HUDSON INSTITUTE

HISTORY, IDEOLOGY, AND U.S. CLIMATE POLICY: BEYOND THE ORTHODOXIES OF LEFT AND RIGHT

LEE LANE

HISTORY, IDEOLOGY, AND U.S. CLIMATE POLICY: BEYOND THE ORTHODOXIES OF LEFT AND RIGHT

BY LEE LANE

DECEMBER 2011

HUDSON INSTITUTE

TABLE OF CONTENTS

INTRODUCTION

"The United States is almost certainly incurring higher costs from its climate policies than it is from climate change… Finding better policies will require doing better analysis."

AS THIS PAPER IS BEING WRITTEN, THE UNITED STATES is almost certainly incurring higher costs from its climate policies than it is from climate change. Confused nostrums dominate the public debate about how best to reduce the threat of climate change. The president asserts that subsidies to more costly sources of energy are the key to "clean" growth. The Keystone XL Pipeline has been halted by shrill claims that the project will spell global doom—even though it can have little impact on either the total supply of oil or the demand for it. Farm state legislators tout the climate savings of subsidizing the use of corn for fuel and underpricing water to irrigate the corn. The secretary of energy scolds consumers for wanting to use light bulbs that he thinks waste money; meanwhile, he is investing large sums of public funds trying to push unwanted technologies into a market that resists them. Yet all of these costly policies will do little or nothing to lessen the harm from climate change. Some of them might even worsen it.

Both climate policy and the way in which it is analyzed are in need of change. The United Nations Intergovernmental Panel on Climate Change (IPCC) is the citadel of orthodox belief on climate. That body has relentlessly beaten the drum for making greenhouse gas (GHG) controls the prime response to climate change. One component of the IPCC, Working Group 3 (WG-3), has led this effort. Surprisingly, WG-3 has largely escaped the criticism that has targeted much of the rest of the IPCC's work, and, to date, GHG control has dominated discourse about how to respond to climate change.

Yet that approach is an abject failure. The quest for a worldwide system of GHG limits has now gone on for over twenty years. The impact on global emissions has been negligible. Most measures that have been adopted in the name of GHG control are structured in ways that ensure that they achieve less and at higher cost than would the policies often

posited by WG-3. Still, most analysis reported by WG-3 remains doggedly fixated on projecting the effects of GHG control systems that do not now exist and that will not be adopted.

Finding better policies will require doing better analysis. Such analysis would probe the forces that have defeated or, worse, perverted, GHG controls. It would explore other ways of lessening the risks of climate change and examine how the factors that have brought GHG control efforts to naught would affect these other strategies. Finally, it would scrutinize how major global trends might affect both climate change and the measures intended to counter it.

Whether the IPCC can play a useful role in this process is an open question. So far, for whatever reasons, this body has not called due attention to the failure of GHG controls, nor has it delved deeply into the causes of that failure. In addition, the IPCC has shied away from weighing alternative strategies. This consistent pattern of failures suggests that the causes of the IPCC's deficiencies may be structural.

One way to shake up stagnant thinking would be to launch the equivalent of what national security studies sometimes call "red team" or "red cell" analysis. In the realm of security studies, such teams adopt the viewpoint of an opponent and probe for their own side's weaknesses. In the case of climate, the need is for an analysis of why GHG control has failed, what alternatives exist, and what factors will affect the prospects for these alternatives' success.

The real problem, though, is deeper. It is that few U.S. political leaders demand rigorous climate policy analysis. Instead, they have clung to the dogmas of either the right or the left. Most public intellectuals have so far done the same. In fact, climate change does pose risks, yet those risks do not imply that massive social engineering for GHG control is either possible or desirable. As awareness of this reality sinks in among public intellectuals, a more serious policy discourse is likely to emerge.

1. How Climate Policy Analysis Forgot History

"The integrated assessment models that are used to project future climate trends cannot explain why climate change appeared when it did, and not a century earlier—or did not appear at all. The source of this failure, moreover, is not climate science; it is economics."

ORTHODOX ANALYSIS OF CLIMATE POLICY CANNOT EXPLAIN some of the main drivers of climate change. Economists cannot easily model changes in institutions and belief systems. History shows, though, that changes in these factors are major drivers of man-made climate change and its effects on society. Policy analysis has tended to focus more on what can be modeled formally than on what matters. As Section 1.1 shows, the current climate models do not explain some of the most striking patterns of economic growth. Section 1.2 offers some insights from history that fill in the gaps left by the models.

1.1 Missing Factors in Climate Policy Analysis

Integrated assessment models (IAMs) have been central to much analysis of climate policy. IAMs are mathematical representations of the links between economic and social systems on the one hand, and Earth's climate system on the other. IAMs have led to useful insights about climate policy. The models of economic growth that they contain cannot, however, represent the workings of institutions, shared beliefs, and forms of organization. Still less do they explain how changes in these factors affect economic performance.

The factors that IAMs omit are among the main drivers of modern economic growth. Moreover, changes in these factors are the only plausible sources of the discontinuity in economic growth rates that began some two hundred years ago. This sharp upward deflection of economic growth rates is not subtle. On the contrary, for the roughly ten thousand years from the start of the Neolithic Revolution to the first years of the nineteenth century, mankind was in a "Malthusian Trap" in which technological progress largely translated into increased population. Then, average per capita income began to rocket upward led by growth in northwest Europe and parts of the New World, the "Great Divergence." Figure 1 on page 8 displays the pattern.

The long-term pattern of population growth resembles that of income per head. Millennia of slow growth give way to a sudden surge. Figure 2 on page 8 displays the trend.

Current models of economic growth can describe the ways in which growth rates will rise or fall as changes in technology and social structures alter the output per worker or per dollar of investment. They do not, however, explain why it was that the process of innovation speed-

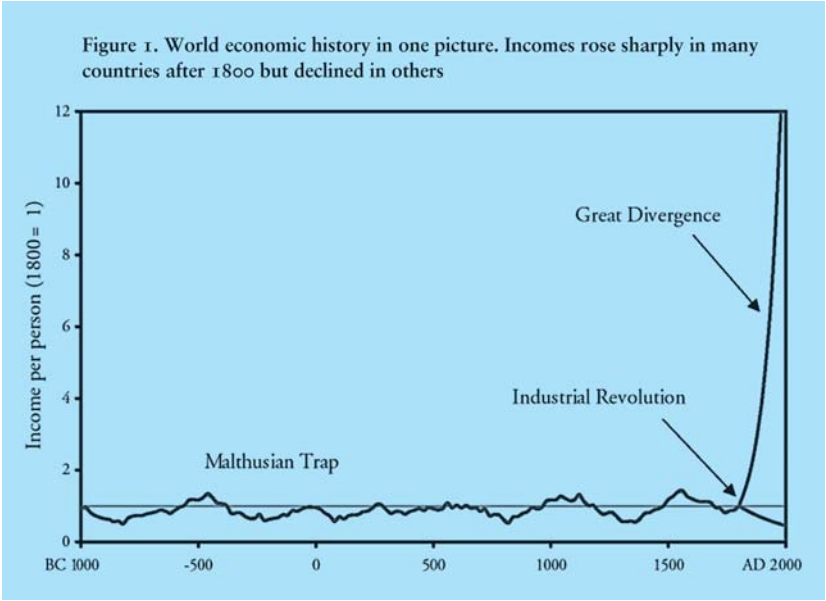

FIGURE 1
Source: Gregory Clark, *A Farewell to Alms: A Brief Economic History of the World* (Princeton University Press, 2007), 2.

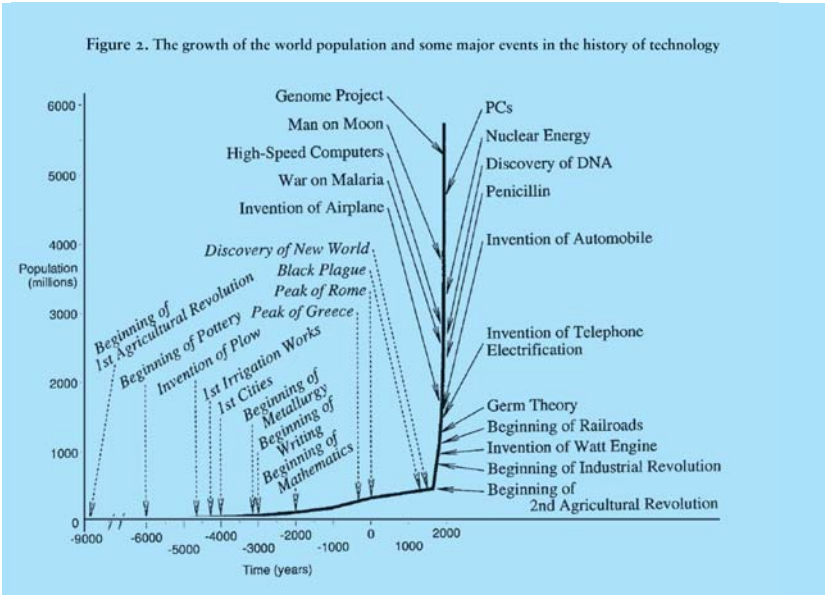

FIGURE 2
Source: Robert W. Fogel, "Catching up with the Economy," *American Economic Review* 89, No. 1 (March 1999), 2.

ed up, or if changes in laws, rules, norms, or social structures made productive endeavor more effective.

The problem must not be brushed aside. The changes portrayed by Figures 1 and 2 are nothing less than the defining signal of the dawn of the modern age. They are also the wellsprings of man-made climate change.[1] Yet today's models cannot backcast these growth surges; therefore, the IAMs that are used to project future climate trends cannot explain why climate change appeared when it did, and not a century earlier—or did not appear at all. The source of this failure, moreover, is not climate science; it is economics.

Such an ahistorical approach might be viable if the models could, at least, explain current trends. They cannot. For instance, most current

	Per capita income in 2000	Number of countries	Percentage of world population	Number of years observed	Percent positive years	Average positive growth rate	Average negative growth rate
(1)	< $20,000	153	87%	5,678	66%	5.35%	−4.88%
(2)	> $20,000	31	13%	1,468	81%	4.19%	−3.49%
(3)	> $20,000 No Oil	27	13%	1,336	84%	3.88%	−2.33%
(4)	All	184		7,146			
(5)	Over $20,000	31	13%	1,468	81%	4.19%	−3.49%
(6)	No Oil	27	13%	1,336	84%	3.88%	−2.33%
(7)	$15,000 to $20,000	12	2%	491	76%	5.59%	−4.25%
(8)	$10,000 to $15,000	14	2%	528	71%	5.27%	−4.07%
(9)	$5,000 to $10,000	37	16%	1,245	73%	5.25%	−4.59%
(10)	$2,000 to $5,000	46	53%	1,708	66%	5.39%	−4.75%
(11)	$300 to $2,000	44	14%	1,706	56%	5.37%	−5.38%

Table 1: Per Capita Income and Income Growth Rate, Selected Countries (2000)

TABLE 1

Source: Douglass C. North, John Joseph Wallis, and Barry R. Weingast, *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History* (New York: Cambridge University Press, 2009), 5.

models predict that the income gap between rich and poor countries should narrow. It has not done so, especially in the case of very poor countries.[2] Table 1 displays some other noteworthy patterns.

