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Energy as a Social Project: Recovering a Discourse

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From climate change to acid rain, contaminated landscapes, mercury pollution, and biodiversity loss,[2] the origins of many of our least tractable environmental problems can be traced to the operations of the modern energy system. A scan of nightfall across the planet reveals a social dilemma that also accompanies this system's operations: invented over a century ago, electric light remains an experience only for the socially privileged. Two billion human beings—almost one-third of the planet's population—experience evening light by candle, oil lamp, or open fire, reminding us that energy modernization has left intact—and sometimes exacerbated—social inequalities that its architects promised would be banished (Smil, 2003: 370 - 373). And there is the disturbing link between modern energy and war.[3] Whether as a mineral whose control is fought over by the powerful (for a recent history of conflict over oil, see Klare, 2002b, 2004, 2006), or as the enablement of an atomic war of extinction, modern energy makes modern life possible *and* threatens its future.

With environmental crisis, social inequality, and military conflict among the significant problems of contemporary energy-society relations, the importance of a social analysis of the modern energy system appears easy to establish. One might, therefore, expect a lively and fulsome debate of the sector's performance, including critical inquiries into the politics, sociology, and political economy of modern energy. Yet, contemporary discourse on the subject is disappointing: instead of a social analysis of energy regimes, the field seems to be a captive of euphoric technological visions and associated studies of "energy futures" that imagine the pleasing consequences of new energy sources and devices.[4]

One stream of euphoria has sprung from advocates of conventional energy, perhaps best represented by the unflappable optimists of nuclear power who, early on, promised to invent a "magical fire" (Weinberg, 1972) capable of meeting any level of energy demand inexhaustibly in a manner "too cheap to meter" (Lewis Strauss, cited in the *New York Times* 1954, 1955). In reply to those who fear catastrophic accidents from the "magical fire" or the proliferation of nuclear weapons, a new promise is made to realize "inherently safe reactors" (Weinberg, 1985) that risk neither serious accident nor intentionally harmful use of high-energy physics. Less grandiose, but no less optimistic, forecasts can be heard from fossil fuel enthusiasts who, likewise, project more energy, at lower cost, and with little ecological harm (see, e.g., Yergin and Stoppard, 2003).

Skeptics of conventional energy, eschewing involvement with dangerously scaled technologies and their ecological consequences, find solace in "sustainable energy alternatives" that constitute a second euphoric stream. Preferring to redirect attention to smaller, and supposedly more democratic, options, "green" energy advocates conceive devices and systems that prefigure a revival of human scale development, local self-determination, and a commitment to ecological balance. Among supporters are those who believe that greening the energy system embodies universal social ideals and, as a result, can overcome current conflicts between energy "haves" and "have-nots."[5] In a recent contribution to this perspective, Vaitheeswaran suggests (2003: 327, 291), "today's nascent energy revolution will truly deliver power to the people" as "micropower meets village power." Hermann Scheer echoes the idea of an alternative energy-led social transformation: the shift to a "solar global economy... can satisfy the material needs of all mankind and grant us the freedom to guarantee truly universal and equal human rights and to safeguard the world's cultural diversity" (Scheer, 2002: 34).[6]

The euphoria of contemporary energy studies is noteworthy for its historical consistency with a nearly unbroken social narrative of wonderment extending from the advent of steam power through the spread of electricity (Nye, 1999). The modern energy regime that now powers nuclear weaponry and risks disruption of the planet's climate is a product of promises pursued without sustained public examination of the political, social, economic, and ecological record of the regime's operations. However, the discursive landscape has occasionally included thoughtful exploration of the broader contours of energy-environment-society relations.

As early as 1934, Lewis Mumford (see also his two-volume *Myth of the Machine*, 1966; 1970) critiqued the industrial energy system for being a key source of social and ecological alienation (1934: 196):

> The changes that were manifested in every department of Technics rested for the most part on one central fact: the increase of energy. Size, speed, quantity, the multiplication of machines, were all reflections of the new means of utilizing fuel and the enlargement of the available stock of fuel itself. Power was dissociated from its natural human and geographic limitations: from the caprices of the weather, from the irregularities that definitely restrict the output of men and animals.

By 1961, Mumford despaired that modernity had retrogressed into a life-harming dead end (1961: 263, 248):

> ...an orgy of uncontrolled production and equally uncontrolled reproduction: machine fodder and cannon fodder: surplus values and surplus populations...

> The dirty crowded houses, the dank airless courts and alleys, the bleak pavements, the sulphurous atmosphere, the over-routinized and dehumanized factory, the drill schools, the second-hand experiences, the starvation of the senses, the remoteness from nature and animal activity—here are the enemies. The living organism demands a life-sustaining environment.

Modernity's formula for two centuries had been to increase energy in order to produce overwhelming economic growth. While diagnosing the inevitable failures of this logic, Mumford nevertheless warned that modernity's supporters would seek to derail present-tense[7] evaluations of the era's social and ecological performance with forecasts of a bountiful future in which, finally, the perennial social conflicts over resources would end. Contrary to traditional notions of democratic governance, Mumford observed that the modern ideal actually issues from a pseudomorph that he named the "democratic-authoritarian bargain" (1964: 6) in which the modern energy regime and capitalist political economy join in a promise to produce "every material advantage, every intellectual and emotional stimulus [one] may desire, in quantities hardly available hitherto even for a restricted minority" on the condition that society demands only what the regime is capable and willing to offer. An authoritarian energy order thereby constructs an aspirational democracy while facilitating the abstraction of production and consumption from non-economic social values.

