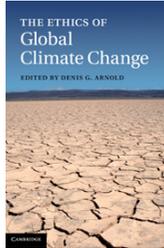


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CHAPTER I

Energy, ethics, and the transformation of nature

Dale Jamieson

Climate change is a complex problem that can be approached from many different perspectives: atmospheric science, global change biology, environmental economics, international law, environmental philosophy, and so on. It involves almost every sector of society from land use planning to forest management. One particularly productive way of framing the problem of climate change is as a problem of energy policy. This is the perspective that I will take in this paper. I begin with some brief remarks about the role of different energy sources in human history. I go on to claim that every currently available energy policy entails difficult trade-offs and that technology will not deliver us from the agony of choice, at least on the time-scale on which we must act to avoid “dangerous anthropogenic interference with the climate system.”¹ I then bring these observations to bear explicitly on the problem of climate change and discuss their implications for policies that are now under active consideration. Finally, I draw some conclusions.

I ENERGY'S HISTORY

Energy use has been central to the development of human civilization, society, and economy. As a first approximation, we can say that the story of human development has been the story of increased use of energy. Indeed, we can even think of human history as falling into epochs marked by the human ability to exploit various sources of energy. According to Vaclav Smil:

All preindustrial societies derived their energy from sources that were almost immediate transformations of solar radiation (flowing water and wind) or that took relatively short periods of time to become available in a convenient form; just a few months of photosynthetic conversion to produce food and feed crops, a few

¹ This is the obligation undertaken by the USA and the other 193 countries who are parties to the Framework Convention on Climate Change. For the text of the treaty, visit http://unfccc.int/essential_background/convention/background/items/2853.php.

years of metabolism before domestic animals and children reached working age; or a few decades to accumulate phytomass in mature trees to be harvested for fuel wood and charcoal.²

What is distinctive about the energy profile of modern societies is their use of fossilized stores of solar energy in the form of coals and hydrocarbons, and their use of electricity generated by burning these fuels, as well as by water, nuclear fission, wind, and the Earth's heat.

Coal was used for various purposes in antiquity, but it was a marginal energy source until the late seventeenth century when Great Britain became the first country to adopt coal as its primary energy source. The transition to coal did not occur in the USA until the 1880s. The demand for coal has continued to increase and the International Energy Agency predicts that global energy demand will grow by 40 percent between 2007 and 2030, and the demand for coal will grow more than the demand for any other energy source.³ Petroleum, like coal, was known in antiquity but played almost no role as an energy source. Until 1870 global petroleum production was negligible, but by 1950 it had risen to 10.42 million barrels per day, and by 2005 production was more than 84 million barrels per day.⁴ Today petroleum makes up 40 percent of total energy consumption in the United States, and fossil fuels make up 86 percent of the world's energy supply.

At some point energy sources became value-valenced, not just by their relative ability to do work, but also by other features with which they are associated. So, for example, in the 1950s nuclear energy was widely seen as good. It was viewed as a cheap, clean, unlimited source of power, and the US government actively promoted its adoption throughout the world.⁵ Nuclear fission had previously been associated with the bombs that had been used to destroy Hiroshima and Nagasaki, and made possible the death grip of "mutually assured destruction" in which the USA and the Soviet Union were then locked. Nuclear energy symbolized the transformation of the power of the atom from a destructive force to one that could serve human development and progress (a word that was frequently invoked in that far-off time). Atoms for peace was an expression of the biblical injunction to "beat . . . swords into ploughshares."⁶

² Vaclav Smil, *Energy in Nature and Society* (Cambridge, MA: MIT Press, 2008), 203.

³ www.iea.org/country/graphs/weo_2009/fig1-1.jpg.

⁴ www.earth-policy.org/Updates/2007/Update67_data2.htm#table1.

⁵ See, e.g., President Dwight Eisenhower's December 1953 "Atoms for Peace" speech. For an account, visit www.eisenhower.archives.gov/digital_documents/Atoms_For_Peace/Atoms_For_Peace.html.

⁶ Isaiah 2:2-4.

Sometime in the 1960s nuclear power became bad, as it came to be seen as a high-risk technology that imposes harms on future generations. The value-valence of nuclear power turned for a number of reasons. First, it soon became clear that nuclear power could not live up to the grand claims that had been made on its behalf (e.g., as producing electricity that would be “too cheap to meter”⁷). Second, once nuclear tests in the atmosphere had been abolished, nuclear plants were the only remaining anthropogenic source of cancer-causing radiation. A third concern was the thermal pollution in waterways caused by nuclear plants, which ran head on into the ecological concerns of the nascent environmental movement. Fourth, it seemed completely unacceptable to many people that we would build nuclear plants that inevitably produce waste that would have to be managed for thousands of years, without any clear plan about how to manage it. Finally, although the Cold War continued into the 1980s, the specter of nuclear war began to diminish in the 1960s, and the fear of catastrophic nuclear disaster began to migrate from nuclear war to nuclear power. These fears seemed to be confirmed by the 1979 accident at the Three Mile Island nuclear plant in Pennsylvania, which occurred just weeks after the release of a popular film depicting nuclear catastrophe.⁸ These fears were reinforced by the 1986 Chernobyl disaster.

Perhaps the most interesting charge against nuclear power was that it is “inappropriate technology.” That nuclear reactions were being used to boil water to create steam to turn turbines seemed to many people like using a scalpel to butter toast or, more revealingly, blanketing entire neighborhoods with persistent pesticides (such as DDT) in order to control mosquitoes. Both seemed to be needlessly complex, high-risk approaches to solving fundamentally manageable problems. In addition, these approaches were seen as inelegant and out of tune with the idea of the simple life that is modest in means and rich in ends. The 1960s also saw a rise of libertarian ideals across the political spectrum that celebrated decentralized approaches to problem solving. Nuclear energy was seen by many as the ultimate expression of highly centralized, technological, “modernist” management of human life and society.

