

THE LEAP:
How to Survive & Thrive in the Sustainable Economy

by Chris Turner
(Random House Canada 2011)

Source Notes

Every effort has been made to verify and document sources, but URLs change and page numbers get mis-transcribed. Should any detail or data point in *The Leap* need further clarification not found in this document, please contact Chris Turner directly at [chris \[at\] turnersleap \[dot\] com](mailto:chris@turnersleap.com).

PROLOGUE: To Furnish More Certain Conveyance

TWO TRACKS AND THE CHASM IN BETWEEN

International Energy Agency quote from IEA *World Energy Outlook 2008*; available for download online at <http://www.worldenergyoutlook.org/2008.asp>

Paul Hawken quote from his 2009 University of Portland commencement speech; transcript available online at <http://www.up.edu/commencement/default.aspx?cid=9456>

Barack Obama quote is from his speech in Newton, Iowa, on April 22, 2009 (Earth Day); full transcript online at the official White House website:

http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-in-Newton-IA/; full video available at YouTube:

http://www.youtube.com/watch?v=52OXVQQtdYA&feature=player_embedded

THE HIDDEN LEGACY OF THE BLACK BALL LINE

The key documents for this section were reprints of original and out-of-print documents in the Samuel Thompson's Nephew & Co. collection (primarily Collection 60, Box 5) of the G.W. Blunt White Library at Mystic Seaport Museum in Mystic, CT. These included copies of the original notices announcing the creation of the Black Ball Line; pages from contemporary Shipping Lists documenting the passage of Black Ball vessels; reprints of unsorted clippings collected by the Thompson company (which was a direct descendent of the Black Ball); "The American Sailing Ship," a paper read before the Stamford Historical Society by Theodore H. Humprey in March 1921; "The Packet Ship Era," a paper presented before the Quincy Historical Society by H. Hobart Holly in February 1950; and "Planning the Black Ball" by Robert G. Albion (*Log of Mystic Seaport*, V. 32, no. 1, spring 1980).

My physical description of the South Street docks in 1818 is drawn primarily from *A Maritime History of New York* by the New York City Unit of the Federal Writers' Project (first published in 1941 by Doubleday, Doran & Co., reprinted by Going Coastal, Inc., New York, 2004; available online at Google Books). See in particular pages 121-23.

The original text of the Black Ball Line's announcements in the *Liverpool Mercury* and the *New York Evening Post*, the letter from Jeremiah Thompson to his English partners, and the *New-York Shipping and Commercial List* for January 13, 1818, were all reprinted in Albion's "Planning the Black Ball."

A Maritime History of New York was also a primary source for details about the early trials and eventual success of the Black Ball Line (p. 121-133). Some additional background and detail comes from K. Jack Bauer, *A Maritime History of the United States* (University of South Carolina Press, 1989), p. 73-79, and Edwin G. Burrows and Mike Wallace, *Gotham: A History of New York City to 1898* (Oxford University Press, 1999), p. 433-440.

Details about the emergence of the “cotton triangle” are taken primarily from Holly’s “The Packet Ship Era,” Bauer’s *A Maritime History of the United States*, and Burrows and Wallace’s *Gotham*. Statistics and other information about New York’s immigrant boom come from Burrows and Wallace’s *Gotham*. The newspaper editorial praising Jeremiah Thompson is quoted in “The Packet Ship Era.”

CHAPTER ONE: The Necessity of the Leap

THE PRECIPICE & THE FALL OF 2008

The primary source for my brief overview of the worldwide financial collapse of 2008 was *Too Big to Fail* by Andrew Ross Sorkin (Viking, 2009). For in-depth coverage of the collapse of Iceland’s banks, see Michael Lewis, “Wall Street on the Tundra” (*Vanity Fair*, April 2009). For contemporary reporting on the British and Icelandic bank failures, see for example “Crisis deepens for Iceland as last of ‘big three’ banks is nationalised” (*The Independent*, 10 October 2008) and “Rescue plan for UK banks unveiled” (BBC, 8 October 2008).

Quotes from IEA *World Energy Outlook 2008* can be found online at <http://www.worldenergyoutlook.org/2008.asp>. George Monbiot’s report on his meeting with IEA

chief economist Fatih Birol was published under the title “When will the oil run out?” in *The Guardian*, 15 December 2008; it can be found online along with a video documentary of the interview at <http://www.guardian.co.uk/business/2008/dec/15/oil-peak-energy-iea>. 2009 *World Energy Outlook* factsheets can be downloaded at <http://www.worldenergyoutlook.org/2009.asp>.

The full text of “The Honolulu Declaration on Ocean Acidification and Reef Management” is available for download at the International Coral Reef Initiative website (<http://www.icriforum.org/icri-documents/associated-publications/honolulu-declaration-ocean-acidification-and-reef-management>); the accompanying press release can be found at PRWeb (http://www.prweb.com/releases/The_Nature/Conservacy/prweb1255804.htm). The first *New York Times* coverage of the declaration I could find was on 30 January 2009 (“Rising Acidity Is Threatening Food Web of Oceans, Science Panel Says,” Cornelia Dean). One of the best general overviews of acidification, its ramifications, and the basics of pH change appeared in *National Geographic* in April 2011 (Elizabeth Kolbert, “The Acid Sea”).

My analysis of the acidification problem and its ramifications and future prognosis for the world’s coral reefs is drawn primarily from *A Reef in Time: The Great Barrier Reef from Beginning to End* by J.E.N. “Charlie” Veron (Belknap Press/Harvard University Press, 2008), as well as my own interviews and email exchanges with Veron in early 2009. I’ve also drawn on an interview with Veron on Australia’s ABC Radio in April 2008 (transcript and audio file available at ABC website: <http://www.abc.net.au/rn/ockhamsrazor/stories/2008/2207734.htm>).

THE AGE OF FAIL

The photo of Ben Bernanke and Henry Paulson testifying with a FAIL sign in the background was widely disseminated in the press; it can be seen at the *Denver Post* website,

among many other places

(<http://www.denverpost.com/portlet/article/html/imageDisplay.jsp?contentItemRelationshipId=2113173>). There is a remarkably thorough overview of the origins and spread of the FAIL meme at Know Your Meme (<http://knowyourmeme.com/memes/fail>).

Henry Paulson's "economic 9/11" quote appeared in Sorkin's *Too Big to Fail*, among other places. George Soros' comment on worldview collapse comes from "The crisis and how to deal with it," a roundtable discussion with Soros, Paul Krugman and others in *The New York Review of Books*, 30 April 2009. Alan Greenspan's "flaw in the model" quote appeared widely in the press after he made it at a congressional hearing on the economic crisis in October 2008. See also Raj Patel, *The Value of Nothing: Why Everything Costs So Much More Than We Think* (HarperCollins, 2009), p. 4-8; and Joseph Stiglitz, *Freefall: America, Free Markets and the Sinking of the World Economy* (W.W. Norton & Co., 2010).

My discussion of the geological facts of peak oil and its implications are based primarily on the work of J. David Hughes, former geologist at the Geological Survey of Canada. I've attended his "Energy Sustainability Dilemma" several times and interviewed and corresponded with Hughes extensively; a PowerPoint version of his presentation similar to the ones I've attended (including most of the facts and figures I quote in this section) is available for download at the website of ASPO Canada (<http://aspocanada.ca/david-hughes-presentation.html>). Hughes is also my source for the statistical summary of the cost of a barrel of oil in human labour equivalent, using the minimum wage for the province of Alberta in early 2009.

My description of the shift in the nature of American labour comes from *City of the Century*, a PBS "American Experience" documentary about the rise of nineteenth-century Chicago (a full transcript of the program is available online at

<http://www.pbs.org/wgbh/amex/chicago/filmmore/pt.html>). Statistics on the decline in American farming come from *Gale Encyclopedia of US History* and the U.S. Department of Agriculture.

A transcript and PDF version of the Department of Energy presentation containing the “Unidentified Sources” slide can be found at the U.S. DOE’s Energy Information Administration website: <http://www.eia.doe.gov/conference/2009/session4.html>. For the emerging “peak coal” problem, see two articles by David Strahan: “The Great Coal Hole” (*New Scientist*, 17 January 2008) and “Lump sums” (*The Guardian*, 5 March 2008).

The passage on the multitude of negative effects from climate change is drawn from a range of sources. For carbon dioxide concentrations reaching their highest levels in 15 million years, see a study by Aradhna Tripathi et al. in the journal *Science*, 8 October 2009. Declining ski season lengths were reported in the *New York Times* (“How Do You Ski if There is No Snow?,” 1 November 2007); declines in avocado production, ash tree growth and French vineyard yields were reported by the Center for American Progress (“The Top 100 Effects of Global Warming,” 24 September 2007); Melbourne’s *The Age*, among others, has reported on the worst-in-history flooding in the state of Queensland in early 2011 (see for example “Qld flood disaster ‘worst in history,’” 17 January 2011); Australia’s worst-ever 2009 bushfires and their connection to drought and climate change was covered by Tim Flannery in *The Guardian* (“Australian bushfires: when two degrees is the difference between life and death,” 10 February 2009); the devastation wrought by mountain pine beetles in Western Canada has been widely reported (see for example CBCNews.ca, “The beetle and the damage done,” 23 April 2009); and the decline of the glaciers in Glacier National Park was reported by *National Geographic* (“No more glaciers in Glacier National Park,” *National Geographic News Online*, 2 March 2009).

The next section on wider environmental woes is also a mixed bag of news sources. The World Wildlife Fund sounded the alarm on bluefin tuna in early 2009, warning of a collapse in breeding stocks within three years (see for example “Overfishing to wipe out bluefin tuna in 3 years: WWF,” Reuters, 14 April 2009); increasingly zealous conservation efforts in the wake of this dire announcement may have reduced the rate of decline slightly, but it’s too soon to tell if they’ve actually had long-term success, and as of April 2011 the International Union for Conservation of Nature still listed the Mediterranean bluefin stocks as “endangered,” citing serious ongoing declines in mature breeding fish (see for example “Many Mediterranean Fish Species Threatened With Extinction, Report Says,” *New York Times* Green blog, 19 April 2011). The Worldwatch Institute’s *Vital Signs Report* for 2001 is a good single source for details on global wetlands decline, including the figure that more than half the earth’s wetlands were lost in the twentieth century (it can be purchased in hardcopy or PDF format at <http://www.worldwatch.org/bookstore/publication/vital-signs-2001>). The reduced water flows in the world’s major rivers was noted in the World Wildlife Fund report *World’s Top 10 rivers at risk*, published in 2007 and available for download at http://wwf.panda.org/about_our_earth/about_freshwater/rivers/). For an overview of the crisis in the Murray-Darling Basin, see “Warming Takes Center Stage As Australian Drought Worsens,” Keith Scheider, *Yale Environment 360*, 2 April 2009 (<http://e360.yale.edu/content/feature.msp?id=2137>). The spread of black stem rust was first widely reported in 2007 (see for example “Millions face famine as crop disease rages,” *The Observer* [UK], 22 April 2007) and has not abated – an international conference in Syria in the spring of 2011, for example, was focused solely on the impact of “wheat rust epidemics” ravaging crops from North Africa to Central Asia (see the website of the International Center for

Agriculture Research in Dry Areas for more details on the International Wheat Stripe Rust Symposium: <http://icarda.org/wheatrust/>). The best single report on the agricultural crisis in the Punjab is “NPR: Industrial age in India on verge of collapse” by Tom Philpott (Grist.org, 16 April 2009), which includes a link to two National Public Radio reports on the failure of the “Green Revolution.” Figures for extinction levels come from the IUCN Red List of Threatened Species (<http://www.iucnredlist.org/>); E.O. Wilson, among others has called this “the worst wave of extinction since the dinosaurs died” (<http://raysweb.net/specialplaces/pages/wilson.html>).

The estimated range of costs for biodiversity loss was reported by UNEP’s The Economics of Ecosystems and Biodiversity (TEEB) study in May 2010 (see press release at <http://www.sciencenewsline.com/nature/2010052112000012.html>).

“Are we now living in the Anthropocene?” was published in the journal *GSA Today*, V. 18, No. 2 (February 2008). Further details and an overview of the term’s evolution in “The Anthropocene Debate” by Elizabeth Kolbert (*Yale Environment 360*, 17 May 2010, <http://e360.yale.edu/content/feature.msp?id=2274>).

IMAGINATION FAIL

Nouriel Roubini made his call for “wholesale reform” in Nouriel Roubini and Stephen Mihm, *Crisis Economics: A Crash Course in the Future of Finance* (Penguin, 2010). Full quote: “Even though they have suffered the worst financial crisis in generations, many countries have shown a remarkable reluctance to inaugurate the sort of wholesale reform necessary to bring the financial system to heel.”

For Matt Simmons’s star turn as “Dr. Doom,” see “The Gulf Coast oil spill’s Dr. Doom,” *Fortune*, 9 June 2010

(http://money.cnn.com/2010/06/09/news/companies/simmons_gulf_oil_spill.fortune/index.htm).

For further details on Simmons's arguments about "replacement costs" of conventional resources, see his presentation "The Oil and Water Mix" (a copy from Marsh's International Oil Companies' Conference 2010 in Dubai available online at http://paul.kedrosky.com/archives/2010/03/matt_simmons_th.html)

An overview of Canadian investments in carbon capture and storage is available at the website of Carbon Management Canada: <http://www.cmc-nce.ca/news/2011/03/15/canada-moves-ahead-with-ccs-projects/>. My brief discussion of Statoil's pioneering work in CCS is based on my own reporting for *Canadian Geographic* ("The Carbon Cleansers," October 2008). See also Statoil's 2008 Annual Report

(http://www.statoil.com/AnnualReport2008/en/Sustainability/Climate/Pages/5-3-2-3_SleipnerCCS.aspx). Details and stats on carbon capture at the Mountaineer Power Plant in West Virginia come primarily from a factsheet on the website of the Carbon Capture and Sequestration Technologies Program at MIT (http://sequestration.mit.edu/tools/projects/aep_alstom_mountaineer.html). Additional detail was drawn from "AEP Chief Wants to Expand Sequestration Project in W.Va.," *New York Times/ClimateWire*, 5 March 2010. The estimated price per tonne of CCS in Canada was reported by Jeffrey Simpson in "On a cost basis, carbon-capture projects are madness," *The Globe & Mail*, 19 October 2009. In April 2011, when final factchecking was completed, the daily spot price for Certified Emissions Reductions on the European Climate Exchange was EUR13.35, about the middle of the overall range for the previous six months. This is about \$20, which is about 1/38 of the \$761 cost reported in the *Globe*. For a report on CCS viability conducted by the German Parliament's Office of Technology Assessment (TAB), see "Making

Dirty Power Green,” *Der Spiegel*, 20 March 2008; similar conclusions have been reached by the Australian energy consultants ACIL Talisman, the World Business Council on Sustainable Development, and the International Renewable Energy Agency. (For an overview, see “New Study Says Commercial Carbon Capture Unlikely by 2020,” at CleanTechnica: <http://cleantechnica.com/2008/08/22/new-study-says-commercial-carbon-capture-unlikely-by-2020/>.)

