

CONTENTS

	Page
Preface	v
Chapter 1	1
Overview	
Investigations	6
Part I	
ENERGY FUNDAMENTALS	
Chapter 2	7
Concept of energy	
Qualitative definition of energy	8
Energy: evolution of a concept	9
Energy in its various forms: first approximation	10
An elementary mathematical prelude	15
Quantitative definition of energy	17
Power	22
Summary	23
Review questions	24
Investigations	25
Chapter 3	27
Laws of energy conversion	
Where does energy come from?	28
Work and heat (first law of thermodynamics)	31
Entropy (second law of thermodynamics)	42
Review questions	51
Investigations	52
Chapter 4	53
Efficiency of energy conversion	
Energy conversion devices and their efficiency	54
Heat engines and system efficiency	59
Heat transfer devices and their efficiency	67
Comparison of efficiencies	70
Review questions	75
Investigations	76
Chapter 5	77
Energy supply and demand	
Exponential growth: population and energy consumption	79
Energy consumption and economic development	84
Renewable and nonrenewable energy	87
Resources and reserves	88
Population and energy demand growth: projections	90
Review questions	94
Investigations	95
Part II	
ENERGY SUPPLY	
Chapter 6	97
Fossil fuels: overview	
The carbon cycle	98
An elementary chemical prelude	102
Comparison of reserves of fossil fuels	105

	Review questions	111
	Investigations	112
Chapter 7	Coal	113
	Coal formation	116
	Properties of coal	117
	Coal utilization	121
	Review questions	133
	Investigations	134
Chapter 8	Petroleum	137
	Petroleum formation	139
	Properties of petroleum	140
	Petroleum utilization	144
	Review questions	162
	Investigations	164
Chapter 9	Natural gas	169
	Formation of natural gas	172
	Properties of natural gas	173
	Utilization of natural gas	174
	Review questions	178
	Investigations	179
Chapter 10	'Synthetic' fuels, oil shale and tar sands	181
	Oil shale	182
	Tar sands	183
	"Synthetic" fuels (synfuels)	184
	Review questions	189
	Investigations	190
Chapter 11	Fossil fuels: environmental effects	191
	Primary air pollutants	192
	Secondary air pollutants	199
	Air pollution control	201
	Greenhouse effect	207
	Review questions	214
	Investigations	216
Chapter 12	Nuclear energy: introduction	219
	A brief historical prelude: isotopes	220
	Nuclear fission and fusion: introduction	223
	Review questions	228
	Investigations	228
Chapter 13	Nuclear fission	229
	Principles of nuclear fission	231
	Nuclear reactors	236
	Nuclear fuel cycle	244
	What happened at Three Mile Island?	251
	What happened at Chernobyl?	253
	Review questions	254

	Investigations	255
Chapter 14	Nuclear fusion	257
	Fusion reactions	258
	A fusion reactor	260
	The “cold fusion” confusion	263
	Investigations	263
Chapter 15	Nuclear energy: environmental issues	265
	Emission of radioactivity	266
	Absorption of radioactivity	271
	Nuclear accidents	273
	Disposal of nuclear waste	277
	Nuclear weapons	279
	Future of nuclear energy: summary	283
	Review questions	284
	Investigations	285
Chapter 16	Water, wind, biomass and geothermal energy	291
	Geothermal energy	293
	Wind energy	296
	Tidal energy	301
	Hydroelectric energy	301
	Wave energy	304
	Biomass energy	305
	Review questions	310
	Investigations	311
Chapter 17	Solar energy	313
	Solar energy balance	314
	Direct solar heating	315
	Indirect production of electricity	321
	Direct production of electricity	323
	Review questions	332
	Investigations	332
Part III	ENERGY DEMAND	
Chapter 18	Electricity	335
	A (very) brief prelude: electric energy	336
	The electric power plant	338
	Electricity supply and demand	342
	Demand-side management	346
	Reading the press: NIMBY	348
	Review questions	351
	Investigations	352
Chapter 19	Residential comfort	355
	A typical home: energy input and output	358
	Our home: analysis of energy input and output	369
	Case study 1: an all-electric home	371

	Case study 2: gas heating and electricity	377
	Case study 3: oil heating and electricity	382
	Case study 4: a complete analysis by a new “energy expert”	383
	EnergyGuide labels	387
	Reading the press: energy conservation	389
	Review questions	391
	Investigations	395
Chapter 20	Transportation	397
	Transportation fuels: consumption trends	399
	The automobile	402
	Mileage: vehicle efficiency	408
	Alternative transportation fuels	415
	Cost of transportation	418
	Reading the press: gasoline conservation tips	422
	Review questions	423
	Investigations	424
Part IV	SUMMARY	
Chapter 21	Energy economics, politics and policies	427
	Economic issues	429
	Political issues	432
	Energy policies	438
	National energy strategy	438
	Clean air act	439
	Sustainable energy strategy	444
	Summary	448
	Review questions	449
	Investigations	450
Further Reading		461
Index		467