

140934

134820



ADAPTING BUILDINGS AND CITIES FOR CLIMATE CHANGE

A 21st Century Survival Guide

Second Edition

Sue Roaf

David Crichton and Fergus Nicol



ELSEVIER

AMSTERDAM • BOSTON • HEIDELBERG • LONDON • NEW YORK • OXFORD
PARIS • SAN DIEGO • SAN FRANCISCO • SINGAPORE • SYDNEY • TOKYO

Architectural Press is an imprint of Elsevier



Architectural
Press



CONTENTS

Preface to the second edition	v
Acknowledgements to the second edition	viii
About the authors	xi
Preface to the first edition	xii
Acknowledgements to the first edition	xiv
1 Climate change: the battle begins	1
2 Risk, scenarios and insurance	32
3 How hot will it get?	51
4 How wet will it get?	76
5 Windstorms	104
6 Sea level rises	118
7 Vulnerability, exposure and migration	134
8 Health implications of climate change	143
9 Climate change and thermal comfort	158
10 The adaptive potential of traditional buildings and cities	179
11 The failure of 'modern buildings'	205
12 The end of the age of tall buildings	237
13 The fossil fuel crisis	266
14 Fuel security: when will the lights go out?	289
15 The players	313
16 Designing buildings and cities for 3°C of climate change	344
List of abbreviations	369
Index	373

INDEX

- 3°C climate change, 344–68
9/11 disaster, 115, 252, 259–60
- Aberdeenshire, 95, 106
- ABI (Association of British Insurers), 72, 93–4, 130–1, 138, 336
- Absolute temperature, 160
- Accountability, 317–18
- Active systems, 201
- Adaptation skills, 135–6
- Adaptive actions, 165–6, 174–175
- Adaptive behaviour, 162–75
- Adaptive opportunities, 169–70, 176, 199, 201
- Adaptive principle, 166, 168, 176
- Admittance method, 217
- Aerosol sprays, 8–9
- Affordable housing, 262
- Agenda 21, 15
- Agoraphobia, 241
- Agriculture, 69–70, 89
- Air movement, 160
- Air pollution, 61–3
- Air quality, 61–2, 218–19
- Air travel, 267–8, 351
see also Aviation emissions
- Air velocity, 172
- Air conditioning:
air quality, 63, 218–19
alternatives, 192
comfort and, 172–3
economic factors, 139
efficiency, 219–21
glass buildings, 217
guidance measures, 221
industry size, 212–15
LEED, 231–2, 234
malls, 227–9
modern buildings, 206, 210–12, 225–7
office blocks, 213, 215
post-war buildings, 208–9
regulation failures, 221–4
system efficiency, 219–21
3°C climate change, 348–9
see also Ventilation
- Alaskan oil fields, 297
- Alcohol, 285–6
- Alderney Renewable Energy, 284
- Algal blooms, 63
- Alps: glaciers, 124
- American Airlines, 267
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), 161, 164
- Animal behaviour, 67–8
see also Companion animals
- Antarctic ice, 119, 125–6
- AR4 report, IPCC, 12, 39, 41, 51
- Aral Sea, 87–8
- Architect's Registration Board (ARB), 323
- Architects/architecture, 321–9
action points, 339
'blob' architecture, 327–9
competitions, 324–5
design morality, 323–4
education, 325–9, 349
glass buildings, 329–30
journalists, 321
Modern Movement, 207–8
traditional architecture, 329
- Arctic ice, 119, 122, 125–7
- Argentina, 217
- Arizona Valley, USA, 225–7
- ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), 161, 164
- Asia, 124–5
see also China
- Aspergillus eurotium* (mould), 250
- Asset Rating: DEC, 223–4
- Association of British Insurers (ABI), 72, 93–4, 130–1, 138, 336
- Athabaskan tar sands, 270
- Athens: Greece, 353, 356–7
- Australia, 5, 15, 359–63
air-conditioning, 214
biodiversity impacts, 67
emissions trading scheme, 18
fire, 65
fossil fuel, 275
Garnaut report, 27
peak power demand, 298
scenario planning, 39
'water wars', 85
- Autumn temperature, 55, 57
- Aviation emissions, 18, 20, 62–3

- Backcasting, 347–8
 Baker, N.V., 169–70
 Bali Action Plan, 11, 13
 Bangladesh, 88, 135
 Bankruptcy, 300
 Barcelona: Spain, 294
 Barnes, Jay, 108–9
 Baroque period, 192
 Basements, 185–6, 191, 195–6
 Basra, Iraq, 187, 190
Beating the Heat report (Hacker/Belcher), 357
 Bedford thermal scale, 164, 172
 Behaviour:
 animals, 67–8
 thermal environment, 158, 161, 162–75
 Beiranvand tribe, 182–4
 Belcher, Stephen, 357
 Bentham Tower: Manchester, 209–10, 238
 Beverage Report 1941, 354
 ‘Beyond tipping point’ theory, 53–8
 BGS (British Geological Survey), 83
 Big Energy, 308, 310
 Bioclimatic buildings, 197, 199
 Biodiesel, 285–6
 Biodiversity, 66–7
 Biofuels, 69, 285–6
 Biological warfare, 249
 Black, F., 215
 Blackouts, 289–312
 health and safety, 332, 334
 summer 2003, 289–90
 see also Fuel security, Power cuts
 Blair, Tony, 322
 Blake, Peter, 248
 ‘Blob’ architecture, 327–9
 Blood pressure, 144
 Blue Book insurance standards, 335
A Blueprint for Survival (Goldsmith), 7
 Body temperature, 159–62, 191–2
 Borehole water, 89
 Boston: USA, 229–30
 Bottled water supplies, 335
Bowling Alone (Putnam), 358, 364
 BP (British Petroleum), 270
 Braer storm, 104–5
 Brand, Stephen, 321
 BRE (Building Research Establishment), 105–6, 352
 Britain:
 eastern/western, 77–8
 see also London; Southeast Britain
 British Biomass, 285
 British Energy, 276, 278
 British Gas, 274
 British Geological Survey (BGS), 83
 British Land, 237
 British Nuclear Fuels, 276
 British Power International, 290
 British Telecom (BT), 282–3
 British upper classes: seasonal migration, 182
 British Waterways, 101
 Brown, Lord, 270
 Brownfield sites, 83
 Brownouts, 289
 see also Blackouts
 BT (British Telecom), 282–3
 Buenos Aires, Argentina, 217
 Building categories, 333
 Building codes/standards, 105–6, 149, 333
 Building industry, 329–30
 see also Construction
 Building performance appraisals, 215
 Building Regulations, 83
 air conditioning, 213, 215, 221–2
 glass buildings, 205–6
 windstorm resilience, 106
 Building Research Establishment (BRE), 105–6, 352
 Building services engineers, 330–2, 339
 Buncefield Oil Storage Depot, 292
 Burj Dubai, 238, 255
 Bush, George W., 2, 5, 22
 Businesses, 334–5, 340
 see also individual businesses
 Buy Back Scheme, 261
 C&C (Contraction and Convergence), 22–5
 CABE (Commission for Architecture in the Built Environment), 322–3, 339
 California: USA, 295
 Campbell, Colin, 268–9, 272
 Campolietto villa, Herculaneum, 195–7, 200
 Canada, 271–2
 Canals, 101
 Canary Wharf, 238, 260, 262
 Cancers, 60
 Capri Island, 196–9
 Car industry, 356
 Carbon dioxide (CO₂):
 carbon pricing, 17–18, 21–2
 carbon sinks, 11
 carbon trading, 14
 coal, 275
 concentrations, 4, 6–7, 24, 27, 39–41
 gas, 274
 heat effects, 53
 Olympics 2012, 298–9
 per capita emissions, 23
 price of 60% reduction, 345–6, 355–6
 renewable energy, 280–1, 285
 sea level rises, 121
 sequestered, 18
 Wyatt of CIBSE, 331
 see also Emissions...
 Carbon Reduction (CRed) communities, 306
 Cardiovascular disease, 143
 Cascading grid fuel distribution model, 308
 CEBE (Centre for Education in the Built Environment), 325
 Central air conditioning systems, 220
 Central heating systems, 146–7
 Centre for Alternative Technology: Wales, 302
 Centre for Education in the Built Environment (CEBE), 325
 CFCs (chlorofluorocarbons), 4, 8–9
 Challon, Colin, 356
 Chandigarh, India, 208–9
 Change: need for, 5
 Chartered Institution of Building Services Engineers (CIBSE), 330–1
 ‘Cheap’ energy, 206–8
 Children, 147–8
 China, 89, 132, 238, 257, 297
 see also Shanghai

