

Index

This index should be cited as:
IPCC, 2018: Index. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 601-616.

Index

Note: [] indicates the term also appears in the Glossary. Italicized page numbers denote tables, figures and boxed material. Bold page numbers indicate main discussion of topics. Supplementary Material is listed by section number, for example, 1.SM.3, 2.SM.1.3.4.*

1.5°C pathways*, 12–17, 51, 59–64, **93–174**, 265–271, 278, 320, 1.SM.4, 1.SM.6
assumptions, 95, 98, 109–112
carbon dioxide removal (CDR)* in, 17, 21, 95, 96, 118–125, 180, 277, 316
classification of, 99–100, 100, 113–114
CO₂ emissions, 1.SM.6
definition, 51, 53, 59–61
demand-side mitigation and, 97, 460–461
emissions and, 5, 6, 12, 13, 14–15, 18, 51, 95–96, 112, 1.SM.6
emissions, benchmark indicators for
sectoral changes in, 4.SM.1
emissions evolution in, 115–118, 117, 119
feasibility*, 18–19, 52, 56, **71–72**, 380–386
four categories of, 59–61, 62, 63
future emissions in, 96, 104–107
impediments to, 93, 95, 110
implications of, 265–271
investments and economics, 16, 95–96, 150–151, 152–155, 264–265
key characteristics, 112–114, 129
knowledge gaps, 388–390
mitigation and adaptation options*, 110–112, 316–317
mitigation measures, 14–15, 19–21, 51–52, 110–112
model pathways, 12, 14–15, 278
multiple strategies for, 157, 469
near-term action, implications of, 126–129, 128
one-in-two to two-in-three chance (of reaching limit) in, 60, 63, 113
overview of, 108–129, 129
pathway archetypes, 99–100, 100, 112–113, 113
pathways remaining below 1.5°C, 100, 113–114, 160
pathways temporarily exceeding 1.5°C, 100, 113–114, 160
policies, 112, 148–150
remaining carbon budget*, 12, 96, 104–107, 108
scenarios, 98–100, 100
strengthening the global response, 18–23, 70–75, **313–443**
sustainable development and, 19–23, 20–21, 98, 156–157, 156, 448–449, 463–472, 465
sustainable development pathways, 64, 448–449, **466–472**, 469, 479–480
synergies and trade-offs, 18–21, 20–21, 316, 391
system/sector transitions, 14–15, 15–16, **323–349**
time frame for mitigation, 95–96
transformations, 129–148, 322–323, 466
transitions, speed and scale of, 320, 320, 322–323
See also Pathways

1.5°C warmer worlds*, 4–6, 274–281
commonalities in, 277
definition, 53
energy supply and demand in (FAQ), 161, 162
equity and, 54–55, 451–453
impacts in, 7–10, 177–179, 319
importance of adaptation in (FAQ), 396–397, 397
key questions, 274–277
knowledge base for, 52, 53–56
poverty, equality, and equity implications, 451–453
projected climatic changes, 7–10, 186–188, 188, 189
projected risks and impacts, 7–10, 11, 51, **175–311**
risks, vs. 2°C worlds, 5, 7–9, 11, 177–181, 277
storyline of this report, 77–78, 78
storylines of, 277
sustainable development and, 18–23, 55–56, 447
temperature in, 283
time frame for mitigation, 277, 278
variation in, 177, 277, 278
watershed management in, 356
See also Global warming of 1.5°C

2030
emissions gap, 358
emissions levels in, 18, 95, 114

2030 Agenda for Sustainable Development*, 56, 73, 469, 477
See also Sustainable Development Goals

A

Acceptability of policy or system change*, 22, 368–369

Adaptability. See Adaptive capacity

Adaptation*, 5, 10
bottom-up approaches, 317, 368
community-based, 315, **330**, 384, 458
definition, 51, 70, 396
ecosystem-based, 386, 457–458
FAQ on, 396–397, 397
feasibility, 380, 381, 385
finance, 21–22, 379, 456
implementing, 51, 315, 383–386
importance of, 396–397, 397
infrastructure investments, 21
integration with mitigation and sustainable development, 75–76, 448, **467**
knowledge gaps, 388–391
levels of, 51
local participation, 456
maladaptation, 19, 386, 396
in Mekong River basin, 239–240
place-specific, 447, 458
potential for, 247–250
rate of temperature change and, 178
risk reduction and, 5, 10
sea level rise and, 10, 457
socio-economic challenges to, 110
specific sectors, 10
sustainable development and, 19, 447, **456–459**
synergies, 18–19, 391, 447, 475
synergies with mitigation, 386–387, 475,

4.SM.4.5.1, 4.SM.5.2
transformational, 5, 315, 322–323, 384, 397, 456–457

Adaptation behaviour*. See Human behaviour

Adaptation limits*, 10, 70, 454–456
examples of, 455
hard limits, 70, 455
residual risks and, 454–455
for Small Island Developing States, 235
soft limits, 70, 455

Adaptation options*, 10, 19, 316–317, 319, 336–337
in agriculture, 70, 315, 457
cost-effectiveness, 316
education and learning, 337, 456
enabling conditions*, 4.SM.2
energy system transitions, 4.SM.4.3.1
feasibility, 381, 384–386, 385, 4.SM.4.3.1–4.SM.4.3.5
industrial system transitions, 4.SM.4.3.4
land and ecosystem transitions, 4.SM.4.3.2
overarching, 336–337, 338, 385, 389, 4.SM.4.3.5
supporting transitions, 336–337, 338
sustainable development and, 457–458
synergies, 18, 19
urban, 10, 70, 263, 340–341, 384–386, 385
urban and infrastructure transitions, 4.SM.4.3.3

Adaptation pathways*, 64, 70, 396, **458–459**
place-specific, 458

Adaptive capacity*,
enhancing, 316, 319, 456–457
factors affecting, 69
limits to, 10
sustainable development and, 447

Adaptive governance. See Governance

Aerosols*, 12, 65, 118, 120, 267–268
aerosol cooling, 96, 267–268
knowledge gaps, 157
precursors, 98, 102–103, 118, 157
radiative forcing, 102–103
See also Black carbon

Afforestation*, 17, 21, 96, 121, 266, 270, 316, **343**
co-benefits, 316
constraints, 316
FAQ, 394, 395
incentivization of, 147
land requirements, 125, 126, 265, 266, 269, 270, 316
trade-offs, 269

AFOLU. See Agriculture, forestry and other land-use

Africa
Fynbos and succulent Karoo biomes, 260, 261
Limpopo Watercourse Commission, 356
Sahel, 180, 236, 259, 261, 262–263
Southern Africa, 260, 261
tipping points*, 262–263, 264
West Africa and the Sahel, 259, 261, 264
West African monsoon, 262–263, 264

Agreement*. See Confidence; Evidence; Likelihood

Agriculture
adaptation options*, 70, 315, 457
agroforestry, 328, 384

- climate-smart agriculture*, 457, 467
conservation agriculture*, 267, 327, 384, 459
crop yields/productivity, 9, 11, 145, 145, 147, 179, 236–237, 252, 259, 263, 264, 267, 316, 327, 452, 3.SM.3.3.5
emissions, 12, 14, 95, 96, 116–118, 147, 147, 157, 265, 315–316
energy crops, 16, 97
intensification of, 266–267, 327
irrigation, 201, 215, 267, 267, 315, 328, 384, 466
land for, 16, 97, 112, 146, 327–329
livelihoods, 55, 315, 447
mitigation potential, 316
peri-urban, 316
risk reduction, 456
technological innovation and, 329, 370
tipping points*, 263, 264
transformational adaptation in, 384
transitions, 315–316
water-energy-food (WEF) nexus, 386–387
- Agriculture, forestry and other land-use (AFOLU)**, 144–148, 463
CDR and, 17, 121, 144–145
drivers of changes in, 145–146
emissions, 14–15, 114, 118, 268
mitigation options*, 462–463
policy assumptions, 145–146
projections for, 17
- Agroforestry**, 328, 384
- Air pollution/quality***, 157, 241, 250, 267, 316, 464
- Albedo***, 70, 267
- Algae, as bioenergy source**, 111–112
- Alpine regions**, 259, 261
- Amazon**, 340
tropical forest, 221, 263, 340
- Ammonia (NH₃) emissions**, 96
- Anomalies***
global mean surface temperature, 183, 210
soil moisture*, 198, 199, 200
- Antarctic ice sheet**, 7, 178, 208–209, 257, 258, 271, 282
- Antarctic sea ice**, 206, 225
- Anthropocene***, 52, 53, 54, 75
as boundary concept for 1.5°C warmer worlds, 54
geological dimension of, 54
- Anthropogenic emissions***, 5, 95
recent trends, 1.SM.7
- Appliances, energy-efficient**, 316, 331, 460, 461
- Aquaculture**, 8, 9, 237–238
hypoxia and, 224
production, 237–238
risks for, 228
- AR5**. See IPCC Fifth Assessment Report (AR5)
- Arctic region**, 258–259, 338–339, 452, 3.SM.3.3.5
adaptation in, 339
economic effects of climate change, 339
ecosystems, 9, 11, 53, 220
as hotspot, 258, 261, 262, 270, 338
indigenous peoples, 9, 339
land regions, 259, 261
risks for, 9, 53, 251, 252, 253, 452
tipping points*, 262, 264
- warming in, 4
See also Arctic sea ice
- Arctic sea ice**, 8, 205–206, 209, 254
beyond end of century, 270
fisheries and, 224–225
as hotspot and tipping point, 258, 261, 262, 270
projected changes, 205, 212, 254
sea-ice free summers, 8, 178, 205, 206, 254
temperature overshoot and, 8, 178, 206
- Asian monsoon**, 262, 264
- Assessment frameworks**, 75–76
climate models and simulations, 76
confidence, uncertainty, and risk, 77
cost-benefit analysis*, 76
detection and attribution, 76
knowledge sources and evidence, 75–76
methodologies, 76
risk assessment*, 183–186
- Atlantic Meridional Overturning Circulation (AMOC)**, 205, 223, 257
- Atlantic Multi-Decadal Oscillation (AMO)**, 201
- Atmosphere-ocean general circulation model (AOGCM)**. See Climate models
- Attribution**. See Detection and attribution
- Avoided impacts**, 18, 68, 183, 253–265, 447
aggregated avoided impacts, 253–258
hotspots, 258–260, 261
poverty and inequality implications, 452–453, 453
Reasons for Concern, 253–259
reduced risks, 452–453, 453, 455
regional tipping points, 262–263, 264
sustainable development
implications, 452–453, 453
- B**
- Baseline period**. See Reference period
- Batteries**, 325
- Behavioural change**. See Human behaviour
- Beijing, peak car use**, 376
- Bhutan, national goals**, 387
- Bio-based feedstocks**, 315, 335–336, 335
- Bio-technologies**, 319
- Biochar***, 121, 268, 270, 345
- Biodiversity***, 8, 256–257
adaptation limits*, 455
Aichi targets, 266
CDR and, 265, 266, 269
impacts and risks at 1.5°C vs. 2°C, 8, 179, 256–257
management, 10
- Bioenergy***, 12, 17, 97, 111–112, 124, 131, 324–325
carbon intensity of, 324–325
crops, 147
emissions increase with, 96
IAMs/modelling, 124, 2.SM.1.2.4
land use for, 19, 146, 147, 265, 269, 343
risks of implementing, 125
sugarcane for bioethanol in Brazil, 371
trade-offs, 97
water use and, 464–466
- Bioenergy with carbon dioxide capture and storage (BECCS)***, 17, 121, 268–270, 316, 342–343, 394, 395
in IAMs, 124
land requirements, 125, 126, 180, 265–266
net zero emissions and, 135
pathways with, 14–15, 17, 96, 180
risks, 125, 268–270
uncertainties, 158
- Bioethanol**, 371
- Biofuel***, 269, 324–325
- Biomass***, 131, 132–133, 138, 269, 324
- Biome shifts**, 216, 217, 247, 250, 256–257
Fynbos and succulent Karoo biomes, 260, 261
- Bivalve molluscs**, 180, 227, 228, 237, 238, 248, 3.SM.3.2.5, 3.SM.3.2.11
- Black carbon (BC)***, 12, 13, 96, 118, 120, 316, 341–342
main characteristics of, 342
reducing emissions of, 341–342
warming impact, 66
- Blue carbon***, 330, 462
- Bolivian Altiplano**, 458
- Boreal forests**, 8, 263, 264
- Bottom-up approaches**, 317, 368
- Brazil**
bioethanol in, 371
National Adaptation Plan, 340
- Buen Vivir**, 480
- Buildings**, 15–16, 139, 140–142, 316
building codes, 332, 339, 377
decarbonization of energy supply, 316
decarbonization of investments, 378
electrification, 141
energy efficiency and, 332, 339, 377, 460
energy supply/use in, 139, 140–142, 141, 331
heating and cooling demand, 141–142, 331
long-lived infrastructure, 142
low-emission, 317, 460
technological innovations, 370
transitions, speed and scale of, 320
- Burden sharing***, 380, 470
- C**
- Cancun Agreement**, 79, 353
- Car use**
peak car use, 376
pricing policies and use reductions, 366
- Carbon budget***, 12, 96, 104–107
in 1.5°C pathways, 113–114
remaining carbon budget*, 12, 24, 96, 104–107, 108
remaining carbon budget*, assessment methods, 104–107, 2.SM.1.1.2
total, 24
uncertainties, 12, 96, 106, 108
- Carbon cycle***, 96, 103, 157
inertia, 107
oceans and, 257–258
terrestrial, 219, 220
uncertainties, 347
- Carbon dioxide (CO₂)***
cumulative emissions, 6, 12, 62, 67, 96, 105, 114, 123, 126–127, 127

