

## INDEX

- absolute limits, environmental sustainability and, 11–13
- Africa
  - equitable agricultural subsidies in, 121–122
  - global water grabbing in, 151–152
- Agricultural Transition, 15, 56, 69–72, 150–151
- agriculture
  - ending subsidies for, 120–126, 170–172
  - evolution of, 23
  - fossil fuel impact in, 35
  - global underfunding of nature and, 115–120
  - intensification in low- and middle-income economies, 110
  - irrigation subsidies and, 170–172
  - land use intensification by, 41–43, 53n.42, 109
  - subsidies for, 120–126, 170–172, 244n.34
  - technological innovation and efficiency improvements in, 124–126
  - water appropriation and expansion of, 37–38, 143–145
  - water reallocation away from, 161
- air pollution
  - fossil fuel expansion and, 38–39, 79–80
  - planetary boundaries perspective and, 43–49
- air transport industry, fossil fuel development and, 35, 51–52n.27
- Amazon land expropriation
  - costs of, 126
  - recent programs for halting, 140n.55
- animals
  - fossil fuel impact on, 35
  - population declines for, 106–107
- Anthropocene
  - creation of, 3–6
  - human evolution and, 22
  - planetary boundary perspective on, 43–49
- Arizona, water banking in, 161–162
- Asian Development Bank (ADB), 244n.27
- Atlantic economy, emergence of, 50n.12
- automobile industry
  - economic development and role of, 35–37, 51n.26
  - electric vehicle development, 79–80, 85–86

## 319 / Index

- Batini, Nicoletta, 131–133  
 Beck, Michael, 190–191  
 Binswanger, Hans, 114  
 biochemical flows, planetary boundaries  
   perspective and, 43–49  
 biodiversity loss  
   businesses awareness of, 253–256,  
     270–271  
   collective action against, 130–137  
   estuarine and coastal ecosystem  
     protections against, 192  
   Great Acceleration impact on, 41–43  
   land use and acquisition and, 105–108  
   planetary boundaries perspective and,  
     43–49  
   smallholder agricultural subsidies and  
     reduction of, 122  
   species diversity assessment, 139n.11  
 biodiversity offsets, 133  
 biodiversity-relevant tax policies, 123  
 biomass energy sources, Industrial  
   Revolution and consumption of,  
   34–35  
 biosand filters for household water  
   treatment, 167  
 Birkenbach, Anna, 189–190,  
   214–215n.26  
 Black Death, 50n.8  
 block rates  
   in developing countries, 165–167  
   water pricing, 170–172  
 block tariffs, water pricing and,  
   163–165, 181n.30  
 blue carbon habitats, 184, 191–192  
 boreholes, for rural water treatment, 167  
 bottom-up strategies  
   carbon mitigation and, 90–93, 99–101  
   sustainable development and, 15–16  
   water markets and, 162–163  
 Boulding, Kenneth, 1–3, 12, 15, 56–60,  
   72n.7  
 Bowen, Alex, 117–118  
 Brabeck-Letmathe, Peter, 1–2  
 Burgess, Jo, 129–130, 136–137  
 Busch, Jonah, 126, 128  
 businesses. *See also* corporations; private  
   sector  
   barriers to green transformation of,  
     266–269  
   climate action initiatives and, 91–93  
   collective action for green transition in,  
     268–272  
   environmental risk awareness of,  
     253–256  
   green policy implementation and  
     management for, 260  
   green washing of sustainable  
     initiatives, 263–264  
   market economy and role of, 246–248  
   penalties for environmental violations  
     by, 254–255  
   structure and characteristics of,  
     248–253  
 Cai, Li, 261  
 cap and trade systems  
   carbon pricing and, 101n.10  
   water pollution, 167–170  
 capital good, environment as, 63–64  
 carbon adjustment border mechanism  
   (CABM), 225–226, 243n.24  
 Carbon Disclosure Project (CDP), 255  
 carbon emissions  
   climate change and, 74–77  
   fishing and, 188  
   Great Acceleration impact on, 41–43  
   land use change and, 105–108  
   social cost of, 77–79  
   sub-national mitigation efforts, 90–93  
 carbon pricing  
   assistance in low- and middle-income  
     countries for, 88–90  
   cap and trade systems, 101n.10  
   combined public policy initiatives  
     involving, 102n.20  
   debt relief and, 99–101  
   EU Green Deal measures for, 225–226  
   internal business initiatives for, 92–93,  
     255  
   national initiatives in, 95–99

## 320 / Index

- carbon pricing (cont.)
  - sub-national initiatives for, 90–93
  - user cost approach in, 102n.13
- carbon sinks
  - estuarine and coastal habitats as, 191–192
  - marine environment and, 184
- carbon tax, 15–16
  - adoption of, 95–99
  - fossil fuel industry support for, 267–268
  - revenue generation from, 82–83
  - revenue neutrality in, 83
  - social costs of carbon and, 77–79
  - tropical carbon tax, 123, 236
- catch documentation systems, 214–215n.26
  - development of, 205–206
- Central Arizona Project (CAP), 152–153
- central banks, green policy
  - implementation and management for, 260
- China
  - green innovation investment in, 84–85, 229–231
  - irrigation infrastructure and pricing, 171–172
  - water grabbing by, 178–179
  - water markets in, 162–163
- cities
  - carbon pricing initiatives by, 90–93
  - water and sanitation infrastructure in, 167
- civilizations, environmental degradation
  - linked to collapse of, 24, 49n.6
- clean energy sources. *See also* specific technologies, e.g., solar energy
  - developing countries' investment in, 87–90
  - development of, 79–80
  - infrastructure development for, 80–86
  - subsidy swaps for, 235
  - transmission infrastructure obstacles for, 86
  - underinvestment in R&D for, 83–86
- climate change
  - businesses awareness of, 253–256
  - coastal ecosystem decline and, 190–193
  - collective action for mitigation of, 90–93
  - economics of, 77–79
  - fossil fuel underpricing and, 15–16
  - Great Acceleration and, 41–43
  - inclusive action on, 93–99
  - overview of, 74–77
  - planetary boundaries perspective and, 43–49
  - transboundary water agreements and, 176
  - water management and, 176
- closed systems, spaceship economy and, 58–59
- Coady, David, 80
- coal industry
  - air pollution and, 38–39
  - Industrial Revolution and expansion of, 34–35
  - moratorium proposals for, 102n.20
  - subsidies for, 82
- coastal ecosystems
  - coastal grabbing and, 184–185
  - conservation and protection initiatives for, 193–198
  - human impact on, 185–188
  - inclusive development and, 210–212
  - insurance industry concern over, 210, 254
  - mismanagement of, 184
  - restoration of, 210
  - underfunding of conservation of, 198–202
  - underpricing and exploitation of, 190–193
- coastal states, marine conservation
  - agreements among, 203–205
- Coastal Zone Management Trust (CZMT), 210

