

Looking Backward, Looking Forward: The Next 40 Years of Environmental Law

by Robert V. Percival

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Summary

The only certainty concerning predictions for the future of the environment is that most of them are likely to be wrong. This is illustrated by the fate of past predictions, such as those contained in Paul Ehrlich's *Population Bomb*, Gregg Easterbrook's *A Moment on the Earth*, and Bjørn Lomborg's *The Skeptical Environmentalist*. While it is difficult to guess at the future of the environment, predictions concerning environmental law are even more hazardous because they turn in large part on the future of politics. After reviewing current political gridlock over environmental concerns, this Article considers contemporary forecasts of the fate of the planet (including those contained in Al Gore's *The Future* and the *2052 Report*) and the role of technological change in creating opportunities for environmental progress.

The one thing we know about predictions for the future of environmental law is that most of them are likely to be wrong. Uncertainty is a fundamental feature of environmental challenges, and the track record of humans in forecasting future environmental challenges is not one that inspires confidence. In an edition of *The Weekly Standard* that went to press on April 16, 2010—four days before the *Deepwater Horizon* offshore oil platform exploded, precipitating the worst oil spill in U.S. history—a fellow at the American Enterprise Institute wrote: “Improvements in drilling technology have greatly reduced the risk of the kind of offshore [oil] spill that occurred off Santa Barbara in 1969. . . . To fear oil spills from offshore rigs is analogous to fearing air travel now because of prop plane crashes in the 1950s.”¹ Oops.

Some predictions have proven more accurate than others. The very first report of the Council on Environmental Quality (CEQ), published in 1970, devoted an entire chapter to concerns that emissions of greenhouse gases (GHGs) could cause global warming and climate change.² While this seems prescient today, prior warnings were issued by the French scientist Joseph Fourier in 1824 and the Swedish scientist Svante Arrhenius in 1896. As sea levels have steadily risen, it was well-known at the beginning of the 21st century that a hurricane could devastate New Orleans or New York City. Following the devastation of New Orleans by Hurricane Katrina, the director of the National Hurricane Center told the U.S. Congress in 2006 that it “is not a question of if a major hurricane will strike the New York area, but when.”³ A year before Hurricane Sandy deluged lower Manhattan in 2012, an author noted a NASA climate study forecasting that “if a Category 3 hurricane, like Katrina, were to hit New York, it could create a storm surge” that “would destroy billions of dollars worth of property and could shut the city down.”⁴

To divine the future of environmental law, it is useful first to consider past predictions, how well they have fared,

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1. Steven F. Hayward, *The Energy Policy Monast*, THE WEEKLY STANDARD, Apr. 26, 2010. The author later issued a “mea culpa,” while arguing that the basic premise of his previous article was correct, despite the BP spill. Steven F. Hayward, *How to Think About Oil Spills*, THE WEEKLY STANDARD, June 21, 2010, <http://www.weeklystandard.com/articles/how-think-about-oil-spills?page=1> (last visited Apr. 29, 2013).
2. CEQ, ENVIRONMENTAL QUALITY—1970 93 (1970).
3. Jennifer Peltz, *Hurricane Barriers Floated to Keep Sea Out of NYC*, ASSOCIATED PRESS, May 31, 2009.
4. ALEX PRUD'HOMME, THE RIPPLE EFFECT 211 (2011) (Hurricane Sandy, which flooded New York City in October 2012, was a Category 3 hurricane).

and why. Thus, this Article begins by reviewing some past predictions in light of what is known today. It then discusses the complicated relationship between public perceptions of environmental problems and legislative responses to them in light of current political gridlock over environmental concerns. The Article then examines contemporary forecasts of the fate of the planet and the role of technological change in creating opportunities for environmental progress. It concludes by offering some observations about the future, extrapolating from emerging global trends.⁵

I. Looking Backward: Past Predictions of the Future Environment

The U.S. environmental movement has deep historical roots in warnings concerning the impact of unchecked development. In the first edition of his classic work, *Man and Nature: Or, Physical Geography as Modified by Human Action*, former U.S. diplomat George Perkins Marsh cited deforestation of the Middle East to warn of the importance of conserving U.S. forests. The more popular second edition of the work, renamed *The Earth as Modified by Human Action*, provided an important boost to the late 19th century campaign to establish national parks.

In the post-World War II era, the publication of Rachel Carson's *Silent Spring* is widely credited as a primary impetus for the birth of the modern environmental movement. Carson alerted the public to the dangers of synthetic organic pesticides that would accumulate in the food chain and cause severe, long-term environmental damage. In the wake of Carson's warnings, the Environmental Defense Fund was founded in 1967 by a group of scientists eager to have dichlorodiphenyltrichloroethane (DDT) banned.

A. Paul Ehrlich's Population Bomb

Population growth inspired early predictions of environmental disaster during the formative years of the modern environmental movement. In his 1968 book *The Population Bomb*, biologist Paul Ehrlich forecast that population growth would soon exceed the earth's carrying capacity, leading to global famines and resource shortages. Calling Ehrlich a "Malthusian," economist Julian Simon argued in *The Ultimate Resource* that "[n]atural resources are not finite" because human ingenuity continually finds more efficient ways to use them. The two agreed in 1980 to test their theories by betting \$1,000 on whether the prices of five metals—chrome, copper, nickel, tin, and tungsten—would be higher or lower in the year 1990. Ehrlich argued that prices

would rise with increased demand for a finite supply of the metals. Simon bet that prices would fall. In 1990, Simon won the bet when the prices of all five metals declined in real terms due in part to the development of substitutes.⁶

The earth now has seven billion people, but population growth has slowly slipped from the forefront of environmental concerns. As countries develop, birth rates consistently have fallen and the rate of overall population growth has slowed. Ironically, Ehrlich's warning may have contributed to the very trends that defeated his bet. Today, Ehrlich believes that a collapse of global civilization can be avoided "because modern society has shown some capacity to deal with long-term threats, at least if they are obvious or continuously brought to attention (think of the risks of nuclear conflict)."⁷ However, Ehrlich has not yet become a full-fledged optimist. He is skeptical of how well environmental concerns will fare in the political process because "the risks are clearly not obvious to most people" and the costs of preventing them are incurred up front, while the benefits accrue to unknown future generations.

