

# Endnotes

## Chapter 1

- 1 World Bank. 2004. *World Development Indicators 2004*.
- 2 BBC News. 2004. *China's Middle Class Growing Fast*. 3 Mar.
- 3 We hasten to clarify that they may be numerically greater but do not have anywhere near the same purchasing power—the poverty line alone in the US is about \$25,000.
- 4 UNEP. 2003. *Global Environment Outlook Yearbook 2003*. www.unep.org/GEO/geo3/
- 5 UNEP. 2004. *UNEP Champions Sustainable Consumption Approach: EU Funded Projects Enables Transfer of Lessons from Europe to Asia*. 2 February.
- 6 Assadourian, Erik. 2004. Economic Growth Inches Up. In *Vital Signs 2003–2004: The Trends That Are Shaping Our Future*. Washington D.C.: Worldwatch Institute.
- 7 Wackernagel, Mathis, Chad Monfreda, and Diana Deumling. 2002. *Ecological Footprint of Nations: November 2002 Update*. Oakland, CA: Redefining Progress.
- 8 *Fortune*. 2004. What China Eats (and Drinks and ...). 11 October.
- 9 Meadows, Donella, Jorgen Randers, and Dennis Meadows. 2004. *Limits to Growth: The 30-Year Update*. Vermont: Chelsea Green Publishing Company.
- 10 This theory is well explained in: (i) Khanna, Neha, and Florenz Plassman. 2004. The Demand for Environmental Quality and the Environmental Kuznets Curve Hypothesis. *Ecological Economics* 51: 225–236 and (ii) Stern, David. 2004. The Rise and Fall of the Environmental Kuznets Curve. *World Development* 32 (8): 1419–1439.
- 11 This argument is most forcefully put in the World Bank's *New Ideas in Pollution Regulation* project (<http://www.worldbank.org/nipr/index.htm>). The literature emanating from this project can be found in: World Bank. 2000. *Greening Industry: New Roles for Communities, Markets, and Governments*. New York: Oxford University Press. Other support for the idea that developing countries are performing better than the EKC would predict can be found in Stern (ibid, p. 1435) who states that “there is little evidence for a common inverted U-shape pathway that countries follow as their income rises.”
- 12 Gunningham, Neil, Robert Kagan, and Dorothy Thornton. 2003. *Shades of Green: Business, Regulation and the Environment*. Stanford, California: Stanford University Press. Gunningham et al discuss the “convergence and variation” in the international pulp mill sector.
- 13 Ward, Halina. 2004. *Public Sector Roles in Strengthening Corporate Social Responsibility: Taking Stock*. Washington D.C.: World Bank and International Finance Corporation.
- 14 This is a standard tenet of neoclassical economics, and is most forcefully represented by the writings of economists such as Milton Friedman. A good review of this school of thought can be found in: Bakan, Joel. 2004. *The Corporation: The Pathological Pursuit of Profit and Power*. Toronto: Viking Canada.
- 15 Drucker, Peter. 1974. *Management: Tasks, Responsibilities, Practices*. New York: Harper and Row.
- 16 The best known exposition of an alternative argument is from Michael Porter of Harvard Business School. [Porter Michael, and Claas van der Linde. 1995. Towards a New Conception of the Environment-Competitiveness Relationship. *Journal of Economic Perspectives* 9 (24): 97-118.] Halal also addresses the “static” nature of profit maximization, but from a more general perspective of corporate responsibility versus profitability. [Halal, William. 2001. The Collaborative Enterprise. *Journal of Corporate Citizenship* 2: 27–42.]
- 17 Some early examples are presented in: (i) Denton, D. Keith. 1994 *Enviro-Management: How Smart Companies Turn Environmental Costs into Profits*. New Jersey: Prentice-Hall; (ii) Koechlin, Dominik, and Kaspar Mueller, eds. 1992. *Green Business Opportunities: The Profit Potential*. London: Pitman Publishing; and (iii) Annandale, David. 1999. *Enviroworks: The Potential for Green Jobs in Western Australia*. Perth: Department of Training.
- 18 Some good examples of this research include: (i) Hart, Stuart, and Gautam Ahuja. 1996. Does It Pay to Be Green? An Empirical Examination of the Relationship Between Emission Reduction and Firm Performance. *Business Strategy and the Environment* 5: 30–37; (ii) Thomas, Anderson. 2001. Corporate Environmental Policy and Abnormal Stock Price Returns: An Empirical Investigation. *Business Strategy and the Environment* 10: 125–134; (iii) King, Andrew and Michael Lenox. 2001. Does It Really Pay to Be Green? An Empirical Study of Firm Environmental and Financial Performance. *Journal of Industrial Ecology* 5 (1). <http://www.SourceOECD.org>; (iv) Konar, Shameek, and Cohen, Mark. 2001. Does the Market Value Environmental Performance? *The Review of Economics and Statistics* 83 (2): 281–289; (v) Rock, Michael. 2003. Public Disclosure of the Sweatshop Practices of American Multinational Garment/Shoe Makers/Retailers: Impacts on Their Stock Prices. *Competition and Change* 7 (1): 23–38; and (vi) Halme, Minna, and Jyrki Niskanen. 2001. Does Corporate Environmental Protection Increase or Decrease Shareholder Value? The Case of Environmental Investments. *Business Strategy and the Environment* 10: 200–214.
- 19 The Social Investment Forum awarded the 2004 Moskowitz Prize to a series of studies by Marc Orlitzky, Frank Schmidt, and Sara Rynes, containing a total of 33,878 observations, which shows that corporate social responsibility does pay, but environmental performance affects corporate financial performance to a lesser degree than various other measures, such as corporate reputation for hiring minorities.
- 20 Reinhardt, Forest. 2000. *Down to Earth: Applying Business Principles to Environmental Management*. Boston: Harvard Business School Press.
- 21 Some useful categorization schemes and definitions of developing “environmental industry sector” business opportunities can be found in: (i) Ellyard, Peter. 2001. *Ideas for the New Millennium*. Melbourne: Melbourne University Press; and (ii) Annandale, 1999 [ref. Chapter 1:17].
- 22 Gutowski, Timothy, Cynthia Murphy, David Allen, Diana Bauer, Bert Bras, Thomas Piwonka, Paul Sheng, John Sutherland, Deborah Thurston, and Egon Wolf. 2004. Environmentally Benign Manufacturing: Observations from Japan, Europe, and the US. *Journal of Cleaner Production* 13 (1): 1–17.

- 23 See, for example: (i) Branzei, Oana, and Ilan Vertinsky. 2002. Eco-Sustainability Orientation in China and Japan: Differences Between Proactive and Reactive Firms. In *Research in Corporate Sustainability: The Evolving Theory and Practice of Organizations in the Natural Environment*. Edited by Sanjay Sharma and Mark Starik. Cheltenham, UK: Edward Elgar; and (ii) National Research Council. 2002. *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*. Edited by Thomas Dietz and Paul Stern. Washington, D.C.: National Academy Press.
- 24 Henriques and Sadorsky are the best proponents of this view. [Henriques, Irene, and Perry Sadorsky. 1996. The Determinants of an Environmentally Responsive Firm: An Empirical Approach. *Journal of Environmental Economics and Management* 30: 381–395.]
- 25 See: (i) Prakash, Aseem. 2000a. *Greening the Firm: The Politics of Corporate Environmentalism*. Cambridge, UK: Cambridge University Press; (ii) Annandale, David, and Ros Taplin. 2003. The Determinants of Mining Company Response to Environmental Approvals Regulation: A Report of Australian Research. *Journal of Environmental Planning and Management* 46 (6): 887–909; and (iii) Darnall, Nicole. 2002. Motivations for Participating in a US Voluntary Environmental Initiative: The Multi-State Working Group and EPA's EMS Pilot Program. In *Research in Corporate Sustainability: The Evolving Theory and Practice of Organizations in the Natural Environment*. Edited by Sanjay Sharma and Mark Starik. Cheltenham, UK: Edward Elgar.
- 26 This conclusion is explained well in Branzei and Vertinsky [ref. Chapter 1:23].

## Chapter 2

- 27 The Korean War was a major trigger for industrialization in Japan in the 1950s and led to major pollution problems in that country.
- 28 In the Great Smog of 1952, conductors walked in front of buses with torches to light the way, gas masks were worn, and funeral parlors couldn't keep up with the demand. This episode directly led to the Clean Air Act of 1956.
- 29 Downs, Anthony. 1972. The Ups and Downs of Ecology—The Issue-Attention Cycle. *The Public Interest* 28 (Summer): 38–50.
- 30 Holliday, Chad, Stephan Schmidheiny, and Philip Watts. 2002. *Walking the Talk: The Business Case for Sustainable Development*. Sheffield: Greenleaf Publishing.
- 31 A good starting point for references on the environment in the PRC is the Professional Association for China's Environment (PACE). <http://chinaenvironment.net/pace/index.php>.
- 32 Brockerhoff, Martin. 1999. Urban Growth in Developing Countries: A Review of Projections and Predictions. Population Council Paper No. 131 (<http://www.popcouncil.org/pdfs/wp/>). See <http://esa.un.org/unpp/> for the latest projections by the UN Population Division.
- 33 Radelet, Steven, and Jeffrey D. Sachs. 1998. The East Asian Financial Crisis: Diagnosis, Remedies, Prospects. *Brookings Papers on Economic Activity* 0 (1) pp. 1–74.
- 34 Human population density greater than 1 person per square kilometer, within 15 kilometers of a road or major river, occupied by urban or agricultural land uses, within 2 kilometers of a settlement or a railway, and/or producing enough light to be visible regularly to a satellite at night.
- 35 Sanderson, Eric, Malanding Jaiteh, Marc A. Levy, Kent H. Redford, Antoinette V. Wannebo, and Gillian Woolmer. 2002. The Human Footprint and the Last of the Wild. *BioScience* 52 (10): 891–904.
- 36 Holliday, Chad, and John Pepper. 2001. *Sustainability Through the Market—Seven Keys to Success*. Geneva: WBCSD. <http://www.wbcsd.ch>
- 37 The Asia and Pacific meetings were held in Indonesia, May 2003, and the Republic of Korea, November 2003.
- 38 The Natural Step is an international organization that uses a science-based, systems framework to help organizations and communities understand and move towards sustainability. <http://www.naturalstep.com>
- 39 <http://www.naturalcapitalism.org>
- 40 Social and Economic Council. 2003. Abstract: *Towards a Sustainable Economy*. Hague: Sociaal-Economische Raad. [http://www.ser.nl/upload/databank\\_engels/2003\\_02.pdf](http://www.ser.nl/upload/databank_engels/2003_02.pdf)
- 41 As of July 2004, there were 128 organizational stakeholders. <http://www.globalreporting.org>.
- 42 Global Reporting Initiative. 2002. *Sustainability Reporting Guidelines*. Boston. <http://www.globalreporting.org/guidelines/2002.asp>
- 43 Aspen Institute. 1998. *Uncovering Value: Integrating Environmental and Financial Performance*. Washington DC. www.aspeninst.org
- 44 For more information on how environmental issues can be integrated into financial analysis, read: Repetto, Robert, and Duncan Austin. 2000. *Pure Profit: The Financial Implications of Environmental Performance*. Washington: World Resources Institute.
- 45 Association for Sustainable & Responsible Investment in Asia. 2003. *SRI in Asian Emerging Markets*. <http://www.asria.org/publications/lib/country/combined.pdf>
- 46 <http://www.socialfunds.com/news/article.cgi/article1316.html>
- 47 Since it was created four years ago, the Winslow Green Index (WGI), an equally weighted index of 100 “green-screened” companies, has had a cumulative increase in value of 98.5%. In comparison, the S&P 500 has had a cumulative decrease in value of -10.69%, while the Russell 2000 had a cumulative return of 32.77%. The annualized return for the period was 16.78% for the Winslow Green Index, in spite of the bear market of 2000 through 2002, while the annual return for the S&P 500 was -2.53% and for the Russell 2000 was 6.62%. www.greenbiz.com
- 48 This conveniently ignores the fact that during the last two decades, millions of individuals have escaped from poverty.
- 49 See Holliday and Pepper [ref. Chapter 2:36]
- 50 Ibid.
- 51 Miller, Doug. 2004. Corporate Social Responsibility and the Nature Agenda: A Global Pollster's View. Presented to the World Conservation Congress, Bangkok, 17 November.
- 52 A good example is the information provided by the American Plastics Council on using recycled plastic products. [http://www.plasticsresource.com/s\\_plasticsresource/index.asp](http://www.plasticsresource.com/s_plasticsresource/index.asp)
- 53 Veblen, Thorstein. 1902. *The Theory of the Leisure Class: An Economic Study of Institutions*. New York: MacMillan.