## 321 / Index

- collective action  
 business green transition and,  
 268–272  
 climate risk reduction and, 90–93  
 deep sea ecosystem monitoring,  
 206–209  
 environmental sustainability and,  
 10–11  
 inclusiveness in, 93–99  
 land and biodiversity loss prevention  
 and, 130–137  
 marine environment preservation,  
 202–210  
 transboundary water resources and,  
 175–179  
 on wealth inequality, 238–239
- Colombia, water pricing reforms in,  
 165–167
- colonization  
 disease and, 50–51n.14  
 environmental degradation and,  
 24–27  
 immigration and, 27–30  
 Ocean empires, 27–30  
 resource consumption and, 27–30  
 slavery and, 29–30, 50n.12
- commodity markets, fossil fuel  
 development and, 35
- community-led total sanitation  
 campaigns, 167
- conflict risk, transboundary water  
 management and, 176
- consumers, sustainability initiatives and  
 role of, 271–272
- Convention on Biological Diversity  
 (CBD, UN), 105–106, 127,  
 264–266
- coral reefs  
 cost of restoration, 215n.51  
 insurance industry concern over, 210,  
 254  
 protective benefit of, 190–191  
 restoration of, 210
- corporate environmental risk (CER), 261  
 green washing and, 263–264
- corporations  
 biodiversity protections and, 270–271  
 green finance and, 256–260  
 market concentration and  
 environmental exploitation by,  
 249–251  
 natural resources dependence of,  
 136–137  
 structure of, 248–249  
 sustainability initiatives of, 17–18,  
 251–252, 256–257
- Costello, Chris, 189–190, 202
- costs of climate change. *See also* social  
 costs  
 economic costs, 6–10, 15  
 present value metric and, 101n.9  
 user cost approach, 102n.13
- COVID-19 pandemic  
 carbon dioxide emissions during,  
 74–77  
 climate-friendly recovery plans and,  
 94–95  
 in developing countries, 87–90  
 environmental impact of, 48–49,  
 276–278  
 financial reforms in wake of, 238–239  
 green economy in post-pandemic  
 conditions, 219–222  
 unemployment and economic  
 disruption linked to, 240  
 wealth inequality during, 14
- Covington, Howard, 261–262
- cowboy economy, Boulding’s concept of,  
 56–60
- Crosby, Alfred, 28–29
- cross-firm externalities, technology  
 spillovers, 83–86
- cross-subsidies, for irrigation and  
 hydroelectricity, 172
- currency-transaction tax, 238
- Dasgupta, Partha, 1–2, 5, 66–67,  
 108–109, 280n.6
- Dean, Thomas, 136–137
- debt-for-nature swaps, 134–136, 141n.71

## 322 / Index

- debt relief
  - carbon pricing and, 99–101
  - in low- and middle-income countries, 133
  - vicious cycle of climate vulnerability, debt and financial crisis, 89–90
- Debt Service Suspension Initiative (DSSI), 89, 233–234
- decarbonization of shipping, 198–202, 206–209
- deep sea ecosystem monitoring, 206–209
- deforestation
  - agricultural intensification in developing countries and, 110
  - data on, 52n.30
  - global trade linked to, 130–131
  - Great Acceleration and growth in, 41–43
  - greenhouse gas emissions and, 117–118
  - land use subsidies and expansion of, 120–126
  - planetary boundaries and, 127–128
  - recent programs for halting, 140n.55
  - restoration costs for, 118
- Deininger, Klaus, 114
- desalination, water management and, 173–175
- developing countries
  - agricultural intensification in, 110
  - clean energy challenges in, 87–90
  - conservation spending in, 131
  - corporate presence in, 251
  - estuarine and coastal ecosystem resources in, 192
  - estuarine and coastal ecosystems in, 191
  - green bonds programs and, 134–136
  - green transition in, 231–237
  - illegal and unregulated fishing in, 205–206
  - irrigation inequality and inefficiency in, 172
  - rent seeking and underpricing in, 111–113
  - transboundary water management and, 176
  - tropical carbon tax in, 124
  - water and sanitation schemes in, 165–167
  - water grabbing in, 178–179
- development
  - green economy initiatives and, 224–231
  - inclusive ocean and coastal development, 210–212
  - inequality in, 48
  - sustainable and inclusive model of, 13–14
- Díaz, Sandra, 127
- diesel fuel, subsidies for, 79–80
- Dinerstein, Eric, 127–128
- disclosures, corporate environmental risk management, 262
- disease
  - colonization and, 50–51n.14
  - global trade and spread of, 24–27, 50n.8
  - habitat loss linked to, 115–120, 278–279
- distribution effects, of sustainable development, 93–99
- doing nothing, social cost of, 78
- Donohue, Ian, 47–48
- dumping of fish by-catch, 189–190, 194–198
- earnings inequality, education and technology innovation and, 239–240
- Earth systems
  - early human impact on, 22–32
  - tipping point threshold for, 3–4, 19n.13
- ecological capital, 7
  - development of, 64–67
  - global trade and, 24–27
- ecological scarcity
  - abolition of underpricing and, 69–72
  - costs of, 8–10, 15, 19n.17

