Politically, pretty much everything about global climate change conspires to let governments sit on their hands. The scariest dangers mostly live in the distant future where they are easier to ignore, but the costs of policies that would eventually lessen warming are immediate. International coordination is essential but hard to orchestrate. The countries that are most vulnerable to climate change and most inspired to stop global warming are also generally the poorest and the least responsible for the problem in the first place. They can’t, on their own, make much of a difference anyway. Those with rapidly increasing emissions, like China, are largely preoccupied with priorities like economic growth rather than diffuse global problems. The United States, the largest single polluter in history, is stuck in congressional gridlock. And a few countries—Russia, notably—even think climate change could lead to a host of positives such as longer growing seasons for crops, a richer cut of timber and lower heating bills. With nations coming at the problem from differing positions, crafting serious international cooperation has been nearly impossible.

Getting a good handle on the impacts of climate change has been hard because there are no crisp answers. Global warming is a game of roulette. Spin the wheel once, and the outcome could be rosy. Spin again, and it may be ugly. Wait a decade or two while even more warming gases accumulate in the atmosphere and the results become all the harder to predict. Even as the science races ahead, experts are discovering further ways the climate will change that they don’t yet understand. New facts keep appearing to suggest that the en-

The Green in the Machine

By David G. Victor


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environment gamble is full of outcomes even worse than originally thought. Polar ice is melting quickly and ecosystems are shifting in scary ways. Beyond warming, all of the carbon dioxide building up in the atmosphere is also acidifying the oceans, which will make it harder for normal aquatic life to thrive. The case for action is getting clearer even as much of what lurks in a warmer world is still unknown.

A long shelf of new books has been coming into print with the goal of helping general audiences make sense of what’s happening. Nearly every one of these offerings sees global climate change as a dark cloud on the horizon that will stress societies and ecosystems and cause general mayhem. Compared with a decade ago, a surprisingly large number see climate change as a challenge so great that it will force humans to rethink their relationship with nature and to redesign industrial society so it leaves a much-smaller footprint on the planet. Such books—like most policy advocacy aligned with being “green”—espouse small, rural, locally oriented, “progressive” solutions. But better answers to the world’s gravest environmental troubles actually lead to big projects—often under central coordination by strong and capable states. Global warming has focused attention on this odd juxtaposition, which is one that both the true believers and the skeptics will have to get used to.

For journalist Bill McKibben in his superbly written book *Eaarth*, danger is everywhere. The oddly misspelled title reflects McKibben’s claim that a new name is needed for a planet that humans have so thoroughly transformed. McKibben is at his best when offering an elegant tour of what is already going wrong and likely to get even worse. Dry areas around the world will probably get even drier; wet areas, even wetter. Storms will strengthen. And nature may be the hardest hit because, unlike humans, it can’t anticipate and adjust easily to the new temperatures, rainfall, cloudiness and other elements that come along with global warming. Most of McKibben’s survey of dangerous changing climates is set in his native Vermont, where rising temperatures mean more troubles with river flooding, ending up in break-the-bank investments to move roads and build new infrastructure.

Compared with the preindustrial era, the average temperature of the planet has already risen by nearly 1 degree centigrade. Another few tenths of a degree will appear as the climate system catches up with all the heat that has already built up from the accumulation of warming gases. In Copenhagen last December, as in many other global forums, the world’s biggest countries signed a pledge to limit temperature increases to just 2 degrees. Adding up the actual policies that those same governments claim they are implementing puts the planet on a path for perhaps a 4 degree increase by 2100, with even higher temperatures later. Already, aspirations and actions are headed in opposite directions, but just how much warming can the world take?

McKibben is a ringleader in the movement to stop warming at 1.5 degrees. With that goal in mind, which would require deep and immediate cuts in emissions, *Eaarth* is a manifesto for radical measures. New technologies alone won’t be enough. People must learn to do with less, and they must become more self-sufficient so they tread more lightly, carefully
and gracefully on the planet. Local, organic foods should be prized over industrial agriculture. Decentralized power should be favored, McKibben says, because central power stations are what got us into this mess in the first place. (He is particularly angry about coal, and thinks that none of the alternatives—such as large clean-coal plants or new nuclear plants that cause no emissions—are economic.) Vermont, which is in the throes of a back-to-nature movement, is a model for what can be done.