Index

- emissions reductions, 18, 95, 96
- net emissions, 12–17, 13, 14–15, 114, 116, 119
- net zero emissions, 5, 12, 24, 95, 107, 116
- permafrost release of, 104
- sector-specific emissions, 119
- time scales of warming due to, 64
- Carbon dioxide capture and storage (CCS)***, 14, 15, 97, 134–136, 136, 268, 277, 315
 - deployment in 1.5°C and 2°C pathways, 134–136, 136
 - direct air carbon dioxide capture and storage (DACCS)*, 17, 125
 - fossil fuels with CCS, 97, 135
 - in industry sector, 335, 336
 - in power sector, 326–327
 - uncertainties, 136
 - See also Bioenergy with carbon dioxide capture and storage (BECCS)
- Carbon dioxide capture and utilisation (CCU)***, 15, 335, 336
- Carbon dioxide capture, utilisation and storage (CCUS)**. See Carbon dioxide capture and utilisation (CCU)
- Carbon dioxide removal (CDR)***, 17, 70, 118–125, 268–270, 342–346, 4.SM.4.2.5
 - in 1.5°C pathways*, 17, 21, 95, 96, 111, 114, 118–125, 122, 180, 265, 277, 316
 - AFOLU sector, 17, 121
 - co-benefits, 121, 266
 - comparison of removal options, 270
 - costs, 344, 4.SM.3
 - cross-cutting issues, 347
 - definition, 24, 70
 - deployment at scale, 17, 70, 96, 114, 121–124, 122, 180, 265–266, 269–270, 343, 4.SM.3
 - deployment potential, 344
 - design and implementation of, 21, 448
 - ethical aspects, 347
 - FAQ on, 394, 395
 - feasibility, 17, 121, 269, 316, 343, 383, 4.SM.4.2.5
 - governance and, 17, 347
 - key messages, 270
 - knowledge gaps, 158, 390
 - land-based, 268–270
 - land footprint of, 125, 126, 180, 265–266, 269, 270, 343
 - limitations of, 96
 - in model pathways, 12, 14–15
 - net negative emissions, 96, 114, 118
 - ramp-up rates for, 119, 123
 - reducing dependence on, 19, 149, 180, 277
 - risks of, 96, 114, 125, 265–266, 344
 - role of, 17, 21, 96, 111, 114, 122–123
 - side effects, 344, 4.SM.3
 - sustainability and, 21, 96, 114, 124–125
 - Sustainable Development Goals and, 448, 462
 - trade-offs, 21, 96, 462
 - types of measures employed, 17, 70, 96, 121, 125, 265, 268, 270, 316, 342–346, 394
 - uncertainties, 96, 158, 343, 347
- Carbon intensity***, 97
 - of bioenergy*, 324–325
 - of electricity, 97, 130
 - of final energy sectors, 129–130, 130, 137–138, 139
 - of residual fuel mix, 130
- Carbon leakage**, 149, 375
- Carbon neutrality***, 14, 96
 - timing of, 12, 96
- Carbon price***, 95, 152–153, 153, 375–377
 - necessity and constraints, 375–377
 - policies on, 95, 317, 375–377, 460
 - uniform world carbon price, 375
- Carbon sequestration***, 67, 95, 112, 114, 121–124, 147, 266
 - marine, 17, 121, 125, 178, 227, 228, 229, 3.SM.3.2.8
 - in peatlands, 221
 - permanence of, 125
 - soil carbon sequestration (SCS)*, 17, 121, 219, 268, 269, 270, 345
 - terrestrial, 112, 121, 125, 146–147, 219, 265, 316
 - tracking progress toward, 67
 - See also Blue carbon; Carbon dioxide capture and storage
- Carbon sink**. See Carbon sequestration
- Carbonate chemistry**, 178, 222, 223
- Caribbean region**, 260, 339–340
 - small island developing states and territories, 339–340
- China**
 - peak car use in Beijing, 376
 - technology and renewables pathways, 471
- Circular economy**, 335–336
- Cities**, 330–334
 - impacts and risks, 180, 182
 - sea level rise, impacts, 231–232
 - transformation* in, 472–474
 - See also Urban areas; and specific cities
- Civil society**, 23, 317
- Clean Development Mechanism (CDM)***, 474
- Climate change commitment***
 - constant composition commitment, 64
 - geophysical warming commitment, 64–66, 65
 - warming commitment from past emissions, 64–66, 65, 1.SM.5
 - zero emissions commitment, 64–65, 65
- Climate education**, 22, 317, 456
- Climate extreme (extreme weather or climate event)***, 4, 182
 - in 1.5°C warmer worlds*, 7
 - human health and, 240–241
 - impacts, 7, 177–178, 182, 240
 - observed changes in, 4, 7, 177, 210, 223, 1.SM.1
 - precipitation extremes, 7, 178, 189, 190–192, 197
 - projected changes, 7, 177–178, 189, 190–191, 192
 - risks from, 11, 181
 - temperature extremes, 7, 177, 187, 189, 190–191, 192, 210, 255
- Climate feedbacks***, 5, 103
 - biophysical feedbacks, 266–267
 - Earth system feedbacks, 65, 103–104
 - land processes and, 268
- Climate forcers**. See Radiative forcing
- Climate models***, 7, 76, 177, 183–184, 274, 3.SM.1.1
 - Coupled Model Intercomparison Project (CMIP)*, 62, 76
 - downscaling*, 76, 186, 194
 - FAIR, 99, 101, 102, 103, 103, 158
 - HAPPI, 76
 - integrated multimodel studies, 99
 - knowledge gaps, 272
 - MAGICC, 99, 101, 102, 103, 103, 127, 127, 158
 - reduced-complexity, 2.SM.1.1.1
 - regional (RCM), 185
- Climate monitoring**, 317
- Climate projections***
 - climate models and simulations, 76, 183–184
 - definition of, 184
- Climate-resilient development pathways (CRDPs)***, 22, 52, 73, 448–449, 450–451, 451, 468–472, 475–476
 - country and community strategies, 470–471
 - definition, 24, 64
 - development trajectories and equity, 469–470
 - FAQ on, 479–480, 480
 - low-carbon development pathways, 471–472
 - regional and national factors, 22
 - sustainable development and, 22, 448–449
 - trajectories and decision-making in, 451, 480
 - transformations, equity, and well-being in, 468–469, 472, 472–474
 - urban transformations* in, 472–473
 - in Vanuatu, 471
- Climate-resilient pathways***, 64
- Climate sensitivity***
 - equilibrium climate sensitivity*, 103, 104
 - transient climate response*, 96, 184–185
 - uncertainties, 12
 - See also Transient climate response to cumulative CO₂ emissions
- Climate services***, 337, 338, 385
- Climate system***, 5, 208
 - as a global commons, 353
 - assessment of changes in, 183, 186
 - observed changes in, 177
 - tipping points in, 262–263, 270
- Climate target***, 98–99, 151
 - policy assumptions and, 149
 - stringent, 112, 126
- Climate variability***, 279–281
- Coal**, 96–97, 132, 132–133, 138, 461
- Coastal communities**, 9, 181, 182, 222, 453, Table 3.SM.4
 - adaptation, 226, 233, 457
 - adaptation limits*, 455
 - coastal protection, 225, 226, 227–228, 3.SM.3.2.9
 - flooding, 11, 181, 231, 235, 249, 252, 252, 3.SM.3.3.3
 - groundwater, 181
 - infrastructure risks, 181, 226, 231, 235, 249
 - livelihoods, 9, 222, 226, 249, 447, 452
 - relocation of, 457
 - sea level rise and, 207, 225, 231–234, 243, 249, 252, 457
 - tourism, 229, 253

Coastal ecosystems, 8, 181, 182, 226, 249, 330,
Table 3.SM.4
blue carbon*, 330, 462
framework organisms in, 225–226, 248
integrated coastal zone management, 226
protection services, 227–228, 228, 248
restoration of, 330
saltwater intrusion, 8
sea level rise and, 207, 225, 249
storms/storm surge, 223, 249
stress management in, 330
Co-benefits*, 2, 67, 157, 268, 316, 319, 323
of sustainable development*, 447
**Common but Differentiated Responsibilities
and Respective Capabilities (CBDR-RC)***, 318
Community-based adaptation, 315, 330, 360,
384, 458
Conference of the Parties (COP)*
COP 15, 378
COP 16 (Cancun), 353
COP 21, 66, 79, 372
Confidence*, 77, 182
See also Evidence; Likelihood; Uncertainty
Conflict, 245
Conservation agriculture*, 267, 327, 384, 459
Consumption, 53, 56
resource-intensive, 95
responsible, 460
Cook stoves, 460
Cooperation, 23, 461
international, 22, 23, 95, 240
regional, 353–354
Copenhagen Accord, 353
Coral reefs, 8, 11, 179, 229–230, 3.SM.3.2.3,
3.SM.3.2.10, 3.SM.3.3.9
adaptation limits*, 455
bleaching and mortality, 70, 228, 229, 254
Great Barrier Reef (Australia), 228, 251
heat stress, 226, 229
impacts, 221
observed loss of, 8, 228–229
projected losses, 8, 179
projected risks, 53, 225–226, 228, 228–229, 248,
251, 252, 254
protection for coastal areas, 228
storm damage, 222
Cost-benefit analysis*, 76, 150–151
Cost-effectiveness*, 150–151, 152–153, 316
Costs, 76
adaptation, 21–22, 316
economic damages from climate change, 243,
264–265
energy sector transition, 374–375
marginal abatement costs, 16, 95, 150
mitigation, 16, 22, 258, 264, 316
regional economic benefits, 258
social cost of carbon (SCC)*, 150–151, 265, 375
See also Carbon price
Coupled Model Intercomparison Project (CMIP)*,
62, 76
Covenant of Mayors initiative, 354, 355
Crop yields, 9, 11, 145, 147, 179, 236–237, 252,

259, 263, 267, 327, 452, 3.SM.3.3.5
Cuba, risk management in, 339
Cultural practices and resilience, 360
D
Danube River Protection Convention, 356
Decarbonization*
of electricity, 95
of energy sector, 95, 148, 277, 316, 461
of industry sector, 140
of investments, 378
macro-level indicators, 129–130
rate of, 12, 468
transport sector, 333, 461
Decision-making, 321, 360, 365, 456, 462, 469
adaptation, 459
information provision and, 367
participatory, 386, 459
problem-solving, 448–449
sustainable development goals and, 451, 480
Decoupling*, 56, 372, 376, 461
Definitions, 24
See also Glossary
Deforestation*, 263, 264
emissions from, 146
of mangroves, 226, 251
rates of, 146
reducing emissions from (REDD+), 329–330
tipping points*, 263
Deltas and estuaries, 232–233
Demand and supply-side measures*, 97, 111,
161, 317
demand-side measures*, 97, 460–461
investments, 153–154
mitigation and, 97
supply-side measures*, 111
See also Energy supply and demand
Dengue fever, 9, 180, 241
Detection and attribution*, 76, 183, 210–212
attribution methods, 3.SM.1.2
human influences on climate, 4, 51, 59, 81, 82,
186–187, 210–212, 282, 1.SM.2, 1.SM.6, 3.SM.2.1
of impacts, 69, 213
regional precipitation on land, 3.SM.2.2.1
regional temperature on land, 3.SM.2.2.1
sea level rise, 252
Developing countries
adaptation finance, 21
development trajectories, 469–470
international cooperation and, 23
Development pathways. *See* Climate-resilient
development pathways; Pathways
Diet, human, 19, 180, 316, 462, Table 3.SM.12
**Direct air carbon dioxide capture and storage
(DACCS)***, 17, 125, 316, 346, 394
Disaster risk management (DRM)*, 10, 316, 336,
338, 385
in Jamaica, 339–340
Disaster*
early warning systems*, 338, 339, 370
preparedness, 339–340

reduction, technological innovations and, 370
Sendai Framework for Disaster
Risk Reduction*, 70
See also Hazard
Discounting*, 152
Disease, 9, 452
dengue fever, 9, 180, 241
diarrhoea, 452
geographic range shifts of vectors, 9, 180, 241
malaria, 9, 180, 241
vector-borne, 9, 180
See also Human health
Displacement*. *See* Migration
Disruptive innovation*, 22, 111, 319, 323
Double dividend*, 376
Downscaling*, 76, 186, 194, 204
Droughts*, 182, 196–201, 211, 215, 247, 250, 255,
3.SM.3.1.1.2
hotspots, 199, 200, 260
management responses/examples, 356
in Mediterranean Basin and the Middle East,
200–201
observed changes, 196, 211
Palmer Drought Severity Index, 199, 215
precipitation minus evapotranspiration, 198–199,
198, 255
projected, for 1.5°C warming, compared with 2°C,
7, 178, 196–201, 199, 211, 215, 247, 250, 255,
3.SM.3.1.1.2
regional changes, 198–200, 198, 199, 200–201
Drylands, 459
E
Early warning systems (EWS)*, 338, 339, 370
Earth system
feedbacks, 65, 96, 103–104
inertia of, 64
Economic factors, 9, 150–151, 152–155, 264–265
access to finance, 21, 23, 155
circular economy, 335–336, 335
co-benefits ('double dividend'), 376
depreciation of assets, 375
'depression economics', 319
economic damages from climate change, 243,
264–265
green economy, 470–471
incentives, 317, 366, 377
marginal abatement costs, 16, 95, 150, 375
pricing instruments, 317
redistributive policies, 21
regional economic benefits, 258
See also Finance; Investments
Economic growth, 53, 180–181, 182, 319
decoupling from emissions, 56, 372, 376, 461
impacts on, 180–181, 182
mitigation costs and, 258
regional economic benefits, 258
risks at 1.5°C, vs. 2°C, 9, 180–181, 182
in SSPs, 110, 149
Economic indicators/variables
discounting*, 152