At the same time that nuclear power was being demonized, a premodern energy source, wood, was being valorized. Wood had largely been given up

⁷ This sentiment has often been attributed to Lewis Strauss, then Chairman of the Atomic Energy Commission, in a 1954 speech, but there is controversy about exactly what he said and even more about what he meant. For more on the issues, visit <http://media.cns-snc.ca/media/toocheap/toocheap/>.

⁸ *The China Syndrome*, starring Jane Fonda, Jack Lemmon, and Michael Douglas.

as old-fashioned, but much of the antinuclear movement embraced wood and other decentralized energy sources. In popular music and in counter-cultural journals, wood was portrayed as a renewable resource that is traditional and natural, and that can be harvested and transformed into energy using simple means, in ways that can be easily understood. Wood was a decentralized resource that encouraged self-sufficiency and supported local economies. Heating with wood was part of taking a home “off-grid.” In many circles wood became symbolic of American rugged individualism and curmudgeonly independence. Unfortunately, however, wood is an extremely polluting energy source unless it is burned in stoves that are outfitted with expensive, high-tech scrubbers. Even then, burning wood contributes more to greenhouse gas emissions than burning natural gas, oil, and perhaps even some kinds of coal.⁹ In addition, it is difficult to use wood on a large scale without significantly transforming ecosystems.

In an age in which our main concern is increasingly with greenhouse gas emissions, and we look to advanced technology to “deliver us from evil,” the value valences of nuclear and wood are beginning to flip again. Nuclear power is being reframed as a clean energy source for a greenhouse world, while wood is increasingly being seen again as a marginal energy source that can be tolerated if used responsibly by a few people living in remote areas.

The move towards seeing energy policy through the lens of climate change was pioneered by scientists rather than environmentalists, contrary to what is widely supposed. Environmental organizations were slow to embrace climate change, in part because it disrupted many of the usual associations that went with environmentalism, of which this idea that nuclear is good and wood is bad is an example. This begins to suggest the extent to which environmentalism (certainly in the USA) has operated as a set of tacit commitments, tendencies, stereotypes, and prejudices rather than as a reflective worldview or a coherent philosophy. Indeed, many environmental issues, rather than being subjected to systematic analyses, have tended to migrate along an axis of what is speakable or unspeakable, depending on reigning political and psychological associations, stereotypes, and so on. Until recently, nuclear power was simply not discussed in polite green company, though it is now entering the domain of the discussable. Population, one of the central green issues of the 1960s and 1970s, became

⁹ It is often said that burning wood is carbon-neutral because the wood that is burned will eventually release its carbon into the atmosphere anyway. Even if this were true, the rate at which carbon is released and sequestered matters enormously in determining atmospheric concentrations of greenhouse gases.

unspeakable during the 1980s and 1990s, and the impact of immigration on the environment is in the same position today.¹⁰ The environmental impacts of dietary choices are only now beginning to reach public consciousness, largely through the statements of Rajendra Pachauri, chair of the IPCC and lifelong vegetarian.¹¹ In these respects environmentalism in the USA has functioned more like an American political party (a large, diverse set of interest groups) than as a set of philosophical commitments or worldviews.

This comes out dramatically when environmentalists are faced with value conflicts. For example, species reintroduction programs are supposed to restore nature to some preferred state, but such programs often make life difficult for individual animals whose interests many environmentalists are concerned to promote. In some cases the interests of protected species can clash; for example, the Sierra big-horned sheep and the mountain lion in parts of California.¹² Perhaps most profoundly, many environmentalists chafe at the plain fact that a poor urban dweller who can't afford to eat much meat lives a much greener lifestyle than the affluent Sierra Club member who "lives close to nature."

To return specifically to energy, the problem that we face is that energy use is at the heart of everything we do or consume. The environmental impact of even a wilderness expedition is to a great extent a function of energy use, because of both the energy involved in producing the gear and the energy used in powering the gearheads. The significance of this second consideration is often overlooked. However, it has been argued that someone who eats a diet heavy in factory-farmed meat could actually decrease their greenhouse gas emissions by giving up meat-fueled walking in favor of gasoline-fueled driving, because the fossil fuel intensity of conventional meat production is so much greater than that of driving.¹³

Energy production necessarily involves transforming nature. Producing energy, whether from fossil fuels or by eating fruits and nuts, leaves nature in a different state than it otherwise would have been in. This matters because environmentalists are in general hostile to the human transformation of nature.

¹⁰ This issue has come up in the Sierra Club in elections for officers, but even there the question has been largely whether the issue is discussable rather than being a discussion of the issue.

¹¹ "This is something that the IPCC was afraid to say earlier, but now we have said it . . . Please eat less meat" (<http://lists.mutualaid.org/pipermail/sustainabletompkins/2008-January/003208.html>).

¹² For more on these conflicts, see my *Ethics and the Environment: An Introduction* (Cambridge University Press, 2008), ch. 6, and "The Rights of Animals and the Demands of Nature," *Environmental Values*, 17(2) (May 2008): 181–199.

¹³ For this argument, see Chris Goodall, *How to Live a Low-Carbon Life* (London: Earthscan, 2007); for a response, see www.pacinst.org/topics/integrity_of_science/case_studies/driving_vs_walking.html.

They typically endorse Paul McCartney's "wistful words of wisdom": "let it be." Moreover, environmentalists value nature and the natural, and these concepts imply little or no human transformation.¹⁴

My point is not that environmentalism is incoherent, or that characteristic green values and dispositions cannot be sharpened and defended. My point is rather that the work needs to be done. What is needed is a philosophy of environmentalism that makes explicit, clarifies, and defends to the greatest extent possible core green commitments. I suspect that in the end some green dispositions and beliefs will have to be reined in, reformulated, or even jettisoned. However, we won't know until they are clarified and defended in the best way possible.

This much is clear: it is not only humans that transform nature, but also other animals and plants. What is generally different about humans is this conjunction: Humans now are transforming nature on a much larger scale than other animals, and they are capable of modulating these transformations through individual and collective action based on reflection. Some would say that phytoplankton transform the planet in an even more dramatic way than humans. I don't think that it is productive to argue this point one way or another. What phytoplankton lack is the second conjunct: the ability to modulate their impact based on reflection. That is why it is true to say that in an important respect phytoplankton are part of nature while humans are not.¹⁵

The fundamental question that is too often avoided is what transformations of nature, under what conditions, with what motivations, for what purposes, in what contexts, are morally acceptable? This is the question that is at the heart of debates over energy policy.