The standard critique of such advice is that it is politically naive to expect people to change quickly, especially when less-is-more strategies mean lower standards of living for most of us. Indeed, all the trends in industrial growth point in the opposite direction. McKibben never offers a vision for how real political systems might deliver the policies he wants, and tiny Vermont is rarely the nation’s guiding star. But there should be room for big, naive ideas when the planet faces a crisis that may require totally new thinking.

The real trouble with McKibben’s advice is that he never carefully checks to see whether his model lifestyle will stop temperatures from rising. Some of what he proposes, such as eating less meat, does make sense in a warming world. Getting calories from beef is about one-third as efficient as getting them from plants directly. A diet based on lots of cows means more land use and more processing—and that leads to more emissions. Worse, both ends of the bovine beast vent lots of methane, which is a strong warming gas. But buying local and organic foods—a good idea for taste reasons and possibly also health—has little impact on global warming in reality. Some studies suggest that buying locally grown, organic foods actually increases emissions by causing more car trips to the market. McKibben likes the rural life, though most evidence suggests that dense urban living is a lot more efficient. A clean, green future may look more like Shanghai than Middlebury.

Conspiracy theorists see McKibben’s sort of advice as evidence that the Far Left wants to use global warming as a strategy to advance a broader social agenda, and it is hard to calm this thinking. Going green is more than just a strategy for protecting vegetation; it is a way of life. If becoming environmentally friendly is the goal, then individual lifestyle choices that are hard to regulate and often costly to alter won’t be the overarching solution to cli-
One of the most worrisome effects for humans of rising temperatures certainly will be their impact on water. Already most countries do a terrible job of managing their scarce water resources. A thoughtful new book by Steven Solomon argues that over the course of history, the management of four “water challenges” has determined the success and failure of civilizations. He offers a way to think about how societies will fare in dealing with new hydraulic stresses, many of which will accompany a changing climate.

First, Solomon contends that the earliest civilizations thrived because they found ways to squeeze extra benefits from the successful management of water supplies for agriculture. That meant taming and channeling rivers as in ancient Egypt or the modern American West. Those extra benefits took the form of economic growth and larger, more capable governments. Managed well, benefits begat benefits and the state grew. Second is naval power, which successful civilizations used to turn a barrier against travel (the ocean) into a means of efficient transport and force projection. Third is water power, which was the first prime mover for the industrial revolution until steam engines appeared on the scene. And fourth is sanitation and drinking water, which have been particularly large challenges for modern cities, where dense living is a liability unless fresh water can be piped in and sewage disposed of.

This sweeping thesis is inevitably Water’s greatest weakness. “Water challenges” is such a broad concept—especially since Solomon includes all of naval power along with more traditional hydraulic concerns—that it is not hard to weave most facts into this grand theory. And none of Solomon’s theses is new, although their treatment in a single, well-written volume that covers the whole sweep of history is a tour de force.

Looking to the future, Solomon sees water troubles defining the twenty-first century, and he might be right. Global population growth is concentrated in areas that are already poor in water resources, such as China, India and the Middle East. Whether climate change multiplies those stresses will depend on if governments turn the issue into a matter of war or an opportunity for innovation.

The pessimistic view is that climate change could turn scarce water into a prized commodity. Indeed, Solomon sees a future where
foreign policies are “realigned and influenced by water-driven alliances, just as they were in the last century by oil.” In theory, it is not hard to see scenarios that plunge the Middle East into an even-deeper crisis as water supplies become more scarce. Many of the region’s rivers—think the Tigris and the Jordan—cross borders between warring states. But in practice, it would take a lot for water to eclipse ethnic, regional and traditional power struggles to become a dominant force in foreign policy outside of a few niche regions. The Middle East was hardly all roses before the water started running short.