The premises of the current energy paradigms are in need of critical study in the manner of Mumford's work if a world measurably different from the present order is to be organized. Interrogating modern energy assumptions, this chapter examines the social projects of both conventional and sustainable energy as a beginning effort in this direction. The critique explores the neglected issue of the political economy of energy, underscores the pattern of democratic failure in the evolution of modern energy, and considers the discursive continuities between the premises of conventional and sustainable energy futures.

The Abundant Energy Machine[8]

Proposals by its stakeholders to fix the modern energy system abound. Advocates envision bigger, more expensive, and more complex machines to spur and sate an endlessly increasing world energy demand. From clean coal to a revived nuclear energy strategy, such developments promise a worldwide movement to a cleaner and more socially benign energy regime that retains its modern ambitions of bigger, more, and better. Proponents even suggest that we might have our cake and eat it too, promoting patterns of energy production, distribution, and consumption consistent with an unconstrained ideology of quantification while also banishing environmental threats and taming social risks that energy critics cite in their challenges to the mainstream. Consistent with a program of ecological modernization, the conventional energy regime's architects are now exploring new technologies and strategies that offer what are regarded as permanent solutions to our energy troubles without harming our ecological future or disturbing the goal of endless economic growth and its attendant social relations.

Greening Fossil Fuels

Among the most prominent techno-fixes for modern energy are those seeking to "green" the fossil fuels (see e.g., Jaccand, 2005). The substitution of natural gas for other hydrocarbons, the emergence of "clean coal," the "ecologically sustainable" mining of what are supposed to be vast, untapped oil reserves in heretofore unfriendly terrains,[9] and the geological sequestration of climate-destabilizing CO_2 emissions are among the most favored in this category. Each represents an effort to legitimate the conventional energy regime without displacing fossil fuel's powerful role in rationalizing centralized energy production and distribution.

Natural gas is said to provide efficiencies equal to, or exceeding, the other fossil fuels while generating far fewer environmentally harmful consequences; as a replacement for oil and coal, it would result in decreased acid rain, smog, and mercury pollution. Natural gas emits fewer pollutants—among them greenhouse gases such as carbon dioxide. In this regard, it is advocated as an effective means by which to mitigate global warming. Low emissions of sulfur dioxide and particulate matter are also benefits of natural gas. Furthermore, the extraction, processing, and consumption of the fuel is said to produce very little solid waste and to have minimal impacts on water quality, unlike coal and oil (Cassedy and Grossman, 1998: 111 – 114).

But while its environmental effects may merit consideration of natural gas as a transitional fuel, the social hazards of bringing this energy source to market are very real. Michael Klare has written of potential armed conflicts to control natural gas reserves and the attendant transportation infrastructure (Klare, 2002b). Bringing natural gas to market will inevitably involve expensive liquefaction of the gas—by cooling it to -259 degrees Fahrenheit (-162 degrees Celsius)—and transportation on potentially vulnerable supertanker ships. And concerns have risen regarding the safety of natural gas receiving terminals in an age of global terrorism (Testa, 2004). A recent study by researchers at Sandia National Laboratories examined the catastrophic potential of explosions, fires, and fireballs caused by ramming, triggered explosion, hijacking, or external terrorist actions such as attack by missile or plane (Hightower et al., 2004). Damage risked by potential explosion, either at a terminal or on a ship, is immense. There are currently five natural gas receiving terminals in the continental United States—one in the highly populated Boston metropolitan area. Forty more are proposed for North American coasts, with nineteen having already received regulatory approval despite the risks of terrorist attack (Federal Energy Regulatory Commission (U.S.), 2005).

Coal, on the other hand, is not nearly as combustible as natural gas. Unlike oil and natural gas, many of the world's largest national energy consumers have significant domestic supplies. It remains plentiful and cheaply extracted, making global conflict over the resource unlikely. For these reasons, coal is enjoying resurgent interest on a scale not seen since the oil embargo of the 1970s. But while the potential for terrorist exploitation and international conflict over coal are low, other social consequences of its extraction and consumption are significant. The polluting effects of coal mining and combustion perpetuate its reputation as a "dirty fuel" contributing to public health problems and significant social inequities.

Truly greening coal would require a great deal of effort from mine to smokestack and beyond. Clean coal proponents advocate use of types of coal lower in sulfur content, gasification of the mineral, and sequestration of its carbon dioxide emissions. While these steps, if successful, would address some of coal's most pernicious effects—air pollution and increased GHG emissions—they leave many other consequences unattended. The environmental and social effects of mining and washing coal are not addressed by most proposals. Neither are its other social consequences: continued vulnerable centralized production, diversion of water from other purposes, land degradation, and extensive hazards to labor (Diesendorf, 2006).