- 54 Layard, Richard. 2003. *Happiness: Has Social Science a Clue?* Lionel Robbins Memorial Lectures 2002/2003. London School of Economics.
- 55 Maslow, Abraham. 1954. *Motivation and Personality*. New York: Harper.
- 56 Venetoulis, Jason, Dahlia Chazan, and Christopher Gaudet. 2004. *Ecological Footprint of Nations*. Oakland: Redefining Progress. <http://www.rprogress.org>
- 57 Ehrlich, Paul R. 1998, 25 Sep. *Recent Developments in Environmental Sciences*. <http://dieoff.org/page157.htm>
- 58 Elgin, Duane. 2004. *Voluntary Simplicity and Soulful Living*. <http://www.soulfuliving.com/voluntarysimplicity.htm>
- 59 <http://www.maxhavelaar.ch>
- 60 Vigneron, Franck, and Lester W. Johnson. 1999. A Review and a Conceptual Framework of Prestige-Seeking Consumer Behavior. *Academy of Marketing Science Review* 1999 (1). <http://www.amsreview.org/articles/vigneron01-1999.pdf>
- 61 <http://www.un.org/esa/sustdev/partnerships/partnerships.htm>
- 62 <http://www.ethicalconsumer.org/boycotts/>
- 63 Parliamentary Office of Science and Technology. 1995. Oil “Rig” Disposal. <http://www.parliament.uk/post/pn065.pdf>
- 64 <http://www.iccr.org>
- 65 Lomborg, Bjorn. 2001. *The Skeptical Environmentalist*. Cambridge: Cambridge University Press.
- 66 Europe has indicated a willingness to exempt generic drugs for critical diseases such as HIV/AIDS.
- 67 US Dept. of Justice. 2004. Report of the Department of Justice’s Task Force on Intellectual Property.
- 68 IACC. 2004. *Facts on Fakes*. International Anti-Counterfeiting Coalition. <http://www.iacc.org>.
- 69 Ibid. Thirty-six percent of the software installed on computers worldwide was pirated in 2003, representing a loss of nearly \$29 billion (<http://www.bsa.org>).
- 70 Ibid.
- 71 CNN.com. 2004. Study: CD Piracy Trade Tops \$4.5 billion. 22 July. The countries named in this study included Russia, PRC, Taipei, China, Thailand, and Pakistan.
- 72 Davis, Bennett. 2004. Fighting Fraud with DNA. *The Scientist*. 21 Jun.
- 73 Hoffmann, Ulrich. 2004. *Specific Trade Obligations in Multilateral Environmental Agreements and Their Relationship with the Rules of the Multilateral Trading System—A Developing Country Perspective*. Geneva: UNCTAD.
- 74 WTO. 2004. *Trade and Environment*. [http://www.wto.org/english/tratop\\_e/envir\\_e/envir\\_e.htm](http://www.wto.org/english/tratop_e/envir_e/envir_e.htm)
- 75 Jeppesen, Soeren, and Michael W. Hansen. 2004. Environmental Upgrading of Third World Enterprises Through Linkages to Transnational Corporations: Theoretical Perspectives and Preliminary Evidence. *Business Strategy and the Environment* 13: 261–274.
- 76 It is sometimes forgotten that this ruling was never made legally binding.
- 77 UNCTAD. 2004. *Trade and Environment Review 2003*. [http://r0.unctad.org/trade\\_env/test1/publications/TER2003eversion/openTERF1.htm](http://r0.unctad.org/trade_env/test1/publications/TER2003eversion/openTERF1.htm)
- 78 See Hoffmann [ref. Chapter 2:73]
- 79 <http://www.unep.ch/etu>
- 80 ENS. 2002. Rising Emissions Push Skyrocketing Climate Costs. Environmental News Service. 30 October 2002.
- 81 Gereffi, Gary, and Miguel Korzeniewicz, eds. 1994. *Commodity Chains and Global Capitalism*. Westport: Greenwood.
- 82 See Jeppesen and Hansen [ref. Chapter 2:75]
- 83 See Porter and van der Linde [ref. Chapter 1:16]

### Chapter 3

- 84 For a collection of case studies on environmental compliance, see the International Network for Environmental Compliance and Enforcement. [http://www.inece.org/region\\_asia\\_documents.html](http://www.inece.org/region_asia_documents.html)
- 85 To address these shortcomings, the Asian Environmental Compliance and Enforcement Network was established in August 2005 with the support of ADB and others. AECEN. 2005. *Workshop Summary, Asian Environmental Compliance and Enforcement Network: Launching a Regional Network on Environmental Compliance and Enforcement*, August 2–3, 2005, Manila, Philippines.
- 86 The concept of “licenses to operate” is well understood in the realm of multinational corporations, and is best exemplified in the literature by Gunningham et al [ref. Chapter 1:12].
- 87 An ISO standard for social responsibility (ISO 26000) is targeted for completion by 2008. At the second meeting of the ISO Social Responsible Working Group held in Bangkok in October 2005, it was agreed that ISO 26000 will simply serve as a guidance standard, and not for certification. <http://www.ethicalcorp.com/content.asp?ContentID=3914>. For more discussion on corporate social responsibility in the environmental realm, see: Hay, Bruce L., Robert N. Stavins, and Richard H.K. Vietor, eds. 2005. *Environmental Protection and the Social Responsibility of Firms: Perspectives from Law, Economics, and Business*. Washington: RFF Press.
- 88 There are many jurisdictions with “public right to know” initiatives. See the International Right to Know Campaign (<http://www.irtk.org/>) and the Aarhus Convention clearinghouse for environmental democracy (<http://aarhusclearinghouse.unece.org/>).
- 89 Afsah, Shakeb, Allen Blackman, and Damayanti Ratunanda. 2000. *How Do Public Disclosure Pollution Control Programs Work? Evidence from Indonesia*. Washington D.C.: Resources for the Future. <http://www.rff.org/Documents/RFF-DP-00-44.pdf>
- 90 Goldar, Bishwanath, and Nandini Banerjee. 2004. Impact of Informal Regulation of Pollution on Water Quality in Rivers in India. *Journal of Environmental Management* 73: 117–130.
- 91 Much of the research supporting this assertion has been undertaken as part of the World Bank’s New Ideas in Pollution Regulation project. Reference to this project can be found at: <http://www.worldbank.org/nipr/index.htm>. See also: (i) Hettige, Hemamala, Mainul Huq, Sheoli Pargal, and David Wheeler. 1996. Determinants of Pollution Abatement in Developing Countries: Evidence from South and Southeast Asia. *World Development* 24 (12): 1891–1904 and (ii) Dasgupta, Susmita, Hemamala Hettige, and David Wheeler. 2000. What Improves Environmental Performance? Evidence from Mexican Industry, *Journal of Environmental Economics and Management*, 39: 39–66.

- 92 <http://www.keidanren.or.jp/english/policy/pol058/>
- 93 For an example of how localization of EIA processes might work in small developing countries, see: Annandale, David. 2001. Developing and Evaluating Environmental Impact Assessment Systems for Small Developing Countries. *Impact Assessment and Project Appraisal* 19 (3): 187–193.
- 94 Clean Air Initiative News. 2004. Singapore Tightening Air Pollutant Regulations. [www.cleanairnet.org/caiasia/1412/article-58313.html](http://www.cleanairnet.org/caiasia/1412/article-58313.html).
- 95 World Resources Institute. 2004. *Taking the High (Fuel Economy) Road: What Do the New Chinese Fuel Economy Standards Mean for Foreign Automakers?* <http://capitalmarkets.wri.org>
- 96 Bell, Ruth G., Kuldeep Mathur, Urvashi Narain, and David Simpson. 2004. Clearing the Air: How Delhi Broke the Logjam on Air Quality Reforms. *Environment* 46 (3): 22–39
- 97 Sabel, Charles, Archon Fung, and Bradley Karkkainen. 2000. *After Backyard Environmentalism*. Boston: Beacon Press.
- 98 See Afsah et al [ref. Chapter 3:89]. Good reviews of PROPER can also be found in World Bank 2000 [ref. Chapter 1:11].
- 99 This conclusion is reached by Afsah et al [ref. Chapter 3:89].
- 100 Sani, Rasio Ridho. 2005. Achieving Compliance Through the PROPER Program. Presentation at the Asian Environmental Compliance and Enforcement Network Regional Workshop, ADB, Manila, 3 August.
- 101 It should also be noted that conventional National Economic Development Plans, which are common in Asia and are often produced at a regular 5-year basis, sometimes include sections dealing with environmental issues.
- 102 World Bank. 1995. *National Environmental Strategies—Learning from Experience*. Washington, DC.
- 103 Immerzeel-Brand, Ellis. 2002. Assessing the Performance of Negotiated Environmental Agreements in the Netherlands. In *Voluntary Environmental Agreements: Process, Practice, and Future Use*. Edited by Patrick ten Brink. Sheffield, UK: Greenleaf Publishing.
- 104 Gunningham, Neil, and Darren Sinclair. 2002. *Leaders and Laggards: Next Generation Environmental Regulation*. Sheffield, UK: Greenleaf Publishing.
- 105 [www.svm-pact.nl](http://www.svm-pact.nl)
- 106 Hanks, Jonathan. 2002. A Role for Negotiated Environmental Agreements in Developing Countries? In *Voluntary Environmental Agreements: Process, Practice, and Future Use*. Edited by Patrick ten Brink. Sheffield, UK: Greenleaf Publishing.
- 107 United Nations Department for Economic and Social Affairs (UNDESA). 2002. *National Implementation of Agenda 21: A Report*. New York: United Nations Publications.
- 108 Ge, Chazhong, Jintian Yang, Yang Tong, Kai Tong and Dong Cao. 2003. *Environmental Enforcement and Compliance Indicators in China*. Chinese Academy for Environmental Planning. Proceedings of International Network of Environmental Compliance and Enforcement, OECD Workshop on Environmental Compliance and Enforcement Indicators, Paris, France, 3–4 November.
- 109 The original 500 recognized firms, however, were reduced to 183 on reappraisal in 1989–1990. Enforcement also remains weak, polluters are allowed to retain the pollution levies (ostensibly to invest in improved pollution-control equipment), and the environment continues to degrade.
- 110 <http://www.env.go.jp/en/pol/agenda/>
- 111 Government of Japan. 2002. *Japan National Assessment for WSSD*. [www.rrcap.unep.org/wssd/documents/japanation.pdf](http://www.rrcap.unep.org/wssd/documents/japanation.pdf).
- 112 Speth, James Gustave. 2004. *Red Sky at Morning: America and the Crisis of the Global Environment*. New Haven: Yale University Press.
- 113 Speth, ibid
- 114 There are approximately 200 environmental treaties in existence. A comprehensive source of information on environmental treaties is: <http://sedac.ciesin.columbia.edu/entri/index.jsp>
- 115 Shaw, Malcolm. 1997. *International Law*. Cambridge, UK: Cambridge University Press
- 116 This Protocol had not entered into force at the time of writing.
- 117 For more details about the implications of EIA for proponents and regulators in developing countries, see Annandale 2001 [ref. Chapter 3:93].
- 118 For a discussion on strategic environmental assessment, see Annandale, David, John Bailey, Ely Ouano, Warren Evans, and Peter King. 2001. The Potential Role of Strategic Environmental Assessment in the Activities of Multilateral Development Banks. *Environmental Impact Assessment Review* 21 (5): 407–429. For an outline of the developing area of sustainability assessment, see Pope, Jenny, David Annandale, and Angus Morrison-Saunders. 2004. Conceptualising Sustainability Assessment. *Environmental Impact Assessment Review* 24 (6): 595–616.
- 119 UNDESA [ref. Chapter 3:107] documented progress since the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. For Asia and the Pacific, about half of the 44 nations reported that they had substantially implemented parts of Agenda 21. The overall impression of the report was that more participatory approaches involving key stakeholders and better integration with economic incentives were needed in the region.
- 120 UNESCAP 2003a. *Promoting the Millennium Development Goals in Asia and the Pacific: Meeting the Challenges of Poverty Reduction*. New York: United Nations Publication
- 121 <http://www.johannesburgsummit.org>
- 122 For an amplification of this argument, see Speth [ref. Chapter 3:112].
- 123 The International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.
- 124 Commission on Environmental Law of the World Conservation Union in cooperation with International Council of Environmental Law. 2004. *Draft International Covenant on Environment and Development*. Gland, Switzerland: IUCN.
- 125 See Speth [ref. Chapter 3:112]. From someone who was at the heart of these negotiations for many years, it is discouraging to read how little Speth believes he and his colleagues achieved through the multilateral environmental agreements.
- 126 UNESCAP 2003b. *Regional Follow-Up to the World Summit on Sustainable Development in Asia and the Pacific*. New York: United Nations Publication.
- 127 (i) UNEP. 2000. *Asia-Pacific Environment Outlook 2*. Nairobi: United Nations Publication. (ii) UNESCAP. 2000. *State of Environment in Asia and the Pacific 2000*. New York: United Nations Publication.