- Chlorofluorocarbons (CFCs), 4, 8–9
 CHP (combined heat and power), 284–5
 Chrysler Building, 238
 CIBSE (Chartered Institution of Building Services Engineers), 330–1
 Circulatory disease, 143–4
 City Hall, New Orleans, 112–13
 Civic engagement, 358
 Civil defence, 320
 Civil unrest, 85–7, 307–8, 353–7
 Clark, Professor, 47–8
 Clean Development Mechanism, 12
 Climate change: 3°C, 344–68
 ‘Climate havens’, 153
 Climate Impacts Programme, UK *see* UKCIP02
 Climate models, 6–7, 29
 AR4 report, 51
 migration, 136
 scenario planning, 34–5, 37–8
 windstorms, 106
 Climate-related disasters *see* Extreme events
 Climatic cycles, 181
 Climatized buildings, 169
see also Air conditioning
 Clothing, 160, 167–8, 172, 182
 Cloud cover, 57, 78
 Club of Rome, 7
 Coal, 275–6
 Australia, 15
 power stations, 274, 306–7, 308
see also Energy
 Coastal communities, 118
 flooding in UK, 128–32
 inundation of, 126–8, 131
 sea temperatures, 121
 vulnerability, 140
 Coca-Cola case, 89–90
 Code for Sustainable Homes, 351
 Cold weather:
 comfort, 159, 163, 165, 176
 extreme events, 71–2
 freeze problems, 71–2, 363
 health effects, 143–4
 seasonal migration, 182
 temperature-modifying buildings, 149–50, 152–3
 vulnerability to, 147
 Collapse of tall buildings, 242
 Colonization, 210–11
 Colonnaded walkways, 193, 195
 Combined heat and power (CHP), 284–5
 Comfort, 158–78
 field studies, 162–63
 rational indices, 162, 164
 temperature, 163–5, 168–75
 time factor, 168, 170–1
 ventilation, 204
 vote, 162–4
 Commission for Architecture in the Built Environment (CABE), 322–3, 339
 Commons Select Committee report 2002, 137, 139–40
 Communities:
 dysfunctional, 353–7
 extreme events, 359–61
 improving resilience, 359–61
 strong, 358–64
see also Social...
 Companion animals, 111–13
 Competitions: architectural, 324–5
 Concrete constructions, 196–7, 208
 Condensation *see* Dampness
 Conduction, 159–60
 Conference of the Parties to the UNFCCC (COP), 10–13
 Construction:
 building industry, 329–30
 concrete, 196–7, 208
 deaths and tall buildings, 249
 government contracts, 330
 industry action points, 340
 Contamination of land, 94
 Contraction and Convergence (C&C), 22–5
 Contracts: construction, 330
 Convection, 159–60, 191–2, 204
 ‘Conventional wisdom’, 5
 Convergence, 22–5
 Cook, Peter, 328–9
 Coolth:
 moving, 187–90
 Naples houses, 193–200
 passive buildings, 184–5, 204
 PV systems, 281
 seasonal migration, 182
see also Air conditioning
 COP (Conference of the Parties to the UNFCCC), 10–13
 Coral reefs, 67
 Costs:
 climate change, 16–18, 91
 social, 356–7
 tall buildings, 243–5
see also Price
 Courtyard dwellings, 185–6, 191, 193, 195
 CRed (Carbon Reduction) communities, 306
 CREST centre for renewable energy, 280
 Crichton, David, xii, 105–6
 Crime, 249
see also Terrorism
 Crises: fossil fuels, 266–88
 Cross-ventilation, 193, 195–7
Cryptosporidium, 91–2
 Cultural aspects of buildings, 149, 176
 Dampness, 144, 150–1
 Dams, 98–101
 Dasht-e-Kavir, Iran, 192
 Dead buildings, 256
 Deaths *see* Fatalities
 Deconstructionism, 326–7
 DECoRuM planning model, 320
 DECs (Display Energy Certificates), 223–4, 315
 Demolishing buildings, 320
 ‘Denial’, 2, 5, 350–3
 Denmark, 297
 Department of Business, Enterprise and Regulatory Reform, 279–80
 Derrida, Jacques, 326
 Desalination plants, 85
 Deserts, 68, 192
 Design, 215, 220, 231–4, 323–5, 344–68
 Despatchable electricity generation, 302
 Deutsche Bank tower, New York, 244, 252
 Developing countries, 137–40
 Diesel, 267, 285–6
 Disability Discrimination Act, 94
 Disasters *see* Extreme events
 Discomfort, 58–9, 161
see also Comfort
 Diseases, 59–60, 91–2, 219

