

# Notes

## Chapter 1. Selling Our Future

1. Sandra Postel, *Pillar of Sand* (New York: W. W. Norton & Company, 1999), pp. 13–21.
2. Guy Gugliotta, “The Maya: Glory and Ruin,” *National Geographic*, August 2007; Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York: Penguin Group, 2005); Postel, op. cit. note 1, pp. 13–21; Joseph Tainter, *The Collapse of Complex Societies* (Cambridge, U.K.: Cambridge University Press, 1998).
3. U.N. Food and Agriculture Organization (FAO), “Soaring Food Prices: Facts, Perspectives, Impacts, and Actions Required,” paper presented at the High-Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy, Rome, 3–5 June 2008; historical wheat, corn, and soybean prices are Chicago Board of Trade futures data from TFC Commodity Charts, “Grain & Oilseed Commodities Futures,” at [futures.tradingcharts.com/grains\\_oilseeds.html](http://futures.tradingcharts.com/grains_oilseeds.html), viewed 16 January 2009; current wheat, corn, and soybean prices are Chicago Board of Trade futures data from CME Group, “Commodity Products,” various dates, at [www.cmegroup.com](http://www.cmegroup.com); rice prices from Nathan Childs and Katherine Baldwin, *Rice Outlook* (Washington, DC: U.S. Department of Agriculture (USDA), Economic Research Service (ERS), 11 June 2009), p. 26.
4. U.N. General Assembly, “United Nations Millennium Declaration,” resolution adopted by the General Assembly, 8 September 2000; FAO, “1.02 Billion People Hungry,” press release (Rome: 19 June 2009).
5. U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009.
6. USDA, *Production, Supply and Distribution*, electronic database, at

- www.fas.usda.gov/psdonline, updated 12 May 2009; U.N. Population Division, op. cit. note 5.
7. Ward's Automotive Group, *World Motor Vehicle Data 2008* (Southfield, MI: 2008), pp. 239–42; USDA, op. cit. note 6; F.O. Licht, "Too Much Too Soon? World Ethanol Production to Break Another Record in 2005," *World Ethanol and Biofuels Report*, vol. 3, no. 20 (21 June 2005), pp. 429–35; U.S. Department of Energy (DOE), Energy Information Administration (EIA), "World Crude Oil Prices," and "U.S. All Grades All Formulations Retail Gasoline Prices," at [tonto.eia.doe.gov](http://tonto.eia.doe.gov), viewed 31 July 2007.
  8. Cropland losing topsoil is author's estimate; USDA, op. cit. note 6; FAO, *The State of Food and Agriculture 1995* (Rome: 1995), p. 175.
  9. Lester R. Brown, *Outgrowing the Earth* (New York: W. W. Norton & Company, 2004), pp. 101–02; Peter H. Gleick et al., *The World's Water 2004–2005* (Washington, DC: Island Press, 2004), p. 88; U.N. Population Division, op. cit. note 5; Andrew England, "Saudis to Phase Out Wheat Production," *Financial Times*, 10 April 2008; John Briscoe, *India's Water Economy: Bracing for a Turbulent Future* (New Delhi: World Bank, 2005); World Bank, *China: Agenda for Water Sector Strategy for North China* (Washington, DC: April 2001), pp. vii, xi.
  10. Shaobing Peng et al., "Rice Yields Decline with Higher Night Temperature from Global Warming," *Proceedings of the National Academy of Sciences*, 6 July 2004, pp. 9,971–75; J. Hansen, NASA's Goddard Institute for Space Studies, "Global Temperature Anomalies in 0.1 C," at [data.giss.nasa.gov/gistemp/tabledata/GLB.Ts.txt](http://data.giss.nasa.gov/gistemp/tabledata/GLB.Ts.txt), updated April 2009; "Summary for Policymakers," in *Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), p. 13.
  11. U.N. Environment Programme, *Global Outlook for Ice and Snow* (Nairobi: 2007); Lester R. Brown, "Melting Mountain Glaciers Will Shrink Grain Harvests in China and India," *Plan B Update* (Washington, DC: Earth Policy Institute, 20 March 2008); USDA, op. cit. note 6.
  12. W. T. Pfeffer, J. T. Harper, and S. O'Neel, "Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise," *Science*, vol. 321 (5 September 2008) pp. 1,340–43; James Hansen, "Scientific Reticence and Sea Level Rise," *Environmental Research Letters*, vol. 2 (24 May 2007); Environmental Change and Forced Scenarios Project, "Preliminary Finds from the EACH-FOR Project on Environmentally Induced Migration" (September 2008), p. 16; U.N. Development Programme, *Human Development Report 2007/2008* (New York: 2007), p. 100; World Bank, *World Development Report 1999/2000* (New York: Oxford University Press, September 1999); USDA, op. cit. note 6; U.N. Population Division, op. cit. note 5.
  13. FAO, *FISHSTAT Plus*, electronic database, at [www.fao.org](http://www.fao.org), updated February 2009.
  14. Wang Tao, Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), Chinese Academy of Sciences, e-mail to author, 4 April 2004; Wang Tao, "The Process and Its Control of Sandy

- Desertification in Northern China," CAREERI, Chinese Academy of Sciences, seminar on desertification, held in Lanzhou, China, May 2002; "Scientists Meeting in Tunis Called for Priority Activities to Curb Desertification," *UN News Service*, 21 June 2006.
15. Noel Gollehon and William Quinby, "Irrigation in the American West: Area, Water and Economic Activity," *Water Resources Development*, vol. 16, no. 2 (2000), pp. 187–95; Sandra Postel, *Last Oasis* (New York: W. W. Norton & Company, 1997), p. 137; R. Srinivasan, "The Politics of Water," *Info Change Agenda*, issue 3 (October 2005); *Water Strategist*, various issues, at [www.waterstrategist.com](http://www.waterstrategist.com); "China Politics: Growing Tensions Over Scarce Water," *The Economist*, 21 June 2004.
  16. USDA, op. cit. note 6; pre-1960 data from USDA, in Worldwatch Institute, *Signposts 2001*, CD-ROM (Washington, DC: 2001).
  17. USDA, op. cit. note 6; pre-1960 data from USDA, op. cit. note 16.
  18. USDA, op. cit. note 6; Kenneth G. Cassman et al., "Meeting Cereal Demand While Protecting Natural Resources and Improving Environmental Quality," *Annual Review of Environment and Resources*, November 2003, pp. 322, 350; Thomas R. Sinclair, "Limits to Crop Yield?" in American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, *Physiology and Determination of Crop Yield* (Madison, WI: 1994), pp. 509–32.
  19. Peter M. Vitousek et al., "Human Appropriation of the Products of Photosynthesis," *BioScience*, vol. 36, no. 6 (June 1986), pp. 368–73.
  20. USDA, op. cit. note 6; U.N. Population Division, op. cit. note 5.
  21. *Financial Times*, "In Depth: The Global Food Crisis," at [www.ft.com/foodprices](http://www.ft.com/foodprices), updated 6 May 2008; USDA, op. cit. note 6.
  22. Office of the President, Republic of the Philippines, "RP Assured of 1.5 Million Metric Tons of Rice Supply from Vietnam Annually," press release (Manila: 26 March 2008); "Yemen to Seek Australian Food Cooperation," *WorldGrain.com*, 19 May 2008; "Indonesia Set to Become Major Rice Exporter Next Year," *WorldGrain.com*, 1 July 2008; "Bahrain to Own Rice Farms in Thailand," *TradeArabia*, online business newswire, 30 May 2008; Javier Blas, "Nations Make Secret Deals Over Grain," *Financial Times*, 10 April 2008; Maria Kolesnikova and Alaa Shahine, "Russia, Egypt Agree on Wheat Deals to Boost Shipments," *Bloomberg*, 23 June 2009.
  23. GRAIN, *Seized! The 2008 Land Grab for Food and Financial Security* (Barcelona: October 2008); USDA, op. cit. note 6; "Libya Agrees Deal to Grow Wheat in Ukraine," *Reuters*, 27 May 2009.
  24. Joachim von Braun and Ruth Meinzen-Dick, "Land Grabbing" by Foreign Investors in Developing Countries, Policy Brief No. 13 (Washington, DC: International Food Policy Research Institute, April 2009).
  25. GRAIN, op. cit. note 23; von Braun and Meinzen-Dick, op. cit. note 24; "Buying Farmland Abroad: Outsourcing's Third Wave," *The Economist*, 21 May 2009.
  26. GRAIN, op. cit. note 23; "Land Deals in Africa and Asia: Cornering Foreign Fields," *The Economist*, 21 May 2009; Javier Blas, "Saudis Get First Taste of Foreign Harvest," *Financial Times*, 4 March 2009; "Saudi's Hadco Eyes Sudan, Turkey in Food Security Push," *Reuters*, 17 February 2009; U.N. World Food Programme, "Countries," at [www.wfp.org/](http://www.wfp.org/)

- countries, viewed 4 June 2009.
27. "Saudis Invest \$1.3 Billion in Indonesian Agriculture," *Reuters*, 24 March 2009; von Braun and Meinzen-Dick, op. cit. note 24.
  28. Von Braun and Meinzen-Dick, op. cit. note 24; USDA, op. cit. note 6; U.N. Population Division, op. cit. note 5; "China 'May Lease Foreign Fields'," *BBC News*, 29 April 2008; Gurbir Singh, "China is Buying Farm Lands Abroad to Ensure Food Supplies at Home," *Business World* (New Delhi), 16 May 2008; "China Eyes Russian Farmlands in Food Push," *Russia Today* (Moscow), 11 May 2008; GRAIN, op. cit. note 23, p. 3; "Govt to Lease Land for FDI in Agriculture," *Myanmar Times*, 11–17 September 2006; U.N. World Food Programme, op. cit. note 26.
  29. USDA, op. cit. note 6; GRAIN, op. cit. note 23, pp. 4, 5; "Buying Farmland Abroad," op. cit. note 25; Javier Blas, "Hyundai Plants Seoul's Flag on 50,000ha of Russia," *Financial Times*, 15 April 2009.
  30. Erik Ansink and Arjan Ruijs, "Climate Change and the Stability of Water Allocation Agreements," *Fondazione Ene Enrico Mattei*, Working Paper No. 16.2007 (February 2007), pp. 21–23.
  31. "Memorandum of Understanding on Construction of Agriculture Technology Transfer Center and Grain Production and Processing Base in the Philippines," available at [www.newsbreak.com.ph/dmdocuments/special%20coverages/China%20Agri/Fuhua%20MOU.pdf](http://www.newsbreak.com.ph/dmdocuments/special%20coverages/China%20Agri/Fuhua%20MOU.pdf), signed 15 January 2007; "China: 'Going Outward' for Food Security," *Stratfor*, 30 April 2008; Luzi Ann Javier, "China's Appetite for Filipino Paddies Breeds Farmer Opposition," *Bloomberg*, 21 February 2008; Tom Burgis and Javier Blas, "Madagascar Scraps Daewoo Farm Deal," *Financial Times*, 18 March 2009; "Zambia's Opposition Condemns Reported Chinese Bio-fuels Project," *Earth Times*, 2 April 2009.
  32. GRAIN, op. cit. note 23, p. 10; "Buying Farmland Abroad," op. cit. note 25.
  33. Amena Bakr, "Pakistan Offers Farmland to Foreign Investors," *Reuters*, 20 April 2009.
  34. Michiyo Nakamoto and Javier Blas, "G8 Move to Halt 'Farmland Grabbing'," *Financial Times*, 26 May 2009; von Braun and Meinzen-Dick, op. cit. note 24.
  35. USDA, op. cit. note 6; U.N. Population Division, op. cit. note 5.
  36. "Cereal Offenders," *The Economist*, 27 May 2008; "Commodities Boom Recalls 70s Surge; Prices Not There Yet," *Dow Jones Newswires*, 27 June 2008; Fred H. Sanderson, "The Great Food Fumble," *Science*, vol. 188 (9 May 1975), pp. 503–09; U.S. Department of the Treasury, "Report on Foreign Holdings of U.S. Securities at End-June 2008," press release (Washington, DC: 30 April 2009); U.S. Department of the Treasury, "Major Foreign Holders of Treasury Securities," current and historical data tables, at [www.treasury.gov/tic](http://www.treasury.gov/tic), updated 16 January 2009.
  37. James Bandler and Nicholas Varchaver, "How Bernie Did It," *Fortune*, vol. 159, no. 10 (11 May 2009); "The Madoff Affair: Going Down Quietly," *The Economist*, 12 May 2009.
  38. Angus Maddison, "Statistics on World Population, GDP and Per Capita GDP, 1–2006 AD," at [www.ggdc.net/maddison](http://www.ggdc.net/maddison), updated March 2009; Mathis Wackernagel et al., "Tracking the Ecological Overshoot of the Human Economy," *Proceedings of the National Academy of Sciences*,

- vol. 99, no. 14 (9 July 2002), pp. 9,266–71; Global Footprint Network, WWF, and Zoological Society of London, *Living Planet Report 2008* (Gland, Switzerland: WWF, October 2008), p. 2.
39. Author's estimate based on previously cited figures for China and India, as well as other countries such as Saudi Arabia and Pakistan where water tables are falling due to overpumping.
  40. FAO, *The State of World Fisheries and Aquaculture 2008* (Rome: 2009), p. 7; Ransom A. Myers and Boris Worm, "Rapid Worldwide Depletion of Predatory Fish Communities," *Nature*, vol. 432 (15 May 2003), pp. 280–83.
  41. Paul Hawken, "Commencement Address to the Class of 2009," speech at University of Portland, Portland, OR, 3 May 2009.
  42. Eric Pfanner, "Failure Brings Call for Tougher Standards: Accounting for Enron: Global Ripple Effects," *International Herald Tribune*, 17 January 2002.
  43. Nicholas Stern, *The Stern Review on the Economics of Climate Change* (London: HM Treasury, 2006).
  44. DOE, EIA, "Weekly Retail Gasoline and Diesel Prices," at [tonto.eia.doe.gov/dnav/pet/pet\\_pri\\_gnd\\_dcus\\_nus\\_w.htm](http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm), viewed 5 June 2009.
  45. International Center for Technology Assessment (ICTA), *The Real Cost of Gasoline: An Analysis of the Hidden External Costs Consumers Pay to Fuel Their Automobiles* (Washington, DC: 1998); ICTA, *Gasoline Cost Externalities Associated with Global Climate Change* (Washington, DC: September 2004); ICTA, *Gasoline Cost Externalities: Security and Protection Services* (Washington, DC: January 2005); Terry Tamminen, *Lives Per Gallon: The True Cost of Our Oil Addiction* (Washington, DC: Island Press, 2006), p. 60, adjusted to 2007 prices with Bureau of Economic Analysis, "Table 3—Price Indices for Gross Domestic Product and Gross Domestic Purchases," *GDP and Other Major Series, 1929–2007* (Washington, DC: August 2007); DOE, op. cit. note 44.
  46. Munich Re, *Topics Annual Review: Natural Catastrophes 2001* (Munich, Germany: 2002), pp. 16–17; value of China's wheat and rice harvests from USDA, op. cit. note 6, updated 12 July 2007, using prices from International Monetary Fund, *International Financial Statistics*, electronic database, at [ifs.apdi.net/imf](http://ifs.apdi.net/imf).
  47. "Forestry Cuts Down on Logging," *China Daily*, 26 May 1998; Erik Eckholm, "China Admits Ecological Sins Played Role in Flood Disaster," *New York Times*, 26 August 1998.
  48. Fund for Peace and *Foreign Policy*, "The Failed States Index," *Foreign Policy*, July/August 2005, pp. 56–65.
  49. Ibid.
  50. Lydia Polgreen, "In Congo, Hunger and Disease Erode Democracy," *New York Times*, 23 June 2006; International Rescue Committee, *Mortality in the Democratic Republic of Congo: An Ongoing Crisis* (New York: January 2008), p. ii; Lydia Polgreen, "Hundreds Killed Near Chad's Border With Sudan," *New York Times*, 14 November 2006; "A Failing State: The Himalayan Kingdom Is a Gathering Menace," *The Economist*, 4 December 2004.
  51. "The Indian Ocean: The Most Dangerous Seas in the World," *The Economist*, 17 July 2008; U.N. Office on Drugs and Crime, *World Drug Report*

- 2009 (Vienna: June 2009), p. 34; Ania Lichtarowica, "Conquering Polio's Last Frontier," *BBC News*, 2 August 2007.
52. Neil MacFarquhar, "Haiti's Woes Are Top Test for Aid Effort," *New York Times*, 31 March 2009; U.S. Central Intelligence Agency, *The World Factbook*, at [www.cia.gov/library/publications/the-world-factbook](http://www.cia.gov/library/publications/the-world-factbook), updated 26 June 2009; Madeleine K. Albright and Robin Cook, "The World Needs to Step It Up in Afghanistan," *International Herald Tribune*, 5 October 2004; Desmond Butler, "5-Year Hunt Fails to Net Qaeda Suspect in Africa," *New York Times*, 14 June 2003; Emilio San Pedro, "U.S. Ready to Aid Mexico Drug Fight," *BBC News*, 2 March 2009.
  53. Fund for Peace and *Foreign Policy*, "The Failed States Index," *Foreign Policy*, July/August issues, 2005–09.
  54. Fund for Peace and *Foreign Policy*, "The Failed States Index," *Foreign Policy*, July/August 2007, pp. 54–63; Table 1–1 from Fund for Peace and *Foreign Policy*, "The Failed States Index," *Foreign Policy*, July/August 2009, pp. 80–93.
  55. Fund for Peace and *Foreign Policy*, op. cit. note 53.
  56. U.N. Population Division, op. cit. note 5; Fund for Peace and *Foreign Policy*, July/August 2009, op. cit. note 54; Richard Cincotta and Elizabeth Leahy, "Population Age Structure and Its Relation to Civil Conflict: A Graphic Metric," *Woodrow Wilson International Center for Scholars Environmental Change and Security Program Report*, vol. 12 (2006–07), pp. 55–58.
  57. Fund for Peace and *Foreign Policy*, July/August 2009, op. cit. note 54.
  58. *Ibid.*; U.N. Population Division op. cit. note 5.
  59. Fund for Peace and *Foreign Policy*, July/August 2009, op. cit. note 54; U.N. Population Division, op. cit. note 5.
  60. Fund for Peace and *Foreign Policy*, July/August 2009, op. cit. note 54; U.N. World Food Programme, op. cit. note 26.
  61. *Financial Times*, op. cit. note 21; Carolyn Said, "Nothing Flat about Tortilla Prices: Some in Mexico Cost 60 Percent More, Leading to a Serious Struggle for Low-Income People," *San Francisco Chronicle*, 13 January 2007; Adam Morrow and Khaled Moussa al-Omrani, "Egypt: Rising Food Costs Provoke Fights Over Subsidised Bread," *Inter Press Service*, 26 March 2008; Raphael Minder, John Aglionby, and Jung-a Song, "Soaring Soybean Price Stirs Anger Among Poor," *Financial Times*, 18 January 2008; Joseph Delva and Jim Loney, "Haiti's Government Falls after Food Riots," *Reuters*, 12 April 2008.
  62. Keith Bradsher, "High Rice Cost Creating Fears of Asian Unrest," *New York Times*, 29 March 2008; Kamran Haider, "Pakistani Troops Escort Wheat Trucks to Stop Theft," *Reuters*, 13 January 2008; Nadeem Sarwar, "Pakistan's Poor, Musharraf Reeling Under Wheat Crisis," *Deutsche Presse-Agentur*, 14 January 2008; Carlotta Gall, "Hunger and Food Prices Push Afghanistan to Brink," *New York Times*, 16 May 2008; U.N. World Food Programme, "Almost 6 Million Sudanese Await WFP Support in 2009," at [www.wfp.org](http://www.wfp.org), 5 March 2009.
  63. United Nations, "United Nations Peacekeeping Operations," background note, at [www.un.org/Depts/dpko/dpko/bnote.htm](http://www.un.org/Depts/dpko/dpko/bnote.htm), viewed 8 June 2009; North Atlantic Treaty Organization, "NATO in Afghanistan," at [www.nato.int/issues/Afghanistan/index.html](http://www.nato.int/issues/Afghanistan/index.html), updated 27 March 2009.

64. U.N. World Food Programme, op. cit. note 26.
65. Stephanie McCrummen, "In an Eastern Congo Oasis, Blood amid the Greenery," *Washington Post*, 22 July 2007.
66. U.N. Population Division, op. cit. note 5.
67. Harold G. Vatter, *The US Economy in World War II* (New York: Columbia University Press, 1985), p. 13; Alan L. Gropman, *Mobilizing U.S. Industry in World War II* (Washington, DC: National Defense University Press, August 1996); Doris Kearns Goodwin, *No Ordinary Time—Franklin and Eleanor Roosevelt: The Home Front in World War II* (New York: Simon & Schuster, 1994), p. 316.
68. U.N. Population Division, *World Population Prospects: The 2008 Revision, Extended Dataset*, CD-ROM (New York: 9 April 2009).
69. CalCars, "All About Plug-In Hybrids," at [www.calcars.org](http://www.calcars.org), viewed 9 June 2009; General Motors, "Imagine: A Daily Commute Without Using a Drop of Gas," at [www.chevrolet.com/electricar](http://www.chevrolet.com/electricar), viewed 8 August 2008.
70. Larry Kinney, *Lighting Systems in Southwestern Homes: Problems and Opportunities*, prepared for DOE, Building America Program through the Midwest Research Institute, National Renewable Energy Laboratory Division (Boulder, CO: Southwest Energy Efficiency Project, June 2005), pp. 4–5; CREE LED Lighting, "Ultra-Efficient Lighting," at [www.cree-lighting.com/efficiency.htm](http://www.cree-lighting.com/efficiency.htm), viewed 17 April 2009.
71. Denmark from Global Wind Energy Council (GWEC), "Interactive World Map," at [www.gwec.net/index.php?id=126](http://www.gwec.net/index.php?id=126), viewed 29 May 2009, and from Flemming Hansen, "Denmark to Increase Wind Power to 50% by 2025, Mostly Offshore," *Renewable Energy Access*, 5 December 2006; GWEC, *Global Wind 2008 Report* (Brussels: 2009), p. 13, with European per person consumption from European Wind Energy Association, "Wind Power on Course to Become Major European Energy Source by the End of the Decade," press release (Brussels: 22 November 2004); China's solar water heaters from Werner Weiss, Irene Bergmann, and Roman Stelzer, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2007* (Gleisdorf, Austria: International Energy Agency, Solar Heating & Cooling Programme, May 2009), p. 20; Iceland National Energy Authority and Ministries of Industry and Commerce, *Geothermal Development and Research in Iceland* (Reykjavik: April 2006), p. 16; share of electricity calculated by Earth Policy Institute using installed capacity from Ruggero Bertani, "World Geothermal Generation in 2007," *GHC Bulletin*, September 2007, p. 9; capacity factor from Ingvar B. Fridleifsson et al., "The Possible Role and Contribution of Geothermal Energy to the Mitigation of Climate Change," in O. Hohmeyer and T. Trittin, eds., *IPCC Scoping Meeting on Renewable Energy Sources, Proceedings* (Luebeck, Germany: 20–25 January 2008), p. 5; total electricity generation from "World Total Net Electricity Generation, 1980–2005," in DOE, EIA, *International Energy Annual 2005* (Washington, DC: 13 September 2007).
72. Se-Kyung Chong, "Anmyeon-do Recreation Forest: A Millennium of Management," in Patrick B. Durst et al., *In Search of Excellence: Exemplary Forest Management in Asia and the Pacific*, Asia-Pacific Forestry Commission (Bangkok: FAO Regional Office for Asia and the Pacific, 2005), pp. 251–59; Daniel Hellerstein, "USDA Land Retirement Programs," in USDA, *Agricultural Resources and Environmental Indicators*

2006 (Washington, DC: July 2006); USDA, ERS, *Agri-Environmental Policy at the Crossroads: Guideposts on a Changing Landscape*, Agricultural Economic Report No. 794 (Washington, DC: January 2001); USDA, op. cit. note 6.

73. Molly O'Meara, *Reinventing Cities for People and the Planet*, Worldwatch Paper 147 (Washington, DC: Worldwatch Institute, June 1999), p. 47; City of Amsterdam, "Bike Capital of Europe," at [www.toamsterdam.nl](http://www.toamsterdam.nl), viewed 2 July 2009; Serge Schmemmann, "I Love Paris on a Bus, a Bike, a Train and in Anything but a Car," *New York Times*, 26 July 2007; Transport for London, *Central London Congestion Charging: Impacts Monitoring* (London: various years).

## Chapter 2. Population Pressure: Land and Water

1. Lester R. Brown, *The Twenty-Ninth Day* (New York: W. W. Norton & Company, 1978).
2. Grain area from U.S. Department of Agriculture (USDA), *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 9 April 2009; cropland losing topsoil is author's estimate based on Mohan K. Wali et al., "Assessing Terrestrial Ecosystem Sustainability," *Nature & Resources*, October-December 1999, pp. 21–33, and on World Resources Institute (WRI), *World Resources 2000–01* (Washington, DC: 2000).
3. U.N. Food and Agriculture Organization (FAO), *ResourceSTAT*, electronic database, at [faostat.fao.org](http://faostat.fao.org), updated April 2009; Lester R. Brown, "Melting Mountain Glaciers Will Shrink Grain Harvests in China and India," *Plan B Update* (Washington, DC: Earth Policy Institute, 20 March 2008).
4. Jacob W. Kijne, *Unlocking the Water Potential of Agriculture* (Rome: FAO, 2003), p. 26.
5. Lester R. Brown, *Outgrowing the Earth* (New York: W. W. Norton & Company, 2004), pp. 101–02.
6. Walter C. Lowdermilk, *Conquest of the Land Through 7,000 Years*, USDA Bulletin No. 99 (Washington, DC: USDA, Natural Resources Conservation Service, 1939).
7. *Ibid.*, p. 10.
8. FAO, "FAO/WFP Crop and Food Assessment Mission to Lesotho Special Report," at [www.fao.org](http://www.fao.org), viewed 29 May 2002; U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009; Michael Grunwald, "Bizarre Weather Ravages Africans' Crops," *Washington Post*, 7 January 2003.
9. USDA, op. cit. note 2; U.N. World Food Programme (WFP), "Lesotho," at [www.wfp.org/countries/lesotho](http://www.wfp.org/countries/lesotho), viewed 5 May 2009.
10. USDA, op. cit. note 2; FAO, *Global Forest Resources Assessment 2005* (Rome: 2006), p. 193; WFP, "Haiti," at [www.wfp.org/countries/haiti](http://www.wfp.org/countries/haiti), viewed 5 May 2009.
11. U.N. Environment Programme (UNEP), *Mongolia: State of the Environment 2002* (Pathumthani, Thailand: Regional Resource Centre for Asia and the Pacific, 2001), pp. 3–7; U.N. Population Division, op. cit. note 8; USDA, op. cit. note 2.
12. FAO, "More People Than Ever are Victims of Hunger," background note (Rome: June 2009).
13. National Aeronautics and Space Administration Earth Observatory, "Dust Storm off Western Sahara Coast," at [earthobservatory.nasa.gov](http://earthobservatory.nasa.gov), viewed 9 January 2005.
14. Paul Brown, "4x4s Replace the Desert Camel and Whip Up a Worldwide Dust Storm," *Guardian* (London), 20 August 2004.
15. *Ibid.*
16. Ann Schrader, "Latest Import from China: Haze," *Denver Post*, 18 April 2001; Brown, op. cit. note 14.
17. Howard W. French, "China's Growing Deserts Are Suffocating Korea," *New York Times*, 14 April 2002.
18. For number of dust storms in China, see Table 1–1 in Lester R. Brown, Janet Larsen, and Bernie Fischlowitz Roberts, *The Earth Policy Reader* (New York: W. W. Norton & Company, 2002), p. 13.
19. U.S. Embassy, "Desert Mergers and Acquisitions," *Beijing Environment, Science, and Technology Update* (Beijing: 19 July 2002), p. 2.
20. Asif Farrukh, *Pakistan Grain and Feed Annual Report 2002* (Islamabad, Pakistan: USDA Foreign Agricultural Service, 2003).
21. UNEP, *Africa Environment Outlook: Past, Present, and Future Perspectives* (Nairobi: 2002).
22. Land area estimate from Stanley Wood, Kate Sebastian, and Sara J. Scherr, *Pilot Analysis of Global Ecosystems: Agroecosystems* (Washington, DC: International Food Policy Research Institute and WRI, 2000), p. 3; FAO, *ProdSTAT*, electronic database, at [faostat.fao.org](http://faostat.fao.org), updated June 2009.
23. Number of pastoralists from FAO, *The State of Food Insecurity in the World 2003* (Rome: 2003), p. 15; Robin P. White, Siobhan Murray, and Mark Rohweder, *Pilot Analysis of Global Ecosystems: Grassland Ecosystems* (Washington, DC: WRI, 2000); U.N. Population Division, op. cit. note 8; FAO, op. cit. note 22; Southern African Development Coordination Conference, *SADCC Agriculture: Toward 2000* (Rome: FAO, 1984).
24. Government of Nigeria, *Combating Desertification and Mitigating the Effects of Drought in Nigeria*, Revised National Report on the Implementation of the United Nations Convention to Combat Desertification (Nigeria: April 2002); U.N. Population Division, op. cit. note 8; FAO, op. cit. note 22.
25. U.N. Population Division, op. cit. note 8; FAO, op. cit. note 22; Iranian News Agency, "Official Warns of Impending Desertification Catastrophe in Southeast Iran," *BBC International Reports*, 29 September 2002.
26. UNEP, *Afghanistan: Post-Conflict Environmental Assessment* (Geneva: 2003), p. 52.
27. FAO, op. cit. note 22.
28. Wang Tao et al., "A Study on Spatial-temporal Changes of Sandy Desertified Land During Last 5 Decades in North China," *Acta Geographica Sinica*, vol. 59 (2004), pp. 203–12.
29. Wang Tao, Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), Chinese Academy of Sciences, e-mail to author, 4 April 2004; Wang Tao, "The Process and Its Control of Sandy Desertification in Northern China," CAREERI, Chinese Academy of Sciences, seminar on desertification, Lanzhou, China, May 2002.