- global perspectives on, 7–8
- land use and acquisition and, 128–129
- natural resources and, 67–69
- spaceship economy and, 58–60
- economics
  - climate change and, 77–79, 101n.10, 102n.13
  - environmental protection and, 5, 276–278
  - fragile planet model for, 15, 18
  - global trade as foundation of, 31–32
  - greening of, 17–18
  - Industrial Revolution impact on, 32–40
  - landscape fragility and, 108–110
  - of marine environment, 185–188
  - underpricing of nature and, 6–10
  - vicious cycle of underpricing nature in, 8–10
  - of water crisis, 146–150
- ecosystems
  - collapse of, businesses awareness and initiatives, 253–256
  - freshwater resources, 145–146
  - as natural capital, 64–67
  - no net loss programs for, 126–130
  - payments for services of, 133
  - rural poverty and unequal access to, 114
  - scale and speed of loss in, 105–108
- educational disparities, technology innovation and, 239–240
- electricity generation
  - cross-subsidies for irrigation and hydroelectricity, 172
  - fossil fuel development and, 35–37
  - subsidies for, 79–80
  - water markets and, 160–161
- electric vehicle development, 79–80
  - subsidies for, 79–80, 85–86
- electrification, economic development and, 35–37
- Ellis, Erle, 109
- emission trading schemes (ETs), 95–99
- empire states, agriculture and rise of, 23
- employment
  - conservation investment and, 131–133
  - displaced worker policies, 98–99
  - low-carbon initiatives' impact on, 93–99
  - ocean-based industries, 185–188
- energy industry
  - energy poverty and, 15–16
  - Great Acceleration impact on, 41–43
  - green transition in, 256
  - Industrial Revolution and
    - consumption of, 34–35
    - subsidy swaps for development of, 234–236
  - technological innovation and growth in, 52n.28
- energy poverty, 87–90, 15–16m
  - abolition of underpricing and reduction of, 99–101
- environmental degradation
  - businesses and risk of, 253–256
  - civilization and, 24, 49n.6
  - COVID-19 pandemic and, 219–222
  - cowboy economy and, 56–60
  - economic costs of, 6–10
  - global magnitude of, 39–40
  - global trade and, 24–27
  - planetary boundary perspective on, 43–49
  - risk reduction of, 60–63
- environmental protection
  - absolute limits and, 11–13
  - collective action and, 10–11
  - economic value of, 6–10, 276–278
  - historical awareness of, 1–3
- environmental risk management
  - business role in, 253–256
  - ecosystem wealth and, 66–67
  - green finance and, 256–257
  - green policy implementation and management for, 260
  - green washing and, 263–264
  - measurement of, 262
  - total capital stock and, 60–63
- Ervin, David, 264

## 324 / Index

- estuarine ecosystems  
 conservation and protection initiatives  
 for, 193–198  
 insurance industry concern over, 210,  
 254  
 restoration of, 210  
 underfunding of conservation of,  
 198–202  
 underpricing and exploitation of,  
 190–193
- EU Green Deal Investment Plan,  
 225–226
- European Emissions Trading Scheme,  
 225–226
- European Investment Bank, 134–136,  
 225–226
- European Union (EU)  
 financial sector reforms and, 238–239  
 Green Deal of, 225–226
- exclusive economic zones (EEZs)  
 foreign fishing encroachment in,  
 205–206  
 marine protected areas in, 194,  
 196–198  
 mismanagement of, 184, 186
- Expapadeas, Anastasios, 127
- extinction rate, estimates of, 47–48
- extractive industries  
 ending subsidies for, 120–126  
 formation of, 29–30  
 freshwater resources and, 145–146  
 green transition in, 256  
 primary production efficiency and  
 sustainability improvements,  
 124–126  
 rent seeking and land underpricing in,  
 112–113  
 water markets and, 160–161
- Extra-European resources, colonization  
 and exploitation of, 28–29
- fairness, planetary boundaries and issues  
 of, 69
- fertilizer subsidies, 120–126
- financial activities tax (FAT), 238
- financial sector. *See also* private sector  
 business-related climate action  
 initiatives as incentives for,  
 91–93  
 education and wage disparities and,  
 239–240  
 green finance initiatives in, 256–260  
 green policy implementation and  
 management for, 260  
 marine conservation funding and,  
 209–210  
 taxation of, 238
- Financial Stability Board, 274n.32
- financial transaction tax (FTT), 238
- fisheries  
 global increase in, 183  
 Great Acceleration impact on,  
 41–43  
 illegal fishing in developing countries,  
 205–206  
 industrialization and, 39  
 in low- and middle-income economies,  
 192  
 marine protected areas as benefit for,  
 194–198  
 subsidies for, 188–193, 203–205  
 subsidy swaps in, 211–212  
 UNCLOS protections for, 202–210  
 underpricing of, 194–198
- fixed service charge, water pricing  
 schemes, 163–165, 170–172
- flood protection, from estuarine and  
 coastal ecosystems, 191–192
- Fold, Niels, 121–122
- Folke, Carl, 251–252
- food industry, green transition in, 256
- Forests and Climate Change program  
 (Mexico), 134–136
- Fossil Fuel Age, 15, 32–40
- fossil fuel industry  
 carbon dioxide emissions from, 74–77  
 developing countries' subsidies for,  
 87–90  
 green business development and,  
 267–268