The table shows that the rich-poor gap persists because poorer countries have more years of negative growth than richer ones, and, during those years, their rates of negative growth are higher. The models used for analyzing climate change cannot explain these episodes of shrinkage.

Economic growth is a major driver of GHG emissions, and poverty greatly boosts the risk that future climate change might harm a society. Climate policymakers, therefore, need to know more about economic growth than IAMs can tell them. Fortunately, economic history can help.

1.2 Missing Factors: Open Science, Open Markets, and Open Politics

History suggests that two large trends are wellsprings of modern growth. One is the rise of the institutions that undergird modern science and bind it to the process of economic production. The other relates to some countries' success in suppressing outbreaks of organized domestic violence.

As modern open science took shape, discoveries led to yet other discoveries; further, scientific advance and industrial practice became linked. Progress in one spurred advance in the other. The pool of useful knowledge from which innovators could draw was constantly refilled.[3] Before these trends could take their modern shape, state structures, education systems, and intellectual property rights had all to be greatly altered.[4]

For science to become a major engine of economic growth, the state, too, had to evolve. Today, the state serves as an educator, research fun-

der, and technology gatekeeper. Moreover, before science could possibly flourish, the state had to grow strong enough to protect its citizens from the depredations of foreigners, maintain law and order, enforce contracts, and provide other public goods.[5]

Yet the need for a strong state gives rise to Weingast's paradox: "A government strong enough to protect property rights and enforce contracts is also strong enough to confiscate the wealth of its citizens."[6] Most states today, as throughout history, take the form of what one analysis describes as "limited WG-3 access orders" or "natural states."[7] Such societies restrict participation in both economic and political markets. In states of this kind, the ruling coalition uses its ability to allocate the scarcity rents created by these entry barriers to buy support, including that of the wielders of armed force. It then uses that support to maintain its grip on power. Decentralized control of armed force maintains a fragile and ever-shifting balance of power within the ruling coalition.

The natural state can boast myriad accomplishments. Its rise is closely bound up with the first economic (or Neolithic) revolution, in which settled farming and urban life took root. Compared to hunter-gatherer societies, the social structures of the natural state offered far greater wealth and security. As natural states continued to evolve, some developed wealthy and complex societies.

Despite these achievements, natural states display an innate brittleness. Within such states, wars, new technology, diseases, climate change, and countless other factors cause ceaseless shifts in power balances among groups. When groups gain in power, they demand larger rewards. Government must strive to maintain a viable ruling coalition; hence, it may be obliged to meet such demands. In a zero-sum society, though, rulers must often reduce the rewards of groups that have lost power in order to placate those that have gained it.[8] Strife can result. Without unified control over armed force, such conflict can easily unleash the use of armed force.[9] The smaller, more fragile natural states are structurally prone to just such outcomes, and this tendency is a major cause of their slow economic growth.[10] The results are all too evident in Table 1 on page 9.

In a few cases, though, societies evolved in ways that limited rulers' powers of predation.[11] By the late nineteenth century, changes in institutions and beliefs caused these societies to begin to function as "open access orders":

All open access orders proscribe the use of violence by organizations other than the military or police. Unlike the natural state, which actively manipulates the interests of elites and non-elites to ensure social order, the open access order allows all individuals to pursue their own interests through organizations. Individuals continue to be motivated by economic rents in both political and economic markets, but the presence of open entry pro-

duces competition, which tends to make such rents temporary. Social order is maintained through the interaction of competition, institutions, and beliefs. Control of the military is concentrated in government, and control over government is subject to both political and economic competition and institutional constraints.[12]

Where open orders take root, the episodes of organized internal violence become rare. As they do, the episodes of negative growth that are so apparent in Table 1 become far less frequent.

2. Institutions and Climate Policy

"Development is a climate policy analogue to adding sound insulation to the buildings near airports. Development would doubtless raise GHG emissions; it would, though, also lessen the harm that they will endure from any given amount of climate change."

The difference between natural states and open access orders has profound implications for climate policy. These differences are likely to affect the course of climate change and the responses to it. To explain some of the implications, Section 2.1 discusses economic development as a response to climate change. Section 2.2 describes the ways in which the institutions of natural states raise their societies' GHG intensity.

2.1 A Coasean View of the Climate Problem

In the early 1960s, Nobel laureate Ronald Coase offered a strikingly new view of environmental problems. Nuisances, Coase noted, arise because many useful and valued actions raise costs elsewhere in the economy. Further, those harmed by a nuisance can often take steps to lessen their own costs. Property owners, for instance, can lower the costs of airport noise by insulating buildings against sound. Faced with such a "reciprocal" problem, the best outcome would be to make that set of changes that yields the greatest net benefit.[13] Reaching that goal will often mean inducing both parties to take measures to lower harm—one by controlling the source, the other by avoiding the effects. But either government or the market will incur transaction costs in the process of inducing the steps needed to lessen the nuisance. Such costs can be high enough to affect the choice of what actions to take. Indeed, they can be high enough, compared to the size of the avoided nuisance, to imply that inaction may be the best course.[14]

Malaysian palm oil plantation

Harm from climate change follows this logic. GHG emissions can alter the climate. Some of the changes may impose costs on some activities and some countries. Yet proposed solutions, like rationing the use of fossil fuels, halting the felling of tropical forests, or shrinking livestock herds, are themselves costly. Hardening the activities affected by climate change against harm might offer lower-cost means to reducing harm from climate change.

In fact, economic development of poor and middle-income states is a promising approach to coping with climate change. Development is a climate policy analogue to adding sound insulation to the buildings near airports. Development of these countries would doubtless raise GHG emissions; it would, though, also lessen the harm that they will endure from any given amount of climate change. For instance, development would lower these countries' dependence on climate-sensitive sectors; then too, it would provide wealth with which to adapt to ill effects; and it would also bring gains unrelated to climate.[15]

How the benefits of economic development compare with the costs of the added emissions that it will cause depends heavily on whether or not structural reform accompanies development. The institutions of natural states impede the growth that would help them to cope with

Industrial devastation in China

climate change, and they also boost the GHG intensity of whatever growth does occur. Section 2.2 offers examples of both effects.

2.2 Natural States and Emission Intensity

One major drawback of economic growth as a means of lessening harm from climate change is that growth in natural states can often be more GHG intensive than it would be in open access orders. When the governments of natural states use entry barriers to create scarcity rents for either sellers or buyers, they often also raise emission intensity. The extra emissions per unit of output are merely another form of the economic waste caused by the grant of market power. China and India, different as they are in many regards, both illustrate the point.

In the case of China, the growth of heavy industry is the main force behind rising emissions. It would remain a powerful driver of GHG growth even if all new investment used the most efficient, world-scale technology.[16] State-owned banks are funding the rapid growth of heavy industry. These banks pay little or no interest to depositors, but they also demand little of those borrowers with government backing.

"The source of China's high GHG intensity is not energy policy per se. Rather, government uses its control over entry in the financial services sector to funnel excess investment to SOEs. Part of the economic waste that results takes the form of more emissions per dollar of output than would be the case were capital markets operating more freely. Reform would harm the de facto owners of the heavy industrial SOEs, that is their managers. Yet the SOE business elite has become a major element in China's ruling coalition. Political reform would have to precede environmental reform."

As a result, the banks invest in the state-owned enterprises (SOEs) in heavy industries well beyond the point of excess capacity. The SOEs have parallel incentives. On the one hand, they cannot earn adequate returns on bank deposits. On the other, government demands so little in dividends from them that they are often awash in cash.[17] Output from the resulting excess capacity can be, in any case, shunted into export markets—thanks to the undervalued yuan.

The point to be stressed is that the source of high GHG intensity is not energy policy per se—though distorted prices do add to the problem.[18] Government uses its control over entry in the financial services sector to funnel excess investment to SOEs. Part of the economic waste that results takes the form of more emissions per dollar of output than would be the case were capital markets operating more freely.

Reform would mean allowing more competition in banking. That step, though, would harm the de facto owners of the heavy industrial SOEs, their managers. Yet the SOE business elite has become a major element in China's ruling coalition.[19] Thus, reforming the capital markets would disrupt the ruling coalition. Economic reform cannot take place without political reform.

In India, the political environment is, of course, vastly different, and the economy is far less GHG intensive. There too, though, governance problems, especially those in the electric power sector, raise emission intensity far above efficient levels.

Several factors are at work. State regulators hold electric power rates below cost; much power is stolen; lack of police protection may prevent power suppliers from denying services to nonpaying customers; and subsidies often do not suffice to cover suppliers' financial shortfalls.[20] With power suppliers beset by financial shortfalls, capacity growth lags far behind that of demand, and service quality is poor. Many households are left without power. They revert to traditional sources of energy, and other customers, including many businesses, respond by building captive generators.[21] The household and diesel emissions that result are major sources of black carbon, an important factor in climate change.[22] So far, attempts at reform have had little effect.[23]

India's federal structure is another source of difficulty. Governance in some states has improved markedly in the reform era; yet in other states, especially in the east, government is more an engine of corruption than a source of public goods.[24] Reform legislation was enacted in 2003, but it has so far failed to inject much competition or efficiency into the power sector.[25]

Governments use their controls over the power sector and over law enforcement to lower rates. This policy wins support from many consumers. But markets are badly distorted. Part of the waste takes the form of overconsumption of fossil fuel. GHG emissions per dollar of

output are higher than they would be if government enforced property rights and allowed market prices to prevail.

Further reform remains politically difficult. While the growing numbers of middle-class voters appear to favor economic reforms, many poorer voters are ill informed about them; indeed, they appear to oppose their thrust.[26] In polities with competitive elections, large voting blocs, when organized by a party *apparat*, can use the power of the state to extract resources from less numerous interests, often at substantial cost to society.[27] This pattern helps to explain the failure of reforms to take hold in parts of India's economy where eliminating wasteful policies, though it would benefit society as a whole, would visibly harm the interests of large blocs like farmers or unionized workers.[28] Many of the distortions that result raise GHG emissions as well as lowering economic output.

3. Combating Climate Change by Decreasing Emissions

This section lays out some of the ways in which institutions are affecting efforts to counter harm from climate change by lessening GHG emissions. Section 3.1 covers global GHG controls. Section 3.2 explains the difficulties posed by current efforts to cut emissions from deforestation. Section 3.3 discusses the effects of ideology and rent-seeking on GHG control efforts.