30. FAO, *The State of Food and Agriculture 1995* (Rome: 1995), p. 175; Rosamond Naylor et al., "Losing the Links between Livestock and Land," *Science*, vol. 310 (9 December 2005), pp. 1,621–22.
31. "The Great North American Dust Bowl: A Cautionary Tale," in Secretariat of the U.N. Convention to Combat Desertification, *Global Alarm: Dust and Sandstorms from the World's Drylands* (Bangkok: 2002), pp. 77–121; John Steinbeck, *The Grapes of Wrath* (New York: Viking Penguin, Inc., 1939).
32. FAO, op. cit. note 30, p. 175; David Christian, *Imperial and Soviet Russia: Power, Privilege, and the Challenge of Modernity* (New York: Palgrave Macmillan, 1997) p. 366; USDA, op. cit. note 2; France from USDA, Foreign Agricultural Service, *World Agricultural Production* (Washington, DC: April 2009), p. 7.
33. David Kaimowitz et al., *Hamburger Connection Fuels Amazon Destruction* (Jakarta, Indonesia: Center for International Forestry Research, 2004); Carlos R. Spehar, "Production Systems in the Savannahs of Brazil: Key Factors to Sustainability," in Rattan Lal, ed., *Soil Quality and Agricultural Sustainability* (Chelsea, MI: Ann Arbor Press, 1998), pp. 301–18; Daniel Nepstad, "Climate Change and the Forest," *Tomorrow's Amazonia: Using and Abusing the World's Last Great Forests* (Washington, DC: The American Prospect, September 2007); Geoffrey Lean, "A Disaster to Take Everyone's Breath Away," *Independent* (London), 24 July 2006.
34. Craig S. Smith, "Saudis Worry as They Waste Their Scarce Water," *New York Times*, 26 January 2003.
35. Andrew England, "Saudis to Phase Out Wheat Production," *Financial Times*, 10 April 2008; USDA, op. cit. note 2; U.N. Population Division, op. cit. note 8.
36. Michael Ma, "Northern Cities Sinking as Water Table Falls," *South China Morning Post*, 11 August 2001; Smith, op. cit. note 34; John Opie, *Ogallala: Water for a Dry Land*, 2nd ed. (Lincoln, NB: University of Nebraska Press, 2000), p. 3.
37. U.N. Population Division, op. cit. note 8; USDA, op. cit. note 2; Christopher Ward, "Yemen's Water Crisis," based on a lecture to the British Yemeni Society in September 2000, July 2001; Fund for Peace and *Foreign Policy*, "The Failed States Index," *Foreign Policy*, July/August 2009, pp. 80–93.
38. Ma, op. cit. note 36; share of China's grain harvest from the North China Plain based on Hong Yang and Alexander Zehnder, "China's Regional Water Scarcity and Implications for Grain Supply and Trade," *Environment and Planning A*, vol. 33 (2001), and on National Bureau of Statistics of China, *China Statistical Yearbook 2008*, electronic database, at [www.stats.gov.cn/tjsj/ndsj/2008/indexeh.htm](http://www.stats.gov.cn/tjsj/ndsj/2008/indexeh.htm), viewed 9 June 2009.
39. Ma, op. cit. note 36.
40. World Bank, *China: Agenda for Water Sector Strategy for North China* (Washington, DC: April 2001), pp. vii, xi; U.N. Population Division, op. cit. note 8; USDA, op. cit. note 2.
41. Number of farmers and well investment from Peter H. Gleick et al., *The World's Water 2006–2007* (Washington, DC: Island Press, 2006), p. 148; number of wells and rate of aquifer depletion from Fred Pearce, "Asian Farmers Sucking the Continent Dry," *New Scientist*, 28 August 2004.

42. Pearce, op. cit. note 41.
43. USDA, op. cit. note 2; John Briscoe, *India's Water Economy: Bracing for a Turbulent Future* (New Delhi: World Bank, 2005); U.N. Population Division, op. cit. note 8.
44. USDA, *Agricultural Resources and Environmental Indicators 2000* (Washington, DC: February 2000), Chapter 2.1, p. 6; irrigated share calculated from FAO, op. cit. note 3; harvest from USDA, op. cit. note 2; Sandra Postel, *Pillar of Sand* (New York: W. W. Norton & Company, 1999), p. 77.
45. U.N. Population Division, op. cit. note 8; fall in water table from "Pakistan: Focus on Water Crisis," *U.N. Integrated Regional Information Networks News*, 17 May 2002.
46. "Pakistan: Focus on Water Crisis," op. cit. note 45; Sardar Riaz A. Khan, "Declining Land Resource Base," *Dawn* (Pakistan), 27 September 2004.
47. Chenaran Agricultural Center, Ministry of Agriculture, according to Hamid Taravati, publisher, Iran, e-mail to author, 25 June 2002; USDA, op. cit. note 2.
48. Deborah Camiel, "Israel, Palestinian Water Resources Down the Drain," *Reuters*, 12 July 2000; USDA, op. cit. note 2; "Palestinian Water Crisis Deepens," *BBC News*, 20 April 2009.
49. U.N. Population Division, op. cit. note 8; Tushaar Shah et al., *The Global Groundwater Situation: Overview of Opportunities and Challenges* (Colombo, Sri Lanka: International Water Management Institute, 2000); Karin Kemper, "Groundwater Management in Mexico: Legal and Institutional Issues," in Salman M. A. Salman, ed., *Groundwater: Legal and Policy Perspectives*, Proceedings of a World Bank Seminar (Washington, DC: World Bank, 1999), p. 117; U.N. Development Programme, *Human Development Report 2006* (Gordonsville, VA: Palgrave Macmillan, 2006), p. 146.
50. Water to make steel from Sandra Postel, *Last Oasis* (New York: W. W. Norton & Company, 1997), pp. 38–39; 1,000 tons of water for 1 ton of grain from FAO, *Yield Response to Water* (Rome: 1979).
51. Noel Gollehon and William Quinby, "Irrigation in the American West: Area, Water and Economic Activity," *Water Resources Development*, vol. 16, no. 2 (2000), pp. 187–95; Postel, op. cit. note 50, p. 137; Pramit Mitra, "Running on Empty: India's Water Crisis Could Threaten Prosperity," *South Asia Monitor*, no. 103 (Washington, DC: Center for Strategic and International Studies, 8 February 2007); R. Srinivasan, "The Politics of Water," *Info Change Agenda*, issue 3 (October 2005); U.N. Population Division, *World Urbanization Prospects: The 2007 Revision Population Database*, at [esa.un.org/unup](http://esa.un.org/unup), updated 2008.
52. Srinivasan, op. cit. note 51; Pearce, op. cit. note 41.
53. "China Politics: Growing Tensions Over Scarce Water," *The Economist*, 21 June 2004.
54. Gollehon and Quinby, op. cit. note 51; *Water Strategist*, various issues, at [www.waterstrategist.com](http://www.waterstrategist.com).
55. Joey Bunch, "Water Projects Forecast to Fall Short of Needs: Study Predicts 10% Deficit in State," *Denver Post*, 22 July 2004.
56. Dean Murphy, "Pact in West Will Send Farms' Water to Cities," *New York Times*, 17 October 2003; Tim Molloy, "California Water District Approves Plan to Pay Farmers for Irrigation Water," *Associated Press*, 13

- May 2004; USDA, National Agricultural Statistics Service (NASS), "Table 10. Irrigation 2002 and 1997," *2002 Census of Agriculture*, vol. 1 (Washington, DC: June 2004), pp. 318–26; USDA, NASS, "Table 10. Irrigation: 2007 and 2002," *2007 Census of Agriculture*, vol. 1 (Washington, DC: February 2009), pp. 372–80.
57. FAO, op. cit. note 50.
  58. Grain from USDA, Foreign Agricultural Service, *Grain: World Markets and Trade* (Washington, DC: various years); USDA, op. cit. note 2.
  59. Nile River flow from Postel, op. cit. note 44, p. 71; grain imports from USDA, op. cit. note 2; calculation based on 1,000 tons of water for 1 ton of grain from FAO, op. cit. note 50.
  60. U.N. Population Division, op. cit. note 8; USDA, op. cit. note 2.
  61. USDA, *Production, Supply and Distribution Country Reports* (Washington, DC: October 1990); USDA, op. cit. note 2; U.N. Population Division, op. cit. note 8.
  62. "Time for Action on Sudan" (editorial), *New York Times*, 18 June 2004; "A First Step to Save Darfur" (editorial), *New York Times*, 3 August 2007; "Hearings to Identify Causes of Conflict Kick Off in Darfur, Reports UN-AU Mission," *UN News Service*, 22 June 2009.
  63. U.N. Population Division, op. cit. note 8; FAO, op. cit. note 22.
  64. U.N. Population Division, op. cit. note 8; Government of Nigeria, *Combating Desertification and Mitigating the Effects of Drought in Nigeria*, National Report on the Implementation of the United Nations Convention to Combat Desertification (Nigeria: November 1999); Somini Sengupta, "Where the Land is a Tinderbox, the Killing Is a Frenzy," *New York Times*, 16 June 2004.
  65. Sengupta, op. cit. note 64.
  66. Ibid.
  67. James Gasana, "Remember Rwanda?" *World Watch*, September/ October 2002, pp. 24–32.
  68. Ibid.
  69. U.S. Census Bureau, Population Division, International Programs Center, *International Database*, at [www.census.gov/ipc/www/idb](http://www.census.gov/ipc/www/idb), updated 15 December 2008; Gasana, op. cit. note 67.
  70. Gasana, op. cit. note 67; Emily Wax, "At the Heart of Rwanda's Horror: General's History Offers Clues to the Roots of Genocide," *Washington Post*, 21 September 2002.
  71. U.N. Population Division, op. cit. note 8; Gasana, op. cit. note 67.
  72. U.N. Population Division, op. cit. note 8; Postel, op. cit. note 44, pp. 141–49.
  73. U.N. Population Division, op. cit. note 8; Postel, op. cit. note 44, pp. 141–49.
  74. U.N. Population Division, op. cit. note 8; Postel, op. cit. note 44, pp. 141–49; Southeastern Anatolia Project Regional Development Administration, *Latest Situation on Southeastern Anatolia Project* (Ankara: Republic of Turkey, Prime Ministry, June 2006), pp. 3–5.
  75. O'Hara quoted in Michael Wines, "Grand Soviet Scheme for Sharing Water in Central Asia is Foundering," *New York Times*, 9 December 2002; Ivan Stanchin and Zvi Lerman, *Water in Turkmenistan* (Rehovot, Israel: Hebrew University of Jerusalem, 2007), p. 1.

76. F.O. Licht, "Too Much Too Soon? World Ethanol Production to Break Another Record in 2005," *World Ethanol and Biofuels Report*, vol. 3, no. 20 (21 June 2005), pp. 429–35; U.S. Department of Energy (DOE), "World Crude Oil Prices," and "U.S. All Grades All Formulations Retail Gasoline Prices," at [tonto.eia.doe.gov](http://tonto.eia.doe.gov), viewed 31 July 2007; USDA, *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 12 May 2009; USDA, *Feedgrains Database*, electronic database at [www.ers.usda.gov/Data/feedgrains](http://www.ers.usda.gov/Data/feedgrains), updated 19 May 2009.
77. F.O. Licht, "World Fuel Ethanol Production," *World Ethanol and Biofuels Report*, vol. 7, no. 18 (26 May 2009), p. 365; "Biodiesel: World Production, by Country," table in F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 14 (26 March 2009), p. 288; "EU Ministers Agree Bio-fuel Target," *BBC News*, 15 February 2007.
78. USDA, *Production, Supply and Distribution*, op. cit. note 76; corn for ethanol from USDA, *Feedgrains Database*, op. cit. note 76; historical wheat, corn, and soybean prices are Chicago Board of Trade futures data from TFC Commodity Charts, "Grain & Oilseed Commodities Futures," at [futures.tradingcharts.com/grains\\_oilseeds.html](http://futures.tradingcharts.com/grains_oilseeds.html), viewed 16 January 2009; current wheat, corn, and soybean prices are Chicago Board of Trade futures data from CME Group, "Commodity Products," various dates, at [www.cmegroup.com](http://www.cmegroup.com); rice prices from Nathan Childs and Katherine Baldwin, *Rice Outlook* (Washington, DC: USDA, Economic Research Service, 11 June 2009), p. 26; Donald Mitchell, *A Note on Rising Food Prices*, Policy Research Working Paper 4682 (Washington, DC: World Bank Development Prospects Group, July 2008), pp. 16–17.
79. Lester R. Brown, "Distillery Demand for Grain to Fuel Cars Vastly Understated: World May be Facing Highest Grain Prices in History," *Eco-Economy Update* (Washington, DC: Earth Policy Institute, 4 January 2007); corn ethanol conversion is author's estimate, based on Keith Collins, chief economist, USDA, statement before the U.S. Senate Committee on Environment and Public Works, 6 September 2006, p. 8; energy content of ethanol relative to gasoline from Oak Ridge National Laboratory (ORNL), "Bioenergy Conversion Factors," at [bioenergy.ornl.gov/papers/misc/energy\\_conv.html](http://bioenergy.ornl.gov/papers/misc/energy_conv.html), viewed 3 August 2007; U.S. gasoline consumption from "Table 10. Energy Consumption by Sector and Source: Total United States," in DOE, Energy Information Administration, "Supplemental Tables to the Annual Energy Outlook 2009," at [www.eia.doe.gov/oiaf/aeo/supplement/supref.html](http://www.eia.doe.gov/oiaf/aeo/supplement/supref.html), updated March 2009; USDA, op. cit. note 2.
80. C. Ford Runge and Benjamin Senauer, "How Biofuels Could Starve the Poor," *Foreign Affairs*, May/June 2007.
81. Celia W. Dugger, "As Prices Soar, U.S. Food Aid Buys Less," *New York Times*, 29 September 2007; WFP, "Our Work: Operations List," at [www.wfp.org/operations](http://www.wfp.org/operations), viewed 9 June 2009; Edith M. Lederer, "U.N.: Hunger Kills 18,000 Kids Each Day," *Associated Press*, 17 February 2007.
82. Ward's Automotive Group, *World Motor Vehicle Data 2008* (Southfield, MI: 2008), pp. 239–42; income calculations from "Gross National Income Per Capita 2007, Atlas Method and PPP," table in World Bank, "Data—Quick Reference Tables," at [siteresources.worldbank.org](http://siteresources.worldbank.org), updated 24

- April 2009, and from U.N. Population Division, op. cit. note 8.
83. Patrick Barta, "Jatropha Plant Gains Steam in Global Race for Biofuels," *Wall Street Journal*, 24 August 2007; "Shell Boosts Stake in Iogen Cellulosic Ethanol," *Reuters*, 15 July 2008; FAO, *State of Food and Agriculture 2008* (Rome: 2008), p. 47.
  84. The White House, "Remarks by the President on National Fuel Efficiency Standards," transcript (Washington, DC: Office of the Press Secretary, 19 May 2009); John M. Broder, "Obama to Toughen Rules on Emissions and Mileage," *New York Times*, 19 May 2009; corn ethanol conversion is author's estimate, based on Collins, op. cit. note 79, p. 8; energy content of ethanol relative to gasoline from ORNL, op. cit. note 79; U.S. gasoline consumption from "Table 10. Energy Consumption by Sector and Source: Total United States," op. cit. note 79; USDA, op. cit. note 2; CalCars, "All About Plug-In Hybrids," at [www.calcars.org](http://www.calcars.org), viewed 9 June 2009.
  85. USDA, op. cit. note 2; F.O. Licht, "World Fuel Ethanol Production," op. cit. note 77, p. 365.
  86. "Scientists Meeting in Tunis Called for Priority Activities to Curb Desertification," *UN News Service*, 21 June 2006.
  87. Alan Cowell, "Migrants Found off Italy Boat Piled with Dead," *International Herald Tribune*, 21 October 2003.
  88. Ibid.
  89. Roberta Russo, "UNHCR Steps up Efforts to Stem Gulf of Aden Crossings As Numbers Mount," *News Stories* (Geneva: U.N. High Commissioner for Refugees (UNHCR), 22 May 2009); Hélène Caux and William Spindler, "Dozens Dead or Missing in Gulf of Aden; Boat People Figures Rise," *News Stories* (Geneva: UNHCR, 4 November 2008).
  90. Miranda Leitsinger, "African Migrants Die an Ocean Away," *Washington Post*, 2 June 2006; Mar Roman, "A New Record for Africans Risking Boat Route to Europe," *Washington Post*, 4 September 2006.
  91. Ginger Thompson, "Mexico Worries About Its Own Southern Border," *New York Times*, 18 June 2006; Instituto Nacional de Migración, *Estadísticas Migratorias*, electronic database, at [www.inami.gob.mx](http://www.inami.gob.mx), updated 30 April 2009.
  92. "Mexico's Immigration Problem: The Kamikazes of Poverty," *The Economist*, 31 January 2004.
  93. Frank Bruni, "Off Sicily, Tide of Bodies Roils Immigrant Debate," *New York Times*, 23 September 2002; Flora Botsford, "Spain Recovers Drowned Migrants," *BBC News*, 25 April 2002; "Boat Sinks Off Coast of Turkey: One Survivor and 7 Bodies Found," *Agence France-Presse*, 22 December 2003; Mary Jordan and Kevin Sullivan, "Trade Brings Riches, But Not to Mexico's Poor," *Washington Post*, 22 March 2003; Robert McLeman and Barry Smit, "Climate Change, Migration and Security," Commentary No. 86 (Ottawa: Canadian Security Intelligence Service, 2 March 2004); number leaving rural areas from FAO, *PopSTAT*, electronic database, at [faostat.fao.org/site/550/default.aspx](http://faostat.fao.org/site/550/default.aspx), updated February 2009; Coalición de Derechos Humanos, "Arizona Recovered Bodies," at [www.derechoshumanosaz.net](http://www.derechoshumanosaz.net), updated 15 June 2009.
  94. Abandoned villages in India from Shah et al., op. cit. note 49; U.N. Population Division, op. cit. note 8.
  95. Wang, e-mail to author, op. cit. note 29; Wang, "The Process and Its Con-

- trol of Sandy Desertification in Northern China," op. cit. note 29.
96. Souhail Karam, "Drought-Hit North Africa Seen Hunting for Grains," *Reuters*, 15 July 2005; African Development Bank and Organisation for Economic Co-operation and Development, *African Economic Outlook 2007* (Tunis and Paris: 2007), p. 386.
  97. Iranian News Agency, op. cit. note 25; Government of Nigeria, op. cit. note 64.
  98. Brazil and Mexico from Heitor Matallo, "General Approach to the Costs of Desertification," presentation at International Workshop on the Cost of Inaction and Opportunities for Investment in Arid, Semi-Arid and Dry Sub-Humid Areas," Rome, 4–5 December 2006; see also Table 5–2 in Brown, op. cit. note 5, pp. 86–87.
  99. Gordon McGranahan, Deborah Balk, and Bridget Anderson, "The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones," *Environment and Urbanization*, vol. 18, no. 1 (April 2007), pp. 17–37; International Institute for Environment and Development (IIED), "Climate Change: Study Maps Those at Greatest Risk from Cyclones and Rising Seas," press release (London: 28 March 2007).

### Chapter 3. Climate Change and the Energy Transition

1. J. Hansen, NASA's Goddard Institute for Space Studies, "Global Temperature Anomalies in 0.1 C," at [data.giss.nasa.gov/gistemp/tabledata/GLB.Ts.txt](http://data.giss.nasa.gov/gistemp/tabledata/GLB.Ts.txt), updated June 2009; Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), pp. 13, 15.
2. IPCC, op. cit. note 1, pp. 5–7; U.N. Environment Programme (UNEP), *Global Outlook for Ice and Snow* (Nairobi: 2007), p. 103; W. T. Pfeffer, J. T. Harper, and S. O'Neel, "Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise," *Science*, vol. 321 (5 September 2008), pp. 1340–43; "Sea Levels Will Rise 1.5 Metres by 2100," *NewScientist.com*, 16 April 2008; Stefan Rahmstorf, "A Semi-Empirical Approach to Projecting Future Sea-level Rise," *Science*, vol. 315 (19 January 2007), pp. 368–70.
3. IPCC, *Climate Change 2007: Impact, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), pp. 241–45.
4. International Energy Agency (IEA), *Oil Market Report* (Paris: August 2001), includes oil, natural gas liquids, and processing gains; historical data from U.S. Department of Defense, *Twentieth Century Petroleum Statistics* (Washington, DC: 1945), cited in Christopher Flavin and Seth Dunn, "Reinventing the Energy System," in Lester R. Brown, Christopher Flavin, and Hilary French, *State of the World 1999* (New York: W. W. Norton & Company, 1999), p. 25; coal from Seth Dunn, "Coal Use Continues Rebound," in Lester R. Brown et al., *Vital Signs 1998* (New York: W. W. Norton & Company, 1998), pp. 52–53.
5. IEA, *Oil Market Report* (Paris: June 2009); Colin J. Campbell, e-mail to



- Jignasha Rana, Earth Policy Institute, 18 June 2009.
6. IEA, *World Energy Outlook 2008* (Paris: 2008), p. 507.
  7. Hansen, op. cit. note 1.
  8. IPCC, op. cit. note 1, pp. 27, 135, 141, 542.
  9. Concentration in 2008 from Pieter Tans, "Trends in Atmospheric Carbon Dioxide—Mauna Loa," NOAA/ESRL, at [www.esrl.noaa.gov/gmd/ccgg/trends](http://www.esrl.noaa.gov/gmd/ccgg/trends), viewed 7 April 2009; R. A. Houghton, "Carbon Flux to the Atmosphere from Land-Use Changes: 1850–2005," in Carbon Dioxide Information Analysis Center, *TRENDS: A Compendium of Data on Global Change* (Oak Ridge, TN: Oak Ridge National Laboratory, 2008); Josep G. Canadell et al., "Contributions to Accelerating Atmospheric CO<sub>2</sub> Growth from Economic Activity, Carbon Intensity, and Efficiency of Natural Sinks," *Proceedings of the National Academy of Sciences*, vol. 104, no. 47 (20 November 2007), pp. 18,866–70.
  10. Sarah Simpson, "The Arctic Thaw Could Make Global Warming Worse," *Scientific American: Earth 3.0*, June 2009; Global Carbon Project, "Super-size Deposits of Frozen Carbon Threat to Climate Change," press release (Canberra, Australia: 1 July 2009).
  11. Veerabhadran Ramanathan et al., *Atmospheric Brown Clouds: Regional Assessment Report with Focus on Asia* (Nairobi: UNEP, 2008), pp. 2, 10.
  12. Ibid., pp. 393–96; Yun Qian et al., "Effects of Soot-Induced Snow Albedo Change on Snowpack and Hydrological Cycle in Western United States Based on Weather Research and Forecasting Chemistry and Regional Climate Simulations," *Journal of Geophysical Research*, vol. 114, issue D3 (14 February 2009); Jane Qiu, "The Third Pole," *Nature*, vol. 454 (24 July 2008), pp. 393–96; Frances C. Moore, "Climate Change and Air Pollution: Exploring the Synergies and Potential for Mitigation in Industrializing Countries," *Sustainability*, vol. 1, no. 1 (24 March 2009), pp. 43–54.
  13. Elisabeth Rosenthal, "Third-World Soot Stove is Target in Climate Fight," *New York Times*, 16 April 2009.
  14. IPCC, op. cit. note 1, pp. 13, 15; Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, eds., *Global Climate Change Impacts in the United States* (New York: Cambridge University Press, 2009), pp. 22–23.
  15. A. P. Sokolov et al., "Probabilistic Forecast for 21st Century Climate Based on Uncertainties in Emissions (Without Policy) and Climate Parameters," *Journal of Climate*, in press.
  16. International Alliance of Research Universities, *Climate Change: Global Risks, Challenges & Decisions*, Synthesis Report from International Scientific Congress (Copenhagen: University of Copenhagen, 2009), pp. 18–19.
  17. "Awful Weather We're Having," *The Economist*, 2 October 2004; Richard Milne, "Hurricanes Cost Munich Re Reinsurance," *Financial Times*, 6 November 2004.
  18. U.S. Department of Agriculture (USDA), *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 11 June 2007; Janet Larsen, "Record Heat Wave in Europe Takes 35,000 Lives," *Eco-Economy Update* (Washington, DC: Earth Policy Institute, 9 October 2003); USDA, National Agricultural Statistics Service, "Crop Production," news release (Washington, DC: 12 August 2005).
  19. Janet Larsen, "Setting the Record Straight: More than 52,000 Europeans

- Died from Heat in Summer 2003," *Eco-Economy Update* (Washington, DC: Earth Policy Institute, 26 July 2006); National Commission on Terrorist Attacks Upon the United States, *The 9/11 Commission Report* (Washington, DC: U.S. Government Printing Office, 2004).
20. National Center for Atmospheric Research and UCAR Office of Programs, "Drought's Growing Reach: NCAR Study Points to Global Warming as Key Factor," press release (Boulder, CO: 10 January 2005); Aiguo Dai, Kevin E. Trenberth, and Taotao Qian, "A Global Dataset of Palmer Drought Severity Index for 1870–2002: Relationship with Soil Moisture and Effects of Surface Warming," *Journal of Hydrometeorology*, vol. 5 (December 2004), pp. 1,117–30.
  21. Susan Solomon et al., "Irreversible Climate Change Due to Carbon Dioxide Emissions," *Proceedings of the National Academy of Sciences*, vol. 106, no. 6 (10 February 2009), pp. 1,704–09.
  22. Donald McKenzie et al., "Climatic Change, Wildfire, and Conservation," *Conservation Biology*, vol. 18, no. 4 (August 2004), pp. 890–902.
  23. Camille Parmesan and Hector Galbraith, *Observed Impacts of Global Climate Change in the U.S.* (Arlington, VA: Pew Center on Global Climate Change, 2004); DeNeen L. Brown, "Signs of Thaw in a Desert of Snow," *Washington Post*, 28 May 2002.
  24. Patty Glick, *Fish Out of Water: A Guide to Global Warming and Pacific Northwest Rivers* (Seattle, WA: National Wildlife Federation, March 2005); Elizabeth Gillespie, "Global Warming May Be Making Rivers Too Hot: Cold-Water Fish Will Struggle, Report Says," *Seattle Post-Intelligencer*, 24 March 2005.
  25. Douglas B. Inkleby et al., *Global Climate Change and Wildlife in North America* (Bethesda, MD: The Wildlife Society, December 2004); J. R. Pegg, "Global Warming Disrupting North American Wildlife," *Environment News Service*, 16 December 2004.
  26. UNEP, op. cit. note 2; Gordon McGranahan et al., "The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones," *Environment and Urbanization*, vol. 18, no. 1 (April 2007), pp. 17–37.
  27. Arctic Climate Impact Assessment (ACIA), *Impacts of a Warming Arctic* (Cambridge, U.K.: Cambridge University Press, 2004); "Rapid Arctic Warming Brings Sea Level Rise, Extinctions," *Environment News Service*, 8 November 2004.
  28. J. R. Pegg, "The Earth is Melting, Arctic Native Leader Warns," *Environment News Service*, 16 September 2004; ACIA, op. cit. note 27, p. 8.
  29. ACIA, op. cit. note 27; Steven C. Amstrup, Bruce G. Marcot, and David C. Douglas, *Forecasting the Range-wide Status of Polar Bears at Selected Times in the 21st Century* (Reston, VA: U.S. Geological Survey (USGS), 2007), p. 2.
  30. Julienne Stroeve et al., "Arctic Sea Ice Decline: Faster than Forecast," *Geophysical Research Letters*, vol. 34 (May 2007); National Snow and Ice Data Center (NSIDC), "Arctic Sea Ice Shatters All Previous Record Lows," press release (Boulder, CO: 1 October 2007); R. Kwok et al., "Thinning and Volume Loss of the Arctic Ocean Sea Ice Cover: 2003–2008," *Journal of Geophysical Research*, vol. 114 (7 July 2009).
  31. David Adam, "Meltdown Fear as Arctic Ice Cover Falls to Record Winter

- Low," *Guardian* (London), 15 May 2006; Kevin Rollason, "Arctic to See First Ice-Free Summer in 2015," *Canwest News Service* (Canada), 6 December 2008; Vincent cited in David Ljunggren, "Arctic Summer Ice Could Vanish by 2013: Expert," *Reuters*, 5 March 2009; Stroeve quoted in "Arctic Ice Retreating 30 Years Ahead of Projections," *Environment News Service*, 30 April 2007.
32. NSIDC, "Processes: Thermodynamics: Albedo," at [nsidc.org/seaice/processes/albedo.html](http://nsidc.org/seaice/processes/albedo.html), viewed 26 July 2007.
  33. UNEP, op. cit. note 2.
  34. J. L. Chen, C. R. Wilson, and B. D. Tapley, "Satellite Gravity Measurements Confirm Accelerated Melting of Greenland Ice Sheet," *Science*, vol. 313 (29 September 2006), pp. 1,958–60; Isabella Velicogna and John Wahr, "Acceleration of Greenland Ice Mass Loss in Spring 2004," *Nature*, vol. 443 (21 September 2006), pp. 329–31; S. B. Luthke et al., "Recent Greenland Ice Mass Loss from Drainage System from Satellite Gravity Observations," *Science*, vol. 314 (24 November 2006), pp. 1,286–89; "Gravity Measurements Confirm Greenland's Glaciers Precipitous Meltdown," *Scientific American*, 19 October 2006.
  35. Paul Brown, "Melting Ice Cap Triggering Earthquakes," *Guardian* (London), 8 September 2007; Robert W. Corell, discussion with Jignasha Rana, Earth Policy Institute, 15 July 2009.
  36. Ohio State University, "Greenland's Glaciers Losing Ice Faster This Year than Last Year, Which Was Record-Setting Itself," news release (Columbus, OH: 13 December 2008).
  37. H. Jay Zwally et al., "Surface Melt-Induced Acceleration of Greenland Ice-Sheet Flow," *Science*, vol. 297 (12 July 2002), pp. 218–22.
  38. U.S. Department of Energy (DOE), Energy Information Administration (EIA), "Antarctica: Fact Sheet," at [www.eia.doe.gov](http://www.eia.doe.gov), September 2000.
  39. "Giant Antarctic Ice Shelves Shatter and Break Away," *Environment News Service*, 19 March 2002; Vaughan quoted in Andrew Revkin, "Large Ice Shelf in Antarctica Disintegrates at Great Speed," *New York Times*, 20 March 2002.
  40. "Breakaway Bergs Disrupt Antarctic Ecosystem," *Environment News Service*, 9 May 2002; "Giant Antarctic Ice Shelves Shatter and Break Away," op. cit. note 39.
  41. NSIDC, "Larsen B Ice Shelf Collapses in Antarctica," at [nsidc.org/news/press/larsen\\_B/2002.html](http://nsidc.org/news/press/larsen_B/2002.html), 21 March 2002; "Breakaway Bergs Disrupt Antarctic Ecosystem," op. cit. note 40; "Giant Antarctic Ice Shelves Shatter and Break Away," op. cit. note 39.
  42. University of Colorado at Boulder, "NASA, CU-Boulder Study Shows Vast Regions of West Antarctica Melted in Recent Past," press release (Boulder: 15 May 2007).
  43. Peter Brown, "NASA Satellites Watch Polar Ice Shelf Break into Crushed Ice," *Scientific American*, July 2008.
  44. NASA Earth Observatory, "Wilkins Ice Bridge Collapse," at [earthobservatory.nasa.gov/IOTD/view.php?id=37806](http://earthobservatory.nasa.gov/IOTD/view.php?id=37806), posted 8 April 2009.
  45. Michael Byrnes, "New Antarctic Iceberg Split No Threat," *Reuters*, 20 May 2002.
  46. Robin McKie, "Scientists to Issue Stark Warning Over Dramatic New Sea Level Figures," *Guardian* (London), 8 March 2009; IPCC, op. cit. note 1,