- 128 “Implementation of Agenda 21 and the outcomes of the Summit should be effectively pursued at the regional and subregional levels, through the regional commissions and other regional and subregional institutions and bodies” (JPOI, para. 158). Inter alia, regional organizations are called upon to “facilitate and promote a balanced integration of the economic, social and environmental dimensions of sustainable development into the work of regional, subregional and other bodies, for example by facilitating and strengthening the exchange of experiences, including national experience, best practices, case studies and partnership experience related to the implementation of Agenda 21” (JPOI, para. 160).
- 129 See UNESCAP 2003b. [ref. Chapter 3:126]
- 130 As of November 2004, Indonesia, Cambodia, and the Philippines had not yet ratified the agreement (<http://www.haze-online.or.id/>).
- 131 UN Economic and Social Council. 2004. *Partnerships for Sustainable Development*. Report of the Secretary-General. Commission on Sustainable Development. Twelfth Session, 14–30 April.
- 132 The database of more than 260 partnerships is at <http://webapps01.un.org/dsd/partnerships/public/>.
- 133 Descriptions of voluntary agreements that have been adopted around the world can be found in: (i) OECD 1999. *Voluntary Approaches for Environmental Policy: An Assessment*. Paris: OECD Publications; (ii) European Environment Agency (EEA). 1997. *Environmental Agreements: Environmental Effectiveness*. Environmental Issues Series 3 (1–2). Copenhagen; (iii) OECD. 2003. *Voluntary Approaches for Environmental Policy: Effectiveness, Efficiency, and Usage in Policy Mixes*. Paris: OECD Publications; and (iv) Moffet, John., and Francois Bregha. 1999. An Overview of Issues with Respect to Voluntary Environmental Agreements. *Journal of Environmental Law and Practice* 8 (1): 63–94.
- 134 Mazurek, Janice. 2002. Government-Sponsored Voluntary Programs for Firms: An Initial Survey. In *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*. Edited by Thomas Dietz and Paul Stern. Washington, D.C.: National Academy Press.
- 135 Market forces appear to focus on the cost savings that can be gained from increased flexibility relative to command-and-control regulation, combined with gains from reduced confrontation.
- 136 For research on the topic of drivers of voluntary agreements, see Annandale and Taplin [ref. Chapter 1:25] and Darnall [ref. Chapter 1:25].
- 137 Reasons for changes in the world order of environmental policymaking are explained by Eckerberg and Joas. [Eckerberg, Katarina., and Marko Joas. 2004. Multi-Level Environmental Governance: A Concept Under Stress? *Local Environment* 9 (5): 405–412.]
- 138 Alberini and Segerson (2002) suggest the following:
- bilateral agreement between a regulatory agency and a polluter (or group of polluters)
  - voluntary government program under which the regulatory agency unilaterally determines both the rewards and obligations from participation, as well as the eligibility criteria. The regulator designs the program, and then seeks participation given the terms it specifies. [Alberini, Anna, and Kathleen Segerson. 2002. Assessing Voluntary Programs to Improve Environmental Quality. *Environmental & Resource Economics* 22:157–184.]
- OECD 1999 [ref. Chapter 3:133] suggests:
- Private agreements between polluters and the polluted. Contracts between a firm (or group of firms) and those who are harmed by its emissions.
  - Environmental agreements negotiated between industry and public authorities.
  - Voluntary programs developed by public authorities, to which individual firms are invited to participate.
- Mazurek [ref. Chapter 3:134] offers:
- Public voluntary: non-mandatory rules developed by a government body.
  - Unilateral commitments: refer to programs established by industry to encourage firms to achieve environmental improvements
  - Negotiated agreements: contracts between public authorities and industry. In contract to public voluntary efforts, negotiated agreements contain specific targets and are legally binding.
- 139 Stratos Inc. 2002. *Industry Codes of Practice and Other Voluntary Initiatives: Their Application to the Mining and Metals Sector*. Report for the Mining, Minerals and Sustainable Development Project of the International Institute for Environment and Development.
- 140 Adapted from Stratos 2002, *ibid*.
- 141 For examples of industry association Codes of Practice in the US, see Nash, Jennifer. 2002. Industry Codes of Practice. In *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*. Edited by Thomas Dietz and Paul Stern. Washington, DC: National Academy Press.
- 142 <http://www.minerals.org.au/environment/code>
- 143 <http://www.icca-chem.org/rcreport>
- 144 There is a substantial literature that describes and evaluates Responsible Care. Examples include (i) Prakash, Aseem. 2000b. Responsible Care: An Assessment. *Business and Society* 39 (2): 183–209. (ii) King, Andrew, and Michael Lenox. 2000. Industry Self-Regulation Without Sanctions: The Chemical Industry’s Responsible Care Program. *Academy of Management Journal* 43 (4): 698–716. (iii) Howard, Jennifer, Jennifer Nash, and John Ehrenfeld. 2000. Standard or Smokescreen? Implementation of a Voluntary Environmental Code. *California Management Review* 42 (2): 63–82.
- 145 <http://www.responsiblecare-us.com/accountability.asp>
- 146 Tahmina, Qurratul Ain, and Philip Gain. 2002. *A Guide to NGO-Business Partnerships*. Dhaka: Society for Environment and Human Development. Many of these relationships focus on certification and eco-labeling, and is dealt with in more detail in Chapter 4. An example is the Better Banana Project (<http://www.bsdflobal.com/viewcasestudy.asp?id=109>). See also: (i) Hartman, Cathy, Edwin Stafford, and Michael Jay Polonsky. 1999. Green Alliances: Environmental Groups as Strategic Bridges to Other Stakeholders. In *Greener Marketing: A Global Perspective on Greening Marketing Practice*. Edited by Martin Charter and Michael Jay Polonsky. Sheffield, UK: Greenleaf Publishing and (ii) Plante, Christopher, and Jem Bendell. 1998. The Art of Collaboration: Lessons from Emerging Environmental Business—NGO Partnerships in Asia. *Greener Management International* 24: 91–104.
- 147 See Gunningham and Sinclair [ref. Chapter 3:104] and Mazurek [ref. Chapter 3:134]

