The Postmodern Greenhouse: Creating Virtual Carbon Reductions From Business-as-Usual Energy Politics

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Climate change presents a fundamental challenge to the current global energy regime. Under the Framework Convention on Climate Change, the international community is developing the architecture of a policy response. Three serious flaws are examined: (a) the potential sacrifice of small island states, (b) the use of market-based policy measures to commodify the atmospheric commons, and (c) the substitution of carbon sequestration for meaningful reductions in energy use. The authors' analysis of the politics of climate change, based on these issues, suggests a new understanding of ecology is emerging—what they term postmodern ecology*—in which a global environmental crisis is risked to secure the future of the world energy regime. An alternative, based on principles of sustainability and equity, is proposed that would require abandoning the global energy status quo.*

Key words: *Climate change, energy system, equity, sustainability, ecological justice*

Much has been made of the "new economy" in recent years, as if the material and energy basis of the global economy had somehow been transformed. Few illusions could be as unconvincing or as unfounded. Beneath the new economy is the "old economy" of the Industrial Revolution, where we burn massive quantities of fossil fuels, transform and transport enormous amounts of materials, and do so largely without regard to resulting social and environmental harm. Although this age trumpets its nanotechnology breakthroughs and genome science revolutions, the altered chemistry of the planet's atmosphere is more likely to be its defining emblem.

Scientific analyses of human-induced change in atmospheric chemistry suggest higher temperatures (i.e., 1.4°C to 5.8°C by 2100), greater weather extremes, and rising sea levels (i.e., 0.1m to 0.9m by 2100) in the new century (Intergovernmental Panel on Climate Change [IPCC], 2001b). Ecologically, there will be changes to the distribution and abundance of species that will increase the likelihood of accelerated biodiversity loss. Social systems of food and fiber production, transport, and settlement, together with associated infrastructure, will be disrupted. Human health will be affected through changes to temperature-related illness, especially from pathogens. Coastal and marine ecosystems are of particular concern, both because of ecological losses and the necessary abandonment of settlements, communities, and even entire islands. Developing nations will bear disproportionate costs because their human health, agricultural production, and infrastructure systems may be less able to address the problems that a warmer planet will induce.

Global climate change presents modernity with an unprecedented contradiction. Essentially, the normal functioning of the international energy system has now been linked to a legacy of carbon dioxide releases to the atmosphere[1] that results in the increased atmospheric retention of the heat from solar radiation. Ecol-

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ogies of every kind and the diversity of biological life on earth are threatened, and equally important, inequalities of wealth and risk are entrenched by the maintenance of the energy monopolies that have, literally, fueled modernization. A disturbing lesson has emerged, namely, that industrial society, the conventional energy system, and protection of the values of ecological sustainability and social equality cannot coexist.

To date, however, the international policy response, notably under processes set forth by the United Nations Framework Convention on Climate Change (hereinafter FCCC, see UNFCCC Secretariat, 1995), has sought ways to maintain the basic elements of the conventional energy system and slowly reduce its output of greenhouse gas (GHG) emissions via nationally differentiated targets. Through the use of the so-called Kyoto mechanisms, a set of market-based policy instruments has been created in which emissions from the industrial world can be reduced at lowest cost through newly created markets for GHG emissions trading and other innovative policy initiatives.[2] In effect, these mechanisms are creating a commodity from what was previously an ecological commons, evoking an array of social, ethical, and political concerns.

A recent development in these ongoing negotiations is the withdrawal of the United States from the FCCC process. Concern over the ecological implications of the Kyoto mechanisms did not prompt the action by the United States. Rather, the expressed rationale by the world's largest GHG polluter is that participation would economically disadvantage the country. Certainly, the U.S. refusal to participate in the treaty weakens the effectiveness of the policy regime. But, it also underscores a deepening conflict between the modern world's ideals of progress and the requirements for basic change in the international energy regime if we are to have any hope of averting climate change.

Below, we examine the political economy of the modern energy regime in the context of the negotiations to address the problem of climate change. After describing the features of current negotiations, three key issues are discussed: (a) the implications for small islands and vulnerable coastal lands, (b) the effects and effectiveness of market-based policy responses to trade responsibility for GHG emission reductions, and (c) the role of carbon sequestration in reducing GHG emissions. As to the first, we argue that a form of "ecological triage" is taking place in which wealthy continental states appear to be prepared to sacrifice small island states to retain energy-intensive lifestyles. In the second case, an "airy politics" is diagnosed as being the result of market-based trading policies in which energy consumption may continue unabated, but virtual carbon dioxide emissions will confidently be found to have declined. And in the third case, it is suggested that we are unlikely to see a genuine increase in the carbon store, but business-as-usual will continue for the fossil-fuel section of the energy store.

Through these cases and, more broadly, an analysis of the politics of climate change, we seek to demonstrate an emerging revision of ecology (that we have called postmodern ecology) in which a world energy system status quo is defended at the expense of causing a global environmental crisis. An alternative pathway, predicated on sustainability and equity, is proposed with civil society as the agent for political advocacy. In this alternative, real and substantial change to the world energy regime is inescapable.

Negotiating Atmospheric Futures

International efforts to address the prospect of climate change are centered on negotiations to implement the FCCC. Three sets of interests are shaping these negotiations—those of science, business, and government. Their interactions are jointly conceiving and creating a nature-society regime[3] that will govern human and nonhuman futures alike in profound ways (including some we surely cannot now fully grasp).