- p. 13; Pfeffer, Harper, and O'Neel, op. cit. note 2; USGS, *Synthesis and Assessment Product 3.4: Abrupt Climate Change* (Washington, DC: 2009), p. 9.
47. McGranahan et al., op. cit. note 26.
  48. Ibid.
  49. World Glacier Monitoring Service, University of Zurich, "Glacier Mass Balance Data 2006 and 2007," at [www.geo.uzh.ch/wgms/mbb/mbb10/sum07.html](http://www.geo.uzh.ch/wgms/mbb/mbb10/sum07.html), updated 30 January 2009.
  50. Lester R. Brown, "Melting Mountain Glaciers Will Shrink Grain Harvests in China and India," *Plan B Update* (Washington, DC: Earth Policy Institute, 20 March 2008).
  51. USDA, *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 12 May 2009.
  52. IPCC, op. cit. note 3, pp. 493–94; Emily Wax, "A Sacred River Endangered by Global Warming," *Washington Post*, 17 June 2007.
  53. Clifford Coonan, "China's Water Supply Could be Cut Off as Tibet's Glaciers Melt," *The Independent* (London), 31 May 2007; UNEP, op. cit. note 2, p. 131; rice irrigation from "Yangtze River–Agriculture," *Encyclopedia Britannica*, online encyclopedia, viewed 25 July 2007.
  54. Qiu, op. cit. note 12.
  55. UNEP, op. cit. note 2, p. 131; Mehrdad Khalili, "The Climate of Iran: North, South, Kavir (Desert), Mountains," *San'ate Hamlo Naql*, March 1997, pp. 48–53.
  56. Lonnie Thompson, "Disappearing Glaciers Evidence of a Rapidly Changing Earth," American Association for the Advancement of Science Annual Meeting, San Francisco, February 2001; Lonnie Thompson, "Receding Glaciers Erase Records of Climate History," *Science News*, 14 February 2009; "The Peak of Mt Kilimanjaro As It Has Not Been Seen for 11,000 Years," *Guardian* (London), 14 March 2005; Bancy Wangui, "Crisis Looms as Rivers Around Mt. Kenya Dry Up," *East Africa Standard*, 1 July 2007.
  57. Eric Hansen, "Hot Peaks," *OnEarth*, fall 2002, p. 8.
  58. Leslie Josephus, "Global Warming Threatens Double-Trouble for Peru: Shrinking Glaciers and a Water Shortage," *Associated Press*, 12 February 2007; *Citation World Atlas* (Union, NJ: Hammond World Atlas Corporation, 2004); Thompson, "Receding Glaciers," op. cit. note 56.
  59. Josephus, op. cit. note 58; U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009.
  60. U.N. Population Division, *Urban Agglomerations 2007 Wall Chart*, at [www.un.org/esa/population](http://www.un.org/esa/population), updated June 2008; James Painter, "Peru's Alarming Water Truth," *BBC News*, 12 March 2007.
  61. Giles Tremlett, "Climate Change Lays Waste to Spain's Glaciers," *Guardian* (London), 23 February 2009.
  62. Anne Minard, "No More Glaciers in Glacier National Park by 2020?" *National Geographic News*, 2 March 2009.
  63. Michael Kiparsky and Peter Gleick, *Climate Change and California Water Resources: A Survey and Summary of the Literature* (Oakland, CA: Pacific Institute, 2003); Timothy Cavagnaro et al., *Climate Change: Challenges and Solutions for California Agricultural Landscapes* (Sacramento,

- CA: California Climate Change Center, 2006).
64. Michael J. Scott et al., "Climate Change and Adaptation in Irrigated Agriculture—A Case Study of the Yakima River," in UCOWR/NIWR Conference, *Water Allocation: Economics and the Environment* (Carbondale, IL: Universities Council on Water Resources, 2004); Pacific Northwest National Laboratory, "Global Warming to Squeeze Western Mountains Dry by 2050," press release (Richland, WA: 16 February 2004).
  65. John E. Sheehy, International Rice Research Institute, e-mail to Janet Larsen, Earth Policy Institute, 1 October 2002; Pedro Sanchez, "The Climate Change—Soil Fertility—Food Security Nexus," speech, Sustainable Food Security for All by 2020, Bonn, Germany, 4–6 September 2002.
  66. K. S. Kavi Kumar and Jyoti Parikh, "Socio-Economic Impacts of Climate Change on Indian Agriculture," *International Review for Environmental Strategies*, vol. 2, no. 2 (2001), pp. 277–93; U.N. Population Division, op. cit. note 59.
  67. Mohan K. Wali et al., "Assessing Terrestrial Ecosystem Sustainability," *Nature & Resources*, October–December 1999, pp. 21–33.
  68. Shaobing Peng et al., "Rice Yields Decline with Higher Night Temperature from Global Warming," *Proceedings of the National Academy of Sciences*, 6 July 2004, pp. 9,971–75; *Proceedings of the National Academy of Sciences*, "Warmer Evening Temperatures Lower Rice Yields," press release (Washington, DC: 29 June 2004).
  69. Sheehy, op. cit. note 65; Sanchez, op. cit. note 65.
  70. Tim P. Barnett et al., "Human-Induced Changes in the Hydrology of the Western United States," *Science*, vol. 319 (22 February 2008); T. M. Shanahan et al., "Atlantic Forcing of Persistent Drought in West Africa," *Science*, vol. 324 (17 April 2009); Marshall B. Burke, David B. Lobell, and Luigi Guarino, "Shifts in African Crop Climates by 2050, and the Implications for Crop Improvement and Genetic Resources Conservation," *Global Environmental Change*, in press.
  71. U.N. Population Division, op. cit. note 59; Burke, Lobell, and Guarino, op. cit. note 70; Marlowe Hood, "Warming May Outstrip Africa's Ability to Feed Itself: Study," *Agence France-Presse*, 17 June 2009.
  72. IEA, op. cit. note 6, pp. 221, 225; DOE, EIA, "How Dependent Are We on Foreign Oil?" at [tonto.eia.doe.gov/energy\\_in\\_brief/foreign\\_oil\\_dependence.cfm](http://tonto.eia.doe.gov/energy_in_brief/foreign_oil_dependence.cfm), updated 23 April 2009; U.S. Bureau of the Census, "Most of Us Still Drive to Work Alone—Public Transportation Commuters Concentrated in a Handful of Large Cities," press release (Washington, DC: 13 June 2007); Peter Whoriskey, "GM to Build Small Car in U.S.," *Washington Post*, 29 May 2009.
  73. Ayesha Rascoe, "U.S. Oil Demand in 2008 Hit a 10-year Low: Government," *Reuters*, 27 February 2009; DOE, EIA, *Short-Term Energy Outlook* (Washington, DC: 7 July 2009), pp. 22; Ayesha Rascoe, "U.S. Public Transit 2008 Ridership Highest in 52 years," *Reuters*, 9 March 2009.
  74. Campbell, op. cit. note 5; Michael T. Klare, "Entering the Tough Oil Era," *TomDispatch.com*, 16 August 2007.
  75. Michael T. Klare, "The Energy Crunch to Come," *TomDispatch.com*, 22 March 2005; Jad Mouawad, "Big Oil's Burden of Too Much Cash," *New York Times*, 12 February 2005; Mark Williams, "The End of Oil?" *Technology Review*, February 2005; John Vidal, "The End of Oil Is Closer

- Than You Think," *Guardian* (London), 21 April 2005.
76. James Picerno, "If We Really Have the Oil," *Bloomberg Wealth Manager*, September 2002, p. 45; Klare, op. cit. note 75; Richard C. Duncan and Walter Youngquist, "Encircling the Peak of World Oil Production," *Natural Resource Research*, vol. 12, no. 4 (December 2003), p. 222; Walter Youngquist, *GeoDestinies: The Inevitable Control of Earth Resources over Nations and Individuals* (Portland: National Book Company, 1997); A. M. Samsam Bakhtiari, "World Oil Production Capacity Model Suggests Output Peak by 2006–07," *Oil and Gas Journal*, 26 April 2004, pp. 18–20.
  77. Fredrik Robelius, *Giant Oil Fields—The Highway to Oil* (Uppsala, Sweden: Uppsala University Press, 9 March 2007), pp. 81–84; Petrobras Brazil, "Production Goes on Stream in Tupi: Year I of a New Era," at [www2.petrobras.com.br/Petrobras/ingles/area\\_tupi.asp](http://www2.petrobras.com.br/Petrobras/ingles/area_tupi.asp), viewed 17 June 2009.
  78. Guy Chazan and Neil King Jr., "Russian Oil Slump Stirs Supply Jitters," *Wall Street Journal*, 15 April 2008; data on declining Russian oil production in IEA, *Oil Market Report* (Paris: May 2009).
  79. Vidal, op. cit. note 75.
  80. Gargi Chakrabarty, "Shale's New Hope," *Rocky Mountain News*, 18 October 2004; Walter Youngquist, "Alternative Energy Sources," in Lee C. Gerhard, Patrick Leahy, and Victor Yannacone, eds., *Sustainability of Energy and Water through the 21st Century*, Proceedings of the Arbor Day Farm Conference, 8–11 October 2000 (Lawrence, KS: Kansas Geological Survey, 2002), p. 65.
  81. Robert Collier, "Canadian Oil Sands: Vast Reserves Second to Saudi Arabia Will Keep America Moving, But at a Steep Environmental Cost," *San Francisco Chronicle*, 22 May 2005; Alberta Department of Energy, *Alberta's Oil Sands, 2008* (Edmonton, Alberta: June 2009); BP, *BP Statistical Review of World Energy 2009* (London: June 2009), p. 11; Robin Pagnamenta, "Canadian Oil-Sand Mines Stuck as Crude Price Plummetts," *The Times* (London), 5 January 2009; Jad Mouawad, "Big Oil Projects Put in Jeopardy by Fall in Prices," *New York Times*, 16 December 2008.
  82. Sheila McNulty, "Tar Sands Refinery Projects Face a Sticky Future," *Financial Times*, 5 January 2009; Collier, op. cit. note 81; Alfred J. Cavallo, "Oil: Caveat Empty," *Bulletin of the Atomic Scientists*, vol. 61, no. 3 (May/June 2005), pp. 16–18; Richard Heinberg, "The End of the Oil Age," *Earth Island Journal*, vol. 18, no. 3 (fall 2003).
  83. IEA, op. cit. note 6, p. 507.
  84. World Health Organization, "Air Pollution," *Fact Sheet 187* (Geneva: revised September 2000); Janet Larsen, "Coal Takes Heavy Human Toll: Some 25,100 U.S. Deaths from Coal Use Largely Preventable," *Eco-Economy Update* (Washington DC: Earth Policy Institute, 24 August 2004).
  85. U.S. Environmental Protection Agency, Office of Science and Technology, "National Listing of Fish Advisories: 2005–06 National Listing," fact sheet (Washington, DC: July 2007).
  86. Jonathan Watts, "Beijing Blames Pollutants for Rise in Killer Cancers," *Guardian* (London), 22 May 2007.
  87. Barbara Demick, "China Blames Pollution for Surge in Birth Defects," *Los Angeles Times*, 2 February 2009; Steven Mufson, "Asian Nations

- Could Outpace U.S. in Developing Clean Energy," *Washington Post*, 16 July 2009.
88. Keith Bradsher, "Green Power Takes Root in the Chinese Desert," *New York Times*, 2 July 2009.
  89. IEA, op. cit. note 6, p. 507.
  90. Paul Hawken, Commencement Address to the Class of 2009, University of Portland, Portland, OR, 3 May 2009.

#### Chapter 4. Stabilizing Climate: An Energy Efficiency Revolution

1. Global Wind Energy Council, *Global Wind 2008 Report* (Brussels: 2009), pp. 3, 56; Erik Shuster, *Tracking New Coal-Fired Power Plants* (Pittsburgh, PA: U.S. Department of Energy (DOE), National Energy Technology Laboratory, January 2009); "Nuclear Dips in 2008," *World Nuclear News*, 29 May 2009; 1 megawatt of installed wind capacity produces enough electricity to supply 300 homes from American Wind Energy Association, "U.S. Wind Energy Installations Reach New Milestone," press release (Washington, DC: 14 August 2006); number of homes calculated using average U.S. household size from U.S. Census Bureau, "2005–2007 American Community Survey 3-Year Estimates—Data Profile Highlights," at [factfinder.census.gov/servlet/ACSSAFFacts](http://factfinder.census.gov/servlet/ACSSAFFacts), viewed 9 April 2009, and population from U.S. Census Bureau, *State & Country QuickFacts*, electronic database, at [quickfacts.census.gov](http://quickfacts.census.gov), updated 20 February 2009.
2. Carbon dioxide pathway modeled using fossil fuel emissions from Tom Boden and Gregg Marland, "Global CO<sub>2</sub> Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751–2006" and "Preliminary 2006–07 Global & National Estimates by Extrapolation," both in Carbon Dioxide Information and Analysis Center (CDIAC), *Fossil Fuel CO<sub>2</sub> Emissions* (Oak Ridge, TN: Oak Ridge National Laboratory (ORNL), 2009), and from land use change emissions from R. A. Houghton, "Carbon Flux to the Atmosphere from Land-Use Changes," in CDIAC, *Trends: A Compendium of Data on Global Change* (Oak Ridge, TN: ORNL, 2008), with decay curve cited in J. Hansen et al., "Dangerous Human-Made Interference with Climate: A GISS ModelE Study," *Atmospheric Chemistry and Physics*, vol. 7 (2007), pp. 2,287–312; current concentration from Pieter Tans, "Trends in Atmospheric Carbon Dioxide—Mauna Loa," National Oceanic and Atmospheric Administration, Earth System Research Laboratory, at [www.esrl.noaa.gov/gmd/ccgg/trends](http://www.esrl.noaa.gov/gmd/ccgg/trends), viewed 7 April 2009.
3. James Hansen et al., "Target Atmospheric CO<sub>2</sub>: Where Should Humanity Aim?" *Open Atmospheric Science Journal*, vol. 2 (15 October 2008), pp. 217–31.
4. Lester R. Brown, "Creating New Jobs, Cutting Carbon Emissions, and Reducing Oil Imports by Investing in Renewable Energy and Energy Efficiency," *Plan B Update* (Washington, DC: Earth Policy Institute, 11 December 2008).
5. S. Pacala and R. Socolow, "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," *Science*, vol. 305 (13 August 2004), pp. 968–72.
6. Ibid.

7. International Alliance of Research Universities, *Climate Change: Global Risks, Challenges & Decisions*, Synthesis Report from International Scientific Congress (Copenhagen: University of Copenhagen, 2009).
8. U.S. Environmental Protection Agency (EPA) and DOE, "Energy Star Change a Light, Change the World," fact sheet (Washington, DC: 23 April 2007); Larry Kinney, *Lighting Systems in Southwestern Homes: Problems and Opportunities*, prepared for DOE, Building America Program through the Midwest Research Institute, National Renewable Energy Laboratory (NREL) (Boulder, CO: Southwest Energy Efficiency Project, June 2005), pp. 4–5.
9. Alice McKeown, "Strong Growth in Compact Fluorescent Bulbs Reduces Electricity Demand," *Vital Signs Online* (Washington, DC: Worldwatch Institute, 27 October 2008); "Alliance Calls for Only Energy-Efficient Lighting in U.S. Market by 2016, Joins Coalition Dedicated to Achieving Goal," press release (Washington, DC: Alliance to Save Energy, 14 March 2007); DOE, *Big Results, Bigger Potential: CFL Market Profile* (Washington, DC: Energy Star, March 2009).
10. Ministry for the Environment and Natural Resources, "World First! Australia Slashes Greenhouse Gases from Inefficient Lighting," press release (Canberra, Australia: 20 February 2007); Rob Gillies, "Canada Announces Greenhouse Gas Targets," *Associated Press*, 25 April 2007; European Parliament, "Incandescent Light Bulbs: Environment Committee Backs Phase-Out Plan," press release (Brussels: 17 February 2009).
11. International Energy Agency (IEA), *Light's Labour's Lost: Policies for Energy-efficient Lighting* (Paris: 2006), p. 375; Deborah Zabarenko, "China to Switch to Energy-Efficient Lightbulbs," *Reuters*, 3 October 2007; Greenpeace India, "India's Light Bulb Phase Out: Setting a Smart Example," press release (New Delhi: 25 February 2009).
12. Retailer rankings from Deloitte, *Feeling the Squeeze, Global Powers of Retailing 2009* (London: 2009); Walmart Stores Inc., "Greenhouse Gas Emissions Fact Sheet" (Bentonville, AR: 2009); Hillary Osborne, "Currys to Stop Selling Incandescent Bulbs," *Guardian* (London), 13 March 2007.
13. CREE LED Lighting, "Ultra-Efficient Lighting," at [www.creelighting.com/efficiency.htm](http://www.creelighting.com/efficiency.htm), viewed 17 April 2009; Navigant Consulting Inc., *Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications* (Washington, DC: DOE, rev. October 2008); Anthony DePalma, "It Never Sleeps, But It's Learned to Douse the Lights," *New York Times*, 11 December 2005; "Mayor Villaraigosa, President Clinton Light the Way to a Greener LA," press release (Los Angeles, CA: Office of the Mayor, 16 February 2009).
14. "Smart LED Lighting Makes Parking Garages Greener, Safer," *Environment News Service*, 13 January 2009.
15. LED life calculated from EPA and DOE, op. cit. note 8, and from "Company Profile: Expanding LED Possibilities at Samsung Electromechanics," *LEDs Magazine*, April 2007.
16. IEA, op. cit. note 11, pp. 25, 29, 38; CREE LED Lighting, op. cit. note 13.
17. Energy savings from lighting efficiency calculated using IEA, op. cit. note 11, pp. 25, 29, and IEA, *World Energy Outlook 2008* (Paris: 2008), p. 507; coal-fired power plant equivalents calculated by assuming that an average plant has a 500-megawatt capacity and operates 72 percent of the time,

- generating 3.15 billion kilowatt-hours of electricity per year.
18. Steven Nadel, *The Federal Energy Policy Act of 2005 and Its Implications for Energy Efficiency Program Efforts* (Washington, DC: American Council for an Energy-Efficient Economy, 2005).
  19. John M. Broder, "Obama Orders New Rules to Raise Energy Efficiency," *New York Times*, 6 February 2009.
  20. National Bureau of Statistics of China (NBS), *China Statistical Yearbook* (Beijing: various years), in e-mail to Jessie Robbins, Earth Policy Institute, from David Fridley, Lawrence Berkeley National Laboratory (LBNL), DOE, 4 June 2009.
  21. "Final Energy Consumption," in LBNL, *China Energy Databook*, v. 7.0 (Berkeley, CA: October 2008); NBS, "Electricity Balance Sheet," in *China Statistical Yearbook 2008*, at [www.stats.gov.cn/english](http://www.stats.gov.cn/english), viewed 21 July 2009.
  22. U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009; Greenpeace, "Your Energy Savings," at [www.greenpeace.org/international/campaigns/climate-change/take\\_action/your-energy](http://www.greenpeace.org/international/campaigns/climate-change/take_action/your-energy), viewed 28 May 2009.
  23. Marianne Haug et al., *Cool Appliances: Policy Strategies for Energy Efficient Homes* (Paris: IEA, 2003); Ministry of Economy, Trade and Industry, *Top Runner Program: Developing the World's Best Energy-Efficient Appliances* (Tokyo: 2008).
  24. Haug et al., op. cit. note 23; Alan K. Meier, *A Worldwide Review of Standby Power Use in Homes* (Berkeley, CA: LBNL, 2002).
  25. Lloyd Harrington et al., *Standby Energy: Building a Coherent International Policy Framework—Moving to the Next Level* (Stockholm: European Council for an Energy Efficient Economy, 2007).
  26. Meier, op. cit. note 24.
  27. Geoffrey Lean and Jonathan Owen, "Giant Plasma TVs Face Ban in Battle to Green Britain," *The Independent* (London), 11 January 2009; California Energy Commission, "Frequently Asked Questions—FAQs Energy Efficiency Standards for Televisions," at [www.energy.ca.gov/appliances/tv\\_faqs.html](http://www.energy.ca.gov/appliances/tv_faqs.html), viewed 29 April 2009.
  28. IEA, op. cit. note 17, p. 507.
  29. U.S. Green Building Council (USGBC), "Green Building Facts" (Washington, DC: April 2009).
  30. Edward Mazria, "It's the Architecture, Stupid! Who Really Holds the Key to the Global Thermostat? The Answer Might Surprise You," *World and I*, May/June 2003; Clinton Foundation, "Energy Efficiency Building Retrofit Program," fact sheet (New York: May 2007).
  31. Davis Langdon, *The Cost & Benefit of Achieving Green Buildings* (Sydney: 2007).
  32. German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), *Heat from Renewable Energies: What Will the New Heat Act Achieve?* (Berlin: July 2008); BMU, *Consolidated Version of the Reasoning Behind the Act on the Promotion of Renewable Energies in the Heat Sector* (Berlin: August 2008).
  33. DOE, "Transforming the Way Americans Use Energy" at [energy.gov/recovery/energy\\_efficiency.htm](http://energy.gov/recovery/energy_efficiency.htm), viewed 9 April 2009; DOE, "Secretaries Donovan and Chu Announce Partnership to Help Working

- Families Weatherize Their Homes," press release (Washington, DC: 27 February 2009).
34. USGBC, "About LEED," fact sheet (Washington, DC: 2007).
  35. USGBC, op. cit. note 29; USGBC, "LEED for New Construction" (Washington, DC: 2007).
  36. USGBC, *LEED 2009 for New Construction and Major Renovations*, Version 3.0 (Washington, DC: April 2009).
  37. Ibid.
  38. USGBC, op. cit. note 29.
  39. NREL, *The Philip Merrill Environmental Center, Chesapeake Bay Foundation: Highlighting High Performance* (Golden, CO: April 2002).
  40. "Toyota Seeks Gold for New Green Buildings," *GreenBiz.com*, 23 April 2003; "The Green Stamp of Approval," *Business Week*, 11 September 2006.
  41. Nick Carey and Iaina Jonas, "Green Buildings Need More Incentives in US," *Reuters*, 15 February 2007; Alexander Durst, The Durst Organization, discussion with Jignasha Rana, Earth Policy Institute, 2 July 2009.
  42. Carey and Jonas, op. cit. note 41.
  43. Barnaby J. Feder, "Environmentally Conscious Development," *New York Times*, 25 August 2004.
  44. World Green Business Council, "Established Green Building Councils" and "Emerging Green Business Councils," at [www.worldgbc.org/green-building-councils](http://www.worldgbc.org/green-building-councils), viewed 10 April 2009; LEED-certified floor space from Marie Coleman, USGBC, e-mail to Jignasha Rana, Earth Policy Institute, 1 June 2009.
  45. USGBC, op. cit. note 34; "Clinton Unveils \$5 Billion Green Makeover for Cities," *Environment News Service*, 16 May 2007.
  46. USGBC, op. cit. note 34; "Clinton Unveils \$5 Billion Green Makeover for Cities," op. cit. note 45; USGBC, "The Clinton Climate Initiative and the U.S. Green Building Council Expand Global Partnership," press release (Washington, DC: 10 February 2009).
  47. Clinton Foundation, "CCI Helps Retrofit Empire State Building," press release (New York: 6 April 2009); Molly Miller, "Leading Example for Energy Efficiency," press release (Boulder, CO: Rocky Mountain Institute, April 2009).
  48. Brad Heavner, Environment Maryland, Testimony before the Subcommittee on Energy and Air Quality, Energy and Commerce Committee, U.S. House of Representatives, Washington, DC, 17 July 2008.
  49. Mazria, op. cit. note 30; information on the 2030 Challenge at [www.architecture2030.org](http://www.architecture2030.org).
  50. Mazria, op. cit. note 30.
  51. Ibid.
  52. Yuri Kageyama, "Toyota US Hybrid Sales Surpass Million Units," *Associated Press*, 12 March 2009; National Highway Traffic Safety Administration, *Summary of Fuel Economy Performance* (Washington, DC: U.S. Department of Transportation, 30 March 2009).
  53. Cost of electricity equivalent to a gallon of gas from Roger Duncan, "Plug-In Hybrids: Pollution-Free Transport on the Horizon," *Solar Today*, May/June 2007, p. 46.
  54. Chris Gaylord, "Electric Cars Around the Corner," *Christian Science*

- Monitor*, 16 March 2009; Micheline Maynard, "Toyota Plans to Leapfrog G.M. with a Plug-In," *New York Times*, 12 January 2009; Norihiko Shirouzu, "Technology Levels Playing Field in Race to Market Electric Car," *Wall Street Journal*, 12 January 2009.
55. Maynard, op. cit. note 54; General Motors, "Imagine: A Daily Commute Without Using a Drop of Gas," at [www.chevrolet.com/electriccar](http://www.chevrolet.com/electriccar), viewed 8 August 2008.
  56. Matthew Dolan and Joan Murphy, "Nissan, Ford Plan Electric Push Aided by U.S.; Demand is Uncertain," *Wall Street Journal*, 24 June 2009; Think, "Think Announces U.S. Factory Plans," press release (Snarøya, Norway: 12 March 2009); CalCars, "How Carmakers are Responding to the Plug-In Hybrid Opportunity," at [www.calcars.org/carmakers.html](http://www.calcars.org/carmakers.html), viewed 3 June 2009.
  57. Michael Kintner-Meyer et al., *Impacts Assessment of Plug-in Hybrid Vehicles on Electric Utilities and Regional U.S. Power Grids—Part 1: Technical Analysis* (Richland, WA: DOE, Pacific Northwest National Laboratory, 2006).
  58. Steve Hamm, "The Electric Car Acid Test," *Business Week*, 4 February 2008, pp. 42–46; Better Place, "Global Progress," at [www.betterplace.com/global-progress](http://www.betterplace.com/global-progress), viewed 14 April 2009.
  59. Hiroki Matsumoto, "The Shinkansen: Japan's High Speed Railway," testimony before the Subcommittee on Railroads, Pipelines and Materials (Washington, DC: Committee on Transportation and Infrastructure, 19 April 2007); Central Japan Railway Company, *Annual Report 2008*, at [english.jr-central.co.jp/company/ir/annualreport/index.html](http://english.jr-central.co.jp/company/ir/annualreport/index.html), viewed 29 May 2009.
  60. Matsumoto, op. cit. note 59.
  61. Ibid.
  62. Inaki Barron, "High Speed Rail: The Big Picture," testimony before the Subcommittee on Railroads, Pipelines and Materials (Washington, DC: Committee on Transportation and Infrastructure, 19 April 2007); Railteam, "European High Speed Rail Operators Launch Railteam," press release (Brussels: 2 July 2007); Bruce Crumley, "European Train Travel: Working on the Railroad," *Time*, 28 May 2009.
  63. "Ave Madrid," *The Economist*, 5 February 2009.
  64. "A High-Speed Revolution," *The Economist*, 5 July 2007.
  65. Barron, op. cit. note 62.
  66. Jack Kinstlinger, *Magnetic Levitation High Speed Rail Service Along the Eastern Seaboard* (Hunt Valley, MD: KCI Technologies, Inc., 2007).
  67. Huang Xin, "China Starts Work on Beijing-Shanghai Express Railway," *Xinhua*, 18 April 2008.
  68. John L. Mica, "Opening Statement: Rep. Shuster from Today's Hearing on High Speed Rail," press release (Washington, DC: Committee on Transportation and Infrastructure, 19 April 2007); *American Recovery and Reinvestment Act of 2009*, Public Law 111–5, 111th Congress, 1st session (6 January 2009).
  69. *National Interstate and Defense Highways Act (1956)*, Public Law 627, Chapter 462, 84th Congress, 2nd session (27 June 1956).
  70. "Californians Approve High-Speed Rail, Nix Fake Clean Energy Props," *Environment News Service*, 5 November 2008.

71. Gerhard Metschies, "Pain at the Pump," *Foreign Policy*, July/August 2007; Ward's Automotive Group, *World Motor Vehicle Data 2008* (Southfield, MI: 2008).
72. Office of the Press Secretary, "President Obama Announces National Fuel Efficiency Policy," press release (Washington, DC: 19 May 2009); Keith Bradsher, "China Is Said to Plan Strict Gas Mileage Rules," *New York Times*, 27 May 2009; Andrew C. Revkin, "Fuel Efficiency Standards: Not So Efficient?" *New York Times*, 19 May 2009.
73. Ernst Ulrich von Weizsäcker, Amory B. Lovins, and L. Hunter Lovins, *Factor Four: Doubling Wealth, Halving Resource Use* (London: Earthscan, 1997); Friedrich Schmidt-Bleek et al., *Factor 10: Making Sustainability Accountable, Putting Resource Productivity into Praxis* (Carnoules, France: Factor 10 Club, 1998), p. 5.
74. William McDonough and Michael Braungart, *Cradle to Cradle: Remaking the Way We Make Things* (New York: North Point Press, 2002); Rebecca Smith, "Beyond Recycling: Manufacturers Embrace 'C2C' Design," *Wall Street Journal*, 3 March 2005.
75. Rona Fried, "Recycling Industry Offers Recession-Proof Investing," *Solar Today*, July/August 2008, pp. 22–23.
76. Claude Mandil et al., *Tracking Industrial Energy Efficiency and CO<sub>2</sub> Emissions* (Paris: IEA, 2007), pp. 39, 59–61.
77. World Steel Association, *World Steel in Figures 2009* (Brussels: 2009); Mandil et al., op. cit. note 76, pp. 39, 59–61.
78. "Iron and Steel Scrap," in U.S. Geological Survey (USGS), *Mineral Commodity Summaries* (Reston, VA: U.S. Department of the Interior, 2009), pp. 84–85; "Steel Recycling Rates at a Glance," fact sheet (Pittsburgh, PA: Steel Recycling Institute, 2007); Mississippi Department of Environmental Quality, "Recycling Trivia," at [www.deq.state.ms.us](http://www.deq.state.ms.us), viewed 17 October 2007.
79. One fourth the energy from Mandil et al., op. cit. note 76, p. 106; cut in energy use calculated from International Iron and Steel Institute (IISI), "Crude Steel Production by Process," *World Steel in Figures 2007*, at [www.worldsteel.org](http://www.worldsteel.org), viewed 16 October 2007; McKinsey Global Institute, *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity* (Washington, DC: May 2007).
80. "Cement," in USGS, op. cit. note 78, pp. 40–41; energy savings by adopting Japanese technologies from U.N. Environment Programme, *Buildings and Climate Change: Status, Challenges and Opportunities* (Paris: 2007), p. 19; energy saving from adopting dry-kiln process calculated from Mandil et al., op. cit. note 76.
81. Bus weight from John Shonsey et al., *RTD Bus Transit Facility Design Guidelines and Criteria* (Denver, CO: Regional Transportation District, February 2006); car weight from Stacy C. Davis and Susan W. Diegel, *Transportation Energy Data Book: Edition 26* (Oak Ridge, TN: ORNL, DOE, 2007), p. 415; car-to-bus ratio from American Public Transportation Association, *The Benefits of Public Transportation—An Overview* (Washington, DC: September 2002).
82. Mandil et al., op. cit. note 76, pp. 265–68.
83. Ljupka Arsova et al., "The State of Garbage in America," *BioCycle*, vol. 49, no. 12 (December 2008); Malia Wollan, "San Francisco to Toughen a

- Strict Recycling Law,” *New York Times*, 11 June 2009; Felicity Barringer, “A City Committed to Recycling is Ready for More,” *New York Times*, 7 May 2008.
84. “New Hampshire Town Boosts Recycling with Pay-As-You-Throw,” *Environment News Service*, 21 March 2007; population data from Town of Lyme Web site, at [www.lymenh.gov](http://www.lymenh.gov), viewed 3 June 2009.
  85. “New Hampshire Town Boosts Recycling,” op. cit. note 84.
  86. Finland in Brenda Platt and Neil Seldman, *Wasting and Recycling in the United States 2000* (Athens, GA: GrassRoots Recycling Network, 2000); Prince Edward Island Government, “PEI Bans the Can,” at [www.gov.pe.ca](http://www.gov.pe.ca), viewed 15 August 2005; Brenda Platt and Doug Rowe, *Reduce, Reuse, Refill!* (Washington, DC: Institute for Local Self-Reliance, 2002); David Saphire, *Case Reopened: Reassessing Refillable Bottles* (New York: INFORM, Inc., 1994).
  87. Sue McAllister, “Commercial Recycling Centers: Turning Debris into Treasure,” *San Jose Mercury News*, 10 April 2007.
  88. Brian Hindo, “Everything Old is New Again,” *BusinessWeek Online*, 25 September 2006.
  89. Junko Edahiro, Japan for Sustainability, e-mail to Janet Larsen, Earth Policy Institute, 16 October 2007; Tim Burt, “VW is Set for \$500m Recycling Provision,” *Financial Times*, 12 February 2001; Mark Magnier, “Disassembly Lines Hum in Japan’s New Industry,” *Los Angeles Times*, 13 May 2001.
  90. “FT Report—Waste and the Environment: EU Tackles Gadget Mountain,” *Financial Times*, 18 April 2007; Jeremy Faludi, “Pop Goes the Cell Phone,” *Worldchanging*, 4 April 2006.
  91. Rick Ridgeway, Environmental Initiatives and Special Media Projects, Patagonia, Inc., discussion with author, 22 August 2006; Patagonia, “Patagonia Announces Major Expansion of Garment Recycling Program,” press release (Ventura, CA: 28 January 2008); Jen Rapp, Patagonia, e-mail to Jignasha Rana, Earth Policy Institute, 28 April 2009.
  92. Hindo, op. cit. note 88.
  93. Daniel Michaels, “Boeing and Airbus Compete to Destroy What They Built,” *Wall Street Journal*, 1 June 2007.
  94. Ibid.
  95. “Gold Statistics,” in T.D. Kelly and G.R. Matos, comps., *Historical Statistics for Mineral and Material Commodities in the United States: U.S. Geological Survey Data Series 140* (Reston, VA: USGS, U.S. Department of the Interior, 2008); World Steel Association, op. cit. note 77; gold ore calculated from New Jersey Mining Company Reserves & Resources, “Estimated Ore Reserves,” at [www.newjerseymining.com](http://www.newjerseymining.com), updated 31 December 2006; steel ore from Mandil et al., op. cit. note 76, p. 115; carbon dioxide emissions calculated using Gavin M. Mudd, “Resource Consumption Intensity and the Sustainability of Gold Mining,” 2nd International Conference on Sustainability Engineering and Science, Auckland, New Zealand, 20–23 February 2007; EPA, *Emission Facts: Average Annual Emissions and Fuel Consumption for Passenger Cars and Light Trucks* (Washington, DC: April 2000).
  96. Catherine Ferrier, *Bottled Water: Understanding a Social Phenomenon* (Surrey, U.K.: WWF, 2001).