The other, optimistic view is more compelling. Solomon’s book makes it clear that better management of water resources is vital; and, happily, little effort is needed to improve in this area. Rampant subsidies encourage waste, especially in agriculture, and the technological potential for using water more wisely has barely been tapped. Solomon suggests that perhaps three-fifths of the world’s water supply is wasted through leaky infrastructure and other bad management. The productivity of what gets to final users is shockingly low. About 80 percent of California’s water goes to farming, which produces only 3 percent of the state’s economic output. That massive misalignment has endured for many years, but the great drought that has descended on the American Southwest is now focusing minds on solutions. For too long, California has lived on other peoples’ water—drawing far above its quota from the Colorado River, but state politicians (with a helpful push from the federal government and courts that are protecting endangered species that need water of their own) are slowly chipping away at the vested interests.

Water crises, as in so many other areas of politics, help spawn solutions. London finally started fixing its sewer system—which dangerously had its water intakes downriver in the filthy Thames—after a “great stink” in 1858 forced Parliament to stop dithering. Climate change will surely bring other pivotal challenges, and when societies focus on the difficulties, they will find much fat in how they use water.

For most authors who see warming as a looming crisis, climate change isn’t just another policy problem. It is a challenge so grave that it will force humans to rethink their relationship to machinery. Must the industrial Frankenstein be stopped by breaking apart the machines into smaller and more controllable systems? Or should industrial society build even-bigger machines run by larger networks of professional experts to fix the problem? The history of success in managing water challenges is largely a story of massive infrastructure such as canals and dams. Most of these projects required investments so large and risky that governments usually played the central role. The world’s forty-five thousand large dams, for example, are mainly the product of government funding and large, state-owned enterprises. Big dams needed big money, which inevitably created strong pressures for central planning. Herbert Hoover, a mining engineer before becoming president, said, “every drop of water that runs to the sea without yielding its full commercial returns to the nation is an economic waste.” Stalin, as Solomon points out, set Soviet dam policy according to the same maxim.

For the most part, where governments
have been able to appropriate the surplus from water infrastructure for themselves, they have turned inward and sclerotic. China suffered that fate when a huge inland canal built in the fifteenth century let the government exert stronger control over a larger territory. The U.S. Army Corps of Engineers—master of huge public-works projects and champion of massive public subsidies—suffered a similar fate in the American West as it created agriculture and cities out of arid lands. (It is particularly ironic that so much of America’s libertarian agitation emanates from that region.)

Solomon shows that when the incentives are right—where governments and markets are allowed to focus on the real costs of and opportunities for using water resources—much better management of water systems follows. In the United States, the demand for water was rising steadily until regulators started getting serious about its scarcity and quality in the 1970s. Water use peaked in 1980. Since, it has declined one-tenth. Across the industrialized world, from the 1960s on, the economic productivity of water—the dollars-of-economic-output per cubic-meter-of-water-inputs across the economy—has risen by a factor of roughly four. In water, and in most resources, modern economies are actually headed toward “postresource” futures. Unlike in the agricultural and industrial revolutions—where raw resources such as soil, timber, coal and oil determined success—it is ingenuity (and governance that encourages smarts) that will largely define the future success of modern societies. Stresses on water supplies may yet make life nasty, thirsty and short. But with a little bit of effort to get the incentives right, most of the world’s water problems don’t seem that hard to solve.

It has been difficult to focus on real solutions because nearly all of the analysts who are most concerned about climate change and the other ills of modern energy systems are blinded by a stock set of answers. Industrial Frankensteins fired with fossil fuels are the problem. Local and renewable are the watchwords for repairing the mess. But the realities probably point in the opposite direction. Fixing global warming will require more machines, less localism and perhaps even more fossil fuels for a period.