With the FCCC having entered into force after the 1992 Earth Summit, international negotiators are focusing their attention on its implementation, a process that occurs primarily through the venue of annual Conferences of the Parties (COP). This process is being shaped by a political dynamic involving the interests of science, industry, and nation-states. Initially, communications from these interests presented a confusing picture of the extent of the problem of climate change. This was exploited by some skeptical scientists, but especially by industry lobbyists and pro-business politicians in the industrialized countries, to discredit claims of global warming from the buildup of so-called GHGs.[4] An apparent shift has taken place, however, wherein the bulk of the scientific community, the majority of nation-states, and a growing number of business leaders have concluded that at least some level of restriction to the emission of carbon dioxide (or CO_2) and other GHGs is needed.

The Kyoto Protocol (resolved in December 1997 COP-3) sets binding reduction targets for industrial nations (namely, those of North America and Europe, as well as Japan, Australia, and New Zealand, which are collectively identified as Annex I nations in the FCCC).[5] These countries are to reduce their collective GHG emissions 5% below 1990 levels, according to nationally differentiated targets established in the protocol. This collective reduction is to be achieved between the years 2008 and 2012. Such a cut amounts to only a small contribution toward the 60% reduction estimated by the UN-sponsored IPCC[6] as needed to stabilize atmospheric concentrations of GHGs (IPCC, 1996c).

At COP-4 in Buenos Aries (1998) and COP-5 in Bonn (1999), great attention was given to a range of policy instruments (called "flexibility mechanisms" in the Kyoto Protocol) that would assist Annex I countries in lowering emissions. COP-6, held in two parts (The Hague in November 2000 and Bonn in July 2001), likewise focused on these policies. Despite the absence of the United States at the Bonn session of COP-6, the meeting carried many of the broad policy positions previously advanced by the United States. With much of the policy architecture firmly in place, the absence of the United States as a negotiating party at COP-7 (held in October/November 2001, in Morocco) had no major policy implications.

The focus on market-style policies is partially a response to the failures of most industrial nations in the initial round to lower emissions by voluntary measures. The COP meetings have mainly focused on realizing low-cost abatement options by allowing wealthy nations to trade with eastern European and other less well-off members of Annex I for the opportunity to slow emissions growth among the latter (through technology transfer). The Kyoto Protocol instruments are based on creating a new market to manage the atmosphere. In effect, under the auspices of the United Nations, an atmospheric commodity trading system is being established. If designed properly, many leaders and experts of industrial nations believe that global policy can constitute the atmosphere as a well-managed environmental property sustained in the interest of present and future generations, an idea broadly consistent with the environment-development arguments promoted by the Brundtland Commission.[7]

We disagree with this belief and offer below three specific cases where the well-managed property system, promised under the existing negotiations, is likely to make the shift to a sustainable and equitable energy system more, not less, difficult.

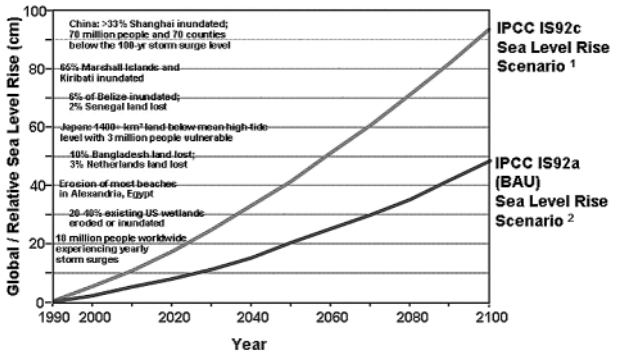

Figure 1. Impacts of Climate Change–Induced Sea Level Rise on Selected Coasts and Islands Worldwide

Source: Gaffin (1999).

Note: IPCC = Intergovernmental Panel on Climate Change. BAU means Business as Usual.

a. IS92c assumes high climate sensitivity parameters.

b. IS92a assumes medium climate sensitivity parameters.

Ecological Triage: Gambling With the Future of Islands

Global average sea level is rising as the climate warms. In turn, this has increased coastal inundation. The South Pacific Regional Environmental Programme reports that rising sea levels have already swamped several small islets in Kiribati and Tuvalu, destroyed coastal roads and bridges, and caused traditional burial places to collapse. Forecasts of future sea level rise vary greatly, but the central range of the IPCC scenarios suggests an increase in the vicinity of 0.5 meters over this century (IPCC, 2001a).[8] Sea level will continue to rise for the next two centuries regardless of future GHG emissions, such is the extent of the lag effect between emissions and the response of the climate and ocean systems.

For coastal communities and especially those on small islands, increasing sea level means the loss of a way of life for some and the loss of habitability on others. Sites for habitation and infrastructure dwindle, availability of fresh water and indigenous food sources is diminished, and normal economic activity is made impossible as a result of coastal habitation threats. The IPCC IS92 scenarios (IPCC, 1992, 1996b) for projected sea level rise and their impacts on selected coasts and islands worldwide are depicted in Figure 1. For a 20-centimeter rise, 18 million additional people worldwide will experience yearly storm surges, and at

an 80-centimeter rise in sea level, 65% of the Marshall Islands and Kiribati will be inundated. It is estimated that a 100-centimeter rise in sea level could inundate 70% of the landmass of the Seychelles (United Nations Department of Public Information, 1999).

