- Editorial note p. xi
- 1 Passive solar heating of buildings K. Voss and V. Wittwer p. 1
- 1.1 Introduction p. 1
- 1.2 The theory of passive solar heating p. 2
- 1.3 Passive solar contributions today--the SolGain results p. 3
- 1.4 High-performance housing--solar gains in buildings with low heat loads p. 6
- 1.4.1 The methodology p. 6
- 1.4.2 Four examples p. 6
- 1.4.3 The shortened heating season p. 9
- 1.4.4 Lessons learned p. 9
- 1.5 Related materials and technologies p. 10
- 1.5.1 Advanced glazing p. 10
- 1.5.2 Solar gains on opaque building elements p. 14
- 1.5.3 Increased thermal capacity p. 15
- 1.6 Related energy supply p. 15
- 1.7 References p. 16
- 2 Active solar heating and cooling of buildings A. M. Papadopoulos p. 17
- 2.1 Introduction p. 17
- 2.2 Classification of solar systems and current state of the art p. 19
- 2.3 Aims for the future: the technologies p. 24
- 2.3.1 Components p. 24
- 2.3.2 Systems' integration and applications p. 25
- 2.4 Aims for the future p. 30
- 2.4.1 The market p. 30
- 2.4.2 A call for sustainable energy policies p. 32
- 2.5 Conclusions p. 34
- 2.6 References p. 35
- 3 Spectrally selective materials for efficient visible, solar and thermal radiation control M. G. Hutchins p. 37
- 3.1 Introduction p. 37
- 3.2 Solar thermal conversion p. 38
- 3.2.1 Solar absorber coatings p. 39
- 3.2.2 The transparent collector cover p. 42
- 3.3 Transparent selective coatings for windows p. 42
- 3.3.1 Spectrally selective low emittance for passive solar gain p. 44
- 3.3.2 Solar control glazing p. 44
- 3.3.3 Evacuated glazing p. 47
- 3.3.4 Nanoparticle-doped polymeric solar control glazing p. 48
- 3.4 Switchable glazing materials p. 48
- 3.4.1 Electrochromic glazing p. 49
- 3.4.2 Thermochromic and thermotropic glazing p. 51
- 3.4.3 Gasochromic glazing p. 52
- 3.5 Measurement of the optical properties p. 55
- 3.5.1 Angle-dependent visible and solar properties p. 55
- 3.5.2 Thermal optical properties measurements p. 56
- 3.5.3 An EU window energy data thematic network (WinDat) p. 59

- 3.6 Conclusions p. 60
- 3.7 Acknowledgements p. 61
- 3.8 References p. 62
- 4 Advanced control systems for energy and environmental performance of buildings G. Guarracino and D. Kolokotsa and V. Geros p. 65
- 4.1 Impact of global control of building in terms of energy performance and sustainable building p. 67
- 4.2 Function and control tasks p. 67
- 4.3 Requirements for the implementation of automatic control p. 69
- 4.4 Communication protocols for the implementation of advanced control systems p. 71
- 4.5 State of the art in advanced control systems p. 76
- 4.6 Smart buildings and internet-based energy services p. 82
- 4.6.1 Services of interest to occupants p. 84
- 4.6.2 Services of interest to maintenance operators/property managers p. 85
- 4.6.3 Services of interest to energy management p. 86
- 4.7 Conclusion p. 86
- 4.8 References p. 87
- 4.9 Bibliography p. 89
- 5 IT Systems for energy and environment monitoring, planning and design J. A. Clarke p. 90
- 5.1 The sustainable energy systems challenge p. 91
- 5.2 Digital cities p. 94
- 5.3 Rational planning p. 98
- 5.4 Virtual design p. 101
- 5.5 Energy services p. 106
- 5.6 Case study p. 110
- 5.7 Technology transfer p. 113
- 5.8 References p. 114
- 6 Natural ventilation in an urban context C. Ghiaus and F. Allard and J. Axley p. 116
- 6.1 Introduction p. 116
- 6.2 Role of natural ventilation p. 117
- 6.2.1 Purposes p. 117
- 6.2.2 Performance criteria p. 117
- 6.3 Physics of natural ventilation p. 118
- 6.3.1 Eddy, turbulent and mean description of flow p. 118
- 6.3.2 Mean flow through openings p. 119
- 6.3.3 Wind pressure p. 120
- 6.3.4 Buoyancy pressure p. 121
- 6.3.5 Urban environment p. 122
- 6.4 Component sizing based on mean behaviour--pressure loop method p. 122
- 6.5 Natural ventilation strategies p. 126
- 6.5.1 Wind variation-induced single-sided ventilation p. 126
- 6.5.2 Wind-driven cross ventilation p. 127
- 6.5.3 Buoyancy-driven stack ventilation p. 129
- 6.5.4 Combined wind- and buoyancy-driven ventilation p. 130
- 6.5.5 Combinations of fundamental strategies p. 132