Index

- economic diversification, 21, 71, 448
- gross domestic product (GDP)*, 158, 243, 256, 258, 265, 373
- gross fixed capital formation (GFCF)*, 317, 373
- Economic sectors**, 242–244, 256, 3.SM.3.5
 - energy systems, 243–244
 - global economic impacts, 256
 - impacts and risks, 180–181, 242–244, 250, 256
 - tourism, 242–243
 - transportation, 244
- Ecosystem(s)***, 179, 182, 216–230, 250
 - adaptation options*, 384, 385, 4.SM.4.3.2
 - Arctic, 9, 11, 53, 220
 - coastal, 8, 181, 182, 226, 249, 330
 - drylands, 459
 - feasibility of mitigation options, 382
 - freshwater, 213–216, 221, 247
 - impacts and risks at 1.5°C, vs. 2°C, 5, 8–9, 11, 179, 182, 250, 453
 - impacts of temperature overshoot, 277
 - knowledge gaps, 388
 - large-scale shifts in, 69
 - mitigation and, 315, 4.SM.4.2.2
 - observed impacts, 253
 - ocean, 8–9, 179, 221–230, 248
 - resilience, 70
 - restoration of, 329–330, 459
 - risks of severe impacts, 53
 - risks, regional and ecosystem-specific, 219–221
 - succession in, 69
 - terrestrial, 8, 11, 179, 216–221, 247, 251, 3.SM.3.3.7
 - trade-offs, 19
 - transformations, 8
 - transitions, 315, 4.SM.4.2.2, 4.SM.4.3.2
- Ecosystem-based adaptation**, 386, 457–458
- Ecosystem restoration**, 16, 70, 329–330, 384
- Ecosystem services***, 17, 19, 179, 247
 - carbon sinks, 69, 220, 221
 - impacts and risks at 1.5°C, vs. 2°C, 8, 9, 179, 247, 256–257
 - irreversible impacts, 8
 - marine, 179, 221–230, 248
 - mitigation and, 315
 - observed changes, 5
 - terrestrial, 221
- Education (climate education)**, 22, 317, 385, 456
- Effective climate sensitivity**. *See* Climate sensitivity
- Effective radiative forcing**. *See* Radiative forcing
- El Niño-Southern Oscillation (ENSO)***, 58, 201, 257
 - deforestation and, 263
 - La Niña events, 235
 - response in Guatemala, 356
- Electric vehicle (EV)***, 316, 332–333, 333
 - costs of, 325
- Electricity generation/use**, 15, 97, 133–134, 135, 138, 243–244, 326
 - carbon intensity* of, 97
 - decarbonization, 95
 - disruptions of, 326
 - enabling conditions, 387
 - energy storage, 325–326
- evolution of supply over time, 134, 135
- investments, 154
- from renewables, 15, 96, 134, 324
- technological innovations, 370
- Electrification**, 15, 95, 97, 111, 134, 315, 316, 326
 - in industry sector, 335, 336
 - in transport sector, 332–333, 333, 460
- Emission pathways***, 12–17, 13, 14–15, 137, 184, 274–276
 - in a prospective scenario, 276
 - definition and categories, 24, 59–61, 62
 - See also* Pathways
- Emissions**
 - 1.5°C pathways*, 6, 12–17, 13, 14–15, 95, 112, 113–118, 113, 117, 463
 - aggregate, 67–68, 115
 - anthropogenic, recent trends, 1.SM.7
 - in archetype pathways, 112–113, 113
 - benchmark values, 115, 4.SM.1
 - calculating, 66–68
 - carbon budget* and, 96
 - CO₂ equivalent emission*, 67, 127
 - cumulative CO₂, 6, 12, 62, 67, 96, 113, 123, 1.SM.6
 - cumulative CO₂ and temperature, 96, 104, 105, 126–127, 127
 - cumulative emissions*, 6, 12, 62, 67, 123
 - at current rate, consequences of, 5
 - decoupling economic growth from, 56, 372, 376, 461
 - emissions gap, 126, 358
 - future emissions, commitment to, 66
 - global, in 2030, 6, 12, 13, 95
 - long-lived climate forcers, 66–68, 116–118, 117
 - measuring progress to net-zero emissions, 66–68
 - Nationally Determined Contributions (NDCs)*, 56, 95, 126–129, 127, 128, 149
 - negative emissions*, 17, 51, 70, 96, 114, 118
 - net-zero emissions, 12, 51, 95, 107, 116
 - net-zero, timing of, 95, 119
 - non-CO₂, 12, 13, 96, 105–107, 115–116, 147, 1.SM.6
 - past emissions, global warming and, 51, 64–65, 65
 - peak, 95, 115, 129
 - peak, timing of, 115, 126–127, 129
 - reductions, 13, 15, 18, 95, 463
 - reductions, behaviour change and, 317, 363
 - reductions, near-term, 17, 96, 124, 126–129, 128
 - reductions, rate of, 51
 - reductions, remaining carbon budget and, 96
 - reductions, technologies and, 369–370
 - reductions, timing of, 5, 6, 18, 61, 95, 96, 107, 114, 116–118
 - sectoral pathways, 137
 - short-lived climate forcers, 64, 66–68, 118, 120, 316
 - timescales and, 5, 61, 64–66
 - timing of, 95, 117, 119
 - warming commitment from past emissions, 64–66, 65, 1.SM.5
 - zero emissions commitment, 64–65, 65
- Enabling conditions***, 18–19, 52, 148–150, 317–318, 338, 352, 386, 474–475, 4.SM.2
 - adaptation options*, 4.SM.2
 - enabling behavioural and lifestyle changes, 362–369
- enabling technological innovations, 369–372, 370
- FAQ, 392–393
- international cooperation, 22, 23
- knowledge gaps, 390–391
- Manizales, Colombia: enabling environment in, 361
- for mitigation implementation, 381–383
- Energy efficiency***, 15, 96, 137, 140, 315, 316, 460–461
 - appliances, 316, 331, 460, 461
 - behavioural responses and, 460–461
 - building codes, 332, 339, 377
 - efficiency standards, 377, 378
 - food production systems, 315–316
 - improving, 377–378
 - in industry sector, 315, 335, 335
 - mitigation options, 460–461
 - policies, 149, 153, 377–378
 - sustainable development goals (SDGs) and, 448
- Energy sector**, 15, 129–144, 243–244, 315, 324–327
 - adaptation options*, 384, 385
 - carbon dioxide capture and storage in, 326–327
 - carbon intensity, 129–130, 130, 137–138, 138, 139
 - decarbonization, 95, 148, 277, 316, 461
 - decarbonization, macro-level indicators, 129–130
 - diversification of, 21, 448
 - electrification, 15, 95, 97, 111, 134, 315, 316, 326
 - emissions, 96, 137, 138
 - end-use sectors, 136–144
 - energy security, 387
 - feasibility of mitigation options, 382
 - final energy, 137, 138
 - fuel switch, 460–461
 - hybrid systems, 326
 - infrastructure, 326, 384, 385
 - investments, 16, 22, 95–96, 153, 155, 372, 373–374
 - knowledge gaps, 388
 - low-carbon pathways, 462, 464–466
 - low-carbon technologies, 15, 16, 96
 - mitigation options, 12, 14, 460–461, 4.SM.4.2.1
 - renewable energy, 14, 15, 96, 111, 131, 132–133, 316, 324
 - solar energy, 96
 - synergies with Sustainable Development Goals, 19
 - transformation, 129–144, 316, 463
 - transitions in 1.5°C pathways*, 15, 96–97, 130, 315, 316, 324–327, 374–375, 4.SM.4.2.1, 4.SM.4.3.1
 - transitions, speed and scale of, 320, 320
 - water and, 326, 384, 464–466
 - water-energy-food (WEF) nexus, 386–387
- Energy supply and demand**, 15, 17, 96–97, 129–136, 316, 460–461, 466
 - in 1.5°C warmer worlds, 161, 162, 316
 - access to energy, 464
 - air conditioning, 243
 - batteries, 325
 - bioenergy*, 12, 17, 96, 111–112, 124, 324–325
 - carbon intensity of, 129–130, 130, 461
 - demand reductions, 95, 137
 - disruptions and vulnerabilities, 326
 - emissions pathways, 12, 14, 15, 95
 - energy storage, 316, 325–326