For more on the dubious research fueling Ontario’s anti-wind lobby, see “Windmill foes are full of hot air,” Marcus Gee, *The Globe & Mail*, 15 February 2011; “False Flag Wind NIMBY Catapults Propaganda,” CleanTechnica.com, 6 August 2009; “Attack on industrial wind puffed with false peer review claims,” Grist.org, 3 August 2009; “Kochs Invade Canada,” Huffington Post, 21 January 2011. Nina Pierpont’s “wind turbine syndrome” is an invention all her own, describing a set of maladies and secondary symptoms so vague they could be describing mild colds, work stresses or the impact of countless other proven environmental hazards, from high-tension wires to air pollution; her claims are contradicted by numerous more rigorous, peer-reviewed studies in Europe and beyond indicating the negligible impacts of wind turbines on human and environmental health; Pierpont is a pediatrician with no training or track record in any of the relevant fields of acoustic science, public health, or medical research. Each of the above online articles includes multiple links to those studies and more.

The International Energy Agency announced its subsidy estimates for 2009 at a press conference in November 2010 (see for example “World should eradicate fossil fuel subsidies: IEA,” Reuters, 9 November 2010). The report cites a figure of \$57 billion for global renewable energy subsidies, but this includes \$20 billion for biofuels (including perverse subsidies to corn ethanol and other gasoline substitutes); the remaining \$37 billion was for electricity production

from renewable sources, smaller than the \$312 billion for fossil fuels by a factor of 8.4. Incidentally, the IEA called for the eradication of fossil fuel subsidies at the same press conference.

Probably the best single-source overview of the fracking boom is “Hydrofracturing: An Energy Revolution” by Bill Chameides of Duke University at his Green Grok blog (<http://www.nicholas.duke.edu/thegreengrok/hydrofrackingresponse>). See also “Fracking's Environmental Footprint to Transform Pennsylvania Landscape,” SolveClimate News, 25 April 2011 (<http://solveclimateneeds.com/news/20110421/natural-gas-fracking-environmental-footprint-marcellus-shale-pennsylvania-forests?page=show>).

Wired Magazine provides one of the clearest examples of the hard-truth “green” argument for nuclear power. See “Nuclear Now!” by Peter Schwarz and Spencer Reiss (*Wired* 13.02, February 2005) and especially “Face It. Nukes Are the Most Climate-Friendly Industrial-Scale Form of Energy” by Spencer Reiss (*Wired* 16.06, June 2008). The worldwide historic shortfall in nuclear energy’s potential is from “Stewart Brand’s nuclear enthusiasm falls short on facts and logic” by Amory Lovins (Grist.org, 14 October 2009); full quote: “In its first half-century, nuclear power fell short of its forecast capacity by about 12-fold in the U.S. and 30-fold worldwide, mainly because building it cost several-fold more than expected, straining or bankrupting its owners.” A 2010 report by the International Panel on Fissile Materials, meanwhile, suggested that next-generation “fast breeder” reactors have, after \$50 billion in investment and several decades of tinkering, arrived at a state that is not “anywhere near economically competitive” with conventional nuclear plants or any other power source. (For a summary of the study, see “Problem-Plagued Reactor No Solution to Long-Term Nuclear Waste Problem,” *Salem News*, 17 February 2010;

news.com/articles/february172010/fast_reactors.php.) The French move to renewables was reported in *Renewable Energy World* (“France Sets Ambitious Renewable Energy Targets,” 2 January 2008), among other places. *The Economist*’s definitive statement on the lack of an economic case for nuclear power appeared in “Power to the People” in its 24 March 1998 issue.

As noted in the text, the best overview of the emerging research field of geoengineering is “The Geoengineering Option” by David G. Victor et al., *Foreign Affairs*, March/April 2009.

The failure of the Copenhagen climate talks (COP15) was widely reported; see for example “Copenhagen conference on the brink of collapse as world leaders arrive at talks,” *The Guardian*, 17 December 2009 and “Why did Copenhagen fail to deliver a climate deal?,” BBC News, 22 December 2009. My reporting of Terry Tamminen’s assessment of the Copenhagen collapse is drawn from my own interview with him by phone in February 2010; see also “Copenhagen Coal in the Stocking?” by Terry Tamminen, a blog posting at the website of 7th Generation Advisors

(http://seventhgenerationadvisors.org/index.php?option=com_content&view=article&id=90:copenhagen-coal-in-the-stocking-by-terry-tamminen&catid=3:main-blog&Itemid=26). I interviewed Hermann Scheer extensively in person in Berlin on 8 September 2009, and the quotes and summary of his assessment of the Kyoto/Copenhagen process are drawn primarily from that conversation.

THE RIGHT TRACK

Bruce Sterling’s definition of sustainability comes from “The Last Viridian Note,” a blog posting at his Viridian Design website (<http://www.viridiandesign.org/>). The Resilience Alliance’s definition of *resilience* can be found at the group’s website:

<http://www.resalliance.org/index.php/resilience>. My overview of the concept is drawn primarily from the work of Dr. Brian Walker and from extensive personal conversations with him (unrecorded) on a research and lecture trip to Australia for the 2008 Alfred Deakin Innovation Lectures. Walker explains his concept of “the paradox of optimization” in the essay “Resilience Thinking” (dated 24 November 2008 and available online at http://www.peopleandplace.net/featured_voices/2008/11/24/resilience_thinking). I also relied on documents from Buzz Holling’s archive at the Resilience Alliance (<http://rs.resalliance.org/2007/04/05/index-of-buzz-hollings-reflections/>) and at the website of the Stockholm Resilience Centre (<http://www.stockholmresilience.su.se>).

CHAPTER TWO: The Mechanics of the Leap

“NOW ALL CONSPIRE IN ONE GRAND CAUSE”

My description of the origins, construction and impact of the Erie Canal draws most heavily on two histories of the canal: *Wedding of the Waters: The Erie Canal and the Making of a Great Nation* by Peter L. Bernstein (W.W. Norton & Co., 2005) and *Bond of Union: Building the Erie Canal and the American Empire* by Gerard Koepfel (Da Capo Press, 2009). Carol Sherrif’s *The Artificial River: The Erie Canal and the Paradox of Progress, 1817-1862* (Hill and Wang, 1996) and Burrows and Wallace’s *Gotham* also informed this section.

The quotes from De Witt Clinton’s 1815 address to the New York legislature are found in *Wedding of the Waters*, p. 178-79; the “madman or a fool” line is also in *Wedding* along with other details of popular resistance to the project, p. 180-81; the mocking Tammany Hall handbill

is detailed in *Bond of Union*, p. 130; the long Bernstein quote is on p. 343 of *Wedding*; the “age of acquisition” and “Ode” quotes are from *Bond of Union*, p. 378 and p. 375, respectively.

TECHNICAL SPECS: THE FOUR LAWS OF GREAT LEAP MECHANICS

As with a surprising number of the most widely traded and beloved bon mots, the primary source for this quote about chasms and leaps has proven remarkably difficult to nail down. The version I’ve quoted is actually an alternate, because it was the version I heard first and which led to the formulation of the Great Leap’s first mechanical law as it appears in the text. The better sourced version goes: “There is nothing more dangerous than to leap a chasm in two jumps.” Wikiquote traces its origin to a 1941 political science text, where it is indeed attributed to David Lloyd George. This and other variations have been variously attributed to Lloyd George, Benjamin Disraeli and Winston Churchill (along with a few less common attributions, including Václav Havel). It seems highly likely, in any case, that something like this was said by some turn-of-the-century British prime minister. As I noted, Wikiquote has the clearest explanation of its murky origins: http://en.wikiquote.org/wiki/David_Lloyd_George.

As in the previous section, the description of the Erie Canal’s construction and the politicking involved is drawn from Bernstein’s *Wedding of the Waters* and Koepfel’s *Bond of Union*. The Gouverneur Morris quote is from an 1812 report prepared by the canal commissioners to the New York state government detailing their unencouraging reception in Washington, D.C., a few months earlier. It is understood to be written mainly by Morris; the quote itself is in *Wedding*, p. 164.

My primary source for the description of the birth and flowering of Chicago is the PBS “American Experience” documentary *City of the Century*. Additional detail was drawn from *The Chicago River: A Natural and Unnatural History* by Libby Hill (Lake Claremont Press, 2000), p. 64-68, and the Encyclopedia of Chicago website (<http://www.encyclopedia.chicagohistory.org/>).

The statistics of the growth of imports at the port of New York were found in *Gotham*, p. 435-37; those on the boom in commodities shipped from the Midwest are from *Bond of Union*, p. 395. The boom in merchant house openings in New York in 1825 is reported in *A Maritime History of New York*, p. 128-29.

The main source for my description of the “progress” faith in nineteenth-century America is Sheriff’s *The Artificial River*, p. 4-5 and p. 15-29. The directly quoted passage is on p. 5. The quote from De Witt Clinton’s 1815 address was found in *Wedding of the Waters*, p. 179. *Wedding* also provides some of the description of the “Yankee ingenuity” at work in the canal’s construction (see especially p. 259-60 and p. 284-5); further details are from *Bond of Union*, p. 236-250.

A CHASM CAN ONLY BE CROSSED IN A SINGLE LEAP

The concept of “punctuated equilibrium” first came to lay audiences in the writing of Stephen Jay Gould in the early 1970s. (PBS has a concise overview of the concept in its online “Evolution Library”: http://www.pbs.org/wgbh/evolution/library/03/5/1_035_01.html). The language evolution study I reference here is Mark Pagel et al., “Languages Evolve in Punctuational Bursts” (*Science*, V. 318, p. 588, 1 February 2008); *New Scientist* has a summary of the study in its issue of 1 February 2008 (Phil McKenna, “Languages evolve in sudden leaps, not creeps”). The finding about evolution in trees comes from another Pagel study, “Large

Punctuational Contribution of Speciation to Evolutionary Divergence at the Molecular Level” (*Science*, V. 314, p. 119, 6 October 2006). From the abstract: “We found that approximately 22% of substitutional changes [in species] at the DNA level can be attributed to punctuational evolution, and the remainder accumulates from background gradual divergence.” The paper I quote from on the speed of climate change is Jonathan Adams et al., “Sudden climate transitions during the Quaternary” (*Progress in Physical Geography*, V. 23, No. 1, 1999). For Charlie Veron’s examination of sudden change in coral reefs, see *A Reef in Time*; the quotes are found on p. 68.

Philip Ball’s overview of phase transitions appears in *Critical Mass: How one thing leads to another* (Arrow Books [UK], 2005), p. 115-20 (quote on p. 120). His discussion of noise and bifurcation points is on p. 128-33. Ball connects the physics of phase transitions to the behaviour of crowds on p. 169-78 and to stock market fluctuations on p. 269-70.

Andy Grove provides his description of strategic inflection points in his book *Only the Paranoid Survive*

As noted in the text, I drew my description of paradigm shifts from Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (University of Chicago Press, 1996); see especially p. 6-34, 47-49 and 86-91. The comparison to political revolutions (including the quotes I use) is on p. 92-93.

My analysis of the origins and impact of the German feed-in tariff here and in Chapter 3 is drawn from extensive field research in Germany in the spring of 2008 and September 2009. This includes meetings and interviews with Social Democrat MP Hermann Scheer, Green MP Hans-Josef Fell, First Solar VP (and former parliamentary aide to Scheer) David Wortmann, Joerg Bagdahn, executive director of the Fraunhofer Center for Silicon Photovoltaics; executives

at Q-Cells, Calyxo, Nanosolar and others; officials at a range of officials at Germany Trade and Invest (the foreign investment arm of the German government),; civic officials and entrepreneurs in Bitterfeld-Wolfen; and city officials, solar energy experts and residents in Freiburg. For a more detailed accounting of sources, see the Notes for Chapter 3.

The German growth stats in this section come primarily from Germany Trade and Invest. For 2010, German greenhouse gas emissions were 23.1 percent below 1990 levels, beating its target of 21 percent. (Bloomberg report: <http://www.bloomberg.com/news/2011-04-12/germany-greenhouse-emissions-rose-4-3-in-2010-stayed-below-kyoto-target.html>). A widely cited 2007 study by Roland Berger Strategy Consultants (see for example “Why It’s Time for a ‘Green New Deal’,” *Newsweek*, 1 November 2008) estimated that the German “environmental technology” field would surpass the automotive industry in employment by 2020. (Summary at German Mission to the U.S. website:

http://www.germany.info/Vertretung/usa/en/06__Climate__Business__Science/01__Climate__Energy__Envir/02__Bus__Climate/Feature__02/___Feature__02.html); more info at Roland Berger website: http://www.rolandberger.com/expertise/industries/environmental_technology/). The average cost of the feed-in tariff on a typical German household’s energy bill was provided to me by Hermann Scheer and David Wortmann and confirmed by Germany Trade and Invest.

The study comparing German and British approaches to renewable energy legislation is “Comparison of feed-in tariff, quota and auction mechanisms to support wind power development” by Lucy Butler and Karsten Neuhoff (*Renewable Energy* V. 33, No. 8, 2008). For details on Britain’s feed-in tariff, which was introduced in April 2010, see “Britain Launches Comprehensive System of Feed-in Rates,” SolveClimate News, 3 February 2010.

My analysis of the transformation of Newton, Iowa, is based on field research in Iowa conducted in May 2010. See Notes for Chapters Four and Seven for full details. The short version in this section of Chapter Two draws most heavily on my interview with Chaz Allen. All told, there have been at least 1,200 new jobs created in Newton since the closure of the Maytag plant, but there are no authoritative figures for how many of these are directly connected to the wind industry and only about 600 or so – 450-500 at TPI Composites, 140 at Trinity Structural Towers, and around 50 at Springboard Engineering – that can be counted as “wind industry” jobs. (See the City of Newton’s “Experience Newton” website for figures:

<http://www.experiencenewton.com/business/quickfacts.html>; further details in a case study prepared for Iowa Workforce Development and available for download in PDF format at their website: http://www.iowaworkforce.org/search/search.cgi?zoom_query=newton).

This brief description of the development of Belmar in Lakewood, Colorado, is based on extensive reporting I conducted for my previous book, *The Geography of Hope* (Random House Canada, 2007) in 2006; see especially p. 243-52. The statistic on property-value premiums in Belmar comes from “The Next Slum?” by Christopher B. Leinberger, *Atlantic Monthly*, March 2008. The wider retrofit boom inspired across Denver by Belmar is covered in *Retrofitting Suburbia* by Ellen Dunham-Jones and June Williamson (John Wiley & Sons, Inc., 2009), p. 154-71; further details at the Congress for the New Urbanism website: <http://www.cnu.org/node/2901>.

My analysis of Clorox’s GreenWorks launch draws from a handful of news reports, particularly “Clorox cleaners take big share of green market” (*San Francisco Chronicle*, 12 October 2008), “Can Burt’s Bees Turn Clorox Green?” (*New York Times*, 6 January 2008) and “Cleaning Solution” (*Fast Company*, September 2008). The broad phosphate ban was reported in

USA Today, among other places (“16 states ban phosphate-laden dishwasher soap,” 30 June 2010).

YOU CAN’T SEE THERE FROM HERE

The basic principles of behavioural economics discussed in this section are drawn from several books by the field’s founders and key contributors: *Nudge: Improving Decisions About Health, Wealth, and Happiness* by Richard H. Thaler and Cass R. Sunstein (Penguin, 2009); *Predictably Irrational: The Hidden Forces That Shape Our Decisions* by Dan Ariely (HarperCollins, 2009); *Switch: How to Change Things When Change is Hard* by Chip Heath and Dan Heath (Random House, 2010); *Sway: The Irresistible Pull of Irrational Behavior* by Ori Brafman and Rom Brafman (Doubleday, 2008); *Expert Political Judgment* by Philip E. Tetlock (Princeton University Press, 2006); and *The Political Mind* by George Lakoff (Viking, 2008).