3.1 The Failure of Global GHG Control

Climate stabilization is a global public good. To supply it through GHG controls would require the major powers to construct an effective global regime. Regimes consist of "implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations."[29] The UN Framework Convention on Climate Change (UNFCCC) is a regime devoted to GHG control, but on its record, no one could call it an effective one. Four problems work against the UNFCCC, as well as against any replacement.

First, as Section 3.3 will describe, even in open orders, domestic institutions ensure that actual controls are far from optimal; therefore, costs of implementing them could easily exceed the benefits.[30] Hence the store

of rewards from which states might be compensated for the costs of reaching, enforcing, and complying with an agreement would appear to be meager at best.

Institutions in natural states are even more problematic for the prospect of global accord on GHG control. For GHG control to work, all participants must be able to trust that other states are faithfully fulfilling their commitments. The opaque nature of the laws, rules, and norms in natural states and the prevalence of corruption make such trust impossible.

In theory, natural states might solve these problems through reform. In practice, though, natural states depend on corruption as one source of the rents with which they buy the support that they need to stay in power. And corruption is as likely to undermine effective GHG control as it is to subvert protection of intellectual property. The only reform that would obviate such abuses would be a transition to an open order, an uncertain and perilous passage to navigate.

Second, national preferences over climate change differ widely. Rich states in the temperate zone have less to fear from warming than do poor ones in the tropics. Then too, transaction costs are raised further because so many states are involved, their values differ widely, and trust among many of them is scarce.[31] In principle, those states most anxious to curb emissions could offer side payments to those that are opposed or indifferent. In practice, the prospect of such payments encourages all states to display reluctance in hopes of being paid.[32]

In any case, only Europe manifests much appetite for building a GHG control regime. Both China and India have made it plain that they have no intention of sacrificing their economic growth rates on the altar of GHG control.[33] Stocks of human, physical, and social capital, plus those of accessible natural resources, are vital to a country's capacity to adapt to climate change.[34] Therefore, there seem to be good reasons to conclude that not only are China and India resolved in their rejection of GHG controls; they are also, in this regard, behaving in an economically rational way.

Third, a coalition of great powers willing to coerce other states is most unlikely to emerge. Coercion is often costly for those applying it. Further, the states best able to impose controls are those with high and rising emissions and high bargaining power. Most such states, though, are less threatened by climate change than are poorer states. The bargaining power of the latter is too feeble for them to affect the course of events.

Fourth, the weakening of U.S. hegemony decreases the odds of a successful bargain. The most powerful state in the global system has typically taken the lead in coercing and cajoling others into joining and obeying regimes. Since WWII, the United States has often played that role, but on GHG control the lack of a U.S. domestic consensus has led the EU to try

Peat swamp in Riau Province, Sumatra, Indonesia

to fill this vacuum. That effort has failed. Absent a state willing and able to act as an effective leader, the transaction costs of regime building rise.

3.2 Emissions, Forests, and Biofuels

Confronted with failure at the 2009 climate conference in Copenhagen, the parties to the United Nations Framework Convention on Climate Change drastically lowered their sights. At the 2010 Cancun conference, they shifted focus to reducing emissions from deforestation and degradation (REDD). The Cancun conference reached a sketchy agreement on REDD. The result was quickly hailed as a great step forward.

It is true that forest-related GHG emissions are a matter for some concern. Tropical ecosystems store some 340 billion metric tonnes of carbon; this amount is more than forty times the current annual emissions from the use of fossil fuels.[35] Much of this stock of carbon is stored in tropical forests or in the soils beneath them. When these forests are felled or burned, carbon dioxide (CO_2), the most important anthropogenic GHG, escapes into the atmosphere.

Tropical forests are shrinking. The Amazon and Southeast Asia are

cases in point; moreover, land-use change and forestry are major sources of these countries' emissions.[36] Already by 2010, though, new studies had found that forest loss and land-use change account for a markedly smaller share of world GHG emissions than had once been thought. These findings show that this source represents about 12.4 percent of total emissions.[37]

Some analysts claim that REDD will be cheap.[38] It is also supposed to be a first step back toward the long hoped-for global, comprehensive, binding agreement. In other words, success with REDD is supposed to set the world on a path toward deep emission cuts. Four points cast doubt on these hopes.

"Not only are China and India resolved in their rejection of GHG controls; they are also, in this regard, behaving in an economically rational way… Without prospects of a global GHG control regime, go-it-alone U.S. controls are at best futile. It is more likely that they are self-destructive … A country that adopts controls throws away a bargaining chip that might someday help to induce reluctant states to adopt controls of their own."

First, weak land tenure will greatly complicate efforts to implement REDD. The details differ from country to country, but tenure problems are pervasive. In Brazil, for example, fear of expropriation discourages owners from renting their land; with fewer options to rent, landless peasants may be more tempted to clear forests.[39] Further, in many natural states, definitions of land tenure rights conflict with one another. Such conflicts create risks of protracted conflict.[40] Resolving such disputes takes both time and money. It adds, therefore, to the appeal of clearing virgin forest.

Governments could, in principle, clarify tenure; yet, doing so would create losers as well as winners. In Brazil, the leaders of the Movement of Landless Peasants block reform because it would deprive them of their function and power base.[41] In Indonesia, which is currently seeking reform, clarifying tenure and law will require reconciling clashing property-rights systems, deciding the claims of rival ministries, and resolving disputes between local and regional governments and Jakarta—disputes that stretch back, literally, to colonial days.[42] The political costs of persevering with such an effort are likely to be high. In other cases, weak states trying to impose top-down land tenure reform have thrown complex, but working, systems into utter chaos.[43]

Further, tension exists between clear and secure property rights and the logic of the natural state. As described in Section 1.2, in such societies, shocks of varied kinds require governments to adjust the social rewards in ways that engorge some interests at the expense of others. Weak property rights may actually give government the freedom to adjust relative rewards in ways needed to maintain order.[44] Again, the logic of natural states clashes with the logic of global GHG control.

Second, REDD projects plus biofuels programs trigger forest/fuel/food trade-offs that work against hopes for lowering emissions through these two approaches. REDD programs will boost the price of cropland, as will biofuels. As cropland becomes more expensive, commodity prices will also rise. And if the affected crops are linked to global markets, higher commodity prices will ripple through those markets. Meta-stud-

ies show that high and rising prices of agricultural commodities are a major driver of tropical forest loss.[45] Hence, biofuels occasion what economists call "leakage." Emissions migrate from the site of the policy to some other place. They are relocated rather than being reduced.

The scale of EU and U.S. biofuels programs exacerbates the problem. Section 3.1 referred to the thicket of regulations that has grown up around the rationale of GHG control in the United States and the EU. Both polities seized on GHG control as a pretext for crafting an array of biofuels mandates and subsidies that raise farm income. These programs are already likely to increase pressures worldwide to expand crop cover at the expense of forests:

> Our prospective analysis of the impacts of the biofuels boom on commodity markets focused on the 2006–2015 time period, during which existing investments and new mandates in the US and EU are expected to substantially increase the share of agricultural products (e.g., corn in the US, oilseeds in the EU, and sugar in Brazil) utilized by the biofuels sector. In the US, this share could more than double from 2006 levels, while the share of oilseeds going to biodiesel in the EU could triple… When it comes to assessing the impacts of these mandates on other economies, the combined policies have a much greater impact than just the US or just the EU policies alone, with crop cover rising sharply in Latin America, Africa and Oceania as a result of the biofuel mandates.[46]

Some factors could constrain the extent of leakage. Currently, tropical forest loss is largely centered in a few countries. In the recent past, Indonesia, Brazil, and Malaysia have accounted for over 60 percent of global tropical forest loss.[47] The degree to which curtailing forest loss in these hot spots would shift action to other countries remains unclear. The investment environment elsewhere may be too poor to support forest loss.

Third, REDD plans are caught in a dilemma between goals that are too strict and those that are too lax. REDD projects offer positive rewards for emissions cuts, rather than penalties for emissions. Therefore, REDD projects must define a baseline emissions path against which to measure progress. All such efforts, though, face a dilemma. An overly strict baseline wastes resources as risk-averse agents shun viable projects. An overly lax baseline wastes resources as investors pay to preserve forests that were never at risk.

Projects in which REDD is used as a source of emission permits are especially at risk. In such projects, those selling REDD-based permits have an incentive to overstate emission abatement. Those buying the permits have no motive to probe too deeply into the validity of the baselines or the amount of abatement. Third-party monitoring and detailed rules may limit abuses, but only by boosting transaction costs. The UN

Clean Development Mechanism displays all these problems.[48] REDD will not escape them. As abuses are disclosed, public outrage will ensue.

Fourth, even were REDD programs to work, they are no model for a larger GHG control system. With REDD, developed countries pay less-developed ones to abate emissions. Many developed countries, though, are in tight fiscal straits. Even before the recent economic downturn, these countries declined to bear anything like the full costs of global GHG control. The notion that they will bear all these costs now is still more chimerical. The post-Copenhagen record on failure to fund adaptation aid shows just how chimerical it is.

3.3 The Perversion of Domestic GHG Control

"Without prospects of a global GHG control regime, go-it-alone domestic controls are at best futile. The country imposing such controls will incur all of the costs but reap only a small share of the benefits. In fact, a country that adopts controls throws away a bargaining chip that might someday help to induce reluctant states to adopt controls of their own. Adopting go-it-alone controls, therefore, is likely to retard progress toward the global control system."

Without prospects of a global GHG control regime, go-it-alone domestic controls are at best futile. It is more likely that they are self-destructive. The country imposing such controls will incur all of the costs but reap only a small share of the benefits. In fact, a country that adopts controls throws away a bargaining chip that might someday help to induce reluctant states to adopt controls of their own. Adopting go-it-alone controls, therefore, if it has any effect at all, is likely to retard progress toward the global control system.

Nonetheless, the EU, Australia, and the United States have adopted such controls. Without doubt, environmental nongovernmental organizations (NGOs) have been crucial in promoting these policies. Were such groups to admit that no prospects exist for effective GHG controls, they would forego large revenue sources. To survive, green NGOs must compete with each other for funding and attention.[49] An organization that admitted the realities of GHG control would voluntarily exit a lucrative market niche. Such a step would conflict with the NGOs' competitive imperatives.

To be sure, the green NGOs could not exploit this issue for money and support unless elements in the larger society found GHG control schemes appealing. Yet most of the gains from GHG control would accrue to foreigners, and to future generations of foreigners at that. For today's citizens, GHG control implies higher energy costs, less consumption, and little real gain.

Furthermore, citizens can have no direct experience of whether GHG control measures are even affecting emissions. Abatement measures either cause the air or water to get cleaner, or they do not. With most pollutants, the public can see the benefits or their absence. With climate policy, the goal is to prevent harm that might otherwise occur decades hence. Today's public can perceive neither the validity of the putative threat nor the efficacy of the proffered remedy.