2 GRASPING THE NETTLE

When we return to the choices we must make regarding energy policy, we see that each choice involves a nettle: it will sting! In this section I will briefly

¹⁴ Robert Goodin, *Green Political Theory* (Cambridge: Polity Press, 1992); Robert Elliot, *Faking Nature* (New York: Routledge, 1997).

¹⁵ Of course in other respects humans are part of nature (e.g., they are constituted by natural materials, they are subject to natural laws, etc.); this brings out the multiplicity of meanings and associations of 'nature' and its cognates. For more on these points, see Bernard Williams, "Must a Concern for the Environment Be Centred on Human Beings?," reprinted in L. Gruen and D. Jamieson (eds), *Reflecting on Nature: Readings in Environmental Philosophy* (New York: Oxford University Press, 1994); and Paul Veitch Moriarity, "Nature Naturalized: A Darwinian Defense of the Nature/Culture Distinction," *Environmental Ethics*, 29 (2007): 227–246.

review the nettles and the stings associated with what are generally regarded as the most environmentally friendly energy sources.

2.1 *Energy efficiency*

Literally, energy efficiency is not an energy source at all, but rather a strategy for reducing the amount of energy that we must produce and thus the extent to which we must transform nature. Virtually everyone agrees that it is the best energy policy, to the extent to which it can be implemented.

There is little doubt that a great deal of energy is wasted: according to one estimate, 66 percent in the electricity sector, 71 percent in transportation, 20 percent in industry, and 20 percent in residential and commercial buildings.¹⁶ One reason that we have not reached higher levels of energy efficiency is that prices do not adequately reflect the costs of producing and consuming energy. However, even when policies are adopted that promote energy efficiency, there are limits to what they can achieve. Even to speak of energy efficiency implies using energy, and using energy implies transforming nature. In some cases improvements in energy efficiency are free (e.g., making greater use of natural light); in other cases they require new products and technologies that in some cases require large amounts of energy to produce. Imagine, for example, how much energy would be required in order to replace the world's automobile fleet with energy-efficient vehicles, fabricated from the most efficient materials and kitted out with the most fuel-efficient engines.¹⁷

2.2 *Solar*

Solar energy can be directly used in various ways. Passive solar systems use the architectural design, natural materials, or absorptive structures of buildings to heat water or homes. Active solar energy systems require solar collectors (such as photovoltaic cells) and can be used to generate electricity. This electricity can be used to directly power a building or can be fed into an existing electrical grid.

¹⁶ The *New York Times* attributes these figures to Lawrence Livermore National Laboratory; see www.nytimes.com/imagepages/2008/04/06/weekinreview/06revkin.html.

¹⁷ I owe this example to Ronald Mitchell. Other examples include more fuel-efficient refrigerators and furnaces. As Robert Darst pointed out in conversation, even compact fluorescent bulbs have more embedded energy than incandescents and impose further environmental costs because they contain small amounts of mercury.

One nettle associated with the use of solar energy to produce electricity is cost, but the costs of solar energy have been steadily declining while the costs associated with fossil fuels have been increasing.¹⁸ Still, electricity generated by photovoltaics is 2–5 times more expensive than electricity currently delivered to residential customers. In addition, it has been argued that much of the luster of photovoltaics dissipates when their embodied energy is taken into account (i.e., the energy used in manufacturing, installing, and maintaining the cells).¹⁹ A third concern is that cadmium may be released in producing photovoltaic cells, which are made of cadmium telluride. Cadmium is a toxic heavy metal that concentrates in the food chain and is implicated in lung and kidney disease. In any case there are limits on the amount of energy that solar can deliver given the variable nature of the solar radiation that strikes the Earth's surface both across space and through time. Furthermore, if solar energy were to supply the American energy grid with a significant fraction of demand, large areas would have to be covered with photovoltaic cells, and some people find this possibility aesthetically objectionable.

2.3 Wind

Wind energy is currently more attractive than solar but also confronts us with some of the same nettles. Wind-generated electricity is much more economically competitive than solar, and is even approaching the cost of electricity generation from a new, coal-fired power plant. There is also much less energy embodied in wind turbines than in photovoltaic cells. However, even more than solar, wind energy is both inconsistent and inconstant. While early concerns about the apparently devastating ecological effects of wind turbines have largely been assuaged, this remains an active area of research.²⁰ A further problem concerns the aesthetic acceptability of wind farms, indicated by controversies about their siting both in North America and Great Britain.²¹

¹⁸ A caveat: The price of coal has not been increasing but the “clean coal” that would have to be part of any sustainable energy future is substantially more expensive than “dirty coal.”

¹⁹ However, such claims are controversial; see, e.g., Colin Bankier and Steve Gale, “Energy Payback of Roof Mounted Photovoltaic Cells,” *Energy Bulletin*, June 16, 2006, www.energybulletin.net/node/17219.

²⁰ While turbines are no longer seen as “bird blenders,” under some circumstances they can seriously threaten bird and bat populations. For a review, see A. Drewitt and R. Langston, “Collision Effects of Wind-Power Generators and Other Obstacles on Birds,” *Annals of the New York Academy of Sciences*, 1134 (2008): 233–266.

²¹ Perhaps the best known controversy in the USA is over Cape Wind's proposal to site a \$900 million wind farm on Horseshoe Shoal in Nantucket Sound off Cape Cod in Massachusetts. For an opinionated account of the controversy, see Wendy Williams and Robert Whitcomb, *Cape Wind: Money, Celebrity, Class, Politics, and the Battle for Our Energy Future on Nantucket Sound* (New York: Public Affairs, 2007).