Proposals for oil differ from those for coal and natural gas. Here, attention is mainly focused on cleaning up its transport and processing and making end-use technology more efficient. Today, enormous vessels move petroleum supplies across oceans in stunning volumes: the amount of oil alone annually carried in cargo holds roughly equals the combined amount consumed annually by the United States, the European Union, and China (Department of the Interior (U.S.), 2002). Interestingly, more than one billion gallons per year fail to reach a market, but nevertheless come ashore (Department of the Interior (U.S.), 2002). The 1989 Exxon Valdez oil spill illustrates the phenomenon. On March 23, the Exxon Valdez oil tanker hit a reef in the Alaskan Prince William Sound and spilled nearly 10 million gallons of crude, causing well-documented ecological harm.[10] While the spill's social implications received less attention, they were no less significant. Gill and Picou note that the compromise, and even extinction, of local cultures can accompany oil transport accidents (1996: 167):

> Of all the groups negatively impacted by the *Exxon Valdez* oil spill, in many ways Alaska Natives were the most devastated. The oil spill destroyed more than economic resources, it shook the core cultural foundation of Native life. Alaska Native subsistence culture is based on an intimate relationship with the environment. Not only does the environment have sacred qualities for Alaska Natives, but their survival depends on the well-being of the ecosystem and the maintenance of cultural norms of subsistence. The spill directly threatened the well-being of the environment, disrupted subsistence behavior, and severely disturbed the sociocultural milieu of Alaska Natives.

Of the spill's impact, Chief Walter Meganack (cited in Gill and Picou, 1996: 167) commented: "the excitement of the season had just begun, and then, we heard the news, oil in the water, lots of oil killing lots of water. It is too shocking to understand. Never in the millennium of our tradition have we thought it possible for the water to die, but it is true." What for some was an example of the environmental implications of the "normal accident" (Perrow, 1984) associated with the modern energy regime was, in fact, a threat to the very way of life of some Alaskan Natives.

Following such a high profile failure as the grounding of the Exxon Valdez (in fact, only the fifty-third largest oil spill in modern times—*Oil Spill Intelligence Report*, 2001), one might think that advocates of the conventional energy regime would practice a measure of modesty in their planning for the future. On the contrary, such failures seem only to stimulate even more grandiose ideas. No doubt future ships will come equipped with improved navigation technology to reduce accidents. Yet, one accident with a new vessel could trigger environmental catastrophe well beyond the Exxon Valdez episode. In this regard, it seems that a commitment to "green" fossil fuels can, nevertheless, result in an escalation of "brown" consequences and heightened risks, a phenomenon observed by Ulrich Beck (1992).

Ecological and cultural threats of the magnitude of the Exxon Valdez incident have much to do with the scale principles of the fossil fuel regime. Without unending energy demand, the system's risks in production and transportation are unnecessary. And without large ships, large ports, and large energy demand, the economics of fossil fuels falls apart. Such synergies drive the development of conventional techno-fixes.

Importantly, the higher and higher financial costs of propping up the fossil fuel regime never seem to doom such thinking.[11] Why is it that a commitment to fossil energy enlarges as the crises it causes deepen? In a recent book, Huber and Mills (2005: 165, emphasis added) suggest that "energy is the key to survival *and* prosperity" and that the only solution to today's energy problems is increased consumption aided by tomorrow's technical developments. They argue that (2005: xxiii, xxvi) "energy begets more energy; tomorrow's supply is determined by today's consumption. The more energy we seize and use, the more adept we become at finding and seizing still more….Energy isn't the problem. Energy is the solution." Huber and Mills also highlight the synergistic relationship between modern energy, modern technology, and the pursuit of "more" (2005: 155, emphasis added): "We will never stop wanting more logic, more memory, more vision, more range—all of which depend upon high grade energy—because we are built to want more of these things, *an unlimited more*."

Describing the ideal energy regime as a "perpetual motion machine" (2005: 4), Huber and Mills suggest that energy consumption spurs technical developments that permit the extraction and consumption of even greater quantities of energy in more usable forms despite, or even because of, increased waste. Emerging technologies, suggest Huber and Mills, are (2005: 43):

> ...as revolutionary as Watt's steam regulator was in 1763, as Otto's spark-ignited petroleum in 1876, as Edison's electrically-heated filament in 1879, as de Laval's hot-gas turbine in 1882. And they too will redefine, yet again, how much energy we want and how much we can get. We will want more—much more. And we will get it, easily. Unless, somehow, our optimism, drive, courage, and will give way to lethargy and fear.

Such sanguinity names its source—modernist confidence in science, technology, and business. The alliance of these three institutions, through a common language of quantity (Mumford, 1934; see also Kumar, 1978, 1988, 2005; Nye, 1999) built the world order in which our daily lives now transpire. Hesitation in the support of this alliance is tantamount to a civilization losing courage, surrendering to lethargy and fear. For conventional energy's enthusiasts, we have nothing to fear—neither climate change nor conflict over energy resources—but fear, itself. In this respect, our future cannot spring from anywhere other than a "bottomless well" (Huber and Mills, 2005) of energy and optimism.