The description of Robert Cialdini’s research and its applications at Opower is reliant in particular on a ClimateWire feature, “Finding the ‘Weapons’ of Persuasion to Save Energy” by Saqib Rahim (reposted by the *New York Times*, 21 June 2010) and a series of articles and interviews with Cialdini by David Roberts at Grist.org (“40 People Who Are Redefining Green,” 12 April 2010; “Never mind what people believe—how can we change what they do? A chat with Robert Cialdini,” 12 January 2010; “Making buildings more efficient: It helps to understand human behavior,” 30 November 2009). The statistics on hotel towel signs and behaviour change is from one of Cialdini’s own presentations, reposted and summarized online at <http://speakingaboutpresenting.com/content/lessons-from-cialdini/>.

My main sources on the life and work of Daniel Kahneman are a *Forbes Magazine* feature interview, “Nobel laureate debunks economic theory” (6 November 2002) and transcripts and videos of two lecture courses taught by Kahneman (“A Short Course in Thinking About Thinking” by Daniel Kahneman, Edge Master Course 2007; and “A Short Course in Behavioural Economics” by Kahneman, Richard Thaler and Sendhil Mullainathan, Edge Master Course 2008; both available online at http://www.edge.org/3rd_culture/bios/kahneman.html); the direct attributed to Kahneman are from the 2007 course.

The direct quote from *Nudge* is found on p. 6; Thaler and Sunstein’s overview of automatic and reflective systems and the range of biases and “heuristics” informing our behaviour is on p. 17-35. Ariely’s overview of the endowment effect and the basketball lottery experiment is in *Predictably Irrational*, p. 130-32; for an explanation of arbitrary coherence, see p. 25-30; the summary quote is on p. 36. The Kahneman quote on the importance of economists as gatekeepers is from his 2008 Edge Master Course.

The study calculating the real cost of a Big Mac was conducted by the Centre for Science and the Environment in India and recounted in Raj Patel’s *The Value of Nothing*, p. 44. The estimated cost of traffic noise in the United States is from “The External Damage Cost of Noise Emitted from Motor Vehicles” by Mark A. Delucchi and Mark A. and Shi-Ling Hsu (*Journal of Transportation and Statistics* V. 1, No. 3, 1998); the study came up with a range of \$100 million to \$40 billion, with \$3 billion to \$5 billion as the most likely range of total damages.

The American Psychological Association’s “Task Force on the Interface Between Psychology and Global Climate Change” met from 2008 to 2009 and published its final report, “Psychology and Global Climate Change: Addressing a Multi-faceted Phenomenon and Set of

Challenges,” in March 2010. (The full report is available for download at the APA website: <http://www.apa.org/science/about/publications/climate-change.aspx>.)

The further discussion of Cialdini’s work that closes this section is from the Grist reports cited above; the energy use stats appeared in the *New York Times/ClimateWire* story.

A QUANTUM LEAP CANNOT BE MEASURED WITH A YARDSTICK

There are obviously a great many ways to count the losses from the 2008 financial meltdown; the figure I’ve used here – \$2.3 trillion – comes from the most recent International Monetary Fund estimate for the “global bank losses from the financial crisis” (see “IMF trims loss estimated from financial crisis,” MSNBC, 20 April 2010). This is probably at the low end, as it excludes the costs of everything from larger unemployment rolls to the costs to medical systems worldwide from stress and poverty, but as it’s a clearly stated figure that clearly indicates a staggering amount of money, it’ll do here.

The main source of information about TEEB in this section is the project final report; as previously noted, the report and much else on the project is available for download at <http://www.teebweb.org/>; the quote from Pavan Sukhdev is from a press release accompanying the report’s publication, dated 20 October 2010.

My brief overview of social capital and its correlation with social health is drawn primarily from Robert Putnam’s *Bowling Alone: The Collapse and Revival of American Community* (Simon & Schuster, 2001) and from the “Social Capital Guide” posted at the website of the British government’s Office for National Statistics (<http://www.ons.gov.uk/ons/guide-method/user-guidance/social-capital-guide/the-social-capital-project/guide-to-social->

capital.html); the quote from ONS is also from its website. The Francis Fukuyama lecture quoted from and paraphrased in this section is “Social capital and Civil Society,” delivered at George Mason University in October 1999; a transcript is available at the IMF’s website (<http://www.imf.org/external/pubs/ft/seminar/1999/reforms/fukuyama.htm>).

A full list of the UN Human Development Index’s indices and methodology is available on its website: <http://hdr.undp.org/en/statistics/>; the Center of Bhutan Studies operates an online clearinghouse for information on Bhutan’s Gross National Happiness index: <http://www.grossnationalhappiness.com/>.

The *New York Times* article on the Stiglitz-Sen report from which I quote is “Study Says New Economic Indicators Are Needed,” Peter S. Goodman, *New York Times*, 22 September 2009; the Joseph Stiglitz quote in this section is in that story as well. Full text of the “Report of the commission on the measurement of economic performance et social progress” by Joseph E. Stiglitz, Amartya Sen and Jean-Paul Fitoussi, was published in September 2009 and is available for download at the Commission’s website (<http://www.stiglitz-sen-fitoussi.fr/en/index.htm>).

For details on renewables surpassing conventional energy in Europe, see *Renewables 2010 Global Status Report*, compiled by REN21 and available for download from the Worldwatch Institute (<http://www.worldwatch.org/node/6481>).

My primary source for historic underestimations of the potential of renewables in Germany is “Renewable Energy – Predictions and Reality,” a report by Björn Pieprzyk and Paula Rojas Hilje (published in May 2009 by Agentur für Erneuerbare Energie e.V., the German Renewable Energies Agency).

There’s some fuzzy math involved in the statistic about German solar capacity’s growth exceeding expectations. The numbers come from the “Predictions and Reality” study. The

original forecast is from a German analyst firm called Prognos, conducted in 1998 for the German Ministry of Economics and Technology; it estimated that Germany would generate 0.44 terawatt-hours of solar power by 2020, a generating capacity reached in 2008. Since 22 years of solar capacity was added in just ten, the *rate* of growth was in a sense 2.2 times faster than expected, which is where I arrived at 220 percent. In truth, the solar capacity boom in Germany is *accelerating*, so the actual growth rate is probably much greater than 2.2 times the prediction. I went with the much more conservative number to avoid accusations of unsubstantiated boosterism.

Just weeks before the German federal election in September 2005, Angela Merkel rejected the targets set by Germany's renewable energy law, telling a German electricity conference it would be "unrealistic to expect that renewables will be able to close the gap that emerges as a result of phasing out nuclear power." (See "Merkel pledges German energy policy changes," *Environment Daily*, 6 September 2005.)

Angela Merkel's announcement of plans to commission 26 new coal plants in Germany was widely reported when it was made in 2006 (see for example "Germany Plans Boom in Coal Power Plants," *SpiegelOnline*, 21 March 2007), but full details of the status of those 26 commissions is harder to obtain. In March 2011, Reuters published a list of recent developments at the 20 most controversial proposed plants ("Controversial German coal-fired power plant projects," Reuters, 10 March, 2011), only three of which were then under construction or fully approved for construction (four others had switched to biofuel, seven were still at the debate stage – often including serious considerations of switching to gas or biofuels – and six had been scrapped entirely). In any case, the urgency of 2005 has evidently vanished, and it seems safe to say nowhere near 26 new coal plants will be built in Germany for the foreseeable future.

Figures from the 2002 *World Energy Outlook* were reported in the “Predictions and Reality” report. The “best case” and “realistic” estimates for European solar growth were drawn from “EPIA Road Map,” published by the European Photovoltaic Industry Association in May 2004.

A full transcript of Franz Alt’s interview with Hermann Scheer, which was published on Alt’s website, Sonneseite.de, in June 2009, can be found at the website of Eurosolar (the European Association for Renewable Energy):

http://www.eurosolar.de/en/index.php?option=com_content&task=view&id=355&Itemid=19.

“Mountaintop removal's environmental double whammy” (*The Economist*, 20 October 2009) includes a detailed description of the process of mountaintop removal mining, which begins by using “explosives and massive drag lines to shear off the top 500-800 feet of the mountain.” My main source on mercury toxicity and coal power generation is an Environmental Defense Fund factsheet called “Mercury Threatens Humans” (<http://www.edf.org/page.cfm?tagID=63464>); it notes that in 2008 “the entire Great Lakes region” was under fish contamination advisories and that 72 percent of airborne mercury pollution comes from burning coal. The Clean Air Task Force, an American nonprofit public health advocacy group, has reported that about 13,000 Americans are killed prematurely each year from the damage wrought by fine particle inhalation from coal plant emissions; in a similar vein, a 2009 report by Physicians for Social Responsibility, “Coal’s Assault on Human Health,” found that burning coal contributes to four of the top five causes of mortality in America, concluding that “coal pollution damages human health at every stage of human life cycle.” (Full report available for download at <http://www.psr.org/resources/coins-assault-on-human-health.html>).

The discussion of the contrasting “techno-logic” of conventional and renewable energy is drawn from my own interview with Hermann Scheer as well as the Franz Alt interview noted above. The Kurt Yeager quote is drawn from “Microgrids: More efficient power,” *Politico*, 22 July 2010 (<http://www.politico.com/news/stories/0710/40086.html>).

Much of the detail in my overview of the conventional energy grid – including key stats on inefficiencies – is drawn from Mariah Blake, “Grid Unlocked,” *Washington Monthly*, May 2009. Additional background and an overview of the basic architecture of the smart grid comes from Nancy Spring, “The Smart Grid and Generation,” *Power Engineering*, 1 September 2009. The source for the figure of 28 percent for the “average global efficiency of coal-fired power stations” has been widely reported, including *Euro Asia Industry* magazine (<http://www.euroasiaindustry.com/page/501/Cleaning-Coal%E2%80%99s-Reputation>) and several issues of *Living Energy*, the Siemens customer magazine (see for example “Accounting and Accountability: The Clean Energy Trade-Off” in the January 2011 issue).

My main source for details about the history and future of Danish energy policy is the Danish Energy Agency (<http://www.ens.dk/en-US/Sider/forside.aspx>); statistical information about wind power comes from the Danish Wind Industry Association (<http://www.vindselskab.dk/en/stats.htm>). Some further background on the current state of the Danish grid and the bulk of the information about Denmark’s proposed smart grid development came from my own interviews with Anders Troi of Siemens and other members of the Project EDISON consortium during a research visit in the fall of 2009, as well as interviews with Danish government officials about renewable energy in Denmark generally conducted during the research for *The Geography of Hope* in 2005 and 2006. I also drew on press releases and backgrounders at the Project EDISON website (<http://www.edison-net.dk/>); further detail came

from *Renewable Energy Report* (“Danish power system needs overhaul for wind energy,” 29 June 2009, and “After lull in wind energy development, Denmark prepares to ramp up construction,” 1 June 2009).

Estimates and targets for electric vehicle sales in Denmark vary widely and have changed repeatedly since first announced in 2009; the Danish government itself has set no hard target, but DONG Energy and Better Place, an EV maker, stated jointly that they are planning for 500,000 EVs in Denmark within the next decade. (See for example “DONG satisfied with electric car tax relief,” *Copenhagen Post*, 29 May 2009: <http://www.cphpost.dk/business/119-business/45732-dong-satisfied-with-electric-car-tax-relief.htm>.) Further background comes from Nelson D. Schwartz, “Denmark is Getting Wired for Fleets of New Cars,” *New York Times News Service*, 29 December 2009.

My estimates for the size of the global smart grid industry in 2009 and 2015 come from an SBI Energy study released in November 2010, which cites the \$69 billion figure and states that it will “surpass \$186 billion” by 2015; I rounded up to the tidier figure of “nearly \$200 billion” (see the Global Smart Grid Federation’s summary here: http://www.globalsmartgridfederation.org/news_20101117_identified.html). The quote from Cisco CEO John Chambers was found in “Smart Grid 2.0” by Alexander Jung (*Spiegel Online International*, 12 May 2010). The statistics about peak demand reductions reducing need for new power plants and 75 percent of American utilities being private monopolies comes from Mariah Blake, “Grid Unlocked,” *Washington Monthly*, May 2009. The details of Connecticut Light & Power test project – officially the “Plan-It Wise Energy Program” were drawn from a CLP press release dated 1 December 2009 (available online at <http://nuwnotes1.nu.com/apps/mediarelease/clp->

pr.nsf/0/0E66EBF11810786085257673004EA13B?OpenDocument); further details came from “The Great Green Grid” by Mike Martin (*E Magazine*, July 2010). The official figure for energy use reductions was 16.1 percent.

My primary source for details about Jan Gehl’s career and the urban design history of Copenhagen is Jan Gehl himself (in an interview conducted in Copenhagen in 2009), as well as his books *Life Between Buildings* (Danish Architectural Press, 2003) and *Public Spaces – Public Life* (Danish Architectural Press, 1996), the latter co-authored with Lars Gemzoe. I also interviewed his primary partner, Lars Gemzoe, Jeff Risom of Gehl Architects, Niels Jensen of the City of Copenhagen’s Planning and Analysis department (its chief bicycle planner) and several of his departmental colleagues, and Mikael Colville-Andersen of Copenhagenize. Much of this research was conducted in the fall of 2009, but the Gemzoe and Risom meetings occurred on a previous research trip in May 2008. Field research in Melbourne, Australia – including interviews with Rob Adams and his colleagues at the City of Melbourne – was conducted in June 2008. Field research on the Department of Transportation’s Sustainable Streets program – including interviews with Janette Sadik-Khan and her colleagues in the NYCDOT – was conducted in October 2010. For full source information on these topics, see the Source Notes for Chapter Five.

Field research on the Spanish AVE train system and its impact on Ciudad Real and Segovia was conducted in September 2009 and included extensive meetings with several members of the planning department at the University of Castile-La Mancha. The decline in air travel between Madrid and Barcelona was reported in *The Guardian* (“High-speed rail in Spain: From Madrid to Barcelona in a flash,” 5 August 2009). For further source details on Spanish high-speed rail, see the Source Notes for Chapter Four.

The LEED Platinum building referenced in passing here is the Godrej Green Business Centre in Hyderabad, India; I visited the building personally on a research trip for *The Geography of Hope* in early 2006. (Full details: <http://www.greenbusinesscentre.com/site/ciigbc/index.jsp>.) The Godrej building was completed in 2004; from 2004 to 2007, India's greenhouse gas emissions increased by 58 percent overall; see "India's greenhouse gas emissions rise 58 percent," *The Guardian*, 12 May 2010.

The *New York Times* reported China's leap to the global lead in solar panel and wind turbine manufacturing ("China is Leading the Race to Make Renewable Energy," Keith Bradsher, 30 January 2010) and its move to the top spot in greenhouse gas emissions ("China overtakes U.S. in greenhouse gas emissions," 20 June 2007). The most authoritative source I could find on the rate of Chinese coal plant construction from around 2006 to 2010 was an MIT study, which reported in October 2008 that "China's power sector has been expanding at a rate roughly equivalent to three to four new coal-fired, 500 megawatt plants coming on line every week" (see MIT News Office summary: <http://web.mit.edu/newsoffice/2008/china-energy-1006.html>). My information on the 12-day Chinese traffic jam was derived largely from a *Christian Science Monitor* online report at its conclusion ("China traffic jam vanishes overnight?," 26 August 2010, <http://www.csmonitor.com/World/Global-News/2010/0826/China-traffic-jam-vanishes-overnight>).