B. Gregg Easterbrook's A Moment on the Earth

More than two decades after Ehrlich's dire warnings, journalist Gregg Easterbrook made a splash by arguing that environmentalists were alarmists because most of the developed world's major environmental problems were nearly solved. In his 1995 book *A Moment on the Earth: The Coming Age of Environmental Optimism*, Easterbrook argued that "the Western world today is on the verge of the greatest ecological renewal that humankind has known; perhaps the greatest that the Earth has known." Easterbrook predicted that in the developed "world pollution will end within our lifetimes, with society almost painlessly adapting a zero-emissions philosophy." He also predicted that "most feared environmental catastrophes, such as runaway global warming, are almost certain to be avoided."⁸

Not surprisingly, Easterbrook's views generated considerable controversy. The Environmental Defense Fund complained that Easterbrook "repeatedly criticizes scientists whose dire predictions have not come to pass, without fully acknowledging that their forecasts catalyzed changes in laws and policies that forestalled the predictions themselves."⁹

5. The author previously addressed the future evolution of environmental law in Robert V. Percival, *Environmental Law in the Twenty-First Century*, 25 VA. ENVTL. L.J. 1 (2007).

6. John Tierney, *A Bet on the Planet Earth*, N.Y. TIMES MAG., Dec. 2, 1990, at 52.

7. Paul R. Ehrlich & Anne H. Ehrlich, *Can a Collapse of Global Civilization Be Avoided?*, 280 Proceedings of the Royal Society, December 2012, available at <http://dx.doi.org/10.1098/rspb.2012.2845>.

8. GREGG EASTERBROOK, *A MOMENT ON THE EARTH: THE COMING AGE OF ENVIRONMENTAL OPTIMISM* (1995).

9. ENVIRONMENTAL DEFENSE FUND, *A MOMENT OF TRUTH: CORRECTING THE SCIENTIFIC ERRORS IN GREGG EASTERBROOK'S A MOMENT ON THE EARTH* (1995).

More than a decade after his book was published, Easterbrook announced that he had modified his position concerning global warming in the light of mounting scientific evidence. “As an environmental commentator, I have a long record of opposing alarmism. But based on the data I’m now switching sides regarding global warming, from skeptic to convert.” Easterbrook proclaimed that “[t]he science has changed from ambiguous to near-unanimous concerning the ‘greenhouse effect’ and that greenhouse gas emissions must be curbed.”¹⁰

C. Bjørn Lomborg’s The Skeptical Environmentalist

While visiting a bookstore in Los Angeles in February 1997, a Danish statistician named Bjørn Lomborg read an interview with Julian Simon in *Wired* magazine.¹¹ Lomborg claims that this experience triggered an epiphany that resulted in his writing *The Skeptical Environmentalist*, published in 2001. In this book, Lomborg claimed that the global environmental movement had vastly overstated the scope of environmental problems. Repeating claims remarkably similar to those of Easterbrook, without citing Easterbrook’s work, Lomborg wrote:

We will not lose our forests; we will not run out of energy, raw materials, or water. We have reduced atmospheric pollution in the cities of the developed world and have good reason to believe that this will also be achieved in the developing world. Our oceans have not been defiled, our rivers have become cleaner and support more life. . . . Nor is waste a particularly big problem. . . . The problem of the ozone layer has been more or less solved. The current outlook on the development of global warming does not indicate a catastrophe. . . . And, finally, our chemical worries and fear of pesticides are misplaced and counterproductive.

Not surprisingly, opponents of environmental regulation quickly embraced Lomborg’s work.¹² He became a highly sought-after critic of the environmental movement, which he dismissed as the captive of fear mongers. Lomborg ignored the fact that much of the progress he cited was a product of the very movement he criticized.¹³ As one reviewer noted: “The ultimate irony is that Lomborg could have presented his mass of data as a tribute to the effectiveness of environmental policy. That he chooses to do the

opposite says far more about him than about any claimed objectivity of his statistical analysis.”¹⁴

Some of Lomborg’s predictions have proven to be wildly optimistic. For example, Lomborg predicted that oil prices would remain below \$27/barrel until 2020. Instead, they soared to more than \$140 per barrel in mid-2008 before plunging to \$40/barrel after the global financial crisis and then rising to current levels more than three times higher than Lomborg’s forecast. Lomborg’s rosy view of the impact of climate change also has been contradicted by recent events. Three years ago, Lomborg conceded that global warming is “undoubtedly one of the chief concerns facing the world today” and “a challenge that humanity must confront.”¹⁵

The dramatic shift that has occurred in U.S. energy supply during the last few years was largely unforeseen. The use of hydraulic fracturing to extract natural gas and oil from shale formations has greatly increased the domestic supply of these fuels. This has produced dramatic reductions in the price of domestic natural gas that have shifted our electric supply away from coal.

II. Legal Responses to Environmental Risks

The relationship between legal change and public perceptions of environmental risk is complex and uncertain. The enactment of environmental legislation often has required some “trigger event” such as a highly publicized incident of visible environmental harm that generates intense and immediate public concern.¹⁶ Examples include the Superfund legislation¹⁷ adopted in 1980 after highly publicized contamination of homes in Love Canal by previously buried hazardous wastes, the Emergency Planning and Community Right to Know Act¹⁸ adopted in 1986 in response to the Bhopal tragedy, and the Oil Pollution Act of 1990¹⁹ adopted in response to the *Exxon Valdez* oil spill.