Clearly, the appeal of GHG controls does not rest on utilitarian grounds. Instead, it largely stems from the quasi-religious reverence for preservation of pristine nature. This value has become deeply engrained in U.S. society.[50] It appears that these reverential attitudes may be even stronger in Europe, based on a comparison of these two publics' revealed preference for climate policy.

Such sentiments, though, by themselves, would be unlikely to lead to go-it-alone GHG controls. In the United States, at least, opinion poll after opinion poll shows that the issue of climate change has low salience with most voters. Therefore, officials hoping to profit politically from offering climate "solutions" often canvass for support among "green" producer interests.

This strategy helps to explain why mandates and subsidies for use of renewable energy, electric vehicles, and "energy-saving" appliances have become the favored tools for GHG control. Such approaches target the transfer of economic rents to the best organized and most powerful interests. Officials can capture some of those benefits in the form of campaign contributions, endorsements, and future employment. The fact that the costs of these measures are both widely diffused and well concealed from the public adds to their appeal.[51]

Thus, the U.S. Congress rejected cap-and-trade, but it has adopted a dense thicket of mandates and subsidies. The U.S. Supreme Court has also called forth a new command-and-control system under a statute regarded by all as ill-suited to the nature of the climate issue. Under this authority and that of another law, the United States is imposing mandates for both fuel economy and renewable fuel use. It would be difficult to find a knowledgeable person who thinks that this farrago of rent-seeking mandates is even close to being a least cost way to curb emissions—let alone to avoid harm from climate change.

4. Energy Technology as a Climate Solution

MANY OBSERVERS HAVE CITED THE APPEARANCE AND SPREAD of new GHG-free energy sources as a potential ray of hope for GHG control. Section 4.1 discusses the impacts of institutions on the creation of such new technologies. Section 4.2 considers diffusion of new energy sources. Taken together, the two sections imply the need for realism about hopes that new energy sources will provide a quick fix to climate concerns.

4.1 Fostering Innovations to Lessen Emissions

The technical challenges of stabilizing atmospheric GHG levels at realistic costs are daunting.[52] After all, renewables supplied most global energy for millennia. They gave way to coal because their supply varied by time, place, and many random factors. Coal's did not. Therefore, substituting coal for renewables raised both capital and labor productivity.[53] Today, renewables still suffer this same drawback. Only a steep fall in the costs of both storing energy and transporting it can solve the problem.

"Renewables supplied most global energy for millennia. They gave way to coal because their supply varied by time, place, and many random factors. Coal's did not. Therefore, substituting coal for renewables raised both capital and labor productivity. Today, renewables still suffer this same drawback."

The policy challenges of stabilizing GHG levels may be even tougher than the technical ones. The credible threat of future emission controls would cause private sector R&D funding to increase. Large scientific breakthroughs, though, often require advances in basic science. Yet the for-profit sector has weak incentives to do basic science research, and, in fact, it does much less than the amount that would maximize social welfare.[54] This fact has long been cited as a rationale for government-funded basic research.

Government energy R&D is, however, beset with institutional problems. Political actors' incentives rarely cause them to back high-risk, high-payoff R&D. For legislators, demonstration projects offer the prospect of creating jobs for constituents. And Congress, for this reason, is apt to hurry concepts into the demonstration phase. Once such projects are launched, office holders prolong funding for them long after they have ceased to yield public benefits.[55] The programs that result bear little likeness to economists' model of stable, but diversified, programs aimed at doing breakthrough research on game-changing technologies.[56]

The incentives that produce these perverse outcomes are deeply rooted in the institutions of government. The electoral process itself raises the political discount rate. Terms in office are short relative to the time lags inherent in R&D. Supporting R&D projects that yield large, but diffuse, net benefits, and even those only after a long time, is a poor re-election strategy.[57] R&D may still be a useful climate policy option, but it is subject to its own complex of institutional distortions.

4.2 Technology Diffusion

R&D-based efforts to lower emissions face another major hurdle. To affect global GHG emissions, a new energy source must win acceptance across many societies. Yet institutions and political factors often determine which technology prevails in a given society.[58] Such factors are likely to be even weightier in energy than they are in other, less highly politicized economic sectors.

In theory, a new energy source might be able to compete with fossil fuel on a pure cost basis. No source is, though, currently close to being workable at the needed scale.[59] Hence, for the new low-GHG energy sources to diffuse widely, government policies must promote their use.

History has often shown that technologic change and institutional change are tightly linked. Often, institutions are harder to transplant than technology. In the nineteenth century, it was relatively easy to export a steam engine to Cairo along with the technicians to assemble it. Exporting the form of a corporation, though, was far more difficult. It required radical changes in the legal system and capital markets, and it took far longer to accomplish.[60] Yet without institutional change, the new technology was very difficult to diffuse.

High engineering costs are clearly one obstacle to the spread of GHG controls. Were they the only one, a strategy based on energy R&D might stand a good chance of long-run success. But Section 3 shows that engineering costs are only one barrier among many. Absent major changes in deeply rooted institutions, the political rewards of non-symbolic GHG control are likely to remain meager.

The dispute between those who advocate GHG control and those who favor energy R&D is, in any case, merely one of emphasis. Neither could succeed without the other. Yet it does not follow that they can succeed together. Rather, the focus on both of these approaches is a symptom of an overemphasis on engineering costs and underemphasis on transaction costs and institutions.

5. Living with GHG Emissions

While chapter 3 discussed ways of lessening GHG emissions, and Chapter 4 addressed the difficulty of quickly applying new technology, this Chapter considers ways by which the *costs* of unavoidable emissions might be lowered. Section 5.1 discusses adapting to climate change. Section 5.2 covers efforts to help poor countries to adapt. Section 5.3 handles ideas to restrain climate change even as emissions continue unabated.

5.1 Adapting to Climate Change

GHG control is at best a very long-term strategy. Countries will need to adapt to whatever climate change unfolds until such GHG control begins to take hold. Adaptation has at least one major advantage over

GHG control. For a developed country, it depends far less on international cooperation. National preferences over adaptation may differ, but, in most cases, each country may act as it chooses.

Managing transborder fresh-water resources is an exception to this generalization. In fact, some have argued that climate change may trigger water wars among states. The record to date, though, shows that cooperation, not conflict, dominates interstate relations over water. As one expert stated the matter, armed conflict over water would be economic nonsense: "Water is neither a particularly costly commodity nor, given the financial resources to treat, store and deliver it, is it particularly scarce. Full-scale warfare, on the other hand, is tremendously expensive. A 'water war' simply would not cost out."[61]

"The poor prospects for development through aid make it all the more important to advance it through trade. In this regard, using environmental concerns as a pretext for new trade barriers is likely to be highly pernicious. The EU biofuels policy barring palm oil–based biodiesel is therefore very troubling. The intent seems clearly protectionist."

In most other regards, adaptation is either the product of market forces or that of domestic policy. Most of the developed world appears to have high capacity for adapting to climate change. In the United States, a great deal could be done merely by reforming western water rights and lowering subsidies to federal disaster insurance. These same reforms would also generate social savings quite apart from any effect on future harm from climate change.

Despite these non-climate-related advantages, both sets of reforms have lagged. Yet, the gains from water rights reform are large. Over time, western population growth will add to them, as may climate change. The rising payoffs for reform might eventually push aside the barriers to it.[62] A similar dynamic may be at work in the case of limiting subsidies to disaster insurance. The main point is that efforts to use institutional reform as a means of adapting to climate change might well produce large cobenefits.

Open access orders are structured in ways that make them well-suited to the challenge of adapting to climate change. These societies are decentralized. Hence, entrepreneurs will devise a wide array of market and policy responses to any large-scale changes; also, their competitive markets and politics will tend to winnow out mistakes fairly rapidly.[63] Some of the richer natural states may have one offsetting advantage. Adaptation will require some public works. Natural states' ability to brush aside non-elite protests may allow them to move more quickly on such projects.

5.2 Adaptation Assistance

Adaptation in poor tropical countries presents problems that are harder to solve. Such countries are more exposed to harm from climate change, and they have fewer resources with which to buffer its effects. Concern for spillover effects from state failure motivates some of this concern.[64]

Responding to these concerns, developed countries have pledged $100 billion a year in aid programs to help poor countries adapt to climate change. Still, the motive to a free ride is strong, and the parlous finances of many donor countries must strengthen it. By August of 2011, only 61 percent of the pledged amount had actually been delivered. More importantly, much of that was merely diverted from other aid programs, and more of the funds were for GHG control rather than adaptation.[65]

Proposals of this kind reveal that climate policy is largely a species of development aid. Therein lies a major weakness. Over the last sixty-five years, a few such aid programs have worked; most have disappointed, and no clear formula for success has so far emerged.[66]

Most of the poorest states still lack institutions to rein in government predation. In many others, governments do not even prevent outbreaks of organized violence. Aid has often not helped. To the contrary, by making governments less dependent on their own taxpayers, it has sometimes actually enabled predation.[67]

Poor states would seem to be able to benefit from copying the institutions of open orders. Yet they rarely do so. The root of this problem is the political logic of the natural state. Governments hold power by using the rents created by barriers to entry in both economic and political systems. Reform would dissipate those rents. It might, therefore, threaten stability of the state itself; if anarchy is the alternative, even many interests outside the ruling coalition may cling to the status quo.[68]

This impasse has led to proposals for altruistic neocolonialism. If the governments of some Third World countries cannot provide, the international community could use armed force to provide it for them.[69] Time and again, though, experience shows that building good governments is many times harder than toppling bad ones. And as the scale of needed military force rises, the number of competent candidates falls off rapidly.

Realistically, then, assisting poor countries' efforts to adapt to climate change is not likely to have much effect. Development would be a powerful antidote to harm from climate change; the difficulty is that no known formula exists for fostering it in the societies where it is most needed.

One thing can be said. The poor prospects for development through aid make it all the more important to advance it through trade. In this regard, using environmental concerns as a pretext for new trade barriers is likely to be highly pernicious. The EU biofuels policy barring palm oil–based biodiesel is therefore very troubling. The intent seems clearly protectionist.[70] A similar case could be made against the U.S. Renewable Fuels Standard Regulations.[71]

More broadly, some advocates propose using trade sanctions to coerce free riders to accept GHG controls. A broader, Coasean view spotlights the contradiction at work within such schemes. Coercing states into GHG controls may close one of the few routes by which they

might seek the economic growth that they need to cope with already unavoidable climate change.

5.3 Climate Engineering

In light of the difficulties posed by other approaches, it is no surprise that the idea of climate engineering (CE) has begun to gain some ground. CE is often posed as a fallback to GHG control, and the two approaches are compared and contrasted. CE would entail engineering changes in the large, highly complex *global* climate system. GHG control, by contrast, would require engineering large changes in nearly every *society* on the planet.