2.4 *Hydropower*

Hydropower is an even cheaper source of energy than burning fossil fuels and is responsible for virtually no greenhouse gas emissions. In many parts of the world, including the USA, there is still a great deal of potential for developing hydropower resources. Still, by damming wild rivers, hydropower development can have enormously damaging ecological effects. In the USA there is a growing movement to remove dams in the Pacific Northwest that have adversely affected salmon populations. The James Bay Project in Canada and the Three Gorges Dam in China have remade nature on a much greater scale, compromising natural values such as wildness and naturalness and disrupting human communities. Proposals to build dams for producing hydropower have given rise to massive protest movements in both South Asia and South America.

2.5 *CCS coal*

A favored choice of policymakers is continuing to burn coal, but in plants that capture carbon that can then be sequestered. A recent MIT study concluded that

CO₂ capture and sequestration (CCS) is the critical enabling technology that would reduce CO₂ emissions significantly while also allowing coal to meet the world's pressing energy needs.²²

Coal is cheap and abundant, and is currently the source of more than one-quarter of the world's energy supply. However, not only does burning coal produce acid rain, poor visibility, and various deleterious health effects, but it also produces 50–100 percent more carbon dioxide per BTU than other fossil fuels. We are now able to control the pollutants produced from burning coal, and if we were able to do the same trick with carbon dioxide, coal would be a very attractive fuel indeed. Unfortunately, capturing carbon dioxide is itself extremely energy intensive, requiring a CCS coal-fired generating plant to consume as much as 25 percent more energy than a conventional plant that emits carbon. This drives up costs, and is what led to the cancellation of the American government's first attempt to build a CCS plant ("FutureGen"). Moreover, at this point no one knows whether these technologies could reliably be deployed on a scale that would make a significant difference to atmospheric concentrations of carbon dioxide.

²² Massachusetts Institute of Technology, "The Future of Coal: An Interdisciplinary MIT Study" (Cambridge, MA: MIT, 2007). <http://web.mit.edu/coal/>.

Even if they could be so deployed, some of the worst effects of the coal cycle would not be eliminated but perhaps would even be exacerbated (e.g., mountain-top removal, occupational safety concerns, etc.).²³

2.6 *Nuclear power*

Like hydropower, nuclear power is attractive because it does not directly emit greenhouse gases. Indeed, heavy reliance on nuclear power is part of why Europe has lower per capita emissions of greenhouse gases than the USA.²⁴ While the figure is not quite so rosy when embodied energy is included, nuclear still does well on this dimension relative to fossil fuels and perhaps even photovoltaics.

The stings of nuclear energy are elsewhere. First and foremost is the problem of storing nuclear waste. Such waste will have to be managed for at least 10,000 years, and no one really knows how to do this. Of course, we may someday come up with methods of storing, decontaminating, or even using these wastes as a resource, but building nuclear plants today entails gambling on other people's futures. In addition, there is a great deal of concern about nuclear plants being "terrorist-magnets." Drawings of American nuclear plants were found in Al-Qaeda documents captured in Afghanistan, and shortly after the 9/11 attacks the nuclear plant at Three Mile Island was temporarily shut down due to a "credible threat." A report from the Union of Concerned Scientists predicted that a terrorist attack on the Indian River Nuclear Plant near Manhattan could kill 44,000 people immediately and as many as 518,000 over the long term.²⁵ Finally, uranium mining raises many of the same issues as coal-mining, but some additional health risks as well since uranium ore emits cancer-causing radon gas.

2.7 *Biofuels*

For the last several years biofuels have been a favored alternative energy source in North America and Europe as well as in Brazil. While calculating subsidies is difficult and controversial, we can estimate that the US

²³ For an overview of some of the issues, consult the Appalachian Center for the Economy and Environment. www.appalachian-center.org/.

²⁴ More than three-quarters of France's electricity, almost half of Sweden's, and more than a third of Europe's is generated by nuclear power. See www.euronuclear.org/info/encyclopedia/n/nuclear-power-plant-europe.htm.

²⁵ Edwin S. Lyman, "Chernobyl on the Hudson?" (Cambridge, MA: Union of Concerned Scientists, 2004). www.ucsusa.org/nuclear_power/nuclear_power_risk/sabotage_and_attacks_on_reactors/impacts-of-a-terrorist-attack.html.

government provides about \$11 billion per year in corn ethanol subsidies while the countries of Europe spend at least half this amount in subsidizing corn ethanol and biodiesel. These policies are remarkably perverse given that recent studies show that corn ethanol could actually double greenhouse gas emissions over the next twenty years and result in further increases for more than a century.²⁶ This could occur because of the effects of the biofuels markets in changing land use patterns.

Changing land use patterns in response to increasing demand for biofuels are already having deleterious ecological effects in countries such as Indonesia, where tropical rainforests and peat lands are being converted to palm oil plantations, resulting both in increases in greenhouse gas emissions because of the loss of carbon sinks and in the destruction of habitat for endangered species such as the orangutan, the Sumatran tiger, and the Asian rhinoceros.²⁷ Indigenous people are also being harmed by these land use changes. In response to these unanticipated consequences, in 2007, the European Union (EU) reduced its 2005 goal for biofuels to constitute 20 percent of all vehicular fuels by 2020 to 10 percent, and even that is controversial.

Perhaps the most dramatic consequence attributed to increased demand for biofuels is increases in food prices, resulting in food shortages and political turmoil around the world. In a speech on April 4, 2008, the World Bank president, Robert Zoellick, reported that staple food costs had risen by as much as 80 percent since 2005, that rice had hit a 19-year high, and that the real price of wheat was at a 28-year high. At the time he was speaking, food riots were occurring in several countries including Egypt, Côte d'Ivoire, Burkino Faso, Haiti, and the Philippines. In his speech, Zoellick identified biofuels as one of the causes of the spike in food prices. Since then, food prices stabilized, declined, and have begun rising again.