- Dispersed electricity generation, 301–3
- Display Energy Certificates (DECs), 223–4, 315
- Distributed electricity generation, 301–3
- Distribution networks, 275
- Dobson Units (DUs), 9, 29–30
- Dolgarrog dam failure, 99
- Doxiades, Constantine, 243
- Drainage, 81, 83, 91, 93, 97
- Draughts, 160
- Drought, 80, 82–3, 88–9
dam embankments, 100
risk alleviation, 363
'water wars', 88–9
weather extremes, 80, 82
- Dry conditions, 80–1, 84–5
see also Drought
- Dubai, 255
- Dublin, Ireland, 353
- Ducts: air, 219
- Durability concept, 205
- DUs (Dobson Units), 9, 29–30
- Dysfunctional communities, 353–7
- Earth climate, 182–3, 185
- Earth Summit 1992, 10, 12, 14–15
- Easter Island, 349
- Eastern Britain, 77–8
see also Britain
- Ecological niches, 182
- Economic factors:
crashes/downturns, 205, 227, 299
heat vulnerability, 148
impacts, 137–9
migrants, 134
restructuring, 66–71
scenarios, 35–7
- EDF (Électricité de France), 316
- Edinburgh, 203, 257
- Education:
architects, 325–9, 349
health, 151, 152
- Eigiau dam, 99
- Eklund, Graham, 334
- Elan Valley dams, 98
- Électricité de France (EDF), 316
- Electricity:
air conditioning, 214
embedded generation, 300–3
Eurelectric, 275
Kuwait, 254
nuclear power, 276–8
quality of supply, 300
system failure, 292–3
see also Energy
- Embankments, 100–1
- Embedded electricity generation, 300–3
- Embodied energy, 214
- Emergencies:
contacts, 110–11
evacuations, 110–11
lighting, 332, 334
planning, 361
see also Evacuation
- Emissions, 2, 4–5, 16, 28
air conditioning, 213, 221
aviation, 18, 20, 62–3
per capita, 20, 23
permit trading, 25
reductions
Contraction and
Convergence, 22–5
European Union, 275–6
IPCC, 11–12
Stern Review, 17–18
scenarios, 37–41
precipitation trends, 77, 79
sea level rises, 119, 121–2
temperature change, 54–8
shipping, 19–20
sulphur dioxide, 275–6
trading schemes (ETS), 14, 18, 20
see also Carbon dioxide
- Empire State Building, 238, 259
- Employers, 332–4, 340
- Energy:
consumption, 16, 20–1
DECS, 223–4, 315
EPBD, 222–4, 315, 322, 352
EPCs, 222, 224, 315, 322
Mind the Gap report, 299
modern buildings, 206–9, 213–14
security, 250–1
soaring prices, 304
storage, 302–3
tall buildings, 244, 250–1, 253–5
traditional buildings, 179
White Papers, 266, 289
see also Fossil fuels, Fuel security; individual energies; Renewable energy
- Energy Crisis 1970s, 8
- Energy Performance of Buildings Directive (EPBD), 222–4, 315, 322, 352
- Energy Performance Certificates (EPCs), 222, 224, 315, 322
- Energy Policy White Paper 2003, 266
- Energy Saving Trust, 316
- Engineers, 330–2, 339
- English Heritage, 240
- Environment Agency, 86–7, 319
- Environmental refugees, 134–42
- EPBD (Energy Performance of Buildings Directive), 222–4, 315, 322, 352
- EPCs (Energy Performance Certificates), 222, 224, 315, 322
- Equality, 27
- Esso, 275
- Ethanol, 285–6
- ETS (emissions trading schemes), 14, 18, 20
- EU *see* European Union
- Eurelectric, 275
- Europe:
colonization, 210–11
engineering standards, 332
EPBD, 222–4, 315, 322, 352
fossil fuel, 270, 272, 274
sea level rises, 120
see also European Union
- European Commission, 289
see also White Papers
- European Union (EU), 18–21
air conditioning, 214
comfort temperatures, 171–5
emissions reduction, 275–6
energy performance legislation, 222–4
fire, 65–6
flooding, 76
heat islands, 57
reduction targets, 314–15
renewable energy, 283, 314–15
temperature concerns, 53
- Eurowinter study, 145, 149–50
- Evacuation:
coastal flooding, 130

- failure causes, 111–13
 plans, 110–13
 urban neighbourhoods, 114–16
 windstorm events, 108–16
- Evaporation:
 clothing and, 168
 comfort, 159–62
 cooling, 191, 192
- Evolution of buildings, 179–80,
 192–200, 212
- Exertional heat stress, 145
- Exposure:
 flooding, 131
 risk, 32–3, 34, 48
 vulnerability, 137, 139
- Extinction events, 1, 28, 66
- Extreme climates: traditional
 skills, 348
- Extreme events, 16, 80–2, 291–2
 building occupiers/owners, 332
 cold weather, 71–2
 community resilience, 359–61
 emergency planning, 361
 escape routes, 107–8
 financial risk, 361
 hazard strategies, 362–3
 insurance, 41–3, 47
 land use planning, 359
 market reactions, 334–5
 mitigation measures, 360–1
 per continent 1993–97, 26
 property protection, 360
 recovery planning, 361
 understanding risks, 359
 weather events, 359–61
see also individual events
- Fanger, P.O., 161, 164
- FASTER (Flood And STorm Event
 Reporting), 335
- Fatalities:
 cold weather, 143–4
 insurance loss events, 10, 17
 tall buildings, 249
 windstorms, 104
see also Mortality
- Faulty Towers* energy efficiency
 report, 255
- Financial risk, 361
- Fire, 64–6, 291–2
 risk alleviation, 362
 safety regulations, 334
 tall buildings, 251–2
- see also* Wildfires
- Fishing industries, 66–7, 99
- Flash flooding, 77, 97
- 'Flip flop': oceanic, 122, 124
- Flood And STorm Event Reporting
 (FASTER), 335
- Flooding, 90–7
 accountability, 317–18
 civil unrest, 85–7
 coastal UK, 128–32
 drought effects, 80
 European Union, 76
 evacuation, 108, 114
 FASTER system, 335
 flood plains, 86–7, 92–7, 107,
 317–20
 health risks, 91–4
 insurance, 43–5, 46, 107, 138
 London, 2, 41–2, 128–30
 planning issues, 318–20
 precipitation, 77–8
 risk, 33–4, 36, 91–4, 130–1, 362
 social resilience, 94–8
 subsidence, 83
 summer 2007, 292
- Florida: USA, 108–10, 128
- Food production, 286
- Food security, 69–70
- Forecasting:
 hurricanes, 109–10
 temperature rises, 347, 350
 wind speeds, 203
- Foresight scenarios, 35–7, 49, 91
- 'Forgiveness factor', 206
- Forum for the Future, 283
- Fossil fuels, 266–88
 coal, 275–6
 crisis, 266–88
 developed world, 4
 future aspects, 286
 gas, 272–4
 insurance industry, 41
 nuclear power, 276–8
 price increases, 274–5
 renewable energy, 278–86
 UK oil/gas 1967–2200, 273
see also Oil
- Foster, Norman, 240, 329
- France:
 EDF, 316
 glass buildings, 218
 nuclear power, 277–8
 solar energy, 279
- storms, 108
 traditional buildings, 190
- Free façades, 207
- Free plan buildings, 207
- Free-running buildings, 168–9,
 173–4
- Freeze problems, 71–2, 363
- Fuel poverty:
 air conditioning, 225
 energy prices, 274
 fuel insecurity, 304–6
 national bankruptcy, 300
 Scotland, 225, 304, 307–8, 355
 vulnerable groups, 147
 winter mortality, 145
- Fuel prices, 171–2, 267, 274–5,
 304, 307
- Fuel security, 289–312
 cascading grid model, 308
 civil unrest, 307–8
 economic downturn, 299
 embedded generation, 300–3
 extreme events, 291–2
 insecurity escalation, 304–7
 lights out scenario, 291
 national bankruptcy, 300
 new power paradigm, 303–4
 supplies management, 295–8
 system failure, 292–5
 terrorism, 300
 uncontrolled demand, 298–9
 weather-caused blackouts,
 289–91
see also Fossil fuels
- 'Funnelling' effects of
 overcrowding, 114
- 'Future proofing' buildings, 105,
 140
- Future risk, 33–5, 44
- Gange Dareh settlement, 180
- Gardens, 70–1, 207
- Garnaut, Ross, 5, 18, 27, 344
- Gas, 272–4
see also Emissions..., Energy;
 Greenhouse gases
- GCMs (general circulation
 models), 29
- GDP (gross domestic product), 36
- Gehry, Frank, 230–1
- General circulation models
 (GCMs), 29
- Genocide, 134