- 148 USEPA set a goal of reducing the total amount of these chemicals released into the environment and transferred off-site by 33% by the end of 1992 and by 50% by the end of 1995. The goal was reached by 1994.
- 149 Mazurek [ref. Chapter 3:134] lists 31 public voluntary programs that were implemented during the 1990s in the US.
- 150 Chidiak, Martina and Matthieu Glachant, M. 2000. *The French Country Study: Case Studies in the Sectors of Packaging Glass and Aluminum. Voluntary Agreements—Implementation and Efficiency*. [www.akf.dk/VAIE](http://www.akf.dk/VAIE)
- 151 The Australian Greenhouse Challenge—launched in 1995—is a joint voluntary initiative between the national government and industry to abate greenhouse gas emissions. Participating organizations sign agreements with the government that provide a framework for undertaking and reporting on actions to abate emissions. More details can be found at: <http://www.greenhouse.gov.au/challenge/>
- 152 UNEP has a good description of negotiated agreements. [UNEP. 2000. *Voluntary Initiatives: Current Status, Lessons Learnt and Next Steps*. ]
- 153 The objectives of the Australian Packaging Covenant are: (i) to establish a framework based on the principle of shared responsibility for the effective lifecycle management of packaging and paper products including their recovery and utilization; (ii) establish a collaborative approach to ensure that the management of packaging and paper throughout its lifecycle and the implementation of collection systems including curbside recycling schemes, produces real and sustainable environmental benefits in a cost effective manner; and (iii) establish a forum for regular consultation and discussion of issues and problems affecting the recovery, utilization and disposal of used packaging and paper, including costs. More information can be found at: <http://www.deh.gov.au/industry/waste/covenant/anzec/>
- 154 Gunningham and Sinclair [ref. Chapter 3:104] describe the Dutch environmental covenant system as an “unusual hybrid” that defies formal classification. This is because the covenants address collective and sector-wide environmental issues and are legally binding on individual enterprises through the permit system. This makes them intimately linked to mainstream command and control. We deal with the Dutch covenant approach earlier in the chapter because it grows out of a National Environmental Policy.
- 155 Environment Canada. 2001. *Policy Framework for Environmental Performance Agreements*. Ottawa. See also UNEP, 2000 [ref. Chapter 3:152].
- 156 See Gunningham and Sinclair [ref. Chapter 3:104]
- 157 Tsutsumi, Rie. 2002. Successful Application of Environmental Agreements in Local Communities: Perspectives from Environment and Pollution Control Agreements in Japan. In *Voluntary Environmental Agreements: Process, Practice, and Future Use*. Edited by Patrick ten Brink. Sheffield: Greenleaf Publishing.
- 158 See OECD 2003 [ref. Chapter 3:133]
- 159 See Hanks [ref. Chapter 3:106]
- 160 See Hanks [ref. Chapter 3:106]
- 161 These arguments are well put in Alberini and Segerson [ref. Chapter 3:138] and Gunningham and Sinclair [ref. Chapter 3:104].
- 162 See: (i) OECD 2003 [ref. Chapter 3:133]; (ii) Alberini and Segerson [ref. Chapter 3:138]; (iii) Nash [ref. Chapter 3:141]; (iv) Harrison, Kathryn. 2002. Challenges in Evaluating Voluntary Environmental Programs. In *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*. Committee on the Human Dimensions of Global Change. Edited by Thomas Dietz and Paul Stern. Washington, D.C.: National Academy Press; and (v) Mazurek [ref. Chapter 3:134].
- 163 See Harrison [ref. Chapter 3:162]
- 164 The “few cases” quoted are the Dutch environmental covenants and the Japanese EPCAs. See 1999 and 2003 OECD reports [ref. Chapter 3:133].
- 165 There is agreement on these points from (i) Gunningham and Sinclair [ref. Chapter 3:104]; (ii) OECD 1999 [ref. Chapter 3:133]; (iii) OECD 2003 [ref. Chapter 3:133]; (iv) Hanks [ref. Chapter 3:106]; and (v) Alberini and Segerson [ref. Chapter 3:138]. Free-riding is a situation where firms do not choose to join a voluntary agreement but reap the benefits of a sectoral agreement where active participants do improve their performance. Regulatory capture theorists suggest that there are intense pressures for regulatory agencies to acquiesce in the negotiation of targets, the result being conditions that are unduly favorable to industry and contrary to the public interest.
- 166 See OECD 1999 [ref. Chapter 3:133]
- 167 See National Research Council 2002 [ref. Chapter 1:23]
- 168 Krut, Riva, and Harris Gleckman, H. 1998. *ISO 14001: A Missed Opportunity for Sustainable Global Industrial Development*. London: Earthscan Publications Ltd. This concept has been recognized by agencies such as the USEPA, which is soon to begin a project with the Chinese Government (through SEPA) to promote voluntary environmental initiatives through trade associations.
- 169 For an extensive investigation into whether developing countries set inefficient environmental standards to attract foreign investment, see: (i) Neumayer, Eric. 2001. *Greening Trade and Investment: Environmental Protection Without Protectionism*. London, UK: Earthscan Publications Ltd. and (ii) Jenkins, Rhys Owen, Jonathan Barton, Anthony Bartzokas, Jan Hesselberg, and Hege Merete Knutsen. 2002. *Environmental Regulation in the New Global Economy: The Impact on Industry and Competitiveness*. Cheltenham, UK: Edward Elgar.
- 170 See Hanks [ref. Chapter 3:106]
- 171 Davy, Aidan. 1997. Environmental Management Systems: ISO 14001 Issues for Developing Countries. In *ISO 14001 and Beyond: Environmental Management Systems for the Real World*. Edited by Christopher Sheldon. Sheffield, UK: Greenleaf Publishing. Davy points out that the numbers of developing country participants are not necessarily an accurate reflection of actual influence. In his view, this is due to the origins of ISO 14001 being rooted in EMS developments in Western Europe, and the poorer resourcing of developing country delegates.
- 172 Significant detail can be found at: <http://www.iso14000.com>
- 173 UNDP. 1996. *ISO 14000 Environmental Management Standard and Implications for Exporters to Developed Markets*. New York: UNDP Private Sector Development Program.
- 174 See Krut and Gleckman [ref. Chapter 3:168]

#### Chapter 4

- 175 Sullivan, Rory, and Hugh Wyndham. 2000. *Effective Environmental Management: Principles and Case Studies*. Sydney: Allen and Unwin
- 176 Uzumeri, Mustafa. 1997. ISO 9000 and Other Metastandards: Principles for Management Practice? *Academy of Management Executive* 11 (1): 21–36.
- 177 Krut and Gleckman [ref. Chapter 3:168] provide a detailed explanation of the differences between European Eco-Management and Audit Scheme and ISO 14001. They state that: “In process and content, the differences between the two standards lie precisely in the areas crucial to sustainable development: public access to information, legal environmental proceedings, assurances of regulatory compliance, and environmental performance assurances and improvements.”
- 178 North American Commission for Environmental Cooperation. 2000. *Improving Environmental Performance and Compliance: 10 Elements of Effective Environmental Management Systems*. <http://www.cec.org> This Guidance Document concludes that “an EMS that follows through on a commitment to continuous improvement allows the organization using it to achieve better performance levels than those required by government regulation.”
- 179 Adapted from: Hortensius, Dick, and Mark Barthel. 1997. Beyond 14001: An Introduction to the ISO 14001 Series. In *ISO 14001 and Beyond: Environmental Management Systems for the Real World*. Edited by Christopher Sheldon. Sheffield, UK: Greenleaf Publishing.
- 180 This critique has been most forcefully put by Krut and Gleckman [ref. Chapter 3:168].
- 181 Christmann, Petra, and Glen Taylor. 2001. Globalization and the Environment: Determinants of Firm Self-Regulation in China. *Journal of International Business Studies* 32 (3): 439.
- 182 Potoski, Matthew, and Aseem Prakash. 2004. Regulatory Convergence in Nongovernmental Regimes? Cross-National Adoption of ISO 14001 Certifications. *Journal of Politics* 66 (3): 885–905.
- 183 Montabon, Frank, Steve Melnyk, Robert Sroufe, and Roger Calantone. 2000. ISO 14001: Assessing Its Perceived Impact on Corporate Performance. *Journal of Supply Chain Management* 36 (2): 4–16.
- 184 Annandale, David, Angus Morrison-Saunders, and George Bouma. 2004. The Impact of Voluntary Environmental Protection Instruments on Company Environmental Performance. *Business Strategy and the Environment* 13: 1–12.
- 185 See Dasgupta et al [ref. Chapter 2:91]
- 186 See Annandale et al [ref. Chapter 4:184]
- 187 Heemskerk, Bert, Pasquale Pistoria, and Martin Scioccluna. 2002. *Sustainable Development Reporting—Striking the Balance*. Geneva: WBCSD.
- 188 Ibid.
- 189 Korean Environment Institute. 2002. Air Pollution in the Megacities of Asia: Stage 1.
- 190 Good examples of the latter are provided in Jones, Kathryn and Tony Alabaster. 1999. Critical Analysis of Corporate Environmental Reporting Scoring Systems. *Journal of Environmental Assessment Policy and Management* 1(1): 27–60.
- 191 European Environmental Benchmarking Network. 2000. *Background*, Fondazione Eni Enrico Mattei. <http://www.eebn.org/>
- 192 European Environment Agency. 2001. *Environmental Benchmarking for Local Authorities: From Concept to Practice*. Copenhagen.
- 193 <http://www.greenglobe21.com>
- 194 <http://www.usaid.gov/in/UsaidInIndia/Act>
- 195 Luken, Ralph, and Rodney Stares. 2005. Small business responsibility in developing countries: A threat or an opportunity? *Business Strategy and the Environment* 14: 38–53.
- 196 Lewis, Helen, and Marjolein Demmers. 1996. Life Cycle Assessment and Environmental Management. *Australian Journal of Environmental Management* 3:110–123.
- 197 Evans, David, and Stuart Ross. 1998. The Role of Life Cycle Assessment in Australia. *Australian Journal of Environmental Management* 5: 137–145.
- 198 Rebitzer, Gerald, Tomas Ekvall, R. Frischeknecht, David Hunkeler, Greg Norris, Tomas Rydberg, Wulf Peter Schmidt, Sangwon Suh, B.P. Weidma, and David Pennington. 2004. Life Cycle Assessment Part 1: Framework, Goal and Scope Definition, Inventory Analysis, and Applications. *Environment International* 30:701–720.
- 199 See Lewis and Demmers [ref. Chapter 4:196]
- 200 Society for Environmental Toxicology and Chemistry (SETAC). 1993. *A Conceptual Framework for Life Cycle Impact Assessment*. Washington, DC: SETAC.
- 201 <http://www.iso.org/iso/en/prods-services/otherpubs/iso14000/application.pdf>
- 202 <http://www.apme.org>
- 203 <http://www.aluminium.org>
- 204 <http://www.fefco.org>
- 205 <http://www.nidi.org>
- 206 [http://www.worldsteel.org/env\\_lca.php](http://www.worldsteel.org/env_lca.php)
- 207 See Rebitzer et al. [ref. Chapter 4:198]
- 208 Pennington, David W., José Potting, Göran Finnveden, Erwin Lindeijer, Olivier Jolliet, Tomas Rydberg, and Gerald Rebitzer. 2004. Life Cycle Assessment Part 2: Current Impact Assessment Practice. *Environment International* 30: 721–739.
- 209 See: (i) Rebitzer et al [ref. Chapter 4:198]; (ii) Lewis and Demmers [ref. Chapter 4:196]; Evans and Ross [ref. Chapter 4:197]
- 210 See Rebitzer et al [ref. Chapter 4:198]
- 211 Hunkeler, David, Konrad Saur, Gerald Rebitzer, Matthias Finkbeiner, Wulf Peter Schmidt, and Allan Astrup Jensen. 2004. *Life Cycle Management Report of the SETAC Working Group on LCM*. Pensacola, USA: SETAC.
- 212 One of the best examples of a simplified LCA process can be found in: Graedel, Thomas, Braden Allenby, and Paul Comrie. 1995. Matrix Approaches to Abridged Life Cycle Assessment. *Environmental Science and Technology* 29 (3): 134–139.
- 213 More information can be found on the website of the Japan Environmental Management Association for Industry (<http://www.jemai.or.jp/english/lca/project.cfm>).
- 214 Zakaria, Zulina, Mohd Hassan, and Muhamad Awang. 1999. Current Status and Needs for Life Cycle Assessment Development in Asian-Pacific Regions. *International Journal of LCA* 4 (4): 191–194.
- 215 Kakkar, Meenakshi, and S. Maudgal. Undated. *Life Cycle Assessment – An Effective Tool for Cleaner Production in the Steel Sector*. [www.aprcp.org/articles/papers/kakkar.htm](http://www.aprcp.org/articles/papers/kakkar.htm).
- 216 <http://www.howproductsimpact.net/box/home/content.htm>
- 217 See Zakaria et al [ref. Chapter 4:214]
- 218 Sometimes shortened to “environmental accounting,” though because this could create confusion with environmental income accounting to calculate “green gross domestic product” and other macroeconomic indicators of national environmental performance, this report will use EMA throughout.
- 219 Yakhou, Mehenna, and Vernon Dorweiler. 2004. Environmental Accounting: An Essential Component of Business Strategy. *Business Strategy and the Environment* 13:65–77.
- 220 <http://www.emawebsite.org>
- 221 <http://www.un.org/esa/sustdev/sdissues/technology/estema1.htm>
- 222 Mathews, M.R. 1997. Twenty-Five Years of Social and Environmental Accounting Research. *Accounting, Auditing, and Accountability Journal* 10 (4):481–531.
- 223 <http://www.emawebsite.org>
- 224 Internationale Weiterbildung und Entwicklung gGmbH. (undated). EMA-SEA : Environmental Management Accounting for South-East Asia.
- 225 Burritt, Roger 2004. Environmental Management Accounting: Roadblocks on the Way to the Green and Pleasant Land. *Business Strategy and the Environment* 13 :13–32.
- 226 <http://www.un.org/esa/sustdev/sdissues/technology/estema1.htm>
- 227 <http://www.eman-ap.net>
- 228 <http://www.environmental-accounting.org>