The figures for India's electrification rates are from the International Energy Agency's Electricity Access Database for 2008 (http://www.iea.org/weo/database_electricity/electricity_access_database.htm); the electrification rate nationwide is 64.5 percent (meaning 35.5 percent of the country has no electricity access, i.e. "more than one-third"), and the rural electrification rate is 52.5 percent.

The figure for India's landline phone subscriber base was found in the *Wall St. Journal* ("Rural India Snaps Up Mobile Phones," 9 February 2009); the best current figure I could find for the number of mobile phone subscribers in India was a story in India's *Economic Times* on 4 May 2011 ("India's 300mn mobile phone 'ghosts'"), which corrected a widely cited figure of 800 million by noting that these were total subscriptions and didn't account for the 300 million subscriptions that were second or third numbers connected to a single phone.

A GREAT LEAP IS POWERED NOT BY A DISRUPTIVE TECHNOLOGY BUT BY A DISRUPTIVE TECHNIQUE

The installation targets and other details about India's solar mission were outlined by the Indian government in a 15-page statement, "Towards Building SOLAR INDIA" (available for download from the Indian government's website: mnre.gov.in/pdf/mission-document-JNNSM.pdf). Further details came from the *Wall St. Journal* ("Budget 2010 puts Money where Mouth is for Solar Energy," 4 March 2010) and SolarIndiaOnline.com, which provided the best estimate for India's current installed solar capacity (precise statistics are always hard to come by in India, and estimates varied from 3 MW to 15 MW; SolarIndiaOnline's figure was 9.84 MW).

William McDonough's "wheels on our luggage" quote can be found in several places, including lectures I've attended; the most readily available source is his TED talk, a full transcript of which is available online:

http://www.ted.com/talks/william_mcdonough_on_cradle_to_cradle_design.html.

My brief overview of E+Co. and SELCO is based on firsthand reporting conducted in 2006 and related in much more detail for *The Geography of Hope*, p. 378-94; this included

interviews with Phil LaRocco and Harish Hande from which the quotes in this section are taken. Details about the solar energy program in Bommalapura were taken from “From Darkness to Light” by Ravindra Bhat (*Deccan Herald*, 23 March 2010); the story of the Mysore scholarship student is from E+Co.’s in-house blog (<http://eandco.net/blog/2010/05/10/selco-india-impact-through-solar-lighting/>).

My summary of Norway’s carbon tax is based on field reporting conducted in April 2008 in Stavanger, the corporate hub of Norway’s offshore oil industry; this included interviews with local and federal officials and executives from Statoil, the Norway-based oil companies. (A more detailed version of this reporting appeared in *Canadian Geographic* in October 2008 under the title “The Carbon Cleansers”). As of May 2011, the Scottish Hywind project was still being actively discussed but construction had not begun; the most recent information is at Recharge News online (http://www.rechargenews.com/business_area/innovation/article249542.ece). Details about Forewind’s Dogger Bank windfarm contract were taken from a Statoil press release (<http://www.statoil.com/en/NewsAndMedia/News/2010/Pages/08JanDoggerBank.aspx>).

For details on Bogota’s transformation, see “Former mayor of Bogota leaves his mark on many cities” by Carolyn Whelan (*New York Times*, 28 December 2007), “Bogota: Building a Sustainable City,” a 2008 PBS documentary, and Enrique Penalosa’s biography at the American Planning Association website. For details on Medellin, see “Medellin mayor turns city around” (*Newsweek*, 11 November 2007), “Sergio Fajardo and Giancarlo Mazzanti” (*BOMB Magazine*, Winter 2010), “Medellin mayor tells tale of change in Colombia” (*Cornell Daily Sun*, 20 February 2009) and “Medellin: Front Line of Colombia’s Challenges” (*Americas Quarterly*, Winter 2010).

CHAPTER THREE: The Nation's Great Leap

THE GOOD LIFE, TWENTY-FIRST CENTURY EDITION (TRANSLATED FROM THE ORIGINAL GERMAN)

As noted in the Source Notes for Chapter Two, the information on German economics, industry and the feed-in tariff in this chapter, as well as street-level details about Bitterfeld-Wolfen and Freiburg, is based on extensive field research conducted in early 2008 and September 2009.

All details about the Müller-Brauns, their home, and its energy consumption figures based on a personal meeting with Harald and Barbara at their home in Vauban on 11 September 2009. The figures for energy use and costs and revenues were copied directly from their energy bills for 2008. (The Canadian dollar equivalents were calculated based on the average conversion rate in 2008.) Some further background on the Solarsiedlung was drawn from a 2006 research trip in which I met with the architect, Rolf Disch; for more information, see *The Geography of Hope*, p. 135-40.

The full text of the German Renewable Energy Sources Act and other background details and overview are available for download in PDF format from the website of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (http://www.bmu.de/english/renewable_energy/downloads/doc/42934.php). In addition to these primary sources, I acquired key background detail on the law, its formulation, passage and

revision, in extensive interviews with Hermann Scheer and Hans-Josef Fell, its primary co-authors.

SNAPSHOTS FROM THE SECOND INDUSTRIAL REVOLUTION

The \$500 billion figure for the current size of the global renewable energy industry is extrapolated from two Datamonitor studies: The 2010 “Oil, Gas, and Renewable Energy: Global Industry Overview” report by Datamonitor, which estimated the size of the 2009 industry at \$436.6 billion (<http://datamonitormarketresearch.blogspot.com/2011/04/oil-gas-and-renewable-energy-global.html>), and the 2009 “Renewable Energy: Global Industry Guide,” which estimated the size of the 2008 global renewables business at \$310.5 billion (<http://www.energybusinessreports.com/shop/Renewable-Energy-Global-Industry-Guide.html?v=1&itemid=1723>). Based on this rate of growth, it’s likely that the size of the global industry was actually approaching \$600 billion by the end of 2010, but I’ve gone with the round and exceedingly conservative figure of \$500 billion. The German government reports that its market share of the global renewable industry was 10.1 percent and growing in 2009, so it is at least \$50 billion at present. (The most recent figure I could find was EUR33.4 billion in revenue for 2008, which as of spring 2011 would convert to \$47 billion or more in US funds.) The German government also reports 340,000 jobs created in the renewable energy sector as of 2009. (See the German government publication *Renewably Employed!*, available as a pdf at http://www.germany.info/Vertretung/usa/en/07__Climate__Business__Science/04__ClimateBrid ge/Studies__Pubs/_Studies__Pubs__S.html).

My figure for the size of the German PV industry in dollar terms is based on the German Solar Industry Association’s estimate of EUR9-billion, found in a factsheet at their website

(<http://en.solarwirtschaft.de/home.html>). Other facts and figures on industry size, market share and total number of installations were drawn from “The Photovoltaic Industry in Germany,” a regularly updated publication of the German government’s Germany Trade and Invest (GTAI) office, and were current as of January 2011. A listing of the world’s largest PV plants can be found at the website PVResources (<http://www.pvresources.com/PVPowerPlants/Top50.aspx>).

Germany’s ranking in the global wind market was reported in “World Wind Energy Market 2010,” a publication of the World Wind Energy Association. GTAI’s “The Wind Energy Industry in Germany” reports that Germany remains the largest wind power manufacturing country. The most recent information on Germany’s offshore wind targets comes from *Der Spiegel* (“North Coast Doldrums,” 27 April 2011), while *Businessweek* reported on the 2030 targets in 2009 (“Germany OKs Huge Offshore Wind Farms,” 21 September 2009). Details about Bard Engineering’s turbine production work in Cuxhaven were reported in *Renewable Energy World* (“5-MW BARD Near-shore Wind Turbine Erected in Germany,” 18 November 2008); details on the expansion of the company’s manufacturing are available at its website (<http://www.bard-offshore.de/>). The technical and financial details on First Solar’s Lieberose power plant were reported in a GTAI press release (“Europe’s Largest Solar Park Opens in Brandenburg,” 20 August 2009).

The quote from Tobias Homann is from my own interview with him, conducted at the GTAI office in Berlin on 7 September 2009.

GERMANY’S GREAT COGNITIVE LEAP

The quotes from Hermann Scheer and paraphrase of his recounting of the origins, drafting, passage and growth of the feed-in tariff are based on my own interview with Scheer at

the Café Einstein in Berlin on 8 September 2009. Some additional detail (but no direct quotation) has been drawn from a phone interview with Scheer I conducted in June 2008.

For an example of the use of “Solar-DAX,” see “Willkommen im Solar-Dax,” Boerse-Online.de, 3 June 2008 (<http://www.boerse-online.de/aktie/nachrichten/deutschland/:Roth-%26-Rau--Willkommen-im-Solar-DAX/499369.html>).

THE STRATEGIC LEAP

My primary source for this section on the subnational origins and spread of the feed-in tariff was Hans-Josef Fell, both in a phone interview and especially in a paper he wrote, “Feed-in Tariff for Renewable Energies: An Effective Stimulus Package without New Public Borrowing” (published by the Heinrich Boell Foundation, available for download in PDF at <http://www.wind-works.org/FeedLaws/Germany/GermanyList.html>). The previously cited interviews with Hermann Scheer also informed this section.

For more information on the failed UK “Renewable Obligation Certificate” program, see the Butler/Neuhoff study cited in the Source Notes for Chapter Two; Ontario’s abandoned “Standard Offer Program” and its replacement with a feed-in tariff is exhaustively documented by Paul Gipe at Wind Works (<http://www.wind-works.org/FeedLaws/Canada/OntarioandtheCampaignforAdvancedRenewableTariffs.html>; Gipe was a key adviser in the formulation of Ontario’s feed-in tariff).

THE FOLLY OF FORECASTING

My primary source on the underestimation of the potential for renewable energy in Germany is the Pieprzyk/Hilje report cited previously (“Renewable Energy – Predictions and Reality.” I interviewed John Anderson at the Rocky Mountain Institute office in Boulder, Colorado, in June 2006, while researching *The Geography of Hope*.

For German renewable energy statistics at the end of 2010, see “New Record for German Renewable Energy” by Paul Gipe (*Renewable Energy World*, 25 March 2011; <http://www.renewableenergyworld.com/rea/news/article/2011/03/new-record-for-german-renewable-energy-in-2010>).

Details on the Kombikraftwerk project, including the quote used in this section, are drawn from a background paper and press release available for download at the project website (<http://www.kombikraftwerk.de/index.php?id=29>).

THE FEED-IN TARIFF GOES VIRAL

The most detailed and authoritative database on the spread of feed-in tariffs worldwide is maintained by Paul Gipe at his Wind-Works.org site (http://www.wind-works.org/articles/feed_laws.html).

The full text of the original 2000 German EEG is available online at <http://www.iwr.de/re/iwr/info0005.html>; the word count on the text is 7,898.

The imminent arrival of grid parity in Italy was first reported in a Research & Markets study (“The German Solar Photovoltaic Market: a New Era of Competition Dawns”) in June 2009; for a summary see “Here Comes the Sun,” M2 Presswire, 26 June 2009.) In May 2011, European Photovoltaic Industry Association president Ingmar Wilhelm was quoted as saying

Italy was on the verge of grid parity (http://www.evwind.es/noticias.php?id_not=11650). A recent, detailed report on Italy's renewable energy boom is "Italy Overhauls Its PV Incentives," *Renewable Energy World*, 19 May 2011. For details on what was then Europe's largest planned solar plant, see "U.S.'s SunEdison to build solar plant in Italy," Reuters, 11 March 2010; see also "Solar Energy Surging in Italy, Surpassing U.S.," SolveClimate News, 22 September 2010.

Paul Gipe of Wind-Works.org provided valuable background information on the evolution of Ontario's renewable energy regulations, both at his website and in a phone interview; he has also reported on the growth of Ontario's solar market. Details of the Samsung deal were reported at the *New York Times'* Green Inc. blog, among other places ("Samsung Signs \$6.6 Billion Deal to Build Wind and Solar Power in Ontario," 21 January 2010), describing it as "the largest deal of its kind in the world." Because several business agreements of similar scope have since been announced in China, I chose to conservatively describe it as the largest in North America.

My primary source on the origins of Gainesville's feed-in tariff was "What, Exactly, Is A Feed-In Tariff" by Bruce Stokes (*National Journal*, 24 April 2009); that story is the source of the Ed Regan quote I've used. See also "The State of Sunshine" (*St. Petersburg Times*, 12 April 2009), which reports that as of April 2009 Florida's grid had "more than three megawatts" of solar power connected to it; to be generous, I rounded the figure up to 4 MW. According to the U.S. Energy Information Administration, Florida's net electricity generating capacity as of 2009 was 59,037 MW; 20 MW is 0.0339 percent of that total.

For background on Spain's feed-in tariff, again see Paul Gipe's Wind-Works.org database. The European Wind Energy Association reported that Spain installed 3,522 MW of wind power in 2007; Germany was second with 1,667 (see "Pure Power: Wind Energy Scenarios

up to 2030,” March 2008). For details on Spain’s solar energy boom, see “It’s Official: Global Solar Market Exploded in 2008” by Dennis Markatos (Huffington Post, 17 March 2009) and “Solar Industry Learns Lessons in Spanish Sun” by Elisabeth Rosenthal (*New York Times*, 8 March 2010). See European Wind Energy Association and European Commission Joint Research Centre reports for national rankings in wind and solar growth.

For an overview of Gamesa’s industrial activities in the Pittsburgh area, see “Wind turbine maker plants firm foot in the state,” *Pittsburgh Tribune-Review*, 7 June 2009.

My critique of Spain’s feed-in tariff (as well as firsthand information on how it was drafted) comes from my conversations with Hermann Scheer.

ALTERNATE LEAPING STYLES, FROM DANISH MODERNE TO SUNNY CALIFORNIAN

Sorting out the overlapping schemes and regimes in Danish energy policy is no easy feat, especially since much of the key documentation is not translated into English. The best single overview of Denmark’s renewable energy policy history I’ve found is “Danish Renewable Energy Policy” by Preben Maegaard (available for download from the World Renewable Energy Council:

http://www.wcre.de/en/index.php?option=com_content&task=view&id=119&Itemid=3). My summary also relies on field research and interviews with Danish energy officials conducted during the research for *The Geography of Hope* in 2005, as well as the European Commission’s review of Danish energy policy in 2005. A brief overview of Danish policy and links to key documents – including the EC’s review I just mentioned – can be found at the World Future Council website [Futurepolicy.org](http://www.futurepolicy.org) (<http://www.futurepolicy.org/2663.html>).

I should note that Danish officials still refer to their energy policy as a feed-in tariff, but the policy is substantially different from the German approach (Paul Gipe, for example, does not include Denmark in his database of feed-in tariffs). And in any case I've differentiated Denmark from the German system here because the foundation of Danish energy policy has been energy independence and specific incentives for the wind industry, not a single feed-in tariff designed to encourage renewable energy production of all types.

My overview of the transformation of Samsø and Aerø is based on my own extensive field reporting on both islands in 2005; for more detail, see *The Geography of Hope*, p. 27-45 and p. 65-70.

Technical specifications of the Avedøre Power Plant and an overview of its operations and impact can be found at Power-Technology.com (<http://www.power-technology.com/projects/avedore/>). Additional detail at the Biopact website (<http://news.mongabay.com/bioenergy/2008/02/worlds-most-efficient-chp-station-uses.html>).

As noted in the Source Notes for Chapter One, my discussion of Norway's carbon tax is based on field reporting for *Canadian Geographic* conducted in the spring of 2008 ("The Carbon Cleansers," October 2008). There is an English-language news report on the Norwegian government's scaling down of its low-emissions gas plants at the *Aftenposten* website ("Government blasted for dropping carbon deal," 18 December 2007), including references to its "moon landing" scale. I also drew on background information provided for me by Jostein Soland, managing director of the Stavanger Chamber of Commerce and Industry, in an interview in Stavanger in May 2008. See also "Critics blast 'moon landing' delay," *Views and News from Norway*, 4 May 2010.