## 325 / Index

- Group of 20 (G20) underpricing of, 81–82
- major economies impact on underpricing, 80–86
- pricing reforms for, 82–83
- social costs of, 15–16
- subsidies for, 15–16, 79–80, 244n.34
- subsidy swaps for, 234–236
- timeline for development and use of, 33–34
- underpricing of, 15–16, 79–80, 102n.19
- Fouquet, Roger, 38–39
- fragility of Earth systems, scientific evidence for, 15
- Frankhauser, Sam, 117–118, 227–228
- Freeman, Rick, 63–64
- freshwater resources. *See also* water management
  - boundaries and, 145–146
  - economics of crisis in, 146–150
  - ending underpricing of, 158–173
  - fossil fuel impact on, 35
  - Great Acceleration impact on, 41–43
  - impending crisis in, 143–145
  - Industrial Revolution and appropriation of, 37–38
  - planetary boundaries perspective and, 43–49
  - transboundary water sources, 175–179
  - underpricing of, 146–150
- gasoline, subsidies for, 79–80
- geographical information systems (GIS), water conservation and, 173–175
- Ghilarcucci, Theresa, 267–268
- Global Agreement on Biodiversity (GAB), proposal for, 270–271
- global carbon budget, depletion of, 69
- global commons, marine environment and, 184
- global conservation funding, to developing countries, 131
- global debt
  - management of, 89
  - in post-pandemic era, 233–234
- Global Frontiers, era of, 27–30
- global green innovation, major economies and, 229–231
- global migration, evolution of, 29–30
- Global Risk Report*, 278–279
- Global Risks Report, 130–131
- global temperatures, climate change and, 74–77
- global trade
  - deforestation and, 130–131
  - environmental degradation and, 24–27
  - fossil fuel development and, 35
  - global underfunding of nature, 115–120
  - global warming, goals for limiting, 90–93
  - global wealth pyramid, 219–222
- governance
  - environmental sustainability and challenge of, 19–20n.19
  - groundwater governance, 157–158
  - of river basins, 154–157
  - Toynbee on functions of, 242–243n.18
  - water management and, 150–158
  - water markets and, 162–163
  - water technology innovation and, 173–175
- Gray, Lewis Cecil, 73n.11
- Great Acceleration of population growth, industrialization and mineral energy use
  - environmental impact of, 41–43
  - historical timeline for, 3–4, 19n.12
- Great Recession of 2008–2009, wealth inequality gap and, 245n.54
- Green, Jessica, 99–101
- green bond market, 134–136, 141n.72, 209–210, 258
- “green bubble” effect in green finance, 259–260, 274n.32
- Green Deal (European Union), 225–226



- green economy  
 business role in, 246–248  
 low- and middle-income economies  
 and, 231–237  
 major sectors of, 227–228  
 in post-pandemic environment,  
 219–222  
 principal components of, 222–224  
 public policies for, 217–219
- Green Exchange (LGX), 134–136,  
 209–210, 258
- green finance initiatives, 256–260
- greenhouse gas (GHG) emissions  
 corporation share of, 249–251  
 fossil fuel underpricing and, 82  
 global statistics on shares of,  
 95–99  
 global trade linked to, 130–131  
 land conversion as source of, 101n.21  
 land use change and reduction of,  
 115–120  
 marine carbon sinks and, 184  
 social costs of, 77–79  
 statistics on, 74–77  
 subsidy removal and reduction of,  
 82–83  
 target goals for reduction of, 90–93  
 tropical carbon tax and, 237–238
- green innovation  
 businesses adoption of, 254–255  
 corporate suppression of, 251  
 industrial development and, 237  
 underinvestment in R&D for, 83–86
- Green New Deals  
 emergence of, 224–231  
 origins of, 101n.21
- Griggs, David, 13
- gross domestic product (GDP)  
 environmental risk impact on,  
 253–256  
 Industrial Revolution and growth of,  
 34–35  
 marine capital and, 185–188  
 regional global shares of, in 1500s, 50  
 groundwater governance, 157–158
- Group of 20 (G20) countries  
 financial tax proposals resisted by,  
 238–239  
 fossil fuel underpricing in, 80–86  
 green economy initiatives and, 224–231  
 international frameworks for  
 corporate and business  
 environmental initiatives,  
 264–266  
 net zero emissions goals and, 78–79  
 tropical carbon tax proposal and, 123
- Hamilton, Stuart, 190–191
- Haveman, Robert, 63–64
- Hecht, Susanna, 121–122
- Helm, Dieter, 79–80
- High-Level Panel for a Sustainable Ocean  
 Economy, 209–211
- Hochard, Jacob, 190–191
- Holocene period, human evolution and,  
 21–22
- Hotelling, H., 73n.11
- human capital  
 defined, 59–60  
 education and wage disparities and,  
 239–240  
 value of, 7, 279–280
- humans  
 early impact on Earth systems of, 22–32  
 evolution of, 21–22  
 Great Acceleration and impact of, 41–43
- Hwang, Joonghyun, 192
- hydraulic mission  
 in fossil fuel era, 37–38, 52n.32  
 groundwater governance and,  
 157–158  
 transformation of water management  
 and, 150–153
- inclusive climate action  
 inclusive economic development and,  
 237–240  
 ocean and coastal inclusive governance  
 and, 210–212  
 strategies for, 93–99

## 327 / Index

- income
  - Great Recession of 2008-2009 and widening inequality in, 245
  - low-carbon initiatives and, 93-99
  - universal basic income, 98-99
  - wage disparities and inequality in, 239-240
- India
  - irrigation subsidies in, 171
  - water markets in, 162-163
- Indigenous cultures
  - land use change and, 114-115
  - ocean governance and, 211
- Indonesia
  - coral reef rehabilitation in, 209-210
  - deforestation initiatives in, 126
  - illegal fishing curtailment in, 206, 216n.59
- Industrial Revolution
  - global ecosystem impact of, 32-40
  - phases of, 51n.21
  - timeline for, 33-34
  - water management and, 151
- inequality
  - developing countries renewable energy development and reduction in, 88-90
  - in fishing subsidies, 188-189
  - Great Recession of 2008-2009 and, 245n.54
  - in green investment initiatives, 259-260
  - inclusive economic development and, 237-240
  - marine protected areas and, 198
  - planetary boundaries and issues of, 69
  - post-pandemic growth of, 219-222
  - rent seeking and land underpricing and, 112-113
  - sustainable development and, 48
  - underpricing and, 113-115
  - wage disparities and, 239-240
  - wealth inequality, 14
- infrastructure development
  - fossil fuel age and, 37-38
  - green transition in, 256
  - water management and sanitation, 163-165
  - water megaprojects and, 152-153
  - water underpricing and, 146-150
- innovation. *See* technology innovation
- insurance industry, coastal and estuarine ecosystem restoration and, 210, 254
- intergenerational equity, 13-14
- Intergovernmental Panel on Climate Change (IPCC), 3
  - goals of, 74-77
- Interis, Matthew, 192
- internal carbon pricing, private sector adoption of, 92-93, 255
- internal combustion engine, fossil fuel development and, 35-37
- international agreements
  - on business and corporate environmental management strategies, 264-266
  - transboundary water management and, 176
- international aid, landscape conservation in developing countries and, 118
- International Geosphere-Biosphere Programme (IGBP), 41-43
- International Institute for Sustainable Development, 234-235
- International Monetary Fund, 80, 89
- International Seabed Authority, 202-210
- investment strategies
  - business-related climate action initiatives as incentives for, 91-93
  - green economy investments, 225-226
  - green finance initiatives, 256-260
  - internal carbon pricing and, 92-93
  - marine conservation and, 198-202
  - smart grid development, 86
  - underinvestment in R&D and, 83-86
- irrigation
  - ending subsidies for, 170-172
  - historical water rights, 159-161
  - subsidy swaps for efficient development of, 235-236
  - water scarcity and, 152-153