Remaining modern, however, also demands an increasing commitment to override what lags behind from a modernist point of view. The bottomless wells to which Huber and Mills refer are increasingly found among the most vulnerable ecologies and communities, and their sacrifice to deliver more energy also involves the geological scale refinement of physical formations, biological scale modification of evolution, and historical scale alteration of social relations. A recent advertisement by Occidental Petroleum blends modernist ideology with the hubris of modern management as "Oxy brings energy to energy solutions" (Occidental Petroleum Corporation, 2005):

> Oxy is on the cutting edge in using advanced techniques to maximize the recovery of oil and natural gas worldwide. Energy is the lifeblood of the sustainable development process that is critical to overcoming poverty and raising living standards. And we're working hard to meet the world's ever growing demand for reliable energy supplies.

While the company imagines energy as the lifeblood of progress, the U'wa people in Colombia, on whose lands the oil envied by Occidental Petroleum resides, describe it as the lifeblood of "Mother Earth." Oil extraction would represent the slow death of both ecology and culture for the U'wa (J. T. Roberts and Thanos, 2003; Lee, forthcoming).

In addition to a disregard for cultural continuity in traditional and indigenous communities, extending the capacity to exploit fossil fuels through modernization of the conventional energy regime carries an additional requirement. As Michael Klare (2004, 2006) indicates, continued dependence upon oil, coupled with diminishing supplies and increasing demand, is likely to mean increased global conflict. The same can be said of natural gas (Klare, 2002b: 81 - 108). An industrialized world moored to the conventional energy regime will, in all likelihood, force further needs to militarize its operations.

Giant Power Revivalism

Life extension projects for the conventional energy regime are not limited to technological "greening" of fossil fuels. Plans also include a revival of "Giant Power" strategies, which had happened upon hard times by the 1980s. Gifford Pinchot, a two-term governor of Pennsylvania (1922-1926 and 1930-1934) is credited with coining the term in a speech, proclaiming:

> Steam brought about the centralization of industry, a decline in country life, the decay of many small communities, and the weakening of family ties. Giant Power may bring about the decentralization of industry, the restoration of country life, and the upbuilding of small communities and the family. [T]he coming electrical development will form the basis of a civilization happier, freer, and fuller of opportunity than the world has ever known.

The first proposals for Giant Power involved the mega-dams of the early and middle twentieth century. The U.S. pioneered this option with its construction of the Hoover, Grand Coulee, and Glen Canyon Dams, among others (Worster, 1992; Reisner, 1993). Undertaken by the U.S. Bureau of Reclamation, these projects were intended to "reclaim" the energy and water development potential from the rivers of the western United States. These were truly mammoth enterprises resulting in integrated water and energy resource development on scales previously unknown. Construction of the Glen Canyon Dam was authorized by the U.S. Congress under the Colorado River Storage Project. Built from 1957 to 1964, it was originally planned to generate 1,000 MW. Over the next few decades two additional generators were added to the dam, allowing the dam to produce 1,296 MW. In 1991 Interim Operating Criteria were adopted to protect downstream resources, which limited the dam releases to 20,000 cubic feet of water and the power output to 767 MW. The dam currently generates power for roughly 1.5 million users in five states (Bureau of Reclamation (U.S.), 2005a).

Mega-dams, such as the Glen Canyon, lost social support in the United States in the 1970s as ecological impacts and financial risks slowed interest. But many countries have shown a resurgent interest in large dams as an energy strategy. Canada has committed to building what will be one of the largest dams in the world—Syncrude Tailings—which will have the largest water impoundment volume in the world at 540 million cubic meters (Bureau of Reclamation (U.S.), 2005b). And China, with more than 20,000 dams of more than fifteen meters in height is constructing what will be the largest hydroelectric facility in the world on Earth's third largest river. The Three Gorges Dam, on the Yangtze, at a "mere" 575 feet tall—sixty-first tallest in the world—will have a generating capacity of more than 18,000 MW, roughly equivalent to 10 percent of China's electricity demand. This will require twenty-six hydro turbines, purchased from ABB, Alstom, GE, Kvaerner, Siemens, and Voith, highlighting the synergies between global corporatism and Giant Power (Power Technology, 2005).

Large-scale hydropower represents an attempt at a techno-fix of the democratic-authoritarian variety. Without disrupting the conventional energy regime's paradigm of centralized generation and distribution, large dams purport to deliver environmentally benign and socially beneficial electricity in amounts that reinforce the giant character of the existing dams. In fact, both ecologically and socially disruptive, large dams represent continued commitment to the promises, prospects, and perils of the conventional energy regime and its social project (McCully, 2001: 265; Hoffman, 2002; Totten, Pandya, and Janson-Smith, 2003; Agbemabiese and Byrne, 2005; Bosshard, 2006).

A second mega-energy idea has been advanced since the 1950s—the nuclear energy project. Born at a time in U.S. history when there were no pressing supply problems, nuclear power's advocates promised an inexhaustible source of Giant Power. Along with hydropower, nuclear energy has been conceived as a non-fossil technical fix for the conventional energy regime.