My description of biofuel use in Helsingborg and the broader context of Sweden's move to eliminate fossil fuels is based on field research in Helsingborg and Malmo in August 2009. For a succinct overview of Sweden's carbon tax regime, see the Carbon Tax Center website (<http://www.carbontax.org/progress/where-carbon-is-taxed/>). For Sweden's 2006 pledge to eliminate fossil fuels, see "Sweden plans to be world's first oil-free economy," *The Guardian*, 8 February 2006. For details on its carbon tax revisions in 2007, see "Sweden's carbon-tax solution to climate change puts it top of the green list," *The Guardian*, 29 April 2008.

My primary source for background detail on California's climate policy is an interview I conducted with Terry Tamminen, the head of the EPA in California at the bill's passage, by phone in February 2010. My overview of the transformation of the California solar business in the wake of the act is based on field research in the Bay area in July 2008, which included interviews with SunPower CEO Tom Werner, Nanosolar CEO Martin Roscheisen, Applied Materials CTO Mark Pinto and cleantech venture capitalist Erik Straser of Mohr, Davidow Ventures, as well as site visits to household and big-box retail solar installations with officials from Akeena Solar and SunPower. Further detail on the standard business model for large-scale rooftop solar in California was drawn from SunPower and SunEdison press releases and case studies.

Full details of the California Global Warming Solutions Act (Assembly Bill C-32) is available on the state government website (<http://www.arb.ca.gov/cc/ab32/ab32.htm>); for the California Renewable Portfolio Standard, see the California Public Utilities Commission website (<http://www.cpuc.ca.gov/PUC/energy/Renewables/index.htm>).

For a detailed explanation of California's ranking as the world's 8th largest economy, see EconPost.com (<http://econpost.com/californiaeconomy/california-economy-ranking-among->

world-economies); the ranking was current as of the end of 2009. For an online version of the *Popular Mechanics* “10 Most Brilliant Products of 2009” list, featuring Akeena Andalay panels, see <http://www.popularmechanics.com/home/improvement/energy-efficient/4332411>.

SOLAR VALLEY & THE CLEANTECH RENAISSANCE

As noted in the Source Notes for Chapter Two, my examination of the origins of Germany’s “Solar Valley” and its impact on the economy and social fabric of Bitterfeld-Wolfen is based on two extensive research visits, the first in May 2008 and the second in September 2009. I met with Q-Cells officials and toured Q-Cells and Calyxo production facilities, interviewed Christian Puschmann of the B-W economic development office twice, toured the region extensively with Puschmann and other economic development office representatives, and met with Andreas Beuster in person at the new Bitterfeld marina. I also interviewed numerous officials at the office of Germany Trade and Invest to put the Bitterfeld-Wolfen transformation in broader context and toured the Bitterfeld-Wolfen Film and Industry Museum with its director, Uwe Holz.

All quotes, physical description and narrative detail in this section are taken from my notes and transcripts of interviews on those research tours.

I have listed Q-Cells as having “numerous” production lines in operation in Solar Valley; there are five built and all five were operating when I visited in 2009, but in the final weeks before this book went to press at least three of these were shut down in order to reduce corporate losses as the company took a beating in the marketplace against cheaper Chinese equipment; see “Q-Cells lays off contract workers,” *pV magazine*, 4 May 2011 (<http://www.pv->

magazine.com/news/details/beitrag/q-cells-lays-off-contract-workers_100002825/). The details about Nanosolar's German factory (in a town called Lückenwalde) are based on a site visit in May 2008; the note on the solar cluster's goals is based on a site visit and interview with Jörg Bagdahn, head of the Fraunhofer Center for Silicon Photovoltaics in Halle in September 2009.

The historic declaration of Bitterfeld as Europe's dirtiest town was made by Berlin author Monika Maron in her 1981 *Flugasche*; the title is not disputed by anyone in the region (in fact it was an official at the Bitterfeld-Wolfen economic development office who first told me about the title). Uwe Holz of the local industry museum (officially *Besichtigung des Industrie- und Filmmuseums Wolfen*) confirmed the grim toll of GDR industry and is quoted directly on the subject, based on my notes from my tour of the museum. The recounting of the "relocation" logistics boom in 1990s Bitterfeld was explained by Andreas Beuster. For further detail on the Bitterfeld transformation, see "The extraordinary transformation of Bitterfeld," *Deutsche Welle*, 7 January 2009 (<http://www.dw-world.de/dw/article/0,,3806024,00.html>) and "Resurrection in the air," *The Independent*, 1 May 1994.

The most recent figure for the total number of operational nuclear plants in Germany comes from Reuters ("Japan Crisis Turns Germany, Italy Against Nuclear," 17 March 2011).

Details on Google Ventures, including the roughly \$100-million-per-year commitment: <http://www.google.com/ventures/where-we-invest.html>

CHAPTER FOUR: The Economy's Great Leap

SUSTAINABILITY UNDER GLASS

My discussion of the history of the Toledo glass industry, its early role in the development of thin-film solar, and its emergence as a research cluster, is based on field research conducted in Toledo in May 2010. This included meetings and interviews with Lloyd Jacobs, president of the University of Toledo; Megan Reichert-Kral, director of incubation at the UT; Al Compaan, professor emeritus of physics at UT; Frank Calzonetti, vice-president of for research development at UT; Norm Johnston, chairman of Ohio Advanced Energy and CEO of Solar Fields LLC; Stephen Weidner of Pilkington Glass; and Steve Weathers of the Regional Growth Partnership in Toledo.

Several of my interview subjects provided their own capsule histories of the glass and solar businesses in Toledo; Norm Johnston and Al Compaan, as former partners of Harold McMaster, were particularly vital in this role. For further historic detail in this section, see “A City Built of Glass,” an essay on the University of Toledo website; the entry for Toledo at the online encyclopedia *Ohio History Central*, and the entry for Libbey Inc. at *Hoover’s Company Profiles* (<http://www.answers.com/topic/libbey-inc>). The *Hoover’s* entry provided key details about the Libbey exhibit at the Chicago Exposition.

During my visit to the University of Toledo, Frank Calzonetti and Megan Reichert-Kral made a presentation on the glass business that included key details about the careers of Michael J. Owens and Harold McMaster (the statistics on glass production today reliant on McMaster’s designs is from their presentation). Further details on McMaster can be found in the citation for his induction into the Inventors Hall of Fame (http://www.invent.org/2008induction/1_3_08_induction_mcmaster.asp) and in “McMaster to Hall of Fame,” *Toledo Blade*, April 2008.

My source for Toledo's changing unemployment rates is the United States Bureau of Labour Statistics (summary available online at <http://www.deptofnumbers.com/unemployment/ohio/toledo/>); Toledo's overall population decline was reported by the *Toledo Blade* ("Population of Toledo falls to 287,208," 10 March 2011).

The superlatives attached to First Solar in this section are based on the widely reported fact that First Solar has been the largest manufacturer of thin-film solar modules since 2009, and their modules are still believed to be the least expensive panels of any kind on the market despite a flood of cheap conventional PV panels made in China (for more information, see "First Solar: 2011 Sales to Jump 46%, Still the Low Cost Leader," Reuters, 14 December 2010).

The employment figure for Toledo's solar cluster comes from the Wright Center for Photovoltaics Innovation and Commercialization at UT (<http://www.pvic.org/NewsEvents/Judy.aspx>); Ohio Governor Ted Stickland gave the Toledo region its official designation on 30 June 2010 (<http://www.development.ohio.gov/Urban/OhioHubs.htm>; full details of air base solar installation can be found via the *Toledo Free Press* (<http://www.toledofreepress.com/2010/01/08/ohio-air-national-guard-expands-solar-energy-field/>). Credit for first use of the term "Silicon Valley of solar energy" in Toledo appears to go to Tom Blaha of the Wood County Economic Development Commission (see <http://www.siteselection.com/theEnergyReport/2009/may/First-solar/index.htm>), though it has also been attributed to both CNN and *Businessweek*.

My description of the potential for a solar boom in Ohio is based on a presentation by Norm Johnston entitled "The Ohio Solar Cluster," which was delivered to the National Academy

of Science and Department of Energy in Washington in April 2009 and updated in April 2010 (Johnston gave an abbreviated version of the presentation for me at his office and provided a copy of the PowerPoint document).

For more on First Solar's Chinese expansion, see for example "First Solar signs massive deal with China," CNet News, 9 September 2009 (http://news.cnet.com/8301-11128_3-10347438-54.html); figures on its workforce size and distribution and its sales figures were drawn from its *Hoover's* profile (http://www.hoovers.com/company/First_Solar_Inc/rhrhjif-1.html)

GREEN-COLLAR AMERICA

As previously noted, full transcript of Obama's Earth Day speech is online at the official White House website: http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-in-Newton-IA/; full video available at YouTube: http://www.youtube.com/watch?v=52OXVQQtdYA&feature=player_embedded.

Much of my description of Newton and the Iowa wind industry is based on field research conducted around the state in May 2010. The story of how Newton came to embrace the wind business is based mainly on an interview with Newton Mayor Chaz Allen; my recounting of the broader wind industry boom draws on interviews with University of Iowa engineering dean Barry Butler and independent wind consultant and Iowa Power Fund board member Thomas A. Wind, as well as documents provided by the Iowa state government (particularly the Office of Energy Independence).

Some detail about the closure of Maytag's Newton plant was drawn from "Is There (Middle Class) Life After Maytag?" by Louis Uchitelle (*New York Times*, 26 August 2007). Employment figures for Newton's wind energy business can be found at the City of Newton's Experience Newton website (<http://www.experiencenewton.com/business/employmentfacts.html>).

The *Des Moines Register* reported that Iowa was already getting at least 15 percent of its power from wind turbines and was on track to hit 20 percent by the end of 2011, hence my phrasing – "more than 15 percent" ("Iowa leads all states in use of wind energy," 8 April 2011). Details of the first wind turbine in Iowa were provided by Tom Wind; case studies published by the Iowa government (download available at www.energy.iastate.edu/AERLP/downloads/SpiritLake_07.pdf) and Northwest Community Energy (<http://nwcommunityenergy.org/wind/wind-case-studies/spirit-lake>) confirm the story.

My overview of Iowa's wind policy history is drawn from my conversations with Wind and Barry Butler; the Institute for Energy Research (<http://www.instituteforenergyresearch.org/renewable-mandates/iowa-renewable-electricity-mandate-status/>); "Renewable Energy Mandate – Iowa," a summary document posted at the New Rules Project website (<http://www.newrules.org/energy/rules/renewable-portfolio-standards/renewable-energy-mandate-iowa>); and the thesis paper "A Holistic Analysis: Wind Energy Integration in the State of Iowa" by Daniel Wallace (University of Iowa, College of Engineering, April 2010, unpublished). T. Boone Pickens' "Saudi Arabia of wind" line has been widely quoted in the mainstream press; see for example "A Wind Power Boonedoggle," *Wall St. Journal*, 22 December 2010.

For statewide cleantech employment figures, see “Wind Energy Awaits Stiffer Breezes” (*Des Moines Register*, 26 September 2010); the figure for wind turbine manufacturing is drawn from a study published by the Environmental Law and Policy Center (for a summary, see <http://www.greencollar.org/employer/wind-industry-supports-2-300-jobs-in-iowa-says-study-news-992.html>).

Gamesa’s contribution to the Pennsylvania economy (with employment figures) was reported in “Gamesa is Named Ex-Im Bank's Renewable-Energy Exporter of the Year”, Reuters, 29 March 2011; for Vestas’ role in Colorado, see “Vestas Makes Colorado a Clean Energy Hub” (*Green Inc./New York Times*, 5 May 2009); Konarka’s Polaroid factory refurbishment was reported by NPR (“Once-dark Polaroid factory goes green,” 5 January 2010); CNN reported on the growth of Hemlock Semiconductor and EnerDel (“Renewables: America’s Next Heavy Industry,” 15 June 2009); the Think plant in Indiana and its relationship with EnerDel was reported by *Indy.com/Indianapolis Star* (“Think plans to assemble cars in Elkhart” by Ted Evanoff, 5 January 2010); EnerDel’s stimulus grant and expansion were reported by WISH-TV (“EnerDel receives \$118.5M stimulus grant,” 4 March 2010).

The report estimating green job creation is “Green Recovery: A New Program to Create Good Jobs and Start Building a Low-Carbon Economy” by Robert Pollin et al. (Center for American Progress, September 2008; available for download at http://www.americanprogress.org/issues/2008/09/green_recovery.html); the employment figures for wind vs. coal mining come from “Wind jobs outstrip coal mining” by Todd Woody (*CNN Fortune*, 28 January 2009). Figures on the coal industry’s economic impact in West Virginia are drawn from a study by Downstream Strategies and the West Virginia Center on Budget and Policy (see the summary news report: “Is coal really worth it in West Virginia?”, Beckley

(WVa.) *Register-Herald*, 22 June 2010; <http://www.register-herald.com/local/x1617559547/Is-coal-really-worth-it-in-West-Virginia>); the report concluded that “the net cost [of the coal industry] to the state in fiscal 2009 came to \$97.5 million.”

For the downturn in Iowa’s wind industry, again see “Wind Energy Awaits Stiffer Breezes” (*Des Moines Register*, 26 September 2010). Quotes from Al Compaan of the University of Toledo are from my interview with him.

For an overview of the PACE financing plan, see the Vote Solar Initiative website (<http://votesolar.org/city-initiatives/solar-municipal-property-tax-financing/>); for details on the scrapped California PACE program and lawsuit, see CalFinder (<http://solar.calfinder.com/blog/solar-funding/ca-pace-solar-funding/>) and Todd Woody’s Green Wombat blog (<http://thegreenwombat.com/2010/07/14/california-sues-fanniefreddie-over-pace-solar-loan-program/>).

THE WALMART EFFECT

Norm Johnston’s Owens Corning anecdote is from my interview with him in Toledo. Ray Anderson’s assessment of Interface’s sustainability program in 2009 is drawn from an internal video available on YouTube (<http://www.youtube.com/watch?v=NYfTu48f848>): for background and historical detail, I relied on my own reporting and interviews with Interface officials in 2006 (for more information see *The Geography of Hope*, p. 213-219 and p. 296-301).

The details about Walmart’s sustainability program are drawn primarily from my reporting in late 2009, including interviews with Walmart Canada vice-president for supply chain Andy Ellis and vice-president for corporate affairs and sustainability Andrew Pelletier and

Walmart consultant Marc Major, as well as a site visit and tour of Walmart Canada's Western Distribution Centre in Balzac, Alberta. I also interviewed Adam Werbach about his work with Walmart in 2008 and spoke with several Rocky Mountain Institute officials about their role while researching *The Geography of Hope* in 2006.