- Germany, 244, 252, 282
 Givoni, Baruch, 204
 GLA (Greater London Authority), 316, 330–1
 Glacier melts, 124–5
 Glare, 229–31
 Glasgow, 261
 Glass buildings:
 architects/architecture, 329
 modern buildings, 205, 215–18, 229–31
 power in building industry, 330
 The Shard of Glass, 238–40, 351
 3°C climate change, 351–2
 Glazing: secondary, 356
 Global Commons Institute, 364
 'Global Sustainability' scenario, 36–7
 Global warming, 14, 16
 see also Heat; Temperature change
 Global Warming Potential (GWP), 14
 Goldsmith, Edward, 7
 Gorrie, John, 211
 Government:
 action points, 338
 construction contracts, 330
 poor buildings, 316
 Gravina palace, Naples, 193, 195
 Great Barrier Reef, 67
 Great Central Desert: Iran, 192
 Great Fire of London, 64–5
 Great Salt Anomaly 1960s, 122
 Greater London Authority (GLA), 316, 330–1
 Greece, 65
 'Green' buildings:
 EPBD, 223–4
 LEED, 215, 220, 231–4
 Greenhouse gases, 3–4
 carbon trading, 14
 insurance, 45
 IPCC report, 10–11
 see also Carbon dioxide, Emissions...
 Greenland ice, 119, 122, 125–6
 Greenspan, Alan, 253
 Gross domestic product (GDP), 36
 Groundwater, 88–9
 Gulf Stream, 122–4
 Gupta, Rajat, 345, 355
 GWP (Global Warming Potential), 14
 Hacker, Jake, 357
 Hadley Centre *see* UKCIP02 scenarios
 Halocarbons, 9
 Hancock Tower, Boston, 229–30
 Hangzhou, China, 257
 Hansen, James, 53, 121
 Hazard element of risk, 33–4, 48, 131, 137
 Health, 143–57
 direct/indirect impacts, 59
 educational campaigns, 151, 152
 flooding, 91–4
 heat, 59–63, 143–5, 149–53
 and safety, 326, 332, 334
 thermal comfort, 158–9, 176
 Heat, 51–75, 80
 balance, 159–62, 167–8, 172
 blackouts, 294–5
 comfort, 159, 163–5, 176
 glass buildings, 216–17
 health effects, 59–63, 143–5, 149–53
 islands, 56–8, 226–7
 liability issues, 334
 loss of, 149, 151
 ocean salinity, 122
 passive buildings, 184–5
 risk alleviation, 362
 seasonal migration, 182
 tall buildings, 244, 250–1, 251
 thermal technologies, 190–2
 vulnerability to, 58, 148
 see also Heatwaves; Temperature change
 Heating, ventilation and air conditioning (HVAC), 232, 234
 Heatwaves:
 air quality, 61–2
 health effects, 143
 insurance pay-outs, 43
 mortality, 146–8
 warning systems, 151
 see also Heat
 Heavy-weight building materials, 196
 Herculaneum, Italy, 195–7, 200
 High Emissions scenario:
 precipitation trends, 77, 79
 sea level rises, 119
 temperature change, 54–5, 57–8
 see also Emissions...
 High-rise buildings, 138
 see also Modern buildings; Tall buildings
 Hilton Hawaiian Village, 249–50
 Hong Kong, 61
 Horizontal sliding windows, 207–8
 Hospitals, 94
 Hot water systems, 241
 Hotels, 211
 Houghton, Sir John, 16
 Housing, 262, 306, 365
 see also Real estate
How Buildings Learn (Brand), 321
 Hulme development, Manchester, 209
 Human Rights Act, 262
 Humidity, 78, 203
 Humphreys, M.A., 163, 165, 168–9
 Hurricanes:
 coastal inundation, 127
 Florida, 108–10
 New Orleans, 112–13, 131, 139
 Hutton, John, 306
 HVAC (heating, ventilation and air conditioning), 232, 234
 Hydro power, 281
 Hypothermia, 143–4
 Ice Age, 179–80
 ICE (Institution of Civil Engineers) report, 303
 Ice melts, 118–23, 124–7
 accelerating rates, 119–23
 glaciers, 124–5
 Ice-houses, 187–90, 195–6
 Ice-making machines, 211
 Ice-ploughs, 187–8
 Imported ice, 188
 Income, 354
 India, 208–9
 Indoor air quality, 218–19
 Indoor temperature:
 comfort, 163–4, 169–70, 173–6
 glass buildings, 217–18
 health, 144–6, 149–52