#### Chapter 5

- 229 DeSimone, Livio, and Frank Popoff. 2000. *Eco-Efficiency: The Business Link to Sustainable Development*. Geneva: WBCSD.
- 230 WBCSD case studies are available at <http://www.wbcd.org>.
- 231 Verfaillie, Hendrik, and Robin Bidwell. 2000. *Measuring Eco-Efficiency: A Guide to Reporting Company Performance*. Geneva: WBCSD.
- 232 <http://www.recyclingtoday.com/news/news.asp?ID=6948>
- 233 <http://www.magiceyes.or.th/Engver/faq.html>
- 234 Gupta, Sanjay. 2004. *Rethinking Waste Management in India*. <http://www.toxicslink.org/art-view.php?id=9>
- 235 Institute for Local Self-Reliance. 2000. Wasting and Recycling in Metropolitan Manila, Philippines. (<http://www.greenpeacesoutheastasia.org>). The Solid Waste Management Act 2000 mandates “zero waste management” as a national policy and requires local government units to recycle 25% of waste collected.
- 236 *Xinhua*. 2004. China Revises Law—Doesn’t Want to be “World’s Largest Dumping Ground.” 4 November.
- 237 <http://www.wm.com/>
- 238 At the time of writing, ferrous scrap was priced at about \$100 per ton, while mixed waste paper was at about \$90 per ton.
- 239 World Energy Council. 1995. *Global Energy Perspectives to 2050 and Beyond*. London.
- 240 Personal communication with Jurg Gerber of Alcan at AEO 2005 Workshop, October 2004.
- 241 See WBCSD case studies [ref. Chapter 5:230]
- 242 Quote from Christian Kornevall from ABB appearing in Walking the Talk, the Business Case for Sustainable Development.
- 243 [http://www.greencouncil.org/web/green\\_label\\_scheme.php](http://www.greencouncil.org/web/green_label_scheme.php)
- 244 <http://www.aela.org.au/homefront.htm>
- 245 Law, Ir Nelson. 2003. *Green Label: HK Green Label - A Product Certification Scheme Using Green Criteria*. [http://www.nlaw.com.hk/articles\\_detail.asp?Article\\_id=35](http://www.nlaw.com.hk/articles_detail.asp?Article_id=35)
- 246 US Environmental Protection Agency. 1997. *Japan’s EcoMark*. Washington, DC.
- 247 <http://www.kela.or.kr/english/cover/cover.asp>
- 248 <http://www.enviro-choice.org.nz/>
- 249 Qing, Xia and Yu Jie. 2003. China’s Environmental Labeling Program. Paper presented at the WTO symposium on Challenges Ahead on the Road to Cancun. Geneva. 16-18, June.
- 250 UNEP. 2004. *Regional Sustainable Consumption and Production Report: Asia and the Pacific*. Paris, France.
- 251 <http://www.greenmark.epa.gov.tw/english/index.asp>
- 252 Bunyagidji, Chaiyod. 2004 Presentation on Green Procurement in Thailand: Challenges and Opportunities for *Asian Productivity Organization Workshop on Green Procurement*. Kuala Lumpur, Malaysia. 3 September.
- 253 [http://www.greencouncil.org/web/publications\\_articles.php?id=1&art\\_id=227](http://www.greencouncil.org/web/publications_articles.php?id=1&art_id=227)
- 254 Sikod, Fondo. 1996. Certification Process in Sustainable Forest Management: Economic Concepts and Indicators. Paper presented at the Conference on Economic, Social, and Political Issues in Certification of Forest Management, Malaysia, 12–16 May.
- 255 These include tenuous ecological and socioeconomic conditions, uncertain or disputed land tenure, social and political conflicts concerning forest use, lack of financial and human resources, and institutional weaknesses.
- 256 *New Scientist*. 2003. Marine Stewardship Council Under Fire. 17, May, Vol 178, Issue 2395. [http://www.eurocbc.org/ns\\_vol178\\_iss2395\\_p3\\_p1of3\\_17may2003page1025.html](http://www.eurocbc.org/ns_vol178_iss2395_p3_p1of3_17may2003page1025.html)
- 257 Marine Stewardship Council. 2004. Trustees’ Report and Accounts. London, UK.
- 258 WWF. 2005. *Fostering Payments for Environmental Services (PES) in the Danube Basin*. Switzerland.
- 259 ECOTEC. 2002. *Analysis of the EU Eco-industries, their Employment and Export Potential*. UK: ECOTEC Research & Consulting Limited.

260 The main difference between the two lists is that minerals and chemicals for water/waste treatment are exclusive to the OECD list, while the APEC list includes a relatively more extensive set of goods needed for environmental monitoring and assessment. The OECD list also contains a large number of environmentally preferable products.

261 Environment Business International is a US-based private research and publishing firm focused on the environmental industry.

262 2003. Summary Report from Seminar on Trade Liberalization in Environmental Goods and Services. Organized by the Ministry of Commerce and Industry, UNCTAD, and TERI. New Delhi, India, 16 May.

263 See ECOTEC [ref. Chapter 5:259]

264 Berg, David, and Grant Ferrier. 1998. *The US Environmental Industry*. Washington DC: US Department of Commerce – Office of Technology Policy.

265 Bora, Bijit, and Robert Teh. 2004. Tariffs and Trade in Environmental Goods. WTO Workshop on Environmental Goods. Geneva. 11 October 2004.

266 UNCTAD. 2003. Report of the Expert Meeting on Definitions and Dimensions of Environmental Goods and Services in Trade and Development. TD/B/COM.1/59. Geneva: UNCTAD.

267 Kim, Joy. 2004. UNU-IAS Working Paper No. 132 on Opportunities and Challenges in Liberalizing the Environmental Goods and Services Market: The Case of Developing Countries in Asia.

268 These are the South-to-North Water Diversion Project, the Three Gorges Project, the comprehensive pollution control and ecological rehabilitation project in the Three-Rivers and Three-Lakes regions, and the National Western Development Project.

269 U.S. Department of Commerce, International Trade Administration. 2005. *Water Supply and Wastewater Treatment Market in China*. Washington, DC.

270 McIlvaine Company. 2004. *World Pump Market to Reach \$31 Billion by 2007*. February.

271 ———. 2004. *Biotechnology and Municipal Wastewater Spending is Boosting Sales of Sedimentation and Centrifugation Equipment*. <http://www.mcilvaine.com/webtofc.html>

272 ———. 2003. *Market for Macrofiltration Equipment and Media to Reach \$4 Billion in 2005*. <http://www.mcilvaine.com/webtofc.html>

273 ———. 2003. *Desalination Will Be the Growth Engine Leading to an \$8 Billion Membrane System Market in 2007*. <http://www.mcilvaine.com/webtofc.html>

274 MCOT News. 2004, December 4. *Six Mekong Countries Co-operate on Alternative Energy*. <http://etna.mcot.net/query.php?nid=33489>

275 Clayton, Mark. 2004. New Greenhouse Gas Emissions from China, India, and the US Will Swamp Cuts from the Kyoto Treaty. *Christian Science Monitor*. 23 December. (<http://www.csmonitor.com/2004/1223/p01s04-sten.html>) Clayton claims that these three countries alone are planning to build 850 new coal-fired plants by 2012, which would emit five times as much carbon dioxide into the atmosphere as the Kyoto Protocol aims to reduce.

276 Bogach, V. Susan, Enno Heijndermans, and Anil Cabraal. 2000. *The Asia Alternative Energy Program*. Background paper prepared for the Energy Sector Strategy. Washington, DC: World Bank.

277 Mindbranch. 2004. Introduction to Renewable Bulk Power Systems: Technologies, Markets, Regulations, Legislation, Incentives, Carbon Funds and Forecasts. <http://www.mindbranch.com/products/R2-789.html>

278 Ibid.

279 Ho, Abigail L. 2005, June 18. Energy Dept to Offer 18 Sites for Wind Power Development. [http://money.inq7.net/breakingnews/view\\_breakingnews.php?yyyy=2005&mon=06&dd=18&file=3](http://money.inq7.net/breakingnews/view_breakingnews.php?yyyy=2005&mon=06&dd=18&file=3)

280 See Mindbranch [ref. Chapter 5:277]

281 Bhattacharya, S.C. 2002. Biomass Energy in Asia: A Review of Status, Technologies and Policies in Asia. *Energy for Sustainable Development VI* (No. 3): 5–10.

282 Ibid.

283 Ibid.

284 <http://www.mcilvaine.com/sampleupdates/ScrubberAdsorberUpdateSample.htm>

285 See Mindbranch [ref. Chapter 5:277]

286 Meier, Peter. 2003, 10 February. Economic Analysis of Solar Home Systems: A Case Study for the Philippines. Washington, DC: World Bank.

287 Samath, Feizal. 2001, August 21. Sun Shines on Sri Lanka's Solar Industry. Asia Times Online. <http://www.atimes.com/indpak/CH17Df02.html>

288 Dr. Noda, Tetsuro. Director, Institute for Geo-Resources. 2002, December 24. Opening Announcement of Fifth Asian Geothermal Symposium. Kuala Lumpur, Malaysia. <http://staff.aist.go.jp/hiro-muraoka/AsianSymptoE.html>

289 Refocus – The International Renewable Energy Magazine. 2001. The Ring of Fire: The Use of Geothermal Energy in Indonesia. Nov/Dec. <http://balisos.com/Energy/ReFocus-Report-GeoThermal-Energy-Indonesia.html>

290 Global Energy Network Institute. Geothermal Potential of the Western Pacific Rim. San Diego, CA. <http://www.geni.org/globalenergy/library/energytrends/currentusage/renewable/geothermal/asia/abstract.shtml>

291 Kaosa-ard, Mingsarn S. and Benjavan Rekasem. 2000. *The Growth and Sustainability of Agriculture in Asia*. Hong Kong, China: Asian Development Bank and Oxford University Press.

292 The average US farm uses 3 kcal of fossil energy in producing 1 kcal of food energy. In feedlot beef production this ratio is 35:1, and this does not include transportation energy for the food produced. [Horrigan, Leo, Robert S. Lawrence, and Polly Walker. 2002. How Sustainable Agriculture can Address the Environmental and Human Harms of Industrial Agriculture. *Environmental Health Perspectives* 110:445–56.]

293 Lowrance Richard, Paul F. Hendrix, and Eugene P. Odum. 1986. A Hierarchical Approach to Sustainable Agriculture. *American Journal of Alternative Agriculture* Vol. 1, No. 4, pp. 169–173

294 Pretty, Jules. 2002. *Agri-Culture: Reconnecting People, Land and Nature*. London: Earthscan.

295 Pretty, Jules. 2003. *Agri-Culture: Some Principles and Lessons for Sustainability*. Cardiff Centre for Ethics, Law and Society. <http://www.ccels.cardiff.ac.uk/pubs/pretypaper.pdf>

296 Reijntjes, Coen, Bertus Haverkort, and Ann Waters-Bayer. 1992. *Farming for the Future: An Introduction to Low-External*

*Input and Sustainable Agriculture*. London: Macmillan.

297 See Horrigan, et. al. [ref. Chapter 5:300]

298 Walz, Erica. 2004. *Fourth National Organic Farmers' Survey: Sustaining Organic Farms in a Changing Marketplace*. Organic Farming Research Foundation, Santa Cruz, California.