At least two sunlight-based CE concepts may be able to offset all the warming expected in this century.[72] One of them involves lofting a fine seawater mist into low-level marine clouds. There, the droplets would "whiten" the clouds; i.e., they would cause them to reflect more sunlight[73] and perhaps lengthen their lives.[74] The second approach contemplates injecting very fine sulfate particles into the stratosphere.[75] After a year or two, particles would fall to the surface as rain or snow; quantities would be small compared to current sulfate emission levels.[76]

Either approach offers the chance of large benefits. One hypothetical CE system has recently been estimated to yield net benefits with a discounted present value (in 2005 dollars) of $4 to $10 trillion.[77] One very important potential advantage of CE is that, in contrast to GHG controls, it might be deployed relatively swiftly should severe harm from climate change appear to be imminent.[78] Against these possible gains, though, stands the risk that CE might trigger costly side effects.[79]

The global politics of CE differ from those of other approaches. CE's relatively low engineering costs imply that any major state could probably afford to do it. One early article on the subject issued strident warnings that some state, terrified of climate change, would launch unilateral CE; supposedly, a grave international crisis would ensue.[80]

While not, perhaps, entirely fanciful, this scenario is hard to credit. Certainly, were a great power to resolve on advancing CE, blocking its path would be difficult. Sanctioning great powers has rarely been tried, and when it has, it has often not worked.[81] How realistic, though, is this scenario?

In fact, so far, no government has sought to advance global-scale CE. To the contrary, most of the interest has been in quashing the concept. The Parliament of the European Union has passed a resolution opposing it.[82] A conference of the convention on biological diversity has done something similar.[83] The U.S. has no coherent research program on the concept.

Thus, the actual state of affairs stands in sharp contrast to fears of

CE "Lone Rangers." The political economy of CE explains the reasons for largely dismissing such fears. To begin with, domestically, the scale of the investments needed to implement CE is small. Therefore, the concept is not a very good pretext for pork-barrel politics. This fact deprives it of a major potential source of support for R&D funding.

Then too, CE fits awkwardly into the ideology of climate policy. In the United States and the EU, many green groups fear that CE offers an escape from costly GHG control schemes. Yet many U.S. conservatives continue to dismiss the idea that climate change might someday pose a problem. Thus, CE remains lost in an ideological no man's land.

Unless climate change were to present a far more imminent threat than it now does, the major powers do not seem likely to embrace CE. After all, for over twenty years, these states' actions—as distinct from their words—have signaled their slight regard for the danger of climate change. Why should they, then, suddenly decide to incur the risks of modifying Earth's climate to cope with a threat to which they can readily adapt?

"Conflict over CE is possible, of course, as it is over GHG control, riparian rights, or technology diffusion. Consider, for instance, the conflicts over nuclear proliferation. It is also true that great-power conflict is costly and dangerous. For that very reason, though, such states, especially since 1945, have gone to great lengths to limit the intensity of such conflicts."

Appearance of a more urgent threat from climate change might alter the situation. In that case, though, many more states would be likely to wish to act. A state wishing to explore CE would have no reason to act as a "Lone Ranger." The fact that some states might, even then, resist the progress toward CE would merely add to the incentives for building a coalition strong enough to overcome the resistance at a cost that is tolerable to each member of the coalition.

Conflict over CE is possible, of course, as it is over GHG control, riparian rights, or technology diffusion. Consider, for instance, the conflicts over nuclear proliferation. It is also true that great-power conflict is costly and dangerous. For that very reason, though, such states, especially since 1945, have gone to great lengths to limit the intensity of such conflicts.

Should future events foster more serious interest in CE, the likely outcome would be that major states would build an international regime to oversee research, testing, and perhaps, eventually, deployment. Such a regime would become the arena in which major powers would thrash out their differences.

The dynamics of managing a CE system would be likely to shape the structure of the regime that does the job. The need to hold down transaction costs dictates that only relatively few states could be active decisionmakers. Yet the regime must be broad enough either to co-opt or to cow all the states able to block its path to its goals. One recent plan foresees a regime built around roughly fifteen of the world's most powerful states.[84] This logic suggests that the manager of CE would be neither a Lone Ranger nor a UN General Assembly–like global tower of Babel.

Thus, as with other regimes, the structures for governing CE would

be likely to formalize the balance of power among the states that create them. The major states, after all, accept limits on their own freedom to act only insofar as other major states compel them to do so; hence, regime rules mirror the distribution of power that prevails at the time of their inception. Further, when the balance of power drifts too far out of alignment with a regime's rules and norms, the major states are apt either to change the rules or to shift control of the policy area to other regimes that more faithfully mirror the new balance of power. Thus, the form of regimes follows both function and power. If it does not, the regime can lose sway.

6. Institutional Trends and the Future of Climate Policy

The previous two chapters pointed out that the institutional framework helps to drive climate change and that it will heavily affect the results of countermeasures to it. But institutions can change. If they could not, modern economic growth would never have taken off. Hence, foreseeing the ways in which future institutions might evolve is vital to assessing climate policy options. The IPCC analysis has used scenario analysis to envision the changes likely to arise from factors that lie beyond the scope of the IAMs. However, it made no effort to check the realism of its scenarios against history or the known patterns of institutional change.

A far better approach would be to define scenarios that would be consistent with the kinds of change that history suggests are both possible and likely to be significant for climate policy. Section 6.1 discusses the prospects for current natural states' becoming open orders and the possible consequences of their failure to do so. Section 6.2 describes the implications for climate policy. Section 6.3 raises some issues about institutional change and the pace of technologic change.

6.1 Prospects for Discontinuous Changes

The future course of climate policy, like the course of much else, largely hinges on two questions. One is whether any large society will transition from a natural state to an open order. The second is what the fate will be of natural states that do not make that transition.

If North, Wallis, and Weingast are right, China's political system must

eventually become far more open to competition if that country's economic growth is to continue. This conjecture does not predict either that China's politics will become more open, or that they will not. It merely postulates that growth will stall if openness does not come to prevail. The conjecture is, though, portentous. China's Communist Party may, it is true, contemplate some kinds of reform, but so far it has sought to confine change strictly within bounds consistent with its monopoly on political power.[85]

That monopoly depends heavily on limiting entry into both politics and economic activity. The limits of competitive reform may already be near. In recent years, market reform has stalled; speculation about a trapped transition has grown apace.[86] Now, a so-called left-wing opposition appears to be gaining prominence. The goals of this movement are, to say the least, murky. It is equally unclear what its continued rise would mean for the current ruling coalition or the social order that it has built. Against this backdrop, what might be the effects of a long-term slowing in per capita income?

India's political economy, of course, differs greatly from China's. In form, India's government is clearly a democracy.[87] Its path toward an open order society is, though, unclear. The analysis cited in Section 2.2 notes that reforms have garnered some degree of elite support, but they have also met popular resistance.[88]

Further liberal reform faces a series of barriers. In so diverse a society, government may lack the social capital—that is, the trust—to effect major reforms.[89] Then too, patronage networks are widespread.[90] Such networks help to maintain cohesion. But political machines rest on the local credibility of patrons. Such systems favor policies that confer benefits on narrowly targeted groups of clients; they do not tend to supply public goods broadly on an impersonal basis.[91]

The forces against reform are, therefore, strong. More generally, nothing ensures that all or most nations will ever become open orders. Even among the few societies that reach a point at which they might, in principle, transition into open access orders, as many fall back into natural states as cross the threshold.[92] Thus, South Africa seemed to hold some promise of becoming an open order. Yet calls for large-scale economic nationalization are growing stronger. Such demands could herald a major loss of economic and political freedom. Argentina and the states of the former Soviet Union offer similar cautionary tales. The latter case also shows that such shrinkage can have large impacts on emissions.

Institutional economics can identify conditions that are likely to promote reform and those that are likely to impede it. More importantly, it can offer conjectures about the likely consequences of either success or failure. It also provides mileposts against which to measure progress.

North, Wallis, and Weingast, for instance, cite three such mileposts. One of these is that the rule of law must come to prevail for elites. A second is that the state and other major organizations must acquire identities transcending those of their current leaders; this step allows them to make credible commitments to act in defined ways after those leaders have left the scene. A third is for the state to gain unified control of the military.[93] For now, suffice it to say that the changes that would have to occur for India to become an open order appear to be very large. Those that would be needed in China seem larger still.

6.2 Climate Policy Implications of Order Change and Its Failure

China and India are large enough for their future course to notably affect the pace of climate change. Both have undergone astonishing institutional change. Either or both of these countries might make the transition to fully open access societies. Whatever the outcome for these countries, however, the smooth unfolding of current trends seems less probable than sharp discontinuities.

A change in social order by any major economy is likely to heavily affect the future course of climate change. Such an order change would not occur overnight. Transitions from advanced natural state to open order typically require several decades. This time frame is consistent with that used in much climate policy analysis.

It seems clear that, were major emitters like China, Indonesia, or India to move toward becoming an open access order, the effects on both climate change and climate policy could be momentous. Total economic output would rise, while GHG intensity would fall. The economic growth need not be the result of a scheme for sustainable development for GHG intensity to fall. Opening markets to greater competition will boost efficiency. Energy and natural resources savings are likely to arise as byproducts.

More transparency would also lower one barrier to global agreement on GHG control. A firm rule of law might make market-based GHG controls feasible—even though it might not make them popular. Stronger protection for intellectual property would certainly remove one current barrier to the diffusion of new technologies.

Impacts on adaptation might be somewhat ambiguous. Freer markets would certainly speed and lower the costs of private sector adaptation to a changed climate. Greater wealth would enable all segments of society to adapt. Yet tighter political constraints on public works might have a mixed impact. The constraints might discourage some of

the cruder forms of corruption. Then again, such constraints might also slow the progress of needed, large-scale public works.

Order changes in smaller states would have much smaller effects on emissions. Emissions from most of Sub-Saharan Africa, for instance, are low. Nigeria and South Africa are partial exceptions, but neither looms especially large on a global scale. Large-scale deforestation, though, should it gain momentum, might reverse this judgment.

Institutional change in these states could greatly affect their resilience to climate change. From the viewpoint of climate policy, the greatest impact of institutional change in Africa is likely to be its effect, either positive or negative, on adaptive capacity. Given Africa's large exposure to climate change, these effects on adaptive capacity seem likely to far outweigh any impact that development might have on emissions.

As with other regions, though, breakthroughs to open orders are low-probability events. In their absence, episodes of shrinkage remain an ever-present danger. Indeed reform itself raises the changes of political instability and violence, and for that reason, even those who would have much to gain from reform often prefer a stable status quo to its risks.[94]

To sum up, large-scale institutional change remains rare. When it does occur, though, it is highly consequential. Change can entail violence. The historical record does not show that institutions are driven by some internal dynamic to move from natural states to open orders. To the contrary, retrogression is frequent. Climate policy analysis should remain alert to change in both directions.

"Rates of innovation vary greatly across sectors and through time as institutions evolve and technological problems wax and wane in difficulty… Contrary to the models used to analyze climate policy, innovations do not arise out of nothing … Analysis that ignores the framework of institutions and organizations surrounding innovation runs the risk of going seriously awry."