97. Oil consumption calculated using number of plastic water bottles from Jennifer Gitlitz et al., *Water, Water Everywhere: The Growth of Non-carbonated Beverages in the United States* (Washington, DC: Container Recycling Institute, February 2007); I. Boustead, *Eco-profiles of the European Plastics Industry: PET Bottles* (Brussels: PlasticsEurope, Association of Plastics Manufacturers, March 2005), pp. 4–9; DOE, Energy Information Administration, “Oil Market Basics: Demand,” at [www.eia.doe.gov/pub/oil\\_gas/petroleum/analysis\\_publications/oil\\_market\\_basics/demand\\_text.htm](http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/demand_text.htm), viewed 23 January 2006; Ward’s Automotive Group, *Ward’s World Motor Vehicle Data 2006* (Southfield, MI: 2006), p. 242; Pacific Institute, “Bottled Water and Energy,” fact sheet (Oakland, CA: 2007).
98. “S.F. Mayor Bans Bottled Water at City Offices,” *Associated Press*, 25 June 2007; Ross C. Anderson, Salt Lake City Mayor, national press telephone conference, Think Outside the Bottle Campaign, 9 October 2007.
99. Janet Larsen, “Bottled Water Boycotts: Back-to-the-Tap Movement Gains Momentum,” *Plan B Update* (Washington, DC: Earth Policy Institute, 7 December 2007); John G. Rodwan, Jr., *Confronting Challenges: U.S. and International Bottled Water Developments and Statistics for 2008* (New York: Beverage Marketing Corporation, April/May 2009).
100. John Roach, “Plastic-Bag Bans Gaining Momentum around the World,” *National Geographic News*, 4 April 2008.
101. Michael Goggin, “Curtailed, Negative Prices Symptomatic of Inadequate Transmission,” *Wind Energy Weekly*, vol. 27, no. 1305 (5 September 2008).
102. Joint Coordinated System Plan, *Joint Coordinated System Plan ’08 Report Volume 1: Economic Assessment*, at [www.jcspstudy.org](http://www.jcspstudy.org), 2008.
103. S. Massoud Amin and Clark W. Gellings, “The North American Power Delivery System: Balancing Market Restructuring and Environmental Economics with Infrastructure Security,” *Energy*, vol. 31, issues 6–7 (May–June 2006), pp. 967–99; Bracken Hendricks, *Wired for Progress 2.0: Building a National Clean-Energy Smart Grid* (Washington, DC: Center for American Progress, April 2009), p. 31.
104. Helen Knight, “Renewable Energy: Will the Lights Stay On?” *New Scientist*, 11 October 2008, pp. 30–31; Repower America, “Unified National Smart Grid,” at [www.repoweramerica.org](http://www.repoweramerica.org), viewed 30 June 2009.
105. Ashlea Ebeling, “What Would You Pay to Stay Cool?” *Forbes*, 15 August 2007.
106. Knight, op. cit. note 104.
107. Ibid.
108. Rebecca Smith, “Consumers: A Little Knowledge...,” *Wall Street Journal*, 30 June 2008; U.S. Department of Labor, Bureau of Labor Statistics, Mid-Atlantic Information Office, *Average Energy Prices in the Washington-Baltimore Area: April 2009* (Philadelphia, PA: 1 June 2009); Ahmad Faruqui and Sanem Sergici, *BGE’s Smart Energy Pricing Pilot Summer 2008 Impact Evaluation* (Cambridge, MA: The Brattle Group, 28 April 2009), pp. 1–2; Baltimore Gas and Electric Company, “Re: Supplement 437 to P.S.C. Md E-6 - Rider 26 - Peak Time Rebate,” electronic filings to Public Service Commission of Maryland, 15 April and 22 June 2009.
109. The Edison Foundation, “Utility-Scale Smart Meter Deployments, Plans

- & Proposals (IOUs),” issue brief (Washington, DC: May 2009).
110. Smart Meters, “Finland Leads Europe in Smart Grid Development,” news release (Isle of Benbecula, Scotland: 16 January 2009).
  111. Erik Olsen, “Smart Meters Open Market for Smart Apps,” Green, Inc., at *Nytimes.com*, 7 October 2008.
  112. IEA, op. cit. note 17, p. 506.
  113. IEA, *World Energy Outlook 2006* (Paris: 2006), p. 492; IEA, op. cit. note 11, pp. 25, 29.
  114. Natalie Mims, Mathias Bell, and Stephen Doig, *Assessing the Electric Productivity Gap and the U.S. Efficiency Opportunity* (Snowmass, CO: Rocky Mountain Institute, January 2009), pp. 6, 16–17.
  115. Mandil et al., op. cit. note 76, pp. 39, 59–61, 95–96, 139–42.

### Chapter 5. Stabilizing Climate: Shifting to Renewable Energy

1. U.S. Department of Energy (DOE), Energy Information Administration (EIA), *Crude Oil Production*, electronic database, at [tonto.eia.doe.gov](http://tonto.eia.doe.gov), updated 28 July 2008; American Wind Energy Association (AWEA), “Installed U.S. Wind Power Capacity Surged 45% in 2007: American Wind Energy Association Market Report,” press release (Washington, DC: 17 January 2008); AWEA, *U.S. Wind Energy Projects*, electronic database, at [www.awea.org/projects](http://www.awea.org/projects), updated 31 March 2009; future capacity calculated from Emerging Energy Research (EER), “US Wind Markets Surge to New Heights,” press release (Cambridge, MA: 14 August 2008); coal-fired power plant equivalents calculated by assuming that an average plant has a 500-megawatt capacity and operates 72 percent of the time, generating 3.15 billion kilowatt-hours of electricity per year; residential consumption calculated using “Residential Sector Energy Consumption Estimates, 2005,” in DOE, EIA, *Residential Energy Consumption Survey 2005 Status Report* (Washington, DC: 2007), with capacity factor from DOE, National Renewable Energy Laboratory (NREL), *Power Technologies Energy Data Book* (Golden, CO: August 2006); population from U.S. Census Bureau, *State & County QuickFacts*, electronic database, at [quickfacts.census.gov](http://quickfacts.census.gov), updated 20 February 2009.
2. “Clipper and BP to JV on 5,050-MW South Dakota Wind Project,” *Wind Energy Weekly*, vol. 27, no. 1300 (1 August 2008); 1 megawatt (MW) of installed wind capacity produces enough electricity to supply 300 homes from AWEA, “U.S. Wind Energy Installations Reach New Milestone,” press release (Washington, DC: 14 August 2006); average U.S. household size from U.S. Census Bureau, “2005–2007 American Community Survey 3-Year Estimates—Data Profile Highlights,” at [factfinder.census.gov/servlet/ACSSAFFacts](http://factfinder.census.gov/servlet/ACSSAFFacts), viewed 9 April 2009, with population from Census Bureau, op. cit. note 1; electricity export from EER, op. cit. note 1; ITC Holdings Corp., “ITC Holdings Corp. Unveils Green Power Express,” press release (Novi, MI: 9 February 2009); TransCanada, “TransCanada’s Zephyr and Chinook Power Transmission Line,” project brochure (Calgary, Alberta: April 2009); Quanta Technology, LLC, *Final Report on the Southwest Power Pool (SPP) Updated EHV Overlay Study* (Raleigh, NC: 3 March 2008), pp. 11–17; “A Window of North Atlantic Opportunity,” *Windpower Monthly*, October 2008, pp. 21–22.
3. Mark Leftly, “Middle East to Fund Scotland’s £5bn Power Grid,” *Inde-*

- pendent* (London), 10 August 2008; currency conversion from [www.bloomberg.com/invest/calculators/currency.html](http://www.bloomberg.com/invest/calculators/currency.html), 9 April 2009; “World Electricity Installed Capacity by Type (Million Kilowatts), January 1, 2006,” in DOE, EIA, “International Energy Annual 2006—World Electricity Data,” at [www.eia.doe.gov/iea/elec.html](http://www.eia.doe.gov/iea/elec.html), updated 8 December 2008.
4. “Algeria Aims to Export Power—Solar Power,” *Associated Press*, 11 August 2007; William Maclean, “Algeria Plans Solar Power Cable to Germany—Paper,” *Reuters*, 15 November 2007.
  5. “World Electricity Installed Capacity by Type (Million Kilowatts),” in DOE, op. cit. note 3; David O’Byrne, “Electricity Generation: Fair Winds Blow for a Clean Alternative,” *Financial Times*, 10 June 2008; Jan Dodd, “Strong Winds and High Prices in Turkey,” *Windpower Monthly*, September 2008; project selection and permitting from Dr. Hilmi Güler, Turkish Minister of Energy and Natural Resources, discussion with author, 20 June 2008.
  6. Peter Janssen, “The Too Slow Flow: Why Indonesia Could Get All Its Power from Volcanoes—But Doesn’t,” *Newsweek*, 20 September 2004; “Geothermal Power Projects to Cost \$US19.8 Bln, Official Says,” *ANTARA News* (Jakarta), 9 July 2008; Gita Wirjawan, “The Oil Cycle: The Wheels are Turning Again,” *Jakarta Post*, 12 March 2009.
  7. D. L. Elliott, L. L. Wendell, and G. L. Gower, *An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States* (Richland, WA: Pacific Northwest National Laboratory, 1991); Cristina L. Archer and Mark Z. Jacobson, “The Spatial and Temporal Distributions of U.S. Winds and Wind Power at 80 m Derived from Measurements,” *Journal of Geophysical Research*, vol. 108 (13 May 2003); China from C. L. Archer and M. Z. Jacobson, “Evaluation of Global Windpower,” *Journal of Geophysical Research*, vol. 110 (30 June 2005), and from Jean Hu et al., “Wind: The Future is Now,” *Renewable Energy World*, July–August 2005, p. 212; Indonesia based on 27,000 MW potential from Alimin Ginting, Indonesia Geothermal Association, “Geothermal Energy: Global Status, Market and Challenge for Developing in Indonesia,” presentation to the Thematic Panel Discussion of LEAD International Training Session on Leadership and Climate Change, 26 November–1 December 2007, Jakarta-Bandung, Indonesia, and on International Energy Agency (IEA), *IEA Statistics*, electronic database, at [www.iea.org/Textbase/stats/index.asp](http://www.iea.org/Textbase/stats/index.asp), viewed 1 May 2009.
  8. Lester R. Brown, “The Flawed Economics of Nuclear Power,” *Plan B Update* (Washington, DC: Earth Policy Institute, 28 October 2008).
  9. International Telecommunication Union, “Key Global Telecom Indicators for the World Telecommunication Service Sector,” at [www.itu.int/ITU-D/ict/statistics/at\\_glance/KeyTelecom99.html](http://www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom99.html), updated 10 March 2009; Molly O. Sheehan, “Mobile Phone Use Booms,” in Worldwatch Institute, *Vital Signs 2002* (New York: W. W. Norton & Company, 2002), p. 85.
  10. “Historical USA PC Sales” and “Historical Worldwide PC Sales,” tables in Computer Industry Almanac Inc., *Worldwide PC Market* (Arlington Heights, IL: September 2008); European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics Until 2013* (Brus-



- sels: April 2009), pp. 3–4; Global Wind Energy Council (GWEC), *Global Wind 2008 Report* (Brussels: 2009), p. 10.
11. Archer and Jacobson, “Evaluation of Global Windpower,” op. cit. note 7; Hu et al., op. cit. note 7.
  12. Elliott, Wendell, and Gower, op. cit. note 7; Archer and Jacobson, “The Spatial and Temporal Distributions of U.S. Winds,” op. cit. note 7; offshore potential from NREL data cited in U.S. Minerals Management Service, *Survey of Available Data on OCS Resources and Identification of Data Gaps*, Report to the Secretary, U.S. Department of the Interior (Washington, DC: April 2009), pp. I–11 to I–14.
  13. European Wind Energy Association (EWEA), “Seas of Change: Offshore Wind Energy,” fact sheet (Brussels: February 2009); Garrad Hassan and Partners, *Sea Wind Europe* (London: Greenpeace, March 2004).
  14. GWEC, op. cit. note 10, pp. 3, 10, 24.
  15. Denmark from GWEC, “Interactive World Map,” at [www.gwec.net/index.php?id=126](http://www.gwec.net/index.php?id=126), viewed 29 May 2009; Germany from GWEC, op. cit. note 10, pp. 34–35.
  16. Flemming Hansen, “Denmark to Increase Wind Power to 50% by 2025, Mostly Offshore,” *Renewable Energy Access*, 5 December 2006.
  17. GWEC, op. cit. note 10, pp. 33, 48–49.
  18. AWEA, “U.S. Wind Energy Industry Installs Over 2,800 MW in First Quarter,” press release (28 April 2009); AWEA, *U.S. Wind Energy Projects*, op. cit. note 1; AWEA and Solar Energy Industries Association, *Green Power Superhighways: Building a Path to America’s Clean Energy Future* (Washington, DC: February 2009).
  19. Southern California Edison, *The Tehachapi Renewable Transmission Project: Greening the Grid* (Los Angeles: March 2008); Paul Klein, Media Relations Group, Southern California Edison, discussion with Jonathan G. Dorn, Earth Policy Institute, 22 October 2007; “Clipper and BP to JV,” op. cit. note 2; Carl Levesque, “Super-Size It: Mega-Wind Farm Proposals Proliferate,” *Wind Energy Weekly*, vol. 27, no. 1303 (22 August 2008).
  20. “Maine Legislature Unanimously Approves Wind Recommendations,” *Wind Energy Weekly*, vol. 27, no. 1286 (1 August 2008); population from Census Bureau, op. cit. note 1; installed capacities from AWEA, *U.S. Wind Energy Projects*, op. cit. note 1; New York from Matthew L. Wald, “Wind Energy Bumps Into Power Grid’s Limits,” *New York Times*, 27 August 2008; “Oregon Siting Council Green-Lights 909-MW Wind Farm,” *Wind Energy Weekly*, vol. 27, no. 1300 (1 August 2008).
  21. Cape Wind, “Project at a Glance,” at [www.capewind.org/article24.htm](http://www.capewind.org/article24.htm), viewed 14 April 2009; Rhode Island from “Deepwater to Start Building R.I. Wind Farm in 2010,” *Reuters*, 8 January 2009; “LIPA & Con Edison Eye Offshore Wind Power,” *Renewable Energy World*, 25 March 2009; “Garden State Offshore Energy Wins Bid for Offshore Wind Farm,” *Renewable Energy World*, 6 October 2008; “Bluewater Wind Signs Contract for Sale of Offshore Wind Power,” *Renewable Energy World*, 24 June 2008; 1 MW of installed wind capacity produces enough electricity to supply 300 homes from sources cited in note 2.
  22. Willett Kempton et al., “Large CO<sub>2</sub> Reductions Via Offshore Wind Power Matched to Inherent Storage in Energy End-Uses,” *Geophysical Research Letters*, vol. 34 (24 January 2007); Steve Gelsi, “Green-Collar Pioneers Eye

- Offshore Wind Riches,” *MarketWatch*, 8 October 2008; Walt Musial, “Deepwater Offshore Wind Technology Research Requirements,” poster prepared for AWEA WindPower 2005 Conference, Denver, CO, 12–18 May 2005.
23. U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009; Archer and Jacobson, “Evaluation of Global Windpower,” op. cit. note 7; GWEC, op. cit. note 10, p. 22; “A Window of North Atlantic Opportunity,” op. cit. note 2.
  24. GWEC, op. cit. note 10, pp. 3, 24–27; Liming Qiao, Policy Director, GWEC, e-mail to J. Matthew Roney, Earth Policy Institute, 29 April 2009.
  25. A 2-megawatt wind turbine operating 36 percent of the time generates 6.3 million kilowatt-hours of electricity per year; capacity factor from DOE, NREL, op. cit. note 1; wholesale electricity price from DOE, *Wholesale Market Data*, electronic database at [www.eia.doe.gov/cneaf/electricity](http://www.eia.doe.gov/cneaf/electricity), updated 22 April 2009; Renewable Fuels Association, *Homegrown for the Homeland: Ethanol Industry Outlook 2005* (Washington, DC: 2005); corn per acre and ethanol per bushel approximated from Allen Baker et al., “Ethanol Reshapes the Corn Market,” *Amber Waves*, vol. 4, no. 2 (April 2006), pp. 32, 34; conservative ethanol price of \$2 per gallon based on F.O. Licht, “Biofuels,” *World Ethanol and Biofuels Report*, vol. 7, no. 15 (14 April 2009), p. 318.
  26. Wind royalties are author’s estimates based on Union of Concerned Scientists (UCS), “Farming the Wind: Wind Power and Agriculture,” fact sheet (Cambridge, MA: 2003).
  27. Laurie Jodziewicz, AWEA, e-mail to author, 16 October 2007; GWEC and Greenpeace, *Global Wind Energy Outlook 2006* (Brussels: 2006).
  28. GWEC, op. cit. note 10, pp. 9–10.
  29. Ward’s Automotive Group, *World Motor Vehicle Data 2008* (Southfield, MI: 2008), pp. 239–42; “Trillions in Spending Needed to Meet Global Oil and Gas Demand, Analysis Shows,” *International Herald Tribune*, 15 October 2007.
  30. David L. Lewis, “They May Save Our Honor, Our Hopes—and Our Necks,” *Michigan History*, September/October 1993; Harry Braun, *The Phoenix Project: Shifting from Oil to Hydrogen with Wartime Speed*, prepared for the Renewable Hydrogen Roundtable, World Resources Institute, Washington, DC, 10–11 April 2003, pp. 3–4; Kathy Barks Hoffman, “GM Plant Shutdowns Further Hurt Michigan Budget,” *Associated Press*, 23 April 2009.
  31. EWEA, “Wind Now Leads EU Power Sector,” press release (Brussels: 2 February 2009); Erik Shuster, *Tracking New Coal-Fired Power Plants* (Pittsburgh, PA: DOE, National Energy Technology Laboratory, January 2009); “Nuclear Dips in 2008,” *World Nuclear News*, 29 May 2009; GWEC, op. cit. note 10, pp. 10, 56–57.
  32. EPIA, op. cit. note 10, pp. 3–4.
  33. Prometheus Institute and Greentech Media, “25th Annual Data Collection Results: PV Production Explodes in 2008,” *PVNews*, vol. 28, no. 4 (April 2009), pp. 15–18.
  34. IEA, *World Energy Outlook 2006* (Paris: 2006); “Power to the Poor,” *The Economist*, 10 February 2001, pp. 21–23.

35. Sybille de La Hamaide, "Bangladesh Seeks World Bank Loan for Solar Power," *Reuters*, 26 April 2007.
36. "Solar Loans Light Up Rural India," *BBC News*, 29 April 2007.
37. Emissions include kerosene and other fuel lamps, from IEA, *Light's Labour's Lost: Policies for Energy-Efficient Lighting* (Paris: 2006), pp. 201–02; DOE, EIA, *International Petroleum Monthly*, at [www.eia.doe.gov/ipm/supply.html](http://www.eia.doe.gov/ipm/supply.html), updated 13 April 2009.
38. "PV Costs Set to Plunge for 2009/10," *Renewable Energy World*, 23 December 2008; "PV Costs Down Significantly from 1998–2007," *Renewable Energy World*, 23 February 2009; Christoph Podewils, "As Cheap as Brown Coal: By 2010, a kWh of PV Electricity in Spain Will Cost Around 9¢ to Produce," *PHOTON International*, April 2007.
39. Ines Rutschmann, "A Country of Megawatt Parks," *PHOTON International* (September 2008), pp. 32–39; Cleantech America, Inc., "KRCD Enters Long Term, Zero Emission Solar Power Plan," press release (San Francisco, CA: 6 July 2007); Ehud Zion Waldoks, "IEC Approves Arava Company's Proposal for World's Largest Photovoltaic Field," *The Jerusalem Post*, 15 February 2009.
40. Matthew L. Wald, "Two Large Solar Plants Planned in California," *New York Times*, 15 August 2008.
41. China Technology Development Group Corporation, "CTDC to Build 30MW On-Grid Solar Power Station in Qaidam Basin," press release (Hong Kong: 2 January 2009); EPIA, op. cit. note 10, p. 10.
42. Svetlana Kovalyova, "Italy's Solar Power Flourishes with State Help," *Reuters*, 12 March 2009; EPIA, op. cit. note 10, p. 8; "Chapter 8.8: California Solar Initiative," in California State Legislature, *Statutes 2006*, SB1, Chapter 132 (Sacramento, CA: 21 August 2006); California Public Utilities Commission, *California Solar Initiative Program Handbook* (San Francisco, CA: January 2009), p. 91; Sara Parker, "Maryland Expands RPS: 1,500 MW Solar by 2022," *Renewable Energy Access*, 12 April 2007; New Jersey's Clean Energy Program, "FAQ: NJ Solar Financing Program," fact sheet (Newark, NJ: New Jersey Board of Public Utilities, 12 September 2007).
43. Calculated from EPIA, op. cit. note 10, pp. 3–4; people who lack electricity from IEA, op. cit. note 34.
44. Rainer Aringhoff et al., *Concentrated Solar Thermal Power—Now!* (Brussels, Almeria, and Amsterdam: European Solar Thermal Industry Association (ESTIF), IEA SolarPACES, and Greenpeace International, September 2005), p. 4; NREL, *U.S. Parabolic Trough Power Plant Data*, electronic database, at [www.nrel.gov/csp/troughnet/power\\_plant\\_data.html](http://www.nrel.gov/csp/troughnet/power_plant_data.html), updated 25 July 2008; "Largest Solar Thermal Plant in 16 Years Now Online," *EERE Network News*, 13 June 2007; Solar Energy Industries Association, *US Solar Industry Year in Review 2008* (Washington, DC: March 2009), pp. 1, 7.
45. Lockheed Martin Corporation, "Lockheed Martin to Support Utility-Scale Solar Power Plant in Arizona," press release (Moorestown, NJ: 22 May 2009); Arizona Public Service, "APS, Starwood Energy to Collaborate on Major Concentrating Solar Plant," press release (Phoenix: 22 May 2009).
46. "Algeria Aims to Export Power," op. cit. note 4; Maclean, op. cit. note 4.

47. "Algeria Aims to Export Power," op. cit. note 4; Maclean, op. cit. note 4; Oak Ridge National Laboratory, "New Energy Algeria (NEAL)," at [www.ornl.gov/sci/eere/international/neal\\_index.htm](http://www.ornl.gov/sci/eere/international/neal_index.htm), viewed 17 April 2009.
48. Douglas Fischer, "Solar Thermal Comes Out of the Shadows," *The Daily Climate*, 20 November 2008; Jonathan G. Dorn, "Solar Thermal Power Coming to a Boil," *Plan B Update* (Washington, DC: Earth Policy Institute, 22 July 2008); "NRG Energy to Develop 500 MW of Solar Thermal," *Renewable Energy World*, 25 February 2009; Vanessa Lindlaw, Bright-Source Energy, e-mail to J. Matthew Roney, Earth Policy Institute, 3 June 2009.
49. Alok Jha, "Power in the Desert: Solar Towers Will Harness Sunshine of Southern Spain," *Guardian* (London), 24 November 2008; proposed plants from Dorn, op. cit. note 48; EER, "Global Concentrated Solar Power Markets & Strategies, 2009–2020," study announcement (Cambridge, MA: April 2009).
50. Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007 Global Status Report* (Paris and Washington, DC: REN21 Secretariat and Worldwatch Institute, 2008), p. 14; DOE, Office of Energy Efficiency and Renewable Energy (EERE), "Concentrating Solar Power Funding Opportunity Announcement," news release (Washington, DC: 25 May 2007).
51. Mark S. Mehos and David W. Kearney, "Potential Carbon Emissions Reductions from Concentrating Solar Power by 2030," in Charles F. Kutscher, ed., *Tackling Climate Change in the U.S.—Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030* (Boulder, CO: American Solar Energy Society, 2007), pp. 79–90; U.S. electricity consumption from DOE, EIA, *Electric Power Annual 2007* (Washington, DC: January 2009), p. 1; U.S. Department of the Interior, Bureau of Land Management, Nevada State Office, "Energy," Arizona State Office, "Arizona, the New Frontier!" and California Desert District, "Solar Energy Projects," all at [www.blm.gov](http://www.blm.gov), updated 19 March 2009.
52. Christoph Richter, Sven Teske, and Rebecca Short, *Concentrating Solar Power Global Outlook 2009* (Amsterdam, Tabernas, and Brussels: Greenpeace International, SolarPACES, and ESTIF, May 2009), pp. 53–59.
53. Werner Weiss, Irene Bergmann, and Roman Stelzer, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2007* (Gleisdorf, Austria: IEA, Solar Heating & Cooling Programme, May 2009), p. 21; "Sunrise or Sunset?" *China Daily*, 25 August 2008; Ryan Hodum, "Kunming Heats Up as China's 'Solar City'," *China Watch* (Washington, DC: Worldwatch Institute and Global Environmental Institute, 5 June 2007); Emma Graham-Harrison, "China Solar Power Firm Sees 25 Percent Growth," *Reuters*, 4 October 2007.
54. Rooftop solar water heaters have a capacity of 0.7 kilowatts per square meter and a capacity factor similar to rooftop photovoltaics (22 percent); nominal capacity from Weiss, Bergmann, and Stelzer, op. cit. note 53, p. 4; capacity factor from DOE, NREL, op. cit. note 1.
55. Ole Pilgaard, *Solar Thermal Action Plan for Europe* (Brussels, Belgium: ESTIF, 2007); Weiss, Bergmann, and Stelzer, op. cit. note 53, p. 21; U.N. Population Division, op. cit. note 23; Janet L. Sawin, "Solar Industry Stays

- Hot,” in Worldwatch Institute, *Vital Signs 2006–2007* (New York: W. W. Norton & Company, 2006).
56. Pilgaard, op. cit. note 55; Weiss, Bergmann, and Stelzer, op. cit. note 53, p. 21; U.N. Population Division, op. cit. note 23.
  57. Uwe Brechlin, “Study on Italian Solar Thermal Reveals a Surprisingly High Contribution to EU Market: 130 MWth in 2006,” press release (Brussels: ESTIF, 24 April 2007); Sawin, op. cit. note 55, p. 38; Les Nelson, “Solar-Water Heating Resurgence Ahead?” *Solar Today*, May/June 2007, p. 28; Pilgaard, op. cit. note 55; Ambiente Italia, *STO Database*, ProSTO Project Web site, at [www.solarordinances.eu](http://www.solarordinances.eu), viewed 3 June 2009.
  58. Nelson, op. cit. note 57, p. 27; Larry Sherwood, *U.S. Solar Trends 2007* (Latham, NY: Interstate Renewable Energy Council, August 2008), p. 9; Jackie Jones, “Such an Obvious Solution,” *Renewable Energy World*, 2 September 2008.
  59. Weiss, Bergmann, and Stelzer, op. cit. note 53, p. 21; incentives from Jones, op. cit. note 58.
  60. If in 2020 the 5 billion people in developing countries outside of China match China’s 0.08 square meters of rooftop water and space heating capacity per person, this would add 400 million square meters to the world total. Assumptions based on Weiss, Bergmann, and Stelzer, op. cit. note 53, p. 21, and on U.N. Population Division, op. cit. note 23.
  61. Nelson, op. cit. note 57, p. 26.
  62. *Ibid.*, p. 28; Ambiente Italia, op. cit. note 57.
  63. EPIA, op. cit. note 10, p. 6; Richter, Teske, and Short, op. cit. note 52, p. 83; Shuster, op. cit. note 31.
  64. Karl Gawell et al., *International Geothermal Development Directory and Resource Guide* (Washington, DC: Geothermal Energy Association (GEA), 2003); EER, *Global Geothermal Markets and Strategies 2009–2020* (Cambridge, MA: May 2009).
  65. Geothermal growth rate calculated using Ruggero Bertani, “World Geothermal Generation in 2007,” *GHC Bulletin*, September 2007, pp. 8–9, and EER, op. cit. note 64.
  66. Bertani, op. cit. note 65, pp. 8–9; Kara Slack, *U.S. Geothermal Power Production and Development Update* (Washington, DC: GEA, March 2009); EER, op. cit. note 64; number of countries with geothermal power from Karl Gawell et al., *2007 Interim Report: Update on World Geothermal Development* (Washington, DC: GEA, 1 May 2007), p. 1; share of electricity calculated using installed capacity from Bertani, op. cit. note 65, p. 9; capacity factor from Ingvar B. Fridleifsson et al., “The Possible Role and Contribution of Geothermal Energy to the Mitigation of Climate Change,” in O. Hohmeyer and T. Trittin, eds., *IPCC Scoping Meeting on Renewable Energy Sources, Proceedings* (Luebeck, Germany: 20–25 January 2008), p. 5, and from “World Total Net Electricity Generation, 1980–2005,” in DOE, EIA, “International Energy Annual 2005—World Electricity Data,” at [www.eia.doe.gov/iea/elec.html](http://www.eia.doe.gov/iea/elec.html), updated 13 September 2007.
  67. World Bank, “Geothermal Energy,” prepared under the PB Power and World Bank partnership program, [www.worldbank.org](http://www.worldbank.org), viewed 23 January 2003.
  68. Jefferson Tester et al., *The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st*