But nuclear energy has proven to be among the most potent examples of technological authoritarianism (Byrne and Hoffman, 1988, 1992, 1996) inherent in the techno-fixes of the conventional energy regime. On April 26, 1986, nuclear dreams were interrupted by a hard dose of reality—the accident at Chernobyl's No. 4 Reactor, with a radioactive release more than ten times that of the atomic bomb dropped on Hiroshima (Medvedev, 1992). Both human and non-human impacts of this greatest of technological disasters have been well-documented (Medvedev, 1992). The Chernobyl explosion and numerous near-accidents, other technical failures, and extraordinary cost-overruns caused interest in nuclear energy to wane during the 1980s and 1990s.

Notwithstanding a crippling past, the nuclear lobby has engineered a resurgence of interest through a raft of technological fixes that purport to prevent future calamitous failures while capitalizing on the supposed environmentally sound qualities of nuclear power. Huber and Mills, for example, title one of their chapters "Saving the Planet with Coal and Uranium" (2005: 156 - 171). A spokesperson for the Electric Power Research Institute has recently suggested that new pebble-bed modular reactors are "walk-away safe—if something goes wrong, the operators can go out for coffee while they figure out what to do" (quoted in Silberman, 2001). Such claims are eerily reminiscent of pre-Chernobyl comparisons between the safety of nuclear power plants and that of chocolate factories (*The Economist*, 1986). Huber and Mills go even further, claiming nuclear power will exceed the original source of solar power—the sun (2005: 180): "Our two-century march from coal to steam engine to electricity to laser will…culminate in a nuclear furnace that burns the same fuel, and shines as bright as the sun itself. And then we will invent something else that burns even brighter."

Critics, however, note that even if such technical advances can provide for accident-free generation of electricity, there are significant remaining social implications of nuclear power, including its potential for terrorist exploitation and the troubling history of connections between military and civilian uses of the technology (Bergeron, 2002; Bergeron and Zimmerman, 2006). As well, the life-cycle of nuclear energy development produces risks that continuously challenge its social viability. To realize a nuclear energy-based future, massive amounts of uranium must be extracted. This effort would ineluctably jeopardize vulnerable communities since a considerable amount of uranium is found on indigenous lands. For example, Australia has large seams of uranium, producing nearly one-quarter of the world's supply, with many mines located on Aboriginal lands (Uranium Information Center, 2005).[12] Even after the uranium is secured and electricity is generated, the project's adverse social impacts continue. Wastes with half-lives of lethal threat to any form of life in the range of 100,000 to 200,000 years have to be buried and completely mistake-free management regimes need to be operated for this length of time—longer than human existence, itself. Epochal imagination of this kind may be regarded by technologists as reasonable, but the sanity of such a proposal on social grounds is surely suspect (Byrne and Hoffman, 1996).

Immaterial techniques

Repair of the existing regime is not limited to efforts to secure increasing conventional supplies. Also popular are immaterial techniques emerging from the field of economics and elsewhere that offer policy reforms as the means to overcome current problems. Electricity liberalization exemplifies this approach. Here, inefficiencies in the generation and distribution of electricity in the conventional energy regime are targeted for remedy by the substitution of market dynamics for regulatory logic. Purported inefficiencies are identified, in large part, as the result of regulations that have distorted market prices either by subsidizing unjustifiable investments or by guaranteeing rates of return for compliant energy companies. Proponents of liberalization promise greater and more reliable energy supplies with the removal of regulation-induced market distortions (Pollitt, 1995; World Bank, 1993, 2003, 2004a).

Environmental concerns with the prevailing energy order can also be used to support liberalized market strategies. For example, while Huber and Mills (2005: 157) suggest that increased use of hydrocarbons is actually the preferred solution to the problem of climate change, arguing that, "for the foreseeable future, the best (and only practical) policy for limiting the buildup of carbon dioxide in the air is to burn more hydrocarbons—not fewer,"[13] others suggest the superiority of immaterial techniques such as the commercialization of the atmospheric commons. Thus, David Victor (2005) attributes the collapse of the Kyoto Protocol to a failure to embrace the economic superiority of emissions trading and other market-oriented mechanisms and calls for conventional energy's collision with climate to be addressed by a healthy dose of competitive marketing of carbon-reducing options. The outcome of a trading regime to reduce carbon will almost certainly be life-extensions for the fossil fuels and nuclear energy since it would 'offset' the carbon problems of the former and embrace the idea of the cost-effectiveness of the latter to avoid carbon emissions.[14]

Such solutions also attempt to mediate the increasing risk that accompanies techno-fixes of the conventional energy regime. The current phase of industrialization is replete with efforts to harmonize market and technological logics in a way that leaves the large-scale centralized energy system intact despite its tendencies to breed significant potential social and environmental crises (Byrne et al, 2002: 287; see also Beck, 1992).

> Progress [has] necessitated commitments to advancing knowledge and its application, along with the distinctive threats that only modernity could augur. Societies are obliged to place their faith in experts, technocratic systems, and management institutions, in the expectation that these offer social and environmental protection. At the same time, catastrophe-scale mistakes are inevitable. . . .Those least equipped to 'model' their problems become the 'lab mice' as human intelligence works out management schemes....

Conventional techno-fixes to increase energy supplies cannot remove risks, nor can market economics, but together they seek to convince society that abandonment of the modern energy project is nonetheless unwarranted.