6.3 The Institutional Supports of Innovation

Other kinds of institutional change are less dramatic than order changes; yet some of these more subtle effects may still affect the extent of climate change and the prospects for dealing with it. The IPCC, for instance, assumes that rapid rates of technologic change will ensure that the world economy's GHG intensity will fall rapidly.

Some experts, though, object that high technical barriers to progress in GHG control imply that the IPCC's projections are too optimistic.[95] The IPCC seems to assume that because a rate of innovation once prevailed, it can always be maintained. This assumption is dangerously oversimple.

Rates of innovation vary greatly across sectors and through time as institutions evolve and technological problems wax and wane in difficulty.[96] There is no obvious reason for thinking that earlier trends in energy saving will go on forever. Indeed some economists regard the institutions that have nurtured innovation as being in serious danger. Others dispute this contention. Three factors warrant notice.

"Innovation creates both winners and losers; the latter have reason to attempt to block rise and spread of threatening technologies. Over time, vested interests seeking to foster rules that freeze in place the status quo multiply. The conflicts over transgenetic crops, nanotechnology, and hydraulic fracturing of gas and oil wells show that such moves are common. Does progress, therefore, give rise to a complex of rules that eventually stifles its own advance?"

First, aging populations, and the fiscal burdens they imply, may limit governments' future financial support for basic science. Since basic science is critical to the process of innovation, the threat, should it materialize, would be serious. The U.S., European, and Japanese populations are aging. Some level of fiscal stringency seems certain to follow, and, at least in the United States, public spending on R&D has already begun to feel a pinch.[97] The future path of innovation may, therefore, hinge on how deeply the relevant R&D will be cut, and how well governments apportion the remainder.

Second, in the view of some, the "privatization of the scientific commons" prompts concerns about the soundness of the foundations of open science. The institutions and group structures that undergird this enterprise stand outside the market nexus.[98] Examples include open science, credit for priority, and standards of scientific proof.

Moves to expand the scope of patent rights and to draw researchers more directly into proprietary research may raise the costs of using existing knowledge as an input to further research.[99] At the extreme, the growing sway of market forces might threaten the organizations and institutions essential to open science.[100] Without them, innovation may wane.[101] And with public sector financial support for science sinking, the pressures to court market-based funding seem likely to build.

Third, and perhaps most troubling, the strength and number of interests with a stake in retarding innovation seem to be growing. Innovation creates both winners and losers; the latter have reason to attempt to block the rise and spread of threatening technologies; if market barriers fail to stop innovation, its organized opponents may have recourse to nonmarket means.[102] Over time, vested interests seeking to foster rules that freeze in place the status quo multiply. The conflicts over transgenetic crops, nanotechnology, and hydraulic fracturing of gas and oil wells show that such moves are common. Does progress, therefore, give rise to a complex of rules that eventually stifles its own advance?[103]

The answer remains unclear. On the one hand, there seems to be evidence that resistance to innovation is growing, at least within the developed world. The accretion of status quo forces is much like that predicted in Mancur Olson's *The Rise and Decline of Nations*. On the other hand, though, the pace of innovation has not demonstrably slowed.[104]

The key point made here is not that the pace of innovation has as yet changed. It relates, instead, to the discussion in Section 1.2 and Chapter 4. Contrary to the models used to analyze climate policy, innovations do not arise out of nothing. In the real world, they are the product of individuals and organizations wrestling with concrete problems and operating within set rules, norms, and procedures. Changes in those institutions and organizational structures are likely to affect the

results. Analysis that ignores the framework of institutions and organizations surrounding innovation runs the risk of going seriously awry.

7. New Policy Analysis for New Policy

Chapters 2 through 6 presented a case for believing that U.S. climate policy has gone badly astray. Section 7 asks why climate policy analysis has done so little to sound the alarm and makes some preliminary suggestions about remedies. Section 7.1 discusses the factors that help to explain the otherwise-puzzling obsession of climate policy with GHG control. Section 7.2 suggests trimming the functions of the IPCC to more closely fit that body's capacity. Section 7.3 argues for a U.S. government "red team" analysis of climate policy. It cautions, though, that such an analysis is unlikely until public intellectuals of both left and right throw off their respective climate policy dogmas.

7.1 The Puzzling Focus on GHG Control

The oddest aspect of climate policy analysis is that it has done so little to break the grip of GHG control on the climate policy debate. Indeed it has rarely even tried to do so. To the contrary, up until the last few years, many climate scientists scorned proposals to deal with climate change through adaptation. They regarded it as a distraction from the "real solution," which was assumed to be GHG control; today, CE still stirs many of the same reactions.[105]

This tunnel vision springs in large part from modern environmental ethics. Such ethics juxtapose man and nature; they designate nature as good; and they judge human impacts on nature as bad.[106] From this ethic has sprung a new maxim. It is that solving one environmental problem by creating a second is wrong per se.[107]

This maxim is widely espoused but incoherent. The solution to one problem almost always occasions others. If melting glaciers threaten water supplies, building dams and reservoirs may well yield greater net benefits than cutting GHG emissions by building windmills and solar arrays. The latter, in any case, as the many local campaigns against wind and solar attest, also substitute one set of environmental problems for another. Therefore, a strict reading of a rule that bans solving

one environmental problem by creating another would decree nearly complete inaction. A more permissive reading of it would merely needlessly raise the costs of solving all environmental problems. Neither outcome seems attractive.

Nonetheless, many green NGOs and many climate scientists, too, have deduced from this maxim a preference for GHG controls over any other possible response to climate change. At the same time, the threat of pervasive social engineering in the name of such controls has pushed many conservatives to deny that climate change poses a threat. The clash of these two ideological forces sets the vector of climate policy discourse. The result has been a policy debate that remains stuck on the least viable of all available countermeasures against harm from climate change.

On many issues, economists have attempted to counter environmentalists' policy prescriptions.[108] To a degree, the same has happened on climate. Most economists, for example, have tended to favor gradual GHG reductions over steep ones.[109] Economists have made the case for strategies that stress adaptation, and for R&D to develop CE and new energy sources. In other cases, economists have raised questions about the realism of GHG control schemes.

Economists, though, have also played a leading part in the work of WG-3, and in generating numerous schemes for GHG control. Only a few have forcefully pointed out the deep structural problems that stymie efforts to enact effective emission controls. Three conjectures might help to explain why the dismal science has done so little to puncture the illusion of GHG controls.

First, experience with other pollutants must have made GHG controls seem like a natural response to climate change. In the United States and then in Europe, early policies successfully abated conventional air and water pollutants. Further, the record of Title IV of the U.S. Clean Air Act was interpreted as showing that cap-and-trade programs could produce abatement at costs far below the costs that were estimated *ex ante*.[110]

These claims turn out to be false. Some of the early cost estimates assumed program designs that differed from those that Title IV actually used; further, costs were driven down by later fortunate surprises such as partial rail rate deregulation and an influx of low-sulfur coal into the market.[111] These developments had nothing to do with cap-and-trade. Nonetheless, the Clinton administration and many green NGOs used this confusion to claim that GHG cap-and-trade would inevitably cost less than predicted. With only a few exceptions, most economists, perhaps out of support for the implied move away from command-and-control mandates, have been less than vigorous in exposing such exaggerations.

Second, many economists tend to draw a veil over the harsher real-

ities of politics. This tendency has also appeared in development economics; there too, international bodies, and many scholars, often tend to minimize harsh political realities.[112] Political and institutional factors are largely impossible to model; so economists tend to simply ignore them.[113] The consequence is, of course, that economic analysis appears to be formal and precise, but this illusion is purchased at the price of excluding all account of the forces that are most affecting events. Most economists' cosmopolitan worldview may also discourage them from enquiring deeply into the distributional conflicts that are so central to national and world politics.

Third, one tradition within the discipline sympathizes with large-scale social engineering. Environmental economics may be especially attuned to this strain of thinking. Pigou, against whom Coase argued in "The Problem of Social Cost," was certainly a proponent of social engineering. Indeed, he was such a strong advocate of environmental taxes that, to this day, economists call such measures "Pigouvian taxes." Little wonder that economists from this tradition would be drawn to GHG abatement. The task is, after all, the *ne plus ultra* of global social engineering.

7.2 The IPCC's Structural Problems

Partly as a result, WG-3, despite economists' strong role in it, has done little or nothing to break the narrow focus on GHG control. Further, the IPCC's rules hobble efforts to solve this problem. The IPCC is, after all, the creature of its member governments. Most of these governments want to maintain the pretense that they are committed to the cause of curbing GHG emissions. Thus, on the one hand, governments would hardly welcome a body of scholars questioning the realism of the goal or the sincerity of states' commitment to it. On the other hand, questioning just these claims is the essential starting point for a more realistic assessment of climate policy options and the trade-offs among them.

WG-3 deals with subjects that are freighted with policy implications. The same could be said of WG-2, which assesses adaptation. The institutions of the IPCC's member states are central in determining choices among strategies for coping with climate change. If these working groups cannot forthrightly consider the effects on those institutions, they have little realistic prospect of discussing the options for dealing with climate change. As a result, these working groups have mainly confined themselves to anodyne generalities and discussions of technology.

One alternative might be for these working groups to highlight the potential importance of institutions and belief systems in shaping events. Such an effort might also, in general terms, point to the poten-

tial impacts of discontinuous change. Even these steps, of course, may not be possible within the IPCC's political and institutional constraints. If they are, though, Working Groups 2 and 3 could highlight the importance of long-neglected issues. They could prompt scholars to explore these subjects, and they might also encourage scholars with more expertise in political economy to study climate policy.

7.3 Toward a U.S. Climate Strategy

Whatever the IPCC does, the U.S. government needs a strategic vision of climate policy. The country lacks an institutional focal point for analysis. The National Intelligence Council explores the impacts of climate change on U.S. security. Sundry cabinet departments consider options that fall within their varied remits. This scattered analysis is not intended, though, to encompass either the domestic impacts of climate change or the effects of climate policy on other U.S. national interests. No person or group is charged with codifying the U.S. government's climate change strategy, let alone with testing the logic on which it rests.

"Ultimately, though, the weakness of U.S. climate policy analysis centers more on the demand side than on the supply side. To date most of the country's political leaders have simply not demanded good analysis."

Partly as a result, the focus of U.S. climate policy analysis can be blurred. Climate policy is often treated as an exercise in global altruism instead of a means of advancing U.S. interests. Climate policy analysis has often leapt from awareness that climate change poses risks, to the inference that GHG controls are the correct response—indeed, the only one. It has ignored the vital import of institutions and institutional change.