The full text of Lee Scott's 2005 "21st Century Leadership" speech is available for download from Walmart's website (<http://walmartstores.com/ViewResource.aspx?id=1965>). Facts, figures and other details on Walmart's size and growth were drawn from a variety of sources: for Walmart's weekly customer tally in the U.S., 7th Generation's reluctance to partner with Walmart and Jeffery Hollender quotes, see "Adversary's Clean Start with Walmart" (*Wall St. Journal*, 26 July 2010); for Walmart's domination of the global organic cotton supply, see "How Walmart Became Organic" (*Fortune*, 31 July 2006); for Adam Werbach's reluctant working relationship with Walmart, see "Working with the Enemy" (*Fast Company*, September 2007); for details on the first phase of Walmart's sustainability pledge, see "The Green Machine" (*Fortune*, 31 July 2006); for Patagonia's relationship with Walmart, see "Patagonia's Founder on Why There's 'No Such Thing as Sustainability'" (*Fast Company*, July 2009) and "Walmart, Patagonia Strengthen Pact to Measure Apparel Impact" (GreenBiz.com, 1 March 2011); David Suzuki delivered a keynote at the Walmart Green Business Summit in Vancouver on 10 February 2010 (for details, see the summit press release at <http://www.newswire.ca/en/releases/archive/February2010/04/c6926.html>); facts and figures on Walmart's supply chain efficiency were provided to me by Walmart officials during my tour of their distribution centre.

The tripling in size of the green household product market was reported by the *Wall St. Journal* (again: "Adversary's Clean Start with Walmart," 26 July 2010); Walmart's central role

in bringing concentrated detergent was noted in “Attention Walmart Suppliers,” *Supply Excellence*, September 2007; Walmart’s sustainability scorecard push was reported in the *New York Times* (“At Walmart, Labels to Reflect Green Intent,” 15 July 2009); the *Advertising Age* quote is from “Why Wal-Mart Has More Green Clout Than Anyone,” 15 October 2007.

Besides ClearGreen Advisors, examples of Walmart-focused green consulting firms include ClearCarbon and Greener Dawn Inc.

Walmart’s plan to build smaller urban stores was widely reported; see for example “Walmart sets sights on San Francisco,” *San Francisco Chronicle*, 21 September 2010.

FAST TRAINS & THE SUSTAINABLE LONG-DISTANCE COMMUTE

My overview of Spain’s AVE train network and its impact on the society and economy of cities along its routes was based on extensive field reporting in September 2009. In addition to multiple long-haul and commuter-hop AVE and AVANT rides, I conducted field reporting and interviews in Ciudad Real and Segovia. In Ciudad Real, I met with Jose Maria de Ureña Frances, Jose Maria Coronado Torsedillas and Maddi Garmendia Antin of the University of Castile–LaMancha; in Segovia, I met with Juan Gonzalez Barrera, director general of Segopolis, the city’s strategic planning body.

Several studies co-authored by Jose Maria de Ureña Frances also provided vital detail: for the impact of high-speed rail on Cordoba, Zaragoza and Lille, France, see “The high-speed rail challenge for big intermediate cities: A national, regional and local perspective” by José M. Ureña, Philippe Menerault and Maddi Garmendia (*Cities* V. 26, 2009); for the unique properties of high-speed rail to transform corridors 400 to 600 km long, see “Changing territorial

implications of High Speed Rail in Spain: from individual lines, stations and services to networks” by Ureña and Jose Maria Coronado J.M. (presented at “City Futures in a Globalising World” conference, Madrid, June 2009).

In December 2010, Agence-France Presse (AFP) reported that Spain’s high speed network overtook France’s as Europe’s most extensive with the completion of the Madrid-Valencia line, 2,056km to 1,896km (“Spain overtakes France as Europe’s high-speed rail leader,” 19 December 2010); the same story reported on costs and job-creation prospects along the new line. AFP also reported on agreements to expand to Portugal and France (“Spain, Portugal and France agree on high-speed rail,” 11 June 2010); *Railway Gazette* detailed the planned Santander line (“High speed concession plan,” 25 August 2010, <http://www.railwaygazette.com/news/single-view/view/high-speed-concession-plan.html>).

Zaragoza’s trade show boom was reported by the BBC (“Trains in Spain signal the future,” 22 September 2009).

The total cost I’m using (EUR100 billion) was roughly current as of my visit to Spain and reported (along with some background detail on Ciudad Real’s AVE-inspired boom) in “Spain’s bullet train changes the nation – and fast,” *Wall St. Journal*, 20 April 2009; the comparative cost of the US interstate system in 2009 dollars was cited by Richard Florida in “Roadmap to a high-speed recovery,” *New Republic*, August 2010 (the range of estimated costs for HSR in the US are in this article as well).

The impact of HSR on German short-haul air travel was reported in *The Guardian* (“High-speed rail in Germany: Inter-city planes are grounded by faster trains,” 5 August 2009); the 2006 unveiling and subsequent expansion of China’s HSR plan was reported in MIT’s *Technology Review* (“China’s High-Speed Rail Revolution,” Peter Fairley, 11 January 2010).

I drew much of my overview of the state of rail travel and HSR in the U.S. from “Taking High Speed Trains into the Future” by Bruce Selcraig (*Miller-McCune Magazine*, 16 August 2010, <http://www.miller-mccune.com/politics/taking-high-speed-trains-into-the-future-20305/>). Comparative statistics on US transport spending from 1956 to 2006 are taken from the 2010 U.S. Public Interest Research Group report “The Right Track: Building a 21st Century High-Speed Rail System for America” (download at <http://www.frontiergroup.org/our-research/transportation/reports-on-transportation/the-right-track#idji8kJ8p4jMNBFw1bCBWsvw>).

A study by Subsidyscope of 2007 US Federal Highway Administration data found that “user fees” accounted for only 51 percent of the total operating cost of America’s roads (<http://subsidyscope.org/transportation/highways/funding/>); a slightly higher figure, 58 percent, was reported without citation in *American Conservative* magazine (<http://www.amconmag.com/blog/keep-america-moving/rail-against-the-machine/>). To err on the side of caution, I’ve qualified the Subsidyscope stat with “as little as.” Figures for America’s annual parking subsidy come from Donald Shoup’s 2005 book *The High Cost of Free Parking*; for a summary, see “Putting Parking into Reverse,” *InTransition Journal*, Winter 2009.

CHAPTER FIVE: The Leap in the City

FOOTLOOSE IN SOLE CITY

The United Nations Population Division issued a report in February 2008 indicating that human populations would be more than 50 percent urban by the end of the year. See “Half of world to live in cities by end of ’08,” Reuters, 26 February 2008.

My description of the history and recent transformation of Bryant Park is drawn from documents, statistical data and other information on the Bryant Park Corporation website (<http://www.bryantpark.org/about-us/history.html>). For the broader context of New York’s decay in the 1970s, I also drew on a five-part retrospective on the blackouts of 1977 published by *The New York Post* in July 2007 and a similar retrospective at *The New York Times*’ City Room blog (“Remembering the ’77 blackout” by Sewell Chan, <http://cityroom.blogs.nytimes.com/2007/07/09/remembering-the-77-blackout/>).

My analysis of the transformation of New York in this section is based largely on field research conducted in October 2010, as well as extensive interviews with Janette Sadik-Khan, Jan Gehl and several partners in his firm (particularly Lars Gemzoe and Jeff Rizom). The description of Broadway post-pedestrianization is drawn from my own notes. Data and further detail have been drawn from numerous NYCDOT publications, particularly *World Class Streets: Remaking the Public Realm* (prepared by Gehl Architects, 2008); *Sustainable Streets: Strategic Plan for the New York City Department of Transportation 2008 and Beyond*; *Sustainable Streets 2009: Progress Report*; *Sustainable Streets Index 2008*; and *Introduction to Bus Rapid Transit Phase II*.

Additional detail and data were provided by “Honk, Honk, Aaaaah” by Michael Crowley (*New York Magazine*, 17 May 2009) and “A Times Sq. ‘Sanctuary’ on First Workday Without Cars” by William Neuman (*New York Times*, 26 May 2009). The figures for pedestrian vs. motor vehicle traffic in Times Square before its pedestrianization are from the *New York* story. The

estimated cost of the makeover comes from Janette Sadik-Khan. For the *New York Post's* reaction, see “City Aces Its Road Test,” “Boos for Chairs in Times Sq.,” and “Real NYers ‘Malled’ By Incredibly Dumb Idea” (by Andrea Peyser), all published on 27 May 2009.

THE DEFEETED CITY (SIC)

Dan Ariely’s description of anchoring and the endowment effect is in *Predictably Irrational*, p. 30-42 and p. 130-38.

The annual cost of road maintenance and failure of fuel taxes and other user fees to cover it is found in “Do motor vehicle users in the US pay their way?” by Mark A. Delucci (*Transportation Research Part A*, 2007).

The sources for my range of estimates for “real” cost of gasoline are: at the bottom end (\$5.28), see the National Defense Council Federation report, “The Hidden Cost of Imported Oil” (2003; summary at the Institute for the Analysis of Global Security website: <http://www.iags.org/n1030034.htm>); at the mid range (pump price + \$8.35 for Persian Gulf oil), see Gal Luft of the Institute for the Analysis for Global Security (reported online at <http://www.hybridcars.com/news/real-cost-gallon-gas-835.html>); at the top end (up to \$15.14), see the 1998 International Center for Technology Assessment report “The Real Cost of Gasoline” (press release and download: http://www.icta.org/press/release.cfm?news_id=12).

On the dangers of exurban roadways, see “The Myth of the Great Wide Way” by Craig Raphael at the Project for Public Spaces website (7 July 2009, <http://www.pps.org/blog/the-myth-of-the-great-wide-way/>); Raphael summarizes several comparative studies, noting that wider lanes, increased road capacity and fewer physical obstacles at the roadside, which improve

safety on controlled-access highways, actually decrease safety on standard roads. Raphael doesn't explicitly cite exurban thoroughfares, but the cumulative description of dangerous design features – wide roads in sparsely populated areas with few roadside objects – is best embodied by the main arterial roads in recent exurban neighbourhoods.

For the skewed psychology of motor vehicle driving, see *Traffic* by Tom Vanderbilt (Knopf, 2008), especially p. 15-30 (quote on p. 21), p. 51, p. 138-42, p. 161-4, and p. 269-73. Vanderbilt also cites studies showing that lower-density suburbs lead to higher traffic fatalities, supporting Raphael's point above.

The excess demand for walkability was cited in Leinberger, "The Next Slum?" (*Atlantic Monthly*, March 2008). The relationship between cul-de-sacs and congestion is from a 2001 University of British Columbia cited in "The Cul-de-Sac Backlash" by Bradford Plumer (*New Republic*, 9 February 2010, <http://www.tnr.com/blog/the-vine/the-cul-de-sac-backlash>; includes link to PDF of original study). Comparative stats on household transport budgets are from Chris Leinberger of the Brookings Institution (cited at Streetsblog New York City, "The Economic Argument for Walkability," 7 October 2009, <http://www.streetsblog.org/2009/10/07/the-economic-argument-for-walkability/>). The rise in suburban poverty is from the Brookings Institution report "The Suburbanization of Poverty: Trends in Metropolitan America, 2000 to 2008" by Elizabeth Kneebone and Emily Garr (Brookings Institution Metropolitan Opportunity Series No. 4, January 2010).

THE RECONQUEST

As noted previously, my analysis of the transformation of Copenhagen is based on extensive field research in the city and interviews with Jan Gehl, his partners, and a range of Copenhagen municipal officials. Jan Gehl's own writing was also a key source of information: see *Life Between Buildings* and *Public Spaces Public Life* (full citations above). Quotes in this section are either from my interviews with Gehl or from his books.

For a detailed overview of the Danish concept of *hygge*, see "'Hygge' heaven" by Jason Wilson, *Boston Globe*, 28 September 2003.

Statistics, details and other data about Copenhagen's pedestrianization from 1971 onward are from *Public Spaces Public Life* and from conversations with Gehl and Gemzoe. See also "Learning from Copenhagen" by Paul Makovsky (*Metropolis Magazine*, August/September 2002).

THE LIBERATED CITY

In its July 2007 issue, *Monocle* ranked Copenhagen No. 2 on its "Top 25 livable cities" survey; it was ranked No. 1 in the July/August 2008 ranking, and No. 2 again in the 2009 and 2010 rankings – the only city to place in the Top 3 all four years. For a summary of the Siemens/*Economist* Intelligence Unit's "Green Cities Index," with Copenhagen in top spot, see <http://www.citymayors.com/environment/greenest-cities-europe.html>. The average per capita energy use in Copenhagen vs. Detroit was cited by architect Norman Foster in "Architecture and Sustainability," a 2003 essay available at the Foster + Partners website. The attrition war on parking spaces in Copenhagen was reported in Vanderbilt's *Traffic*, p. 148, and also cited by Jan Gehl in my conversations with him.

My explanation of the city's "Green Wave" bike commuter lanes is based on conversations with Mikael Colville-Andersen of Copenhagenize.com and Niels Jensen of the City of Copenhagen.

For Copenhagen's municipal carbon neutrality pledge, see "Copenhagen aims to be carbon neutral by 2025," Agence-France Presse, 19 March 2009.

COPENHAGENIZATION

The quote from Tony Judt's *Ill Fares the Land* (Penguin, 2010) can be found online at the Public Sphere Forum website (<http://publicsphere.ssrc.org/judt-the-disintegration-of-the-public-sector/>).

The Jan Gehl quote ("Cultures and climates differ . . .") was found in "Our Place in the World" by Jay Walljasper (*Ode Magazine*, June 2005). A full accounting of the projects and studies completed by Gehl's design firm worldwide can be found at the Gehl Architects website (<http://www.gehlarchitects.com/index.php?id=159110>).

Sources for data on New York's pedestrianization are the same as noted above.

For details on Portland's shift to multimodal transit, see "Portland Bicycle Counts 2008" (available for download at <http://www.portlandonline.com/transportation/index.cfm?c=44671>); the Human Transit blog (<http://www.humantransit.org/2010/01/portland-a-challenging-chart.html>); and the Thoreau Institute website (<http://www.ti.org/transit.html>).

For background on the closure of Rue Ste-Catherine in Montreal, see CBC News (<http://www.cbc.ca/news/canada/montreal/story/2008/06/16/qc-streetclosure0616.html>) and the Spacing Montreal blog (French only, <http://spacingmontreal.ca/2008/06/24/la-rue-ste-catherine->

pietonniere-de-berri-a-papineau/); for Bixi details, see the Bixi website (<https://montreal.bixi.com/>).

As previously noted, data on the property value premiums in Belmar and Reston Town Center, Virginia, was reported in Leinberger, “The Next Slum?” (*Atlantic Monthly*, March 2008); the other stat on premiums (\$4,000-34,000) is drawn from the CEOs for Cities study *Walking the Walk: How Walkability Raises Housing Values in US Cities* (21 August 2009, download at <http://sustainablecitiescollective.com/cooltownstudios/8505/walkable-homes-get-4000-34000-premium>).

For details on the Delhi Metro, see “The Miracle Worker of the Delhi Metro,” *Businessweek*, 19 March 2007; reference to Bangkok’s SkyTrain based on my own reporting in the city in 2006.

COPENHAGENIZATION DOWN UNDER

The overview of Melbourne’s Copenhagenization is drawn primarily from my own field reporting in Melbourne in June 2008, including an extensive interview with Rob Adams and meetings with other civic officials. Most of the data in this section and quotes from the 1978 *Age* article are drawn from the Gehl Architects/City of Melbourne joint report *Places for People: Melbourne 2004* (published by the City of Melbourne).

For details about Melbourne civic building’s green features, see the City of Melbourne website’s factsheet on CH2 (<http://www.melbourne.vic.gov.au/Environment/CH2/aboutch2/Pages/AboutCH2.aspx>).