- standards, 333
 traditional buildings, 185, 199–200
 winter mortality, 145–6
- Inequality, 353–5
- Insect infestations, 60
- Institution of Civil Engineers (ICE) report, 303
- Instituto Motori, Naples, 197, 199–200
- Insulation:
 clothing, 167–8
 health benefits, 146, 149–50, 152
- Insurance, 40–8
 coastal homes, 127–8
 dams, 100–1
 drainage floods, 91
 flood plains, 92–4, 97
 flooding, 91–4, 97, 318
 foresight scenarios, 37
 insurers, 335–6, 340
 investment in buildings, 336
 loss events, 10, 17, 44
 premiums, 33, 41, 46–7, 94
 standards, 335–6
 subsidence damage, 44, 82–5
 Thames Gateway development, 130
 viability of industry, 42–6
 vulnerability, 137–8
 water pipe damage, 72
 windstorm damage, 104–7
- Insurance Council of Australia, 359–61
- Intergovernmental Panel on Climate Change (IPCC), 9–12, 18, 38–9, 41, 51–3, 118, 346
- International community, 314–15
- International Organization for Standardization (ISO), 220–1
- Internet, 320–2, 339
- Intramural migrations, 179, 185–6, 193
- Inundations: coastal communities, 126–8, 131
- Investment assets, 205–7
- IPPC (Intergovernmental Panel on Climate Change), 9–12, 18, 38–9, 41, 51–3, 118, 346
- Iran, 180, 182–7, 190–2
- Iraq war, 27, 187, 190
- Island nations, 126
- ISO (International Organization for Standardization), 220–1
- Italy, 290, 296
- Japan, 21
- Jinmao Tower: China, 238
- Jordan River, 87
- Journalists, 321
- Julio Polibio villa, Pompeii, 193–4
- Katrina hurricane, 112–13, 131, 139
- Keighley, E.C., 216–17
- Keynes, Maynard, 329
- Khayyam, Omar, 337
- King, David, 53
- 'Knowledge', 1–2, 5
- Kochi, India, 89–90
- Kovats, Sari, xii–xiii
- Krier, Leon, 245, 329
- Kuwait, 254–5
- Kyoto process, 314
- Kyoto Protocol, 11, 20, 314
- Laban Dance Centre, Deptford, 324
- Labelling schemes: Japan, 21
- Land:
 flood contamination, 94
 ice melts, 118–19
 landfill sites, 64
 landslides, 108
 planning usage, 359
- Las Vegas, 253–4
- Latin America, 187
- Le Corbusier, 207–8
- Leading in Energy and Environmental Design (LEED), 215, 220, 231–4
- Legal action:
 flood plain developments, 86–7
 USA, 15, 30, 136–7
- Leggett, Jeremy, 272
- Legislation, 221–4
- Libel laws, 322, 358
- Libeskind, Daniel, 327
- Lifestyle adaptation, 182–7
- Lifts, 107, 241–2, 244
- Light:
 access rights, 246–8
 blackouts, 289–312
 emergency lighting, 332, 334
 fuel security, 289–312
- Lightweight buildings, 215–18
- Liquid natural gas (LNG), 274
- 'Little Ice Age', 181, 189
- Liverpool, 262
- Livingstone, Ken, 240, 262, 329, 351
- LNG (liquid natural gas), 274
- Local Government Association, 316
- 'Local Stewardship' scenario, 36–7
- Logging, 108
- LogicaCMG energy report, 299
- London:
 air pollution, 61–3
 air conditioning, 215
 blackout 2003, 293, 296
 Canary Wharf, 238, 260, 262
 evacuation strategies, 116
 flooding, 2, 41–2, 128–30
 Great Fire, 64–5
 heat islands, 56–8
 Olympics 2012, 298–9
 The Shard of Glass, 238–40, 351
 tall buildings, 238–40, 244–5, 251, 255, 260
 temperature in 2080s, 202–3
 Underground, 293, 296
 work environments, 58–9
- Loss: insurance, 10, 17, 44
- Loss Prevention Council, 105–6
- Loudon, A.G., 216
- Loudon, F.J., 216–17
- Lovins, Amory, 357
- Low Carbon Wolvercote, 305–6
- Low Emissions scenario:
 precipitation trends, 77, 79
 sea level rises, 119
 temperature change, 54, 57
see also Emissions...
- Low-lying coastal countries, 126
- Luristan, Iran, 180
- Lynas, Mark, 18
- McCartney, K.J., 170–1
- MacCormac, Richard, 240
- Maintenance of tall buildings, 244–5
- Mala Parte villa, Capri Island, 196, 198–9
- Malls, 227–9
- Managed retreat, 128, 363
- Manchester, 203, 209–10, 238

- Marburg: Germany, 282
Market forces, 205, 220
Market reactions to extreme events, 334–5
Markham, S.F., 139–40, 210–11
Marriott Hotel, New Orleans, 112–13
Marseille: France, 202
Maslow's needs triangle, 344–5
Matsuura, Koichiro, 257
Mauna Loa records, 6
Mawhinney, Mark, 141
Mayans, 180, 181
Mechanical systems, 205–6
see also Air conditioning
Media, 320–2, 339
Medical advice *see* Health
Mediterranean region, 192
Medium High Emissions scenario, 55–6
see also sea level rises, 121–2
see also Emissions
Medway, Kent, 306
Melts *see* Ice melts
Mental health, 147
Metabolic heat, 162, 172
Methane (CH₄), 4
Meyer, Aubrey, 22–5, 364
Micro-climates, 70–1
Middle East, 271
Migration, 134–42
health impacts, 59
intramural, 179, 185–6, 193
seasonal, 180–2
Millennium Dome, 323
Milroy, E., 215
Mind the Gap energy shortages report, 299
Minimalism, 208
Miralles, Enric, 324
Models *see* Climate models
Modern buildings, 201
bioclimatic, 197, 199
failure of, 205–36
risk, 32
windstorms, 106–7
see also Tall buildings
Modern Movement architects, 207–8
Moisture, 185, 203
Monofunctional buildings, 115
Montreal Protocol, 9
Moral issues in design, 323–4
Mortality:
heat effects, 144–50
winter excess, 145–6, 149–50
see also Fatalities
Mortgages, 260–1
Motori Instituto, Naples, 197, 199–200
Mould:
health effects, 144, 151
insurance, 41
tall buildings, 250
Mountain communities, 68–9
Mud-brick houses: Yazd, 183–5
Munich Re bulletin, 41–2, 44
Murti, Arjun N., 253
Myanmar, 126–7, 216
Naples, Italy, 64, 192–200
National Centre for Popular Music, Sheffield, 327–8
'National Enterprise' scenario, 36–7
National Library, Paris, 218
National Trust, 128
Nationalizing fuel industries, 275
Natural catastrophes *see* Extreme events
Natural gas *see* Gas
Needs: Maslow's triangle, 344–5
New England, USA, 295
New Orleans, USA, 112–13, 131, 139
New York, USA, 293–5
NGOs (non-governmental organizations), 352
Nicol, J.F., xi–xii, 163, 165, 170–1
Night-time temperature, 55, 57–8
9/11 disaster, 115, 252, 259–60
Nitrous oxide (N₂O), 4
NLV (Norwalk-like virus), 61
Nocturnal convective cooling, 204
Noise, 64, 215–17
Nomads, 180–2
Non-governmental organizations (NGOs), 352
North America, 120
see also Canada; United States of America
Norwalk-like virus (NLV), 61
Norway, 273
Nuclear power, 274, 276–80, 307–8
see also Energy
Occupiers of buildings, 332–4, 340
Oceans:
'flip flop' effect, 122, 124
salinity levels, 122
thermal expansion, 124
Office blocks:
air conditioning, 213, 215
Building Regulations, 205
glass buildings, 215–16
Oil, 267–72
Alaskan fields, 297
conventional fields, 269–72
depletion of resources, 8
how much is left, 269–72
Kuwait, 254
Las Vegas, 253
non-conventional sources, 269, 272
Oil Crunch scenarios, 272
prices, 267
production 1925–2125, 271
USA lobby, 15
world usage scenario 1900–2100, 268
see also Energy
Older people, 146, 147–8
Olympics 2012, 275, 298–9
OpenHydro, 283
Opportunities: adaptive, 169–70, 176, 199, 201
Ormen Lange gas field: Norway, 273
Outdoor temperature:
comfort, 168–71
health issues, 143–4
traditional buildings, 185, 200
Overcrowding, 61, 114–15, 245–6
Overglazed buildings, 215–18
Owners of buildings, 332–4, 340
Oxborough, Ron, 272
Oxford Ecohouse, 304–6
Ozone depletion, 8–9, 62
Ozymandias, 259, 365–6
Pakistan, 163, 171–5
Pallazzo Gravina, 193, 195
Paris, France, 218, 240, 259
Parliament building, Scotland, 324
Passive buildings:

- adaptive potential, 183–7, 191–2, 201–2, 204
- admittance method, 217
- modern buildings, 214–15
- Naples, 192–200
 - see also Traditional buildings
- Passive insurance systems, 46
- Passive low-energy architecture (PLEA), 232–4
- Peak Oil, 267–9, 306
- People and Planet, 352
- Permeability of clothing, 168
- Permits for emissions trading, 25
- Pet owners, 111–13
- Petrol prices, 267, 307
- Philip, Prince (Duke of Edinburgh), 325
- Phoenix, Arizona, 225–7
- Photovoltaic (PV) systems:
 - 2°C climate change, 356
 - LEED, 234
 - Oxford Ecohouse, 305–6
 - renewable energy, 279, 281–2
- Physiological effects of heat, 144–5, 149, 158, 162
- Piano, Renzo, 238
- Pitt, Michael, 85–6, 317
- Place-specific buildings, 182–7
- Planning, 318–20
 - action points, 338
 - assessment tools, 320
 - emergencies, 361
 - flood plain policy, 95–6
 - insurance, 46, 48
 - land use, 359
 - planners, 318–20
 - scenarios, 34–5, 37–8
 - tall building space, 240–2
 - training, 319–20
- Plants, 70–1
- PLEA (passive low-energy architecture), 232–4
- PMV (Predicted Mean Vote), 164, 166
- Political aspects, 221, 358
- Pollution:
 - air, 61–3
 - biofuels, 285
 - liability, 136
 - 'polluters pay', 136–7
 - water, 63
- Pompeii, Italy, 193–4
- Pompidou Centre, Paris, 47
- Portugal, 282–4
- Post-war buildings, 208–9, 216
- Poverty, 137
 - see also Fuel poverty
- Power:
 - cuts, 289–312, 297, 332
 - failures, 138–9
 - stations, 274, 276–80, 306–8
 - see also Blackouts; Energy; Fossil fuels
- Power play in building industry, 329–30
- Prasad, Sunand, 325
- Precipitation:
 - annual averages, 2
 - trends in UK, 76–9, 84, 90–1
 - winter, 77–82, 84, 90
- Predicted Mean Vote (PMV), 164, 166
- Prediction of Regional scenarios and Uncertainties for Defining European Climate change risks and Effects (PRUDENCE), 77, 90–1
- Predictions see Forecasting; Scenario planning
- Prefabricated rafters, 106
- Prescott, John, 315, 317
- Price:
 - 60% carbon reduction, 345–6, 355–6
 - diesel, 267
 - energy, 304
 - fuel, 171–2, 267, 274–5, 304, 307
 - housing improvements, 365
 - oil, 267
 - petrol, 267, 307
 - real estate, 337
- Privatization, 296–7, 315–16
- Property protection, 360
 - see also Real estate
- Proportionality, 27
- PRUDENCE project, 77, 90–1
- Psychology of tall buildings, 242–3
- Psychophysics, 161, 163
- Public health see Health
- Putnam, Richard, 358
- PV see Photovoltaic systems
- Quality of life, 35
- Quangos, 322–3
- Radiation, 159–60, 184, 217–18
- Rafters: prefabricated, 106
- Rainfall trends, 76–9
 - see also Precipitation
- Ranzo villa, Capri Island, 196–7, 199
- Rapa Nui syndrome, 349
- RCEP (Royal Commission Report on Environmental Pollution), 37, 44
- Reactive insurance systems, 46
- Real estate, 336–7, 340
- Reflectance, 229–31
- Refrigerators, 211
- Refugees, 134–42
- Refurbishment of buildings, 320
- Regional economies: biodiversity, 66–7
- Registered power zones (RPZs), 302
- Regulations:
 - air conditioning, 221–4
 - see also Building Regulations
- Relative humidity, 78, 203
- Renewable energy, 278–86
 - bio diesel, 285–6
 - biofuels, 285–6
 - CHP, 284–5
 - ethanol, 285–6
 - European Union, 283, 314–15
 - fair representation, 309–10
 - hydro power, 281
 - solar energy, 278–82, 356
 - tidal power, 284
 - wave power, 283–4
 - wind power, 278–83
 - see also Energy
- Rescue services, 130
 - see also Emergencies
- Research:
 - foresight scenarios, 35
 - London Metropolitan University, 327
 - loss of facilities, 352
 - privatization, 316
 - reopening facilities, 309
- Reservoirs, 98–101
 - 1975 Act, 100
- Resilient constructions, 104–7