Among the titles that purport to work through the technological solutions to climate change is Al Gore’s *Our Choice*, a beautifully produced description of the world energy system. Prior to its release, Gore claimed (on the op-ed page of the *New York Times*) that his plan would allow the United States to shift fully to emission-free (mainly renewable) power in a decade, though it is hard to find much serious analytical support for that assertion in his book. Other analysts arrive at similar conclusions. A big essay in November’s *Scientific American* offers a plan for the planet to go fully renewable by 2030, but its authors never actually contend with the costs or the reliability needed if such a vision were to become a practical reality. If you sift through the citations in most of the offerings calling for radical change, you find an echo chamber of analysts who usually cook the numbers to make central power supplies (e.g., nuclear) look ugly, while renewables come out crunchy green.

The whole case for renewable power needs a lot more scrutiny. So far, the largest renew-
able power systems are giant hydro dams, but those are falling out of favor because of their environmental impact. That leaves wind and a few other sources, such as solar and geothermal. (Often these systems also have large footprints—such as massive wind farms—but since they are “green” power, their backers usually ignore the horrors they cause to landscapes.) The best sites are often far from people, which means more power lines and a still-bigger footprint. But the people are not fooled, and renewable power systems are increasingly finding it hard to get local consent. That has pushed developers of wind power offshore, where the giant towers are less visible and the power lines are hidden on the seabed far from human view—although probably not much less of a footprint on nature. Others look for more local supplies, such as solar panels on rooftops, but that option—the sexiest and politically most attractive—is extremely costly. And when it comes to electricity, it is proving very difficult to build and operate renewable energy supplies with the reliability that is essential, not to mention on a scale that will make them relevant for cutting emissions. Similar practical troubles are emerging with energy efficiency, which is in theory the cheapest way to avoid emissions, yet in practice has proved very difficult to implement as widely as necessary.

At this stage, all that is really certain is that the viability of renewable power on the scale needed to make a dent in emissions is unknown. While the days are still early, the current craze for renewable power could end badly. So far, most of the industry thrives on policies that are designed to hide true costs, such as mandates that force utilities to purchase renewable energy regardless of the expense and subsidies like so-called “feed-in tariffs,” where the government guarantees lucrative prices for renewable-energy suppliers that largely divorce the industry from real market risks. (In some countries—Spain is the most prominent recent example—all of the market distortions have produced unsustainable bubbles in renewable-energy supplies.) And even if renewable power does work, it seems likely that energy systems will become bigger and more centralized, not local and huggable. Interconnecting large numbers of intermittent supplies will require new technologies—notably, cost-effective power storage—and professional, centralized management.

The future may also lie heavily with fossil fuels. Natural gas is the big wild card in the energy system because it is the cleanest and most flexible fossil fuel, and new technologies are making it economically viable to produce massive supplies of the resource that were previously beyond reach. If gas supplies can scale up rapidly then it, by far, would be the cheapest transition to a lower-emissions future. The numbers are staggering. Switching nearly all of the coal-fired power plants in the United States to natural gas would lift total U.S. demand for this resource by half. Beyond fossil fuels, getting serious about cutting emissions will also probably require many new, large, nuclear-power stations.

Global climate change is the result of a long chain of causes and effects, and each link carries a dose of uncertainty. Industrial societies pump warming gases into the atmosphere. As they build up—at a rate that is hard to forecast because the processes that

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cleanse the atmosphere are not known with much surety—some level of warming follows. With all that warming comes other changes, such as new amounts of rainfall and different storm patterns. And that, in turn, affects things like ecosystems and water supplies that humans ultimately care about. As the chain of causes and effects lengthens, the uncertainties multiply.

One of the oddest things in the public debate about warming is that the so-called skeptics have mostly leveled their attacks on the first links of the cause-and-effect chain, where the science is already about as airtight as it can get. The safest bet in climate science is that warming gases are rising and global temperatures are responding largely as expected. (Another odd thing is that “skeptic” has become a pejorative term when, in fact, science thrives on skepticism.) But the doubters are barking up the wrong tree. The uncertainties and the unknown unknowns are much bigger farther down the chain.