- Century* (Cambridge, MA: Massachusetts Institute of Technology, 2006); John W. Lund and Derek H. Freeston, “World-Wide Direct Uses of Geothermal Energy 2000,” *Geothermics*, vol. 30 (2001), pp. 34, 46, 51, 53.
69. Tester et al., op. cit. note 68, pp. 1–4; Julian Smith, “Renewable Energy: Power Beneath Our Feet,” *New Scientist*, 8 October 2008.
  70. Rachel Nowak, “Who Needs Coal When You Can Mine Earth’s Deep Heat?” *New Scientist*, 19 July 2008; Tester et al., op. cit. note 68.
  71. UCS, “How Geothermal Energy Works,” at [www.ucsusa.org/clean\\_energy/renewable\\_energy\\_basics/offmen-how-geothermal-energy-works.html](http://www.ucsusa.org/clean_energy/renewable_energy_basics/offmen-how-geothermal-energy-works.html), viewed 22 April 2009; Slack, op. cit. note 66.
  72. “Geothermal Power Projects to Cost \$US19.8 Bln, Official Says,” op. cit. note 6; Ed Davies and Karen Lema, “Geothermal-Rich SE Asia Struggles to Tap Earth’s Power,” *Reuters*, 30 June 2008; Bertani, op. cit. note 65, pp. 8–9; “Energy Dev Corp.: Bid to Become Top Geothermal Producer,” *Agence France-Presse*, 14 January 2009; Geysir Green Energy, “Philippines,” at [www.geysirgreenenergy.com/Operations-and-Development/asia/philippines](http://www.geysirgreenenergy.com/Operations-and-Development/asia/philippines), viewed 22 April 2009.
  73. German Federal Institute for Geosciences and Natural Resources (BGR), “African Rift Geothermal Facility (ARGeo),” at [www.bgr.de/geotherm/projects/argeo.html](http://www.bgr.de/geotherm/projects/argeo.html), viewed 22 April 2009; U.N. Environment Programme (UNEP), “Hot Prospect—Geothermal Electricity Set for Rift Valley Lift-Off in 2009,” press release (Nairobi: 9 December 2008); Bertani, op. cit. note 65, pp. 8–9; DOE, op. cit. note 3.
  74. Yoko Nishikawa, “Japan Geothermal Projects Pick Up After 20 Years: Report,” *Reuters*, 4 January 2009; Bertani, op. cit. note 65, pp. 8–9; Lund and Freeston, op. cit. note 68, p. 46.
  75. Werner Bussmann, “Germany: The Geothermal Market is Expanding,” presentation to the Renewable Energy Exhibition, Lyon, Paris, 25–28 February 2009; Jane Burgermeister, “Geothermal Electricity Booming in Germany,” *Renewable Energy World*, 2 June 2008; UNEP, op. cit. note 73.
  76. DOE, EERE, “Energy Savers: Geothermal Heat Pumps,” updated 24 February 2009, and “Energy Savers: Benefits of Geothermal Heat Pump Systems,” updated 30 December 2008, both at [www.energysavers.gov](http://www.energysavers.gov); Burgermeister, op. cit. note 75.
  77. Iceland National Energy Authority and Ministries of Industry and Commerce, *Geothermal Development and Research in Iceland* (Reykjavik, Iceland: April 2006), p. 16; World Bank, op. cit. note 67.
  78. Lund and Freeston, op. cit. note 68, pp. 34, 51, 53.
  79. World Bank, op. cit. note 67.
  80. *Ibid.*
  81. Lund and Freeston, op. cit. note 68, pp. 46, 53.
  82. United States from Tester et al., op. cit. note 68; Japan based on assumption that Enhanced Geothermal Systems could double 72,000 MW potential, from Hirofumi Muraoka et al., “Assessment of Hydrothermal Resource Potentials in Japan 2008,” *Abstract of Annual Meeting of Geothermal Research Society of Japan* (Kanazawa, Japan: 2008); Hirofumi Muraoka, National Institute of Advanced Industrial Science and Technology, e-mail to J. Matthew Roney, Earth Policy Institute, 13 July 2009.
  83. Stephen R. Gliessman, *Agroecology: The Ecology of Sustainable Food Systems*, 2nd ed. (Boca Raton, FL: CRC Press, 2006), p. 256; Pew Center

- on Global Climate Change, "Climate TechBook: Solar Power," fact sheet (Arlington, VA: May 2009); Richter, Teske, and Short, op. cit. note 52, pp. 18–19.
84. Ralph P. Overend and Anelia Milbrandt, "Potential Carbon Emissions Reductions from Biomass by 2030," in Kutscher, op. cit. note 51, pp. 112–30; DOE, op. cit. note 51, p. 24.
  85. Swedish Energy Agency, *Energy in Sweden 2008* (Eskilstuna, Sweden: December 2008), pp. 96, 111.
  86. Population data from Census Bureau, op. cit. note 1; Anders Rydaker, "Biomass for Electricity & Heat Production," presentation at Bioenergy North America 2007, Chicago, IL, 16 April 2007.
  87. Oglethorpe Power Corporation, "Oglethorpe Power Announces Plans to Build Biomass Electric Generating Facilities," press release (Tucker, GA: 18 September 2008).
  88. World Alliance for Decentralized Energy, *Bagasse Cogeneration—Global Review and Potential* (Washington, DC: June 2004), p. 32; sugar production from U.S. Department of Agriculture (USDA), *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 9 April 2009.
  89. Waste to Energy Conference, "Power and Heat for Millions of Europeans," press release (Bremen, Germany: 20 April 2007); Confederation of European Waste-to-Energy Plants, "2008 Country Reports on Waste Management," at [www.cewep.eu](http://www.cewep.eu), viewed 23 July 2009; Jeffrey Morris, "Comparative LCAs for Curbside Recycling Versus Either Landfilling or Incineration with Energy Recovery," *International Journal of Life Cycle Assessment*, vol. 10, no. 4 (July 2005), pp. 273–84.
  90. Puget Sound Energy, "King County, PSE, and Bio Energy-Washington Teaming Up to Generate Green Energy from Landfill Gas," press release (Seattle, WA: 6 April 2009).
  91. Ray C. Anderson, presentation at Chicago Climate Exchange, Chicago, IL, 14 June 2006.
  92. F.O. Licht, "World Fuel Ethanol Production," *World Ethanol and Biofuels Report*, vol. 7, no. 18 (26 May 2009), p. 365; F.O. Licht, "Biodiesel: World Production, by Country," *World Ethanol and Biofuels Report*, vol. 7, no. 14 (26 March 2009), p. 288.
  93. F.O. Licht, "World Fuel Ethanol Production," op. cit. note 92, p. 365; Bill Guerin, "European Blowback for Asian Biofuels," *Asia Times*, 8 February 2007.
  94. Timothy Searchinger et al., "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land-Use Change," *Science*, vol. 319 (29 February 2008), pp. 1,238–40.
  95. Joseph Fargione et al., "Land Clearing and the Biofuel Carbon Debt," *Science*, vol. 319 (29 February 2008), pp. 1,235–38.
  96. "Biofools," *The Economist*, 11 April 2009; P. J. Crutzen et al., "N<sub>2</sub>O Release from Agro-biofuel Production Negates Global Warming Reduction by Replacing Fossil Fuels," *Atmospheric Chemistry and Physics*, vol. 8 (29 January 2008), pp. 389–95; industry reaction from Lauren Etter, "Ethanol Craze Cools As Doubts Multiply," *Wall Street Journal*, 28 November 2007; R. W. Howarth and Stefan Brinzeu, eds., *Biofuels: Environmental Consequences and Interactions with Changing Land Use*, Pro-

- ceedings of the Scientific Committee on Problems of the Environment (SCOPE) International Biofuels Project Rapid Assessment, 22–25 September 2008 (Ithaca, NY: Cornell University, 2009), pp. 1–13.
97. DOE, EERE, "Starch- and Sugar-Based Ethanol Feedstocks," at [www.afdc.energy.gov/afdc/ethanol/feedstocks\\_starch\\_sugar.html](http://www.afdc.energy.gov/afdc/ethanol/feedstocks_starch_sugar.html), updated 4 February 2009; DOE and USDA, *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply* (Washington, DC: April 2005); Jason Hill et al., "Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels," *Proceedings of the National Academy of Sciences*, vol. 103, no. 30 (25 July 2006), pp. 11,206–10; M. R. Schmer et al., "Net Energy of Cellulosic Ethanol from Switchgrass," *Proceedings of the National Academy of Sciences*, vol. 105, no. 2 (15 January 2008), pp. 464–69; Purdue University, Department of Agricultural Communication, "Fast-Growing Trees Could Take Root as Future Energy Source," press release (West Lafayette, IN: 23 August 2006).
  98. J. E. Campbell, D. B. Lobell, and C. B. Field, "Greater Transportation Energy and GHG Offsets from Bioelectricity than Ethanol," *Science*, vol. 324 (22 May 2009), pp. 1,055–57; DOE and USDA, op. cit. note 97, pp. i–ii.
  99. Nic Lane, *Issues Affecting Tidal, Wave, and In-Stream Generation Projects* (Washington, DC: Congressional Research Service, 26 November 2008).
  100. IEA, *World Energy Outlook 2008* (Paris: 2008), p. 165; IEA, *Member Countries and Countries Beyond the OECD*, electronic database, at [www.iea.org/Textbase/country/index.asp](http://www.iea.org/Textbase/country/index.asp), viewed 23 April 2009; International Rivers Network, "Frequently Asked Questions about Dams," fact sheet (Berkeley, CA: 2004).
  101. "Rural Areas Get Increased Hydro Power Capacity," *Xinhua*, 7 May 2007.
  102. Jason Palmer, "Renewable Energy: The Tide is Turning," *New Scientist*, 11 October 2008; European Commission, "Tidal Energy—Promising Sites Worldwide," ATLAS project Web site, at [ec.europa.eu/energy/atlas/html/tidalsites.html](http://ec.europa.eu/energy/atlas/html/tidalsites.html), viewed 24 June 2009; ABS Energy Research, *The Ocean Energy Report* (London: 2009), pp. 13–23.
  103. Choe Sang-Hun, "South Korea Seeks Cleaner Energy Sources," *International Herald Tribune*, 9 May 2007; Choe Sang-Hun, "As Tides Ebb and Rise, South Korea Prepares to Snare Them," *International Herald Tribune*, 31 May 2007; ABS Energy Research, op. cit. note 102, pp. 13–23; Lunar Energy, "British Firm Announces World's Largest Tidal Power Development," press release (East Yorkshire, U.K.: 11 March 2008); IEA, *Implementing Agreement on Ocean Energy Systems (IEA-OES), 2008 Annual Report* (Lisbon, Portugal: February 2009), p. 83.
  104. Palmer, op. cit. note 102; Choe, "As Tides Ebb and Rise," op. cit. note 103; ABS Energy Research, op. cit. note 102, pp. 13–23; "World Electricity Installed Capacity by Type (Million Kilowatts), January 1, 2006," in DOE, op. cit. note 3.
  105. "Issued Hydrokinetic Projects Preliminary Permits," table in Federal Energy Regulatory Commission, "Hydropower-Industry Activities," at [www.ferc.gov/industries/hydropower/indus-act/hydrokinetics.asp](http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics.asp), updated 2 July 2009; Mike Hoover, Oceana Energy Company, e-mail to J.

- Matthew Roney, 30 June 2009.
106. Robert Silgado et al., *Finavera Renewables Inc.: Where There is Wind There is a Wave* (Toronto, ON: Dundee Securities Corporation, 18 June 2007); “Issued Hydrokinetic Projects Preliminary Permits,” op. cit. note 105; San Francisco from Tom Zeller, Jr., “Wave Power for San Francisco?” Green Inc., at *Nytimes.com*, 27 February 2009.
  107. Pelamis Wave Power, “Aguçadoura,” at [www.pelamiswave.com](http://www.pelamiswave.com), viewed 23 April 2009; Mario de Queiroz, “Portugal: Waves of Energy Come Ashore,” *Inter Press Service*, 24 September 2008; “Wave Hub Names Fourth Developer for Wave Energy Farm,” *Renewable Energy Access*, 15 May 2007; European Commission, *Report on the Workshop on Hydropower and Ocean Energy—Part I: Ocean Energy* (Brussels: 13 June 2007), pp. 1, 3; IEA, op. cit. note 7; “Aquamarine to Develop 1 GW of Ocean Energy,” *Renewable Energy World*, 24 February 2009; wave potential from World Energy Council, *2007 Survey of Energy Resources* (London: 2007), p. 544; “World Electricity Installed Capacity by Type (Million Kilowatts), January 1, 2006,” in DOE, op. cit. note 3.
  108. REN21, *Renewables Global Status Report: 2009 Update* (Paris and Washington, DC: REN21 Secretariat and Worldwatch Institute, 2009), p. 23; Lila Buckley, “Hydropower in China: Participation and Energy Diversity Are Key,” *China Watch* (Washington, DC: Worldwatch Institute and Global Environmental Institute, 24 April 2007); “Rural Areas Get Increased Hydro Power Capacity,” op. cit. note 101; Pallavi Aiyar, “China: Another Dammed Gorge,” *Asia Times*, 3 June 2006; Gary Duffy, “Brazil Gives Amazon Dams Go-Ahead,” *BBC News*, 10 July 2007; Patrick McCully, *Before the Deluge: Coping with Floods in a Changing Climate* (Berkeley, CA: International Rivers Network, 2007), pp. 22–23.
  109. DOE, EIA, *Annual Energy Outlook 2009* (Washington, DC: March 2009), p. 74; National Hydropower Association, “NHA Applauds President Obama and Congress for Turning to Hydro in the Stimulus,” press release (Washington, DC: 19 February 2009).
  110. Table 5–1 by Earth Policy Institute, with 2020 goals cited throughout chapter and with 2008 figures calculated using the following sources: wind from GWEC, op. cit. note 10, p. 10; rooftop solar electric systems and solar electric power plants from EPIA, op. cit. note 10, p. 3, and from Rutschmann, op. cit. note 39; geothermal electricity from EER, op. cit. note 64; biomass electricity and heat and hydropower, including tidal and wave power, from REN21, op. cit. note 108, p. 23; rooftop solar water and space heaters from Weiss, Bergmann, and Stelzer, op. cit. note 53, p. 21; geothermal heat from Tester et al., op. cit. note 68, p. 9.
  111. “‘Wind Can Power Up Entire Nation,’” *China Daily*, 18 June 2009; Rujun Shen and Tom Miles, “China’s Wind-power Boom to Outpace Nuclear by 2020,” *China Daily*, 20 April 2009.
  112. Table 5–2 by Earth Policy Institute with existing fossil fuel and nuclear capacity from “Existing Capacity by Energy Source, 2007,” and “Planned Nameplate Capacity Additions from New Generators, by Energy Source, 2008 through 2012,” in DOE, op. cit. note 51, p. 25, and from Shuster, op. cit. note 31; renewables based on data and growth rates from AWEA, EPIA, GEA, DOE, Navigant Consulting, NREL, USDA, and Electric Power Research Institute.

113. “Texas to Spend Billions on Wind Power Transmission Lines,” *Environment News Service*, 18 July 2008; Eileen O’Grady, “Texas Finalizes Plan to Expand Wind Lines,” *Reuters*, 29 January 2009; residential supply calculated as described in note 2.
114. TransCanada, op. cit. note 2.
115. Scott DiSavino, “ITC Proposes Project to Move Wind Power to Chicago,” *Reuters*, 9 February 2009; ITC Holdings Corp., op. cit. note 2; DOE, “Locke, Chu Announce Significant Steps in Smart Grid Development,” press release (Washington, DC: 18 May 2009).
116. Cristina L. Archer and Mark Z. Jacobson, “Supplying Baseload Power and Reducing Transmission Requirements by Interconnecting Wind Farms,” *Journal of Applied Meteorology and Climatology*, vol. 46 (November 2007), pp. 1,701–17.
117. Janice Massy, “Grand Vision on Paper: Blueprint for a European Supergrid,” *Windpower Monthly*, December 2008, p. 37; Alok Jha, “Solar Power from Saharan Sun Could Provide Europe’s Electricity, Says EU,” *Guardian* (London), 23 July 2008; David Strahan, “From AC to DC: Going Green with Supergrids,” *New Scientist*, 14–20 March 2009; Paul Rodgers, “Wind-fuelled ‘Supergrid’ Offers Clean Power to Europe,” *Independent* (London), 25 November 2007.
118. Strahan, op. cit. note 117; Emmet Curley, Mainstream Renewable Power, discussion with J. Matthew Roney, Earth Policy Institute, 2 July 2009; The ABB Group, “The NorNed HVDC Link,” at [www.abb.com](http://www.abb.com), updated 28 May 2009.
119. DESERTEC Foundation, “12 Companies Plan Establishment of a Desertec Industrial Initiative,” press release (Munich: 13 July 2009); potential generating capacity estimated by author, based on Initiative’s stated goal of meeting a substantial portion of the producer countries’ electricity needs and 15 percent of Europe’s electricity needs by 2050, using IEA, op. cit. note 100, pp. 506-07, with capacity factor from DOE, NREL, op. cit. note 1.
120. Edwin Clark, former senior economist, White House Council on Environmental Quality, letter to author, 25 July 2001; Joseph E. Aldy and Robert N. Stavins, Harvard Project on International Climate Agreements, “Economic Incentives in a New Climate Agreement,” prepared for The Climate Dialogue, Copenhagen, Denmark, 7–8 May 2008.
121. Kate Galbraith, “Europe’s Way of Encouraging Solar Power Arrives in the U.S.,” *New York Times*, 12 March 2009; Karlynn Cory, Toby Couture, and Claire Kreycik, *Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions* (Golden, CO: NREL, March 2009), p. 1; REN21, op. cit. note 50, p. 23; Database of State Incentives for Renewables & Efficiency, “Rules, Regulations, & Policies for Renewable Energy,” updated April 2009, and “Federal Incentives for Renewables and Efficiency,” updated 19 February 2009, electronic databases, both at [www.dsireusa.org](http://www.dsireusa.org).

## Chapter 6. Designing Cities for People

1. U.N. Population Division, *World Urbanization Prospects: The 2007 Revision Population Database*, electronic database, at [esa.un.org/unup](http://esa.un.org/unup), updated 2008.

2. Urban population in 1900 from Mario Poläse, "Urbanization and Development," *Development Express*, no. 4, 1997; U.N. Population Division, *World Urbanization Prospects: The 2007 Revision* (New York: February 2008).
3. Molly O'Meara, *Reinventing Cities for People and the Planet*, Worldwatch Paper 147 (Washington, DC: Worldwatch Institute, June 1999), pp. 14–15; U.N. Population Division, op. cit. note 2, pp. 8–10; U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, electronic database, at esa.un.org/unpp, updated 11 March 2009.
4. Christopher Flavin, "Hearing on Asia's Environmental Challenges: Testimony of Christopher Flavin," Committee on International Relations, U.S. House of Representatives, Washington, DC, 22 September 2004; Subir Bhaumik, "Air Pollution Suffocates Calcutta," *BBC News*, 3 May 2007; David Schrank and Tim Lomax, *2007 Urban Mobility Report* (College Station, TX: Texas Transportation Institute, September 2007), p. 1.
5. Francesca Lyman, "Twelve Gates to the City: A Dozen Ways to Build Strong, Livable, and Sustainable Cities," *Words and Pictures Magazine*, Issue 5, 2007; Lisa Jones, "A Tale of Two Mayors: The Improbable Story of How Bogota, Colombia, Became Somewhere You Might Actually Want To Live," *Grist Magazine*, 4 April 2002.
6. Claudia Nanninga, "Energy Efficient Transport—A Solution for China," *Voices of Grassroots*, November 2004; Enrique Peñalosa, "Parks for Livable Cities: Lessons from a Radical Mayor," keynote address at the Urban Parks Institute's Great Parks/Great Cities Conference, Chicago, 30 July 2001; Susan Ives, "The Politics of Happiness," *Trust for Public Land*, 9 August 2002; Jones, op. cit. note 5.
7. Peñalosa, op. cit. note 6.
8. Lara de Lacerda Santos Rodrigues, Curitiba City Government, e-mail to J. Matthew Roney, Earth Policy Institute, 24 July 2009.
9. O'Meara, op. cit. note 3.
10. Los Angeles from Sandra Postel, *Last Oasis*, rev. ed. (New York: W. W. Norton & Company, 1997), p. 20; Joel Simon, *Endangered Mexico* (San Francisco: Sierra Club Books, 1997); Chinese Ministry of Water Resources, *Country Report of the People's Republic of China* (Marseilles, France: World Water Council, 2003), pp. 60–61.
11. U.S. Department of Agriculture, Foreign Agricultural Service, *Grain: World Markets and Trade and Oilseeds: World Markets and Trade* (Washington, DC: various issues).
12. Richard Register, "Losing the World, One Environmental Victory at a Time—And a Way to Solve That Problem," essay (Oakland, CA: Ecocity Builders, Inc., 31 August 2005); Richard Register, *Ecocities: Rebuilding Cities in Balance with Nature: Revised Edition* (Gabriola Island, BC: New Society Publishers, 2006).
13. Register, "Losing the World, One Environmental Victory at a Time," op. cit. note 12; population estimate from U.S. Census Bureau, *State & County Quickfacts*, electronic database, at quickfacts.census.gov, updated 5 May 2009.
14. Register, "Losing the World, One Environmental Victory at a Time," op. cit. note 12.
15. Berliner Verkehrsbetriebe (BVG), "Means of Transport & Routes," at

- www.bvg.de, viewed 11 May 2009.
16. Jay Walljasper, "Unjamming the Future," *Ode*, October 2005, pp. 36–41; Breakthrough Technologies Institute, *Transport Innovator* newsletter (various issues); Victoria Transport Policy Institute, "Bus Rapid Transit," *Online TDM Encyclopedia*, updated 22 July 2008; Institute for Transportation & Development Policy (ITDP), "China Bus Rapid Transit," at www.chinaBRT.org, updated 1 May 2009.
17. Bernardo Baranda, "Insurgentes Sur BRT Line Opens in Mexico City," ITDP, at www.itdp.org, 24 June 2008; Bernardo Baranda, "Mexico City Opens Second BRT Corridor," ITDP, at www.itdp.org, 21 December 2008; Karl Fjellstrom, "Guangzhou BRT Construction Begins," ITDP, at www.itdp.org, 17 December 2008; Karl Fjellstrom, ITDP, e-mail to J. Matthew Roney, Earth Policy Institute, 25 May 2009.
18. Tehran Public & International Relations Department, "Tehran Mayor Inaugurates 1st BRT Line," at www.tehran.ir, viewed 17 May 2009; Victoria Transport Policy Institute, op. cit. note 16; Breakthrough Technologies Institute, op. cit. note 16.
19. Molly O'Meara Sheehan, "Making Better Transportation Choices," in Lester R. Brown et al., *State of the World 2001* (New York: W. W. Norton & Company, 2001), p. 116.
20. William D. Eggers, Peter Samuel, and Rune Munk, *Combating Gridlock: How Pricing Road Use Can Ease Congestion* (New York: Deloitte, November 2003); Tom Miles, "London Drivers to Pay UK's First Congestion Tax," *Reuters*, 28 February 2002; Randy Kennedy, "The Day the Traffic Disappeared," *New York Times Magazine*, 20 April 2003, pp. 42–45; James Savage, "Congestion Charge Returns to Stockholm," *The Local*, 1 August 2007; currency conversion from www.oanda.com/convert/classic.
21. Transport for London, *Central London Congestion Charging: Impacts Monitoring* (London: various years).
22. "Milan to Impose 'Pollution Charge' on Cars," *Reuters*, 23 July 2007; "Milan Introduces Traffic Charge," *BBC News*, 2 January 2008; Malia Wollan, "San Francisco Studies Fees to Ease Traffic," *New York Times*, 3 January 2009; "Thousands Demonstrate Against Kyiv Mayor's Policies," *Radio Free Europe/Radio Liberty*, 12 February 2009; Paul Melia, "Drivers Facing Congestion Charge within Three Years," *Independent* (Dublin), 27 January 2009; Mathew Dearnaley, "Road Tolls a Hot Potato Since the Harbour Bridge," *New Zealand Herald*, 26 August 2008.
23. Serge Schmemmann, "I Love Paris on a Bus, a Bike, a Train and in Anything but a Car," *New York Times*, 26 July 2007; Katrin Bennhold, "A New French Revolution's Creed: Let Them Ride Bikes," *New York Times*, 16 July 2007.
24. Steven Erlanger, "A New Fashion Catches on in Paris: Cheap Bicycle Rentals," *New York Times*, 13 July 2008; City of Paris, "Vélib: Subscriptions and Prices," at www.en.velib.paris.fr, viewed 12 May 2009; Alexandra Topping, "Free Wheeling: Paris's New Bike System," *Washington Post*, 23 September 2007; number of trips as of May 2009 from JCDecaux press officer, discussion with J. Matthew Roney, 14 May 2009.
25. Schmemmann, op. cit. note 23; La Fédération de Paris du Parti Socialiste, ed., *Ce Que Nous Avons Fait Ensemble* (Paris: Office of Mayor Bertrand Delanoë, 2007), pp. 20–25; program expansion from JCDecaux press offi-

- cer, op. cit. note 24; Alok Jha, "Boris Johnson Unveils Blueprint for London's 'Cycling Revolution,'" *Guardian* (London), 27 April 2009.
26. John Ritter, "Narrowed Roads Gain Acceptance in Colo., Elsewhere," *USA Today*, 29 July 2007; John Ritter, "'Complete Streets' Program Gives More Room for Pedestrians, Cyclists," *USA Today*, 29 July 2007.
  27. National Complete Streets Coalition, "Complete the Streets: Who We Are," at [www.completestreets.org/whoweare.html](http://www.completestreets.org/whoweare.html), viewed 16 August 2007; AARP, "About AARP," at [www.aarp.org/aarp/About\\_AARP](http://www.aarp.org/aarp/About_AARP), viewed 12 May 2009; Ritter, "Narrowed Roads," op. cit. note 26.
  28. National Complete Streets Coalition, "Illinois Passes Complete Streets Law," press release (Washington, DC: 16 October 2007); Stefanie Seskin, National Complete Streets Coalition, e-mail to J. Matthew Roney, Earth Policy Institute, 28 May 2009; Office of Congresswoman Doris Matsui, "Congresswoman Matsui and Senator Harkin Introduce Bill to Make Streets Safer and Encourage Healthier America," press release (Washington, DC: 12 March 2009).
  29. U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study: Transportation Characteristics of School Children* (Washington, DC: July 1972), p. 3; American Academy of Pediatrics, Committee on Injury, Violence, and Poison Prevention and Council on School Health, "Policy Statement: School Transportation Safety," *Pediatrics*, vol. 120, no. 1 (July 2007), pp. 213–20; International Walk to School, "About the Walk," at [www.iwalkto.school.org/about.htm](http://www.iwalkto.school.org/about.htm), viewed 12 May 2009.
  30. Car trip reduction is author's estimate.
  31. O'Meara, op. cit. note 3, p. 45.
  32. J. Matthew Roney, "Bicycles Pedaling into the Spotlight," *Eco-Economy Indicator* (Washington, DC: Earth Policy Institute, 12 May 2008); Ward's Automotive Group, *World Motor Vehicle Data 2008* (Southfield, MI: 2008), pp. 239–42; German Eslava, "1st in EU: Italian Government Spurs Bike Sales with Incentives," *Bike Europe*, at [www.bike-eu.com](http://www.bike-eu.com), 28 April 2009; Jack Oortwijn and Jan-Willem van Schaik, "European Bike Season Kicks Off with Record Highs," *Bike Europe*, at [www.bike-eu.com](http://www.bike-eu.com), 12 May 2009; Jan-Willem van Schaik, "Giant Targets 10% Growth in 2009," *Bike Europe*, at [www.bike-eu.com](http://www.bike-eu.com), 21 April 2009.
  33. Calculated by Earth Policy Institute from U.N. Population Division, op. cit. note 3, from 3.44 persons per Chinese household in Bingham Kennedy, Jr., *Dissecting China's 2000 Census* (Washington, DC: Population Reference Bureau, June 2001), and from National Bureau of Statistics of China data cited in Jme McLean, "Backpedal to the Future: China's Strength is in Its Bicycles," *E Magazine*, at [www.emagazine.com/view/?3729](http://www.emagazine.com/view/?3729), viewed 15 January 2008; ownership from Netherlands Ministry of Transport, Public Works and Water Management and Fietsberaad, *Cycling in the Netherlands* (The Hague and Utrecht: 2009), p. 14.
  34. Chinese bicycle production compiled from United Nations, *Yearbook of Industrial Statistics* (New York: various years) and from *Industrial Commodity Statistics Yearbook* (New York: various years); "World Players in the Bicycle Market 2000–2007," in John Crenshaw, *Bicycle Retailer and Industry News*, e-mail to J. Matthew Roney, Earth Policy Institute, 9 May 2008; cars in China from Ward's Automotive Group, op. cit. note 32.