A strong, bipartisan consensus in favor of federal regulation launched the comprehensive environmental legislation Congress passed during the 1970s and early 1980s. While these laws still form the infrastructure of U.S. environmental policy today, for much of the past two decades, legislative gridlock has prevailed in Congress. Today, even highly publicized environmental disasters such as the April 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico have generated scant legislative response. Members of President

10. Steven Milloy, *Global Warming Skeptic Claims Environmental Conversion*, FOX NEWS.COM, May 25, 2006, <http://www.foxnews.com/story/2006/05/25/global-warming-skeptic-claims-environmental-conversion/> (last visited Apr. 29, 2013).

11. Jeroen C.J.M. van den Bergh, *An Assessment of Lomborg, The Skeptical Environmentalist and the Ensuing Debate*, 7 J. INTEGRATIVE ENVTL. SCI. 23 (Mar. 2010).

12. See, e.g., Alex Kozinski, *Gore Wars*, 100 MICH. L. REV. 1742 (2002) (book review).

13. Robert V. Percival, *Skeptical Environmentalist or Statistical Spin-Doctor? Bjørn Lomborg and the Relationship Between Environmental Law and Environmental Progress*, 53 CASE W. RES. L. REV. 263 (2002).

14. Michael Grubb, *Relying on Manna From Heaven?*, 294 SCI. 1285, 1286 (Nov. 9, 2001). See also Douglas A. Kysar, *Some Realism About Environmental Skepticism: The Implications of Bjørn Lomborg’s The Skeptical Environmentalist for Environmental Law and Policy*, 30 ECOLOGY L.Q. 223 (2003).

15. Matthew Moore, *Climate “Sceptic” Bjørn Lomborg Now Believes Global Warming Is One of World’s Greatest Threats*, THE TELEGRAPH, Aug. 31, 2010, <http://www.telegraph.co.uk/earth/environment/globalwarming/7972383/Climate-sceptic-Bjorn-Lomborg-now-believes-global-warming-is-one-of-worlds-greatest-threats.html> (Apr. 29, 2013).

16. Robert V. Percival, *Environmental Legislation and the Problem of Collective Action*, 9 DUKE ENVTL. L. & POL’Y F. 9 (1998).

17. 42 U.S.C. §§9601-9675, ELR STAT. CERCLA §§101-405.

18. 42 U.S.C. §§11001-11050, ELR STAT. EPCRA §§301-330.

19. 33 U.S.C. §§2701-2761, ELR STAT. OPA §§1001-7001.

Barack Obama's National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling have sharply criticized Congress for failing to implement the Commission's recommendations.²⁰ Even a modest proposal to repeal the \$75 million limit on liability for non-negligent oil spills from offshore facilities²¹ failed to win approval in the U.S. Senate.

It now seems clear that the bipartisan consensus that spawned ambitious U.S. environmental legislation during the 1970s and 1980s has disappeared. During the 2012 U.S. presidential election campaign, the two major political parties were sharply split in their views concerning regulatory policy. Republican candidates blamed environmental regulation for high unemployment and slow economic growth, while Democrats generally tried to change the subject. Yet, until the 2008 global financial crisis, which produced the greatest economic downturn next to the Great Depression, the U.S. economy prospered despite stringent environmental regulation. Extractive industries, newly freed from the restrictions of campaign finance laws by the U.S. Supreme Court's decision that they have a First Amendment right to spend directly on election campaigns,²² flooded the airwaves with ads blaming high unemployment on U.S. Environmental Protection Agency (EPA) regulation. Despite all-time record temperatures and hurricanes that caused unprecedented devastation to coastal areas, climate change nearly disappeared from U.S. political discourse during the 2012 presidential campaign. Climate change was never once mentioned during three 90-minute debates between the presidential candidates.

Public support for environmental protection remains high, and President Obama defeated a candidate who promised to roll back environmental regulation. However, a sluggish economy in the wake of the global financial crisis of 2008 appears to have eroded public support for environmental protection measures. In April 2013, the Gallup polling firm reported that only 47% of the public believed that the U.S. government is doing "too little" to protect the environment, down from 62% in 2006, while 16% believe the government is doing "too much," an increase from 4% in 2006.²³ Given that this period encompassed some environmental and climate-related catastrophes, including the 2010 *Deepwater Horizon* oil spill, the 2011 Fukushima Daiichi nuclear accident, and Hurricane Sandy's devastation of the northeast United States in 2012, these poll results may discourage environmentalists.

Predicting future federal law and policy is difficult because it depends in large part on the country's future political leadership,²⁴ who will be determined based largely on factors exogenous to the environment. Environmental issues played virtually no role in pivotal presidential campaigns in 1980 and 2000, both of which resulted in leaders who pursued sharp changes in federal environmental policy.

Because President Ronald Reagan was ideologically opposed to regulation, congressional distrust of his executive agencies spawned a backlash that led Congress to strengthen U.S. environmental laws during the 1980s. When it reauthorized the federal regulatory statutes, Congress added new provisions specifying actions that regulatory agencies must take coupled with statutory deadlines for completing them. It also adopted far-reaching legislation in 1986 requiring companies to make annual public disclosures concerning their emissions of toxic chemicals.²⁵

However, today, legislative gridlock prevails in Congress. The Republican takeover of the U.S. House of Representatives in the 2010 elections produced the most anti-environmental house of Congress in U.S. history. During the 112th Congress, the House of Representatives adopted 317 anti-environmental measures, including 145 to reduce EPA's authority and 95 to dismantle the Clean Air Act.²⁶ These measures did not become law because they could not win passage in the Senate, which is controlled by Democrats more sympathetic to environmental regulation. Due to the partisan split in the two houses of Congress, it has become virtually impossible for Congress to enact any new environmental legislation.