These days, the most dire news is coming from the world’s icy regions. In Antarctica, massive ice shelves are calving into the sea, and as that ice melts, the much-larger quantities sitting atop the continent will slide more quickly into the oceans and raise sea levels. (The same process of melting and sliding now seems to be fully under way in Greenland. Together, these areas hold most of the world’s frozen water.) These places matter because they are highly sensitive to temperature change, which makes them an early warning sign. They are also pivotal to feedback loops that are likely to amplify warming in nasty ways. Because ice is white, it reflects most incoming sunlight back to space; higher temperatures leave behind darker surfaces, such as oceans, that absorb solar heating more readily and beget still more warming.

The exact events that would unfold this far along the chain are hard to pin down. Uncertainties in how ice sheets will respond to changing temperatures, for example, yield a wide range of possible fluctuations in sea level. Over the next century, the seas may rise just a foot, which many coastal societies could probably tolerate, or perhaps up to six feet, which would be difficult for even the richest and most capable countries to handle. It has proven very difficult to narrow the forecast because the closer scientists probe, the more new unknowns they discover.

A troika of new books on the Arctic make the area more accessible to readers, many of whom are flocking to the region as tourists. The tiny Canadian outpost of Churchill has become the polar-bear tourism capital of the world. Visits to the North Pole, which a century earlier required sled dogs and a hubristic
willingness to risk death, are now common. The Northwest Passage, open during summer months for a few ships in recent years, is now ferrying tourists, and will probably soon reliably host large numbers of cargo ships keen to shorten the travel time between Europe and Asia. People often gather to witness an endgame—much of what they are seeing in the icy Arctic may soon disappear.

The polar bear is poised to become a prime mover of climate politics, just as “charismatic megafauna” have driven so many other ecological policies. In a bold move, in 2008 the United States deemed the bear a threatened species under the Endangered Species Act—a first step that could lead to protective regulations in the future. The chief cause for this listing was a steep decline in Arctic ice. Less ice means fewer platforms for the bears to hunt their main prey—seals.

These new books focus a lot on the bears. Richard Ellis, a perennial visitor to the region, offers *On Thin Ice*—a chatty and thoughtful but disjointed diary of bears throughout history. Alun Anderson’s *After the Ice* looks at the broader impact of warming on the region’s geopolitics and environment, though the book takes on so many themes it never really gains traction. Charles Emmerson’s *The Future History of the Arctic* has the strongest narrative of the three because his is most firmly grounded in a knowledge of the region’s past. Anderson and Emmerson both struggle with the question of whether a warming world will also open the Arctic’s vast reserves of oil and especially natural gas. In Emmerson’s view, a model for exploiting the region is Norway, which already taps similar resources while setting the world standard for ecological stewardship. Norway’s success rests on a strong, well-run government directing a highly competent, state-owned oil company to tread lightly while producing ever-more hydrocarbons at lower cost.

In the Arctic, the odds of very nasty outcomes are high. This should compel even-swifter regulation by governments, not a universal head-in-the-sand stance. And all the uncertainties compel even-stricter action as a precaution against horrible outcomes. This will require coordination by governments. Pollution comes from a world economy; effects of regulation are not concentrated within any single nation. Only by working in concert will countries begin to dampen their concern that onerous regulations at home will push industry and jobs to other dirtier locales.

A full-blown system for international cooperation will take many decades to build. Today, the key question is how to get started. The answer hinges on two countries: America and China. As the Copenhagen conference made clear, the Chinese have been wary about costly international obligations that could derail their economic miracle, and they fear the external inspection and enforcement that would accompany any serious plan. The United States, which has the highest per capita emissions of any major economy, still has no serious federal policy, even though warming has been on the agenda for at least twenty-two years (since the summer of 1988, when high-profile congressional hearings originally concentrated national attention). A modest first step, the Waxman-Markey bill which passed in the House last June, included a
strict warning that nothing much would be done in America unless other countries, notably China, implemented similar policies. Just to make sure that point was clear, the bill also included a form of trade sanctions that could bludgeon other nations into compliance. And President Obama’s left-leaning coalition includes trade unions whose members fear job losses from changes in climate policy and support limits on emissions only if the economic playing field is leveled with the Chinese.