The search for harmonized market-style policies to strengthen the energy status quo in the face of its mounting challenges reflects the growing political power of energy neoliberalism in an era of economic globalization (Dubash, 2002; Dubash and Williams, 2006). The two processes build a complimentary, if circular, politics in support of conventional energy: the logic is that global economic development requires energy use, which can only be properly planned if international capitalist institutions can be assured that the lubricant of globalization, namely, the unfettered power of markets, is established by enforceable policy (Byrne et al., 2004). Correspondingly, resulting carbon emissions can only eventually be abated if economic globalization is protected so that international capitalist institutions find it profitable to begin to lower carbon emissions and/or sequester them.[15] Consumers and producers, rather than citizens, are judged to be the proper signatories to the social contract because these participants, without the stain of politics, can find rational answers to our problems.

In sum, conventionalists counsel against preconceiving the social and environmental requirements for an energy transition, preferring a continuation of the existing energy regime that promises to deliver a "reasonable," "practical" future consistent with its past. Scheer (2002: 137) describes the erroneous assumption in such reasoning: "The need for fossil energy is a practical constraint that society must respect, for better or worse; whereas proposals for a swift and immediate reorientation...are denounced as irresponsible." An orderly transition is thus forecast from the current energy status quo of fossil fuel and nuclear energy dominance to a new energy status quo with possibly less carbon, but surely with giant-sized fossil and nuclear energy systems in wide use.

The Sustainable Energy Quest

The problems of the conventional energy order have led some to regard reinforcement of the status quo as folly and to instead champion sustainable energy strategies based upon non-conventional sources and a more intelligent ideology of managed relations between energy, environment, and society consonant with environmental integrity. This regime challenger seeks to evolve in the social context that produced the conventional energy regime, yet proposes to fundamentally change its relationship to the environment (at least, this is the hope). Technologies such as wind and photovoltaic electricity are purported to offer building blocks for a transition to a future in which ills plaguing modernity and unsolved by the conventional energy regime can be overcome (Lovins, 1979; Hawken et al., 2000; Scheer, 2002; Rifkin, 2003; World Bank, 2004b).

While technical developments always include social, material, ecological, intellectual, and moral infrastructures (Winner, 1977: 54 - 58; Toly, 2005), and may, therefore, be key to promoting fundamentally different development pathways, it is also possible that technologies, even environmentally benign ones, will be appropriated by social forces that predate them and, thereby, can be thwarted in the fulfillment of social promises attached to the strategy. Indeed, if unaccompanied by reflection upon the social conditions in which the current energy regime thrives, the transition to a renewable energy regime may usher in very few social benefits and little, if any, political and economic transformation. This is the concern that guides our analysis (below) of the sustainable energy movement.

At least since the 1970s when Amory Lovins (1979) famously posed the choice between "hard" and "soft" energy paths, sustainable energy strategies have been offered to challenge the prevailing regime. Sometimes the promise was of no more than "alternative" and "least cost" energy (Energy Policy Project of the Ford Foundation, 1974a, 1974b; O'Toole, 1978; Sant, 1979), but adjectives such as "appropriate," "natural," "renewable," "equitable," and even "democratic" have also been envisioned (Institute for Local Self-Reliance, 2005; Scheer, 2002: 34).[16] The need to depart from the past, especially in light of the oil crises of the 1970s and the energy-rooted threat of climate change that has beset policy debate since the late 1980s, united disparate efforts to recast and reconceive our energy future.

Partly, early criticisms of the mainstream were reflective of a broader social agenda that drew upon, among other things, the anti-war and anti-corporate politics of the 1960s. It was easy, for example, to connect the modern energy regime to military conflicts of the period and to superpower politics; and it was even easier to ally the mainstream's promotion of nuclear power to the objectives of the Nuclear Club. With evidence of profiteering by the oil majors in the wake of the 1973-1974 OPEC embargo, connecting the energy regime with the expanding power of multinational capital was, likewise, not difficult. Early sustainable energy strategies opposed these alliances, offering promises of significant political, as well as technological, change.

However, in the thirty years that the sustainable energy movement has aspired to change the conventional regime, its social commitments and politics have become muddled. A telling sign of this circumstance is the shifted focus from energy politics to economics. To illustrate, in the celebrated work of one of the movement's early architects, subtitles to volumes included "breaking the nuclear link" (Amory Lovins' *Energy/War*, 1981) and "toward a durable peace" (Lovins' *Soft Energy Paths*, 1979). These publications offered poignant challenges to the modern order and energy's role in maintaining that order.

