## ENERGY USE

## AND ENVIRONMENT

F. PETER W. WINTERINGHAM

## Contents

2.1 The world today 2.2 The population explosion 2.3 Historical growth of energy use 2.4 Disparities in energy use and their implications  3. Energy Technologies, Resources, and Uses	1.	The Nature of Energy1				
1.3 Metabolic energy 1.4 The emerging energy crisis of technology-based society 1.5 Energy use as a societal indicator  2. Energy Use in the Global Context		1.1	Introduction			
1.4 The emerging energy crisis of technology-based society 1.5 Energy use as a societal indicator  2. Energy Use in the Global Context		1.2	Force, energy, and power			
2. Energy Use in the Global Context		1.3	Metabolic energy			
2. Energy Use in the Global Context		1.4	The emerging energy crisis of technology-based	socie	ty	
2.1 The world today 2.2 The population explosion 2.3 Historical growth of energy use 2.4 Disparities in energy use and their implications  3. Energy Technologies, Resources, and Uses		1.5				
2.1 The world today 2.2 The population explosion 2.3 Historical growth of energy use 2.4 Disparities in energy use and their implications  3. Energy Technologies, Resources, and Uses	2.	Energy Use in the Global Context				
2.3 Historical growth of energy use 2.4 Disparities in energy use and their implications  3. Energy Technologies, Resources, and Uses						
2.3 Historical growth of energy use 2.4 Disparities in energy use and their implications  3. Energy Technologies, Resources, and Uses		2.2	The population explosion			
2.4 Disparities in energy use and their implications  3. Energy Technologies, Resources, and Uses		2.3				
3.1 Historical development and principles 3.2 Comparative aspects 3.3 Energy storage 3.4 Energy uses  4. The Benefit-Detriment Approach		2.4				
3.1 Historical development and principles 3.2 Comparative aspects 3.3 Energy storage 3.4 Energy uses  4. The Benefit-Detriment Approach	3.	Energy	y Technologies, Resources, and Uses		15	
3.2 Comparative aspects 3.3 Energy storage 3.4 Energy uses  4. The Benefit-Detriment Approach		100				
3.3 Energy storage 3.4 Energy uses  4. The Benefit-Detriment Approach		3.2				
4. The Benefit-Detriment Approach		3.3				
4.1 Principles 4.2 The 'Chernobyl' nuclear accident of 1986 4.3 The nuclear vs. coal-based energy debate 4.4 Conclusions  5 Fossil-Carbon Based Energy						
4.1 Principles 4.2 The 'Chernobyl' nuclear accident of 1986 4.3 The nuclear vs. coal-based energy debate 4.4 Conclusions  5 Fossil-Carbon Based Energy	4.	The Benefit-Detriment Approach			23	
4.3 The nuclear vs. coal-based energy debate 4.4 Conclusions  5 Fossil-Carbon Based Energy						
4.3 The nuclear vs. coal-based energy debate 4.4 Conclusions  5 Fossil-Carbon Based Energy		4.2	The 'Chernobyl' nuclear accident of 1986			
5. Fossil-Carbon Based Energy		4.3				
5.1 Introduction 5.2 Nature and origin 5.3 Uses and benefits 5.4 Limits and detriments 5.5 The "greenhouse effect" and "acid rain" 5.6 Conclusions  Biomass Fuels		4.4	Conclusions			
5.1 Introduction 5.2 Nature and origin 5.3 Uses and benefits 5.4 Limits and detriments 5.5 The "greenhouse effect" and "acid rain" 5.6 Conclusions  Biomass Fuels	5.	Fossil-			33	
5.3 Uses and benefits 5.4 Limits and detriments 5.5 The "greenhouse effect" and "acid rain" 5.6 Conclusions  Biomass Fuels						
5.4 Limits and detriments 5.5 The "greenhouse effect" and "acid rain" 5.6 Conclusions  Biomass Fuels		5.2	Nature and origin			
5.5 The "greenhouse effect" and "acid rain" 5.6 Conclusions  Biomass Fuels		5.3	Uses and benefits			
Biomass Fuels		5.4	Limits and detriments			
Biomass Fuels		5.5	The "greenhouse effect" and "acid rain"			
<ul> <li>6.1 Biomass-based energy technologies</li> <li>6.2 Photosynthesis and use by combustion of plant products</li> <li>6.3 Biogas technologies</li> <li>6.4 Biomass-derived oils</li> </ul>		5.6				
<ul> <li>6.1 Biomass-based energy technologies</li> <li>6.2 Photosynthesis and use by combustion of plant products</li> <li>6.3 Biogas technologies</li> <li>6.4 Biomass-derived oils</li> </ul>	5.	Biomass Fuels47				
<ul> <li>6.2 Photosynthesis and use by combustion of plant products</li> <li>6.3 Biogas technologies</li> <li>6.4 Biomass-derived oils</li> </ul>		6.1				
6.3 Biogas technologies 6.4 Biomass-derived oils		6.2		produ	cts	
6.4 Biomass-derived oils		6.3		ETT		
		6.4				
6.5 Biomass-derived alcohol		6.5	Biomass-derived alcohol			