The most insightful look at how this relationship might unfold isn’t in the nonfiction section of the bookstore. It is a novel—Matthew Glass’s *Ultimatum*, which appears in paperback this spring. The curtain rises on this fast-paced climate thriller with the election of the forty-eighth president of the United States after a campaign based on straight talk about the need for a massive relocation plan. Sea levels are rising and millions of Americans need help moving to higher ground. But shortly before taking office, the green president gets a secret briefing from a government agency that has early, accurate evidence that the seas are rising even faster than expected. More relocation will be needed; efforts to cut emissions must be redoubled. (The Kyoto talks, which by then have reached round four, are bogged down, as in Copenhagen, by squabbling and a string of unfulfilled promises.) With that briefing, his whole presidency is rewired to focus on a bigger relocation effort and on forcing China to do its part in emission control.

Glass has quick prose and clever insights into the making of a presidency. He adds smart color through his attention to speechmaking and White House intrigue. This book isn’t *Primary Colors*, perhaps the best novel on American politics in the last couple of decades, but it is a terrific and fast-moving story that never loses focus or pace.

Glass is at his best when grappling with global warming’s two central geopolitical challenges. First, what’s the best strategy for getting cooperation? The new president campaigned on support for the Kyoto process, but he knows the UN-sponsored talk shop doesn’t deliver results. All the top EU leaders are unified behind Kyoto, but they too know it is a dead end. The UN secretary-general is a pathetic figure who must be placated and also demands that Kyoto keep its monopoly on global-warming diplomacy. Universal multilateralism becomes a death march, and the new president struggles to craft a secret deal with China while pretending to favor Kyoto, because the political costs of anything anti-Kyoto are too painful. For Glass, the only route to broader multilateral solutions wisely starts small—initially with just the top two polluters. Yet the new president’s failure to engage other key players—notably in Europe, Japan and Russia—makes it hard to convince the Chinese that serious cooperation is essential. Neither hypermultilateralism nor pure bilateralism can save the day.

Glass also reminds us that serious deal making must address a second problem: Who is in charge? The issue that occupies most of this fictional new president’s time is the question of who speaks for Beijing. Deals are made by one faction and then rejected by another. Bargaining of both the explicit and tacit varieties is plagued by wrong and misread signals. Not only is it hard to know who is the true Chinese agent, but China’s interests also

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deviate radically from those of most Western countries; the president struggles to understand what could really clinch a deal. For the Chinese, says Glass, survival of the party is everything. And the ugly outcome reveals just how far they will let things go until extinction looms.

The final deal, interestingly, is a hard-nosed plan to make painful, deep cuts in emissions. Not a page of this book is devoted to the question that occupied nearly all of the talks in Copenhagen: financial transfers from rich countries to poorer nations that are more reluctant to spend their own money on global problems. It is hard to see, in the real world, how Western countries will agree to transfer large amounts of money and technology to their economic competitors, such as China. (Transfers to the poorest nations, especially to help them adapt to climate change, are a different matter—if a scheme can be devised to make them actually useful. But in the no-nonsense geopolitics that are needed to solve global warming, those transfers are a lot less important than the great-power ultimatums that occupy Glass.)

If anything was learned in Copenhagen it was that the sprawling UN system is not the best way to craft global climate policy. Smaller and more flexible groups are needed. There is no shortage of candidates. The G8, the G8+5, the G20, the Asia Pacific Partnership, the Major Economies Forum and others are all toiling away. The real problem is that no major government has actually done much in any of these forums except host meetings and issue declarations. We cannot avoid the conclusion that most of the world actually has no interest in spending resources to slow warming even though the political benefits from cheap solutions are huge. Thus the outcome is symbolic politics: bold goals such as limiting warming to 2 degrees and empty plans for actually meeting those goals.

The Copenhagen conference has opened a vacuum in governance on the important issue of reducing global warming. Filling it will require new policies in the biggest emitter states, practical strategies for international cooperation and a lot of political elbow grease. So far, none of that is evident. And even once it begins, gases will still accumulate in the atmosphere and the climate will change. The world is in for a lot of warming. Unfortunately, the grim look at what could happen is now easy to find on both the nonfiction and fiction shelves of the bookstore. □