35. Percent of police forces calculated from Matthew Hickman and Brian A. Reaves, *Local Police Departments, 2003* (Washington, DC: U.S. Department of Justice, Bureau of Justice Statistics, May 2006), pp. 3, 13; arrest rate from a member of the Washington, DC, police force, discussion with author.
36. Katie Zezima, "With Free Bikes, Challenging Car Culture on Campus," *New York Times*, 20 October 2008.
37. Ibid.
38. Glenn Collins, "Old Form of Delivery Thrives in New World of E-Commerce," *New York Times*, 24 December 1999.
39. O'Meara, op. cit. note 3, pp. 47–48; John Pucher and Ralph Buehler, "Making Cycling Irresistible: Lessons from the Netherlands, Denmark, and Germany," *Transport Reviews*, vol. 28, issue 4 (July 2008), pp. 495–528.
40. Pucher and Buehler, op. cit. note 39.
41. Cornelia Dean, "Bicycle Evangelist with the Wind Now at His Back," *New York Times*, 13 January 2009.
42. O'Meara, op. cit. note 3, pp. 47–48; Fietsberaad, "Amsterdam: for the First Time More Transfers by Bike than by Car," at [www.fietsberaad.nl](http://www.fietsberaad.nl), 22 January 2009.
43. Walljasper, op. cit. note 16; Interface for Cycling Expertise (I-ce), "Bicycle Partnership Program," at [www.bikepartners.nl](http://www.bikepartners.nl), viewed 12 May 2009.
44. O'Meara, op. cit. note 3, pp. 47–48; Japan from author's personal observation.
45. Jonathan Weinert, Chaktan Ma, and Chris Cherry, "Transition to Electric Bikes in China: History and Key Reasons for Rapid Growth," *Transportation*, vol. 34, no. 3 (May 2007), pp. 301–18; Austin Ramzy, "On the Streets of China, Electric Bikes Are Swarming," *Time*, 14 June 2009; "India 2007: LEVs to Grow to 70,000 Units," *Bike Europe*, at [www.bike-eu.com](http://www.bike-eu.com), 15 May 2008; Vietnam News Agency, "Helmet Aversion, Petrol Boost Bicycle Sales," *Viet Nam News*, 8 October 2007; Elliot Gluskin, Gluskin Townley Group, discussion with J. Matthew Roney, Earth Policy Institute, 16 June 2009; Jack Oortwijn, "E-Bikes Beat the Crisis," *Bike Europe*, 8 April 2009.
46. Sunita Narain, "The Flush Toilet is Ecologically Mindless," *Down to Earth*, 28 February 2002, pp. 28–32; dead zones from Robert J. Diaz and Rutger Rosenberg, "Spreading Dead Zones and Consequences for Marine Ecosystems," *Science*, vol. 321 (15 August 2008), pp. 926–29; World Health Organization (WHO), *World Health Report 2007* (Geneva: 2007), p. 4; U.N. Food and Agriculture Organization (FAO), *The State of Food Insecurity in the World 2005* (Rome: 2005).
47. Narain, op. cit. note 46.
48. Ibid.
49. U.S. Environmental Protection Agency (EPA), "Water Efficiency Technology Factsheet—Composting Toilets" (Washington, DC: September 1999); Jack Kieffer, Appalachia—Science in the Public Interest, *Humanure: Preparation of Compost from the Toilet for Use in the Garden* (Mount Vernon, KY: ASPI Publications, 1998).
50. EPA, op. cit. note 49; EPA, "Wastewater Virtual Tradeshow Technologies," at [www.epa.gov/region1/assistance/ceitts/wastewater/techs.html](http://www.epa.gov/region1/assistance/ceitts/wastewater/techs.html),

- updated 14 April 2009; people lacking sanitation from WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation, *Progress on Drinking Water and Sanitation: Special Focus on Sanitation* (Geneva and New York: 2008), p. 2.
51. Rose George, "Yellow is the New Green," (editorial), *New York Times*, 27 February 2009.
  52. Tony Sitathan, "Bridge Over Troubled Waters," *Asia Times*, 23 August 2002; "Singapore Opens Fourth Recycling Plant to Turn Sewage into Water," *Associated Press*, 12 July 2005; Randal C. Archibold, "From Sewage, Added Water for Drinking," *New York Times*, 27 November 2007; Randal C. Archibold, "Los Angeles Eyes Sewage as a Source of Water," *New York Times*, 16 May 2008.
  53. Peter H. Gleick, *The World's Water 2004–2005: The Biennial Report on Freshwater Resources* (Washington, DC: Island Press, 2004), p. 149.
  54. Ibid.
  55. "Farming in Urban Areas Can Boost Food Security," *FAO Newsroom*, 3 June 2005.
  56. Ibid.
  57. Jac Smit, "Urban Agriculture's Contribution to Sustainable Urbanisation," *Urban Agriculture*, August 2002, p. 13; Hubert de Bon, "Dry and Aquatic Peri-urban and Urban Horticulture in Hanoi, Vietnam," in René van Veenhuizen, ed., *Cities Farming for the Future—Urban Agriculture for Green and Productive Cities* (Philippines: ETC-Urban Agriculture, 2006), pp. 338–39.
  58. Smit, op. cit. note 57, p. 13; pond coverage from Nitai Kundu et al., "Planning for Aquatic Production in East Kolkata Wetlands," in van Veenhuizen, op. cit. note 57, pp. 408–09; fish production from Stuart Bunting et al., "Urban Aquatic Production," in van Veenhuizen, op. cit. note 57, p. 386.
  59. Smit, op. cit. note 57, p. 12.
  60. "Gardening for the Poor," *FAO Newsroom*, 2004; P. Bradley and C. Marulanda, "A Study on Microgardens That Help Reduce Global Poverty and Hunger," *Acta Horticulturae* (ISHS), vol. 742 (2007), pp. 115–23.
  61. Katherine H. Brown and Anne Carter, *Urban Agriculture and Community Food Security in the United States: Farming from the City Center to the Urban Fringe* (Venice, CA: Community Food Security Coalition, October 2003), p. 10.
  62. Ibid., p. 7.
  63. Ibid.
  64. U.N. Population Division, op. cit. note 3; U.N. Population Division, op. cit. note 2, p. 1.
  65. Hari Srinivas, "Defining Squatter Settlements," Global Development Research Center Web site, at [www.gdrc.org/uem/define-squatter.html](http://www.gdrc.org/uem/define-squatter.html), viewed 9 August 2005.
  66. Ibid.
  67. O'Meara, op. cit. note 3, p. 39.
  68. Rasna Warah, *The Challenge of Slums: Global Report on Human Settlements 2003* (New York: U.N. Human Settlements Programme, 2003).
  69. Srinivas, op. cit. note 65.
  70. E. O. Wilson, *Biophilia* (Cambridge, MA: Harvard University Press,

- 1984); S. R. Kellert and E. O. Wilson, eds., *The Biophilia Hypothesis* (Washington, DC: Island Press, 1993).
71. Theodore Roszak, Mary Gomes, and Allen Kanner, eds., *Restoring the Earth, Healing the Mind* (San Francisco: Sierra Club Books, 1995).
  72. American Public Transportation Association (APTA), "Unlinked Passenger Trips by Mode (Millions)," in *2009 Public Transportation Fact Book, Part 2: Historical Tables* (Washington, DC: April 2009), pp. 1–2; APTA, *Public Transportation Ridership Report: Fourth Quarter 2008* (Washington, DC: 5 March 2009).
  73. Ding Guangwei and Li Shishun, "Analysis of Impetuses to Change of Agricultural Land Resources in China," *Bulletin of the Chinese Academy of Sciences*, vol. 13, no. 1 (1999).
  74. Ayres, McHenry & Associates, "Survey of Metro Atlanta Registered Voters Regarding Transportation Issues," conducted on behalf of Transit Planning Board (Alexandria, VA: March 2008); Molly O'Meara Sheehan, *City Limits: Putting the Breaks on Sprawl*, Worldwatch Paper 156 (Washington, DC: Worldwatch Institute, June 2001), p. 11; David Schrank and Tim Lomax, *2005 Urban Mobility Study* (College Station, TX: Texas Transportation Institute, May 2005); Luc Nadal, "Bike Sharing Sweeps Paris Off Its Feet," *Sustainable Transport*, fall 2007, pp. 8–13.
  75. Jim Motavalli, "The High Cost of Free Parking," *E: The Environmental Magazine*, March–April 2005; Donald Shoup, *The High Cost of Free Parking* (Chicago: American Planning Association Planners Press, 2005), p. 591; Daniel B. Klein, "Free Parking Versus Free Markets," *The Independent Review*, vol. XI, no. 2 (fall 2006), pp. 289–97.
  76. O'Meara, op. cit. note 3, p. 49; Donald C. Shoup, "Congress Okays Cash Out," *Access*, fall 1998, pp. 2–8.
  77. Libby Nelson, "Broadway's Car-free Zones: This Space for Rent," *New York Times*, 9 July 2009; "Paris to Cut City Centre Traffic," *BBC News*, 15 March 2005; J. H. Crawford, "Carfree Places," at [www.carfree.com](http://www.carfree.com), viewed 17 August 2007; see also J. H. Crawford, *Carfree Cities* (Utrecht, Netherlands: International Books, July 2000).
  78. Yuri Kageyama, "Cars No Longer Coveted by Young," *Japan Times*, 4 January 2009; Japan Automobile Manufacturers Association, Inc., *Motor Vehicle Statistics of Japan 2008* (Tokyo: 2008), p. 8; Japan Automobile Manufacturers Association, Inc., "Forecast for Vehicle Demand 2009," at [www.jama-english.jp/statistics/forecast/2009/081218.html](http://www.jama-english.jp/statistics/forecast/2009/081218.html), 18 December 2008; European Automobile Manufacturers' Association, "Passenger Cars: European Market at –4.9% in May," press release (Brussels: 16 June 2009); Bill Heenan, Steel Recycling Institute, discussion with J. Matthew Roney, Earth Policy Institute, 20 July 2009.
  79. Kageyama, op. cit. note 78.
  80. City of New York, *PlaNYC Progress Report 2009* (New York: Mayor's Office of Long-Term Planning & Sustainability, 2009), pp. 3–4, 30, 35, 38; City of New York, Mayor's Office of Operations, "PlaNYC/Sustainability Reports," at [www.nyc.gov/html/ops/planyc/html/home/home.shtml](http://www.nyc.gov/html/ops/planyc/html/home/home.shtml), viewed 16 June 2009.
  81. Kitson & Partners, "Babcock Ranch Florida—Embracing Nature," at [www.babcockranchflorida.com/nature.asp](http://www.babcockranchflorida.com/nature.asp), viewed 16 June 2009; Michael Grunwald, "A Solar-Powered Solution to Florida Sprawl," *Time*, 9 April



- 2009; Sydney Kitson, discussion with author, 14 May 2009.
82. Glover Park Group, "First Solar-Powered City to Fuel Clean Industry, Economic Recovery," press release (Washington, DC: 9 April 2009); Kitson & Partners, op. cit. note 81.
  83. Kevin Bullis, "A Zero-Emissions City in the Desert," *Technology Review* (March/April 2009), pp. 56–63.
  84. Ibid.
  85. Adam Federman, "Roadkill: How NYC's Congestion Pricing Plan Crashed," *Earth Island Journal*, summer 2008, pp. 25–30; Robin Pogrebin, "Visions of Manhattan: For the City, 100-Year Makeovers," *New York Times*, 4 November 2006.
  86. Federman, op. cit. note 85; Partnership for New York City, *Growth or Gridlock? The Economic Case for Traffic Relief and Transit Improvement for a Greater New York* (New York: December 2006), pp. 2–4.

### Chapter 7. Eradicating Poverty and Stabilizing Population

1. U.N. General Assembly, "United Nations Millennium Declaration," resolution adopted by the General Assembly, 8 September 2000; World Bank, *Global Monitoring Report 2007: Millennium Development Goals* (Washington, DC: 2007), p. 39; World Bank, *Global Monitoring Report 2009: A Development Emergency* (Washington, DC: 2009), p. 17.
2. World Bank, "Millennium Development Goals—Country Tables," at [www.developmentgoals.org](http://www.developmentgoals.org), updated April 2009; U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009.
3. World Bank, op. cit. note 2; U.N. Population Division, op. cit. note 2; Jeffrey D. Sachs, "India Takes the Lead," *Korea Herald*, 4 August 2004; International Monetary Fund (IMF), *World Economic Outlook*, electronic database, [www.imf.org](http://www.imf.org), updated April 2009.
4. UNESCO, *Overcoming Inequality: Why Governance Matters, Education for All Global Monitoring Report 2009* (Paris: 2008), p. 195; Sara Miller Llana, "Brazil Becomes Antipoverty Showcase," *Christian Science Monitor*, 13 November 2008; World Bank, op. cit. note 2; U.N. Population Division, op. cit. note 2.
5. U.N. Statistics Division, *Millennium Development Goals Indicators*, electronic database, at [mdgs.un.org/unsd/mdg/Data.aspx](http://mdgs.un.org/unsd/mdg/Data.aspx), updated 14 July 2009; World Bank, *Global Monitoring Report 2008: MDGs and the Environment* (Washington, DC: 2008), p. 2.
6. World Bank, *Global Economic Prospects: Commodities at a Crossroads 2009* (Washington, DC: 2009), pp. 11–12; World Bank, *Poverty Data: A Supplement to World Development Indicators 2008* (Washington, DC: 2008), p. 1.
7. U.N. Population Division, op. cit. note 2; G-8 leaders, "Gleneagles Communiqué on Africa, Climate Change, Energy and Sustainable Development," document from G-8 Summit, Gleneagles, Scotland, July 2005; fragile states from World Bank, *Global Monitoring Report 2007*, op. cit. note 1, p. 4.
8. U.N. General Assembly, op. cit. note 1.
9. World Bank, *Global Monitoring Report 2009*, op. cit. note 1, p. 14; U.N. Food and Agriculture Organization, "1.02 Billion People Hungry," press

- release (Rome: 19 June 2009); U.S. Department of Agriculture (USDA), *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 12 May 2009; USDA, *Feedgrains Database*, electronic database at [www.ers.usda.gov/Data/feedgrains](http://www.ers.usda.gov/Data/feedgrains), updated 19 May 2009; U.N. Population Division, op. cit. note 2.
10. UNESCO, op. cit. note 4, p. 65.
  11. Martha Campbell et al., "Return of the Population Growth Factor," *Science*, vol. 315 (16 March 2007), pp. 1501–02; Martha Campbell, discussion with Janet Larsen, Earth Policy Institute, 8 October 2007; All Party Parliamentary Group on Population Development and Reproductive Health, *Return of the Population Growth Factor: Its Impact on the Millennium Development Goals* (London: Her Majesty's Stationery Office, January 2007), pp. 1–9.
  12. World Bank, *Global Monitoring Report 2009*, op. cit. note 1, p. 19; Hilaire A. Mputu, *Literacy and Non-Formal Education in the E-9 Countries* (Paris: UNESCO, 2001), p. 5; Polly Curtis, "Lack of Education 'a Greater Threat than Terrorism': Sen," *Guardian* (London), 28 October 2003.
  13. Paul Blustein, "Global Education Plan Gains Backing," *Washington Post*, 22 April 2002; World Bank, "World Bank Announces First Group of Countries for 'Education For All' Fast Track," press release (Washington, DC: 12 June 2002); Gene Sperling, "The G-8—Send 104 Million Friends to School," *Bloomberg News*, 20 June 2005.
  14. United Nations, *Millennium Development Goals Report 2008* (New York: 2008), p. 14; World Bank, *Global Monitoring Report 2009*, op. cit. note 1, Annex.
  15. Gene Sperling, "Toward Universal Education," *Foreign Affairs*, September/October 2001, pp. 7–13.
  16. Gene Sperling, "Educate Them All," *Washington Post*, 20 April 2002.
  17. U.K. Treasury, *From Commitment to Action: Education* (London: Department for International Development, September 2005).
  18. UNESCO, *EFA Global Monitoring Report 2007: Strong Foundations* (Paris: 2006), p. 2; U.N. Commission on Population and Development, Thirty-sixth Session, Population, Education, and Development, press releases, 31 March–4 April 2003; UNESCO, "Winners of UNESCO Literacy Prizes 2003," press release, 27 May 2003.
  19. George McGovern, *The Third Freedom: Ending Hunger in Our Time* (New York: Simon & Schuster: 2001), chapter 1.
  20. Jeffrey Sachs, "A New Map of the World," *The Economist*, 22 June 2000; George McGovern, "Yes We CAN Feed the World's Hungry," *Parade*, 16 December 2001.
  21. McGovern, op. cit. note 20.
  22. Ibid.
  23. Ibid.
  24. World Bank, *Global Monitoring Report 2009*, op. cit. note 1, Annex; UNICEF, "Under-five Mortality Rate," at [www.childinfo.org/mortalityunderfive.php](http://www.childinfo.org/mortalityunderfive.php), updated January 2009.
  25. World Bank, *Global Monitoring Report 2009*, op. cit. note 1, p. 72.
  26. Mustaque Chowdhury, *Health Workforce for TB Control by DOTS: The BRAC Case, Joint Learning Initiative Working Paper 5-2* (Global Health Trust, 2004).

27. Jeffrey D. Sachs and the Commission on Macroeconomics and Health, *Macroeconomics and Health: Investing in Health for Economic Development* (Geneva: World Health Organization (WHO), 2001); “UNICEF Lists Top Causes of Child Deaths,” *Reuters*, 13 September 2007; Ruth Levine and the What Works Working Group, *Millions Saved: Proven Successes in Global Health* (Washington, DC: Center for Global Development, 2004).
28. Bill and Melinda Gates Foundation, “Global Health Program Fact Sheet” (Seattle, WA: 2009).
29. John Donnelly, “U.S. Seeks Cuts in Health Programs Abroad,” *Boston Globe*, 5 February 2003.
30. Joint United Nations Programme on HIV/AIDS (UNAIDS), *Report on the Global AIDS Epidemic 2008* (Geneva: August 2008), pp. 15–16, 30.
31. Nita Bhalla, “Teaching Truck Drivers About AIDS,” *BBC*, 25 June 2001; C. B. S. Venkataramana and P. V. Sarada, “Extent and Speed of Spread of HIV Infection in India Through the Commercial Sex Networks: A Perspective,” *Tropical Medicine and International Health*, vol. 6, no. 12 (December 2001), pp. 1,040–61, cited in “HIV Spread Via Female Sex Workers in India Set to Increase Significantly by 2005,” *Reuters Health*, 26 December 2001.
32. Mark Covey, “Target Soldiers in Fight Against AIDS Says New Report,” press release (London: Panos Institute, 8 July 2002); “Free Condoms for Soldiers,” *South Africa Press Association*, 5 August 2001; HIV prevalence rate from UNAIDS, op. cit. note 30, p. 215.
33. Condoms needed from Population Action International, “Why Condoms Count in the Era of HIV/AIDS,” fact sheet (Washington, DC: 2008); cost per condom and condom distribution from United Nations Population Fund (UNFPA), *Donor Support for Contraceptives and Condoms for STI/HIV Prevention 2007* (New York: 2008).
34. Nada Chaya and Kai-Ahset Amen, with Michael Fox, *Condoms Count: Meeting the Need in the Era of HIV/AIDS* (Washington, DC: Population Action International, 2002); cost per condom from UNFPA, op. cit. note 33.
35. UNAIDS, “Global Facts and Figures,” fact sheet (Geneva: August 2008); UNAIDS, op. cit. note 30, p. 135.
36. “AIDS Summit: The Economics of Letting People Die,” *Star Tribune*, 16 July 2003.
37. Sachs and Commission on Macroeconomics and Health, op. cit. note 27; WHO, “Smallpox,” fact sheet at [www.who.int](http://www.who.int), viewed 10 October 2005.
38. WHO, “Polio Eradication: Now More Than Ever, Stop Polio Forever,” at [www.who.int/features/2004/polio/en](http://www.who.int/features/2004/polio/en), viewed 11 June 2009; Petina Dixon, Rotary International, discussion with Jignasha Rana, Earth Policy Institute, 6 July 2009; Bill and Melinda Gates Foundation, “Financial Innovation Will Buy Vaccine to Help Eradicate Polio Worldwide,” press release (Seattle, WA: 29 April 2003).
39. “Wild Poliovirus 2000–2009,” in WHO Global Polio Eradication Initiative, “Wild Poliovirus Weekly Update,” at [www.polioeradication.org](http://www.polioeradication.org), updated 3 June 2009; Donald G. McNeil, Jr., “Mecca Pilgrims May Be Spreading Polio, Experts Say,” *New York Times*, 11 February 2005; Nigeria from WHO, *Global Polio Eradication Initiative: Annual Report 2006* (Geneva: 2007), p. 6.

40. “Wild Poliovirus 2000–2009,” op. cit. note 39; “Pakistan Polio Drive is Suspended,” *BBC News*, 8 August 2007; Isambard Wilkinson, “Taliban Blocks UN Polio Treatment in Pakistan,” *Telegraph* (London), 27 March 2009.
41. Declan Butler, “\$630-Million for Push to Eradicate Polio,” *Nature News*, 21 January 2009; Barack H. Obama, “Remarks by the President on a New Beginning,” speech at Cairo University, Cairo, Egypt, 4 June 2009.
42. Michele Barry, “The Tail of Guinea Worm—Global Eradication Without a Drug or Vaccine,” *New England Journal of Medicine*, vol. 356, no. 25 (21 June 2007), pp. 2,561–64.
43. “Grants Push Guinea Worm to All-Time Low,” news release (Atlanta, GA: The Carter Center, 20 January 2009); The Carter Center, “Distribution by Country of 4,647 Cases of Indigenous Cases of Dracunculiasis Reported During 2008,” at [www.cartercenter.org/health/guinea\\_worm/index.html](http://www.cartercenter.org/health/guinea_worm/index.html), viewed 13 May 2009.
44. Tobacco deaths from WHO, “Chronic Obstructive Pulmonary Disease (COPD),” fact sheet (Geneva: November 2006); “The Tobacco Epidemic: A Crisis of Startling Dimensions,” in *Message from the Director-General of the World Health Organization for World No-Tobacco Day 1998*, at [www.who.int](http://www.who.int); air pollution from WHO, “Air Pollution,” fact sheet 187 (Geneva: rev. September 2000).
45. Alison Langley, “Anti-Smoking Treaty Is Adopted by 192 Nations,” *New York Times*, 22 May 2003; information on WHO Tobacco Free Initiative at [www.who.int/tobacco/index.cfm](http://www.who.int/tobacco/index.cfm); treaty goals and Bloomberg from Alexi A. Wright and Ingrid T. Katz, “Tobacco Tightrope—Balancing Disease Prevention and Economic Development in China,” *New England Journal of Medicine*, vol. 356, no. 15 (12 April 2007), pp. 1,493–96.
46. Cigarette consumption from USDA, *Production, Supply and Distribution*, op. cit. note 9, and from Tom Capehart, *Tobacco Outlook* (Washington, DC: USDA, Economic Research Service (ERS), 24 April 2007); per capita estimates made with population from U.N. Population Division, op. cit. note 2; Daniel Yee, “Smoking Declines in U.S.—Barely,” *CBS News*, 10 November 2004.
47. Betsy McKay, “Cigarette Tax Clouds Boosts Among States,” *Wall Street Journal*, 8 February 2009.
48. Cigarette consumption from USDA, *Production, Supply and Distribution*, op. cit. note 9, and from Capehart, op. cit. note 46; per capita estimates made using population from U.N. Population Division, op. cit. note 2.
49. “Smoking Bans Around the World,” *Reuters*, 10 January 2005; “New Zealand Stubs Out Smoking in Bars, Restaurants,” *Reuters*, 13 December 2004.
50. “Bangladesh Bans Smoking in Many Public Places,” *Reuters*, 15 March 2005; Italy from “Europeans Back Public Smoking Ban,” *BBC News*, 31 May 2006; “England Smoking Ban Takes Effect,” *BBC News*, 1 July 2007; France from Howard K. Koh et al., “Making Smoking History Worldwide,” *New England Journal of Medicine*, vol. 356, no. 15 (12 April 2007), pp. 1,496–98; “French Cafes Set to Ban Smoking,” *BBC News*, 28 December 2007; “Bulgaria Votes for Smoking Ban in Public Places,” *Reuters*, 15 May 2009; Ivana Sekularac, “Smoking Ban Angers Cafes, Smokers in Croatia,” *Reuters*, 6 May 2009.

51. "Connections between Diabetes and Alzheimer's Disease Explored," *Science Daily*, 11 May 2009.
52. "Cancer Most Lethal Illness in China Last Year," *China Daily*, 8 May 2007; Barbara Demick, "China Blames Pollution for Surge in Birth Defects," *Los Angeles Times*, 2 February 2009.
53. Sachs and Commission on Macroeconomics and Health, op. cit. note 27.
54. Countries with more than 1 million people and natural rate of increase of 0.4 percent or less retrieved from U.N. Population Division, *World Population Prospects: The 2008 Revision, Extended Dataset*, CD-ROM (New York: 9 April 2009).
55. Lesotho and Swaziland population data from Population Reference Bureau (PRB), *Datafinder*, electronic database, at www.prb.org.
56. U.N. Population Division, op. cit. note 54.
57. Ibid.
58. Ibid.
59. Program for Appropriate Technology in Health (PATH) and UNFPA, *Meeting the Need: Strengthening Family Planning Programs* (Seattle, WA: 2006), pp. 5–11; quote from All Party Parliamentary Group, op. cit. note 11, p. 22.
60. Janet Larsen, "Iran's Birth Rate Plummeting at Record Pace," in Lester R. Brown, Janet Larsen, and Bernie Fischlowitz-Roberts, *The Earth Policy Reader* (New York: W. W. Norton & Company, 2002), pp. 190–94.
61. Ibid.; see also Homa Hoodfar and Samad Assadpour, "The Politics of Population Policy in the Islamic Republic of Iran," *Studies in Family Planning*, March 2000, pp. 19–34, and Farzaneh Roudi, "Iran's Family Planning Program: Responding to a Nation's Needs," *MENA Policy Brief*, June 2002; Iran population growth rate from United Nations, *World Population Prospects: The 2004 Revision* (New York: 2005).
62. Larsen, op. cit. note 60.
63. Ibid.
64. Ibid.; population growth rates from PRB, *2005 World Population Data Sheet*, wall chart (Washington, DC: August 2005); U.N. Population Division, op. cit. note 2.
65. Pamela Polston, "Lowering the Boom: Population Activist Bill Ryerson is Saving the World—One 'Soap' at a Time," *Seven Days*, 21 August 2005.
66. Ibid.
67. Ibid.
68. Ibid.
69. Additional spending from J. Joseph Speidel et al., *Family Planning and Reproductive Health: The Link to Environmental Preservation* (San Francisco: Bixby Center for Reproductive Health and Research Policy, University of California, 2007), p. 10, and from J. Joseph Speidel, discussion with J. Matthew Roney, Earth Policy Institute, 16 October 2007.
70. PATH and UNFPA, op. cit. note 59, p. 18.
71. "Bangladesh: National Family Planning Program," *Family Planning Programs: Diverse Solutions for a Global Challenge* (Washington, DC: PRB, 1994); Speidel et al., op. cit. note 69, p. 10.
72. UNFPA, *The State of World Population 2004* (New York: 2004), pp. 14–15.
73. United Nations, op. cit. note 61; UNFPA, op. cit. note 72, p. 39.

74. Fund for Peace and *Foreign Policy*, "The Failed States Index," *Foreign Policy*, July/August issues, 2005–09; U.S. Department of State, "Background Note: Liberia," at www.state.gov/r/pa/ei/bgn/6618.htm, updated June 2009; María Cristina Caballero, "'Ma Ellen,' African Symbol of Hope, Returns to Harvard," *Harvard University Gazette*, 16 September 2006; "UN's Ban to Visit Liberia as Blue Helmets Prepare Pullout," *Agence France-Presse*, 20 April 2008.
75. Fund for Peace and *Foreign Policy*, op. cit. note 74; Fund for Peace, "Country Profile: Colombia," at www.fundforpeace.org, viewed 8 July 2009.
76. Commission on Weak States and U.S. National Security, *On the Brink: Weak States and U.S. National Security* (Washington, DC: Center for Global Development, 2004), p. 27.
77. The U.S. Commission on National Security in the 21st Century, *Road Map for National Security: Imperative for Change* (Washington, DC: February 2001), p. 53.
78. Commission on Weak States and U.S. National Security, op. cit. note 76, pp. 30–32.
79. Organisation for Economic Co-operation and Development (OECD), *Agricultural Policies in OECD Countries 2008: At a Glance* (Paris: 2008), p. 9; OECD, "Development Aid at its Highest Level Ever in 2008," press release (Paris: 30 March 2009); "The Hypocrisy of Farm Subsidies," *New York Times*, 1 December 2002.
80. "The Hypocrisy of Farm Subsidies," op. cit. note 79.
81. OECD, "Development Aid," op. cit. note 79; OECD, *OECD Statistics*, electronic database, at stats.oecd.org/wbos, updated 2009; "South Africa: Weaning States Off Subsidies," *Africa News*, 19 August 2005.
82. Julian Alston et al., *Impacts of Reductions in US Cotton Subsidies on West African Cotton Producers* (Boston: Oxfam America, 2007); OECD, op. cit. note 81; Elizabeth Becker, "U.S. Will Cut Farm Subsidies in Trade Deal," *New York Times*, 31 July 2004; Randy Schnepf, *U.S. Agricultural Policy Response to WTO Cotton Decision* (Washington, DC: Congressional Research Service, updated 8 September 2006).
83. Schnepf, op. cit. note 82; Randy Schnepf, *Brazil's WTO Case Against the U.S. Cotton Program: A Brief Overview* (Washington, DC: Congressional Research Service, 17 March 2009).
84. World Bank, *Global Economic Prospects*, op. cit. note 6, pp. 11–12.
85. "Ending the Cycle of Debt," *New York Times*, 1 October 2004; debt servicing from World Bank, *Little Data Book on External Debt in Global Development Finance 2007* (Washington, DC: 2007), p. 8; health care spending calculated from IMF, *World Economic and Financial Surveys: Regional Economic Outlook—Sub-Saharan Africa* (Washington, DC: September 2006), pp. 36, 43, from David Goldsbrough, "IMF Programs and Health Spending," presented at Global Conference on Gearing Macroeconomic Policies to Reverse the HIV/AIDS Epidemic, Brasilia, 20 November 2006, and from U.N. Population Division, *World Population Prospects: The 2006 Revision Population Database*, at esa.un.org/unpp, updated 2007.
86. "G8 Finance Ministers' Conclusions on Development," Pre Summit Statement by G-8 Finance Ministers, London, 10–11 June 2005; Oxfam Inter-

- national, "Gleneagles: What Really Happened at the G8 Summit?" *Oxfam Briefing Note* (London: 29 July 2005).
87. Oxfam International, "The View from the Summit—Gleneagles G8 One Year On," briefing note (Oxford, U.K.: June 2006).
  88. World Bank, *Global Monitoring Report 2009*, op. cit. note 1, p. 8; U.N. World Food Programme, "Financial Crisis and High Food Prices," fact sheet (Rome: updated 11 June 2009).
  89. World Bank, "Financial Crisis Could Trap 53 Million More People in Poverty," news release (Washington, DC: 12 February 2009); World Bank, *Global Economic Prospects*, op. cit. note 6, pp. 11–12; Robert Zoellick, "Seizing Opportunity from Crisis: Making Multilateralism Work," speech delivered at the Thomas Reuters Building, Canary Wharf, London, 31 March 2009.
  90. Costs of meeting social goals in Table 7–1 based on the following sources: universal primary education from U.K. Treasury, op. cit. note 17; adult literacy campaign is author's estimate; school lunch program from McGovern, op. cit. note 20; assistance to preschool children and pregnant women is author's estimate of extending the U.S.'s Women, Infants, and Children program, based on *ibid.*; reproductive health and family planning from Speidel et al., op. cit. note 69, and from Speidel, op. cit. note 69; universal basic health care from Sachs and Commission on Macroeconomics and Health, op. cit. note 27; closing the condom gap estimated from UNFPA, op. cit. note 33, and from Population Action International, op. cit. note 33.
  91. Sachs and Commission on Macroeconomics and Health, op. cit. note 27.
  92. Jeffrey D. Sachs, *The End of Poverty: Economic Possibilities for Our Time* (New York: Penguin Group, 2005).