III. Looking Forward: Contemporary Predictions of the Environmental Future

Contemporary predictions for the fate of the planet seem to be shaped in large part by forecasts concerning the future of technology.

A. Al Gore's The Future

In a book entitled *The Future: Six Drivers of Global Change*, former Vice President Al Gore identifies six emerging trends that will pose challenges crucial to the future health of the planet. These include a more deeply interconnected global economy; planetwide electronic communications; a new balance of global political, economic, and military

20. OIL SPILL COMMISSION ACT, ASSESSING PROGRESS THREE YEARS LATER, Apr. 17, 2013 (giving Congress a Grade of D+ on implementing the Commission's regulations). See also TOM ZELLER JR., OIL SPILL COMMISSION ACTION GROUP GIVES CONGRESS LOW GRADES FOR REGULATORY REFORM ON DRILLING, Apr. 17, 2012, http://www.huffingtonpost.com/2012/04/17/oil-spill-commission-action-grades_n_1431886.html (last visited Apr. 29, 2013).

21. 33 U.S.C. §2704(a)(3).

22. *Citizens United v. Federal Election Commission*, 558 U.S. 310 (2010).

23. Frank Newport, *Nearly Half in U.S. Say Government Environmental Efforts Lacking*, GALLUP POLITICS, <http://www.gallup.com/poll/161579/nearly-half-say-gov-environmental-efforts-lacking.aspx> (last visited Apr. 29, 2013).

24. DAVID VOGEL, *THE POLITICS OF PRECAUTION: REGULATING HEALTH, SAFETY, AND ENVIRONMENTAL RISKS IN EUROPE AND THE UNITED STATES* 34 (2012).

25. See, e.g., Emergency Planning and Community Right-to-Know Act, 42 U.S.C. §§11001-11050, ELR STAT. EPCRA §§301-330.

26. 42 U.S.C. §§7401-7671q, ELR STAT. CAA §§101-618. Database of Anti-Environment Votes in the 112th Congress, updated Sept. 21, 2012, <http://democrats.energycommerce.house.gov/index.php?q=legislative-database-anti-environment&legislation=All&topic=All&statute=All&agency=All> (last visited Apr. 29, 2013).

power that has shifted influence from states to private actors and from political systems to markets; rapid unsustainable growth; a revolutionary new set of powerful genetic and materials sciences technology; and a radically new relationship between the aggregate power of human civilization and the earth's ecological systems.

Gore notes that there has been substantial progress on many fronts, including the fact that global poverty is declining and wars seem to be on the decline. In March 2012, the United Nations announced that the world already had achieved the Millennium Development Goal of cutting in half the proportion of people who lack sustainable access to safe drinking water in advance of a 2015 deadline.²⁷ However, the goal of having 75% of the world's population with access to improved sanitation is unlikely to be met by 2015, when it is projected that only 67% will have such access. Signs of global environmental progress noted by Gore include the following:

Some fearsome diseases have been conquered and others are being held at bay. Lifespans are lengthening. Standards of living and average incomes—at least on a global basis—are improving. Knowledge and literacy are spreading. The tools and technologies we are developing—including Internet-based communication—are growing in power and efficacy. Our general understanding of our world, indeed, our universe (or multiverse!) has been growing exponentially. There have been periods in the past when limits to our growth and success as a species appeared to threaten our future, only to be transcended by new advances—the Green Revolution of the second half of the twentieth century, for example.²⁸

While Gore calls himself “an optimist,” he founds such optimism on a belief that Americans eventually will be able to overcome a political system that has been “hacked” by special interests to restore the United States to a leadership role on global environmental issues. “As more of the power to make decisions about the future flows from political systems to markets, and as ever more powerful technologies magnify the strength of the invisible hand, the muscles of self-government have atrophied.”²⁹ The vast majority of members of Congress “now represent the people and corporations who donate money, not the people who actually vote in their congressional districts.”³⁰

B. The 2052 Project

The most detailed forecasts concerning the environmental future come from the Club of Rome, a group better known for its 1972 report called *The Limits of Growth*. That report warned that population growth and development were rapidly exceeding the carrying capacity of

the planet. Like Ehrlich's *Population Bomb*, the report attracted considerable attention, though it is often dismissed today as overly pessimistic. Jørgen Randars, a Norwegian professor who was one of the authors of *The Limits to Growth*, has authored a new report for the Club of Rome predicting the future of the planet in 2052. Randars incorporated 35 predictions from experts in various fields to help guide his predictions.

He concludes that nearly four decades from now, the world will no longer have an expanding population. The *2052 Report* forecasts that global population will reach a peak of 8.1 billion in the early 2040s before declining to 7 billion people by the year 2075. By 2052, 80% of the world population will be living in large urban cities (10–40 million people) or smaller cities (1–5 million) surrounding megacities, shifting political focus onto water, noise, and air pollution as well as traffic.

The report forecasts that by 2052, the world economy will be 2.2 times larger than it is today, meaning that 120% more goods and services will be produced. Average consumption rates will increase, making for a larger “human ecological footprint” that will only be softened by increased efficiency in the use of natural resources and energy. It is predicted that China will pass the United States in the size of its economy, and India's economy will come close to the size of the U.S. economy by the year 2050. But China still is forecast to have a per capita gross domestic product (GDP) that trails both the United States (\$56,000 per capita versus a U.S. GDP of \$73,000 per capita) and the non-U.S. Organization for Economic Cooperation and Development (OECD) (\$63,000).