Small islands will bear among the worst harms from global warming, yet this crisis is not in any way of their making. Island communities can have little impact on global carbon dioxide emissions because their per capita emissions are small and their populations low. The average 1996 per capita emissions for 32 island states and territories that are members of the Alliance of Small Island States (AOSIS) was 0.9 metric tons of carbon dioxide equivalent (molecular weight) (Marland, Boden, & Andres, 2001). By contrast, most Annex I countries exceed 6 tons of carbon dioxide per capita, with the United States in excess of 19 tons per capita.

The Kyoto Protocol lacks any provision to prevent the sacrifice of island states. In fact, its elevation of economic efficiency above sustainability promises to risk this prospect as part of the ineluctable logic of a global least-cost strategy. Cost-benefit calculations among wealthy countries will direct attention to emission trades that are cheap and easily managed in national portfolios (see the discussion below of airy politics for details). This almost certainly will favor actions that are well suited to the technological and economic strategies of the Organization for Economic Cooperation and Development. Such a rationale for international action can bring little comfort to island states. The omission in the protocol of any measure of the effectiveness of its policies in terms of island impacts is disturbing. Islands are left to experience the first major threats from surface warming, whereas the rest of the international community congratulates itself for committing to act on the problem.

With use of the earth's atmosphere as a sink having been put up for bid as a result of the Kyoto Protocol, island countries will have to compete with the rest of the world if they expect not merely to participate but to negotiate terms of participation. These mechanisms may constitute the best pathway to accessing much-needed funds for adaptation to climate change. This is doubly ironic. First, island states will be forced to acquire the means to reduce their emissions cheaply, even though their releases did not cause the problem. Second, precisely because their emissions are small, they will be unattractive candidates for trading. Compared to larger nations, small island states present higher transaction costs per ton of avoided GHG for

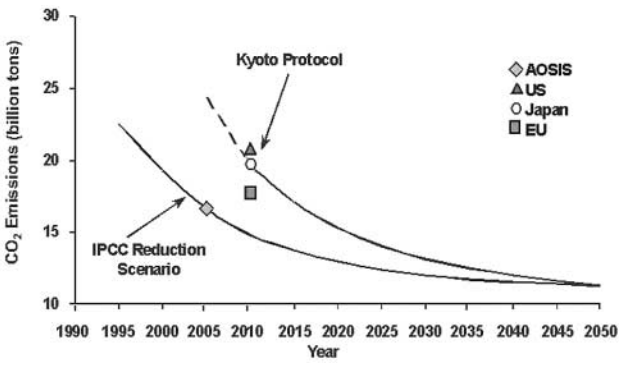

Figure 2. Climate Change Negotiating Positions
Note: AOSIS = Alliance of Small Island States; EU = European Union; IPCC = Intergovernmental Panel on Climate Change.

emission traders because they require similar overhead expenditures for winning a bid, but these costs are spread over very small amounts of avoided GHG. Empirical evidence supports this expectation. A review of 122 international climate change projects identified only 4 involving AOSIS nations (Foundation for International Environmental Law and Development, 1999).

Island countries must also struggle with the problem of ensuring that the Kyoto measures are used in a manner that is consistent with the objective of reducing GHG emissions. As Figure 2 indicates, the negotiated reduction to date is far less than the IPCC indicates is needed to avert a level of climate change that is certain to threaten island sustainability. Pressuring the wealthy continental states to adopt the IPCC reduction scenario (see Figure 2) poses a difficult political challenge, on which AOSIS must expend a great deal of energy, even though there is little likelihood that the concerns of the island states will sway the decisions of the international community.

In brief, the Kyoto framework may represent a significant barrier to island sustainability. The protocol is shaped by the needs of wealthy continental interests who, because of their comparatively lesser vulnerability (especially those of North America, Europe, and Australia), can "go slow" (Nordhaus, 1991) and have adaptation strategies available to them that are simply not feasible for small islands. In a reverse of the more typical triage strategy, those at greatest risk are being left to fend for themselves, whereas continental states are provided "flexibility" to protect their self-interest (Byrne & Inniss, 2000, pp. 21-44). Islands have a dual interest in the rapid development of renewable energy technologies, both for their domestic energy service needs and for averting the worst impacts of climate

change. Regrettably, nothing in current international negotiations augurs well for a significant change to the existing energy system that the continued well-being of island communities requires.

Airy Politics: Turning the Atmosphere Into a Commodity

International climate change negotiations under the FCCC have largely focused on policies to assist participating nations in meeting GHG emission targets set under the Kyoto Protocol. To meet these modest targets, negotiators have promulgated broad rules for the use of emissions trading and joint implementation of projects among Annex I countries that would purportedly lower the costs of meeting the protocol's mitigation goals. This effort was partially in response to the failures of most Annex I nations in the initial round to lower emissions by voluntary measures. Negotiators also fashioned a clean development mechanism (CDM) intended to attract developing country partners for Annex I efforts to lower GHG emissions. These mechanisms mainly focus on realizing low-cost abatement options by allowing wealthy nations in the Annex I group to trade with eastern European and other less well-off countries for the opportunity to slow emissions growth among the latter (through technology transfer) in lieu of cutting their own.