CHAPTER SIX: The Community's Great Leap

POWERLESS

For an in-depth overview of social capital, see Robert Putnam, *Bowling Alone: The Collapse and Revival of American Community* (Simon & Schuster, 2001); the defining quote I use here is taken from Putnam's Saguaro Seminar at the Harvard Kennedy School website (<http://www.hks.harvard.edu/saguaro/socialcapitalprimer.htm>).

For data and other details on the New York blackout of 1977, see "Remembering the '77 Blackout," *New York Times* City Room blog, 9 July 2007 (<http://cityroom.blogs.nytimes.com/2007/07/09/remembering-the-77-blackout/>; includes photo of Bedford-Stuyvesant looting I describe); the Blackout History Project (<http://blackout.gmu.edu/events/tl1977.html>); "After 20 years, New Yorkers recall night the lights went out," CNN, 12 July 1997; and "July 13, 1977: Massive Blackout Plunges New York Into Rioting," Wired.com, 13 July 2007. The *Time* cover I reference is archived online at <http://www.time.com/time/covers/0,16641,19770725,00.html>.

(COMPLETE) STREET VALUE

For an overview of the "Walk Score" system, see <http://www.walkscore.com/how-it-works.shtml>.

My primary source for the discussion of suburban community redevelopment in this section is *Retrofitting Suburbia: Urban Design Solutions for Redesigning Suburbs* by Ellen Dunham-Jones and June Williamson (John Wiley & Sons, 2009). For Phoenix's La Grange Orange, see p. 70-72; for Boca Raton's Mizner Park, see p. 123-25; for Walmarts, ghostboxes, and big-box churches, see p. 3 and p. 66-69.

For the postwar history of the Oak Cliff neighbourhood in Dallas, Texas, see <http://www.oakcliff.com/history.htm>, <http://www.worthpoint.com/worthopedia/sivils-drive-in-car-hop-photograph-dallas>

My description of the "Better Block" project in Dallas, Texas, is based on videos, photos and blog entries at Bike Friendly Oak Cliff (<http://bikefriendlyoc.wordpress.com/>) and Go Oak Cliff (<http://www.gooakcliff.org/>); see especially "How to Build a Better Block" (<http://www.gooakcliff.org/how-to-build-a-better-block/>), "Recap of the Better Block 2" (<http://www.gooakcliff.org/2010/09/recap-of-the-better-block-2/>), "Guerilla Urbanism" (<http://bikefriendlyoc.wordpress.com/2010/04/20/guerilla-urbanism-north-oak-cliff-residents-create-their-own-complete-street/>), and "Dallas' First Complete Street A Success" (<http://bikefriendlyoc.wordpress.com/2010/04/12/dallas-first-complete-street-a-success/>). The Jason Roberts quote is taken from the Better Block Project video (<http://www.youtube.com/watch?v=hdZpJ5MwbqA>).

THE RUINS OF THE UNSUSTAINABLE & SUBURBAN UTOPIA

Bruce Sterling was quoted on "the ruins of the unsustainable" by Alex Steffen of Worldchanging.com (<http://www.worldchanging.com/archives/007801.html>).

The description of Vauban and its redevelopment in this section is based primarily on my own field research in August 2009, and also draws on research and interviews conducted in Freiburg on an earlier trip in May 2006 for *The Geography of Hope*. On the 2009 trip, I stayed in Vauban itself as a resident and spent hours touring houses and the neighbourhood with Gisele Bänfer and Ian Harrison and their family and with Barbara Braun and Harold Müller. Additional background information and data was drawn from the brochure *Quartier Vauban: A Guided Tour*, prepared by the Vauban District Association and published by Management and Marketing for the City of Freiburg in 2008.

The *Time Magazine* citation appeared in its 22 September 2009 issue (“Heroes of the Environment: Residents of Vauban,” http://www.time.com/time/specials/packages/article/0,28804,1924149_1924154_1924430,00.html). The estimated cost of a parking space in Vauban was cited in “Auto-ban: German town goes car-free” by Tony Patterson (*The Independent*, 26 June 2009, <http://www.independent.co.uk/news/world/europe/autoban-german-town-goes-carfree-1720021.html>).

For background and technical details on on the first Passivhaus in Germany, see http://www.passivhaustagung.de/Kran/First_Passive_House_Kranichstein_en.html; for further information, see the Passive House Institute website (<http://www.passiv.de>). For a late 2008 estimate of the number of Passive houses worldwide (and other details), see “No Furnaces but Heat Aplenty in ‘Passive Houses,’” by Elisabeth Rosenthal (*New York Times*, 26 December 2008, <http://www.nytimes.com/2008/12/27/world/europe/27house.html>).

The passage on the ubiquity of the standard European urban form and the resilience of Prenzlauer Berg in Berlin is based on my own observations in Denmark, Germany and Spain

during field research in 2009. A capsule history of Prenzlauer Berg is available online at http://www.jurkun.de/en_geschichte.htm.

A FIG TREE GROWS IN BROOKLYN

The photo of Bedford-Stuyvesant looting I describe accompanies “Remembering the ’77 Blackout,” *New York Times* City Room blog, 9 July 2007 (<http://cityroom.blogs.nytimes.com/2007/07/09/remembering-the-77-blackout/>). My description of Brooklyn Rescue Mission and Bed-Stuy Farm is based on my own visit and interviews with the Jacksons in October 2008. For more information, see <http://brooklynrescuemission.org/Bedstuyfarm.aspx>.

For background on “food deserts,” see “Sales Using Food Stamps Double at Greenmarkets,” *New York Times* City Room blog, 23 November 2009. For more on urban farming in America, see “City Farmers’ Crops Go from Vacant Lot to Market,” Tracie MacMillan, *New York Times*, 7 May 2008; “Street Farmer” by Elizabeth Royte, *New York Times Magazine*, 1 July 2009; “Where Industry Once Hummed, Urban Garden Finds Success,” *New York Times*, 20 May 2008; Growing Power (Milwaukee) website (<http://www.growingpower.org/headquarters.htm>); Resource Center’s City Farm (Chicago) website (<http://www.resourcecenterchicago.org/70thfarm.html>); and Greensgrow Farm (Philadelphia) website (<http://www.greengrow.org/farm/overview/>). For Leaf & Lyre, see “Urban farmers want your land,” CBC Calgary, 1 April 2010 (<http://www.cbc.ca/news/canada/calgary/story/2010/04/01/calgary-urban-farming-backyard-intensive-olson-kile.html?ref=rss>). For farmers market growth stats, see “How Design Can Help

Farmers' Markets Feed a Growing Demand” by Alissa Walker (*Good Magazine*, 10 August 2009). The global organic food sales figure cited is from the Organic Trade Association (<http://www.ota.com/organic/mt/business.html>).

The reference to a Midwestern farm on marginal land is based on reporting in “Betting the Farm” by Sam Hurst, *Gourmet Magazine*, April 2008.

The data on Russia’s wildfires and grain prices is from “Russian response to wildfires gives an early glimpse of climate change impact” by Gwynne Dyer (*Georgia Straight*, 6 August 2010); figures on the global spike in food prices are from “Why our agricultural empire will fail” by Riddhi Shah (*Slate*, 26 August 2010); for the farming crisis in Australia, see “Warming Takes Center Stage as Australian Drought Worsens” by Keith Schneider (*Yale Environment* 360, 2 April 2009, <http://e360.yale.edu/content/feature.msp?id=2137>).

For details and data on agricultural crisis in India, see “India’s Water Future” by Daniel Stellar (Earth Institute at Columbia University, 26 August 2009, <http://blogs.ei.columbia.edu/2009/08/26/indias-water-future/>); “India’s Farming ‘Revolution’ heading For Collapse,” NPR, 13 April 2009 (<http://www.npr.org/templates/story/story.php?storyId=102893816>); “Thirsty Pakistan gasps for water solutions,” Reuters, 18 June 2010; and “Punjab farmers switch to water harvesting, organic farming” *Financial Express* (India), 22 March 2004.

For more detail on black stem rust, see “Millions fear famine as crop disease rages,” *The Observer* (UK), 22 April 2007; for the looming crisis in the Central Valley of California, see “The New Dust Bowl” by Josh Harkinson, *Mother Jones*, November/December 2010; for the South Saskatchewan Basin, see “The South Saskatchewan River runs dry” by Allan Casey, *Canadian Geographic*, October 2010. For an overview of the global fishery crisis, see “A

solution to worldwide fishery collapse?,” Mongabay.com, 18 September 2008 (http://news.mongabay.com/2008/0918-hance_fish.html). For waste in the US food system, see “Waste Not, Want Not” by Nicole Miller and Michael Penn, *Utne Reader*, September-October 2010.

For details on Manhattan’s food footprint and Dutch design, see the Pioneers of Change website (<http://www.pioneersofchange.nl/news/>). My description of Houweling’s new greenhouses is drawn from “Camarillo-area greenhouses produce 21st century crops” by Jerry Hirsch, *Los Angeles Times*, 14 May 2009, and from the Houweling’s website (<http://www.houwelings.com/>).

The primary source for my overview of no-till farming is “No-Till: the Quiet Revolution” by David R. Huggins and John P. Reganold, *Scientific American*, July 2008. See also the Rodale Institute website (http://www.rodaleinstitute.org/20100726_applied-no-till-for-carbon-positive-farming). For more on Fred Kirschenmann, see the Leopold Institute website (http://www.leopold.iastate.edu/about/moreaboutfred/fred_bio.htm) and an interview with Kirschenmann at Grist.org (<http://www.grist.org/article/2010-04-14-interview-with-fred-k.-winner-of-nrdcs-growing-green-thought-lea>). For more on the Land Institute’s perennial grains studies, see the Land Institute website (<http://www.landinstitute.org/vnews/display.v/ART/2007/03/15/45facffb6ccd6>) and “Perennial grains could transform agriculture, save soils,” *National Geographic News Watch*, 17 June 2010. For the System of Rice Intensification, see “Groundbreaking Method Enables Small Farmers to Grow More Food with Less Water,” *infoZine*, 27 October 2010 (<http://www.infozine.com/news/stories/op/storiesView/sid/44235/>) and the SRI homepage at Cornell University (<http://sri.ciifad.cornell.edu/index.html>).

FIELD OF AMERICAN DREAMS

The detail and data in this section is drawn primarily from my own field research in Des Moines, Iowa City and Jefferson, Iowa, in May 2008, including interviews with Jefferson wind farmer David Ausburger, wind developer Tom Wind, and University of Iowa engineering dean Barry Butler.

See also “Big Blades Turn Heads on Iowa Roads,” *Des Moines Register*, 29 September 2008; “Wind energy blows into Iowa town,” *High Plains Journal*, 17 March 2008; “Wind energy a reality in Hardin County,” *Ada (IA) Herald*, 26 June 2009; and the wind energy factsheet at the Iowa Office of Energy Independence website (http://www.state.ia.us/government/governor/energy/Renewable_Energy/Wind.html).

For further detail on carbon neutral projects worldwide, see Ashton Hayes (<http://www.goingcarbonneutral.co.uk/>), Svanholm (http://www.ecovillagenews.org/wiki/index.php/Svanholm_Goes_Carbon-Neutral), Findhorn (http://www.ecoarc.co.uk/case-study2_Findhorn.html).

CHAPTER SEVEN: The Grid’s Great Leap

DUMB GRID

For the early history of Thomas Edison's electric company, see "Emergence of Electrical Utilities in America" at the Smithsonian Institution website (<http://americanhistory.si.edu/powering/past/h1main.htm>); "Pearl Street Station" at IEEE Global History Network (http://www.ieeeahn.org/wiki/index.php/Pearl_Street_Station); and the history section of the ConEdison website (<http://www.coned.com/history/electricity.asp>).

Key sources for my overview of the wonky economics of energy pricing were: "AC/DC: What's the true cost of energy?" by Keith Johnson, *Wall St. Journal*, 9 February 2009; "Estimating the Cost of Generating Electricity" factsheet at the Government of Oregon's website (<http://www.oregon.gov/ENERGY/RENEW/costs.shtml>); "The True Cost of Electricity," Energy Matters (Australia) (http://www.energymatters.com.au/index.php?main_page=news_article&article_id=316); "Shocker: We don't pay enough for electricity" by Don Dewees, *Globe & Mail*, 15 January 2010; and "The Real Cost of Energy Generating Alternatives: A Portfolio Approach" by Shimon Awerbuch (presentation to Oil, Petrochemical and Energy Risks Association, London, UK, 22 February 2005; slides available online via <http://www.awerbuch.com/shimonpages/saspresentations.html>).

The estimated price of coal power with externalized costs factored in is from a Paul Scherrer Institute (Switzerland) study cited in the *Wall St. Journal* story "AC/DC" above (original study is *Internalisation of external cost in the power generation sector: Analysis with Global Multi-regional MARKAL Model* by Peter Rafaj and Socrates Kypreos); the added cost of the most efficient coal plants is from the *Wall St. Journal* as well. The cost of CCS per kwh is from *Realistic Costs of Carbon Capture* by Mohammed Al-Juaied and Adam Whitmore, a discussion paper published by Harvard University's Belfer Center for

Science and International Affairs (available online at http://belfercenter.ksg.harvard.edu/publication/19185/realistic_costs_of_carbon_capture.html?breadcrumb=%2Fproject%2F43%2Fenvironment_and_natural_resources). The information on the Powder River Basin coal industry is from Plains Justice, a regional environmental law centre (<http://plainsjusticeblog.wordpress.com/2010/10/20/coal-the-biggest-corporate-bailout-of-all-part-1-of-3/>).

The sources for my figures on fossil vs. renewable subsidies were noted in Chapter Two, above. The idea of “risk-adjusted” energy costs is from the Shimon Awerbuch presentation cited above, as is much of the critique of current methods of “levelized” costing throughout this section. The phrase “nuclear socialism” is attributed to Mark Cooper of the Vermont Law School’s Institute for Energy and Environment in a 2010 study. The Duke University study referenced in this section is *Solar and Nuclear Costs—The Historic Crossover* by John O. Blackburn and Sam Cunningham, published by NC WARN in June 2010. The *Wall St. Journal* quote is from the “AC/DC” article noted above.

For data and other details on the American Coalition for Clean Coal Electricity, see Source Watch (http://www.sourcewatch.org/index.php?title=American_Coalition_for_Clean_Coal_Electricity).

Details on the 2010 standstill in the Iowa wind industry and the legislative morass that produced it were reported by the *Des Moines Register* (“Wind Energy Awaits Stiffer Breezes” 26 September 2010); the *Register* also reported on the 2008 boom, including the number of trucks plying Iowa highways (see “Big Blades Turn Heads on Iowa Roads,” *Des Moines Register*, 29 September 2008).

THE SUN TEMPLES OF ANDALUSIA & OTHER WONDERS OF THE GREEN WORLD

The physical and technical details of the Solucar Solar Platform are drawn from my own field research in Spain in September 2009, including a guided tour of the facility and interviews with onsite Abengoa Solar engineers and public relations staff. Further detail is available from Abengoa Solar's Solucar website (http://www.abengoasolar.com/corp/web/en/nuestras_plantas/plantas_en_operacion/espana/) and from *Power Technology* magazine (<http://www.power-technology.com/projects/Seville-Solar-Tower/>).

For full details on CSP projects in the US, see Greentechmedia's CSP Project Tracker (<http://www.greentechmedia.com/articles/read/cspprojecttracker/>). For details on the Ferrostaal/eSolar partnership, see "eSolar & Ferrostaal To Provide Turnkey Solar Thermal Plants," *Renewable Energy World*, 18 February 2010.