The *2052 Report* forecasts that substantial additional investments will need to be made in the development and implementation of (1) scarce resources to substitute for oil, gas, and phosphorus, (2) measures to control dangerous emissions, (3) replacement of formerly free ecological services such as freshwater and fish protein, (4) repair of accumulated environmental damage from nuclear plants and offshore drilling, (5) measures to protect against future threats such as rising sea levels, (6) measures to rebuild infrastructure damaged by extreme weather, and (7) maintenance of military forces to defend resources, to fight off immigration, and to provide manpower during emergencies. Forced investments from adaptation and disaster costs will increase by 1–10% as the weather gets wilder, crowded locations require expensive new infrastructure investments to be made in exposed locations, and the expected lifetime of existing infrastructure decreases.

Growing economies will correlate with increased emissions and rising global temperatures. By 2052, global energy use will increase by 50% and more than one-half of world energy use will involve fossil fuels. Energy use will remain high, but more of it will be used wisely and sustainably with the sun either directly (through solar heat or electricity) or indirectly (wind, hydro, or biomass) providing an increased share. The greatest uncertainty in this forecast is the speed at which a transition to sustainable

27. UNICEF AND WHO, PROGRESS ON DRINKING WATER AND SANITATION 2012 (Mar. 6, 2012).

28. AL GORE, THE FUTURE: SIX DRIVERS OF GLOBAL CHANGE 72 (Apple Store iPad edition, Original font of 1,962 pages, 2013).

29. *Id.* at 50.

30. *Id.* at 53.

energy sources will occur. This transition already is underway, but it will encounter serious difficulties before and after the year 2052. Energy use is forecast to peak in the 2030s before declining as a proportion of GDP by 30% in light of growing incentives, and increased ability to conserve energy.

The *2052 Report* recognizes that increased energy taxes could speed the transition to sustainable energy sources. But it predicts that this will not occur given strong political opposition to it. Other predictions in the 2052 report include the following:

- As global warming increases average temperatures, the oceans will rise more than one foot on average and the risk of the tundra melting and releasing methane gases will increase.
- The use of coal and gas as domestic energy sources will peak by the 2040s due to rapidly increasing use of renewable energy sources.
- As climate change becomes more visible during the 2030s, energy efficiency will increase with rapid growth of renewable energy sources during the 2030s.
- Use of nuclear energy will decline until it reaches 3% of global energy sources, while use of renewable energy will expand to 37% of such sources by 2052.
- Developing countries such as China, India, and South Africa will continue to use coal heavily until these countries turn to natural gas to decarbonize their energy sources, which will help pave the way for greater reliance on renewable energy sources.
- Renewable energy will increase to 30% of total energy sources by 2030, with hydropower and wind being the most significant sources of renewable energy and solar power becoming the dominant renewable source of electric generation by 2052.
- Carbon capture and storage (CCS) will be installed in nearly 1,000 power plants by 2052 to capture roughly one billion tons of carbon dioxide (CO₂) per year. Yet, nearly nine billion tons of CO₂ will be emitted annually (retrofitting of plants could reduce this by 20%, though the cost of such measures suggests they will likely not be undertaken by 2052).
- The use of genetically modified organisms (GMOs) will increase food production, but agriculture will be severely challenged by climate change. Increased levels of CO₂ will increase the growth of plants, but extreme high and low temperatures that stunt growth provide a mixed estimate of future crop yields (either + or – 5% for crop yields by 2052).
- Average consumption in the developed world will be four times the “subsistence level” as food production continues to increase. Elites in society will move away from red meat toward fish as aquaculture

increases and fish sources are limited to farms and certified fisheries.

- Unregulated fisheries in Asia, Africa, and South America will collapse and bluefin tuna will become extinct by 2020, but fisheries regulated by the United States, countries in Oceania, Japan, and the European Union will have recovered by 2052.
- About 25% of biodiversity will be eliminated by 2052, with 8% of the world’s plants threatened with extinction because of continued destruction of natural habitats and the introduction of exotic species.

C. *Emerging Technologies: The Case of Driverless Motor Vehicles*

Changes in technology, which are among the most difficult to predict, can have an enormous impact on future environmental conditions. The effect of the Internet on communications technology and the impact of hydraulic fracturing on the U.S. energy supply have been dramatic developments that were largely unforeseen. One example of a technology currently under development that may have dramatic environmental consequences in the future is the use of driverless motor vehicles.³¹

According to Google, which has heavily invested in driverless technology, the possible benefits of a driverless car include “a 90 percent reduction in accidents, 90 percent less time and fuel wasted in commuting, 1.9 billion gallons of fuel saved, 4.8 billion fewer commuting hours, and \$101 billion in savings in lost productivity and fuel costs.”³² This could save 1.9 billion gallons of gasoline and potentially reduce CO₂ emissions by 16 million tons.³³ Enormous reductions in fuel consumption would be the result of the ability of driverless cars to communicate with other “smart” vehicles and to adjust their driving accordingly. Vehicle-to-vehicle communication will reduce congestion by preventing car accidents and needless braking.³⁴ Vehicle-to-vehicle communication also will enable driverless cars to take advantage of “drafting,” or decreased air drag, because driverless cars are able to travel much

31. See Angela Greiling Keane, *Self-Driving Cars More Jetsons Than Reality for Google Designers*, BLOOMBERG.COM (Feb. 6, 2013), <http://www.bloomberg.com/news/2013-02-06/self-driving-cars-more-jetsons-than-reality-for-google-designers.html> (last visited Apr. 29, 2013) (noting that Google, Inc. believes it can have self-driving cars “available to consumers in three to five years”); see also Jessica Matsumoto, *BMW Pledges to Have Driverless Cars by 2010*, AUTOMEDIA.COM (Feb. 28, 2013) (discussing BMW’s collaboration with Continental Automotive and its desire to have a “fully automated” vehicle implemented by 2020).