299 Setboonsarng, Sununtar, and Jonathan Gilman. 1999. *Alternative Agriculture in Thailand and Japan*.

300 Bezdek, Roger, and Robert Wendling. 2005. Job Creation and Environmental Protection. *Nature* 434: page 678.

301 McIlvaine Company. 2001. *U.S. Industry Market Leadership in Asia's Air Pollution Control Sector*. Prepared for the US-Asia Environmental Partnership. Washington, DC.

302 Ibid.

303 Ellyard, Peter. 1998. *Creating and Preparing for the Jobs of the 21st Century*. Paper presented to the conference: Working 2001, WA Department of Training, Perth, Australia.

304 (i) Macdonald, Jacqueline A. 1997. Hard Times for Innovative Cleanup Technology. *Environmental Science and Technology*, 31 (12): 560A; (ii) O'Hara, Patrick, Daniel E. Kennedy, and David B. Frazier. 1997. Adapting to Hazardous Waste Markets. *Engineering News Record*. October 20, 239 (16): E3.

305 <http://www.wm.com/wm/about/Overview.asp>

306 Renner, Michael. 1991. *Jobs in a Sustainable Economy*. Worldwatch Paper 104. Washington DC, Worldwatch Institute

307 International Energy Agency. 1991. *Energy Conservation in International Energy Agency Countries*. Paris. OECD Publications.

## Chapter 6

308 Halal, William E. 1998. *The Infinite Resource: Creating & Leading the Knowledge Enterprise*. San Francisco: Jossey-Bass.

309 Patent filing by Japan, the Republic of Korea, and PRC is growing at more than 15% per annum. <http://www.wipo.int>

310 The TechCast Project is conducted by Prof. William E. Halal and his associates at George Washington University and George Mason University. For information on the Project, see <http://www.TechCast.org>.

311 Kincaid, Lori, Gary Davis, and Jed Meline. 1996. *Cleaner Technologies Substitutes Assessment: A Methodology and Resource Guide*. <http://www.epa.gov/opptintr/dfe/pubs/tools/ctsa/index.htm>

312 <http://www.etsu.com/fantasia/public.html>

313 Pine, Joseph, and Stan Davis. 1998. Change—Or Else. *Inc. Magazine*. 23 May.

314 *Aviation Week & Space Technology*. 2000. The Nanotech Revolution. 12 Jun.

315 *Engineer*. 2000. Ready for the Next Big Thing? 10 Mar.

316 Other products on the drawing boards include (i) single-walled carbon nanotube fibers; (ii) plastics with carbon nanotubes to improve extrusion; (iii) photonic crystals for optical and quantum computing; (iv) DNA tags to prevent counterfeiting; (v) infrared sensors for detecting fires; (vi) gallium nitride nanowires for miniature semiconductors; (vii) luminescent quantum dots to pinpoint cancer cells; (viii) molecular materials to switch light with light for faster Internet connections; (ix) more powerful chips; (x) medical treatments; and (xi) coated windows that change their shading or let light in and keep heat out.

317 K. Eric Drexler is founder and chairman emeritus of the Foresight Institute. He is an author and expert in the field of emerging technologies.

318 *New Scientist*. 2003. Doubts About Nanotechnology. 14 Aug.

319 *Yahoo News*. 2003. Los Alamos Envisions Space Elevator. 27 Oct.

320 (i) *BusinessWeek*. 2003. Nanochips May Be Around the Corner. 27 Oct. (ii) *EETimes*. 2003. Nantero Reports 10 Gbit Nanotube Array. 8 May.

321 *BusinessWeek*. 2002. Nanotechnology. 25 Mar.

322 United Nations Economic Commission for Europe. 2004. World Robotics 2004. Geneva.

323 As robots become smarter and behave more like humans, we will emotionally react to them as if they were thinking, animate beings. Anyone who doubts this should watch children playing with the new canine robots or “virtual pet” key chains. Recognizing this affinity, a toy company has started to manufacture robot babies that mimic the awkward stumbling steps and babbling of real infants.

324 *BusinessWeek*. 2001. Planes that Know What to Bomb. 12 Nov.

325 Smith, Emily. 2004. Robotics: The Brave New World of Surgery. *The Australian*. 31 July.

326 Wilkinson, Stuart. 2000. “Gastrobots.” Benefits and Challenges of Microbial Fuel Cells in Food Powered Robot Applications. *Autonomous Robots* 9: 99–111. Amsterdam: Kluwer Academic Publishers.

327 *Christian Science Monitor*. 2004. Robot Forecasts. 5 Feb.

328 *BusinessWeek*. 2003. Adaptive Aircraft: No Flight of Fancy? 7 Jan.

329 Gillett Stephen L. 2002. Nanotechnology: Clean Energy and Resources for the Future (white paper for Foresight Institute). <http://www.foresight.org/impact/GillettWhitePaper.txt>

330 *Professional Safety*. 1998. Computers Advance Highway Safety. Dec.

331 *Mechanical Engineering*. 1998. Smart Cars and Automated Highways. May.

332 *BusinessWeek*. 2003. Japan: A Tiny Leap Forward. 6 Oct; *Technology Review*. 2004. Hybrid's Rising Sun. Apr.

333 Lovins, Amory. 1999. A Road Map for Natural Capitalism. *Harvard Business Review*. May–Jun.

334 Toyota and Honda rolled out the first fuel cell autos in 2002 costing \$1 million each. They expect costs of \$100,000 by 2010. Japan is planning to have 50,000 fuel cell cars by 2010 and 5 million by 2020. Germany leads the world and has produced hydrogen using electrolysis of water. (*Futurist*. 2002. A Hydrogen Future. Jan-Feb.) Daimler-Chrysler will introduce a fuel cell car soon and estimates costs will match conventional cars by 2010. (*BusinessWeek*. 2001. Hybrids Are Headed for Main Street. 11 Jun.) GM has designed a new platform for fuel cell autos and is developing 3 cars to be introduced by 2010. GM has also invested heavily in suppliers that produce fuel cells, hydrogen storage tanks, and reformers that convert gas into hydrogen. (*USA Today*. 2001. GM Buys Stake in Hydrogen. 13 Jun.) The Company increased investment in hydrogen research from \$1 million to \$1 billion a year. They hope to become the first automaker to sell 1 million fuel cell cars. (*Wired*. 2003. Fuel Cell Cars Trump Hybrids. 6 Aug.) A GM official said “Fuel cells are the first technology in 100 years with the potential for competing with the

internal combustion engine.” Exxon Mobil is developing auto fuel cells, Shell and BP have formed hydrogen divisions, and Texaco is working on storage. (*Futurist*. 2002. A Hybrid Future. Jan-Feb.) Ballard, the world’s leading maker of fuel cells is planning to reduce costs from \$2000/kw to \$50/kw by mass producing 300,000 fuel cells in 2005. (*BusinessWeek*. 2000. How Hybrids Work. 8 May.) The US has committed \$1.7 billion to support hydrogen research, the EU is investing \$2 billion, and Japan \$2 billion. Iceland is building the world’s first hydrogen economy. PRC is hungry for energy, and many think it will take the lead by committing to fuel cell development. (*Toronto Star*. 2004. 20 Sep.) The California Fuel Cell Partnership, which includes major carmakers and energy firms, plans to place 300 fuel cell cars into demonstration tests and to build fueling stations every 20 miles on major highways. (*Fleet Owner*. 2004. Come to the Fair. May.) Pacific Northwest National Laboratory is developing an under-the-hood reformer that produces hydrogen from gas on demand. Further, the process produces twice the energy output than the original gas. (*BusinessWeek*. 2004. Vapor and Steam Beat Gasoline. 17 May.)

335 *Issues in Science & Technology*. 2002. Updating Automotive Research. Spring.

336 In 2003, the PRC launched the world’s only commercial maglev running between downtown Shanghai and the city’s airport that is expected to carry 20 million by 2010. (*Design Engineering*. 2003. Transrapid International Introduces Magnetic Levitation Train in Shanghai. 4 Feb.) Another \$15 billion project is being planned to connect Shanghai and Beijing reducing travel time from 17 hours to 4 hours. (*Financial Times*. 2000. China to Get Maglev Train. 9 Feb.)

337 *The Engineer*. 2004. Maglev Trains: Pulling Power. 23 Jan.

338 *Japan Times*. 2002. Maglev Gives Quick Thrill. 18 Jun.

339 Russia is building a flying lab designed to test hydrogen and hydrocarbon ramjet engines flying at Mach 8.5. (BBC. 2003. Russia To Test Hypersonic Plane. 26 Aug.) Aerospaciale Matra is developing a new supersonic transport that could be flying by 2015, followed by a 1,000-seat flying wing in 2020. (*Futurific*. 2000. Flying Supersonic. August.) NASA is testing an upgraded X-43A scramjet aircraft capable of Mach 7 to 10 at 95,000 feet for possible use as passenger aircraft or advanced space missions. (*Knight-Ridder Tribune Business News*. 2004. Aerospace Firm Back on Track with Experimental Flight. March.) TC Corp. and Purdue University have formed an alliance to develop propulsion systems for Mach 7 flight. The Australians won an international competition to test fly the world’s first rocket powered by a scramjet. (*New York Times*. 2002. The Scramjet. Dec.)

340 Sao Paulo, Brazil, is home to more than 500 private helicopters used to commute executives to work in 15 minutes. (*Forbes* 2002. Copter Crazy. 13 May.) The Robinson R22 is the world’s most popular helicopter, selling at \$150,000 and carrying 2 passengers. More than 3,000 were sold as of 2001. Honda is developing a small cost-efficient air taxi designed to ferry 4–5 people between airports, and GE is building the jet engine. (*BusinessWeek*. 2004. Gotta Fly to the Office. 13 Sep.) Eclipse Aviation has 2,100 orders for its two-engine, five-passenger jet selling for \$1 million, one-fourth the cost of a corporate jet. Cessna and Adam Aircraft are building similar “personal jets,” due out in 2007. (*Newsweek*. 2003. A Taxicab at 30,000 Feet. 6 Oct.) Moller International is building a “Skycar” that travels at 350 mph and gets 15 mpg fuel efficiency. Global positioning systems and automatic pilot provide hands-free computer controlled travel. (*Herman Group*. 2001. Fly Your Car. 3 Jan.)

341 Mitsui OSK Lines Highlights for 2004. www.MOL.co.jp

342 *Computerworld*. 2003. Customs Will Fine Shippers. 23 Jan.

343 *New Scientist*. 2001. Rising Tide of Micro-Plastics. 20 Jan.

344 <http://www.planktos.com>

345 Other telematic technologies considered were combined on-board emissions and engine management; multimodal traveler information/trip planning; dynamic route planning; in-vehicle traffic information; electronic tolling; navigation; traffic control; parking management; automated driverless transport; anticollision systems; smart card; drive-by-wire; vision enhancement; autonomous intelligent cruise control; fleet management; integration of information technologies; rail traffic management for long-distance passenger and freight; lane keeping; and driver monitoring.

346 <http://www.iea.org>

347 Deffeyes, Kenneth. 2001. *Hubbert’s Peak: The Impending World Oil Shortage*. New Jersey: Princeton University Press.

348 England is building 18 offshore wind farms housing 6,000 turbines and Denmark expects to derive half of its energy from wind. European wind power overall grew from 500 megawatts in 1990 to 23,000 in 2002, a 50-fold increase. (*Fortune*. 2003. A Mighty Wind. 22 Dec.) The US is investing \$3 billion in wind power because North Dakota, Kansas, Texas, and other states alone could provide all of America’s energy needs. Experts estimate that wind power could supply 12% of the world’s energy needs by 2020.