- evolution of primary energy contributions, 130–132, 131, 132–134
final energy demand, 137, 138
fossil fuels, 96–97
grid flexibility resources (GFR), 325
low-demand scenarios, 110, 111, 448
mitigation options, 460–461
primary energy supply, 96–97, 130–132, 131, 132–133
smart grids, 316
in SSPs, 109–110, 110
sustainable development goals (SDGs) and, 447–448
synergies and trade-offs, 19, 20–21, 448
transformations in, 129–136, 130–135
urban, 331
See also Electricity generation/use
- Enhanced weathering***, 17, 112, 268, 269, 270, 345–346, 462–463
costs, 316, 345
side effects, 345–346
- Equality***, 448–449, 451–453
in 1.5°C warmer worlds*, 451–453
inequality, 456
inequality, reducing, 18–23, 445–538
- Equilibrium climate sensitivity.**
See Climate sensitivity
- Equity***, 18, 23, 51, 54–55, 448–449, 456, 469–470, 479
in 1.5°C warmer worlds*, 451–453
burden sharing*, 380, 470
climate-resilient development pathways*, 22, 448–449, 469–470
conditions for achieving, 474–475
disproportionate impacts and, 51
fairness* and, 449, 469, 479
gender equity*, 23
intergenerational equity*, 55
international equity, 55
justice and, 22, 55, 456, 470
mitigation efforts and, 18, 55
national equity, 55, 470
policies and, 22, 456
procedural equity*, 55, 73
research gaps, 475–476
responsibility–capacity–need assessment, 470
in social-ecological systems*, 338–341
trade-offs, 19
- Ethics***, 51, 52
- European Union, Covenant of Mayors**, 354, 355
- Evidence***, 451
- Exposure***
factors influencing, 53
numbers of people exposed, 178, 246, 453
See also Hazard; Risk; Vulnerability
- Extinction**, 8, 179, 218, 256–257
commitment to, 218
- Extratropical cyclone***, 203–204, 211
See also Tropical cyclone
- Extreme weather events***, 182, 255
floods and droughts, 214–215, 255
frequency of, 223
heavy precipitation, 255
See also Climate extreme
- Extremes.** *See* Climate extreme; *and specific topics, e.g., precipitation*
- F**
- Fairness***, 449, 469, 479
nation-level fair shares, 470
- FAQs.** *See* Frequently Asked Questions
- Farmer managed natural regeneration (FMNR)**, 459
- Feasibility***, 18–19, 52, 56, 71–72, 380–386, 381, 392–393, 393
adaptation options*, 381, 384–386, 385, 4.SM.4.3.1–4.SM.4.3.5
assessment of, 71–72, 380, 381, 382–383, 4.SM.4.1
definition, 52
dimensions of, 71–72, 380, 381, 392
enabling conditions*, 18–19, 52, 56
mitigation options*, 381, 381, 382–383, 4.SM.4.2.1–4.SM.4.2.5
- Feedback.** *See* Climate feedbacks
- Fiji, freshwater resources**, 368
- Finance**, 21–22, 23, 148–149, 317, 361–362, 372–380, 474
access to, 21, 23, 155, 317, 456
adaptation financing, 21–22, 379, 456
challenges of, 372–375, 373–374, 379
climate-friendly products, 378
de-risking, 317, 378–379
global and national systems for, 317–318, 380
Green Climate Fund, 74, 379
green instruments, 378, 474
innovative, 315, 380
knowledge gaps, 391
low-emission assets, 317
mobilization of, 19, 456
multilateral and national development banks, 317
new forms of, 374, 380, 474
policy instruments and, 317, 372–380
private sector, 21, 22
public-private partnerships, 317, 474
public sector, 21, 317
redirection of, 317, 374, 378
See also Investments
- Financial institutions***, 361–362
- Fires**, 244, 259
forest fires, 8, 247
tundra, 262
- Fisheries**, 8, 9, 11, 237–238, 248, 452
adaptation measures, 238
fin fish, 180, 226–227, 237–238, 3.SM.3.2.7, 3.SM.3.3.10, 3.SM.3.2.12, 3.SM.3.2.13
foodwebs and, 226–227, 248
hypoxia and, 224
livelihoods, 452
management, 227
productivity change, 225, 249, 258
projected impacts, 8, 9, 11, 178, 222, 228, 248, 257
range shifts, 222, 248
restoration of, 330
risks, 180, 228, 237–238, 251, 252, 257
- Floods***, 11, 182, 201–203, 211, 214–215, 3.SM.3.1.1.2
coastal, 181, 231, 235, 249, 252, 252, 3.SM.3.3.3
damage from, 214, 215
Danube River Protection Convention, 356
fluvial, 201–203, 214, 247, 251–252, 252, 3.SM.3.3.4
management in Rotterdam, The Netherlands, 342
numbers of people at risk, 452
observed changes, 201, 211
Philippines, flood measures, 368
projected changes, 179, 201–203, 202, 211, 214, 3.SM.3.1.1.2
risks, with 1.5°C warming, compared with 2°C, 7, 178, 179, 181, 201–203, 202, 214–215, 247, 251–252, 252
sea level rise and, 8
- Fluorinated gases**, 118, 120
- Food**, Table 3.SM.12
GHG-intensive foods, 97, 147
healthy diets and choices, 19, 97, 147, 180, 462
land use for, 97, 145
plant-based proteins, 112
prices, 447, 462, 464
quality/nutrition, 327, Table 3.SM.12
water-energy-food (WEF) nexus, 386–387
- Food demand**
reducing, 464, 466
in SSPs, 110, 110, 111
- Food production systems**, 178, 236–240, 250, 252, 327–329, 453, 464, Table 3.SM.5
climate-smart food production, 239
efficiency of, 315–316, 464
genome modification, 329
land use and, 327–329
mixed crop-livestock production, 315, 328
projected impacts, 179–180, 236–240, 250
technological innovations, 316, 329
tipping points*, 263, 264
See also Agriculture; Crop yields
- Food security***, 180, 182, 237, 238–240, 250
decline in, 53
enhancing, 315–316
food insecurity, 447
mitigation pathways and, 464
projected impacts, 179–180, 239, 250, Table 3.SM.5
risks to, 238–239
strategies for improving, 239–240
- Food shortages**, 9
- Food wastage***, 316, 328–329, 462
- Forcing.** *See* Radiative forcing
- Forest fires**, 8, 247
- Forests***, 220, 316, 329–330
agroforestry, 328, 384
Amazon tropical forest, 221, 263, 340
Australian rainforest, 254
boreal, 8, 263, 264
as carbon sinks, 340
CDR options and, 316
ecosystem restoration, 329–330
emissions, 14
impacts, 220

Index

land area for, 16, 97
land-use change, 146
rainforests, 254, 263, 264
REDD+, 329–330
responsible sourcing of products, 462
risks, 8, 220–221
tipping points*, 263, 264
See also Afforestation; Deforestation; Reforestation

Fossil fuels*
in 1.5°C pathways*, 14–15, 15, 96–97
combined with CCS, 97, 135
countries/economies dependent on, 448, 461, 462
energy sector use, 15, 96–97, 131, 131, 132–133, 138
greenhouse gas emissions, 53, 114
market preference, shifting, 317
reducing investments in, 378

Framing and context, 49–92
assessment and methodologies, 75–76
confidence, uncertainty and risk, 77
feasibility, 71–72
framing asymmetries, 55
global response, 70–75
impacts, 69–70
knowledge base, 53–56, 75–76
sustainable development, 73–75
transformation and transitions, 73
understanding 1.5°C, 56–64

Frequently Asked Questions (FAQs)
How Close are we to 1.5°C?, 81, 82
What are Carbon Dioxide Removal and Negative Emissions?, 394, 395
What are the Connections between Sustainable Development and Limiting Global Warming to 1.5°C above Pre-Industrial Levels?, 477–478, 478
What are the Impacts of 1.5°C and 2°C of Warming?, 282–283, 283
What are the Pathways to Achieving Poverty Reduction and Reducing Inequalities while Reaching a 1.5°C World?, 479–480, 480
What do Energy Supply and Demand have to do with Limiting Warming to 1.5°C?, 161, 162
What Kind of Pathways Limit Warming to 1.5°C and are we on Track?, 159, 160
What Transitions Could Enable Limiting Global Warming to 1.5°C?, 392–393, 393
Why are we Talking about 1.5°C?, 78, 80
Why is Adaptation Important in a 1.5°C-Warmer World?, 396–397, 397

Freshwater systems, 182, 213–216, 221, 247
adaptation initiatives, 368
extreme events, 214–215
freshwater stress, 181
knowledge gaps, 272
water temperature, 214
See also Water resources

Fuel switch, 460–461, 481–506

Fynbos and succulent Karoo biomes, 260, 261

G

Gender equity*, 23, 452

General circulation model (GCM). See Climate models

Genome modification techniques, 329

Geophysical relationships, 101–107
climate and Earth-system feedbacks, 103–104
geophysical uncertainties, 96, 101–104
knowledge gaps, 157–158
non-CO₂ climate forcers, 101–103, 103

Geophysical warming commitment, 64–66, 65

Glaciers*, 206

Global climate model (GCM). See Climate models

Global financial systems, 317–318

Globalisation, 319

Global mean surface temperature (GMST)*, 56–57, 57, 177, 186, 274
1.5°C rise, factors in, 4, 274
anomalies*, 183, 210
definition, 24
measurement of, 12
observed, 4, 6, 186
past emissions and, 51

Global mean surface air temperature (GSAT)*, 12, 56

Global response, strengthening, 18–23, 70–75, 313–443
1.5°C-consistent pathways, implications of, 320–321, 320, 448
accelerating the response, 319–320
adaptation options, 321, 336–337, 338
change, far-reaching and rapid, 352–380, 392
change, historical rates of, 322
cooperation, 22, 23
enabling change, 21–22, 315–318
feasibility assessments, 380–386, 381, 382–383, 385
finance and investments, 317, 321, 361–362, 372–380
governance and policies, 23, 71, 315, 316, 317, 321, 352–355
implementation, 23, 70, 71, 315, 317, 319, 320–323, 352–380
implementing adaptation, 383–386, 385
implementing mitigation, 381–383
integration and enabling transformation, 380–387
knowledge gaps, 318, 387, 388–391
levels of ambition, raising, 315
monitoring and evaluation (M&E)*, 386
policy instruments and finance, 372–380
response options, 19–21, 70–71, 316–317
sustainable development and, 18, 22, 316, 321
synergies and trade-offs, 316, 386–387
system transitions, and rates of change, 322–323
systemic changes, 323–349
transformation and transitions, 70, 73, 315, 380–387
transitions, speed and scale of, 317, 320, 320

Global Temperature-change Potential (GTP), 66–68

Global warming*, 4–6
commitment to continued warming, 64–66, 65,

1.SM.5
current level of, 4, 51, 53, 76, 106, 177, 1.SM.1
definition, 24, 51, 56
with emissions continuing at present rate, 4
geophysical warming commitment, 64–66, 65
human experience of present-day, 53, 1.SM.1
human-induced, 4–5, 51, 53, 53, 54, 59, 81, 82, 186–187, 282, 1.SM.2, 1.SM.6
level in 2017, 51, 59, 81
maximum temperature reached, 5
observed, 4, 51, 53, 53, 58–59, 189–190, 1.SM.1, 1.SM.2, 1.SM.3, 1.SM.6
past emissions and, 51, 64–65, 65, 72
peak in, 5, 65, 96, 101, 177, 277, 278
pre-industrial* reference period, 51, 56, 57–59, 184
projections, 4, 81, 82, 95, 187–188, 188
reference periods, 56–59, 184
regional/seasonal variations in, 4, 59, 60, 81
temperatures used for definition, 51, 106
timescales and persistence, 5
total warming, 59, 61
See also Global mean surface temperature; Temperature

Global warming of 1.5°C, 4–6, 56–64, 187, 274
1.5°C pathways*, 12–17, 51, 93–174
already experienced in some regions and seasons, 4, 51, 59, 68, 81, 452
closeness to (FAQ), 81, 82
context of sustainable development and poverty eradication, 18–23
framing and context, 4–6, 49–92
future emissions and, 6, 13
impacts and risks, compared with 2°C, 5, 7–10, 11, 51, 175–311, 261
not considered ‘safe’, 447, 455
projected climatic changes, 7–10, 186–188
projected timeline for reaching, 4, 95–96, Table 3.SM.7
Reasons for concern (RFCs)*, 10, 11, 181
reference period, 56–59, 184
returning to, after overshoot, 5, 17, 61, 96
stabilization responses/scenarios, 147, 158, 182, 184–185
strengthening the global response, 18–23, 70–75, 313–443
synergies and trade-offs, 19
temperature range for, 51, 187, 188, 275
See also 1.5°C warmer worlds*

Global warming of 2°C, 100
emissions and, 116
impacts and risks, compared with 1.5°C, 5, 7–10, 11, 175–311, 261
OECD scenario for, 373
Reasons for concern (RFCs)*, 10, 11
regions with high risks, 247–250
runoff and floods, 178, 211

Global warming of 3°C, 18, 261
rainforests and, 263

Global Warming Potentials (GWPs), 66–68

Governance*, 19, 71, 316, 317, 352–355
adaptive governance*, 315

challenges in 1.5°C pathways, 95
Covenant of Mayors initiative, 354, 355
governance capacity*, 71
governance framework, 317, 359
inclusive, 475
international, 352–354, 474
knowledge gaps, 390
linkages across sectors, 71
local and regional, 316, 354, 355
multilevel governance*, 19, 23, 317, 352–355, 355, 356, 384, 386, 474–475
national, 316, 353, 361
partnerships among actors, 23
sub-national, 354
water-energy-food (WEF) nexus, 386–387
See also Policies

Green bonds, 378

Green Climate Fund, 74, 379

Green economy, 470–471

Green infrastructure*, 10, 316, 334, 334, 384, 385
investment in, 316

Greenhouse gas(es) (GHGs)*,
long-lived, 64–66, 66–68, 116–118
short-lived, 64, 66–68, 316
See also Carbon dioxide; Methane; Nitrous oxide; Ozone

Greenhouse gas emissions, 14–15, 18
aggregate, 115
benchmark values, 115
cumulative emissions*, 6, 12, 62
drivers of, 53
global, in 2030, 12, 13
reductions in, 6, 12, 13, 14–15, 95
reporting of, 66
timing of reductions, 6, 13, 95
See also Emissions

Greenhouse gas removal*. *See* Carbon dioxide removal (CDR)

Greenland ice sheet, 7, 178, 206, 208–209, 257, 271, 282

Gross domestic product (GDP)*, 158, 243, 256, 258, 265, 373

Gross fixed capital formation (GFCF)*, 317, 373

Gross world product (GWP), 256

Groundwater, 15, 3.SM.3.1.1.3
coastal, 181

Guatemala
Indigenous Table for Climate Change, 360
Maya watershed meteorological forecasts, 360
response to drought and El-Niño, 356

Gulf Cooperative Council (GCC) countries, 462

H

Happiness index (Bhutan), 387

Hazard*, 68, 186–212, 210–212
collocated and/or concomitant, 188
See also Disaster; Risk; Vulnerability

Health. *See* Human health

Heat-related morbidity and mortality, 9, 11, 180, 240–241, 250, 252, 252, 263, 264, 3.SM.3.3.1

Heat stress, 452

coral reefs, 226, 229

Heatwaves*, 9, 263, 264
in cities, 242
deadly, 263, 264
extreme, 177
marine, 177
numbers of people exposed, 178
observed changes, 177
projected changes, 177–178
tipping points*, 263, 264

Holocene*, 53
Holocene Thermal Maximum (HTM), 208

Hotspots, 182, 258–260, 261
drought*, 199, 200
precipitation, 193, 194
temperature, 190–191, 193

