

Contents

List of tables XIII

List of figures XV

1 New challenges in technology development: the environmental problem 1

- 1.1 Introduction 1
- 1.2 Environmental problems 1
 - 1.2.1 Environmental problems: From local to global 2
 - 1.2.2 Solutions: From national to international 3
 - 1.2.3 The technological option 4
- 1.3 The scientific response 5
 - 1.3.1 The rise of environmental sciences 5
 - 1.3.2 The interaction with economic sciences 6
- 1.4 The structure of this book 7

Part A Theoretical part

2 Transport, technology and sustainable development 11

- 2.1 Introduction 11
- 2.2 Transport and the environment 11
 - 2.2.1 Stratification within the transportation sector 12
 - 2.2.2 The environmental concern 14
- 2.3 The technology card 19
 - 2.3.1 Environmental technologies 19
 - 2.3.2 The political setting 21
 - 2.3.3 Two paradoxes 24
- 2.4 The concept of sustainable development 26
 - 2.4.1 Linking the environment and economics 27
 - 2.4.2 Risk and uncertainty 33
 - 2.4.3 The need for an attitudinal change 34

3	The evolutionary theory of technology dynamics	39
3.1	Introduction	39
3.2	The evolutionary theory of technology dynamics	39
3.2.1	The relevance of technology forecasting	39
3.2.2	Technology; a definition	40
3.2.3	From macro-trends to micro-analysis	42
3.3	Critics of the modern theory	54
3.4	The relevance of technology dynamics for sustainable development and the transportation sector	58
3.4.1	Technological innovations and sustainable development	58
3.4.2	Technological innovations in the transport sector	61
3.5	Respecting heuristics; a new opportunity	65
4	Policy making in networks and alliances: implications for a sustainable technology policy	69
4.1	Introduction	69
4.2	Network management and public policy making	69
4.2.1	The crises in public policy	69
4.2.2	The concept of network management	72
4.2.3	Network management and steering	74
4.2.4	A new role for the government	81
4.2.5	Instruments	87
4.3	Network management and the private sector	90
4.3.1	Changing positions and performances	91
4.3.2	Strategic alliances as networks	97
4.4	Cooperation in networks	101
4.4.1	Networks and strategic cooperation	101
4.4.2	Network management and technology policy	104
4.4.3	Network management and sustainable development	108
5	Directing innovations in the transport sector: a synthesis	115
5.1	Introduction	115
5.2	Processes of change	115
5.2.1	The dynamic environment of innovations	116
5.3	Establishing a technology policy for transport and sustainable development	119
5.3.1	General policy requirements	119
5.3.2	Technology policy requirements	121
5.4	Towards a sustainably-sound technology policy for the transport sector: a strategy framework	124

Part B Empirical part

6 Exploring trends and ‘weak signals’	139
6.1 Introduction	139
6.2 Global mobility patterns	139
6.2.1 Passenger transport	140
6.2.2 The development of freight transport	145
6.3 Expected trends and ‘weak signals’	147
6.3.1 Public policy perspective	148
6.3.2 Business perspective	148
6.3.3 Environmental perspective	149
6.3.4 Transportation perspective	151
6.4 Transportation – the environment – technological opportunities: a challenging future	152
7 The Maglev-technology	155
7.1 Introduction	155
7.2 Rail transport – the history of high speed trains	155
7.3 The potentials of the Maglev-technology	158
7.3.1 The state of development	159
7.3.2 Technical performance	160
7.3.3 Economic issues	161
7.3.4 Environmental impacts	162
7.4 An evaluation of the Maglev from the viewpoint of network management, technology dynamics and sustainable development ...	166
7.4.1 Actors and activities	166
7.4.2 The strategy framework	167
7.5 The Maglev: hype or technological revolution?	175
7.5.1 Prospects for motive power applications	176
7.5.2 The implementation gap	176
8 The Fuel-cell technology	179
8.1 Introduction	179
8.2 The historical context	179
8.2.1 The history of the fuel-cell	179
8.2.2 A competitive technology?	182
8.3 The potentials of fuel-cell technology	185
8.3.1 The state of development	185
8.3.2 Technical performance	188
8.3.3 Economic issues	189
8.3.4 Environmental impacts	190

8.4	An evaluation of the FC-technology from the viewpoint of network management, technology dynamics and sustainable development . . .	191
8.4.1	Actors and activities	192
8.4.2	The strategy framework	199
8.5	The fuel-cell: a great future?	209
8.5.1	Prospects for motive power applications	209
8.5.2	The implementation strategy	213
9	Some conclusions and reflections	217
9.1	Introduction	217
9.2	Technology dynamics and networks	217
9.2.1	Sustainable development and objectives in the transport sector	217
9.2.2	The role of sustainability-oriented technologies in the transport sector and the meaning of the evolutionary theory of technology dynamics	218
9.2.3	The role of the government in generating sustainability-oriented technologies	220
9.3	Defining a Window of Technological Opportunity (WTO)	223
9.3.1	Characteristics of innovation processes for sustainability-oriented technologies in transport	223
9.3.2	Realising the Window of Technological Opportunity	223
9.3.3	The empirical results	224
9.4	Epilogue	226
Annex	229
Annex I	List of interviewed persons	229
Annex II	Technology evaluation manual and tables	231
Annex III	The technology clusters and their impact on the environment	245
References	251