### Chapter 8. Restoring the Earth

1. Craig A. Cox, "Conservation Can Mean Life or Death," *Journal of Soil and Water Conservation*, November/December 2004.
2. *Ibid.*
3. U.N. Food and Agriculture Organization (FAO), *The State of the World's Forests 2009* (Rome: 2009), pp. 109–15.
4. FAO, *ForesSTAT*, electronic database, at [faostat.fao.org](http://faostat.fao.org), updated 12 January 2009, using five-year averages; U.S. Environmental Protection Agency (EPA), *Municipal Solid Waste in the United States: 2007 Facts and Figures* (Washington, DC: 2008), p. 102.
5. FAO, op. cit. note 3, p. 129; Daniel M. Kammen, "From Energy Efficiency to Social Utility: Lessons from Cookstove Design, Dissemination, and Use," in José Goldemberg and Thomas B. Johansson, *Energy as an Instrument for Socio-Economic Development* (New York: U.N. Development Programme, 1995).
6. Kevin Porter, "Final Kakuma Evaluation: Solar Cookers Filled a Critical Gap," in Solar Cookers International, *Solar Cooker Review*, vol. 10, no. 2 (November 2004); "Breakthrough in Kenyan Refugee Camps," at [solarcooking.org/kakuma-m.htm](http://solarcooking.org/kakuma-m.htm), viewed 30 July 2007.
7. FAO, *Agriculture: Towards 2015/30, Technical Interim Report* (Geneva: Economic and Social Department, 2000), pp. 156–57.
8. Alliance for Forest Conservation and Sustainable Use, "WWF/World

- Bank Forest Alliance Launches Ambitious Program to Reduce Deforestation and Curb Illegal Logging," press release (New York: World Bank/WWF, 25 May 2005); WWF/World Bank Global Forest Alliance, *Annual Report 2005* (Gland, Switzerland, and Washington, DC: December 2006), p. 31.
9. Forest Stewardship Council (FSC), *Forest Stewardship Council: News & Notes*, vol. 7, issue 6 (July 2009); FSC, "Global FSC Certificates: Type and Distribution (March 2009)," PowerPoint Presentation, at [www.fsc.org](http://www.fsc.org), June 2009.
  10. A. Del Lungo, J. Ball, and J. Carle, *Global Planted Forests Thematic Study: Results and Analysis* (Rome: FAO Forestry Department, December 2006), p. 13; U.S. Department of Agriculture (USDA), *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 9 April 2009.
  11. R. James and A. Del Lungo, "Comparisons of Estimates of 'High Value' Wood With Estimates of Total Forest Plantation Production," in FAO, *The Potential for Fast-Growing Commercial Forest Plantations to Supply High Value Roundwood* (Rome: Forestry Department, February 2005), p. 24; plantation area in "Table 4. Total Planted Forest Area: Productive and Protective—61 Sampled Countries," in Del Lungo, Ball, and Carle, op. cit. note 10, pp. 66–70.
  12. Ashley T. Mattoon, "Paper Forests," *World Watch*, March/April 1998, pp. 20–28; USDA, op. cit. note 10.
  13. FAO, op. cit. note 7, p. 185; Chris Brown and D. J. Mead, eds., "Future Production from Forest Plantations," *Forest Plantation Thematic Paper* (Rome: FAO, 2001), p. 9.
  14. M. Davis et al., "New England—Acadian Forests," in Taylor H. Ricketts et al., eds., *Terrestrial Ecoregions of North America: A Conservation Assessment* (Washington, DC: Island Press, 1999); David R. Foster, "Harvard Forest: Addressing Major Issues in Policy Debates and in the Understanding of Ecosystem Process and Pattern," *LTER Network News: The Newsletter of the Long Term Ecological Network*, spring/summer 1996; U.S. Forest Service, "2006 Forest Health Highlights," various state sheets, at [fhm.fs.fed.us](http://fhm.fs.fed.us), viewed 2 August 2007.
  15. C. Csaki, "Agricultural Reforms in Central and Eastern Europe and the Former Soviet Union: Status and Perspectives," *Agricultural Economics*, vol. 22 (2000), pp. 37–54; Igor Shvytov, *Agriculturally Induced Environmental Problems in Russia*, Discussion Paper No. 17 (Halle, Germany: Institute of Agricultural Development in Central and Eastern Europe, 1998), p. 13.
  16. Se-Kyung Chong, "Anmyeon-do Recreation Forest: A Millennium of Management," in Patrick B. Durst et al., *In Search of Excellence: Exemplary Forest Management in Asia and the Pacific*, *Asia-Pacific Forestry Commission* (Bangkok: FAO Regional Office for Asia and the Pacific, 2005), pp. 251–59.
  17. *Ibid.*
  18. Turkish Foundation for Combating Soil Erosion, at [english.tema.org.tr](http://english.tema.org.tr), viewed 31 July 2007.
  19. Reed Funk, letter to author, 9 August 2005.
  20. U.S. Embassy, Niamey, Niger, "Niger: Greener Now Than 30 Years Ago," reporting cable circulated following national FRAME workshop, October

- 2006; Chris Reij, "More Success Stories in Africa's Drylands Than Often Assumed," presentation at Network of Farmers' and Agricultural Producers' Organisations of West Africa Forum on Food Sovereignty, 7–10 November 2006.
21. U.S. Embassy, op. cit. note 20; Reij, op. cit. note 20.
  22. Vattenfall, *Global Mapping of Greenhouse Gas Abatement Opportunities up to 2030: Forestry Sector Deep-Dive* (Stockholm: June 2007), p. 1.
  23. "Forest Area and Area Change," in FAO, op. cit. note 3, pp. 109–15.
  24. Johanna Son, "Philippines: Row Rages Over Lifting of Ban on Lumber Exports," *InterPress Service*, 17 April 1998; John Aglionby, "Philippines Bans Logging After Fatal Floods," *Guardian* (London), 6 December 2004; Republic of the Philippines, "President Okays Selective Lifting of Log Ban," press release (Manila: 7 March 2005).
  25. "Forestry Cuts Down on Logging," *China Daily*, 26 May 1998; Erik Eckholm, "China Admits Ecological Sins Played Role in Flood Disaster," *New York Times*, 26 August 1998; Erik Eckholm, "Stunned by Floods, China Hastens Logging Curbs," *New York Times*, 27 September 1998; Chris Brown, Patrick B. Durst, and Thomas Enters, *Forests Out of Bounds: Impacts and Effectiveness of Logging Bans in Natural Forests in Asia-Pacific* (Bangkok, Thailand: FAO Regional Office for Asia Pacific, 2001); John Aglionby, "Philippines Bans Logging After Fatal Floods," *Guardian* (London), 6 December 2004.
  26. Geoffrey Lean, "A Disaster to Take Everyone's Breath Away," *The Independent* (London), 24 July 2006; Daniel Nepstad, "Climate Change and the Forest," *Tomorrow's Amazonia: Using and Abusing the World's Last Great Forests* (Washington, DC: The American Prospect, September 2007); S. S. Saatchi et al., "Distribution of Aboveground Live Biomass in the Amazon Rainforest," *Global Change Biology*, vol. 13, no. 4 (April 2007), pp. 816–37.
  27. Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), pp. 541–84; Vattenfall, op. cit. note 22, p. 16; sequestration per tree calculated assuming 500 trees per hectare, from U.N. Environment Programme (UNEP), Billion Tree Campaign, "Fast Facts," at [www.unep.org/billiontreecampaign](http://www.unep.org/billiontreecampaign), viewed 10 October 2007; growing period from Robert N. Stavins and Kenneth R. Richards, *The Cost of U.S. Forest Based Carbon Sequestration* (Arlington, VA: Pew Center on Global Climate Change, January 2005), p. 10.
  28. Carbon sequestration potential based on IPCC, op. cit. note 27, pp. 543, 559.
  29. Johan Eliasch, *Climate Change: Financing Global Forests* (London: The Stationary Office Limited for Her Majesty's Stationery Office, 2008), pp. xvi–xvii, 69–80; McKinsey & Company, *Pathways to a Low Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve* (London: 2009).
  30. UNEP, Billion Tree Campaign, at [www.unep.org/billiontreecampaign](http://www.unep.org/billiontreecampaign), viewed 13 July 2009; carbon sequestration assuming that three fourths of trees will be in tropics and one fourth in temperate regions, using seques-

- tration rates in Vattenfall, op. cit. note 22, p. 16; UNEP, "Tree Planting Campaign Hits Four Billion Mark," press release (Nairobi: 10 June 2009).
31. UNEP, "The State of Paraná in Brazil Undertakes a Major Reforestation Project," at [www.unep.org/billiontreecampaign/CampaignNews](http://www.unep.org/billiontreecampaign/CampaignNews), viewed 12 October 2007; UNEP, "31 July—The Greenest Day of the Calendar in India and a Tree Planting Record by 600,000 Volunteers," at [www.unep.org/Documents.Multilingual](http://www.unep.org/Documents.Multilingual), viewed 12 October 2007.
  32. Chang-Ran Kim, "Tokyo Turns to Rooftop Gardens to Beat the Heat," *Reuters*, 7 August 2002; Washington, D.C., program from Casey Trees, at [www.caseytrees.org](http://www.caseytrees.org), viewed 17 June 2009.
  33. Kathy Wolf, "Urban Forest Values: Economic Benefits of Trees in Cities," fact sheet (Seattle, WA: Center for Urban Horticulture, November 1998); Greg McPherson et al., "Municipal Forest Benefits and Costs in Five US Cities," *Journal of Forestry*, December 2005, pp. 411–16.
  34. "The Great North American Dust Bowl: A Cautionary Tale," in Secretariat of the U.N. Convention to Combat Desertification, *Global Alarm: Dust and Sandstorms from the World's Drylands* (Bangkok: 2002), pp. 77–121.
  35. Jeffrey Zinn, *Conservation Reserve Program: Status and Current Issues* (Washington, DC: Congressional Research Service, 8 May 2001); USDA, Economic Research Service, *Agri-Environmental Policy at the Crossroads: Guideposts on a Changing Landscape* (Washington, DC: 2001).
  36. USDA, Natural Resources Conservation Service, *CORE4 Conservation Practices Training Guide: The Common Sense Approach to Natural Resource Conservation* (Washington, DC: August 1999); Rolf Derpsch, "Frontiers in Conservation Tillage and Advances in Conservation Practice," in D. E. Stott, R. H. Mohtar, and G. C. Steinhardt, eds., *Sustaining the Global Farm*, selected papers from the 10th International Soil Conservation Organization Meeting, at Purdue University and USDA-ARS National Soil Erosion Research Laboratory, 24–29 May 1999 (Washington, DC: 2001), pp. 248–54.
  37. Rolf Derpsch and Theodor Friedrich, "Development and Current Status of No-till Adoption in the World," presentation for International Soil Tillage Research Conference, Izmir, Turkey, 16 June 2009; Conservation Technology Information Center, Purdue University, "National Tillage Trends (1990–2004)," from the *2004 National Crop Residue Management Survey Data*; FAO, *Intensifying Crop Production with Conservation Agriculture*, at [www.fao.org/ag](http://www.fao.org/ag), viewed 20 May 2003.
  38. FAO, op. cit. note 37.
  39. Souhail Karam, "Drought-Hit North Africa Seen Hunting for Grains," *Reuters*, 15 July 2005.
  40. Godwin Nnanna, "Africa's Message for China," *China Dialogue*, 18 April 2007; International Institute for Sustainable Development, "African Regional Coverage Project," *Eighth African Union Summit—Briefing Note*, vol. 7, issue 2 (7 February 2007), p. 8; Federal Republic of Nigeria, Ministry of Environment, "Green Wall Sahara Programme," at [www.greenwallsahara.org](http://www.greenwallsahara.org), viewed 17 October 2007; Anne Woodfine and Sandrine Jauffret, *Scope and Pre-Feasibility Study on the Great Green Wall for the Sahara and Sahel Initiative* (Hemel Hempstead, U.K.: HTPSE Ltd., June 2009).

41. Evan Ratliff, "The Green Wall of China," *Wired*, April 2003; Wang Yan, "China's Forest Shelter Project Dubbed 'Green Great Wall,'" *Xinhua News Agency*, 9 July 2006; Sun Xiufang and Ralph Bean, *China Solid Wood Products Annual Report 2002* (Beijing: USDA, 2002); Jonathan Watts, "China Suspends Reforestation Project over Food Shortage Fears," *Guardian* (London), 23 June 2009.
42. Author's discussion with officials of Helin County, Inner Mongolia (Nei Monggol), 17 May 2002.
43. *Ibid.*
44. U.S. Embassy, *Grapes of Wrath in Inner Mongolia* (Beijing: May 2001).
45. A. Banerjee, "Dairying Systems in India," *World Animal Review*, vol. 79/2 (Rome: FAO, 1994).
46. Rattan Lal, "Soil Carbon Sequestration Impacts on Global Climate Change and Food Security," *Science*, vol. 304 (11 June 2004), pp. 1,623–27.
47. Partnership for Interdisciplinary Studies of Coastal Oceans, *The Science of Marine Reserves*, 2nd ed., International Version (Oregon and California: 2007).
48. *Ibid.*
49. W. Renema et al., "Hopping Hotspots: Global Shifts in Marine Biodiversity," *Science*, vol. 321, no. 5889 (1 August 2008), pp. 654–57.
50. "About the Papahānaumokuākea Marine National Monument," at [hawaii reef.noaa.gov/about/welcome.html](http://hawaii reef.noaa.gov/about/welcome.html), viewed 8 May 2009; John M. Broder, "Bush to Protect Vast New Pacific Tracts," *New York Times*, 6 January 2009; "Establishment of the Marianas Trench Marine National Monument," Proclamation 8335, "Establishment of the Pacific Remote Islands Marine National Monument," Proclamation 8336, and "Establishment of the Rose Atoll Marine National Monument," Proclamation 8337, *Federal Register*, Vol. 74, No. 7 (12 January 2009); U.S. Fish and Wildlife Service, "Establishment of the Northwestern Hawaiian Islands Marine National Monument," at [www.fws.gov/midway/presidential%20proclamation.pdf](http://www.fws.gov/midway/presidential%20proclamation.pdf), viewed 11 May 2009.
51. Population Reference Bureau, *Datafinder*, electronic database, at [www.prb.org/DataFinder.aspx](http://www.prb.org/DataFinder.aspx), updated 2008; Emma Young, "Ocean Biodiversity: Depths of Ignorance," *New Scientist*, 12 April 2008.
52. Andrew Balmford et al., "The Worldwide Costs of Marine Protected Areas," *Proceedings of the National Academy of Sciences*, vol. 101, no. 26 (29 June 2004), pp. 9,694–97; Tim Radford, "Marine Parks Can Solve Global Fish Crisis, Experts Say," *Guardian* (London), 15 June 2004.
53. Balmford et al., op. cit. note 52; Radford, op. cit. note 52.
54. Radford, op. cit. note 52; Richard Black, "Protection Needed for 'Marine Serengetis,'" *BBC News*, 4 August 2003; Balmford et al., op. cit. note 52.
55. American Association for the Advancement of Science (AAAS), "Leading Marine Scientists Release New Evidence that Marine Reserves Produce Enormous Benefits within Their Boundaries and Beyond," press release (Washington, DC: 12 March 2001); "Scientific Consensus Statement on Marine Reserves and Marine Protected Areas," presented at the AAAS annual meeting, 15–20 February 2001.
56. AAAS, op. cit. note 55; "Scientific Consensus Statement," op. cit. note 55, p. 2.
57. R. J. Diaz, J. Nestlerode, and M. L. Diaz, "A Global Perspective on the

- Effects of Eutrophication and Hypoxia on Aquatic Biota," in G. L. Rupp and M. D. White, eds., *Proceedings of the 7th Annual Symposium on Fish Physiology, Toxicology and Water Quality, Estonia, 12–15 May 2003* (Athens, GA: EPA, Ecosystems Research Division, 2004); UNEP, *GEO Yearbook 2003* (Nairobi: 2004); R. J. Diaz and R. Rosenberg, "Spreading Dead Zones and Consequences for Marine Ecosystems," *Science*, vol. 321 (15 August 2008), pp. 926–29.
58. WWF, *Hard Facts, Hidden Problems: A Review of Current Data on Fishing Subsidies* (Washington, DC: 2001), pp. ii; Balmford et al., op. cit. note 52; Radford, op. cit. note 52; fishery subsidy value includes "bad" subsidies and fuel subsidies as estimated in Fisheries Center, University of British Columbia, *Catching More Bait: A Bottom-Up Re-Estimation of Global Fisheries Subsidies* (2nd Version) (Vancouver, BC: 2006), p. 21.
59. U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009.
60. World Wide Fund for Nature (WWF), "Problems: Inadequate Protection," at [www.panda.org](http://www.panda.org), viewed 8 May 2009.
61. Conservation International, "Biodiversity Hotspots," at [www.biodiversity hotspots.org](http://www.biodiversity hotspots.org), viewed 8 May 2009.
62. U.S. Fish and Wildlife Service, "The Endangered Species Act of 1973," at [www.fws.gov/endangered](http://www.fws.gov/endangered), viewed 31 July 2007.
63. Table 8–1 from the following: planting trees to reduce flooding and conserve soil and protecting topsoil on cropland from Lester R. Brown and Edward C. Wolf, "Reclaiming the Future," in Lester R. Brown et al., *State of the World 1988* (New York: W. W. Norton & Company, 1988), p. 174, using data from FAO, *Fuelwood Supplies in the Developing Countries*, Forestry Paper 42 (Rome: 1983); planting trees to sequester carbon based on IPCC, op. cit. note 27, pp. 543, 559; restoring rangelands from UNEP, *Status of Desertification and Implementation of the United Nations Plan of Action to Combat Desertification* (Nairobi: 1991), pp. 73–92; restoring fisheries from Balmford et al., op. cit. note 52; protecting biological diversity from World Parks Congress, *Recommendations of the Vth IUCN World Parks Congress* (Durban, South Africa: 2003), pp. 17–19, and from World Parks Congress, "The Durban Accord," at [www.iucn.org/themes/wcpa](http://www.iucn.org/themes/wcpa), viewed 19 October 2007; stabilizing water tables is author's estimate.
64. Chong, op. cit. note 16.
65. Brown and Wolf, op. cit. note 63, p. 175.
66. Runsheng Yin et al., "China's Ecological Rehabilitation: The Unprecedented Efforts and Dramatic Impacts of Reforestation and Slope Protection in Western China," in Woodrow Wilson International Center for Scholars, *China Environment Forum*, China Environment Series, Issue 7 (Washington, DC: 2005), pp. 17–32.
67. Brown and Wolf, op. cit. note 63, p. 176.
68. IPCC, op. cit. note 27, pp. 543, 559.
69. Brown and Wolf, op. cit. note 63, p. 173–74.
70. *Ibid.*, p. 174.
71. *Ibid.*
72. *Ibid.*
73. Restoring rangelands from UNEP, op. cit. note 63, pp. 73–92, with figures converted from 1990 to 2004 dollars using implicit price deflators from

- U.S. Department of Commerce, Bureau of Economic Analysis, "Table C.1. GDP and Other Major NIPA Aggregates," in *Survey of Current Business*, September 2005, p. D-48.
74. H. E. Dregne and Nan-Ting Chou, "Global Desertification Dimensions and Costs," in H. E. Dregne, ed., *Degradation and Restoration of Arid Lands* (Lubbock, TX: Texas Tech. University, 1992); restoring rangelands from UNEP, op. cit. note 63, pp. 73-92.
  75. Balmford et al., op. cit. note 52.
  76. World Parks Congress, *Recommendations*, op. cit. note 63, pp. 17-19; World Parks Congress, "The Durban Accord," op. cit. note 63.
  77. Irrigated cropland from FAO, *ResourceSTAT*, electronic database, at faostat.fao.org, updated April 2009.
  78. Jordan from Tom Gardner-Outlaw and Robert Engelman, *Sustaining Water, Easing Scarcity: A Second Update* (Washington, DC: Population Action International, 1997); Mexico from Sandra Postel, *Last Oasis* (New York: W. W. Norton & Company, 1997), pp. 150-51.
  79. Sandra Postel, *Pillar of Sand* (New York: W. W. Norton & Company, 1999), pp. 230-35; Mexico from Postel, op. cit. note 78, pp. 167-68.

#### Chapter 9. Feeding Eight Billion People Well

1. U.S. Department of Agriculture (USDA), *Production, Supply and Distribution (PS&D)*, electronic database, at www.fas.usda.gov/psdonline, updated 12 May 2009; USDA, *Feedgrains Database*, electronic database at www.ers.usda.gov/Data/feedgrains, updated 19 May 2009.
2. U.N. Food and Agriculture Organization (FAO), "FAO-OECD to Weigh Investments Against Hunger," press release (Rome: 4 May 2009); Shenggen Fan and Mark W. Rosegrant, *Investing in Agriculture to Overcome the World Food Crisis and Reduce Poverty and Hunger* (Washington, DC: International Food Policy Research Institute (IFPRI), June 2008).
3. USDA, *PS&D*, op. cit. note 1; U.N. Population Division, *World Population Prospects, The 2008 Revision Population Database*, electronic database, at esa.un.org/unpp, updated 11 March 2009.
4. USDA, *PS&D*, op. cit. note 1.
5. Historical data compiled by Worldwatch Institute from FAO, *Fertilizer Yearbook* (Rome: various years), and by Earth Policy Institute from International Fertilizer Industry Association (IFA), *IFADATA*, electronic database at www.fertilizer.org/ifa/ifadata/search, retrieved 3 February 2009; current data from Patrick Heffer, *Medium-Term Outlook for World Agriculture and Fertilizer Demand 2007/08 - 2012/13* (Paris: IFA, June 2008), p. 34, and from IFA, *Fertilizer Consumption 2007/08 - 2012/13 Country Reports* (Paris: June 2008), pp. 8, 19, 21.
6. Irrigation data for 1950-60 compiled from Lester R. Brown, "Eradicating Hunger: A Growing Challenge," in Lester R. Brown et al., *State of the World 2001* (New York: W. W. Norton & Company, 2001), pp. 52-53; data for 1961-2007 from FAO, *ResourceSTAT*, electronic database at faostat.fao.org, updated April 2009.
7. Lester R. Brown, *Increasing World Food Output: Problems and Prospects*, Foreign Agricultural Economic Report No. 25 (Washington, DC: USDA, Economic Research Service (ERS), 1965), pp. 13-14; L. T. Evans, *Crop*

- Evolution, Adaptation and Yield* (Cambridge, U.K.: Cambridge University Press, 1993), pp. 242-44.
8. USDA, *PS&D*, op. cit. note 1; Margriet F. Caswell et al., *Agricultural Biotechnology: An Economic Perspective* (Washington, DC: USDA, ERS, 1998), p. 19; Kenneth G. Cassman and Adam J. Liska, "Food and Fuel for All: Realistic or Foolish?" *Biofuels, Bioproducts and Biorefining*, vol. 1, no. 1 (2007), pp. 18-23.
  9. World Food Prize Foundation, "A World-Brand Name: Yuan Longping, The Father of Hybrid Rice," at www.worldfoodprize.org/laureates/yuan-spotlight.htm, viewed 15 July 2009.
  10. USDA, *PS&D*, op. cit. note 1; FAO, *FAOSTAT*, electronic database, at faostat.fao.org, updated June 2009.
  11. USDA, *PS&D*, op. cit. note 1.
  12. IFA, *IFADATA*, op. cit. note 5; IFA, *Country Reports*, op. cit. note 5, pp. 8, 19, 21; USDA, *PS&D*, op. cit. note 1; USDA, National Agricultural Statistics Service (NASS), *Crop Production 2008 Summary* (Washington, DC: January 2009), p. 5.
  13. USDA, *PS&D*, op. cit. note 1.
  14. Lester R. Brown, *Eco-Economy* (New York: W. W. Norton & Company, 2001), pp. 145-46; Thomas R. Sinclair, "Limits to Crop Yield?" in American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, *Physiology and Determination of Crop Yield* (Madison, WI: 1994), pp. 509-32; USDA, *PS&D*, op. cit. note 1.
  15. U.N. Population Division, op. cit. note 3; World Bank, "Malawi, Fertilizer Subsidies and the World Bank," at web.worldbank.org, viewed 14 July 2008; Celia W. Dugger, "Ending Famine, Simply by Ignoring the Experts," *New York Times*, 2 December 2007; USDA, *PS&D*, op. cit. note 1.
  16. Ben Block, "African Leaders Pursue 'Malawi Miracle'," *Eye on Earth*, at www.worldwatch.org, 26 May 2009.
  17. USDA, op. cit. note 12, pp. 5, 13.
  18. USDA, *PS&D*, op. cit. note 1; 1950 data from USDA, in Worldwatch Institute, *Signposts 2001*, CD-ROM (Washington, DC: 2001).
  19. Jorge Sanchez and Jiang Junyang, *China Grain and Feed Annual 2009* (Beijing: USDA, March 2009); USDA, *PS&D*, op. cit. note 1.
  20. A. Govindian, *India Grain and Feed Annual 2009* (New Delhi: USDA, February 2009); USDA, *PS&D*, op. cit. note 1; U.N. Population Division, op. cit. note 3.
  21. Richard Magleby, "Soil Management and Conservation," in USDA, *Agricultural Resources and Environmental Indicators 2003* (Washington, DC: February 2003), Chapter 4.2, p. 14.
  22. USDA, *PS&D*, op. cit. note 1; Randall D. Schnepf et al., *Agriculture in Brazil and Argentina* (Washington, DC: USDA ERS, 2001), pp. 8-10.
  23. Pedro Sanchez, "The Climate Change-Soil Fertility-Food Security Nexus," summary note (Bonn: IFPRI, 4 September 2001).
  24. Edward Cody, "Chinese Lawmakers Approve Measure to Protect Private Property Rights," *Washington Post*, 17 March 2007; Jim Yardley, "China Nears Passage of Landmark Property Law," *New York Times*, 9 March 2007; Zhu Keliang and Roy Prosterman, "From Land Rights to Economic Boom," *China Business Review*, July-August 2006.
  25. Land productivity from USDA, *PS&D*, op. cit. note 1, with pre-1961 data

- from USDA, in Worldwatch Institute, op. cit. note 18; water requirements for grain production from FAO, *Yield Response to Water* (Rome: 1979).
26. Water use from I. A. Shiklomanov, "Assessment of Water Resources and Water Availability in the World," *Report for the Comprehensive Assessment of the Freshwater Resources of the World* (St. Petersburg, Russia: State Hydrological Institute, 1998), cited in Peter H. Gleick, *The World's Water 2000–2001* (Washington, DC: Island Press, 2000), p. 53; Sandra Postel and Amy Vickers, "Boosting Water Productivity," in Worldwatch Institute, *State of the World 2004* (New York: W. W. Norton & Company, 2004), pp. 51–52.
  27. Wang Shucheng, discussion with author, Beijing, May 2004.
  28. FAO, *Crops and Drops* (Rome: 2002), p. 17; Alain Vidal, Aline Comeau, and Hervé Plusquellec, *Case Studies on Water Conservation in the Mediterranean Region* (Rome: FAO, 2001), p. vii.
  29. Postel and Vickers, op. cit. note 26, p. 53.
  30. Sandra Postel et al., "Drip Irrigation for Small Farmers: A New Initiative to Alleviate Hunger and Poverty," *Water International*, March 2001, pp. 3–13.
  31. Ibid.
  32. "Punjab's Depleting Groundwater Stagnates Agricultural Growth," *Down to Earth*, vol. 16, no. 5 (30 July 2007).
  33. R. Maria Saleth and Ariel Dinar, *Water Challenge and Institutional Response: A Cross-Country Perspective* (Washington, DC: World Bank, 1999), p. 6; Comisión Nacional del Agua (CONAGUA), *National Water Program 2007–2012* (Coyoacán, Mexico: February 2008), p. 71.
  34. World Bank and Swiss Agency for Development and Cooperation, Summary Report, Middle East and North Africa Regional Water Initiative Workshop on Sustainable Groundwater Management, Sana'a, Yemen, 25–28 June 2000, p. 19; Mei Xie, senior water resources specialist, World Bank Institute, e-mail to J. Matthew Roney, Earth Policy Institute, 10 July 2009.
  35. USDA, *PS&D*, op. cit. note 1; Cynthia Guven and Sherif Ibrahim, *Egypt Grain and Feed Annual 2009* (Cairo: USDA, March 2009); "Rice Cropped for Water," *China Daily*, 9 January 2002; National Bureau of Statistics of China, *Statistical Data*, electronic database, at [www.stats.gov.cn/english/statisticaldata/yearlydata](http://www.stats.gov.cn/english/statisticaldata/yearlydata), viewed 9 June 2009.
  36. U.N. Population Division, op. cit. note 3; USDA, *PS&D*, op. cit. note 1; water calculation based on 1,000 tons of water for 1 ton of grain from FAO, op. cit. note 25.
  37. USDA, *PS&D*, op. cit. note 1.
  38. FAO, *1948–1985 World Crop and Livestock Statistics* (Rome: 1987); FAO, op. cit. note 10; U.N. Population Division, op. cit. note 3.
  39. Conversion ratio for feed-to-poultry derived from data in Robert V. Bishop et al., *The World Poultry Market—Government Intervention and Multilateral Policy Reform* (Washington, DC: USDA, 1990); beef based on Allen Baker, Feed Situation and Outlook staff, ERS, USDA, discussion with author, 27 April 1992; pork from Leland Southard, Livestock and Poultry Situation and Outlook staff, ERS, USDA, discussion with author, 27 April 1992; fish from Rosamond Naylor et al., "Effect of Aquaculture on World Fish Supplies," *Nature*, vol. 405 (29 June 2000), pp. 1,017–24.