It is clear that there are multiple causes for increases in the price of food including growing demand for meat and dairy products in developing

²⁶ Timothy Searchinger, Ralph Heimlich, R. A. Houghton, Fengxia Dong, Amani Elobeid, Jacinto Fabiosa, Simla Tokgoz, Dermot Hayes, and Tun-Hsiang Yu, "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change," *Science*, 319 (February 29, 2008): 1238–1240. See also Joseph Fargione, Jason Hill, David Tilman, Stephen Polasky, and Peter Hawthorne, "Land Clearing and the Biofuel Carbon Debt," *Science*, 319 (February 29, 2008): 1235–1238. For further discussion, visit www.bioenergywiki.net/Searchinger_Wang_debate.

²⁷ Center for Science in the Public Interest, "Cruel Oil: How Palm Oil Harms Health, Rainforest and Wildlife" (Washington, DC: May 2005). www.cspinet.org/palm/PalmOilReport.pdf.

countries such as China and India, and an increasing preference for wheat rather than rice or maize among the emerging urban middle classes in many developing countries. For example, per capita meat consumption in China has increased 250 percent in the last twenty-five years and is now more than 100 lbs (45.4 kg) per year, but still less than half the per capita meat consumption of Americans.²⁸ Local and regional droughts and floods (some probably triggered by climate change) have periodically reduced harvests in parts of the world. For example, a multi-year drought in Australia resulted in wheat exports dropping by 46 percent from 2005 to 2006, and then another 24 percent in 2007.²⁹ The collapse of the dollar has also contributed to the 2007–8 food crisis since much of the global commodities market is denominated in dollars.

What is the impact of the increased consumption of biofuels? While this is controversial, some things are clear. US ethanol production is increasing at rates from about 15–40 percent per year. According to the the US General Accounting Office, by 2012 almost one-third of the US corn crop will be devoted to producing ethanol.³⁰ While a spokesman for the US government claimed that increased demand for ethanol was responsible for only about 2–3 percent of the increase in the price of food during 2007–8,³¹ the British newspaper, *The Guardian*, reported that an unpublished World Bank Study attributed 75 percent of the increase in food prices to increased demand for ethanol.³² The United Nations Food and Agriculture Organization identified rising demand for biofuels as one of the causes of the 2007–8 price spike, and cites increasing demand for biofuels as “a leading driver” of the most recent spike in prices.³³ Wherever the exact truth lies, it seems clear that ethanol subsidies and mandates are playing a significant role in pushing up food prices.³⁴

²⁸ BBC, “The Cost of Food: Facts and Figures,” October 16, 2008, http://news.bbc.co.uk/2/hi/in_depth/7284196.stm; and Humane Society of the United States, “Farm Animal Statistics: Meat Consumption,” November 30, 2006, www.humanesociety.org/news/resources/research/stats_meat_consumption.html.

²⁹ David Challenger, “Blue Skies, Blue Days in Rural Australia,” CNN, October 28, 2008. http://articles.cnn.com/2008-10-28/world/australia.drought_1-blue-skies-worst-drought-drought-condition.

³⁰ Reuters, “Ethanol to Take 30 pct of U.S. Corn Crop in 2012: GAO,” July 11, 2007. www.reuters.com/article/idUSN1149215820070611.

³¹ Andrew Martin, “Food Report Criticizes Biofuel Policies,” *New York Times*, May 30, 2008. www.nytimes.com/2008/05/30/business/worldbusiness/30food.html.

³² Aditya Chakraborty, “Secret Report: Biofuel Caused Food Crisis,” *The Guardian*, July 3, 2008. www.guardian.co.uk/environment/2008/jul/03/biofuels.renewableenergy.

³³ Food and Agriculture Organization of the United Nations, “Food Outlook,” December 2009. www.fao.org/docrep/012/ak341e/ak341e00.htm.

³⁴ See the *New York Times* editorial, “Man-Made Hunger,” Sunday, July 6, 2008, available at www.nytimes.com/2008/07/06/opinion/06suni.html.

Many promoters of biofuels put their faith in “second-generation” biofuels that exploit “waste” materials rather than food crops. Champions of other energy sources also look past the problems of the present into a gauzy future of endless possibility. In the next section we will examine these hopes. First, however, I want to restate the main point of this section: using energy transforms nature, and developing energy sources involves grasping nettles.

3 TECHNOLOGY’S GRACE

The idea of American exceptionalism runs very deep in American culture.³⁵ Part of what makes America exceptional today by industrial world standards is the fact that so many Americans believe that they will be delivered from their sins by divine intervention. Perhaps this belief in God’s grace in the next world is mirrored by a belief in technology’s grace in this world.

When it comes to energy policy, like Adam after the Fall, we now have knowledge of good and evil. Thanks to climate scientists from Arrhenius to the IPCC, we know at least the broad outlines of what our use of fossil fuels is doing to the climate system. Although we may choose to avert our eyes, we also know that existing alternative energy systems also entail unwanted consequences. This is what the problem of grasping the nettle is all about. The promise of technology is that it will save us from having to grasp a nettle. It will deliver us from our fallen state and return us to the Eden of cheap, unlimited energy that leaves nature pristine, untouched by human hand or intention.

Those who have this faith often talk about the need for something along the lines of a Manhattan or Apollo project to create new energy technologies.³⁶ They talk about crash programs to develop fusion, “second-generation” biofuels, photovoltaics “beyond conventional silicon,” and so on. While I do not want to dismiss the importance of technology development especially over the long term, what is needed most urgently is individual and collective action. This is obscured by the “technofix” mentality and “crash-project” analogies. While all analogies limp to some extent, these analogies are particularly lame in some important respects. The Apollo project (for example) was directed toward producing a single, well-defined

³⁵ The recognition of this is usually attributed to Alexis de Tocqueville’s 1835 book, *Democracy in America*. For discussion, see Seymour Martin Lipset, *American Exceptionalism: A Double-Edged Sword* (New York: W. W. Norton & Company, 1996).

³⁶ See, for example, Martin Hoffert, “An Energy Revolution for the Greenhouse Century,” *Social Research*, 73(3) (Fall 2006): 981–1000.

result: American boots on the moon. Our current challenge is the much more thoroughgoing one of transforming the global energy systems which support human life. This is a challenge of diffusion and adoption at least as much as a challenge of technological innovation.