Emissions trading allows the Annex I to buy GHG emission allowances as part of national strategies to meet their Kyoto Protocol GHG reduction targets. What will be an "efficient" trade under the Kyoto Protocol? The emission caps set in Kyoto for Russia and the Ukraine call for carbon dioxide emissions in 2008 to 2012 that are equivalent to each country's 1990 level. However, as a consequence of economic implosion on the way to their respective capitalist transitions, neither country is expected to realize 1990 emission levels by 2008 to 2012, even under generous business-as-usual forecasts. This is because Russia's emissions are currently 36% below their 1990 level, and the Ukraine's are 51% lower (International Energy Agency, 2001). Therefore, Russia and the Ukraine can sell their emissions credits to other Annex I nations, and the purchasers can reduce the extent of their necessary domestic emissions reductions by making money, that is, by selling high-efficiency technology to both countries.

Furthermore, efficient emissions trading could paradoxically increase global GHG output. Technology transfers to Russia and Ukraine that enable them to increase their emissions by, say, 35% and 50%, respectively, will mean that both countries remain below their allowable maxima under the protocol, while permitting other Annex I buyers to also increase their domestic emissions. Before the United States withdrew from the FCCC, it was explicit in its strategy to trade with former Soviet bloc countries to meet as much as 56% of its Kyoto commitments (see Kopp & Anderson, 1998). Through such trades, together with other "flexibility" measures, there is the arresting prospect that the United States might be able to meet their Kyoto obligation by actually increasing its carbon emissions by 10% (Flavin & Dunn, 1998; Pearce, 1998).

The purchase of so-called hot air allowances, or allowances from other nations that are not accompanied by meaningful long-term domestic carbon reduction measures, has the merit of profit, if not environmental sustainability. Relying on purchased allowances also reduces the impetus for significant technological change in Annex I countries, thereby sheltering their populations from the inconveniences of "inefficient" reductions of carbon dioxide. In effect, emissions trading allows carbon dioxide emissions growth for countries that can afford to pay for permits and relies on those who cannot to bear the de facto burden of emissions abatement.

The Kyoto Protocol also authorizes joint implementation projects among Annex I countries. Under this policy, countries may receive credits toward meeting their targets through project-based emission reductions or carbon sink expansions (such as reforestation) in other countries. The private sector is to lead in the execution of this mechanism. It is not obvious how joint implementation, as defined in the Kyoto Protocol, can serve the goal of sustainability because it will only offset one Annex I country's increased emissions with another's reduced emissions (for example, countries in western Europe count the sink value of forests planted in eastern Europe to offset their own emission growth). With Annex I nations responsible for nearly two thirds of cumulative carbon dioxide emissions since 1950, and with the need to reduce world carbon dioxide emissions to 60% of 1990 levels to stabilize GHG levels in the atmosphere (IPCC, 1996c), a program of emission offsets is unlikely to produce large-scale GHG reductions.

As well, the CDM is promoted in the protocol as a means for North-South cooperation in lowering GHG releases. It will allow industrialized countries to earn credit for carbon reduction activities in developing countries. The rationale of the mechanism is that

wealthy countries will be able to reduce emissions at lower cost through projects in developing countries than they could at home, whereas developing countries will be able to secure low-carbon technology that can allow them to grow more sustainably. Importantly, certified emission reductions under CDM are scheduled to begin immediately with adoption of the Kyoto Protocol and will count toward compliance with the first budget period of 2008 to 2012.

One problem with this approach is the type of technology transfer that might ensue. Promoting the transfer of technology to those that are profitable to northern suppliers—which is what CDM facilitates—vests the incentive for transfer in the economic calculations of the Annex I group. Meeting developing nations' needs for technology would require transfers that are responsive to their circumstances, yet CDM may often accomplish the opposite, shaping such transfers to meet the circumstances of northern exporters, despite the best efforts of governments in recipient countries.

Furthermore, CDM raises the possibility of phantom emission reductions. It is in the interest of firms and project managers in developing countries to overestimate future increases in carbon dioxide emissions, with the outcome that the CDM arrangement substitutes present-tense emissions growth in Annex I countries for projected emission reductions in developing countries. In practical terms, nonexistent emissions that may (or may not) appear in the future are "lowered" to spare wealthy countries the costly need to cut actually existing emissions.

Notwithstanding the rhetoric of reduction, Annex I emissions trading and CDM respond to economic rather than ecological need. Their first priority is to introduce profit into efforts to manage the atmosphere, not to act on danger signals of surfacing warming. The loophole of hot air allowances has been known since the 1997 Kyoto negotiations. It has not been closed. The emission inflation incentive in CDM has similarly been discussed for years without an international decision to remove it. Whereas both features are counterproductive to efforts to abate climate change, each provides a level of easy money intended to ensure corporate participation. True to neoliberal politics, progress is presumed to hinge on reactions of the business sector rather than the condition of the environment.

There is little in the scope of these policy approaches that assists the necessary transition to a global sustainable energy system or to greater applications of renewable energy, energy conservation, and energy efficiency in the industrial world. Further evidence of resistance of the fossil fuel energy regime to change is provided by the recent *National Energy Policy* report of the United States (National Energy Policy Development Group, 2001). Having already withdrawn from the FCCC negotiations, the U.S. administration now seeks a greatly expanded program of energy supply from fossil fuel sources, notably electricity generation using coal and oil from the Arctic National Wildlife Refuge to fuel the nation's growing fleet of sport utility vehicles—two spectacular examples of energy extravagance substituted for global environmental health.

Creative Accounting: The Issue of Carbon Sequestration

Besides emissions trading, joint implementation, and CDM, all of which represent efforts to find least-cost technology strategies to meet the Kyoto targets, land use patterns and activities are also included as possible sources of credits for Annex I members. At the Bonn session of COP-6 in July 2001, the decision was reached to allow human-induced carbon sequestration (as a result of changes in land use and forestry management policies undertaken after 1990) to be counted as a GHG mitigation strategy. The specific activities eligible for carbon credit are afforestation, reforestation, and reforms in land use planning that reduce land conversion rates.