349 Photovoltaic cells (PVC) presently cost \$4/watt, compared with \$.40/watt for oil and gas. But costs are expected to reach \$1/watt by 2007, and companies like Nanosys are using nanotech to build plastic PVCs costing \$.20/watt that are 70% efficient compared with the present 20%. (*The Economist*. 2002. The End of the Oil Age. 20 Jun.) Japan has 80,000 homes with solar panels, and 10% of new homes have solar panels. German solar power has grown 300% in 2 years, with 120,000 homes having solar panels. British Petroleum is building a \$100-million solar plant. The solar energy reaching Earth is 10,000 times our global energy consumption. It is thought that a patch of thermal solar plants in the Sahara 500 kilometers across could meet the world’s entire energy needs. (*New Scientist*. 2004. Power of the Midday Sun. 10 May.)

350 About 70% of Americans now favor nuclear energy. Nuclear produces no pollution, has a sound safety record, and costs 1.9 cents/kwh compared with 3.4 cents for oil and gas. An International Atomic Energy Agency study found that oil pollutants kill 32 times as many people as nuclear. New designs like the “pebble bed” reactor are immune to meltdowns and storing waste in glass (vitrification) can be safe for 200,000 years. The head of the US Nuclear Regulatory Commission was surprised to note interest in building new plants: “The possibility was unthinkable a year ago.” The PRC alone is planning to build 30 nuclear reactors.

351 *New Scientist*. 2003. The Clean Green Energy Dream. 16 Aug.

352 Analysts expect distributed power to produce 20% of all electric energy by 2010. John Benner, National Renewable Energy Lab, thinks local power sources will supply 25% of new capacity by 2020. 2000. *Purdue Extrapolations*. Winter.

353 *Technology Review*. 2004. Biotech Crops About to Bloom. 16 Jul.

354 *Sydney Morning Herald*. 2004. City with a Future. 15 May.

355 *New Scientist*. 2004. Smog-Busting Paint. Feb 4.

356 United Nations Association of Greater Boston. 2003. Water Scarcity: Averting a Global Crisis. Conference on Public Private

Sector Collaboration in Addressing the UN Millennium Water and Sanitation Goals, Massachusetts, 22 May.

357 *Fortune*. 2000. Water, Water Everywhere. 15 May.

358 Ovation Products, for instance, claims it can distill water contaminated with anything into pure drinking water for about 1 cent/gallon. (*Technology Review*. 2003. Would You Drink Purified Sewage? 22 Dec.)

359 For instance, the French firms, Vivendi and Suez, are the largest water treatment companies in the world and growing rapidly. In 1999, Suez had annual sales of \$32 billion. (*Fortune*. 2000. Water, Water Everywhere. 15 May.) California is building 13 plants that could supply 10–20% of the State’s water. Florida is building a \$110-million plant, the largest in the Western hemisphere, and Texas is planning 9 plants. Israel has 5 large projects. CDT Systems has developed a “capacitative deionization” technique that produces clean water at half the cost of the conventional reverse osmosis technique. (*Technology Review*. 2003. Hold the Salt. 24 Dec.)

360 *Christian Science Monitor*. 2003. How to Feed the World. 20 Feb.

361 *Los Angeles Times*. 2002. Organic Farms Viable Despite Lower Yields. 21 May.

362 *Croplife*. 2002. Digitize It. Dec.

363 One study found a yield monitor useful only when combined with global positioning systems. Another found variable rate fertilizers to be unprofitable on wheat and barley, sometimes profitable on corn, and profitable on sugar beets. (*Journal of the ASFMRA*. 2002.)

364 *Croplife*. 2001. Seed Money. Dec.

365 *Apply*. 2004. From the Top. 1 Feb.

366 Mining data is from the Industrial Technologies Program website, <http://www.oit.doe.gov>. Information on the PRC is from: Kurtenbach, Elaine. 2004. China Paying Price for Industrial Boom. *Associated Press Online*. 1 Jan.

367 Kawatra, S Komar, and K A Natarajan. 2001. *Mineral Biotechnology. Society for Mining, Metallurgy, and Exploration. Mining Industry Roadmap for Crosscutting Technologies*. <http://www.oit.doe.gov>

368 *Ibid*.

369 Mellon, Margaret, and Jane Rissler. 2003. *Environmental Effects of Genetically Modified Food Crops. Union of Concerned Scientists*. Paper presented by Margaret Mellon at a conference, Genetically Modified Foods—the American Experience, sponsored by the Royal Veterinary and Agricultural University, Copenhagen, Denmark, June 12–13, 2003.

370 *New Scientist*. 2002. 20-year Study Backs Organic Farming. 30 May.

371 NASA has set up an Office of Exploration Systems to develop technologies for the proposed moon mission. By 2008, the crew exploration vehicle (CEV), which ferries astronauts to and from the moon, will be tested for a manned mission in 2014. The European Union has its own plan, Aurora, to construct a permanent moon base from which to launch Mars missions. They envisage collaborating with the US New rocket motors, hybrid fuels, and myriad technologies can be used to create even more powerful rockets. TransHab, a multi-storey inflatable habitat, can provide semi-permanent accommodation for up to six astronauts. (*New Scientist*. 2004, 31 Jan. *Ibid*)

372 *MicroScope*. 2004. Biometrics: Next Killer App. 24 May.

373 *Technology Review*. 2003. Boosting Biometrics. Jun

374 The UK is setting up a National Identity Register based on biometrics for its 600 million citizens. The Enhanced Border Security Act will upgrade all US passports and visas to biometrics at a cost of \$3.2 billion over three years. The Department of Defense worldwide information infrastructure based on biometrics will be in place by 2010. The European Union will start issuing biometric passports in 2005 and uses fingerprints to identify people at borders. Suruga Bank launched Japan’s first biometric deposit account in July 2004. Japan’s NTT DoCoMo launched the world’s first biometric-enabled phone in July 2003. (*Wireless Week*. 2004. Eyeing Biometrics 15 Jan.) Forty-two airports are using electronic fingerprint-scanning technology, often in combination with RFID tags. New York’s John F. Kennedy Airport is implementing a \$1.2 million iris recognition project. (*Airport Security Report*. 2004. Airports to Deploy Biometrics. 19 May.)

375 Lehman Brothers thinks the market for biometrics will grow 30–35% annually, and another study estimates growth at 37%. (*Security Systems News*. 2004. IBG Report Predicts Double Digit Growth for Biometrics. Feb.) Sales of biometrics were \$600 million in 2002, \$1 billion in 2004, and are expected to exceed \$4 billion by 2007. It is thought that fingerprints will replace credit cards by 2007. (*Wireless Week*. 2004. Eyeing Biometrics. 15 Jan.)

376 IDC expects Internet traffic to double annually the next 5 years due to broadband. IDC. 2003, 27 Feb. Broadband Will Drive Internet Growth. [www.IDC.com](http://www.IDC.com).

377 Verizon and Bell South are investing \$20 billion in fiber optic cables running at 30 Mbps to 36 million homes, a 20-fold increase in speed. NTT, Fujitsu, and the Japanese government are planning to install cables operating at 10 Gbps by 2010, 100 times faster than their current 100 Mbps connections and a 10,000 times faster than in the US. (*TechCrazy*. 2004. Internet Will Hit 10 Gbit by 2010. 29 Aug.) New versions of WiFi operate at 70 Mbps, an order of magnitude faster than today’s broadband, and Internet II runs at 7 Gbps, a thousand times faster. (*New York Times*. 2003. Schools Keep Vigil for Internet. 14 Aug.)

378 At the end of 2003, Jupiter says 33% of US households used broadband, while a PEW study put it at 31%. By 2005, Yankee expects use to reach 40%, and Jupiter says 38%. Forrester Research expects 38% of households to use broadband in 2005, 47% in 2006, 55% in 2007, and 62% in 2008.

379 IBM and Microsoft have speech recognition program that are expected to reduce the error rate from 95% to 99% by 2010, thereby matching humans. An IBM scientist said “We have made very good progress ... and crossed the threshold where users will accept it.” (*News Com*. 2003. Talking Computers Nearing Reality. 9 Jul.) Speech recognition call centers are replacing the maddening touch-tone call centers. Amtrak’s “Julie” provides train schedules, makes reservations, and accepts payment; customer satisfaction is up and Amtrak recovered its investment in one year. AT&T Labs is developing a voice controlled “Intelligent Secretary” to handle calls, organize files, transmit documents, and schedule meetings. Nokia, Sony, and other companies are creating intelligent agents operating on 3G mobile phones that make purchases, among other tasks. (*New Scientist*. 2003. Smart Cellphones Would Spend Your Money. 15 Jun.) The National Science Foundation has sponsored research to move speech recognition from software onto chip designs, making it 1,000 times more effective. [www.Kurzweilai.net](http://www.Kurzweilai.net)

380 A wide variety of AI is being used now by the military and for risk management, financial analysis, process and quality control, biometrics, spot shifts in credit card usage patterns, biometrics, interpret facial expressions, filter spam, manage PCs, create video games, diagnose medical problems, trade securities, etc. The entrance to Cambridge University has replaced its attendant

with a robotic head that gives visitors information. DARPA is developing a hyper-smart computer that can maintain itself, make adaptive changes, and respond to different situations. It has also invested millions in Carnegie Mellon's "Perceptive Assistant that Learns" (PAL) and SRI's "Cognitive Agent that Leans and Observes" (CALO). (*Post-Gazette*. 2003. CMU Team to Develop Software "Secretary." 17 Jul.) The US Department of Energy is developing systems that infer intent, remember experiences, and make decisions. The scientist in charge thinks "cognitive systems will be embedded in most computers within 10 years." IBM's "autonomic computing" allows computer systems to solve problems and reconfigure themselves to reach a goal, just as organisms use an autonomic nervous system to regulate heartbeat and body temperature. *Wired*. 2003. Machine Thinks, Therefore I Am. 27 Aug.

381 The old 32-bit chips made today's graphical user interface possible (windows), and the 64-bit chips are designed for speech recognition, video, and other advanced capabilities.

382 Roughly half of US firms were installing voice recognition call systems in 2004, and all are expected to do so in 1–2 years, with a potential market of \$3.5 billion by 2007. The market for speech recognition should reach \$5 billion by 2008. (*New Scientist*. 2003. No One Understands Me As Well As My PC. 1 Nov.) One expert thinks the market will reach \$20 billion by 2013. Total AI sales is expected to grow from \$1 billion in 1993, to \$12 billion in 2002, to \$21 billion in 2007. A futurist thinks AI will allow voice commands to be used for 3D Internet, television, mobile phones, medical care, and other services by 2010–2020. Scientists generally estimate that computer power will match the human brain by 2020. (Kurzweil, Ray. 2002. *The Age of Spiritual Machines*. New York: Viking.) The CEO of Native Minds, a virtual robot maker, thinks "The Internet will be filled with robots by 2010."

383 *Boston Globe*. 2002. MIT Researchers Working to Make Computers Intuitive. 12 Aug.