Human behaviour*, 362–369
adaptation behaviour*, 363
adaptation options*, 457
behavioural change*, 19, 21, 22, 97, 315, 317, 461
behavioural change, enabling, 362–369
behavioural change, knowledge gaps, 390–391
dietary choices, 19, 97, 147, 180, 316, 462
energy efficiency* and, 460–461
factors affecting, 364–365
habits, heuristics, and biases, 365, 461
knowledge and, 364
mitigation behaviour*, 362, 363
motivation and, 364–365
rebound effect, 460
See also Values

Human health, 9, 178, 182, 240–241, 250, 385
adaptation limits*, 455
air quality and, 241, 250, 464, Table 3.SM.9
benefits of emissions reductions, 12
co-benefits, 157
cold-related mortality, 241
heat-related morbidity and mortality, 9, 11, 180, 240–241, 250, 252, 252, 263, 264, 3.SM.3.3.1
impacts and risks at 1.5°C, vs. 2°C, 9, 180, 182, 240–241, 250, 252, 453
occupational health, 241, 250
population health, 337, 338, 385, 457
risks, 180, 240–241, 252
temperature-related risks, Table 3.SM.8
tipping points*, 263, 264
trade-offs, 19
urban areas, 180
vector-borne diseases, 9, 180, 241, Table 3.SM.10

Human-induced warming, 4, 51, 59, 81, 82, 186–187, 188, 282, 1.SM.2, 1.SM.6
equal to observed warming, 51, 59
rate of, 66

Human population, 51, 319
current, 319
displacement/migrations of, 180, 181, 244–245, 337, 338, 385
growth of, 95, 319
in regions where 1.5°C already exceeded, 51
in SSPs, 109, 110

Human rights*, 55, 450, 460, 469–470, 475

Human security*, 9

Hydrofluorocarbons (HFCs), 12, 96, 118, 341–342, 342
radiative forcing from, 342

Hydrogen, 15, 315, 335, 336

Hydrological cycle*, 191–196

Hydropower, 201, 214, 243, 466

I

Ice sheets*
albedo and, 257
Antarctic ice sheet, 7, 178, 208–209, 257, 258, 271, 282
Greenland ice sheet, 7, 178, 206, 208–209, 257, 271, 282
marine ice sheet instability (MISI), 257, 258
sea level rise and, 7, 178, 206, 208, 257, 271
thresholds, 257
time frame for loss of, 257
tipping points, 282
(Climate change) Impact assessment*, 76, 185–186

Impacts*, 7–10, 68–70, 175–311
in 1.5°C and 2°C warmer worlds*, 7–10, 177–179, 182, 319
in 1.5°C pathways, vs. overshoot pathways, 51, 61, 62
attribution for, 69, 213
avoided, 18, 68, 183, 253–265, 447, 452–453, 453, 475
climate extremes and, 7, 177–178, 182
coastal and low-lying areas, 231–234, Table 3.SM.4
definitions, 24, 68
direct vs. indirect, 69
disproportionate, 11, 51, 447, 452
distribution of, 10, 11, 18, 181, 255–256
drivers of, 69
economic sectors and services, 180–181, 182, 242–244, 250, 256
ecosystems, 178, 179, 182
emission pathways* and, 51, 282
FAQ on, 282–283, 283
food systems, 179–180, 182, 236–240, 250, Table 3.SM.5
global aggregate, 10, 11, 181, 182, 256–257
global and regional climate changes, 186–212, 210–212
human health, 9, 180, 182, 240–241, 250, 252, 453
impact assessment*, 76, 185–186
impact cascades, 69, 245, 452
irreversible, 5, 61, 177, 251, 252, 254
knowledge gaps, 272–273
land use, 179–180
livelihoods, poverty, and migration, 244–245, 447
marine ecosystems, 8–9, 179, 221–230
non-linearity, 69–70
observed, 5, 53, 212–253
ocean, 5, 8–9, 178, 179, 180, 182, 221–230, 228, 248–249, 3.SM.3.2.1–3.SM.3.2.13
projected risks, 7–10, 212–253
regional, 9, 68, 180–181, 182, 189–196
sea level rise, 7–8, 181, 182, 206–207, 212

Index

- small islands and coastal areas, 181, 182
- summary of, 182–183, 182, 247–250, 251–253
- terrestrial ecosystems, 8, 11, 179, 216–221, 252, Table 3.SM.2
- time-integrated, 61, 62
- timescales of, 61, 62
- uncertainties*, 69
- uncertainty propagation, 3.SM.1.3
- urban areas, 241–242
- water resources, 179, 3.SM.3.1.1.2–3.SM.3.1.1.4
- Implementation.** See Global response, strengthening
- Inclusion/inclusive processes,** 331, 333, 353, 381, 449, 475
 - cultural considerations, 384
 - decision-making, 456
- Incremental adaptation.** See Adaptation
- India, technology and renewables pathways,** 471
- Indigenous knowledge*,** 22, 315, 337, 338, 339, 385, 456, 480
 - community adaptation and, 360
 - in Guatemala, 360
 - Indigenous Table for Climate Change (Guatemala), 360
 - in Pacific Islands and small island developing states, 360
 - in Tanzania, 360
- Indigenous peoples,** 23, 447
 - in Arctic, 9, 339
 - cultural beliefs, 364
 - land tenure, 462
 - Maya (in Guatemala), 360
 - risks and impacts, 9
- Industry sector,** 334–336, 4.SM.4.3.4
 - adaptation options*, 385, 386
 - bio-based feedstocks, 335–336, 335
 - carbon capture and storage (CCS), 335, 336
 - changes in structure of, 375
 - decarbonization, 140
 - electrification and hydrogen, 335, 336, 460
 - emissions, 15, 114, 140, 334
 - energy efficiency, 315, 335, 335, 460
 - energy-intensive industry, 334
 - feasibility of mitigation options, 383
 - final energy demand and use, 138–140, 139
 - knowledge gaps, 389
 - mitigation options*, 335, 4.SM.4.2.4
 - substitution and circularity, 335, 335, 460
 - technological innovations, 370, 460
 - transitions in, 15, 334–336, 460, 4.SM.4.3.4
 - transitions, speed and scale of, 320, 320
- Inequality**
 - in 1.5°C warmer world*, 447
 - adaptation pathways* and, 458–459
 - increased, 53, 319
 - persistent, 471
 - reducing, 18–23, 72, 445–538, 456, 475
 - research gaps, 475–476
 - See also Equality
- Information and communication technology (ICT)*,** 316, 319
- Information flow and sharing,** 377–378, 456, 457
- Infrastructure**
 - adaptation options*, 384–386, 385, 4.SM.4.3.3
 - climate-resilient, 386
 - coastal, 181, 226, 231, 235, 249
 - decommissioning of existing, 374
 - feasibility of mitigation options, 382
 - floods and, 181
 - green infrastructure*, 10, 316, 334, 334, 384, 385
 - investments in, 21, 333, 373–374, 374
 - knowledge gaps, 388–389
 - lock-in of carbon-emitting, 18, 126
 - low-emission, 317, 374
 - mitigation options*, 4.SM.4.2.3
 - sea level rise and, 8, 231, 249
 - transitions in, 15–16, 4.SM.4.3.3
 - urban, 331, 333
- Insects,** 254–255
 - phenology, 216, 218
 - pollination by, 216, 218, 255
 - range loss, 254–255, 256–257
 - species loss, 179, 218
- Institutional capacity*,** 19, 71, 359–362
 - cooperative institutions and social safety nets, 362
 - enhancing, 359–362, 384
 - monitoring, reporting, and review, 361
 - policy design and implementation, 359–360
- Institutions*,** 359–362, 474–475
 - financial, 361–362
 - institutional capacities, 359–362
 - knowledge gaps, 390
 - monitoring, reporting, and review, 361
 - reform: Manizales, Colombia, 361
- Integrated assessment*,** 95
- Integrated assessment models (IAMs)*,** 99, 100–101, 108–109, 136–137
 - assumptions, 2.SM.1.2.2, 2.SM.1.2.3
 - bioenergy and BECCS deployment in, 124, 268
 - CDR and, 268–269
 - global economic impacts, 256
 - knowledge gaps, 158
 - land use and bioenergy modelling, 2.SM.1.2.4
 - multiple IAMs, 463–464
 - scope, use and limitations, 2.SM.1.2.1
- Integrated assessment model (IAM) scenario database**
 - configuration, 2.SM.1.3.1
 - data collected, 2.SM.1.3.4
 - modelling Framework Reference Cards, 2.SM.2 Part 2
 - overview of mitigation measures, 2.SM.1.2.6
 - overview of scenarios, 2.SM.1.3.2
 - overview of studies, 2.SM.1.3.3
 - scenario classification, 2.SM.1.4
 - summary of models, Table 2.SM.7
- Interconnectivity,** 52, 54, 319
- International agreements,** 70, 317
- International cooperation,** 22, 23, 95
 - Mekong River Commission, 240
- International governance,** 352–354, 474
- Internet of Things (IoT)*,** 331
- Invasive species,** 8, 9, 223
- Investments,** 21, 95–96, 149, 153–155, 316, 372–380
 - decarbonization*, 378
 - energy-related, 16, 95–96, 153, 155
 - green investment, 474
 - incentives, 317
 - investment needs, 373–374
 - knowledge gaps, 158
 - low-emission, 154, 317, 378
 - mitigation, 21, 95–96, 466
 - policy instruments and, 317
 - speed and scale of change, 321
 - upscaling of, 15, 317
 - world investment, 317, 373
 - See also Finance
- IPCC Fifth Assessment Report (AR5),** 51, 81
- IPCC Special Report on 1.5°C (SR1.5),** 4, 74, 79
 - storyline, 77–78, 78
 - timeline of, 80
- Iron fertilization.** See Ocean fertilization
- Irreversibility*,** 5, 61, 177, 251, 252, 254, 262, 277
 - temperature overshoot and, 8, 61, 179
 - See also Tipping points
- Italy, Province of Foggia, multilevel governance in,** 355
- J**
- Jamaica,** 339–340
- Justice*,** 448–449, 456, 469
 - distributive justice*, 55
 - justice-centered pathways, 470
 - procedural justice*, 55
 - social justice*, 22, 448–449
 - See also Equity; Ethics; Fairness; Human rights
- K**
- Kampala, Uganda, Climate Change Action Strategy,** 340
- Kigali Amendment,** 118
- Kiribati, adaptation in,** 368, 471
- Knowledge gaps,** 157–158, 388–391
 - impacts and risks, 272–273
 - See also specific topics
- Knowledge sources,** 52, 53–56, 75–76
 - grey literature, 76, 451
 - indigenous knowledge*, 22, 315, 337, 338, 339, 385, 456, 480
 - local knowledge*, 22, 339, 457
 - scientific literature, 75, 451
- Krill,** 227, 228, 3.SM.3.2.6
- Kyoto Protocol*,** 80, 353
 - Kyoto GHG-emissions, 14, 115–116, 117, 119, 126
- L**
- Land management,** 17, 19, 180
 - carbon dioxide removal and, 121, 180
- Land surface air temperature*,** 56
- Land use*,** 144–148, 180, 327–329
 - adaptation options*, 384, 385, 4.SM.4.3.2