Although the basic processes of sequestration are reasonably well known in science, reliable measurement of national carbon stocks and fluxes has not been completed. The inclusion of sequestration as a carbon reduction strategy, therefore, is a source of controversy within the international negotiations. A driving concern among many parties is the sheer magnitude of the carbon stocks involved (see IPCC, 2000b). In fact, some nations with large forests may not need to reduce GHG emissions if rules determining the size and eligibility of their sequestered carbon stocks are favorably written.

A major problem with carbon sequestration is its estimation and verification. The challenge is compounded by the variety of the world's soils and vegetation that sequester carbon at different rates (IPCC, 2000b). Establishing confident baselines has been difficult and contentious, added to which are the problems of future uncertainties. For example, as atmospheric concentrations of carbon dioxide increase, a "fertilization" effect could boost overall plant growth. But, estimating the magnitude of this effect is not easy.

With varying real conditions in terms of water, nutrients, and biological competition, atmospheric fertilization effects could be counteracted. There is little that laboratory experiments can offer to remove these uncertainties. By contrast, estimates of energy consumption are standardized: The purchase, sale, and use of fossil fuel are monitored and regulated with relatively high accuracy in Annex I nations, and the effects of technology upgrades are known. Commodity trades that focus on technology-induced GHG reductions can at least be institutionalized in a manner that allows for a fair degree of scrutiny, as required to undertake national GHG accounting. But, comparable measurement and verification protocols are not available for sequestered carbon trading.

Policies to rapidly promote the expansion of land use management practices to maximize carbon sequestration carry attendant environmental risks. Sequestration in forests occurs most rapidly in young trees during the phase prior to maturation, tending to stabilize in mature and senescent forest stands. Conservation of existing forests, therefore, appears to be in conflict with strategies seeking to maximize carbon sequestration increases. Significantly expanded human intervention in the determination of types of forest cover and the presumption that global management should decide worldwide species selection and broad-scale forest management alarm many environmentalists and scientists and may represent a new threat to indigenous peoples as their forests may be found to be an "inefficient" form of land cover for the purposes of carbon storage.

One factor that large-scale reforestation for sequestration fails to address is its ecological uncertainty. Carbon sequestered carefully over decades or longer in forests can be released in moments through forest fires, pestilence, and other disturbances, dissipating the stored carbon. Climate change impacts on weather systems could also reduce forest growth in some areas, lowering actual sequestration rates over those forecasted by experts.

Carbon sequestration by means of land use, land use change, and forestry policies is poised for cooptation by those countries with the institutional, technological, and economic resources needed to invest in this option. Annex I members have significant advantages in preparing forecasts of national sink capacity (including the capacities of other nations' sinks) and developing seedlings and nutrient support for engineered forests. Carbon sequestration projects proposed under the CDM and undertaken in developing nations will not have the benefit of such readily available forecasts.

Furthermore, industrial countries will have the advantage of being able to claim credits for what are essentially management activities not necessarily implemented in response to the problem of global climate change. Under Article 3.3 of the FCCC as it is now formulated, developed countries can take credit for sink accumulations resulting from routine measures taken to correct domestic problems of tree removal. For example, the U.S. GHG Emission and Sink Inventory (for 1990-1997) concluded that improved forest management practices, the regeneration of previously cleared forest areas, and modified timber harvesting have resulted in an increase in the annual net uptake of carbon between 1990 and 1997 (U.S. Environmental Protection Agency, 1999). Thus, a study may provide the United States with the opportunity to take credit for expanded domestic sinks unrelated to actions to address climate change.[9]

A trading scheme that assumes equivalence between permanent emissions abatement and temporary sequestration appears flawed in the absence of countervailing policy initiatives. An implication of the loss of sequestered carbon from lighting strikes or other unpredictable events that forms part of an emissions trade is that the offset for the GHG emissions is lost without corresponding diminution in emissions. If accidents occur in managed forests, atmospheric concentrations of GHGs inevitably rise, defeating the rationale of the trading policy.

As with its flexibility-oriented companions, carbon sequestration seems mainly motivated by a symbolic politics of ecological concern, while actually tending to result in little or no change in production and consumption patterns among wealthy countries—the real source of the global warming threat. Certainly, this device is altogether silent on the questions of energy transformation that seemed so clearly necessary when negotiations to address the prospect of climate change began more than a decade ago. Indeed, creative accounting of carbon stores may have the singular merit of being a complete distraction from the systematic problems caused by the current energy regime.

Postmodern Ecology

Considered together, the flexibility mechanisms of the Kyoto Protocol rewrite the principle of ecology. A material understanding of nature and its interconnectedness is being replaced by a virtualist ecology in

which human manipulation of modeled nature through accounting schemes, simulations, and the practice of neoclassical economics is presumed to accurately represent actual ecological conditions. In terms of measurable material impact, none of the flexibility mechanisms appears likely to reduce actual GHG emissions. Emissions trading is likely to stimulate purchases of increases in GHG releases in Russia, the Ukraine, and other nations (compared to present levels) as though they were reductions. In this way, trading postpones real domestic actions by Annex I trading partners. The CDM will encourage developing nations to inflate forecasts of their future GHG releases and then auction future emissions that have not occurred as substitutes for reductions in present-tense releases by Annex I countries. And, carbon sequestration promises to count carbon already stored as a deduction against anthropocentric emissions or, worse, to encourage revisionist ecology in which carbon stores are destroyed to make way for humanly designed "high-efficiency" ones. All three promise only to make money for participating parties, not assist efforts to avert climate change.