For more than a generation, analysts have been talking about “no regrets” policies and “harvesting the low-hanging fruit.”³⁷ What they mean by this is that significant actions can be taken to address climate change that would either be cost-free or cost-effective, wholly independent of the climate change threat. Yet, to a great extent, these actions have not been taken. Consider, for example, the fact that the hybrid engine, which is only now beginning to seriously penetrate the automobile market, was first developed in 1916.³⁸ Or consider the fact that the 1908 Model T got 25 miles (40 km) per gallon (3.79 liters), while the 2004 fleet average for all American cars was 21 miles (33.6 km) per gallon.³⁹ We can develop fancy new technologies but they will do little to solve our energy problems if they are not deployed. As Lovins and others have shown, an enormous amount could be done that is not being done with existing technologies.⁴⁰ What explains this failure to act?

Many factors are involved but much of the explanation lies in individual attitudes and values, and collective (including political) responses. It also matters how these responses are layered and how they relate to each other. We need to provide incentives for adopting a coherent and consistent energy policy, and to develop and implement the technologies that support it. Most of all, we need citizens who are willing to change their behavior and to commit to binding themselves in various ways, including not punishing politicians who impose costs on them to spur challenges in their behavior. For example, each of us may prefer to drive while others take public transport, but since acting on this desire leads to worse consequences for each of us than taking public transport, we need to be willing to take public transport and not punish politicians who adopt policies that discourage us from driving.

Technology matters but its grace will not save us from ourselves. We are back to the nettles.

³⁷ See, e.g., Amory B. Lovins *et al.*, *Least-Cost Energy: Solving the CO₂ Problem* (Andover, MA: Brickhouse Publication, 1981).

³⁸ www.hybridcars.com/history/history-of-hybrid-vehicles.html.

³⁹ www.wanttoknow.info/050711carmileageaveragempg.

⁴⁰ This is one of the implications of S. Pacala and R. Socolow, “Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies,” *Science*, 305 (August 13, 2004): 968–972.

4 CLIMATE CHANGE: THE BIG ENCHILADA

Choices in energy policy implicate a range of issues including cost, national security, ecological destruction, and pollution. Looming over all of these issues is climate change. It is the big enchilada because of the magnitude and scale of the threat. Climate change is a global phenomenon that has the potential to extinguish half the species on the planet, threaten food supplies in much of the world, set off massive refugee flows, and disrupt relations among countries. It is especially difficult for us to act on climate change because it challenges our conceptions of rational self-interest, ethics, and justice among states.

4.1 *Self-interest*

Climate change will in aggregate be bad for the people of the world but it is difficult to say exactly how bad and to make this assessment independent of ethical considerations. Nordhaus claims that it will be moderately bad: the optimal policy is a carbon tax of about \$17 in 2005, ramping up to \$270 in 2100.⁴¹ Stern, on the other hand, holds that future economic damages could be 20 percent of global GDP, and that the optimal carbon tax now is \$311.⁴² To a great extent the difference between them rests on the choice of a discount rate, what Stern believes is an ethical decision and Nordhaus believes is an empirical one. Questions of ethics also enter because climate change, at least to some level of warming, will produce both winners and losers.

Even from an individual point of view it is difficult to know how to think about self-interest and climate change. Some, such as Steven Schneider, have analogized spending on climate change to buying insurance. He has said:

We buy fire insurance for a house and health insurance for our bodies. We need planetary sustainability insurance.⁴³

While in some respects this analogy may be illuminating, viewing climate change spending as buying insurance is peculiar in that we have no relevant actuarial tables. Moreover, those who can afford planetary insurance – rich people who are now alive – are those who are least likely to be severely

⁴¹ *A Question of Balance: Weighing the Options on Global Warming Policies* (New Haven, CT: Yale University Press, 2008).

⁴² Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge University Press, 2007).

⁴³ Regina Nuzzo, "Profile of Stephen H. Schneider," *Proceedings of the National Academy of Sciences of the USA*, 102(44) (2005): 15725–15727. www.ncbi.nlm.nih.gov/pmc/articles/PMC1276082/.

affected by climate change. Those who are most likely to be severely affected – poor people who will come after us – are not in a position to purchase such insurance.

4.2 *Morality*

Climate change poses questions of morality since it involves some people harming other people.⁴⁴ However, how these people are related and how these harms come about depart significantly from our normal conception of a moral problem.

A paradigm moral problem is one in which an individual acting intentionally harms another individual; both the individuals and the harm are identifiable; and the individuals and the harm are closely related in time and space. A paradigm case of a moral problem is Jack intentionally stealing Jill's bicycle. Jack acts intentionally in harming Jill; Jack and Jill and the harm are clearly identifiable; and Jack and Jill and the harm are closely related in time and space. If we vary the case on any of these dimensions, we may still see the case as posing a moral problem, but its claim to be a paradigm moral problem is weaker. For example, if Jack is part of an unacquainted group of strangers, each of whom acting independently takes one part of Jill's bike, resulting in the bike's disappearance, we may still see Jack as acting wrongly, but this is less clear than in the first example. If we vary the case on several dimensions simultaneously, the view that morality is involved is weaker still, perhaps disappearing altogether. Imagine a case in which, acting independently, Jack and a large number of unacquainted people set in motion a chain of events that prevents a large number of future people who will live in another part of the world from ever having bikes. The core of what constitutes a moral problem remains: some people have acted in such a way that harms other people.⁴⁵ However, since most of what typically accompanies this core has disappeared, recognizing climate change as a moral problem may require us to revise or expand our concept.⁴⁶

⁴⁴ In his paper in this volume, John Nolt calculates that each American is responsible for about two deaths as a consequence of their climate-altering activities.

⁴⁵ There is, of course, room to argue that, while some people have made other people worse off, no harm has occurred; I cannot take up that challenge here.

⁴⁶ The ideas in this subsection were first developed (at greater length) in my "The Moral and Political Challenges of Climate Change," in S. Moser and L. Dilling (eds), *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change* (New York: Cambridge University Press, 2007), 475–482. For more on the themes of this and the subsequent subsection, see also my "Climate Change, Responsibility, and Justice," *Science and Engineering Ethics*, 16 (2010): 431–445.