- for agriculture and food, 16, 97, 112, 146, 327–329
carbon dioxide removal (CDR)* and, 125, 126, 265–266, 268–270, 343
climate-resilient, 333
feasibility of mitigation options, 382
governance and, 17
intensification of, 16
knowledge gaps, 388
mitigation options, 148, 265–266, 382, 462–463, 4.SM.4.2.2
mitigation potential, 315
modelling, 2.SM.1.2.4
planning: Manizales, Columbia example, 361
risks of carbon release, 221
sustainability of, 16, 97
synergies and trade-offs, 19, 20–21
transitions in, 16, 17, 96, 97, 144–148, 315, 327–329, 4.SM.4.3.2
urban, 316, 333
- Land-use change (LUC)***, 112, 126, 144–148, 179, 180
in agricultural sector, 98, 144–148
bioenergy production and, 69
biophysical feedbacks, 266–267
CDR and, 268–269
overview of, 145
pace of, 145, 146
risks in mitigation pathways, 69, 97, 265–266
in SSPs, 145
- Large scale singular events**, 10, 11, 181, 254, 257–258
- Last Glacial Maximum (LGM)**, 208
- Lifestyles**, 315
choices, 97, 180
consumption and, 53, 56, 95, 97
emissions reduction through, 317
lifestyle change, enabling, 362–369
lifestyle change, knowledge gaps, 390–391
low energy demand, 97
low resource use, 97
mitigation and adaptation behaviour, 362–363
in SSPs, 110
sustainable, 276
See also Food; Human behaviour
- Likelihood***, 77, 182
- Limpopo Watercourse Commission**, 356
- Livelihoods***, 73, 182, 244
agricultural, 55, 315, 447
coastal, 9, 222, 226, 249, 447, 452, 455
impacts and risks of 1.5°C warmer worlds*, 452
poverty and, 244
security, promoting, 456–457
- Livestock**, 9, 180, 264, 327–328
animal feed, 112
emissions, 147, 327
land use, 97
mixed crop-livestock production, 315, 328
production, 237
in the tropics and subtropics, 263, 264
- Local communities**, 23
- Local knowledge***, 22, 339, 457
- Local participation**, 456
- Lock-in***, 18, 126, 129
- London, U.K.**
adaptation and disaster risk management, 458
car use/policies, 366
- Long-lived climate forcers (LLCF)***, 66–68, 116–118, 117
time scales, 64–66
- Loss and Damage***, 454–456
- Low-carbon pathways**, 471–472
- M**
- Maharashtra, India, water resources**, 368
- Maladaptive actions (Maladaptation)***, 19, 386, 396
- Malaria**, 9, 180, 241, 452
- Mangroves**, 225, 226, 228, 228, 248, 252, 462, 3.SM.3.2.1, 3.SM.3.3.8
replanting, 330, 457
- Manizales, Colombia**, 361
- Marginal abatement costs**, 16, 95, 150, 375
- Marine ecosystems**. *See* Ocean ecosystems
- Mayan K'iché population in Guatemala**, 360
- Mediterranean region**, 259, 261
droughts, 200–201
threatened systems, 254
- Mekong River basin**, 239–240
- Methane (CH₄)***, 268, 316, 341, 342
AFOLU sector, 118, 147, 147
agricultural, 96
emissions, 13, 118, 120
emissions, evolution of, 96
emissions reduction, 12, 95, 102, 157, 268, 316
mitigation potential, 118
release from permafrost*, 12, 104
release from wetlands, 12
zero emissions commitment (ZEC), 65
- Migration***, 180, 181, 232, 244–245, 337, 338, 385
as adaptation, 457
(internal) displacement*, 245
sea level change* and, 232
- Millennium Development Goals (MDGs)***, 74, 450, 477
- Mitigation***, 19–21, 70, 93–174
in 1.5°C pathways*, 12–17, 51–52, 93–174, 465
adaptation and, 19, 386–387, 4.SM.4.5.1
classification of, 99–100, 100
costs, 16, 22, 258, 264, 316
decisions after 2030, 56
definition, 70
demand-side measures*, 97
equity considerations, 55
feasibility, 15, 380, 381
global response, strengthening, 19–21, 70–75, 313–443
implementing, 381–383
integrated mitigation studies, 95
investments, 21, 95–96, 466
knowledge gaps, 388–391
non-CO₂ mitigation, 95, 96, 105–106, 108, 115–116, 120, 265, 268
risks and risk reduction, 5, 179, 448
socio-economic challenges to, 110
sustainable development and, 12, 19–21, 97, 156–157, 447–448, 459–466, 465, 481–509
synergies and trade-offs, 18–21, 20–21, 72, 97, 157, 316, 386–387, 391, 459–463, 465, 4.SM.4.5.1
synergies with adaptation, 386–387, 475, 4.SM.4.5.1, 4.SM.5.2
time frames for, 277, 278, 279–281
See also 1.5°C pathways; Pathways
- Mitigation behaviour**. *See* Human behaviour
- Mitigation options***, 19–21, 316–317, 319, 323, 324–347, 463, 481–509
1.5°C pathways*, 100, 110–112, 316–317, 465
CDR, 4.SM.4.2.5
emissions reduction with, 12, 13, 14–15
enabling conditions, 381–383
energy supply and demand, 460–462, 4.SM.4.2.1
feasibility assessment, 381, 381, 382–383, 4.SM.4.2.1–4.SM.4.2.5
industrial system, 4.SM.4.2.4
land-based, 16, 462–463, 4.SM.4.2.2
mitigation–SDG table, 481–509
overview, 2.SM.1.2.6
SDGs and, 19–21, 20–21, 448
synergies and trade-offs, 459–463, 463, 465, 4.SM.4.5.1
urban and infrastructure, 4.SM.4.2.3
- Mitigation pathways***, 93–174, 265–271
1.5°C pathways*, 12–17, 13, 14–15, 60–61, 98, 101, 102, 108–129, 110, 2.SM.1.5
2°C pathways, 96, 100, 101, 102
adaptive mitigation pathway, 60–61
carbon dioxide removal (CDR) in, 118–125, 180
challenges, opportunities, and co-impacts, 147–157
emissions and, 12, 14–15
four model pathways, 12, 14–15, 61, 62
geophysical characteristics, 101–104
groups/classification, 61, 62, 113–114, 113
land-use change, 265–266
overview, 108–129, 129
prospective, 60, 63
scenarios in, 98–100, 100, 277, 279–281
sustainable development and, 463–472, 465, 2.SM.1.5
synergies and trade-offs, 465
transformations, 129–157, 466
See also 1.5°C pathways; Pathways
- Mitigation potential**, 118, 315, 363
- Mitigation scenarios***. *See* Mitigation pathways
- Models**. *See* Climate models; Integrated assessment models (IAMs)
- Monitoring and evaluation (M&E)***, 386
- Monitoring, reporting, and review institutions**, 361
- Monsoon**, 194, 262–263, 264
- Montreal Protocol**, 118, 353
- Mosquitoes**, 241
- Motivation***, 364–365
- Mountain ecosystems**, 254

Index

N

Narratives*, 52, 109

Nationally Determined Contributions (NDCs)*, 56, 95, 126–129, 127, 128, 149, 159, **357–359**
adaptation and, 359
consistency of, 357–359
remaining carbon budget and, 113–114
uncertainties and, 358

Natural gas, 97

NDCs. See **Nationally Determined Contributions (NDCs)**

Negative emissions*, 17, 51, 70, 118–121, 394, 395, 474
CDR, role in, 70, 114, 118
FAQ on, 394, 395
See also **Net-zero emissions**;
Net-zero CO₂ emissions

Net negative emissions*, 51, 96, 114, 116, 474

Net-zero emissions*, 5, 24

Net-zero CO₂ emissions*, 12, 51, 95, 116
definition, 24
measuring progress to, 66–68
necessary to stabilize GMST, 116, 161
timing of, 5, 12, 13, 61, 95, 107, 116, 119

New York, United States, adaptation initiatives, 340

Nitrogen fertilizer, 116

Nitrous oxide (N₂O)*, 13, 66
agricultural, 96, 116–118, 147
bioenergy and, 12
emission increases, 96
emission reductions, 116–118

Non-CO₂ climate forcers, 96, 120, 341–342
geographical variation in, 103
reductions in, 95
uncertainties, 101–103, 103, 106, 108

Non-CO₂ emissions*, 12, 13, 96, 106, 115–116, 265, 1.SM.6
agricultural, 147, 147
reducing, 341
remaining carbon budget* and, 105–107, 108

Non-governmental organizations, 22

Non-overshoot pathways. See **Overshoot**; **Pathways**

Nuclear energy, 14, 15, 325, 461
costs of, 325
role in primary energy supply, 130–131, 132, 132–133
safety of, 325
water use and, 466

O

Ocean(s), 8–9, 178, 182, 221–230, 248–249, 3.SM.3.2, Table 3.SM.3
adaptation options, 225
biodiversity, 8
carbon sequestration, 17, 121, 178, 222, 227, 228, 248, 257–258
carbon uptake, 17, 121, 178, 227, 228, 229, 3.SM.3.2.8
circulation, 204–205, 212, 223, 248
foodwebs, 226–227, 228, 248

heatwaves*, 177
hypoxia and dead zones, 179, 210, 224, 248
impacts and risks at 1.5°C, vs. 2°C, 5, 8–9, 178, 179, 180, 182, 221–230, 228, 248–249, 3.SM.3.2.1–3.SM.3.2.13
irreversible impacts, 8
knowledge gaps, 272–273
productivity/fisheries, 8, 179, 249
projected changes, 8–9
pteropods, 224, 226–227, 3.SM.3.2.4
Reasons for Concern, 3.SM.3., Table 3.SM.6
salinity, 209
Southern Ocean, 257–258
storms, 222–223, 249
stratification, 222, 224, 248
temperature, 8, 177, 204–205, 212, 222, 223–224, 248
thermal inertia/expansion of, 64–65, 107, 282
warming over, 4, 51
See also **Coastal communities**; **Coral reefs**;
Fisheries; **Sea level change**

Ocean acidification (OA)*, 8, 209–210, 212, 223–224, 248, 282
pH*, 212, 222, 223
reversal of, 5, 67
risks from, 180, 223–224, 227

Ocean alkalization, 17, 121, 345–346

Ocean chemistry, 209–210, 223–224
carbonate chemistry, 178, 222, 223

Ocean ecosystems, 8–9, 179, 221–230, 248
blue carbon*, 330, 462
critical thresholds, 179
ecosystem services, 227–229, 228
foodwebs, 226–227, 228, 248
framework organisms, 225–226, 248
impacts, 8, 9, 178, 179, 221–230, 228, 248
ocean circulation and, 223, 248
species range shifts, 222, 248

Ocean fertilization*, 346, 462–463

Organization for Economic Co-operation and Development (OECD), 373

Overshoot*, 12, 14–15, 18, 51, 100, 179, 265
CDR and, 17, 95
definition, 24
emission reductions and, 13, 14–15, 18, 95, 116
impacts of, 60
irreversible impacts, 61, 179
low-OS vs. high-OS, 100
magnitude and duration of, 179, 265
no or limited overshoot, 12–17, 13, 14–15, 60–61, 62
returning to 1.5°C after overshoot, 5, 17, 61, 96
risks of, 5, 177, 179, 277

Ozone (O₃)*, 268
ozone-related mortality, 9, 180, 250
precursors, 98, 118, 241
tropospheric, 236

P

Pacific decadal variability (PDV), 201

Paris Agreement*, 4, 18, 77, 79, 353

aim and context, 54–55, 66, 74, 77, 79, 359
equity principle, 51, 54, 479
goal of adaptation, 359
goal of limiting warming, 51
time horizon for, 74
transparency framework, 361

Pathway archetypes, 99–100, 100, 112–113, 113, 147
cumulative CO₂ emissions, 123
electricity generation, 135
land-use change (LUC)*, 126, 145
land use/footprint, 147
primary energy contributions, 130–131, 131

Pathways, 12–17, 49–64, 62–64, **93–174**
1.5°C pathways*, 12–17, 14–15, 52, 59–64, **93–174**, 100, 160, 265–271, 274–276, 320, 1.SM.4, 1.SM.6
2°C pathways, 96, 100, 101, 102
adaptation pathways*, 64, 70, 396, **458–459**
assumptions, 95, 109–112
bioenergy with carbon dioxide capture and storage (BECCS)*, 17, 96
carbon dioxide removal (CDR)* in, 17, 21, 95, 96, 111, 118–125, 180, 265–266
classification of, 61, 62, 99–100, 100, 113–114, 113
climate-resilient development pathways, 22, 52, 64, 73, 448–449, 450–451, 451, **468–472**, 475–476, 479–480, 480
definitions of, 59–61, 63–64
emissions in, 12–17, 13, 14–15, 24, 95, 96
four categories/model pathways, 12, 14–15, 59–61, 62, 63, 265–271
geophysical characteristics, 101–104
implications beyond end of century, 270–271, 278
net-zero CO₂ emissions*, 12, 61, 66–68, 116
nexus approaches, 467
no or limited overshoot, 12–17, 13, 14–15, 60–61, 62, 100
non-CO₂ mitigation, 265, 268
overshoot pathways, 12, 14–15, 18, 24, 51, 60–61, 62, 100, 277
overview, 108–129
portfolio of measures, 12, 15
prospective mitigation pathways, 60, 63
Representative Concentration Pathways (RCPs)*, 62
scenarios used, 98–100, 100
sector and system transitions, 14–15, 15–16
Shared Socio-economic Pathways (SSPs)*, 62–63, 109–110, 110, 111, 448, 467–468
sustainable development and, 18–23, 98–101
156–157, 156, 463–466, 465
Sustainable Development Pathways, 64, 448–449, **466–472**, 469, 479–480
temperature pathways, 59–61, 62, 63
time frame for, 95–96
transformation pathways*, 70, 148–157
transformations, whole-system, 129–148
transitions, speed and scale of, 15, 320, 320, 392
uncertainty, 60, 98
used in this report, 59–61, 62, 63
See also 1.5°C pathways; **Climate-resilient development pathways**; **Pathway archetypes**;
Scenarios