Today, however, the bestsellers of the movement chart a course toward "natural capitalism" (Hawken et al., 2000), a strategy that anticipates synergies between soft path technologies and market governance of energy-environment-society relations. Indeed, a major sustainable energy think tank has reached the conclusion that "small is profitable" (Lovins et al., 2002) in energy matters and argues that the soft path is consistent with "economic rationalism." Understandably, a movement that sought basic change for a third of a century has found the need to adapt its arguments and strategies to the realities of political and economic power. Without adaptation, the conventional energy regime could have ignored soft path policy interventions like demand-side management, integrated resource planning, public benefits charges, and renewable energy portfolio standards (see Lovins and Gadgil, 1991; Sawin, 2004), all of which have caused an undeniable degree of decentralization in energy-society relations. In this vein, it is clear that sustainability proponents must find ways to speak the language and communicate in the logic of economic rationalism if they are to avoid being dismissed. We do not fault the sustainable energy camp for being strategic. Rather, the concern is whether victories in the everyday of incremental politics have been balanced by attention to the broader agenda of systemic change and the ideas needed to define new directions.

A measure of the sustainable energy initiative's strategic success is the growing acceptance of its vision by past adversaries. Thus, *Small is Profitable* was named 'Book of the Year' in 2002 by *The Economist*, an award unlikely to have been bestowed upon any of Lovins' earlier works. As acceptance has been won, it is clear that sustainable energy advocates remain suspicious of the oil majors, coal interests, and the Nuclear Club. But an earlier grounding of these suspicions in anti-war and anti-corporate politics appears to have been superseded by one that believes the global economy can serve a sustainability interest if the 'raison de market' wins the energy policy debate. Thus, it has been suggested that society can turn "more profit with less carbon," by "harnessing corporate power to heal the planet" (Lovins, 2005; L. H. Lovins and A. B. Lovins, 2000). Similarly, Hermann Scheer (2002: 323) avers: "The fundamental problem with today's global economy is not globalization per se, but that this globalization is not based on the sun—the only global force that is equally available to all and whose bounty is so great that it need never be fully tapped." However, it is not obvious that market economics and globalization can be counted upon to deliver the soft path (see e.g. Nakajima and Vandenberg, 2005). More problematic, as discussed below, the emerging soft path may fall well short of a socially or ecologically transforming event if strategic victories and rhetorics that celebrate them overshadow systemic critiques of energy-society relations and the corresponding need to align the sustainable energy initiative with social movements to address a comprehensive agenda of change.

Catching the Wind

To date, the greatest success in 'real' green energy development is the spread of wind power. From a miniscule 1,930 MW in 1990 to more than 47,317 MW in 2005, wind power has come of age. Especially noteworthy is the rapid growth of wind power in Denmark (35 percent per year since 1997), Spain (30 percent per year since 1997), and Germany (an astonishing 68 percent per year since 2000), where policies have caused this source to threaten the hegemony of fossil fuels and nuclear energy. Wind now generates more than 20 percent of Denmark's electricity and the country is the world leader in turbine manufacture. And as the Danes have demonstrated, offshore wind has the potential to skirt some of the land-use conflicts that have sometimes beset renewable energy alternatives. Indeed, some claim that offshore wind alone might produce all of Europe's residential electricity (Brown, 2004). National energy strategists and environmental movements in and beyond Europe have recognized the achievements of the Danes, Spaniards, and Germans with initiatives designed to imitate their success.

What are the characteristics of this success? One envied feature is the remarkable decline in the price of wind-generated electricity, from $0.46 per kWh in 1980 to $0.03 to $0.07 per kWh today (Sawin, 2004), very close to conventionally-fueled utility generating costs in many countries, even before environmental impacts are included. Jubilant over wind's winning market performance, advocates of sustainable energy foresee a new era that is ecologically much greener and, yet, in which electricity remains (comparatively) cheap. Lester Brown (2003: 159) notes that wind satisfies seemingly equally weighted criteria of environmental benefit, social gain, and economic efficiency:

> Wind is...clean. Wind energy does not produce sulfur dioxide emissions or nitrous oxides to cause acid rain. Nor are there any emissions of health-threatening mercury that come from coal-fired power plants. No mountains are leveled, no streams are polluted, and there are no deaths from black lung disease. Wind does not disrupt the earth's climate...[I]t is inexhaustible...[and] cheap.

This would certainly satisfy the canon of economic rationalism.

It is also consistent with the ideology of modern consumerism. Its politics bestow sovereignty on consumers not unlike the formula of Pareto optimality, a situation in which additional consumption of a good or service is warranted until it cannot improve the circumstance of one person (or group) without decreasing the welfare of another person (or group).[17] How would one know "better off" from "worse off" in the wind-rich sustainable energy era? Interestingly, proponents seem to apply a logic that leaves valuation of "better" and "worse" devoid of explicit content. In a manner reminiscent of modern economic thinking, cheap-and-green enthusiasts appear willing to set wind to the task of making "whatever"—whether that is the manufacture of low-cost teeth whitening toothpaste or lower cost SUVs. In economic accounting, all of these applications potentially make some in society "better off" (if one accepts that economic growth and higher incomes are signs of improvement). Possible detrimental side effects or externalities (an economic term for potential harm) could be rehabilitated by the possession of more purchasing power, which could enable society to invent environmentally friendly toothpaste and make affordable, energy-efficient SUVs. Sustainable energy in this construct cooperates in the abstraction of consumption and production. Consumption-of-what, -by-whom, and -for-what-purpose, and, relatedly, production-of-what, -by-whom, and -for-what-purpose are not issues. The construct altogether ignores the possibility that "more-is-better" consumption-production relations may actually reinforce middle class ideology and capitalist political economy, as well as contribute to environmental crises such as climate change. In the celebration of its coming market victory, the cheap-and-green wind version of sustainable energy development may not readily distinguish the economic/class underpinnings of its victory from those of the conventional energy regime.