- 6.5.6 Solar-assisted ventilation p. 133
- 6.6 Natural ventilation strategies for urban environment p. 134
- 6.6.1 Balanced stack ventilation p. 134
- 6.6.2 Passive evaporative cooling p. 136
- 6.6.3 Double-skin facade p. 137
- 6.7 Conclusion p. 138
- 6.8 References p. 138
- 7 Cooling by natural sinks S. Alvarez and J. L. Molina p. 140
- 7.1 Introduction p. 140
- 7.2 Conventional cooling and cooling based on environmental sinks p. 141
- 7.3 Ground cooling p. 143
- 7.3.1 The cool medium p. 143
- 7.3.2 Effective environmental temperature p. 144
- 7.3.3 System description and performance p. 145
- 7.3.4 Innovative design options p. 146
- 7.4 Evaporative cooling p. 147
- 7.4.1 The cold medium p. 147
- 7.4.2 System description and performance p. 147
- 7.4.3 Innovative design options p. 149
- 7.5 Radiative cooling p. 153
- 7.5.1 The cold medium p. 153
- 7.5.2 Effective environmental temperature p. 154
- 7.5.3 System description and performance p. 154
- 7.6 Climatic qualification p. 156
- 7.7 Earth sheltering p. 157
- 7.8 Roof solutions p. 159
- 7.8.1 Roof pond p. 159
- 7.8.2 Planted roofs p. 159
- 7.8.3 Radiator roofs p. 160
- 7.9 Future priorities p. 161
- 7.9.1 Basic research on the coupling of NCT to different types of buildings p. 161
- 7.9.2 Incorporation in building design tools p. 161
- 7.9.3 Systematic study of potential applicability of NCT p. 161
- 7.9.4 Design guidelines (for NCT, different types of buildings, climates) p. 162
- 7.9.5 Introduction of standards for NCT calculation p. 162
- 7.9.6 Demonstration projects for dissemination p. 162
- 7.9.7 NCT in the European Directive for Energy Efficiency in Buildings p. 162
- 7.10 References p. 162
- 8 Thermal comfort F. Nicol p. 164
- 8.1 Prologue p. 164
- 8.2 Background p. 164
- 8.2.1 The need for a new approach p. 164
- 8.2.2 Why is thermal comfort important in energy conservation? p. 165
- 8.3 State of the art p. 165
- 8.3.1 The underlying processes p. 165
- 8.3.2 Developing an index of thermal comfort p. 167

- 8.3.3 Adaptive thermal comfort p. 171
- 8.4 Recent developments and future directions p. 178
- 8.4.1 New research in thermal comfort p. 178
- 8.4.2 Defining an adaptive standard for buildings p. 180
- 8.4.3 Developing a new dynamic approach to predicting thermal comfort in buildings p. 183
- 8.5 References p. 188
- 9 Passive cooling S. Hassid p. 192
- 9.1 Introduction p. 192
- 9.2 Cooling versus heating problems p. 193
- 9.3 PASCOOL programme p. 193
- 9.4 Essential features of passive cooling p. 194
- 9.4.1 Prevention of heat gains p. 194
- 9.4.2 Modulation of heat by internal (mainly) thermal mass p. 194
- 9.4.3 Heat sinks p. 194
- 9.5 Future research needs in passive cooling p. 197
- 9.5.1 Microclimate around buildings p. 197
- 9.5.2 Ventilation and air quality aspects p. 197
- 9.5.3 New thermal comfort standards p. 198
- 9.5.4 Natural ventilation and air flow in urban environments p. 198
- 9.5.5 Research on natural cooling techniques p. 198
- 9.5.6 Advanced solar control modelling and development of new components p. 199
- 9.5.7 Integration actions p. 199
- 9.5.8 Seasonal storage p. 199
- 9.5.9 Non-conventional AC techniques p. 199
- 9.6 Conclusion p. 200
- 9.7 References p. 200
- 10 Solar and energy efficiency as an option for sustainable urban built environments M. Santamouris p. 201
- 10.1 Introduction p. 201
- 10.2 Urbanization at the end of the 20th century p. 203
- 10.2.1 Increase of the urban population p. 203
- 10.2.2 The size of the world's cities p. 205
- 10.3 Urban environmental problems p. 206
- 10.3.1 Cities in the developed world p. 206
- 10.3.2 Cities in the less developed world p. 211
- 10.4 Urban sustainability--an oxymoron or a realistic perspective? p. 213
- 10.5 We do not have 'solutions' but we have ideas p. 215
- 10.5.1 Improve the urban microclimate p. 216
- 10.5.2 Use of sustainable energy supply systems p. 219
- 10.5.3 Use of demand side management techniques p. 224
- 10.5.4 Use of passive and active solar systems in urban buildings p. 225
- 10.5.5 Appropriate legislation for buildings p. 227
- 10.5.6 Towards more compact cities p. 228
- 10.6 Conclusions p. 230
- 10.7 References p. 231

- Index p. 236