Options exist for correcting these biases. One good starting place might be to launch a variant of a "red team" or "red cell" analysis. Such an analysis should avoid issues of climate science; rather its goal should be to challenge the dogmas of climate policy. Such an effort might, for one thing, generate new scenarios reflecting far more of the logic of institutional change and the patterns of history than did those defined by the IPCC. They might, for instance, look for sources of discontinuous change in national preferences, global power balances, and institutional capacity.

Ultimately, though, the weakness of U.S. climate policy analysis centers more on the demand side than on the supply side. To date most of the country's political and thought leaders have simply not demanded good analysis. Instead, leaders on the left have been willing to turn over climate policy to the green NGOs and a phalanx of green-cloaked rent seekers.

Meanwhile, most leaders on the right have seemed mesmerized by a version of Weingast's paradox: they fear, doubtless with good reason, that a state empowered to impose GHG controls will use this remit as a pretext for gross predation. The right has not, though, promoted remedies

more in line with the defense of the public's liberties and wallets; rather, it has often tried to deny the evidence of all risk from climate change.

In the long run neither of these stances is tenable. Climate change does pose some risks; yet those risks do not imply that massive social engineering for GHG control is either possible or desirable. Only when an awareness of this reality sinks in among public intellectuals is a more serious policy discourse likely to emerge.

NOTES

1 John R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: W.W. Norton & Company, 2000), 108.
2 Paul Collier, *The Bottom Billion: Why the Poorest Countries are Failing and What Can Be Done About It* (New York: Oxford University Press), 2007.
3 Joel Mokyr, "Innovation in an Historical Perspective: Tales of Technology and Evolution," in *Technological Innovation & Economic Performance*, ed. Benn Steil, David G. Victor, and Richard R. Nelson (Princeton: Princeton University Press, 2002), 25; Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2004), 19.
4 Douglass C. North, *Structure and Change in Economic History* (New York: W.W. Norton & Company, 1981), 172–73.
5 Mancur Olson, *Power and Prosperity: Outgrowing Communist and Capitalist Dictatorships* (New York: Basic Books, 2000), 11–13.
6 Barry R. Weingast, "The Economic Role of Political Institutions: Market-Preserving Federalism and Economic Development," *Journal of Law, Economics, and Organization* 11 (1995): 1–31.
7 Douglass C. North, John Joseph Wallis, and Barry R. Weingast, *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History* (New York: Cambridge University Press, 2009), 21–25.
8 North et al., *Violence and Social Orders*, 50.
9 North et al., *Violence and Social Orders*, 21.
10 Paul Collier, *Wars, Guns, and Votes: Democracy in Dangerous Places* (New York: HarperCollins, 2009), 7–8.
11 Daron Acemoglu and James A. Robinson, "Paths of Economic and Political Development," in *The Oxford Handbook of Political Economy,* ed. Barry R. Weingast and Donald E. Wittman (New York: Oxford University Press, 2006), 688.
12 North et al., *Violence and Social Orders*, 255.
13 Ronald Coase, "The Problem of Social Cost," in *The Firm, the Market, and the Law* (Chicago: University of Chicago Press, 1988), 96.
14 Coase, "The Problem of Social Cost," 118.
15 Thomas C. Schelling, "What Makes Greenhouse Sense? Time to Rethink the Kyoto Protocol," *Foreign Affairs* 81, no. 3 (2002): 3.
16 Daniel H. Rosen and Trevor Houser, "China Energy: A Guide for the Perplexed," Center for Strategic and International Studies, and Peterson Institute for International Economics, May 2007, 4.
17 C. Fred Bergsten, Charles Freeman, Nicholas R. Lardy, and Derek J. Mitchell,

China's Rise: Challenges and Opportunities (Washington, DC: Peterson Institute for International Economics, 2008), 148–49.

18 Bergsten et al., *China's Rise,* 149–50.

19 Bergsten et al., *China's Rise,* 152.

20 Erica S. Downs, "Business Interest Groups in Chinese Politics: The Case of the Oil Companies," in *China's Changing Political Landscape: Prospects for Democracy*, ed. Cheng Li (Washington, DC: Brookings Institution Press, 2008), 122.

21 Montek S. Ahluwallia, "Economic Reforms in India Since 1991: Has Gradualism Worked?" in *India's Economic Transition: The Politics of Reforms*, ed. Rahul Mukherji (New York: Oxford University Press, 2007), 101.

22 Pranab Bardhan, *Awakening Giants, Feet of Clay: Assessing the Economic Rise of China and India,* (Princeton: Princeton University Press, 2010), 56.

23 Robert E. Baron, W. David Montgomery, and Sugandha D. Tuladhar, "Black Carbon Mitigation," in *Smart Climate Solutions*, ed. Bjorn Lomborg (Cambridge: Cambridge University Press, 2010), 142.

24 Bardhan, *Awakening Giants*, 56.

25 Stuart Corbridge, "The Contested Geographies of Federalism in Post-Reform India," in *Understanding India's New Political Economy: A Great Transformation?* ed. Stuart Corbridge, John Harris, Sanjay Reddy, Sanjay Ruparelia, (New York: Routledge, Taylor & Francis Group, 2011), 72.

26 Bardhan, *Awakening Giants*, 56–57.

27 Ashutosh Varshney, "Mass Politics or Elite Politics? Understanding the Politics of India's Economic Reforms," in *India's Economic Transition: The Politics of Reforms*, ed. Rahul Mukherji (New York: Oxford University Press, 2007), 148; Radhika Desai, "Hindutva's Ebbing Tide?" in *Understanding India's New Political Economy: A Great Transformation?* ed. Stuart Corbridge, John Harris, Sanjay Reddy, and Sanjay Ruparelia, (New York: Routledge, Taylor & Francis Group, 2011), 173.

28 Robert H. Bates, *Beyond the Miracle of the Market: The Political Economy of Agrarian Development in Kenya* (New York: Cambridge University Press, 2005), 86.

29 Varshney, "Mass Politics or Elite Politics?" 158.

30 Stephen D. Krasner, "Structural Causes and Regime Consequences: Regimes as Intervening Variables," in *Power, the State, and Sovereignty: Essays on International Relations*, ed. Stephen D. Krasner (New York: Routledge, 2009), 113.

31 Richard S. J. Tol, "An Analysis of Mitigation as a Response to Climate Change," in *Smart Climate Solutions*, ed. Bjorn Lomborg (Cambridge: Cambridge University Press, 2010), 95.

32 Lee J. Alston and Bernardo Mueller, "Property Rights and the State," in *Handbook of New Institutional Economics*, ed. Claude Ménard and Mary M. Shirley (Dordrecht: Springer, 2008), 581.

33 Paul Collier, *The Plundered Planet: Why We Must—and How We Can—Manage Nature for Global Prosperity* (New York: Oxford University Press, 2010), 178.

34 CENTRA Technology, Inc., and Scitor Corporation, *China: The Impact of Climate Change to 2030*, National Intelligence Council Conference Report CR 2009-09, June 2009, 4; CENTRA Technology, Inc., and Scitor Corporation, *India: The Impact of Climate Change to 2030*, National Intelligence Council Conference Report CR 2009-07, May 2009, 3.

35 Gary Yohe and Richard S. J. Tol, "Indicators for Social and Economic Coping

Capacity—Moving Toward a Working Definition of Adaptive Capacity," *Global Environmental Change* 12 (2002): 26.

36 Lloyd Gruber, *Ruling the World: Power Politics and the Rise of Supranational Institutions* (Princeton: Princeton University Press, 2000), 37.

37 Robert Gilpin, *Global Political Economy: Understanding the International Economic Order* (Princeton: Princeton University Press, 2001), 95.

38 Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton: Princeton University Press, 1984), 183.

39 Holly K. Gibbs et al., "Carbon Payback Times for Crop-Based Biofuel Expansion in the Tropics: The Effects of Changing Yield and Technology," *Environmental Research Letters* 3 (2008): 2.

40 Erin C. Meyers Madeira, *Policies to Reduce Emissions from Deforestation and Degradation (REDD) in Developing Countries: An Examination of the Issues Facing the Incorporation of REDD into Market-Based Climate Policies*, (Washington, DC: Resources for the Future, 2008), 52.

41 Carlos A. Nobre, "Tropical Land-Use Change Emissions—Smaller, but Still Very Significant," in *Climate Change Blog,* The World Bank Group, 2010, http://climatechange.worldbank.org/node/5405.

42 Meyers Madeira, *Policies to Reduce Emissions from Deforestation and Degradation*, 24.

43 Lee J. Alston and Bernardo Mueller, "Property Rights, Land Conflict and Tenancy in Brazil," National Bureau of Economic Research, Working Paper no. 15771, February 2010, 2, http://www.nber.org/papers/w15771.

44 Lorenzo Cotula and James Mayers, *Tenure in REDD: Start-Point or Afterthought?* (London: International Institute for Environment and Development, 2009), 16.

45 Lee J. Alston and Bernardo Mueller, "Property Rights and the State," in *Handbook of New Institutional Economics*, ed. Claude Menard and Mary M. Shirley (Dordrecht: Springer, 2008), 582.

46 Dan Slater, *Ordering Power: Contentious Politics and Authoritarian Leviathans in Southeast Asia* (New York: Cambridge University Press, 2010), 63.

47 William Easterly, "Institutions: Top Down or Bottom Up?" *American Economic Review* 98, no. 2 (May 2008): 97–98.

48 Barry R. Weingast, "Why Developing Countries Prove So Resistant to the Rule of Law," in *Global Perspectives on the Rule of Law*, ed. James J. Heckman, Robert L. Nelson, and Lee Cabatingan (New York: Routledge-Cavendish, 2010), 47.

49 Helmut J. Geist and Eric F. Lambin, "Proximate Causes and Underlying Driving Forces of Tropical Deforestation," *Bioscience* 52, no. 2 (February 2002): 146.

50 Thomas W. Hertel, Wallace E. Tyner, and Dileep K. Bir, "The Global Impacts of Biofuel Mandates," *Energy Journal* 31, no. 1 (2010): 98.

51 Meyers Madeira, *Policies to Reduce Emissions from Deforestation and Degradation*, based on Table 2-2, p. 21.

51 Michael Wara, "Measuring the Clean Development Mechanism's Performance and Potential," *UCLA Law Review 55* (2008): 1759–1803.

53 Christopher J. Bosso, *Environment, Inc.: From Grassroots to Beltway* (Lawrence: University Press of Kansas, 2005), 12–13.

54 Willett Kempton, James S. Boster, and Jennifer A. Hartley, *Environmental Values in American Culture* (Cambridge, MA: MIT Press, 1995), 211–14.

55 R. Douglas Arnold, *The Logic of Congressional Action* (New Haven: Yale University Press, 1990), 9.

56 Isabel Galiana and Chris Green, "An Analysis of a Technology-led Climate Policy as a Response to Climate Change," in *Smart Climate Solutions*, ed. Bjorn Lomborg (Cambridge: Cambridge University Press, 2010), 302.