32. Katherine Ling, *Part-Time Driverless Cars Could Provide Benefits Soon*, GREENWIRE (Feb. 19, 2013), <http://www.eenews.net.ezproxy.law.umaryland.edu/Greenwire/2013/02/19/19> (last visited Apr. 29, 2013).

33. See *id.* (using EPA’s formula for CO₂ emitted per gallon of gasoline combusted to estimate the impact of driverless cars on CO₂ emissions).

34. See Kevin Bullis, *How Vehicle Automation Will Cut Fuel Consumption*, MIT TECH. REV. (Oct. 24, 2011), <http://www.technologyreview.com/news/425850/how-vehicle-automation-will-cut-fuel-consumption/> (last visited Apr. 29, 2013) (stating vehicle-to-vehicle communication will reduce congestion “by cutting accidents, coordinating traffic intelligently, and ‘getting rid of those drivers who accelerate through red lights.’”).

closer together than normal automobiles. Because vehicle-to-vehicle communication will result in fewer accidents, car manufacturers will be able to design vehicles with lighter materials, which will result in vehicles with greater fuel efficiency.

Driverless cars also have the potential of “enabling households to live with fewer cars” by extending “current automobile-sharing systems.”³⁵ Because driverless cars will be able to locate, travel to, and deliver users, car-sharing networks could displace today’s personal automobile and shrink the overall supply of vehicles. A reduction in the supply of vehicles would mean a reduction in the environmental impact of the production of millions of vehicles.

Driverless cars also could reduce the need for large parking garages, as fewer cars do not require the same amount of parking space. This could allow cities to repurpose parking garages and lots and reduce harmful runoff. Even if driverless cars do not result in fewer cars on the road, drivers no longer will have to search for a parking spot, as vehicle-to-vehicle communication will allow driverless cars to drop off a user and travel to the nearest parking spot, greatly reducing congestion.

IV. Conclusion: The Future of Global Environmental Law

Some environmental challenges that will command the attention of future policymakers already are well-known. Conflicts over water resources are a significant problem that is likely to become even more challenging over time. The most widely forecast environmental challenge—anthropogenic climate change—now has become a contemporary reality as its effects become more apparent each year. Public policy responses to climate change are now heavily focused on adaptation. While in New Orleans for the American Association of Law Schools conference, where this presentation initially was made, the author observed numerous television advertisements for companies that raise homes to reduce their chances of flooding due to further sea-level rise.³⁶ The National Climatic Data Center confirmed on January 8 that 2012 was the hottest year ever in the United States. Average temperatures were more than one degree warmer (at 55.32 degrees Fahrenheit) than in 1998, the previous hottest year.

The year 2012 was only the world’s 8th or 9th warmest on record due in part to a La Niña weather pattern that affected other parts of the world. But the 10 warmest years on record for the planet all have occurred within the past 15 years. Last year’s drought in the United States was not quite as severe as the drought that produced the Dust Bowl during the 1930s, but it covered more than 60% of the nation and devastated soybean and corn crops. At least 11

natural disasters occurred in 2012 that each caused more than \$1 billion in damage, with Hurricane Sandy’s damage likely to exceed \$60 billion.³⁷ In January 2013, record heat waves struck Australia fueling wildfires in Tasmania, New South Wales, the state of Victoria, and the Australian Capital Territory.³⁸ The extreme heat in Australia convinced Australia’s Bureau of Meteorology to add additional color codes to its temperature maps for temperatures between 52 and 54 degrees Centigrade (125.6 to 129.2 degrees Fahrenheit) and above 54.

Future technological advances, as outlined in Gore’s new book, raise both new challenges and opportunities for improvement in the global environment. During the last few years, technological changes have affected U.S. energy production in a manner that few could have foreseen. The widespread use of hydraulic fracturing has significantly increased domestic production of natural gas and oil. China’s oil imports are growing by 8% annually, while U.S. oil imports are declining by 8% per year. As a result, China will soon pass the United States as the world’s largest oil importer.³⁹ In November 2012, the International Energy Agency predicted that the United States will become the world’s largest oil producer by 2020 and that by 2030 the United States will become a net exporter of oil.⁴⁰

Accidents and natural disasters have posed unexpected challenges to environmental policy. The *Deepwater Horizon* oil spill demonstrated the dangers of extracting oil at ever-increasing depths, and Shell’s ill-fated efforts to drill in the Arctic have shown the difficulties of drilling in that harsh environment. Just as a new generation of nuclear power plants were about to be launched, the tsunami and Fukushima Daiichi disaster caused countries around the world to rethink their policies toward nuclear power.

One cannot be confident that new technology will largely solve future environmental problems, leading to the dawn of the zero-emissions society Easterbrook and Lomborg had forecast. The history of environmental law demonstrates that innovations in pollution control technology are highly correlated with increases in the stringency of emissions controls. If federal regulators continue to demand cleaner and more-efficient production processes and means of transportation, as illustrated by significant increases in fuel economy standards, further progress can be expected in the transition toward a green society. It is less likely that technological progress will occur with respect to environmental problems that are not the focus of regulatory pressure. This is illustrated by the finding of the president’s Oil Spill Commission that virtually no progress has been made in oil spill cleanup

35. Ethan Goffman, *Can Driverless Cars Drive Sustainability?*, SSPP BLOG (Oct. 9, 2012), <http://ssppjournal.blogspot.com/2012/10/can-driverless-cars-drive-sustainability.html> (last visited Apr. 29, 2013).

36. See, e.g., Southern Elevations & Shoring Inc., whose motto is “Raising Louisiana’s Homes to Safer Levels,” <http://www.southernelevations.com> (last visited Apr. 29, 2013).