- Respiration, 143–4, 146, 159–60
- Rio de Janeiro, Earth Summit, 10, 12, 14–15
- Risk, 32–50
 - analysis and scenarios, 38
 - economic impacts, 137
 - financial, 361
 - flooding, 33–4, 36, 91–4, 130–1, 362
 - future risk, 33–5, 44
 - geographic location, 32–3
 - impacts, 33–4
 - management, 46–7
 - perception of, 111
 - scenario planning, 34–41, 45, 48–9
 - temperature change, 347
 - triangle, 32–3
 - weather-related, 359, 362–3
- Road tax, 21
- Roaf, Sue, xi
- Rogers, Richard, 238–9, 314, 329–30
- Roman constructions, 192
- Roofing damage, 105–6
- Rooftop rooms, 185–6
- Royal Commission Report on Environmental Pollution (RCEP), 37, 44
- RPZs (registered power zones), 302
- Rudge, Janet, xii
- Rudofsky, Bernard, 323
- Running mean temperature, 171
- Russia, 273–4
- Ryghaug, Marianne, 325
- S
- São Paulo, Brazil, 245–6, 250, 252
- Safety:
 - evacuation centres, 110–11
 - fire regulations, 334
 - see also* Health
- Sainsbury's Bull Ring supermarket, Birmingham, 328
- Salingaros, Nickos, 114–15
- Salinity levels in oceans, 122
- Salmond, Alex, 307
- San Francisco, USA, 232–4, 247
- San Francisco Federal Building, 232–4
- Sani people, 182
- Sarking boards, 105
- SARS (severe acute respiratory syndrome), 60–1
- Scenario planning:
 - precipitation trends, 77, 79, 84, 91
 - risk, 34–41, 45, 48–9
 - sea level rises, 119, 121–4
 - temperature change, 54–8
- SCEP (Study of Critical Environmental Problems), 7
- Schnellhuber, John, 40
- Science of climate change, 1–2
- Scotland:
 - flood plains, 95, 97
 - foresight scenarios, 37
 - freeze problems, 71–2
 - fuel poverty, 225, 304, 307–8, 355
 - ice-houses, 188
 - nuclear power stations, 307
 - Parliament building, 324
 - precipitation trends, 76–8
 - risk, 33, 46, 48, 92
 - school blackouts, 290–1
 - sea levels, 121
 - 'water wars', 88
 - see also* individual cities
- Sea ice, 125–7
- Sea level rise, 97–8, 118–33
 - causes, 123–6
 - impacts, 126–32
 - IPCC report, 51
 - risk alleviation, 362
- Seasonal migration, 180–2
- Seasonal temperature change, 80
- Second World War, 354
- Secondary glazing, 356
- Secondary lighting, 332, 334
- Security, 249–51
 - see also* Fuel security
- Sellafield nuclear site, 276–7
- Sense and Science approach, 357–8, 365
- Sequestered carbon dioxide, 18
- SET (standard effective temperature), 166
- Severe acute respiratory syndrome (SARS), 60–1
- Severe weather events *see* Extreme events
- Severn Barrage, 284
- Sewage systems, 319
- Shade, 60, 217
- Shadows, 246–7
- Shanghai, China:
 - evacuation strategies, 114–15
 - power shortages, 297
 - subsidence, 83–4
 - tall buildings, 246–7
 - World Financial Centre, 238
- The Shard of Glass tower, 238–40, 351
- Shell, 270, 272–3
- Shelley, P.B., 259
- Shelter, 180
- Shipping emissions, 19–20
- Shopping malls, 227–9
- Sick building syndrome, 206, 218–19
- Singapore, 209
- 'Singing' buildings, 229–31
- Size of buildings, 237–40
- Ski resorts, 68–9
- Skills: traditional, 348
- Skin:
 - cancer, 60
 - moisture changes, 172
 - temperature, 163, 191–2
 - see also* Body temperature
- Sky climate, 182–3, 185
- Skyscrapers *see* Tall buildings
- Sliding windows, 207–8
- 'Smart' windows, 197, 199
- SMIC (*Study of Man's Impact on the Climate*), 7–8
- Smith, Horace, 365
- Smith, M.K., 364
- Snowfall, 78, 82, 124
- Social factors:
 - connectedness, 358, 364
 - costs, 356–7
 - heat vulnerability, 148
 - housing, 262
 - inequality, 353–5
 - resilience to flooding, 94–8
 - scenarios, 35–6
 - ties, 364
- Solar access rights, 246–8
- Solar energy, 278–82, 356
- Solar hot water systems, 241
- Solar radiation, 203, 217–18
- Southeast Britain:
 - Commons Report, 140
 - dams, 101
 - sea level rise, 121–2, 128
 - water shortages, 90, 137
 - see also* Britain; London

- Space planning, 240–2
- Spain:
 blackout 2007, 294
 energy consumption, 20–1
 renewable energy, 283
 'water wars', 85
- Specific humidity, 78
- Sports utility vehicles (SUVs), 356
- Spring temperature, 55, 57
- Standard effective temperature (SET), 166
- Standards:
 air conditioning, 220–1
 buildings, 105–6, 149
 engineering, 332
 indoor climates, 333
 insurance, 335–6
 ISO, 220–1
 property protection, 360
- Standeven, M.A., 169–70
- Stern Report 2007, 346
- Stern Review 2006, 16–19
- Stochastic electricity generation, 302
- Stockmarkets, 45, 47
- Storage:
 energy, 302–3
 thermal, 199
- Storms:
 coastal surges, 128–30
 damage, 44
 escape routes, 107–8
 extreme storms, 107–8
 risk alleviation, 363
 sea level rise, 121
 tornadoes, 71
 windstorms, 43, 104–17
 winter, 77, 91
see also Extreme events, Hurricanes
- Stroud, Gloucestershire, 306
- Study of Critical Environmental Problems (SCEP), 7
- Study of Man's Impact on the Climate* (SMIC), 7–8
- Subsidence damage, 44, 82–5
- SUDS (Sustainable Drainage Systems), 97
- Sulphur dioxide emissions, 275–6
- Summer precipitation, 77–9, 84, 90
- Summer temperature, 54–8, 63, 80, 150–2
- Supply management of fuel, 295–8
- Sustainability:
 community plan, 319
 development, 14–15, 130–1, 351
 flooding risk, 130–1
 growth, 25
 SUDS, 97
- Sustainable Communities plan, 319
- Sustainable Drainage Systems (SUDS), 97
- SUVs (sports utility vehicles), 356
- Sweat production, 145, 161–2, 192
- Sweden, 9, 277
- Taipei 101 building, 238
- Tall buildings, 206, 237–65
 cities with problems, 253–5
 costs, 243–5
 dead buildings, 256
 energy security, 250–1
 fire, 251–2
 future ideas, 257–9
 high-rise buildings, 138
 historic cities, 256–7
 light access rights, 246–8
 mathematical singularities, 115
 overpopulating districts, 245–6
 psychological problems, 242–3
 security, 249–51
 size, 237–40
 solar access rights, 246–8
 space planning, 240–2
 'target' buildings, 249
 wind access rights, 246–8
 wind proofing, 248–9
 windstorms, 115
see also Modern buildings
- Tanganyika Lake, Africa, 99
- Tar sands, 270–1
- Taxation schemes, 21
- Taylor, Derek, 246
- TB (tuberculosis), 219
- Technical education, 326
- Technology policy, 17–18
- Television reception, 262
- Temperature:
 autumn, 55, 57
 body temperature, 159–62, 191–2
 buildings as modifiers, 149–53, 158–78
 control, 158, 169–70, 172–4
 London by 2080s, 202–3
 mean radiant, 160
 outdoor, 143–4, 168–71, 185, 200
 standard effective, 166
 summer, 54–8, 63, 80, 150–2
 tall buildings, 241
 winter, 54, 56–8, 68
see also Indoor temperature
- Temperature change, 51–75
 air conditioning, 214, 226–7
 annual averages, 2
 coastal waters, 121
 design for 3°C, 344–68
 1°C, 350–353
 2°C, 353–358
 3°C, 358–364
 choice of target, 346–9
 forecasting, 347, 350
 risks diagram, 347
 strategies, 359–63
 timing scenarios, 348
 emissions, 54–8
 glass buildings, 217–18
 global variations, 181
 health effects, 143–4, 145–7, 150–2
 ice melts, 124–6
 scenario planning, 40
 sea level rise, 118
 seasonal, 80
 Stern Review, 16–17, 18–19
 traditional buildings, 179–87, 189–200
- Tents, 180, 182–4
- Tepco (Tokyo Electric Power Co.), 277
- Terrorism, 1, 28, 41, 47–8, 300
- Thames Gateway development, 90, 128, 130–1, 317, 319, 322
- The Moving Finger* poem (Omar Khayyam), 337
- Theft, 307
- Thermal comfort, 158–78
- Thermal expansion of oceans, 124
- Thermal storage, 199
- Thermal technologies, 190–2
- Thermoregulatory processes, 161
- 3°C of climate change, 344–68
see also Temperature change
- Tidal power, 284