## 328 / Index

- Japan, green innovation investment in, 229–231
- Jones, Eric, 28–29
- Just Transition Mechanism (EU), 225–226
- Kaczan, David, 189–190
- Kates, Robert, 11
- Kneese, Allen, 63–64
- knowledge spillovers, technology for  
 efficiency and sustainability  
 improvements and, 124–126
- Knudson, Michael, 121–122
- labor  
 colonialization and, 50n.12  
 fossil fuel impact on, 35  
 wage disparities and  
 underemployment of, 239–240
- Lade, Steven, 45–47
- landscape degradation, restoration of, 115–120
- land use and acquisition  
 agricultural intensification and, 41–43, 53n.42  
 biodiversity management and, 105–108  
 coastal ecosystem exploitation and, 190–193  
 collective action against loss of, 130–137  
 data on, 52n.30  
 economics of underfunding for, 118–120  
 ending underpricing of, 120–126  
 evolution of, 23  
 fossil fuel development and changes to, 30–37  
 fragility economics and, 108–110  
 Global Frontiers era, 27–30  
 global trade and, 24–27  
 global value of landscape and, 130–137  
 greenhouse gas emissions from, 101n.21  
 green investment in, 259–260  
 green transition in, 256  
 in low- and middle-income countries, 110  
 no net loss of ecosystems and, 126–130  
 planetary boundaries perspective and, 43–49  
 poverty and unequal access to, 113–115  
 rent seeking and underpricing of, 111–113  
 subsidies for equitable distribution, 120–126  
 sustainable development and, 16  
 underpricing and, 108–110  
 water rights and, 159–160
- Latin America, equitable agricultural  
 subsidies in, 121–122
- lending practices, climate risks and  
 opportunities linked to, 93
- Lenton, Timothy, 47–48
- life expectancy, fossil fuel age impact on, 34–35
- Little Ice Age, 21–22
- Living Planet Index (LPI), 106–107
- living standards, fossil fuel age impact  
 on, 34–35
- local governments  
 carbon pricing initiatives by, 90–93, 99–101  
 ocean governance and, 211  
 water reallocation programs and, 161
- Lovelock, James, 2–3
- low-carbon green growth initiative  
 (Asian Development Bank), 244n.27
- low-carbon transition  
 combined public policy initiatives  
 involving, 102n.20  
 employment and income effects of, 93–99
- low-income economies  
 agricultural subsidies in, 120–126  
 clean energy development challenges  
 in, 87–90

- conservation investment in, 131–133
- estuarine and coastal ecosystem
  - resources in, 192
- green transition in, 231–237
- illegal fishing and plastics pollution in
  - marine environment of, 205–206
- irrigation inequality and inefficiency
  - in, 172
- land use intensification in, 110
- rent seeking and underpricing in,
  - 111–113
- water and sanitation in, 165–167
- water grabbing in, 178–179
- wealth inequality and fossil fuel
  - subsidies in, 88–90
- Luxembourg Stock Exchange, 134–136,
  - 209–210, 258
- major economies. *See also* Group of 20 (G20) countries
  - fossil fuel underpricing by, 80–86
  - global green innovation by, 229–231
  - green economy initiatives for, 224–231
- Malthus, Thomas, 58
- mangroves
  - benefits of restoring, 198–202,
    - 215n.51
  - as blue carbon habitats, 191–192
  - protection of coastal zones and,
    - 190–191
- mariculture
  - categories of, 216n.53
  - innovations in, 198–202
- marine and ocean industries. *See also* seafood industry; shipping industry
  - categories of, 214n.10
  - green investment in, 259–260
  - green transition in, 256
  - marine conservation with revenues
    - from, 206–209
  - taxation of revenues and profits of,
    - 209–210
- marine environment. *See also* oceans
  - collective action for protection of,
    - 202–210
  - conservation and protection initiatives
    - for, 193–198
  - cultural connections to, 192–193
  - deep sea ecosystem monitoring,
    - 206–209
  - economic management of, 17,
    - 185–188
  - Great Acceleration impact on, 41–43
  - history of human impact on, 187
  - inclusive development of ocean and
    - coastal systems, 210–212
  - industrialization and fossil fuel use
    - and, 39
  - plastic pollution in, 41–43
  - underfunding of conservation of,
    - 198–205
  - underpricing of marine capital, 184,
    - 188–193
- marine protected areas
  - benefits of investment in, 198–202
  - development of, 215n.47
  - expansion of, 193–198
  - impact on fishing of, 196–198
- market economy
  - disincentives of R&D investment in,
    - 83–86
  - ecosystem underpricing and, 108–110
  - global trade and evolution of, 24–27
  - green economy and, 222–224
  - land and resource scarcity and,
    - 128–129
  - natural resource and ecological
    - scarcity and, 67–69
  - public policy based on, 217–219
  - underpricing and, 69–72, 79–80
  - water crisis economics and, 146–150
  - water technology innovation and,
    - 173–175
- McDermott, Grant, 196
- Mehlum, Halvor, 112–113
- Mekong River Basin Agreement,
  - 178–179
- Menéndez, Pelayo, 190–191
- middle-income economies
  - agricultural subsidies in, 120–126