	6.6	Comparative benefits and detriments	
	6.7	The future	
7.	Solar-,	Wind-, Geothermal-, and Water-Based Power	57
	7.1	Solar energy	
	7.2	Wind power	
	7.3	Geothermal and OTG energy sources	
	7.4	Hydro and tidal-power	
	7.5	Conclusions	
8.	The Fu	iture of Nuclear-Based Power	67
	8.1	Introduction	
	8.2	Present status and societal attitudes	
	8.3	Radioactive waste disposal	
	8.4	The fast-breeder reactor	
	8.5	Nuclear fusion	
	8.6	Miscellaneous nuclear reactor developments	
	8.7	Conclusions	
9.	Non-N	uclear R & D for the ruture	75
	9.1	The potential of current non-nuclear-based energy technologies	
	9.2	Use of wastes	
	9.3	Secondary chemical fuels	
	9.4	Energy storage, batteries, and fuel cells	
	9.5	Conclusions	
10.	Energ	y, Agriculture, Forestry, and Fisheries	83
100	10.1	Introduction	
	10.2	Cultivated land	
	10.3	Productivity and demand	
	10.4	Agricultural intensification	
	10.5	Trends in forestry and fisheries	
	10.6	Emerging problems and constraints	
	10.7	The future	
11.	Globa	al Trends, Problems, and Needs	93
- Carroll	11.1	Population and energy use	
	11.2	Resource depletion and pollution	
	11.3	Consumer saturation and wastes	

	11.4	The escalating potential for destruction and injury	
	11.5	Needs for the future	
12.	Sustain	able Agriculture, Food, Water, and Environmental	
	Quality		
	12.1	The needs	
	12.2	Current research and development	
	12.3	Recycling of soil nutrients	1
	12.4	The future	
	12.5	Conclusions	
13.	Energy	Use, Attitudes, and Conservation	117
	13.1	Introduction	
	13.2	Energy use and attitudes	
	13.3	Energy conservation	
	13.4	Implementation of conservation measures	
	13.5	Conclusions	
14.	Educat	ion for the Future	125
	14.1	Introduction	
	14.2	Progress and attitudes	
	14.3	Education for progress in the scientific context	
	14.4	Some common lessons of history and science	
	14.5	International implications	
	14.6	Conclusions	
15.	The Go	oal of Peaceful Planetary Management	137
	15.1	Introduction	
	15.2	Prospects, problems, and priorities	
	15.3	Management or collapse	
	15.4	The lessons of history but grounds for optimism	
16.	Glossary of Terms, Units, and Acronyms1		
	16.1	Terms and definitions	
	16.2	Units of measurement and expression	
	16.3	Acronyms and abbreviations	
	16.4	A "global-green" glossary	
17.	Key Re	eferences to Information and Data Sources	155
	17.1	List of references cited in the text	

	17.2 17.3	Recommended background reading List of tables and figures	
1	Postscrip	t	
	18.1	Environment and resources	
	18.2	The international scene	
]	Index		