40. FAO, op. cit. note 10.
41. FAO, *FISHSTAT Plus*, electronic database, at [www.fao.org](http://www.fao.org), updated February 2009; Naylor et al., op. cit. note 39.
42. FAO, op. cit. note 41; Taija-Riitta Tuominen and Maren Esmark, *Food for Thought: The Use of Marine Resources in Fish Feed* (Oslo: WWF-Norway, 2003); Rosamond Naylor and Marshall Burke, "Aquaculture and Ocean Resources: Raising Tigers of the Sea," *Annual Review of Environmental Resources*, vol. 30 (November 2005), pp. 185–218.
43. FAO, op. cit. note 41.
44. S. F. Li, "Aquaculture Research and Its Relation to Development in China," in World Fish Center, *Agricultural Development and the Opportunities for Aquatic Resources Research in China* (Penang, Malaysia: 2001), p. 26; FAO, op. cit. note 41.
45. FAO, op. cit. note 10; FAO, op. cit. note 41.
46. Naylor et al., op. cit. note 39; W. C. Nandeesha et al., "Breeding of Carp with Oviprim," in *Indian Branch, Asian Fisheries Society, India*, Special Publication No. 4 (Mangalore, India: 1990), p. 1.
47. "Mekong Delta to Become Biggest Aquatic Producer in Vietnam," *Vietnam News Agency*, 3 August 2004; "The Mekong Delta Goes Ahead with the WTO," *Vietnam Economic News Online*, 8 June 2007; FAO, op. cit. note 41.
48. Naylor et al., op. cit. note 39; FAO, op. cit. note 41; USDA, NASS, *Catfish Production* (Washington, DC: 30 January 2009), pp. 17–20; U.N. Population Division, op. cit. note 3.
49. USDA, Foreign Agricultural Service, *Oilseeds: World Markets and Trade* (Washington, DC: May 2009).
50. USDA, *PS&D*, op. cit. note 1.
51. Historical data from USDA, in Worldwatch Institute, op. cit. note 18; USDA, *PS&D*, op. cit. note 1.
52. FAO, op. cit. note 10.
53. S. C. Dhall and Meena Dhall, "Dairy Industry—India's Strength in Its Livestock," *Business Line*, Internet Edition of *Financial Daily*, Hindu group of publications, 7 November 1997; see also Surinder Sud, "India Is Now World's Largest Milk Producer," *India Perspectives*, May 1999, pp. 25–26; A. Banerjee, "Dairying Systems in India," *World Animal Review*, vol. 79, no. 2 (1994).
54. FAO, op. cit. note 10; U.N. Population Division, op. cit. note 3.
55. Dhall and Dhall, op. cit. note 53; Banerjee, op. cit. note 53; FAO, op. cit. note 10.
56. John Wade, Adam Branson, and Xiang Qing, *China Grain and Feed Annual Report 2002* (Beijing: USDA, 2002); Gao Tengyun, "Treatment and Utilization of Crop Straw and Stover in China," *Livestock Research for Rural Development*, February 2000.
57. USDA, ERS, "China's Beef Economy: Production, Marketing, Consumption, and Foreign Trade," *International Agriculture and Trade Reports: China* (Washington, DC: July 1998), p. 28.
58. FAO, op. cit. note 10; FAO, op. cit. note 41; U.N. Population Division, op. cit. note 3.
59. U.N. Population Division, op. cit. note 3; China's economic growth from International Monetary Fund (IMF), *World Economic Outlook Data-*



- base, at [www.imf.org/external/pubs/ft/weo](http://www.imf.org/external/pubs/ft/weo), updated April 2009; FAO, FAOSTAT, electronic database at [faostat.fao.org](http://faostat.fao.org), updated 30 June 2007.
60. Lisa McLaughlin, "Inner-City Farms," *Time*, 4 August 2008; Caryn Rousseau, "More Schools Cultivate Learning in Student Gardens," *Associated Press*, 17 November 2008; USDA, Agricultural Marketing Service, "Farmers Market Growth: 1994–2008," at [www.ams.usda.gov](http://www.ams.usda.gov), updated 22 September 2008.
  61. Historical trend from Carolyn Dimitri, Anne Efland, and Neilson Conklin, *The 20th Century Transformation of U.S. Agriculture and Farm Policy* (Washington, DC: USDA, ERS, June 2005), p. 5; USDA, NASS, *2007 Census of Agriculture* (Washington, DC: February 2009), pp. 7, 64, 110–11; Andrew Martin, "Farm Living (Subsidized by a Job Elsewhere)," *New York Times*, 8 February 2009.
  62. Martin, op. cit. note 61; USDA, op. cit. note 61, pp. 52, 66–67.
  63. Marian Burros, "Obamas to Plant Vegetable Garden at White House," *New York Times*, 20 March 2009; Michael Pollan, "Farmer in Chief," *New York Times Magazine*, 12 October 2008.
  64. Cristina Milesi et al., "Mapping and Modeling the Biogeochemical Cycling of Turf Grasses in the United States," *Environmental Management*, vol. 36, no. 3 (19 July 2005), pp. 426–38.
  65. McLaughlin, op. cit. note 60; "Digging Their Way Out of Recession," *The Economist*, 26 February 2009; Adrian Higgins, "Community Gardens Need Room to Grow," *Washington Post*, 14 February 2008.
  66. USDA, op. cit. note 60; current total from Joan Shaffer, USDA, Agricultural Marketing Service, discussion with J. Matthew Roney, Earth Policy Institute, 13 May 2009; Valerie Bauman, "More Farmers Markets to Accept Food Stamps," *Associated Press*, 26 August 2008.
  67. Rousseau, op. cit. note 60; Mary MacVean, "Maria Shriver Says Edible Garden Will Be Planted in Capitol Park Flower Bed," *Los Angeles Times*, 27 March 2009.
  68. Marian Burros, "Supermarket Chains Narrow Their Sights," *New York Times*, 6 August 2008; "Digging Their Way Out of Recession," op. cit. note 65.
  69. Rich Pirog and Andrew Benjamin, *Checking the Food Odometer: Comparing Food Miles for Local Versus Conventional Produce Sales to Iowa Institutions* (Ames, IA: Leopold Center for Sustainable Agriculture, Iowa State University, July 2003); Michael Pollan, *In Defense of Food* (New York: The Penguin Group, 2008), pp. 157–58; Marc Xuereb, *Food Miles: Environmental Implications of Food Imports to Waterloo Region* (Waterloo, ON: Region of Waterloo Public Health, November 2005); Erika Engelhaupt, "Do Food Miles Matter?" *Environmental Science and Technology Online*, at [pubs.acs.org](http://pubs.acs.org), 16 April 2008.
  70. "The Environment: Not on the Label," *The Economist*, 19 May 2007; John Waples, "Tesco Turns Itself into a Green Giant," *Sunday Times* (London), 31 May 2009; Tesco PLC, "Tesco Wins Green 'Gold Standard' Award," press release (Hertfordshire, U.K.: 5 June 2009); Miles Costello, "Tesco Reports Record £3 Billion Profit," *The Times* (London), 21 April 2009.
  71. Lauren Etter, "Lofty Prices for Fertilizer Put Farmers in a Squeeze," *Wall Street Journal*, 27 May 2008; David A. Vaccari, "Phosphorus: A Looming

- Crisis," *Scientific American*, June 2009, pp. 54–59.
72. Program for Appropriate Technology in Health and U.N. Population Fund, *Meeting the Need: Strengthening Family Planning Programs* (Seattle, WA: 2006), pp. 5–11.
  73. Author's calculations from USDA, *PS&D*, op. cit. note 1; U.N. Population Division, op. cit. note 3.
  74. USDA, *PS&D*, op. cit. note 1; U.N. Population Division, op. cit. note 3; FAO, FAOSTAT, electronic database at [faostat.fao.org](http://faostat.fao.org), updated May 2008.
  75. Organisation for Economic Co-operation and Development, "Total Health Expenditure per Capita, US\$ PPP," in *OECD Health Data 2008 – Frequently Requested Data*, at [www.oecd.org](http://www.oecd.org), December 2008; FAO, op. cit. note 59.
  76. Gidon Eshel and Pamela A. Martin, "Diet, Energy, and Global Warming," *Earth Interactions*, vol. 10, no. 9 (April 2006), pp. 1–17.
  77. Poultry from data in Bishop et al., op. cit. note 39; beef from Baker, op. cit. note 39; fish from Naylor et al., op. cit. note 39.
  78. Land area estimate from Stanley Wood, Kate Sebastian, and Sara J. Scherr, *Pilot Analysis of Global Ecosystems: Agroecosystems* (Washington, DC: IFPRI and World Resources Institute, 2000), p. 3.
  79. Yields from USDA, NASS, *Agricultural Statistics 2008* (Washington, DC: 2008), pp. I-21, III-16.
  80. USDA, *PS&D*, op. cit. note 1; USDA, *Feedgrains Database*, op. cit. note 1; U.N. Population Division, op. cit. note 3.
  81. Money going to land acquisitions from Joachim von Braun, IFPRI, cited in Joe DeCapua, "Food Crisis Triggers Land Grab in Developing Countries," *Voice of America News*, 29 April 2009.

#### Chapter 10. Can We Mobilize Fast Enough?

1. Peter Goldmark, Environmental Defense Fund, e-mail to author, 28 June 2009.
2. Lester R. Brown, "Could Food Shortages Bring Down Civilization?" *Scientific American*, May 2009, pp. 50–57.
3. Mohammad Yunus and Karl Weber, *Creating a World Without Poverty* (New York: PublicAffairs, 2008), p. 105.
4. Øystein Dahle, discussion with author, State of the World Conference, Aspen, CO, 22 July 2001.
5. Norway, Costa Rica, and the Maldives from U.N. Environment Programme (UNEP), Climate Neutral Network, "Countries," at [www.unep.org/climateneutral](http://www.unep.org/climateneutral), viewed 24 June 2009; Olivia Lang, "Maldives Vows to be First Carbon-neutral Nation," *Reuters*, 15 March 2009.
6. UNEP, "UNEP Unveils the Climate Neutral Network to Catalyze a Transition to a Low Carbon World" press release (Nairobi: Climate Neutral Network, 21 February 2008).
7. Redefining Progress, "The Economists' Statement on Climate Change," at [www.rprogress.org/publications/1997/econstatement.htm](http://www.rprogress.org/publications/1997/econstatement.htm), viewed 26 June 2008.
8. Centers for Disease Control and Prevention, *Sustaining State Programs for Tobacco Control: Data Highlights 2006* (Atlanta, GA: 2006).
9. Campaign for Tobacco-Free Kids, "State Cigarette Excise Tax Rank and

- Ratings,” fact sheet (Washington, DC: 28 May 2009); Campaign for Tobacco-Free Kids, “Raising Cigarette Taxes Reduces Smoking, Especially Among Kids (And the Cigarette Companies Know It),” fact sheet (Washington, DC: 9 January 2009); Campaign for Tobacco-Free Kids, “Cigarette Tax Increases by State per Year 2000–2009,” fact sheet (Washington, DC: 28 May 2009).
10. Gasoline indirect cost calculated based on International Center for Technology Assessment (ICTA), *The Real Price of Gasoline*, Report No. 3 (Washington, DC: 1998), p. 34, updated using the following: ICTA, *Gasoline Cost Externalities Associated with Global Climate Change: An Update to CTA’s Real Price of Gasoline Report* (Washington, DC: September 2004), ICTA, *Gasoline Cost Externalities: Security and Protection Services: An Update to CTA’s Real Price of Gasoline Report* (Washington, DC: January 2005), Terry Tamminen, *Lives Per Gallon: The True Cost of Our Oil Addiction* (Washington, DC: Island Press, 2006), p. 60, and Bureau for Economic Analysis, “Table 3—Price Indices for Gross Domestic Product and Gross Domestic Purchases,” *GDP and Other Major Series, 1929–2007* (Washington, DC: August 2007); U.S. Department of Energy (DOE), Energy Information Administration (EIA), *This Week in Petroleum* (Washington, DC: various issues); EIA, “US Weekly Retail,” *Retail Gasoline Historical Prices* (Washington, DC: 15 June 2009).
  11. American Petroleum Institute, *State Gasoline Tax Report* (Washington DC: 1 April 2009); DOE, EIA, “Weekly (Monday) Retail Premium Gasoline Prices, Selected Countries,” at [www.eia.doe.gov/emeu](http://www.eia.doe.gov/emeu), updated 16 June 2009; gasoline consumption from International Energy Agency (IEA), in World Resources Institute, “Energy and Resources: Energy Consumption by Source: Oil and Petroleum Products (2005),” *EarthTrends* electronic database, at [www.earthtrends.wri.org](http://www.earthtrends.wri.org), updated 2007.
  12. U.S. Department of Agriculture, Economic Research Service, “Cigarette Price Increase Follows Tobacco Pact,” *Agricultural Outlook*, January–February 1999.
  13. Markus Knigge and Benjamin Görlach, *Effects of Germany’s Ecological Tax Reforms on the Environment, Employment and Technological Innovation: Summary of the Final Report of the Project* (Berlin: Ecologic Institute for International and European Environmental Policy, August 2005); Michael Renner, Sean Sweeney, and Jill Kubitz, *Green Jobs: Towards Decent Work in a Sustainable, Low Carbon World* (Nairobi: UNEP, 2008), p. 97.
  14. Estimate of Swedish tax shifting based on Paul Ekins and Stefan Speck, “Environmental Tax Reform in Europe: Energy Tax Rates and Competitiveness,” in Nathalie J. Chalifour et al., *Critical Issues in Environmental Taxation* (Oxford: Oxford University Press, 2008), pp. 77–105; Ministry of Finance, Sweden, “Taxation and the Environment,” press release (Stockholm: 25 May 2005); household size from Target Group Index, “Household Size,” *Global TGI Barometer* (Miami: 2005) and from U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009; Andrew Hoerner and Benoît Bosquet, *Environmental Tax Reform: The European Experience* (Washington, DC: Center for a Sustainable Economy, 2001); European Environment Agency, *Environmental Taxes: Recent Develop-*

- ments in Tools for Integration*, Environmental Issues Series No. 18 (Copenhagen: 2000); polls from David Malin Roodman, *The Natural Wealth of Nations* (New York: W. W. Norton & Company, 1998), p. 243.
15. Redefining Progress, op. cit. note 7; N. Gregory Mankiw, “Gas Tax Now!” *Fortune*, 24 May 1999, pp. 60–64.
  16. Confederation of European Waste-to-Energy Plants, *Landfill Taxes and Bans* (Brussels: April 2007); Tom Miles, “London Drivers to Pay UK’s First Congestion Tax,” *Reuters*, 28 February 2002; Energy Council, *Energy Efficiency Policies and Indicators* (London: 2001), Annex 1; “DONG Satisfied with Electric Car Tax Relief,” *Copenhagen Post*, 22 May 2009; Nick Kurczewski, “Scariest Place in the World to Buy a Car,” *New York Times Wheels Blog*, 7 May 2008; Office of the Mayor, “Car Plate Prices Climb” (Shanghai: 21 June 2009).
  17. South Australian Fisheries Management Series, *Management Plan for the South Australian Southern Zone Rock Lobster Fishery* (Adelaide, South Australia: 2007); South Australian Research and Development Institute, *Southern Zone Rock Lobster (Jasus edwardsii) Fishery*, assessment report to PIRSA (Adelaide, South Australia: 2008).
  18. Edwin Clark, letter to author, 25 July 2001.
  19. André de Moor and Peter Calamai, *Subsidizing Unsustainable Development* (San José, Costa Rica: Earth Council, 1997).
  20. World Bank, *World Development Report 2003* (New York: Oxford University Press, 2003), pp. 30, 142; IEA, *World Energy Outlook 2006* (Paris: 2006), p. 279.
  21. Belgium, France, and Japan from Seth Dunn, “King Coal’s Weakening Grip on Power,” *World Watch*, September/October 1999, pp. 10–19; Germany from UNEP, *Reforming Energy Subsidies: Opportunities to Contribute to the Climate Change Agenda* (Nairobi: 2008), and from DOE, EIA, *International Energy Annual 2006* (Washington, DC: October 2008), Table 1.4; China, Indonesia, and Nigeria subsidy cuts from GTZ Transport Policy Advisory Service, *International Fuel Prices 2007* (Eschborn, Germany: April 2007), p. 3.
  22. John Whitelegg and Spencer Fitz-Gibbon, *Aviation’s Economic Downside*, 3rd ed. (London: Green Party of England & Wales, 2003); dollar conversion based on August 2007 exchange rate in International Monetary Fund, “Representative Exchange Rates for Selected Currencies in August 2007,” *Exchange Rate Archives by Month*, at [www.imf.org/external](http://www.imf.org/external), viewed 16 August 2007; U.N. Population Division, op. cit. note 14.
  23. Doug Koplow, *Subsidies in the U.S. Energy Sector: Magnitude, Causes, and Options for Reform* (Cambridge, MA: Earth Track, November 2006); Doug Koplow, Earth Track, e-mail to Jessie Robbins, Earth Policy Institute, 2 July 2009.
  24. Fishery subsidy value includes “bad” subsidies and fuel subsidies as estimated in Fisheries Center, *Catching More Bait: A Bottom-Up Re-Estimation of Global Fisheries Subsidies* (2nd Version) (Vancouver, BC: University of British Columbia, 2006), p. 21.
  25. Coal Moratorium NOW!, “Progress Towards a Coal Moratorium: 59 Coal Plants Cancelled or Shelved in 2007,” press release (San Francisco: 17 January 2008); Mark Clayton, “Rising Construction Costs and Potential Climate Legislation in Congress Halt at Least 18 Proposed Power

- Plants in the Past Nine Months,” *Christian Science Monitor*, 25 October 2007; Janet Larsen, “Coal Takes Heavy Human Toll,” *Eco-Economy Update* (Washington, DC: Earth Policy Institute, 24 August 2004).
26. Sierra Club, “Stopping the Coal Rush,” online database, accessed 23 July 2009, at [www.sierraclub.org/environmentallaw/coal/plantlist.asp](http://www.sierraclub.org/environmentallaw/coal/plantlist.asp); Kathleen Krust, Sierra Club, discussion with Jessie Robbins, Earth Policy Institute, 23 July 2009.
  27. Opinion Research Corporation, *A Post Fossil-Fuel America: Are Americans Ready to Make the Shift?* (Princeton, NJ: October 2007).
  28. Andrew Ross Sorkin, “A Buyout Deal That Has Many Shades of Green,” *New York Times*, 26 February 2007; “Texas Decision Could Double Wind Power Capacity in the U.S.,” *Renewable Energy Access*, 4 October 2007.
  29. Timothy Gardner, “Florida Gov. Might Allow New Coal Power Plants,” *Reuters*, 4 October 2007; Buck Parker, Earthjustice, letter to author, October 2007; Coal Moratorium NOW! op. cit. note 25.
  30. Jim Jelter, “Coal Stocks Tumble on Citigroup Downgrade,” *Market-Watch*, 18 July 2007; Steve James, “Coal Shares Fall After Merrill Downgrade,” *Reuters*, 3 January 2008; Citigroup, “Leading Wall Street Banks Establish the Carbon Principles,” press release (New York: 4 February 2008); Jeffrey Ball, “Wall Street Shows Skepticism Over Coal,” *Wall Street Journal*, 4 February 2008; Jeffrey Ball, “Bank of America Puts a Price on Carbon,” *Wall Street Journal*, 13 February 2008.
  31. Martin Griffith, “Reid Fights New Coal-Fired Plants,” (Salt Lake City) *Deseret News*, 26 August 2007; Nicholas D. Kristof, “The Big Melt,” *New York Times*, 16 August 2007; Governor Jennifer M. Granholm, “Priorities for Michigan’s Economic Future: Jobs, Education and Protecting Families,” State of the State Address, 3 February 2009; State of Washington 60th Legislature, Climate Change—Mitigating Impacts, Engrossed Substitute Senate Bill 6001, Chapter 307, Laws of 2007, 22 July 2007; Carla Vigue, “Governor Says No to Coal for State Heating Plants in Madison,” press release (Madison, WI: Office of the Governor, 1 August 2008); Audrey Chang, “California Takes on Power Plant Emissions: SB 1368 Sets Groundbreaking Greenhouse Gas Performance Standard,” fact sheet (New York: Natural Resources Defense Council, August 2007); Gardner, op. cit. note 29.
  32. Granholm, op. cit. note 31.
  33. Kristen Lombardi, *Coal Ash: The Hidden Story: How Industry and the EPA Failed to Stop a Growing Environmental Disaster* (Washington, DC: Center for Public Integrity, 19 February 2009).
  34. Ibid.; “Enviros Demand Locations of 44 ‘High Hazard’ Coal Ash Sites,” *Environmental News Service*, 19 June 2009.
  35. James Hansen, “Why We Can’t Wait,” *The Nation*, 7 May 2007; Noelle Straub and Peter Behr, “Energy Regulatory Chief Says New Coal, Nuclear Plants May Be Unnecessary,” *Greenwire*, 22 April 2009.
  36. Supreme Court of the United States, *Massachusetts et al. v. Environmental Protection Agency et al.*, No. 05–1120, 549 U.S. 497, decided 2 April 2007, Washington, DC; Environmental Appeals Board, U.S. Environmental Protection Agency, “In Re: Deseret Power Electric Cooperative, PSD Permit No. PSD-OU-0002-04.00” (Washington, DC: 13 November 2008); David Biello, “EPA Ruling Halts All New Coal-Fired Power Plants,” *Sci-*

- entific American*, 14 November 2008; Deborah Zabarenko, “EPA Finds Greenhouse Gases Endanger Health,” *Reuters*, 23 March 2009.
37. Sierra Club, “Beyond Coal,” at [www.sierraclub.org/coal](http://www.sierraclub.org/coal), viewed 25 June 2009.
  38. Mathias Bell, Rocky Mountain Institute, e-mail to Jessie Robbins, Earth Policy Institute, 30 June 2009; Natalie Mims, Mathias Bell, and Stephen Doig, *Assessing the Electric Productivity Gap and the U.S. Efficiency Opportunity* (Snowmass, CO: Rocky Mountain Institute, January 2009).
  39. Erik Shuster, *Tracking New Coal-Fired Power Plants* (Pittsburgh, PA: DOE, National Energy Technology Laboratory, January 2009); Julie Clendenin and Shawna Seldon, “Wind Energy Grows by Record 8,300 MW in 2008,” press release (Washington, DC: American Wind Energy Association (AWEA), 27 January 2009); AWEA, *U.S. Wind Energy Projects*, electronic database, at [www.awea.org/projects](http://www.awea.org/projects), updated 31 December 2008.
  40. Henry Manczyk and Michael D. Leach, “Combined Heat and Power Generation and District Heating in Denmark: History, Goals, and Technology,” at [www.energy.rochester.edu/dk/manczyk/denmark.pdf](http://www.energy.rochester.edu/dk/manczyk/denmark.pdf), viewed 13 February 2008; “New Zealand Issues Ten-Year Ban on New Thermal Power Plants,” *Power Engineering*, 11 October 2007; Global Wind Energy Council, *Global Wind 2008 Report* (Brussels: 2009); Jad Mouawad, “Chinese Clean Coal Will Be Critical, a Report Says,” *Green Inc.* at *Nytimes.com*, 20 April 2009.
  41. Table 10–1 calculated with the following: fossil fuel and transport carbon reductions using IEA, *World Energy Outlook 2008* (Paris: 2008), p. 507, industry reductions using IEA, *Tracking Industrial Energy Efficiency and CO<sub>2</sub> Emissions* (Paris: 2007), avoided deforestation and planting trees from Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), pp. 543, 559, and soil carbon sequestration based on conservative estimates in Rattan Lal, “Soil Carbon Sequestration Impacts on Global Climate Change and Food Security,” *Science*, vol. 304 (11 June 2004), pp. 1,623–27.
  42. IEA, *World Energy Outlook 2008*, op. cit. note 41, p. 507.
  43. R. A. Houghton, “Carbon Flux to the Atmosphere from Land-Use Changes: 1850–2005,” in Carbon Dioxide Information Analysis Center (CDIAC), *TRENDS: A Compendium of Data on Global Change* (Oak Ridge, TN: Oak Ridge National Laboratory (ORNL), 2008); carbon sequestration based on IPCC, op. cit. note 41.
  44. Lal, op. cit. note 41.
  45. Carbon dioxide pathway modeled using fossil fuel emissions from Tom Boden and Gregg Marland, “Global CO<sub>2</sub> Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751–2006” and “Preliminary 2006–07 Global & National Estimates by Extrapolation,” both in CDIAC, *Fossil Fuel CO<sub>2</sub> Emissions* (Oak Ridge, TN: ORNL, 2009), and from land use change emissions from Houghton, op. cit. note 43, with decay curve cited in J. Hansen et al., “Dangerous Human-Made Interference with Climate: A GISS ModelE Study,” *Atmospheric Chemistry and*

- Physics*, vol. 7 (2007), pp. 2,287–312.
46. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, *Renewable Energy-Employment Effects: Impact of the Expansion of Renewable Energy on the German Labor Market* (Berlin: June 2006); “German Plan to Close Coal Mines,” *BBC News*, 29 January 2007; Michael Levitin, “Germany Says Auf Wiedersehen to Nuclear Power, Guten Tag to Renewables,” *Grist*, 12 August 2005.
  47. Tim Weiner, *Legacy of Ashes: The History of the CIA* (New York: Doubleday, 2009), p. 429.
  48. Surgeon General’s Advisory Committee on Smoking and Health, *Smoking and Health* (Washington, DC: Office of the Surgeon General, 1964).
  49. Cigarette consumption from U.S. Department of Agriculture (USDA), *Production, Supply and Distribution*, electronic database, at [www.fas.usda.gov/psdonline](http://www.fas.usda.gov/psdonline), updated 31 August 2006, and from Tom Capehart, *Tobacco Outlook* (Washington, DC: USDA, Economic Research Service (ERS), 24 April 2007); American Cancer Society, “Guide to Quitting Smoking: Tobacco and Cancer,” at [www.cancer.org](http://www.cancer.org), updated 21 May 2009.
  50. Duff Wilson, “Congress Passes Measure on Tobacco Regulation,” *New York Times*, 13 June 2009; USDA, ERS, “Cigarette Price Increase Follows Tobacco Pact,” *Agricultural Outlook*, January–February 1999.
  51. DOE, EIA, *Annual Energy Outlook 2009 with Projections for 2030* (Washington, DC: March 2009); BP, *BP Statistical Review of World Energy 2009* (London: British Petroleum, June 2009); Sharon Silke Carty, “This Year’s Auto Sales Forecast Falls to 10 Million,” *USA Today*, 22 May 2009; cars scrapped from R. L. Polk & Co., “U.S. Vehicle Median Age Increased in 2008, According to Polk,” press release (Southfield, MI: 3 March 2009).
  52. U.S. Department of Transportation, *Summary of Fuel Economy Performance* (Washington, DC: 30 March 2009).
  53. DOE, EIA, *Annual Energy Outlook 2007 with Projections for 2030* (Washington, DC: February 2006); DOE, op. cit. note 51.
  54. For information on mobilization, see Francis Walton, *Miracle of World War II: How American Industry Made Victory Possible* (New York: Macmillan, 1956).
  55. Franklin Roosevelt, “State of the Union Address,” 6 January 1942, at [www.ibiblio.org/pha/7-2-188/188-35.html](http://www.ibiblio.org/pha/7-2-188/188-35.html).
  56. Harold G. Vatter, *The US Economy in World War II* (New York: Columbia University Press, 1985), p. 13; Alan L. Gropman, *Mobilizing U.S. Industry in World War II* (Washington, DC: National Defense University Press, August 1996).
  57. Doris Kearns Goodwin, *No Ordinary Time—Franklin and Eleanor Roosevelt: The Home Front in World War II* (New York: Simon & Schuster, 1994), p. 316; “Point Rationing Comes of Age,” *Business Week*, 19 February 1944.
  58. “War Production—The Job ‘That Couldn’t Be Done,’” *Business Week*, 5 May 1945; Donald M. Nelsen, *Arsenal of Democracy: The Story of American War Production* (New York: Harcourt, Brace and Co., 1946), p. 243.
  59. Goodwin, op. cit. note 57, p. 316.
  60. Grey quoted in Walton, op. cit. note 54.

61. Jeffrey Sachs, “One Tenth of 1 Percent to Make the World Safer,” *Washington Post*, 21 November 2001.
62. Universal primary education from U.K. Treasury, *From Commitment to Action: Education* (London: Department for International Development, September 2005); adult literacy campaign is author’s estimate; universal basic health care from Jeffrey D. Sachs and the Commission on Macroeconomics and Health, *Macroeconomics and Health: Investing in Health for Economic Development* (Geneva: World Health Organization, 2001); reproductive health and family planning from J. Joseph Speidel et al., *Family Planning and Reproductive Health: The Link to Environmental Preservation* (San Francisco: Bixby Center for Reproductive Health and Research Policy, University of California, 2007), p. 10, and from J. Joseph Speidel, discussion with J. Matthew Roney, Earth Policy Institute, 16 October 2007.
63. In Table 10–2, closing the condom gap estimated from Population Action International, “Why Condoms Count in the Era of HIV/AIDS,” fact sheet (Washington, DC: 2008); cost per condom and condom distribution from United Nations Population Fund (UNFPA), *Donor Support for Contraceptives and Condoms for STI/HIV Prevention 2007* (New York: 2008); school lunch program from George McGovern, “Yes We CAN Feed the World’s Hungry,” *Parade*, 16 December 2001; assistance to preschool children and pregnant women is author’s estimate of extending the U.S.’s Women, Infants, and Children program, based on United Nations, *World Population Prospects: The 2004 Revision* (New York: 2005); UNFPA, *The State of World Population 2004* (New York: 2004), p. 39.
64. In Table 10–2, restoring the earth budget compiled from the following: planting trees to reduce flooding and conserve soil and protecting topsoil on cropland from Lester R. Brown and Edward C. Wolf, “Reclaiming the Future,” in Lester R. Brown et al., *State of the World 1988* (New York: W. W. Norton & Company, 1988), p. 174, using data from U.N. Food and Agriculture Organization, *Fuelwood Supplies in the Developing Countries*, Forestry Paper 42 (Rome: 1983); planting trees to sequester carbon from IPCC, op. cit. note 41, pp. 543, 559; restoring rangelands from UNEP, *Status of Desertification and Implementation of the United Nations Plan of Action to Combat Desertification* (Nairobi: 1991), pp. 73–92; restoring fisheries from Andrew Balmford et al., “The Worldwide Costs of Marine Protected Areas,” *Proceedings of the National Academy of Sciences*, vol. 101, no. 26 (29 June 2004), pp. 9,694–97; protecting biological diversity from World Parks Congress, *Recommendations of the Vth IUCN World Parks Congress* (Durban, South Africa: 2003), pp. 17–19, and from World Parks Congress, “The Durban Accord,” at [www.iucn.org/themes/wcpa](http://www.iucn.org/themes/wcpa), viewed 19 October 2007; stabilizing water tables is author’s estimate.
65. Table 10–3 compiled from Stockholm International Peace Research Institute (SIPRI), *Military Expenditure Database*, electronic database at [www.sipri.org](http://www.sipri.org), updated 2009.
66. SIPRI, op. cit. note 65.
67. Amy Belasco, *The Cost of Iraq, Afghanistan and Other Global War on Terror Operations Since 9/11* (Washington, DC: Congressional Research Service, 15 May 2009); Linda Bilmes and Joseph Stiglitz, *The Economic*

*Costs of the Iraq War: An Appraisal Three Years After the Beginning of the Conflict* (Cambridge, MA: National Bureau of Economic Research, February 2006); Linda Bilmes and Joseph Stiglitz, "The \$10 Trillion Hangover," *Harper's*, January 2009.

68. Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York: Penguin Group, 2005); Ronald Wright, *A Short History of Progress* (New York: Carroll and Graf Publishers, 2005); Joseph A. Tainter, *The Collapse of Complex Societies* (Cambridge, U.K.: Cambridge University Press, 1988).
69. SIPRI, op. cit. note 65.
70. The Institute for Intercultural Studies, at [www.interculturalstudies.org](http://www.interculturalstudies.org), viewed 8 July 2009.
71. Richard Register, e-mail to author, 16 October 2007.
72. Gidon Eshel and Pamela A. Martin, "Diet, Energy, and Global Warming," *Earth Interactions*, vol. 10, no. 9 (2006).