4.3 *Global justice*

When we view nation states as climate change actors, it is obvious that the rich countries of the North disproportionately emit greenhouse gases while the poor countries of the South disproportionately suffer the damages.

Consider the example of Bangladesh. A sea-level rise of 1 meter will flood one-third of its coastline, creating 20 million environmental refugees. Saltwater will intrude inland, fouling water supplies and crops, and harming livestock. Cyclones and other natural disasters will become more frequent and perhaps more intense, causing even greater damage. Four billion dollars is needed for Bangladesh to begin to adapt to climate change by building embankments, cyclone shelters, roads and other infrastructure, yet Bangladesh's 2007 total national budget was less than \$10 billion.⁴⁷ Bangladesh will suffer in all these ways from climate change, yet its carbon dioxide emissions per capita are 1/20th of the global average, and about 1/100th of US emissions.

It is facts such as these that lead us to see climate change as posing problems of global justice. Yet climate change strays from the paradigm. The problems posed by climate change are not like those posed by one country unjustly invading another country. The nation state is one level of social organization that is relevant because it is causally efficacious, but it is not the primary bearer or beneficiary of moral responsibilities.⁴⁸

Climate change is largely caused by rich people, wherever they live, and is suffered by poor people, wherever they live. Greenhouse gas emissions vary greatly within countries as well as across countries. For example, the emissions profiles of people in California and New York, on a per capita basis, are more similar to those of Europeans than to other North Americans. Urban people in India emit more than rural people, regardless of income. Viewed globally, half the world's carbon is emitted by the world's richest 500 million people.⁴⁹ These 500 million people live disproportionately in North America, Europe, Australasia, or Japan, but they exist in every country of the world. Indeed, there are more of these high emitters in China than there are in New Zealand, and probably more than there are in Australia.

⁴⁷ Xinhua News Agency, "Bangladesh Gov't to Set Up Fund for Long-Term Disaster Management," July 6, 2008. www.reliefweb.int/rw/rwb.nsf/db900sid/KKAA-7GA9MT?OpenDocument.

⁴⁸ For further discussion, see my "Duties to the Distant: Humanitarian Aid, Development Assistance, and Humanitarian Intervention," *Journal of Ethics*, 9(1-2) (2005): 151-170.

⁴⁹ I owe this point to a presentation by Steve Pacala.

Moreover, there will be a great deal of variability within nations on who will suffer the damages of climate change. It is likely that more poor people will suffer from climate change in the USA than in many G77 countries due to the high US population, the large number of poor people, and the relatively undeveloped systems of land use management and emergency response in many parts of the country.

4.4 *Respect for nature*

In addition, to challenging our ideas of self-interest, morality, and global justice, climate change also invokes a concern in some people about dominating nature. This concern does not need to be based on biocentrism or ecocentrism, but rather can be based on a richer conception of what it takes for humans and other sentient beings to flourish. The concern may be seen as prudential, moral, or grounded in some other way. However it figures, it is an important concern for many people although it can be difficult to articulate and defend.

Humans, like other animals, modify the environments in which they live. The extent and degree of anthropogenic changes, measured in any reasonable way, is currently overwhelming and increasing exponentially.

There are various ways of measuring the human impact on nature. In 1986 Vitousek and his colleagues approached this problem by calculating the fraction of the Earth's net primary production (NPP) that is appropriated by humanity, and thus not directly available for other forms of life.⁵⁰ What they found is that humanity probably appropriates about 40 percent of Earth's terrestrial NPP.⁵¹ Another approach to assessing the human impact on nature is ecological footprint analysis, pioneered by William Rees and Mathis Wackernagel.⁵² The ecological footprint of a nation, community, or individual is the amount of land area required to produce the resources it consumes and to absorb the wastes it generates, given its standard of living and prevailing technology.

⁵⁰ Peter Vitousek, Paul R. Ehrlich, Anne H. Ehrlich, and Pamela Matson, "Human Appropriation of the Products of Photosynthesis," *BioScience*, 36(6) (June 1986). NPP is the amount of biomass that remains after primary producers (autotrophic organisms such as higher plants or algae) have accounted for their respiratory needs.

⁵¹ Subsequent studies using different methodologies have produced a range of figures, but Vitousek *et al.*'s original claim seems roughly correct. For a review, see Christopher B. Field, "Sharing the Garden," *Science*, 294(555121) (December 2001): 2490–2491.

⁵² Mathis Wackernagel and William Rees, *Our Ecological Footprint: Reducing Human Impact on the Earth* (Gabriola Island, CA: New Society Publishers, 1996).

In a 1997 article, a group of distinguished scientists led by Vitousek reviewed the broad range of human impacts on nature.⁵³ What they found was that between one-third and one-half of the Earth's land surface has been transformed by human action; carbon dioxide in the atmosphere has increased by more than 30 percent since the beginning of the Industrial Revolution; more nitrogen is fixed by humanity than all other terrestrial organisms combined; more than half of all accessible surface fresh water is appropriated by humanity; and about one-quarter of the Earth's bird species have been driven to extinction. Their conclusion was that "it is clear that we live on a human dominated planet."⁵⁴ According to the World Wildlife Fund's *Living Planet Report*, some time in the late 1980s humanity began to consume resources faster than the Earth can regenerate them, and this gap is increasing every year.⁵⁵ The bottom line from both studies is that we are treating the Earth and its fundamental systems as if it were a toy that we could treat carelessly. It is as if we have scaled up slash and burn agriculture to a planetary scale, as if we could move to another planet once we have exhausted this one.⁵⁶

In dominating the Earth in these ways, we are failing to show respect for nature. But why should we think that we should respect nature? Several reasons can be given but here is one: nature provides a background condition against which our lives have meaning. Respect is a fitting response to the role that nature plays, and also contributes to nature continuing to play this role in the future. Relating oneself to nature in this way is not a necessary or sufficient condition for all lives having meaning at all times and all places, but it is a very important condition for many of us here and now in the societies in which we live in which meaning is often so difficult to find.