57 Douglas W. Allen, *The Institutional Revolution: Measurement and the Economic Emergence of the Modern World* (Chicago: University of Chicago Press, 2012, 27.

58 Kenneth J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," in *The Rate and Direction of Inventive Activity: Economic and Social Factors*, ed. Richard Nelson (Princeton: Princeton University Press, 1962), 619; Nathan Rosenberg, "Why Do Firms Do Basic Research (With Their Own Money)?" *Research Policy* 19 (1990): 165–74.

59 Jeffrey S. Banks, Linda R. Cohen, and Roger G. Noll, "The Politics of Commercial R&D Programs," in *The Technology Pork Barrel* (Washington, DC: Brookings Institution Press, 1991), 73–74.

60 Kenneth J. Arrow, Linda R. Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, L. Lee Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll, and Anne E. Smith, "A Statement on the Appropriate Role for Research and Development in Climate Policy," *Economists' Voice*, 6, no.1 (2008): Article 6.

61 Banks et al., "The Politics of Commercial R&D Programs," 57–58.

62 Mokyr, *The Gifts of Athena*, 220.

63 Martin I. Hoffert, et al, "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet," *Science* 298 (2002): 986.

64 Timur Kuran, *The Long Divergence: How Islamic Law Held Back the Middle East* (Princeton: Princeton University Press, 2011), 16.

65 Aaron T. Wolf, "Conflict and Cooperation over Transboundary Waters," UN Human Development Report Occasional Paper 2006/19, 44.

66 Gary D. Libecap, "Water Woes: Using Markets to Quench the Thirst of the American West," *Milken Institute Review*, fourth quarter (2010): 68.

67 North et al., *Violence and Social Orders*, 133–34.

68 Susan Rice, "The National Security Implications of Global Poverty," in *Confronting Poverty: Weak States and U.S. National Security,* ed. Susan E. Rice, Corinne Graff, and Carlos Pasqual (Washington: Brookings Institution Press, 2010), 6.

69 *Bloomberg New Energy Finance,* "Have Developed Nations Broken Their Promise on $30bn 'Fast-Start' Finance?" white paper, September 5, 2011.

70 William Easterly, *The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good* (New York: Penguin Press, 2006), 11.

71 Robert H. Bates, *Prosperity and Violence: The Political Economy of Development* (New York: W.W. Norton & Company, 2010), 64.

72 Barry R. Weingast, "The Political Foundations of Democracy and the Rule of Law," *American Political Science Review* 91, no. 2 (June 1997): 261.

73 Collier, *Wars, Guns, and Votes*, 232.

74 Fredrik Erixon, "Green Protectionism in the European Union: How Europe's Biofuels Policy and the Renewable Energy Directive Violate WTO Commitments," *ECIPE* paper no. 1, 2009, 13.

75 Lee Lane, "Emission Controls, Economic Growth, and Palm Oil Production," Hudson Institute, October 2011, 13.

76 Tim M. Lenton and Nem E. Vaughan, "The Radiative Forcing Potential of Different Climate Geoengineering Options," *Atmospheric Chemistry & Physics Discussions* 9 (2009): 5553.

77 John Latham et al., "Global Temperature Stabilization via Controlled Albedo Enhancement of Low-Level Maritime Clouds," *Philosophical Transactions of the Royal Society* (2008): 3969.

78 Keith Bower et al., "Computational Assessment of a Proposed Technique for Global Warming Mitigation via Albedo-Enhancement of Marine Stratocumulus Clouds," *Atmospheric Research* 82, no. 1-2 (2006): 329.

79 Alan Robock et al., "The Benefits, Risks, and Costs of Stratospheric Geoengineering," *Geophysical Research Letters* 36 (2009): 4–7.

80 Paul J. Crutzen, "Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to Resolve a Policy Dilemma?" 77, no. 3-4 *Climatic Change* (2006): 213.

81 J. Eric Bickel and Lee Lane, "An Analysis of Climate Engineering as a Response to Climate Change," in *Smart Climate Solutions*, ed. Bjorn Lomborg (Cambridge: Cambridge University Press, 2010), 40.

82 Bickel and Lane, "An Analysis of Climate Engineering as a Response to Climate Change," 20–21.

83 Alan Robock, "20 Reasons Why Geoengineering May be a Bad Idea," *Bulletin of the Atomic Scientists* 64, no. 2 (2008): 14–18.

84 David G. Victor, M. Granger Morgan, Jay Apt, John Steinbruner, and Katharine Ricke,"The Geoengineering Option: A Last Resort Against Global Warming?" *Foreign Affairs* 88, no. 2, (2009).

85 Daniel W. Drezner, *All Politics is Global: Explaining International Regulatory Regimes* (Princeton: Princeton University Press, 2007), 34.

86 Josh Horton, *Geoengineering Politics*, "European Parliament Comes out against Geoengineering," http://geoengineeringpolitics.blogspot.com/2011/10/european-parliament-comes-out-against.html.

87 Masahiro Sugiyama and Taishi Sugiyama, "Interpretation of CBD COP 10 Decision on Geoengineering," Central Research Institute of Electric Power Industry (Japan), http://criepi.denken.or.jp/en/serc/research_re/download/10013dp.pdf.

88 Ambassador Richard Benedick, presentation at the International Conference on Climate Intervention Technologies, Asilomar, 2010. See Eli Kintisch, "Scientists Call for 'Climate Intervention' Research with 'Humility,'" *Science Insider*, March 26, 2010.

89 Andrew J. Nathan, "China's Political Trajectory: What are the Chinese Saying?" in *China's Changing Political Landscape: Prospects for Democracy*, ed. Cheng Li (Washington, DC: Brookings Institution Press, 2008), 39.

90 Minxin Pei, *China's Trapped Transition: The Limits of Developmental Autocracy* (Cambridge: Harvard University Press, 2006), 31.

91 Charles Tilly, *Democracy* (New York: Cambridge University Press, 2007), 55.

92 Bardhan, *Awakening Giants*, 126.

93 Tilly, *Democracy,* 57.

94 Bruce Bueno de Mesquita, Alastair Smith, Randolph M. Siversn, and James D. Morrow, *The Logic of Political Survival* (Cambridge, MA: MIT Press, 2003), 471.

95 Philip Keefer and Razvan Vlaicu, "Democracy, Credibility and Clientelism," World Bank WPS-3472, 26, 2007, http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2005/02/02/000009486_20050202165259/Rendered/PDF/wps3472.pdf.

96 North et al., *Violence and Social Orders*, 253–54.

97 North et al., *Violence and Social Orders*, 151.

98 Barry R. Weingast, "Why Developing Countries Prove So Resistant to the Rule of Law," in *Global Perspectives on the Rule of Law*, ed. James J. Heckman, Robert L. Nelson, and Lee Cabatingan (New York: Routledge-Cavendish, 2010).

99 Galiana and Green, "An Analysis of a Technology-led Climate Policy as a Response to Climate Change," 195–96.

100 Richard R. Nelson and Sidney G. Winter, "In Search of Useful Theory of Innovation," *Research Policy* 6, no. 1 (1977): 47–48.

101 Peter S. Heller, *Who Will Pay? Coping with Aging Societies, Climate Change, and Other Long-Term Fiscal Challenges* (Washington, D.C.: International Monetary Fund, 2003); Donald E. Stokes, *Pasteur's Quadrant: Basic Science and Technological Innovation* (Washington, DC: Brookings Institution Press, 1997), 58–59.

102 Richard R. Nelson, "The Market Economy, and the Scientific Commons," 2, http://www.law.umich.edu/centersandprograms/lawandeconomics/workshops/Documents/winter2006/nelson.pdf.

103 Nelson, "The Market Economy, and the Scientific Commons," 7.

104 Paul A. David, "The Historical Origins of 'Open Science': An Essay on Patronage, Reputation and Common Agency Contracting in the Scientific Revolution," *Capitalism and Society* 3, no. 2 (2008): 13.

105 David, "The Historical Origins of 'Open Science,'" 6.

106 Mokyr, *The Gifts of Athena*, 254.

107 Mokyr, *The Gifts of Athena*, 278.

108 Mokyr, *The Gifts of Athena*, 275.

109 Robert H. Nelson, "Earth's Optimal Temperature," *Faculty Voice*, University of Maryland, May 2006, 6.

110 Robert H. Nelson, *The New Holy Wars: Economic Religion vs. Environmental Religion in Contemporary America* (University Park, PA: Pennsylvania State University Press, 2010), 117–18.

111 Phillip E. Tetlock and Michael Oppenheimer, "The Boundaries of the Thinkable," *Daedalus* (Spring 2008): 137, 2; 69.

112 Nelson, *The New Holy Wars*, 3.

113 David L. Kelly and Charles D. Kolstad, "Integrated Assessment Models for Climate Change Control," in *International Yearbook of Environmental and Resource Economics 1999/2000: A Survey of Current Issues*, ed. Henk Folmer and Tom Tietenberg (Cheltenham: Edward Elgar, 1999).

114 Anne E. Smith, Jeremy Platt, and A. Denny Ellerman, "The Costs of Reducing Utility SO_2 Emissions—Not as Low as You Might Think," Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology, Working Paper 1998–10, at http://web.mit.edu/ceepr/www/publications/workingpapers/98010.pdf.

115 Smith et al., "The Costs of Reducing Utility SO_2 Emissions," 9, 12.

116 Bates, *Prosperity and Violence*, xi–xii.

117 Gilpin, *Global Political Economy*, 71.

ABOUT THE AUTHOR

LEE LANE is a Hudson Institute Visiting Fellow; he is also a Senior Consultant at Charles River Associates. Previously, Lane was Co-Director of the Geoengineering Project at the American Enterprise Institute, Executive Director of the Climate Policy Center, Vice President for Reearch at CSX Corporation, Vice President for Policy at the Association of American Railroads, and he founded the consulting firm Policy Services, Inc.

He is the author of *Strategic Options for the Bush Administration Climate Policy* (AEI Press, 2006), and he has authored or co-authored numerous policy briefing papers, articles, and book chapters. NASA selected Lane to be the lead author of a report on geoengineering as a tool of climate policy. He has testified before the U.S. House of Representatives Committee on Science and Technology and has frequently been an invited expert at policy conferences.

Lane has published columns or been quoted in the *Wall Street Journal*, the *New York Times*, the *Financial Times*, *Time Magazine*, the *Washington Times*, *Regulation*, *Milken Institute Review*, and many other outlets.

HUDSON INSTITUTE

Hudson Institute is a nonpartisan policy research organization dedicated to innovative research and analysis. Founded in 1961, Hudson is celebrating a half century of forging ideas that promote security, prosperity, and freedom. **www.hudson.org**

50th ANNIVERSARY 1961–2011

HUDSON INSTITUTE

1015 15TH STREET, N.W., SIXTH FLOOR, WASHINGTON, D.C. 20005
TELEPHONE 202-974-2400 WWW.HUDSON.ORG