In this respect, international negotiations on climate change appear to have postmodernized ecology, infusing the material with a virtual representation in ways that make it difficult to detect which is which. Except, of course, the actual processes of surface warming, sea level rise, loss of biodiversity, and island triage will not be fooled by postmodern ecology. Only the social domain of the society-nature relation can be deceived. Still, we seem haughtily ready to indulge in postmodern fallacy with the same arrogance as the economist, who on being informed that continued pursuit of optimality might bring human life to an end is reported to have responded, "So what?" (Gare, 1995, p. 12).

Of course, the compromise of ecology for economic gain is not new. What distinguishes climate change negotiations is the attempt to capture global ecology within a globalist regime of economic relations. Although agriculture, urbanization, and industrialization have, at ever-increasing scales, reorganized specific environments to serve economic interests (see Foster, 1994, and Crosby, 1988), the geography of impact could be spatially delimited. Even as these forces globalized, ecological disruption was spatially and biologically distinct. This is largely because economic interest in nature was concentrated on its resource dimension, as economic actions in nature sought to exploit specific plants, animals, ores, nutrients, energy forms, and so forth. The locations of these resources were specific, and the economic interest in mining nature for its commodity value was likewise specific.

But, as Escobar (1996) and others have noted, economic interest has transformed recently with regard to nature. Increasingly, nature's processes and structures command economic interest, shifting attention away from exclusively commodification-focused activity to ones intending to capitalize, for example, the biology, geology, chemistry, and climatology of the natural order. Climate change negotiations are an archetype of this shifted focus.

The atmosphere is inherently a global natural commons, indivisible in its structure and processes that continually regenerate it. There is no local (i.e., spatially distinct) atmosphere, and there is no possibility of human manufacture of a planetary substitute. Economic interest cannot be established by typical measures such as privatization and appropriation. Instead, climate change challenges the economic system to build management regimes that can moderate significant adverse effects (i.e., disasters such as high-intensity storms, droughts, and floods) and avoid natural volatility that could translate into unacceptable economic uncertainty. As a result, the atmosphere and climate are now subjects of capitalization interests, rather than the conventional forces of commodification.

Global management represents a new stage of nature-society relations, elevating social control of nature from the comparatively modest enterprise of acquiring and selling "free" natural resources and services to, in a basic sense, planning global nature's (as well as society's) future. In essence, the sky has become a long-term problem of economic management.

The flexibility mechanisms of the Kyoto Protocol can be seen as prototypes, or pilot demonstrations, of managing a global ecological system—something previously only attempted with such policies as the Law of the Sea Treaty and the Montreal Protocol (and one could argue that these attempts were never comparable to the one underway for the climate; see, for example, Bouton, 1999). That these mechanisms offer little promise of reducing GHG emissions is of lesser importance, at this point, than their effort to organize management systems at the global ecological and economic scales.

Eventually, of course, successful management will hinge on controlling atmospheric chemistry in a manner and to the degree that promises long-term profit-

ability of the economic system. In the interim, though, commodity interests embedded, for example, in the existing energy system will demand that their profitability is maintained. Indeed, growing interest in the atmosphere as capital can expect to be confronted with increasing forcefulness by contending commodity interests in fossil fuels and the urban-industrial partners they energize. The contest in climate change negotiations between atmospheric capital and energy-industry commodity values is likely to continue. Postmodern ecology is a product of that contest, and whereas its assumptions about nature may be regarded as fanciful, its reflection of the motives of the global economic system should be carefully considered. Simply assuming that ecological necessity will, or must, yield international action to avert global calamity trivializes the power of the global political economy and, even more important, fails to recognize the capture of the whole of nature that is now underway (Byrne, Glover, & Martinez, in press).

Living in the Greenhouse: Sustainability and Equity

The international regime built around a global GHG emissions market has placed the interests of industrial nations and their corporate underwriters above those of civil society generally and especially civil forces in developing countries. It is in civil society that the values of equity and sustainability are nourished, however fragile they may be. Organizations such as the Centre for Science and Environment (India), the Global Commons Institute (United Kingdom), and the World Wildlife Fund (United States) promulgate strategies and standards to promote climate justice. In civil agendas like theirs, equity and sustainability have the status of core values of the lifeworld that are evaluated above the commodity and capital values of modernity (Byrne & Yun, 1999). If basic change in the energy and industrial regimes is to occur, it will be led by this sector.

One approach consistent with recent civil positions in the climate change debate is, first, to challenge the management thrust of global political economy with a commons strategy that returns the atmosphere's destiny to natural processes and structures that comprise and reproduce it. Second, the commodity demands of global political economy should be confronted by the equity interest of civil life. Operationalizing the first challenge, a GHG reduction target for the year 2050 can be set at the level indicated by the IPCC for climate stability.[10] This target withdraws humanity from the modernist hubris of seeking to control the atmospheric commons. The resulting volume of allowable emissions, when divided by the world's population, establishes an equitable relation between humanity and nature that places the collective interest above that of short-term individual profit. As a practical agenda, this operationalization means an allowance of GHG emissions of approximately 3.3 tons of carbon dioxide equivalent per capita per year. This proposal[11] abides by the democratic principle that no human being is entitled to greater access to our atmospheric commons. In addition, it embodies the ecological principle that the human community has an obligation to conduct its activities within the regenerative capacities of the lifeworld (Shiva, 1994).