Peatlands, 221

Permafrost*, 182, 262, 271

- beyond end of century, 271
- feedbacks, 103–104, 262
- irreversible loss of carbon from, 262, 264
- remaining carbon budget and, 12
- thawing, 8, 12, 104, 220, 259, 262
- tipping points*, 262, 264

pH*. See Ocean acidification

Phenology, 216–218

Philippines, flood measures, 368

Phytoplankton, 224, 226

Policies*, 19, 21–22, 71, 148–150, 317, 372–380

- acceptability* of, 22, 368–369
- assumptions in 1.5° pathways, 112, 149
- car/transport pricing policies, 366
- carbon pricing, 95, 317, 375–377, 460
- coordination and monitoring of, 449
- design and implementation, 71, 321, 359–360, 460
- enabling climate finance, 372–380
- equity in, 22
- innovation, 22
- integrated policy packages, 379–380, 383
- international agreements, 70, 317
- internationally cooperative, 22, 23, 95
- investment, 22
- knowledge gaps, 391
- for low-emission transition, 372–375
- mobilization and integration of, 150, 317
- national, 316
- promoting climate action, 366–368
- redistributive, 21, 448
- regulatory measures, 377–378
- for residual risk and loss and damage, 456
- Sustainable Development Goals and, 448
- technology, 95, 148, 370–371
- See also Governance

Population. See Human population

Poverty*, 9, 53, 180, 182, 244

- in 1.5°C warmer worlds*, 447, 451–453
- adaptation limits*, 455
- avoided impacts of 1.5°C vs. 2°C, 452–453
- climate change influence on, 55, 282, 447, 450, 452
- disproportionate impacts, 9, 51
- energy poverty, 464
- increase in, 180
- livelihoods* and, 244
- multidimensional, 55, 450, 457
- Multidimensional Poverty Index, 55
- numbers of people at risk, 447, 452
- ‘poverty scenario’ (SSP4), 452
- projections for, 9, 10, 180

Poverty eradication*, 18–23, 55, 72, 445–538

- conditions for achieving, 474–475
- mitigation pathways and, 22
- research gaps, 475–476
- sustainable development and, 450

Power asymmetries, 449, 459, 462, 471, 475

Prairie pothole ecosystems, 221, 254

Precipitation, 182, 191–196

- extremes, observed, 191–192, 197

- extremes, projected, 189, 197, 214–215
- extremes, Sub-Saharan Africa, 197
- heavy precipitation, 7, 177, 178, 194–196, 195, 211, 255
- hotspots, 193, 194
- monsoon, 194, 262–263, 264
- observed changes, 177, 191–194, 211
- projected changes, 7, 178, 187–188, 188, 211
- regional, 191–196, 196, 3.SM.2.3.1, 3.SM.2.3.2
- runoff*, 201–203, 211
- See also Droughts; Floods

Precursors*, 64, 65, 98, 102–103, 118

Pre-industrial*, 24

- reference period, 51, 56, 57–59, 81, 184

Procedural equity. See Equity

Pteropods, 224, 226–227, 3.SM.3.2.4

Public acceptability, 22, 317, 368–369

R

Radiative forcing*, 59, 66–67, 188

- aerosols*, 102–103
- long-lived climate forcers (LLCF)*, 64–66, 66–68, 116–118
- natural forcings, 59, 66–67
- non-CO₂ forcings, 5, 6, 95, 96, 101–103, 103
- recent trends, 1.SM.7
- short-lived climate forcers (SLCF)*, 64, 66–68, 118, 120, 316
- uncertainties in, 96, 101–104, 103

Rainfall. See Precipitation

Reasons for concern (RFCs)*, 10, 11, 181, 182, 251–258, 3.SM.3.3.1–3.SM.3.3.7

- RFC1 (Unique and threatened systems), 10, 11, 181, 251, 253–255, 254
- RFC2 (Extreme weather events), 10, 11, 181, 251–252, 254, 255
- RFC3 (Distribution of impacts), 10, 11, 181, 251–253, 254, 255–256
- RFC4 (Global aggregate impacts), 10, 11, 181, 251–254, 254, 256–257
- RFC5 (Large scale singular events), 10, 11, 181, 254, 257–258

Recycling, 335, 335, 460

Reducing Emissions from Deforestation and Forest Degradation (REDD+)*, 329–330

Reference period*, 56–59, 81, 184

- periods shorter than 30 years, 51
- pre-industrial* temperatures, 51, 56, 57–59
- 30-year period used, 51, 56

Reforestation*, 17, 70, 121, 265, 266, 270, 316, 343, 394, 395

- constraints, 316
- incentivization of, 147
- trade-offs, 269

Region(s)*, 187

- climate differences in, 177–178
- cooperation and governance, 353–354
- with high risks at 2°C, 247–250
- hotspots, 258–260, 261
- regions used in this report, 187
- tipping points, 262–263, 264

- warming of >1.5°C already experienced, 4, 51, 68, 81, 452
- See also specific regions and countries

Regional climate change, 68, 177, 188–191

- drought*, 198–200, 198, 199, 200–201, 260
- runoff*, 201–202, 202, 211
- temperatures on land, 188–191, 189, 192, 193, 196, 197
- See also Regional impacts; Regional precipitation; Regional temperatures

Regional impacts, 9, 68, 177–178, 182

- crop production, 9, 259, 263
- economic growth, 9, 180–181
- variation in, 450

Regional precipitation, 191–196, 196

- observed changes, 191–194, 3.SM.2.3.1
- projected changes, 193, 194–196, 195, 196, 3.SM.2.3.2
- Sub-Saharan Africa, 197

Regional temperatures, 59, 60, 189–191, 196, 283

- observed changes, 189–190, 197, 1.SM.1, 1.SM.3, 3.SM.2.2.1
- projected changes, 189, 190–191, 192, 193, 196, 197, 283, 3.SM.2.2

Regulatory measures, 377–378

Remaining carbon budget*, 12, 96, 104–107, 2.SM.1.1.2

- 1.5°C pathways*, 113–114
- agricultural emissions and, 147
- assessment of, 104–107, 108
- CO₂ and non-CO₂ contributions, 105–107, 108
- definition, 24, 96
- overshoot minimization and, 177
- permafrost thawing and, 105, 107
- uncertainties, 12, 96, 108

Remedial measures, 70–71

Renewable energy, 14, 15, 96, 111, 131, 132–133, 316, 324

- acceptability of, 368–369
- deployment and scaling up, 461, 464–466
- feasibility of, 324
- hybrid systems, 326
- water demands for, 464

Representative Concentration Pathways (RCPs)*, 62

Resilience*, 316, 456

- climate-resilient land use, 333
- cultural practices and, 360
- See also Climate-resilient development pathways (CRDPs); Vulnerability

Risk(s)*, 5, 7–10, 177–181, 186–253, 210–212, 247–250

- confidence and likelihood qualifiers, 77, 182
- de-risking policies and investments, 317, 378–379
- definition, 24, 68
- ecosystems*, 8–9, 11
- factors influencing, 5, 277
- with global warming of 1.5°C, compared with 2°C, 5, 7–10, 11, 177–181, 186–253, 210–212, 247–250, 453
- human health, 180, 182, 250
- interacting and cascading, 245, 452

Index

- key elements of, 251–253, 252
multi-sector, 246
multiple and compound, 10, 178, 181
to natural and human systems, 178, 179–181, 212–253, 247–250
Reasons for concern (RFCs)*, 10, 11, 181
residual, 454–456
social-ecological systems, 338–341
summary of, 247–250, 251–253
of temperature overshoot, 5, 177, 179
of unavoidable impacts, 455
uncertainty, 77
urban areas, 183
to vulnerable populations, 53
- Risk assessment***, 55, 183–186
Risk management*, 336
adaptation* and, 5, 10
Sendai Framework*, 70
See also Disaster risk management
Risk sharing, 316, 336–337, 338, 385
Rotterdam, The Netherlands, adaptation strategy, 341
Runoff*, 178, 201–203, 211
observed changes, 201, 211
projected changes, 201–203, 202, 211
- ## S
- Sahel, Africa, projected risks and impacts in**, 180, 236, 259, 261, 262–263
Scenarios*, 52, 62–64, 98–100, 276, 277, 279–281
1.5°C- and 2°C scenarios, 98–100, 100, 184
comparison of, 279–281
database of, 99
definition of, 63
emission scenarios*, 184, 276
faster transition scenario, 131, 135
inclusion of CDR in, 277
OECD scenario for 2°C, 373
primary energy supply in, 132–133
socio-economic scenario*, 62–63
SRES, 62
used in this report, 63
See also Narratives; Pathways
Scientific evidence, 52
Scientific institutions, 23, 317, 451
Sea ice*, 182, 205–206, 212, 224–225, 249, 270
Antarctic, 206, 225
Arctic, 8, 178, 205–206, 209, 212, 224, 254, 258, 261, 262
beyond end of century, 270
irreversible changes, 257, 262
temperature overshoot and, 8
as tipping point, 261, 262, 270
Sea level change*, 7–8, 182, 206–207, 212, 225, 231–234, 248, 249
adaptation and, 10
beyond end of century, 271
coastal areas and, 207, 231–234, 243, 248, 249, 252
commitment to continued rise, 7, 51, 67, 207, 257, 271, 282
deltas and estuaries, 232–233
detection and attribution, 252
emissions and, 5, 7, 51
glaciers and, 206
global mean sea level rise, 178, 206–207, 212
ice sheets* and, 7, 178, 206, 208, 257, 271
impacts, 178, 181, 182
migration due to, 232
multi-metre rise, 7, 178, 271
numbers of people at risk, 178, 231, 232, 234, 256
past climate episodes and, 208
projected, for 1.5°C, vs. 2°C, 7–8, 178, 206–207, 207, 212, 231–234, 234
regional, 178, 207, 234
sea level rise, 7–8, 67, 178, 206–207, 225, 231–234, 248, 249, 252
small islands and, 7, 8, 232
time-integrated impacts, 61, 62
UNESCO World Heritage sites at risk, 243
Sea surface temperature (SST)*, 204, 223–224, 248
in definition of 1.5°C, 51
Seagrasses, 225–226, 228, 248, 3.SM.3.2.1
Seasonal warming, 4, 51, 59, 60, 68
Sendai Framework for Disaster Risk Reduction*, 70
Sequestration. See Carbon sequestration
Shared Socio-economic Pathways (SSPs)*, 62–63, 109–110, 110, 111, 448, 467–468
land-use change and, 145
policy assumptions, 149
SDGs and, 321, 448, 467–468
Shipping, 333
Short-lived climate forcers (SLCF)*, 64, 66–68, 118, 120, 316, 341–342
co-benefits of reducing, 342, 342
emission reductions, 67, 316, 341–342
knowledge gaps, 389
main characteristics of, 342
mitigation options*, 341
projected emissions, 96, 157
SDGs and, 157
Singapore, road pricing and car use, 366
Sink*. See Carbon sequestration
Small Island Developing States (SIDS)*, 9, 234–235, 255, 260, 261
adaptation approaches, 339–340
adaptation limits, 235, 455
in Caribbean, 339–340
climate hazards for, 234–235, 471
climate-resilient development pathways* in, 471, 471
disproportionate impacts/risks, 9, 53, 447
flooding, 235
freshwater resources, 9, 213, 234, 235
Kiribati, adaptation in, 368, 471
livelihoods, 232, 235
migration and, 181
multiple, compounded risks, 10, 178, 181, 260, 261
Pacific Islands, indigenous knowledge in, 360
risks, 9, 181, 232, 255
sea level rise and, 7, 8, 232, 234–235
storm damage, 235
tourism, 229
Vanuatu, planning for climate-resilient development, 449, 471
Snow, 182
Social cost of carbon (SCC)*, 150–151, 265, 375
Social costs*, 67, 265, 317, 365, 375
Social-ecological systems*, 338–341
Social learning*, 449, 475
Social safety nets, 362, 385
Societal choices, 98, 99
Societal (social) transformation.
See Transformation
Socio-economic drivers, 109–110, 110
Socio-economic scenario*, 62–63
Soil carbon sequestration (SCS)*. See Carbon sequestration
Soil erosion, 216
Soil moisture*, 190, 191, 196
anomalies, 198, 199, 200
Solar energy, 96, 131, 131, 132–133
water use and, 464–466
Solar radiation modification (SRM)*, 12–13, 70–71, 347–349, 349–352
carbon budget and, 351
in context of 1.5°C pathways*, 349–352
feasibility, 347–349, 351–352
governance, 347–348
impacts and ethical issues, 71, 317, 349, 351
knowledge gaps, 390
overview/main characteristics, 348
risks of, 13, 347
social acceptability of, 349
sustainable development and, 351
timing and magnitude, 349–351
uncertainties and limitations, 12–13, 316–317
Southeast Asia, vulnerability and risks in, 259, 267
Southern Ocean, role in global carbon cycle, 257–258
Special Report on 1.5°C. See IPCC Special Report on 1.5°C (SR1.5)
Species
interactions, phenology and, 216–218
invasive, 8, 9, 223
loss and extinction, 8, 179, 218
range loss/shifts, 8, 179, 218, 222, 247, 248, 256–257
SSPs. See Shared Socio-economic Pathways (SSPs)
Stabilisation (of GHG or CO₂-equivalent concentration)*, 116, 122, 147, 158, 184–185
Stockholm, congestion charge and car use, 366
Storms, 181, 222–223, 249
extratropical, 203–204
storm surge, 223
tropical cyclones, 203–204, 211
Stranded assets*, 18
Structured Expert Dialogue (SED), 79
Sub-national actors*, 23
Sub-Saharan Africa, changes in climate extremes, 197
Sulphur dioxide (SO₂), 96, 118, 120
Supply-side measures. See Demand and supply-side measures