## 330 / Index

- middle-income economies (cont.)  
 clean energy development challenges  
 in, 87–90  
 conservation investment in, 131–133  
 estuarine and coastal ecosystem  
 resources in, 192  
 green transition in, 231–237  
 illegal fishing and plast production in,  
 205–206  
 irrigation inequality and inefficiency  
 in, 172  
 land use intensification in, 110  
 water and sanitation in, 165–167  
 water grabbing in, 178–179  
 wealth inequality and fossil fuel  
 subsidies in, 88–90
- mineral extraction  
 ending subsidies for, 120–126  
 fossil fuel development and expansion  
 of, 32–40, 52n.28  
 technological innovation and efficiency  
 improvements in, 124–126
- mining  
 ending subsidies for, 120–126  
 water markets and, 160–161
- Mobilizing Private Finance for Nature*,  
 266–267
- Moene, Karl, 112–113
- Montoya, José, 47–48
- Mughal Empire, 30–31
- Murray-Darling River Basin, 160–161
- national governments  
 carbon pricing initiatives of, 95–99  
 net zero emissions and, 90–93
- natural capital. *See also* resource  
 consumption  
 defined, 59–60  
 economic view of, 73n.11  
 ecosystems as, 64–67  
 environmental risk reduction and, 60–63  
 environmental sustainability and, 49  
 evolution of, 23  
 resource stocks as, 63–67  
 underpricing of, 6–10
- natural climate solutions (NCS)  
 cost-effectiveness of, 123–124  
 land use management and, 117–118  
 tropical carbon tax, 123, 236
- natural forests  
 industry protection programs for,  
 136–137  
 planetary boundaries and, 127–128
- natural resources  
 early human impact on, 23  
 ecological scarcity and, 67–69  
 Global Frontiers era and, 27–30  
 global trade and, 24–27  
 Industrial Revolution and expansion  
 of, 30–37  
 as natural capital, 63–67  
 rent seeking and underpricing of,  
 111–113  
 rural poverty and underpricing of,  
 113–115  
 spaceship economy and, 58–59  
 underpricing of, 7–8
- nature and natural habitat  
 conservation and protection funding  
 for, 115–120  
 early human impact on, 22–32  
 economic benefits of, 115–120  
 global domination of, 31–32  
 human impact on, 105–108  
 preservation proposals for, 106–107  
 underpricing of, 15–16, 55–56, 59–60,  
 67–72, 108–113, 115–120
- nature-based solutions (NBS), 140n.29
- Nature Conservancy, 210
- negative pricing, of ecosystems,  
 108–109, 280n.6
- neo-European states, formation of,  
 29–30, 51n.15
- Network for Greening the Financial  
 System (NGFS), 264–266, 274n.44
- net zero emissions  
 abolition of underpricing and, 99–101  
 climate change and, 74–77  
 fossil fuel underpricing as barrier to,  
 80–86

- Green Deal (European Union)
  - objectives for, 225–226
  - Group of 20 role in, 78–79, 86
  - sub-national initiatives for, 90–93
  - UNEP guidelines for, 101n.6
- no net loss programs, ecosystem
  - protection and, 126–130
- no-take marine reserves, 193–198, 215n.47
- nutrient pollution of water, 167–170
- ocean empires, natural resource trading and, 27–30
- oceans. *See also* marine environment
  - acidification of, 43–49
  - inclusive development of, 210–212
  - ocean grabbing, 184–185
  - underfunding of conservation of, 198–202
- Odell, Rice, 49n.6
- offshore oil and gas
  - ecosystem impact of, 206–209
  - market concentration and environmental exploitation by, 214n.10, 249
- Organization for Economic Cooperation and Development (OECD), 221–222, 239–240
- overfishing. *See* fisheries
- Paris Climate Change Agreement, 90–93, 99–101
- Parry, Ian, 80
- Partnership for Marketing Implementation (PMI), 88–90
- Partnership for Market Readiness (PMR), 88–90
- Pearce, David, 8–10
- Pendrill, Florence, 130–131
- per capita human welfare, total capital stock and, 60–63, 72–73n.10
- performance assessments, corporate environmental risk management, 262
- petro-chemical industry
  - categories in, 52n.29
  - fossil fuel development and, 35–37
- Petrolia, Daniel, 192
- physical capital, 7, 59–60, 279–280
- Pimm, Stuart, 47–48
- planetary boundaries, 19n.13
  - absolute limits and, 11–13
  - Anthropocene impact and, 43–49
  - criticism of, 47–48, 53–54n.55
  - current human impacts, 45–47
  - ecosystem preservation an, 105–108
  - establishment of framework, 45–47
  - freshwater resources, 145–146
  - no net loss programs and, 126–130
  - principles of, 5
  - safe operating space in, 67–69
  - spaceship economy and, 58–59
  - on tropical natural forests, 129–130
- plastic pollution
  - assistance for developing countries with, 205–206
  - corporation control of, 249–251
  - marine environmental damage and, 41–43, 184
  - tax on single-use plastic industries and, 249–251, 268
- pollution absorption, as capital good, 63–64
- population growth
  - Great Acceleration and, 3–4, 41–43
  - marine ecology and, 183
- post-pandemic stimulus spending, absence of green investment in, 219–222
- poverty
  - freshwater scarcity and, 143–145
  - green economy initiatives and elimination of, 231–237
  - post-pandemic growth of, 219–222
  - pricing reforms impact on, 83
  - pro-poor strategies and, 124
  - underpricing and, 113–115
  - underpricing of resources and, 15–16
  - water and sanitation costs and, 165–167

## 332 / Index

- pricing reforms
  - ending underpricing, 82–83
  - equitable management of, 83
  - for irrigation, 170–172
  - water market proposals, 158–173
  - water pollution reduction and, 167–170
  - water technology innovation and, 173–175
- primary production
  - efficiency and sustainability improvements for, 231–237
  - planetary boundaries on space for, 127–128
  - technology for efficiency and sustainability improvements, 124–126
- private sector. *See also* businesses; corporations; financial sector
  - biodiversity protections and, 270–271
  - collective action on climate change and role of, 91–93
  - marine conservation and, 206–209
  - underinvestment in research and development by, 83–86
- public goods, collective action on behalf of, 10–11, 20n.20
- public hand pumps, for rural water treatment, 167
- public policy
  - businesses and, 246–248, 255
  - combined policies to offset economic efficiency losses, 102n.20
  - distributional effects of sustainable development and, 93–99
  - five principles of, 217–219
  - green innovation investment and, 229–231
  - green policy implementation and management initiatives, 260
  - hydraulic mission and, 151–152
  - inclusive economic development and, 237–240
  - of major economies, 224–231
  - market-based initiatives in, 218–219
  - national and sub-national initiatives and, 90–93
  - reforms of subsidies and underpricing and, 83
  - sustainable development and, 17–18
  - underpricing prevalence and, 218–219
  - water conservation and innovation, 173–175
  - water management and sanitation, 150–153, 163–165
- quality of life, fossil fuel age impact on, 34–35
- quantitative analysis, green policy implementation and management initiatives, 260
- Quintana Roo, Mexico, coral reef restoration in, 209–210, 254
- race to fish
  - costs of ending, 198–202
  - external consequences of, 214n.24
  - management reforms for reduction of, 196–198
  - subsidies as catalyst for, 189–190, 196
  - underpricing and, 194–198
- Ramsar Convention on Wetlands, 64
- Randall, Alan, 53–54n.55
- raw materials, fossil fuel development and consumption of, 35–37
- regions
  - carbon pricing initiatives by, 90–93
  - freshwater shortages in, 143–145
  - water markets in, 162–163
  - water reallocation programs in, 161
- remote sensing, water conservation and, 173–175
- renewable energy
  - cost of, 79–80
  - developing countries and investment in, 87–90
  - green investment in, 259–260
  - job and income implications of, 93–99