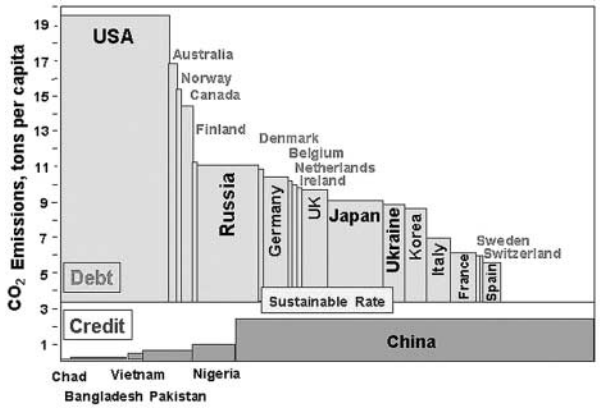

Figure 3. CO_2 Emissions per Capita for Selected Countries
Source: World Resources Institute (2001).
Note: Width of a block represents a country's proportion of the world population in 1990.

This rate can be used to establish the environmental debt or credit positions of countries with respect to climate change by comparing it with actual per capita national emissions. Although the method does not fully reflect the cumulative effects of emissions from different societies,[12] it furnishes a useable portrait of national responsibility for the climate change problem (see Figure 3). As the graph indicates, Annex I nations substantially overuse the atmosphere as a sink. Independent forecasts suggest that these nations can be expected to continue to be environmental debtors well into the 21st century (IPCC, 2000a). A climate-sensitive response from this bloc would mean lowering domestic emissions from, for example, the nearly 20 tons of carbon dioxide equivalent per person in the United States to a 3.3 ton sustainable and equitable emission rate by 2050.

To borrow the 50 years anticipated in Byrne, Wang, Lee, and Kim's (1998) strategy to retire the debt,

Annex I members would make payments to an international fund for use by southern countries in their efforts to build sustainable development paths of their own, while the North rehabilitates its currently unsustainable tendencies. Payment rates would be set at the cost of avoiding a ton of carbon dioxide emissions through, for example, the adoption of energy conservation and renewable energy alternatives, as well as by adopting practices that lower resource consumption overall. This would dramatically alter the currently centralized energy regime and, relatedly, would erode the link between energy and economic globalization.

This approach comes under the general heading of contraction and convergence. Essentially, such approaches envisage a global system in which industrial nations lower their emissions to a specific level, while developing countries increase their emissions to that same level, over a specified period. Population growth is incorporated into this per capita approach; otherwise, it can be argued that growing nations would enjoy an advantage over those with stable populations. Setting the population level under the scheme to an agreed reference year (1990) for all nations means that each country has a fixed emission allotment. After 1990, any national population increases will work to the disadvantage of a nation, as this would decrease its effective per capita allowance. With such a reference year system, the per capita approach ensures long-run equity.

Critical to the effectiveness of any global system is protecting against nations' lowering their emissions simply by shifting key high-emission industries to another country. Industry relocation from the North to the South has been under way for many years. Until recently, relocation was prompted by such factors as the search for cheap labor and lower environmental standards, but now the intention to shift GHG emissions may also become an influential factor. Clearly, an international system based on equity and sustainability should prevent this problem, known in climate change policy jargon as leakage. This problem does not occur in the scheme advocated here because emissions are calculated at the 1990 level, so that subsequent trades cannot alter the emissions baseline.

Such an exercise of environmental and social justice, rather than pecuniary interest, is instructive on several counts. First, it promises to actually reduce carbon dioxide emissions, not an inconsiderable achievement given the track record of the negotiations to date. Moreover, the outlined strategy offers a realistic hope that the risk of human-induced climate change might be removed by the middle of the next century, again no small triumph when compared to current policy directions. Third, it addresses the need for global democracy that the existing international climate change regime has effectively precluded because of its preference for profit and efficiency. Fourth, such a strategy promises to take seriously the need for an ecologically just path to sustainability. Indeed, evaluated against the existing strategy being negotiated, the principal failure of the approach is only that it will not make money for those who fail to cut carbon dioxide emissions. Finally, implementation of this strategy inescapably requires a fundamental change in energy regimes—from a centralist energy political economy based on nonrenewable fuels and extravagant levels of consumption to one powered by renewable energy, grounded in conservation and efficiency, and practicing an ethos of equity and sustainability.

Conclusion

The conventional energy system is producing a set of ecological and social impacts highly unequal in their effects. In the creation of an international policy response to climate change, there are opportunities to address the failings of the current energy system and to pursue the goal of ecological justice, namely a justice that embraces the interests of living and future generations, nonhuman life, and the integrity of ecological processes. So far, however, the FCCC and the Kyoto Protocol have pursued global goals primarily through a set of market-based policy instruments that are at odds with the tenets of ecological justice.

The Annex I bloc may manage to capture the atmospheric commons as though it was a line of products available for sale. Indeed, UN-organized negotiations may effect an enclosure of a global commons under the management of Annex I shopkeepers. In this event, literally the air and weather—undeniably elements of the lifeworld of all species—will be commandeered by a handful of countries and companies. Their aim will be essentially to exploit the highest profit options, and cutting global emissions will have no direct relevance. Predictably, any success in making money off the atmosphere will be in the old-fashioned, imperial way: They will claim as theirs something they do not own and sell it back to the rest of us at a sizable markup. The majority of the world's human population and all of its nonhuman species are regrettably money poor, and

thus, their only participation is likely to be looking through the shop window.