384 Fifty nations joined together to create the Global Earth Observation System of Systems that will continually monitor land, sea, and air around the world. The network integrates 10,000 weather stations, 1,000 buoys, 100,000 daily observations by 7,000 ships and 3,000 aircraft, and 50 weather satellites. (*Washington Post*. 2004. Nations Collaborate to Take Planet's "Pulse." 26 Jul.) Radio Frequency ID tags (RFID) are being used to identify and track everything from groceries to people. Wal-Mart now requires suppliers to attach RFID tags to their products. AeroAstro Corporation produces "nanosatellites"—small communication satellites designed to monitor the movement of cargo, the location and health of people, maintenance status of machinery, and almost any other activity. "Smart dust"—sensors the size of rice seeds—are being dispersed through the winds to monitor traffic, weather, the environment, and military intelligence. A computer scientist is developing tiny "motes" that only use power when relaying data to each other so they can be powered by small batteries. *Technology Review*. 2003. Wireless Sensor Networks. Feb. Many firms are working together to develop a common standard for communications among home appliances via the Internet. The 3G mobile phone system is being converted into a "machine-to-machine" (M2M) system that connects cars, security systems, and other devices into an intelligent network. Analysts expect 26–100 million micro-devices of this type to be in use by 2006. Wireless home networks are introducing a "digital home" in which electronic components can be connected together easily. GE, Whirlpool, and Sunbeam are introducing Internet-equipped appliances. (*BusinessWeek*. 2003. Digital Homes. 21 Jul.)

385 *Technology Review*. 2003. Quantum Cryptography. Feb.

386 *Electronic Engineering Times*. 2002. Error May Stall Quantum Computing. 9 Dec.

387 *InfoWorld*. 2003. Japan Reports Quantum Computing Breakthrough. 29 Oct.

388 *New Scientist*. 2004. First Quantum Cryptography Network Unveiled. 16 Jun.

389 NEC Corp. succeeded in controlling superposition and entangled two solid-state qubits, demonstrating two keys to quantum computing. The US NIST transmitted a single photon as the key to an encrypted message at 100 times the previously recorded speed. IBM and Stanford University are pioneering the new field of "spintronics," which manipulates the spin of electrons to store information. Researchers have successfully entangled 5 photons. (*TRNMag.com*. 2004. Five Photons Linked. 30 Aug.)

390 Ibid.

391 SimDesk provides cheap access to basic programs (word processing, e-mail, etc.), processing power, and storage for a few dollars per person per year. The service is used by 200,000 people in Houston, 400,000 students in Chicago, 6 million people in Indiana, and the firm is working with 31 other states plus some nations. (*BusinessWeek*. 2004. A Sweet Deal in Suite Software. 5 Jul.) IBM is investing \$10 billion to make utility computing the heart of its corporate strategy, "E-Business on Demand." It is also introducing "Workplace" as a server-based alternative to Microsoft Office. "This is exactly what customers want," said the CEO, Samuel Palmisano. "It's going to drive phenomenal productivity." Hewlett-Packard and Sun are developing an "intraorganizational" approach. HP's "Utility Data Center" and Sun's "N1" system both provide more effective computing networks to serve units within a corporation. (*BusinessWeek*. 2003. Utility Computing. 25 Aug.)

392 For instance, H-P, GM, and the DoD use VR systems to let design teams walk through autos, ships, and aircraft before building prototypes, saving millions of dollars in design work and time. (*The Futurist*. 2002. Virtual Reality is Getting Real. May–Jun.)

393 Broadband, wireless, speech recognition, AI, and more powerful computers should improve VR considerably (see Intelligent Interface). Japanese researchers have developed hologram projectors on a circuit board to be used for 3D TV, movies, and video. Commercial products are expected in 3–5 years. Digital Research Labs has created 3D movies that surround the viewer. (*New York Times*. 2004. For the Viewer, No Escape Hatch in a Digital 3-D Film. 6 May. Olympus and Sony have introduced comfortable goggles that project vivid video and sound, enabling full body interaction with a virtual environment without the hassle of bulky, dizzying 3D glasses.

394 "There" is a multimedia website featuring 3D computer-generated environments populated with avatars that interact with users and other avatars. The UCLA Virtual Reality Lab recreates ancient Rome with 3D images of temples and monuments that users can walk around in. Planetariums have begun providing people the experience the sensations of flying through space. VR tools are being used to create 3D x-rays to help surgeons plan procedures or assist in surgery miles away. Media companies are introducing "virtualized reality" that should soon allow the viewer to ride a football from the quarterback to the receiver. Hidden relationships in complex data sets can be grasped quickly. For instance, VR enables more accurate decisions in financial markets. The Waldorf Astoria Hotel in New York City has been using a 4X7 foot video conferencing system for years, and is so convenient that it is always booked. Virtual "walk-through displays" are being used in museums. Internet 2 offers "tele-immersion," which allows people to walk around a virtual object and to hold virtual meetings with 3-dimensional images.

395 <http://www.kurzweil.ai>. 2003. Kurzweil Teleports in 3-D to World Economic Forum. 24 Sep.

396 *Washington Post*. 2002. Wireless Computing. 23 May.

397 The name commonly given to the IEEE 802.16 standard.

398 A third-generation standard offering broadband mobile data with a peak rate of 2.4 Mbps.

399 EvDO technology may surpass WiFi because it can operate at comparable speeds over existing cell networks to provide seamless coverage. Motorola Labs has operated multiplexing wireless technologies at 300 Mbps, speeds, which were previously thought unattainable.

400 Forrester Research. <http://www.forrester.com>.

401 *Fortune*. 2002. Death to Bureaucrats. 26 Jun.

402 *DM News*. 2003. Virtual Shopping Habits. 27 Aug.

403 *BusinessWeek*. 2003. E-Shoppers Are Now E-Spenders. 8 Dec.

404 *New York Times*. 2000. Where Video Will Come From. 13 Aug.

405 *BusinessWeek*. 2002. The Battle of Online Content Models. 13 May.

406 *On the Horizon*. 2003. The Online Education Market: Much Is at Stake for Institutions of Higher Education 11 (3).

407 *New York Times*. 2003. Professor View with Web for Class's Attention. 2 Jan.

408 *Chronicle of Higher Education*. 2003. Survey Finds College Administrators Optimistic About the Future of Online Education. 4 Sep.

409 <http://www.ban.org>

410 *New Scientist*. 2004. We Can Rebuild Them. 28 Feb; *Washington Post*. 2004. Firm Strives to Give Amputees Natural Gait. 12 Apr; <http://www.News.Scottsman.com>.

411 <http://www.longbets.com>

412 By sending brain signals through the array, Warwick was able to control a wheelchair and an intelligent artificial hand. His signals were also sent to a less complicated chip implanted in his wife's arm. Warwick believes that "the step to Cyborgs—part human part computer—offers humans a natural, technological upgrade" with extraordinary capabilities. [www.rdg.ac.uk/ KevinWarwick](http://www.rdg.ac.uk/KevinWarwick).

413 *Newsweek*. 2001. Full Stem Ahead. 12 Feb.

414 *New Scientist*. 2001. Stem Cell 2001 "Immortality" Gene Found. 5 Mar.

415 Hall, Stephen. 2003. *Merchants of Immortality: Chasing the Dream of Human Life Extension*. New York: Houghton-Mifflin

416 For instance, Dr. James Vaupel, Director of the Lab on Longevity at the Max Planck Institute, finds that life spans will increase 2 to 3 years per decade, and he forecasts life spans approaching 130 years by 2050. Prof. Aubrey de Grey at University of Cambridge claims average life spans will reach 130 years by 2030. The Center for Strategic and International Studies thinks a female born today will have a 40% chance of living to 150 years.

417 *Washington Post*. 2000. The Promise of Precision Prescriptions. 24 Jun.

418 Perlegen Sciences is developing more convenient tests based on identifying the differences in genetic makeup between people who are prone to certain illnesses, rather than analyzing the entire genome. (*Technology Review*. 2004. Personal Genomics. Feb.) Dr. Craig Venter, the scientist who almost single-handedly deciphered the human genome, has launched the world's largest genome sequencing center to make genetic tests commonly available. "Our goal is to do a whole genome analysis in minutes or hours," he said. Research is identifying which patients will respond to different cancer drugs. A scientist called it "The most striking advance in decades." (*BusinessWeek*. 2004. Taking Better Aim at Cancer. 10 May.) Some experts think it will be common for patients to be genetically tested before treatment at about 2010. (*Washington Post*. 2000. The Promise of Precision Prescriptions. 24 Jun.)

419 *Fortune* 2003. IT Takes on the ER. 24 Nov.

420 "Electronic intensive care units" used to monitor patients can reduce mortality by half. (*Washington Post*. 2002. Intensive Care from a Distance. 2 Jun); MRI and robotic devices allow remote diagnosis without exploratory surgery. Colonoscopy is being replaced by CT scanners. Scientific advances should soon diagnose disease at the molecular level. (*AdvaMed*. 2001. Advances in Diagnostic Imaging. 10 Apr.) Kaiser Permanente is completing a \$2-billion project to move 9 million patients at 362 hospitals served by 10,000 medical staff to web systems. The Detroit Medical Center gives 6,000 clinicians online access to patient records, medical databases, and ordering drugs and tests. Brigham & Women's Hospital uses 30,000 workstations to integrate all health care for 700,000 outpatients. As of 2000, 30% of physicians used handheld PDAs to access medical data. Forty million Americans used the Internet to find health data. And 32 states have systems to provide online consultations. Physician training is now IT-intensive, including the use of PDAs, CD-ROM, patient simulators. "The computer is the physician's black bag of the future," said the dean of a medical school.

421 North, Douglass. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge U. Press.

422 For further information, see: Halal, William. 1998. *The New Management: A Guide to the Parallel Transformations in Technology, Business, and Leadership*. San Francisco: Berrett-Koehler.

423 For more on this topic, see *Institutional Change*, a special issue of *On the Horizon* in 2004.

424 Halal, William E. 2004. The Intelligent Internet. *Futurist*. Mar–Apr.

425 For instance, see Halal, William, Ali Geranmayeh, and John Pourdenah. 1993. *Internal Markets: Bringing the Power of Free Enterprise Inside Your Organization*. New York: John Wiley

426 [www.un.org/esa/sustdev/partnerships/partnerships.htm](http://www.un.org/esa/sustdev/partnerships/partnerships.htm)

427 See Halal, 2001 [ref. Chapter 1:16]

428 World Scientists' Warning to Humanity 1992. [www.ucusa.org](http://www.ucusa.org)

429 Wilson, Edward O. 1989. *In Search of Nature*. Washington D.C.: Island Press. (Includes the essay "Is Humanity Suicidal?")

430 Ibid.

431 Joy, Bill. 2000. Why the Future Doesn't Need Us. *Wired Magazine*. April. <http://www.wired.com/wired/archive/8.04/joy.html>

432 [www.Kurzweilai.com](http://www.Kurzweilai.com)

433 Gelbspan, Ross. 1997. *The Heat Is On: The High Stakes Battle over the Earth's Threatened Climate*. Reading, Mass.: AddisonWesley.

434 Lehman, Scott, and Lloyd Keigwin. 1992. Sudden Changes in North Atlantic Circulation During the Last Deglaciation. *Nature*

- 356: 757–762.
- 435 Davenport, Thomas, and Laurence Prusak. 1998. *Working Knowledge*. Boston: Harvard Business School Press.
- 436 A good source of this research is Bruyn, Severyn. 2000. *Civil Economy: Transforming the Market in the 21<sup>st</sup> Century*. Ann Arbor: University of Michigan Press.
- 437 Meadows et al [ref. Chapter 1:9]
- 438 Erlich, Paul, and Anne Erlich. 2004. *One with Nineveh: Politics, Consumption, and the Human Future*. Washington DC: Island Press.