## 333 / Index

- in rural areas, 231–237
- subsidies for, 82–83
- subsidy swaps for development of, 234–236
- transmission infrastructure obstacles to, 86
- rent seeking, underpricing of land and, 111–113
- research and development
  - business support for, 268
  - global green race and, 229–231
  - public and private support for, 83–86, 226–227
- reserves exploration and exploitation, fossil fuel subsidies for, 82
- revenue generation
  - distributional effects of sustainable development and, 95–99
  - elimination of fossil fuel underpricing and, 82–83, 226–227
  - environmental taxes and, 244n.35
- Richards, John, 31–32
- riparian rights, 159
- river basin management
  - history of, 153–154
  - integrated approach to, 154–157
  - transboundary agreements on, 176
- roads and highways, fossil fuel development and expansion of, 35–37, 52n.28
- Rodrik, Dani, 84
- rule of capture, groundwater governance, 157–158
- rural areas
  - energy poverty in, 15–16, 87–88
  - estuarine and coastal ecosystems and protection of, 191
  - green economy in, 231–237
  - pro-poor strategies in, 124
  - subsidy swaps for energy development in, 235
  - underpricing, poverty and inequity in, 113–115
  - water supply programs, 167
- Sala, Enric, 194
- sanitation
  - in low- and middle-income countries, 165–167
  - pricing for management of, 167–170
  - subsidy swaps for efficient development of, 235–236
  - water management and, 163–165
- Santa Fe, New Mexico, water banking in, 161–162
- scenic views, as capital good, 63–64
- Seafood Business for Ocean Stewardship (SEABOS), 269
- seafood industry, sustainable technologies for, 198–202, 206–209, 216n.64, 252–253, 269
- Seychelles, blue bond initiative, 209–210
- shipping industry
  - colonization and, 24–27
  - decarbonization of, 198–202
  - fossil fuel impact on, 35
  - marine conservation with revenues from, 206–209
- single-use plastics industries, pollution tax for, 249–251, 268
- sinks and resources
  - carbon sinks, 184
  - corporation control of, 249–251
  - pollution and, 43–49
  - spaceship economy and, 58–59, 72n.9
- slavery, colonization and, 29–30, 50n.12
- smallholder agriculture
  - green transition and investment in, 231–237
  - irrigation pricing and, 170–172
  - subsidies for, 120–126
- small-scale fisheries
  - industrial fishing encroachments on, 205–206
  - inequality in subsidies and, 188–189
  - marine protected areas and, 198
  - ocean governance and, 211–212
  - subsidy swaps for, 236
- smart grid development, investment in, 86, 226–227



## 334 / Index

- Smith, Marty, 189–190  
 social “bads,” taxation of, 237–238  
 social costs  
   of carbon, 77–80  
   of fossil fuels, 15–16  
 solar energy  
   declining costs of, 85–86  
   development of, 79–80  
 South Korea, green innovation  
   investment in, 84–85, 229–231  
 sovereign rights of coastal states, marine  
   environment protection and,  
   202–210  
 spaceship economy, 1–3, 12, 15, 56–60,  
   72n.7  
 species diversity assessment, 139n.11  
 Stavins, Rob, 188–189  
 Steffen, Will, 44–45, 127–130  
 Stern, Nicholas, 77–79  
 Sterner, Thomas, 68, 129–130  
 storm damage, estuarine and coastal  
   ecosystem protection from,  
   190–193  
 sub-national jurisdictions, carbon  
   mitigation efforts by, 90–93,  
   99–101  
 subsidies  
   agricultural subsidies, 120–126,  
   170–172, 244n.34  
   equitable management of subsidy  
   swaps, 83, 87–90  
   green economic transition and  
   elimination of, 226–227  
   Group of 20 (G20) underpricing as,  
   80–86  
   irrigation subsidies, 170–172  
   land underpricing using, 120–126  
   in low- and middle-income countries,  
   93–99  
   marine capital underpricing and,  
   188–193, 196  
   for research and development, 83–86  
   underpricing and, 79–80  
   water management and sanitation,  
   163–167, 174–175, 181n.30  
 subsidy swaps  
   equitable management of, 83, 87–90  
   for irrigation, 235–236  
   in low- and middle-income countries,  
   234–236  
   for small-scale fisheries, 211–212, 236  
 Sukhdev, Pavan, 248–256, 271–272  
 sustainability-linked lending, 258–259  
 sustainable development  
   challenges in developing countries for,  
   87–90  
   green finance and, 256–257  
   inclusivity in, 13–14  
   spaceship economy and, 58–60  
   subsidies for, 120–126  
 Tar-Pamlico River Basin (North  
   Carolina), 169–170  
 Taskforce for Nature-Related Financial  
   Disclosures (TNFD), 264–266  
 Task Force on Climate-Related  
   Disclosures (TCFD), 264–266,  
   274n.274  
 taxation  
   biodiversity-relevant tax policies, 123  
   currency-transaction tax, 238  
   deforestation tax, 128–129  
   excess profits taxes, 275n.47  
   financial transaction tax, 238  
   of ocean industries’ revenues and  
   profits, 209–210  
   of social “bads,” 237–238  
   tax on single-use plastic industries,  
   268  
   water pollution reduction and,  
   167–170  
 technology innovation  
   business support for, 268  
   efficiency and sustainability  
   improvements and, 124–126  
   global green race and, 229–231  
   inclusiveness in, 93–99  
   Industrial Revolution and, 33–34  
   infrastructure development for, 80–86  
   irrigation technology, 170–172