Surface air temperature (SAT)
in definition of 1.5°C, 51, 56
global average temperature and, 56–57

Sustainable development (SD)*, 18–23, 72, 73–75, 445–538
and 1.5°C pathways*, 93, 97, 98, 156–157, 253, 450–451, 463–466, 465
and 1.5°C warmer worlds*, 55–56, 447, 451–453
adaptation and, 19, 447, **456–459**
avoided impacts and, 452–453, 453, 475
climate-resilient development pathways (CRDPs)* and, 22, 52, 64, 448–449, 450–451, 451, **468–472**, 475–476, 479–480
co-benefits, 447
conditions for achieving, 474–475
definition, 73
equity and, 55–56, 448–449
integration with adaptation and mitigation, 75–76, 448, **467**
mitigation and, 12, 18, 19–21, 97, 156–157, 156, 447–448, **459–466**, 481–509
mitigation pathways and, 463–466, 465
overview, 450, 475–476
pathways to 1.5°C, 466–472, 469, 479–480
research gaps, 475–476
risks to, 253
in social-ecological systems*, 338–341
synergies and trade-offs, 457–458, 459–463, 463, 475
trajectories, 451, 469–470, 480
transformation* and, 22, 56, 73, 448, 456, 466

Sustainable Development Goals (SDGs)*, 18, 19–21, 73–75, 156–157, 156
adaptation options* and, 457–458
avoided impacts and, 18, 68, 183, **253–265**, 447, 453, 475
CDR and, 448, 462
climate change and, 73, 74, 75, 157, 158, 252
energy efficiency and, 448
equity and, 51
food security and nutrition, 238
mitigation options and, 19–21, 20–21, 448, **459–463**
mitigation pathways, interactions with, 2.SM.1.5
mitigation-SDG table, 481–509
overview, 450
policy instruments and, 448
prioritizing, 447
risks from 1.5°C, vs. 2°C, 453
SDG Global Index Scores, 53
SDG-interaction scores*, 481–509
Shared Socio-economic Pathways* and, 321, 448, 467–468
synergies and trade-offs, 19–21, 21–22, 319, 447, 463, 475
system transitions and, 317

Sustainable Development Pathways, 64, 448–449, **466–472**, 469, 479–480

Synergies, 18–19, 20–21, 72, 269, 316, 477, 4.SM.4.5.1, 4.SM.5.2
adaptation and SDGs, 447
knowledge gaps, 391

mitigation and SDGs, 19–21, 20–21, 157, 459–463, 463, 465
mitigation and sustainable development, 459–463, 463, 475
uneven distribution of, 466

Synfuels, 333

Systemic changes/transitions, 14–15, 15–16, 21–22, 315, **323–349**, 449, 476
enabling, 315–318
rates of change, 322–323
See also Transitions

T

Tanzania, indigenous knowledge used in, 360

Technology, 22
access to, 23
biotechnology/genome modification, 319, 329
deployment of, 72
disruptive, 22, 111, 319, 323
general purpose technologies (GPT)*, 369–370, 383
information and communication
technology (ICT)*, 316, 319
innovation in, 19, 21, 22, 316, 369–370
innovation, enabling, 369–372
innovation, examples of, 370
innovation, knowledge gaps, 391
low-carbon, 15, 16, 96, 153, 331
new, 15, 22, 319
policies, 95, 148, 370–371
Power-2-X, 111
smart technology/IoT, 331
standards, 332, 378

Technology transfer*, 19, 23, 371–372, 371, 449, 474

Temperature, 182
carbon budget, emissions, and, 96
datasets, 53, 56, 57, 58, 59, 1.SM.1
fluctuations in, natural, 56, 59
global average, defined, 56–57, 81
global mean surface temperature (GMST)*, 56–57, 57, 177, 186
heat-related morbidity and mortality, 9, 11, 180, 240–241, 250, 252, 252, 263, 264, 3.SM.3.3.1
heatwaves*, 9, 177–178, 263, 264
land-sea contrast in warming, 8, 51, 59, 187, 190, 205
land surface air temperature*, 56
number of hot days, 190, 193, 210
observed warming, 6, 51, 53, 53, 58, 106, 189–191, 1.SM.1, 1.SM.2, 1.SM.3, 1.SM.6
peak in, 5, 96, 101, 104, 177, 277
peak, reducing after, 17, 18, 278
projections, 4, 7, 177, 187–188, 188, 190–191, 192, 193
rate of change, 54, 177, 178
regional variation in, 177, 283
sea surface temperature (SST)*, 51, 204, 223–224, 248
temperatures used in definition of 1.5°C, 51, 187, 188
See also Global warming

Temperature extremes, 255, 263
hotspots (key risks), 190–191, 193

and human health, 263, 264
observed, 210
probability ratio of, 192
projected, 7, 177, 189, 190–191, 192, 210, 255
Sub-Saharan Africa, 197

Temperature overshoot*. *See* Overshoot

Temperature threshold, 65, 66

Terrestrial ecosystems, 8, 179, 216–221, 247, 252, 3.SM.3.3.7
biomass and carbon stocks, 219, 220
biome shifts, 216, 217, 247, 250
ecosystem function, 219
impacts and risks at 1.5°C, vs. 2°C, 8, 11, 179, 216–221, 247, 251, 252, 3.SM.3.3.7, Table 3.SM.2
knowledge gaps, 272
phenology, 216–218
productivity, 220
regional and ecosystem-specific risks, 219–221
respiration, 219
severe ecosystem changes, 217

Thermohaline circulation. *See* Atlantic Meridional Overturning Circulation (AMOC)

Tipping points*, 182, 262–263, 264, 270, 282
identifying, 458
See also Irreversibility

Tourism, 11, 178, 181, **242–243**, 253, 3.SM.3.3.2
coastal areas, 229, 253
observed impacts, 181
projected impacts, 181, 242–243, 253
risks, 181, 253
seasonal, 181, 243

Trade-offs, 18–19, 72, 73, 269, 4.SM.4.5.1, 4.SM.5.2
example of, 477
knowledge gaps, 391
mitigation options and sustainable development, 459–463, 465
reconciling, 467
with SDGs, 19, 73
specific mitigation options, 97
uneven distribution of, 466

Transformation*, 22, 52, 70, 73, 112, 129–157, 315, 468–469
1.5°C pathways*, 95, 112–113, 129–148, 448, 472
1.5°C warmer worlds*, 73
challenges, opportunities, and co-impacts, 148–157
cities/urban areas, 472–474
in climate-resilient development pathways, 468–469
context-specific, 469
energy system, 129–144, 463
FAQ on, 392–393, 393
feasibility of, 52, 72
fundamental elements of, 73
implementing, 276
societal (social) transformation*, 22, 52, 73, 448–449, 466
sustainable development and, 22, 448, 456
trade-offs, 73
upscaling and accelerating, 314
whole systems approach, 392
See also Transitions

Transformation pathways*. *See* Pathways

Index

Transformational adaptation. *See* Adaptation

Transient climate response*, 184–185
See also Climate sensitivity

Transient climate response to cumulative CO₂ emissions (TCRE)*, 96, 104, 106

Transition Movement, 480

Transition Towns (TTs), 473–474

Transitions*, 14–15, 15–16, 21–22, 73, 315–318, 323–349, 4.SM.4.2.1–4.SM.4.2.5, 4.SM.4.3.1–4.SM.4.3.5
adaptation options* supporting, 321, 336–337, 338
enabling, 19, 21–22, 315–318
in energy sector, 15, 96–97, 315, 324–327, 374–375, 4.SM.4.2.1, 4.SM.4.3.1
equity* in, 22
FAQ on, 392–393, 393
in land use, 16, 17, 96, 97, 315, 327–329, 4.SM.4.3.2
policies supporting, 22
risks and ethics, 319
speed and scale of, 15, 314, 317, 320, 320, 322–323, 392, 394
sustainable development and, 22
synergies, 316, 4.SM.5.2
system/sector transitions, 14–15, 15–16, 21–22, 96–97, 315–318, 323–349
See also specific sectors

Transnational emission reduction initiatives (TERIs), 149

Transport sector, 244, 316, 332–333
biofuels, 325
car/transport pricing policies, 366
decarbonization* of, 316, 461
demotorization, 316, 366, 376
electric vehicle (EV)*, 316, 332–333, 333
electrification of, 332–333, 333, 460
emissions, 96, 114, 142–144, 143
emissions reduction, 366
final energy demand and use, 139, 142–144, 143, 332
impacts of weather and climate on, 244
international transport, 333
investments in, 373–374
road safety for pedestrians, 461
road transport, 142–143, 461
strategies to reduce energy consumption, 142
sustainable transport, 332
technological innovations, 370
transitions, 15–16, 316
transitions, speed and scale of, 320, 320
urban environments, 316, 332

Tropical cyclone*, 203–204, 211
Cyclone Pam, 471

Tundra, 8, 179, 216, 220
tipping points*, 262, 264

U

Uncertainty*, 69, 77
of climate response to mitigation, 60, 63
geophysical, 96, 101–104
in mitigation pathways, 60, 63

propagation of, 3.SM.1.3

Unique and threatened systems, 10, 11, 181, 251, 253–255, 254

United Kingdom Overseas Territories (UKOT), 339

United Nations Framework Convention on Climate Change (UNFCCC)*, 79, 80, 353
adaptation financing, 21
Conference of the Parties (COP)*, 79
Green Climate Fund, 74, 379

Uptake*. *See* Carbon sequestration

Urban areas, 180, 241–242, 330–334
adaptation examples, 340–341
adaptation options*, 10, 70, 263, 384–386, 385, 4.SM.4.3.3
agriculture in, 316
demotorization, 316, 366, 376
energy systems, 331
feasibility of adaptation options, 384–386, 385
feasibility of mitigation options, 382
global urbanization, 472
governance, 473
green infrastructure*, 10, 334, 334, 385
heat island effect, 9, 180, 242
heat-related extreme events, 241–242
impacts and risks, 180, 182, 183, 241–242
informal urban settlements, 473
infrastructure, 331, 333
knowledge gaps, 388–389
land use, 316, 333
low-carbon cities, 331
mitigation options*, 4.SM.4.2.3
numbers of people in, 330, 340
peri-urban agriculture, 316
poverty and, 242
risks and risk reduction, 331, 456
sea level rise and, 231–232, 241
transformation* in, 472–474
transformational adaptation, 386
Transition Towns (TTs), 473–474
transitions, 15–16, 316, 330–334, 4.SM.4.2.3, 4.SM.4.3.3
transport, 316, 331, 332–333
urban planning, 148
water services, 316, 334
See also specific cities

Urban heat islands, 9, 180, 242

V

Values, 22, 71, 317, 364–365
re-examination of, 449, 469, 475
societal, 448, 476
value judgements, 55

Vanuatu, planning for climate-resilience, 449, 471

Vector-borne disease, 9, 180, 241
Aedes mosquitoes, 241

Vulnerability*, 69, 447
disproportionate impacts and, 9, 51, 447
factors influencing, 53
international cooperation and, 23
multiple, interrelated climate risks, 10
new vulnerabilities, 10

redistributive policies and, 21
reducing, 19, 447, 457
risks and, 53, 452
sustainable development and, 447
systemic, 22, 447, 457

W

Warm Spell Duration Index (WSDI), 190

Water availability, 178, 213–214

Water cycle. *See* Hydrological cycle

Water management, 10

Water resources, 179, 182, 213–216, 464–466
bottom-up initiatives, 368
demand for, 464–466
groundwater, 181, 215, 3.SM.3.1.1.3
impacts and risks, 213–216, 247
irrigation, 201, 215, 267, 267, 315, 328, 384, 466
projections, 179
regional, 179, 247
in urban areas, 316, 334
water-energy-food (WEF) nexus, 386–387
water quality, 215–216, 3.SM.3.1.1.4
water temperature, 214
watershed management, 356
See also Precipitation

Water scarcity, 179, 213, 452, 453, 466

Water security, 464–466

Water stress, 9, 181, 247, 452, 466

Well-being*, 18, 180
Bhutan's happiness index, 387
place-specific adaptation and, 447
well-being for all, 469

Wetlands, 179, 225, 254, 330, Table 3.SM.2
management, 330
methane release from, 12
salinization of, 233
sea level rise and, 233

Wind energy, 96, 131, 131, 132–133

Z

Zero emissions commitment (ZEC), 64–65, 65