Consider the following analogy. Representational painting is not the only kind of valuable painting, but it is one very important kind of valuable painting. Indeed, it seems plausible to regard it as the mother from which other forms of valuable painting emerged. This kind of valuable painting exploits the contrast between foreground and background. What is in the foreground gains its meaning from its contrast with the background. What I want to suggest is that nature provides the background against which we live

⁵³ Peter M. Vitousek, Harold A. Mooney, Jane Lubchenco, and Jerry M. Melillo, "Human Domination of Earth's Ecosystems," *Science*, 277(5325) (July 25, 1997): 494–499.

⁵⁴ *Ibid.*, p. 494.

⁵⁵ World Wildlife Fund, "2010 Living Planet Report," www.panda.org/about_our_earth/all_publications/living_planet_report/.

⁵⁶ I owe this analogy to Jeremy Waldron.

our lives, thus providing an important source of meaning. This, I submit, is sufficient reason for us to respect nature. For when we fail to respect nature, we lose this important source of meaning.

Another reason to be concerned about respecting nature is from a concern with psychological wholeness. Respecting the Other as independent and autonomous is central to knowing who we are and respecting ourselves.⁵⁷ Whitman, the sage poetic observer of American democracy, had something like this in mind when he wrote: "I swear the Earth shall surely be complete to him or her who shall be complete."⁵⁸

5 SLOUCHING TOWARD THE FUTURE

Now back to the nettles. The current conventional view is that if we are to avoid "dangerous anthropogenic interference with the climate system," then our global greenhouse gas emissions are going to have to peak within the next 10–15 years, decline by at least 50 percent by mid-century, and then move toward virtual elimination by the end of the century. The decisions we must make now have even greater urgency since some poor countries need to increase emissions (e.g., most African countries) and some large emitters have relatively low per capita emissions compared to industrialized countries (e.g., China, India, Brazil).⁵⁹ Moreover, energy crises are breaking out all over the world (e.g., China, Chile), and decisions are being made now that commit countries to particular energy policies and emissions patterns for the next generation. This is happening while many of the options that are most discussed (e.g., hydrogen cars, new generations of nuclear plants, "clean" coal, etc.) are not available in the real time in which decisions must be made. According to Jim Hansen, we must actually stabilize emissions in the next decade – not agree to do so, decide to do so, or develop a plan to do so.

Given this way of understanding our problem, how do we decide which nettles to grasp? It is reasonable to say that these are political decisions, but

⁵⁷ Part of the anxiety we feel about Timothy Treadwell (portrayed in Werner Herzog's Film *Grizzly Man*) is that the special empathy he feels for the bears often slips into psychological appropriation and a failure of respect. I believe that some of these themes relating respect to psychological integrity can be found in the writings of Kant and Freud, but I cannot develop this point here. On this topic I have benefited from conversations with Beatrice Longuenesse.

⁵⁸ From his poem, "A Song of the Rolling Earth," available at <http://classclit.about.com/library/bl-etexts/wwhitman/bl-ww-rollingearth.htm>.

⁵⁹ It is sobering to realize that a single Southern company power plant in Juliette, Georgia, emits more greenhouse gasses annually than Brazil's entire power sector. Juliet Eilperin, "World's Power Plant Emissions Detailed," *Washington Post*, Thursday, November 15, 2007.

I'm skeptical that our political institutions are up to it. The problem we face is unprecedented in its nature and difficulty.⁶⁰ Jurisdictional boundaries and competing scales cause multiple, overlapping and hierarchically embedded collective action problems. On a daily basis we witness policy failures and dysfunctions with respect to problems that are much less complex. There is a strong status quo bias of people and institutions, and an even stronger status quo bias is built into our particular form of representative government as opposed to that of Britain or Germany, for example. Finally, the interest-group nature of our system is especially prone to create gridlock.

Consider just two examples in which decision-makers have attempted to grasp nettles: There have been attempts to locate large wind farms off the coasts of Massachusetts and Delaware that have run into enormous opposition from a variety of sources. An ambitious plan to introduce congestion pricing in parts of Manhattan, advocated by the mayor and approved by the city council, was killed by the New York State legislature, which simply refused to vote on it. These experiences do not augur well for the USA implementing an effective "cap-and-trade" system for reducing carbon emissions. Even if we get a cap-and-trade system that is considered a policy success, it may be a substantive failure. In order to be effective, such a system must be sensitive to concerns about the ceiling, whether the permits are auctioned or given away, how they are distributed across sectors, the level at which controls are implemented, and so on. In addition, there are ancillary policies (discussed under the rubrics of "safely valves," "price ceilings," and "competitive policies") that could cripple such a system just at the point at which it might become most effective.⁶¹

The only way to break through on this problem, which is the world's largest and most complex collective action problem, is through the actions of a morally motivated global citizens' movement that acts as a highly committed political interest group. Such a movement would stigmatize coal, meat eating, trophy houses, overheating and overcooling, large living spaces, and private automobiles. It would celebrate living lightly with dignity and elegance, relying on nature's own energy, rediscovering food and the pleasures of eating, the joys of living with nature and other people, and the satisfaction of effective political activism. I think (and hope) that we may be witnessing the birth of such a movement.

⁶⁰ I first began to argue this in "The Epistemology of Climate Change: Some Morals for Managers," *Society and Natural Resources*, 4 (1991): 319–329.

⁶¹ For more on these themes, see my "The Post-Kyoto Climate: A Gloomy Forecast," *Georgetown Journal of International Environmental Law*, 20 (2008): 537–551.

6 CONCLUSION

Climate change is a new issue that presents us with some old problems: How can representative democracy respond to long-term problems that have global reach? How can we integrate our moral and political lives in a way that is consistent with liberal democracy? Our best shot at solving this problem is a highly motivated, global citizens' movement that can create the conditions for political action. If we can solve the problem of climate change, we will have succeeded in solving larger problems that haunt American democracy and global governance.