## 335 / Index

- in low- and middle-income economies, 237
- major economies' role in, 224–231
- support for research and development in, 83–86
- wage and education disparities and, 239–240
- water management and, 150–153
- water-saving innovations, 173–175
- technology-push policies, 173–175
- technology spillovers, 83–86
- terrestrial realm, planetary boundaries and preservation of, 127–128
- The Economics of Biodiversity* (Dasgupta), 1–2
- The Economics of Spaceship Earth* (Boulding), 56–60
- The Economist*, 258–260, 274n.32
- third-party fishery certification, 205–206
- 30 by 2030 biodiversity target, 127, 193, 202–203
- timber crops, smallholder subsidies for, 122
- tipping points
  - criticism of evidence on, 47–48
  - Earth climate systems, 3–4, 19n.13
  - Holocene period, 22
  - planetary boundaries and, 43–49
  - spaceship economy and, 58–59
- Tobin, James, 238
- Tobin tax, 238
- Torvik, Ragnar, 112–113
- total capital stock
  - defined, 59–60
  - environmental risk reduction and, 60–63
- Toynbee, Arnold, 2, 19–20n.19, 32, 242–243n.18
- tradeable water pollution permits, 167–170
- transboundary water sources
  - collective action concerning, 175–179
  - water grabbing and, 178–179
- transmission infrastructure, clean energy sources and lack of, 86
- transnational corporations (TNCs)
  - market concentration and environmental exploitation by, 249–251
  - sustainability initiatives for, 251–252
- transportation industry
  - fossil fuel impact on, 35
  - highway development and, 35–37
- tropical carbon tax, 123–124, 234, 236
- Tulare River Basin (California), 170–172
- 200 mile limit, 202–210
- underfunding of nature
  - agriculture subsidies and, 115–120
  - coastal ecosystem underfunding, 198–202
  - green business practices and, 267–268
  - green economic transition and ending of, 226–227
  - land use and acquisition and, 118–120
- underpricing of nature
  - business role in, 246–248, 271–272
  - ecological scarcity and, 67–69
  - elimination of, 6–10, 16, 55–56, 59–60, 69–72, 108–110, 115–120, 279–280
  - estimation and calculation of, 102n.19
  - of fisheries, 194–198
  - fossil fuel subsidies linked to, 15–16, 79–80
  - green business development and, 266–269
  - green economy and elimination of, 222–224, 226–227
  - of irrigation, 170–172
  - of land and natural resources, 111–113, 120–126
- in low- and middle-income countries, 87–90, 234
- major economies as leaders in, 80–86
- of marine capital, 17, 184, 188–198, 203–205
- poverty and inequity and, 113–115
- revenue gains from abolition of, 95–99
- suppression of technological innovation and, 79–80

## 336 / Index

- underpricing of nature (cont.)
  - of water, 16–17, 143–150, 158–173
- UN Environment Programme Finance Initiative, 261–262
- United Nations Convention on the Law of the Sea (UNCLOS), 202–210
- United States, fossil fuel development and global hegemony of, 35–37
- universal basic income (UBI), 98–99, 240
- urbanization
  - evolution of, 23–24
  - global trade and, 24–27
  - water appropriation and expansion of, 37–38
  - water scarcity and, 152–153
- user cost approach, cost of climate change and, 102n.13
  
- Vardas, Giannis, 127
- vicious cycle of climate vulnerability, debt and financial risk, 89–90
  - water underpricing and, 146–150
- virtuous cycle of ecosystem management, 69–72
- volumetric water charges, 170–172
- Volz, Ulrich, 89
  
- waste reduction
  - in global agricultural system, subsidies for, 122
  - pricing for management of, 167–170
  - subsidy swaps for efficient development of, 235–236
  - water management and sanitation, 163–165
- water banking programs, 161–162
- water grabbing
  - collective action concerning, 175–179
  - global expansion of, 178–179
  - global water scarcity and, 151–152
- water management. *See also* freshwater resources
  - governance reforms and, 153–158
  - groundwater governance, 157–158
  - hydraulic mission and transformation of, 150–153
  - integrated river basin approach to, 154–157
  - megaproject development and, 152–153
  - river basins and watershed catchments, 153–154
  - sanitation and, 163–165, 235–236
  - subsidies and, 163–167, 174–175, 181n.30
  - sustainable development and, 16–17
  - system development for, 37–38, 52n.32
  - technology innovations in, 173–175
  - transboundary water sources, 175–179
  - water crisis economics and, 146–150
  - water quality trading schemes, 167–170
- water markets, proposals for, 158–173
- water pollution, pricing reforms for reduction of, 167–170
- water pricing schemes, 163–165, 170–172
- water rationing, research on, 170–172
- water rights
  - history of, 159
  - land ownership and, 159–160
- water scarcity
  - hydraulic mission and, 151–152
  - reallocation and management of, 16–17, 146–150
  - transboundary water management and, 176
- water-transfer schemes, 152–153
- wealth creation and distribution
  - agriculture and, 23
  - disparities in, 242n.13
  - early human impact and, 22–32
  - ecosystems as, 66–67, 108–110
  - Fossil Fuel Age and, 32–40
  - Global Frontier and, 27–30
  - global trade and, 24–27
  - Great Recession of 2008–2009 and widening inequality in, 245n.54

## 337 / Index

- inclusive economic development and
  - equality in, 237–240
  - nature as source of, 7
  - post-pandemic inequality in, 219–222
  - spaceship economy and, 59–60
  - total capital stock and, 60–63
- wealth inequality, COVID-19 pandemic and, 14
- wetland ecosystems, as ecological capital, 64–67
- Williams, Hyel, 47–48
- woodland green revolution, 122
- World Bank, 88–90, 95–99, 134–136, 256–257, 266–267
- World Commission on Environment and Development (WCED), 13
- World Economic Forum, 1–2, 143–145, 253, 278–279
- world economy, evolution of, 24–27
- Zeng, Yiwen, 191