounds	...	145
3.7	Cost Coefficients	...	146
3.8	Objective Function	...	148
3.9	Constraints	...	150

APPENDICES (CHAPTER 4)

4.1	Capacity Related Parameters	...	161
4.2	Resource Related Parameters	...	171
4.3	Technical Parameters	...	180
4.4	Demand Related Parameters	...	213
4.5	Upper/Lower Bounds	...	227
4.6	Cost Coefficients	...	232
4.7	Classification of Non-Coking Coal	...	288

ANNEXURE (CHAPTER 4)

4.1	Calorific values/Specific Gravities	...	159
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R E F E R E N C E S	...	292-305
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BIODATA