- Timber-based buildings, 65–6
 'Tipping points', 53–8
 Titmuss, Richard, 354
 Tokyo Electric Power Co. (Tepco), 277
 Tolerance, 364
 Tornados, 71
 Tower blocks, 209–10
 see also Tall buildings
 Trade unions, 334
 Traditional buildings, 179–204
 architecture, 329
 modern vs traditional, 213–14
 risk, 32
 temperature modification, 149
 Training, 319–20, 365
 Transco, 297–8
 Transition Towns, 306, 353
 Transparency: insurance, 42
 Travel times: tall buildings, 242
 Tribal life, 182–4
 Trust, 364
 Tschundi, 187
 Tuberculosis (TB), 219
 Tufa construction, 195
 Tuvalu island, 5, 126, 135
 Twin Towers:
 World Trade Center, 238, 242, 251–2
 see also 9/11
- UKCIP02 scenarios:
 flooding, 91
 rainfall, 77, 79
 risk and insurance, 37–9, 48
 sea level rises, 119, 121–4
 subsidence, 84
 temperature increase, 54–6
 UN *see* United Nations
 Underground, London, 293, 296
 Underwriting, 44, 46
 UNESCO world heritage status, 257
 United Nations Framework
 Convention on Climate
 Change (UNFCCC), 10–13
 United Nations (UN), 7, 9, 15
 UNESCO, 257
 UNFCCC, 10–13
 United States of America (USA),
 15–16, 22, 26
 air pollution, 62–3
 air conditioning, 211–15, 225–9
 animal behaviour, 67–8
 blackouts, 293–6
 coastal inundation, 127–8
 'denial', 2, 5
 fire, 65
 fossil fuels, 270–1
 freeze problems, 72
 gas, 272
 glass buildings, 229–31
 'green' buildings, 232–4
 heat islands, 57
 hurricanes, 108–9, 112–13, 131, 139
 Iraq war, 27
 legal action, 15, 30, 136–7
 malls, 227–9
 scenario planning, 39
 tall buildings, 238–9, 251–2
 vulnerability, 138–9
 see also 9/11; *individual cities*;
 North America
 Urban evacuation strategies,
 114–16
 Urban flooding, 97
 Urban heat islands *see* Heat:
 islands
 Urban piracy, 250
 Urban webs, 114–15
 USA *see* United States of
 America
 Vasoconstriction, 162
 Vasodilatation, 162
 Venice, Italy, 98
 Ventilation, 152, 193, 195–7, 199, 204
 see also Air conditioning; HVAC
 Vernacular buildings *see*
 Traditional buildings
 Vertical circulation in tall buildings,
 241–2
 Vertical land movement, 119
 Vertigo, 240–1
 Villa Campolietto, Herculaneum,
 195–7, 200
 Villa Julio Polibio, Pompeii, 193–4
 Villa Mala Parte, Capri Island, 196,
 198, 199
 Villa Ranzo, Capri Island, 196–7,
 199
 Violence, 134
 Volcanic stone, 195
 Vulnerability, 137–41
 cold weather, 147
 flooding, 130–1
 heat, 58, 148
 impacts of change, 137–41
 migration effects, 134
 modern buildings, 215–18
 risk, 32–4, 48
 windstorms, 106–7
- Wales, 302
 Walt Disney Concert Hall, 230–1
War and Social Policy (Titmuss), 354
 Warming *see* Global warming;
 Heat; Temperature change
 Warning systems, 16, 151
 Waste, 63–4
 Water:
 bottled water, 335
 capacity calculations, 90
 dead zones, 63
 'ownership', 89–90
 pipe damage, 71–2
 pollution, 63
 quality, 98–9
 shortages, 90, 137, 253–4
 solar hot water systems, 241
 'water wars', 16, 30, 76, 85–9, 137
 water-borne pathogens, 91–2
 waterways, 101
 Watson, Bob, 53
 Wave power, 283–4
 Weather:
 blackouts, 289–91
 forecasting, 109–10
 risk, 359, 362–3
 see also Climate...; Cold
 weather
 Welsh National Assembly, 324
 Wembley Stadium, 323
 Wenham ice, 188
 Western Britain, 77–8
 Wetness, 76–103, 151
 WhisperGen CHP plant, 284
 White Papers: energy policy, 266, 289
 Wildfires, 43
 Wilkinson, Richard, 353
 Wilson, Brian, 290
 Wind:
 access rights, 246–8
 generators, 246

- power, 278–83
- proofing, 248–9
- storms, 43, 104–17
- tall buildings, 246, 248–9
- windcatchers, 183–6, 190–2
- Wind speeds:
 - fire, 64–5
 - forecasts to 2080, 203
 - heat islands, 58
 - insurance data, 107
 - tall buildings, 244, 248–9
- Windows:
 - modern buildings, 207–8, 216
 - passive buildings, 195, 197, 199
 - thermal comfort, 172–3, 176
- see also* Glass buildings
- Wine production, 69
- Winter:
 - health effects, 143–6, 149–52
 - precipitation, 77–82, 84, 90
 - ski resorts, 68
 - storms, 77, 91
 - temperature, 54, 56–8, 68
- Work environments, 58–9
- World Disasters Report, 44
- World heritage status: UNESCO, 257
- 'World Markets' scenario, 35–7
- World Meteorological Organization, 9
- World Trade Center:
 - Twin Towers, 238, 242, 251–2
 - see also* 9/11
- Wyatt, Terry, 330–1
- Yangon, Myanmar, 216
- Yangtze River, China, 89
- Yazd, Iran, 183–7, 190–1
- Zagros mountains: Iran, 180, 182–3
- Zero-carbon housing, 306
- Zoonoses, 91