The potential solar thermal energy stats for the US Southwest are from energy consultant Morse and Associates, as reported in Greentech Media ("Solar Thermal: Which technology is best?," 28 April 2009, <http://www.greentechmedia.com/articles/read/solar-thermal-which-technology-is-best-6091/>). The Severin Borenstein study cited is *The Market Value and Cost of Solar Photovoltaic Electricity Production* (UCEI, January 2008); for a summary, see MIT's *Technology Review* (<http://www.technologyreview.com/Biztech/20356/>).

For the Texas wind power record, see "Setting Wind Power Records in Texas," *New York Times* Green Inc., 5 March 2010. For details on wind energy growth in the U.S., see the Energy Information Administration's Wind Data and Information website (<http://www.eia.gov/cneaf/solar.renewables/page/wind/wind.html>).

For an overview of Britain's feed-in tariff, see Wind-Works.org (<http://www.wind-works.org/FeedLaws/Great%20Britain/BritainLaunchesComprehensiveSystemofFeed-inRates.html>). The opening of the world's largest wind farm was reported at MSNBC, among other places (http://www.msnbc.msn.com/id/39324391/ns/us_news-environment/t/whopper-wind-farm-opens-britain/).

China's solar water heating use was reported in the REN21 report *Renewables Global Status Report 2010* (for more information see the Worldwatch Institute website, <http://www.worldwatch.org/node/6482>).

OF PARKED CARS & POWER PLANTS

My description of Denmark's smart grid initiative, Project EDISON, is based on field research conducted in Denmark in August 2009. Background detail and an archive of news reports on the project can be found at the Project EDISON website (<http://www.edison-net.dk/>). See also "In Denmark, ambitious plans for electric cars," *New York Times*, 2 December 2009; "Denmark to power electric cars by wind in vehicle-to-grid experiment," *The Guardian*, 16 June 2009; *EcoGrid.dk Phase I Summary Report: Steps towards a Danish Power System with 50 % Wind Energy* (published by Energinet.dk, 2008); "Denmark's electric dreams," *Utility Week* (UK), 8 December 2010 (http://www.utilityweek.co.uk/news/news_story.asp?id=193541&title=Denmark%27s+electric+dreams); and *Wind Power to Combat Climate Change*, an Energinet.dk brochure.

For details on the Rocky Mountain Institute "Smart Garage" charette (including the long-quote scenario cited in this section), see *Smart Garage Charette Report* (v2.0, December 2008,

available for download at RMI website: http://www.rmi.org/rmi/Library%2F2008-14_SmartGarageCharetteReport). The quote from RMI's Michael Brylawski is from my own transcription of the post-charette conference call.

The John Doerr quote is from "The Bloom Box: An Energy Breakthrough?" (*60 Minutes*, CBS, 18 February 2010). As noted above, my estimates for the size of the global smart grid industry in 2009 and 2015 come from an SBI Energy study released in November 2010; see Source Notes for Chapter Two for full citation. Details of the Kleiner Perkins 2008 cleantech investment funds were reported by TechCrunch (<http://techcrunch.com/2008/05/01/kleiner-perkins-goes-green-with-12-billion-in-two-new-funds/>); its investment in Silver Spring was reported shortly thereafter at CNet News (http://news.cnet.com/8301-11128_3-10059830-54.html).

For an overview and data on smart metering in Europe, see "European metering is getting smarter," *Power Engineering International*, 1 May 2009; for the US market, estimates for 2012 vary from 6 million to the 40 million figure I cited, which is attributed to Google; for details, see <http://2ndgreenrevolution.com/2009/02/21/smart-meters-in-6-million-homes-by-2012/> and http://www.smartgridnews.com/artman/publish/Technologies_Metering/Bringing-the-Smart-Grid-to-the-Smart-Home-It-s-Not-Only-About-the-Meter-1711.html.

For details on Google's Power Meter, see "Google's PowerMeter Can Track Your Power," ExtremeTech.com, 11 February 2009; for GE's Nucleus, see "GE brings smart grid home with energy monitor, EV charger," CNet News, 13 July 2010, as well as the GE Appliances website (<http://www.geappliances.com/home-energy-manager/>); for Envision's SolarTree launch, see "Envision Solar Joins Bright Automotive to Unveil Revolutionary Automotive, Solar-to-Electric Vehicle Charging Technologies on Capitol Hill," BusinessWire,

21 April 2009. More background on time-of-use pricing can be found at http://www.ieso.ca/imoweb/siteshared/smart_meters.asp and http://www.liberty-energy.com/pages/time_of_use.html.

For more information on the EcoBlue, see the launch press release at the Volkswagen website (http://www.volkswagenag.com/vwag/vwcorp/info_center/en/news/2010/11/Launch_of_the_home_power_plant.html).

My discussion of the WhisperGen is based on my own field research in Calgary in 2009 and 2010; quotes are from my interview with Gary Holden. See also “Second generation WhisperGen micro-CHP for Britain,” *Power-Gen Worldwide*, 29 March 2010; the WhisperGen website’s official history (<http://www.whispergen.com/main/companyhistory/>); and a press release at the website of Mondragon on the partnership with WhisperGen’s parent (<http://www.mondragon-corporation.com/ENG/Press-room/articleType/ArticleView/articleId/36.aspx>).

My primary source on the Naperville smart grid project is the Galvin Electricity Initiative’s *The Naperville Smart Grid Initiative: Case Study 2010* (download the report and other background info at <http://www.galvinpower.org/transforming-grid/perfect-power-systems/illinois/naperville>).

My source for the reliability advantages of distributed smart grids is Anders Troi, lead engineer on Project EDISON; for the NREL study on the reliability of wind power, see “Wind Power Unreliable? Build More Turbines,” *New York Times Green*, 20 January 2010 (<http://green.blogs.nytimes.com/2010/01/20/wind-power-unreliable-build-more-turbines/>).

THE GREAT LEAPFROG

In addition to the *60 Minutes* report cited above, my overview of the Bloom Box in this section drew on “Bloom Energy Shifts Power via Fuel Cells” (*Businessweek*, 7 December 2009); “Bloom Energy claims a new Fuel Cell Technology” (*New York Times*, 23 February 2010); “Bloom Energy Unveils Its Ultra-Secretive Bloom Box Fuel Cell” (*Fast Company*, 21 February 2010); and “The Economics of Bloom Energy’s ‘Breakthrough’ Fuel Cell” (*Forbes*, 24 February 2010).

For more on the Indian green building boom, see the Indian Green Building Council website (<http://www.igbc.in/site/igbc/certifiedbuilding.jsp>). The most recent news on Tata’s European production of the Indica Vista EV as this book went to press was at <http://www.thechargingpoint.com/news/tata-begins-production-of-vista-ev-in-coventry-uk.html>). For more on the development of Delhi’s subway system, see “The Miracle-Worker of the Delhi Metro,” *Businessweek*, 19 March 2007.

For Morocco’s wind farm launch, see <http://www.energyboom.com/wind/africas-largest-wind-farm-opens-morocco>; for Brazil’s cleantech boom, see <http://blog.cleantechies.com/2010/09/14/brazil-invest-renewable-energy-sources/>; for wind energy’s potential in Argentina, see <http://www.renewableenergyworld.com/rea/news/article/2011/01/argentina-looks-to-wind-for-the-answer-to-its-energy-woes>.

For background on Masdar, see “In Arabian Desert, A Sustainable City Rises” (*New York Times*, 25 September 2010); “Masdar City: A Source of Inspiration” (*Renewable Energy World*, 14 April 2009); “Masdar Update: The Green City in the Middle East Struggles With Dust and

Departures” (Greentechmedia, 26 July 2010, <http://www.greentechmedia.com/articles/read/masdar-update/>); and “Masdar: Abu Dhabi’s Carbon Neutral City” (BBC News, 28 March 2010).

For Suzlon Energy’s rise and Indian growth, see <http://www.reinforcedplastics.com/view/12755/suzlon-reaches-5-gw-of-wind-power-in-india/> and http://www.suzlon.com/about_suzlon/12.aspx?11=1&12=1.

For China’s 2010 growth in wind and solar, see “China Is Leading the Race to Make Renewable Energy” (*New York Times*, 31 January 2010); for Vestas in China, see “Vestas wins order for 25 turbines” (Reuters, 7 January 2011); for Yingli’s conquest of California, see “From California, Chinese Solar Maker Looks East” (*New York Times Green*, 3 March 2010). For cleantech job growth in China, see “China’s Global Dominance in Green Jobs Growing, Report Says” (SolveClimate News, 6 October 2010); for Chinese auto manufacturing, see “China to Invest Billions in Electric and Hybrid Vehicles” (*New York Times*, 19 August 2010); for BYD’s 2010 sales, see “BYD fails to meet 2010 sales target, report says” (*China Daily*, 5 January 2011); for its first international sales, see “BYD to inaugurate electric buses in Denmark” (*China Daily*, 11 March 2011).

The WHO pollution fatalities stat was cited in China builds a green dream machine (*The Guardian*, 26 February 2009). there are a wide range of estimates of the number of people in China living below the poverty line today vs. 1990 and the figures are disputed, but I have gone with the figure cited in *The Economist*, based on a World Bank study in 2007 (see “On the poverty line,” 22 May 2008); there is, in any case, no serious argument against the number being in the hundreds of millions. China’s possible emissions peak was reported by Bloomberg (“China’s Carbon Emissions May Reach Peak by 2030, State Researcher Says,” 23 July 2010).

For details on China's new five-year plan, see "China's New National Plan: Green by Necessity" (CommonCurrent.com, 29 November 2010). The Bob Inglis quote was reported by *Mother Jones* ("Outgoing GOPer Slams Climate Denying Colleagues," 18 November 2010).

EPILOGUE: The Leap Not Taken

THE SUMMER OF THE SPILL & THE MYTH OF BUSINESS AS USUAL

For details on the origin of the BP spill, as revealed in Congressional documents, see "BP used cheaper casing on oil well to save money, Congress papers show," *The Times* (UK), 27 May 2010. My calculations of the size of the BP spill are taken from figures found at the U.S. Department of the Interior website (<http://www.doi.gov/news/pressreleases/US-Scientific-Teams-Refine-Estimates-of-Oil-Flow-from-BP-Well-Prior-to-Capping.cfm>) and *The Daily Green* (<http://www.thedailygreen.com/environmental-news/latest/bp-oil-spill-size-0528>). The "America's Chernobyl" quote is from Louie Miller of the Sierra Club and was widely reported (see for example "Sierra Club: "Oil spill is America's Chernobyl," WLOX-TV Biloxi, 1 May 2010, <http://www.wlox.com/Global/story.asp?S=12410421>).

My figures on the depth of the BP drilling operation are from a factsheet at Gulf Oil & Gas (<http://www.gulfoilandgas.com/webpro1/projects/3dreport.asp?id=102868>); the comparative figures for the Macondo Prospect (which the Deepwater Horizon tapped) and the East Texas Oil Field in terms of estimated recoverable oil are 50 million barrels and at least 5.2 billion barrels

respectively (see “BP's Gulf Well: One Of America's Biggest Oil Fields?,” *Forbes*, 6 August 2010).

For details on the total number of oil wells in the Gulf of Mexico, see for example *E&P Magazine* (<http://www.epmag.com/Magazine/2011/5/item82667.php>). The \$900-million figure for Brazilian oil rigs is drawn from “Brazil’s Petrobras unveils costly new oil platform,” Reuters, 21 August 2007; for further details on Brazil’s Campos Basin, see “Brazil quietly secures its offshore oil platforms,” *The Guardian*, 15 June 2010, and “New Discoveries Sweeten Brazil's Campos Basin,” *Dow Jones/Rigzone*, 11 February 2010.

For the sea ice decline in the Arctic, see “Arctic Ice in Death Spiral,” IPS, 20 September 2010. For details on the Northeast Passage, see “Two German merchant ships conquer famed Arctic passage,” Associated Press, 12 September 2009. For a concise overview of Russian wildfires and Pakistani flooding, see “Weather Extremes and Climate Change,” *New York Times Green*, 17 August 2010. For a summary of Richard Seager’s research on drought in the US southwest, see “Dust Bowl 2: Drought detective predicts drier future for American Southwest,” *Grist.org*, 12 August 2010. For recent details on the Gulf of Mexico’s “dead zone,” see “Farm Runoff in Mississippi River Floodwater Fuels Dead Zone in Gulf,” PBS, 18 May 2011. The climate threat to one in eight species of birds was reported in *The New Scientist* (“One in eight bird species threatened by climate change,” 19 May 2008). The overfishing epidemic was reported by Agence-France Presse (“Over 80 percent of fisheries overfished: report,” 26 May 2008).

For the US government’s 2010 shale gas push internationally, see “US mounts global push for shale gas,” Agence-France Presse, 24 August 2010. For the shale gas boom in Pennsylvania, see “Rural Pennsylvania town fights big gas,” Reuters, 8 September 2010, and

“Gas plans divide Central Pennsylvania community,” *Pittsburgh Tribune-Review*, 26 September 2010. For reports of health problems in “fracking” regions of Wyoming, see “Wyoming Survey Points to High Incidence of 'Fracking' Related Health Problems,” *SolveClimate News*, 23 August 2010.

For the Lloyd’s of London alarm call on the energy crisis, see “Lloyd’s adds its voice to dire ‘peak oil’ warnings,” *The Guardian*, 11 July 2010. The British government’s private concerns about peak oil were also reported in *The Guardian* (“Peak oil alarm revealed by secret official talks,” 22 August 2010).

Skyrocketing nuclear costs in Bulgaria and Finland were reported by the *New York Times* Green (“New Warnings About Costs of Nuclear Power,” 31 August 2010).

THE PIPELINE & THE SPIRIT BEAR

The physical detail, background, quotes and much of the historical and socioeconomic contextualization of the Great Bear Rainforest in this section is based on field research I conducted in September 2010. I met and interviewed Helen Clifton and several other Gitga’at, numerous anti-pipeline activists (including Ian MacAllister of Pacific Wild), the general manager of King Pacific Lodge, and many others. For additional detail, see “Pipeline would bring tankers into B.C. inlets,” *Georgia Straight*, 5 February 2009; “New report highlights gaps in Enbridge's Northern Gateway pipeline application,” Pembina Institute news release, 16 December 2010; “\$4-billion Pipeline to Land in Kitimat,” *Vancouver Sun*, 15 October 2005.

For details on the Enbridge Kalamazoo spill, see “Regulators Warned Enbridge About Monitoring of Pipeline Corrosion” (*New York Times*, 29 July 2010).

OUR BRIGHTEST POSSIBLE FUTURE

Much of the cleantech detail in this section has already been noted elsewhere in the book and in these Source Notes. For the world's largest wind farm, see "RWE, Stadtwerke & Siemens To Build 576-MW Offshore Wind Farm," *Renewable Energy World*, 7 June 2010. Germany's gigawatt solar summer was reported in *Renewable Energy World* as well ("Germany Adds Nearly 1% of Electricity Supply with Solar in Eight Months," 4 October 2010). China's new renewable energy commitments were reported by *The Guardian* ("China plans to make a million electric vehicles a year by 2015," 18 February 2011). The record year for cleantech venture capital was reported by *Venture Beat* ("Record \$7.8 billion year for cleantech venture capital in 2010, but two quarters of decline," 7 January 2011). The Novozymes pledge was reported in *The New York Times Green* ("Cellulosic Fuel Gets Cheaper, Companies Say," 16 February 2010).

Details on Dyesol and its partnerships with Tata Steel and Pilkington in this section are based on my own field reporting in Toledo, Ohio, and Canberra, Australia.