37. Justin Gillis, *It’s Official: 2012 Was Hottest Year Ever in the U.S.*, N.Y. TIMES, Jan. 8, 2013.

38. Enda Curran, *Record Heat Wave Fuels Wildfires Across Australia*, WALL ST. J., Jan. 8, 2013, at A11.

39. Benoit Faucon, *China to Overtake U.S. as World’s Largest Oil Importer*, OPEC SAYS, WALL ST. J., Apr. 3, 2013, <http://online.wsj.com/article/SB1001424127887323646604578400410832143602.html> (last visited Apr. 29, 2013).

40. Benoit Faucon & Sarah Kent, *IEA Pegs U.S. as Top Oil Producer by 2020*, WALL ST. J., Nov. 12, 2013, <http://online.wsj.com/article/SB10001424127887323894704578114492856065064.html> (last visited Apr. 29, 2013).

technologies in the decades since the *Exxon Valdez* oil spill. Nonpoint source pollution is one of the top problems that federal regulatory policy has failed to address effectively, and agricultural interests that strongly oppose actions to redress this problem remain politically powerful.

Astonishing improvements in information technology have created an illusion of technological progress that, some argue, has masked stagnation in other areas.

[W]e bounded forward in the 1950s and 1960s thanks to a generation of scientists who did not just believe in a better future but invented it. They popularised jet aviation, fed a growing world with the harvest of the “green revolution,” switched on the first nuclear reactors for civilian power, launched the first satellites for communications and built the first integrated circuit, laying the foundations for decades of innovation in information technology.

The genuine progress in IT [information technology] from the 1970s up to the 2000s masked the relative stagnation of energy, transportation, space, materials, agriculture and medicine. . . . We can now use our phones to send cute kitten photos around the world or watch episodes of *The Jetsons* while riding a century-old subway; we can programme software to simulate futuristic landscapes. But the actual landscape around us is almost identical to the 1960s. Our ability to do basic things such as protect ourselves from earthquakes and hurricanes, to travel and to extend our lifespans is barely increasing.⁴¹

When environmental problems become so bad as to become politically salient, regulation has produced notable successes. In the developed world, air pollution standards have been an unbridled success story. In 2011, EPA released a study finding that air pollution controls mandated by the CAA Amendments of 1990 are saving so many lives that they will produce net benefits of \$1.935 trillion by 2020. The phaseout of leaded gasoline in the United States has now been adopted throughout the world, producing dramatic reductions in levels of lead in children’s blood.

Horrendous levels of pollution in parts of the developing world are generating pressure to upgrade environmental standards. In January 2013, air pollution in China reached levels described on local microblogs as “postapocalyptic,” “terrifying,” and “beyond belief” and by the U.S. Embassy’s @Beijing Air Twitter feed as “crazy bad.”⁴² Pollution in Beijing became so bad that it forced airlines to cancel flights because of poor visibility. The Chinese government required some factories to close to reduce emissions, and it ordered government cars to cut back on travel. But air pollution in China has been so severe that it is causing many to argue for a fundamental rethinking of the country’s air pollution control strategies.⁴³

Air pollution is the seventh leading cause of death worldwide, contributing to 3.2 million premature deaths annually.⁴⁴ Most of the global deaths from air pollution occur in Asia. Air pollution is the fourth leading cause of death in China (trailing dietary factors, high blood pressure, and smoking), causing 1.2 million premature deaths there in 2010. In India, air pollution is estimated to cause 620,000 premature deaths annually.⁴⁵

In addition to harming public health, pollution takes a heavy toll on the economy. The Chinese Academy of Environmental Planning estimates that the cost of environmental damage in China had risen to \$230 billion annually by 2010, 3.5% of the country’s GDP. This estimate is nearly four times greater than the \$62 billion in environmental damage calculated for 2004, which then represented 3.05% of China’s GDP. In 2010, it was estimated that the cost of environmental damage in China had risen in 2008 to \$185 billion. Most economists view these estimates as underestimates of actual environmental damage because researchers lack considerable important data.⁴⁶

Initially, environmental law responded to polluting industries by encouraging them to locate away from populated areas. This “zoning function” performed by the early common law eventually was replaced by a “technology-forcing” one as fear of liability inspired industry to develop new pollution control technology. Responding to new controls on various environmental risks in developed countries, industry exported some of those risks to developing countries. Today, this pattern is rapidly changing as developing countries upgrade their environmental standards and nongovernmental organizations (NGOs) shine the spotlight of international publicity on companies who degrade the environment in any part of the world, even if such degradation is legal under domestic law.

Due to the growth of NGO networks throughout the world, no corporation can damage the environment in some remote corner of the planet without fear of protests at its far away corporate headquarters. NGOs in the developing world are using creative information disclosure strategies to promote environmental protection. In China, Ma Jun’s Institute of Public and Environmental Affairs (IPEA) has made major strides in improving environmental and working conditions in the supply chains of major multinational electronics companies. Faced with audits by the IPEA and other NGOs revealing environmental and labor violations in its suppliers, Apple Corpo-

lution in eastern China has become is provided by reports that pollution so impaired visibility in Zhejiang province that a furniture factory was on fire for four hours before anyone noticed.

41. Garry Kasparov & Peter Thiel, *Our Dangerous Illusion of Tech Progress*, *FIN. TIMES*, Nov. 8, 2012, <http://www.ft.com/cms/s/0/8adeca00-2996-11e2-a5ca-00144feabdc0.html#axzz2Qxv7t8jQ> (last visited Apr. 29, 2013).

42. Edward Wong, *On Scale of 0 to 500, Beijing’s Air Quality Tops “Crazy Bad” at 755*, *N.Y. TIMES*, Jan. 13, 2013, at 16.