In the end, though, capitalization of the atmosphere will merely reproduce the same self-contradictory nature-society regime that has characterized the modern era. It will strip away communal rights of access and create new inequalities where none previously existed. An oxymoron of scarce atmosphere will result with no abatement of the crisis. To actually avert global warming, an international regime founded on entirely different principles will be needed. The one advocated here—a social obligation to limit GHG emissions on the democratic principles of equity and sustainability—serves the interests of ecological justice. It would lead to industrialized nations substantially cutting their GHG emissions and bearing the costs themselves to achieve such cuts (rather than transferring the burden to poor countries, as contemplated in the Kyoto Protocol). The existing energy regime and its support of unequal development would be undermined as locally available, sustainably based conservation and renewable energy alternatives receive international attention. Southern nations would be far better served as postmodern ecology is abandoned for a nature-society relation that restores dignity for cultures that emphasize stewardship over mining.

All serious alternatives begin with the rejection of capitalization and commodification of nature. Scientific, political, and economic discourses need to recognize this and begin the process of recovering their understanding of nature and society as common regimes. Such a task cannot be deferred to future generations but needs to be placed at the forefront of efforts to build a postgrowth political economy that actually cuts GHG emissions, calls off the experiment to design climate, and seeks a genuinely sustainable and equitable relation among societies and between humanity and nature as a whole.

Notes

1. According to the Intergovernmental Panel on Climate Change (IPCC), about three quarters of the carbon dioxide emissions (the principal greenhouse gas [GHG]) in the past 20 years derive from fossil fuel combustion (see IPCC, 2001b).

2. Three mechanisms were adopted at COP-3 in Kyoto: (a) GHG emissions trading, (b) so-called joint implementation, and (c) the clean development mechanism. All are discussed below. Also under the Kyoto Protocol, carbon sequestration can be counted against a nation's emissions mitigation target.

3. This term is used here to denote a system of political and economic power—a political economy—that institutionalizes social access to and use of nature; propounds ideas of nature, society, and their relationships; and broadly seeks to frame the value of nature to society. When used in this article, the term *energy regime* is meant as a representation of the broader nature-society regime guiding modernity.

4. The three principal GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Of these, CO_2 is the most significant. Chlorofluorocarbons are also GHGs but are dealt with separately under the Montreal Protocol.

5. Following the ratification of the United Nations Framework Convention on Climate Change (FCCC) in March 1994, Conference of the Parties–1 (COP-1) was held in March/April of the next year in Berlin, with COP-2 in July 1996 in Geneva. Although several issues were discussed in the two early COP meetings, the viability and effectiveness of the goal for Annex I nations to return to their 1990 GHG emission levels by 2000 took center stage. COP-3 then established binding emission targets for Annex I signatories.

6. The IPCC was formed in 1988 to investigate the possibility that anthropogenic (or human-caused) emissions of carbon dioxide and other heat-trapping gases may actually force a new, warmer climate in the 21st century. Its membership includes approximately 2,500 international scientists drawn from a wide variety of disciplines. Early efforts by the IPCC to support the FCCC process produced the first assessment report (IPCC, 1992), which tentatively concluded that there was evidence of anthropocentric forcing of global climate change. In the second assessment reports (IPCC, 1996a, 1996b), the panel found substantial evidence of human-induced global warming. In its third assessment reports, the IPCC (2001a, 2001b) confirmed earlier findings and revised upwards its scenarios of forecast global temperature rise and resultant impacts on human and natural systems.

7. See World Commission on Environment and Development (1987). The 1987 report of the World Commission on Environment and Development is often referred to as the Brundtland Commission, after its chairperson, the then Norwegian minister of environment Gro Brundtland.

8. IPCC assessment reports employ a number of GHG emission scenarios from which sea level rise forecasts are derived. High- and middle-range values have been used here for illustrative purposes. Note that each scenario is based on different assumptions, and the IPCC does not indicate probabilities associated with each. Thus, middle-range values, for example, cannot be attributed to have greater or lesser likelihood than those at the extremes.

9. Net carbon sequestration from U.S. forests in 1997 was 208.6 MMTCE (million metric tons of carbon equivalent) (U.S. Environmental Protection Agency [EPA], 1999, Table 6.3). As to the quantitative impact of this carbon sink on potential emissions reduction, "The net carbon sequestration reported for 1997 represents an offset of about 14 percent of the 1997 CO_2 emissions from fossil fuel combustion" (EPA, 1999, pp. 6-3).

10. The IPCC (2000b) has commented at length on the uncertainties involved in measuring precisely the global carbon sink. But, the 60% reduction target for GHG releases identified in the IPCC's first and second assessments is widely accepted as a reasonable benchmark for defining a climate-stable circumstance in which little additional anthropogenic forcing of climate change would be evident. Thus, the IPCC reduction target provides a prac-

tical basis for measuring the global carbon sink for a sustainability-minded climate policy.

11. Byrne, Wang, Lee, and Kim (1998) proposed the use of 3.3 tons of carbon dioxide equivalent emissions (molecular weight) per person as an annual sustainable and equitable emission rate.

12. Measuring historical emissions is a difficult matter.

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