43. Aaron Back & Josh Chin, *Wen Urges Clean-Air Action as China’s Skies Clog Again*, *WALL ST. J.*, Jan. 30, 2013. One unusual illustration of how bad pol-

44. *Global Burden of Disease Study 2010*, *THE LANCET*, Dec. 2012, <http://www.thelancet.com/themed/global-burden-of-disease> (last visited Apr. 29, 2013).

45. Edward Wong, *Early Deaths Linked to China’s Air Pollution Totaled 1.2 Million in 2010, Data Shows*, *N.Y. TIMES*, Apr. 2, 2013, at A9.

46. Edward Wong, *Cost of Environmental Damage in China Growing Rapidly Amid Industrialization*, *N.Y. TIMES*, Mar. 30, 2013, at A4.

ration has agreed to employ regular independent auditors to police its supply chain.⁴⁷

Information disclosure strategies also have been used to create incentives for Chinese government officials to implement the law. The Natural Resources Defense Council, in partnership with the IPEA, publishes an annual Pollution Information and Transparency Index (PITI) report. The PITI report ranks 113 cities in China on how well they have performed in making environmental information available to the public under China's Open Information Law. The publicity that it has received has spurred many local officials to contact the IPEA and the NRDC to find out how they can improve their performance. As environmental conditions continue to deteriorate in China, the Chinese public is becoming increasingly militant in demanding greater transparency. Barbara Finamore, NRDC's Asia Director, expresses optimism that China may move toward regular publication of some form of Pollution Release and Transfer Register, as more than 50 other countries have done (see, e.g., the U.S. Toxics Release Inventory).⁴⁸

While environmental concerns continue to command broad popular support, it has now become virtually impossible to shepherd new environmental legislation through Congress. Proponents of environmental progress need to work on building creative, bipartisan coalitions to win the political battles of the future. For example, economic conservatives who oppose federal subsidies could be strong supporters of efforts to eliminate some of the most environmentally destructive subsidy programs. The perceived political wisdom is that new energy taxes are political suicide, following the ill-fated effort in the early days of the first Clinton Administration to persuade Congress to adopt a British thermal unit (BTU) tax.⁴⁹ Yet, it makes enormous sense to consider shifting much of the tax burden away from productive labor and toward discouraging

environmentally damaging production and consumption decisions. Energy taxes can create powerful incentives to improve energy efficiency and to reduce overall energy consumption, and they need not increase the overall tax burden if they are rebated in a proper manner.

Great progress has been made in controlling air and water pollution in the developed world, but climate change is creating substantial new environmental challenges to countries throughout the world. It would be comforting to be able confidently to predict a future of unbroken progress in environmental protection, but such progress is not inevitable.⁵⁰ The notion that globalization would result in an unstoppable and beneficial spread of democracy, capitalism, and innovation is now being openly questioned.⁵¹

Until bipartisanship returns to environmental politics,⁵² the future of environmental policy will depend largely on who controls the White House and Congress, which usually is determined by factors divorced from voters' environmental values. The global financial collapse in 2008 created an opportunity for opponents of environmental regulation to erect a deceptive narrative blaming it for unrelated economic troubles. This narrative seeks to depict environmental regulation as excessive and economically damaging. It seeks to exploit high levels of unemployment to demonize regulation as "job killing,"⁵³ even though "life saving" usually would be a more appropriate description. The narrative is founded on a false dichotomy between environmental regulation and a robust economy. Economic history demonstrates that strong environmental protection measures can coexist with a strong economy, but political history shows that a weak economy can be a threat to environmental protection. Thus, promotion of a strong economy is crucial for improving the future of environmental policy and, in turn, the kind of planet our progeny will inherit.

47. Charles Duhigg & Nick Wingfield, *Apple Asks Outside Group to Inspect Factories*, N.Y. TIMES, Feb. 13, 2012, <http://bits.blogs.nytimes.com/2012/02/13/apple-announces-independent-factory-inspections/> (last visited Apr. 29, 2013). Apple now issues an annual supplier responsibility report that discloses steps it has taken to ensure that its suppliers comply with China's environmental and labor laws. APPLE CORPORATION, SUPPLIER RESPONSIBILITY: 2013 PROGRESS REPORT (2013), available at http://www.apple.com/supplierresponsibility/pdf/Apple_SR_2013_Progress_Report.pdf.

48. Barbara Finamore, *A Step Forward for Environmental Transparency in China*, NRDC.ORG, http://switchboard.nrdc.org/blogs/bfinamore/a_step_forward_for_environment.html (last visited Apr. 29, 2013).

49. William O'Keefe, *Will the Carbon Tax Make a Comeback?*, WALL ST. J., Dec. 20, 2012, <http://online.wsj.com/article/SB10001424127887324469304578145640617261224.htm> (last visited Apr. 29, 2013).

50. Cf. STEVEN JAY GOULD, *FULL HOUSE: THE SPREAD OF EXCELLENCE FROM PLATO TO DARWIN* (1996) (explaining why progress is not inevitable).

51. See, e.g., Gillian Tett, *Davos Man's Belief in Globalisation Is Being Shaken*, FIN. TIMES, Mar. 8, 2013, at 24.

52. As depressing as the current partisan split on environmental issues may be, things could be worse. See David Deming, *What the Oil Business Could Learn From the NRA*, WALL ST. J., Mar. 1, 2013, at A11 (advocating that the oil industry should embrace the scorched-earth lobbying tactics of the National Rifle Association when lobbying against environmental initiatives).

53. See, e.g., Michael J. Boskin, *The Anatomy of Government Failure*, WALL ST. J., Oct. 20, 2012, at A13 ("Consider the EPA's ever-tighter pollution standards of dubious benefits causing ever higher additional costs").