Wind enthusiasts also appear to be largely untroubled by trends toward larger and larger turbines and farms, the necessity of more exotic materials to achieve results, and the advancing complications of catching the wind. There is nothing new about these sorts of trends in the modern period. The trajectory of change in a myriad of human activities follows this pattern. Nor is a critique per se intended in an observation of this trend. Rather, the question we wish to raise is whether another feature in this pattern will likewise be replicated—namely, a "technological mystique" (Bazin, 1986) in which social life finds its inspiration and hope in technical acumen and searches for fulfillment in the ideals of technique (Mumford, 1934; Ellul, 1964; Marcuse, 1964; Winner, 1977, 1986; Vanderburg, 2005).

This prospect is not a distant one, as a popular magazine recently illustrated. In a special section devoted to thinking "After Oil," *National Geographic* approvingly compared the latest wind technology to a well-known monument, the Statue of Liberty, and noted that the new machines tower more than 400 feet above this symbol (Parfit, 2005: 15 - 16). It was not hard to extrapolate from the story the message of Big Wind's liberatory potential. *Popular Science* also commended new wind systems as technological marvels, repeating the theme that, with its elevation in height and complexity lending the technology greater status, wind can now be taken seriously by scientists and engineers (Tompkins, 2005). A recent issue of *The Economist* (2005) included an article on the wonder of electricity generated by an artificial tornado in which wind is technologically spun to high velocities in a building equipped with a giant turbine to convert the energy into electricity. Indeed, wind is being contemplated as a rival able to serve society by the sheer technical prowess that has often been a defining characteristic of modern energy systems.

Obviously, wind energy has a long way to go before it can claim to have dethroned conventional energy's "technological cathedrals" (Weinberg, 1985). But its mission seems largely to supplant other spectacular methods of generating electricity with its own. The politics supporting its rapid rise express no qualms about endorsing the inevitability of its victories on technical grounds. In fact, Big Wind appears to seek monumental status in the psyche of ecologically modern society. A recent alliance of the American Wind Energy Association and the U.S. electric utility industry to champion national (subsidized) investment in higher voltage transmission lines (to deliver green-and-cheap electricity), illustrates the desire of Big Wind to plug into Giant Power's hardware and, correspondingly, its ideology (see American Wind Energy Association, 2005, supporting "Transmission Infrastructure Modernization"). The transformative features of such a politics are unclear. Indeed, wind power—if it can continue to be harvested by ever-larger machines—may penetrate the conventional energy order so successfully that it will diffuse, without perceptible disruption, to the regime. The air will be cleaner but the source of this achievement will be duly noted: science will have triumphed still again in wresting from stingy nature the resources that a wealthy life has grown to expect. Social transformation to achieve sustainability may actually be unnecessary by this political view of things, as middle-class existence is assured via clean, low-cost and easy-to-plug-in wind power.

Small-is-Beautiful Solar[18]

The second fastest growing renewable energy option—solar electric power—is proving more difficult to plug in. Despite steady declines in the cost per kWh of energy generated by photovoltaic (PV) cells, this alternative remains a pricey solution by conventional standards. Moreover, the technology does not appear to have significant scale economies, partly because the efficiency of PV cannot be improved by increasing the size of the device or its application. That is, unit energy costs of large installations of many PV arrays do not deviate appreciably from those for small installations comprised of fewer arrays. Instead, the technology seems to follow a modular economic logic in which unit costs neither grow nor decline with scale. Some have praised this attribute, suggesting that PV's modularity means there are no technical or economic reasons for scaling its application to iconic levels that conventional power plants now represent, potentiating a more robust system of distributed generation and delivering clean energy to previously marginalized populations (Martinot and Reiche, 2000; Martinot et al., 2002).

Small-Is-Beautiful Solar is attributed with social empowerment potential by Vaitheeswaran (2003: 314) who notes that PV (and other small scale electricity generation technologies) can overcome social barriers through a "collision of clean energy, microfinance, and community empowerment," three properties that may lift the burden of poverty and promote democratic social relations. "Micropower," he argues (2003: 314), "is beginning to join forces with village power." Thus, it would seem that a Solar Society might depend upon a different politics than Big Wind in displacing a fossil and nuclear energy driven world economy.

Perhaps because PV has, so far, found wider social usage in rural contexts where poverty (as modernly conceived) persists, discussions, in fact, crop up about solar's social project. For example, arguments have formed around the gender interests of PV, at least as it has been diffused in rural life to date (see, for example, Allerdice and Rogers, 2000). And criticism has surfaced about PV's 'capture' by the state as a tool to quiet, if not mollify, the rural poor (Okubo, 2005: 49 - 58). There has even been a charge that PV and other renewables are being used by multilateral organizations such as the World Bank to stall Southern development. By imposing a fragmented patchwork of tiny, expensive solar generators on, for example, the African rural landscape, instead of accumulating capital in an industrial energy infrastructure, the World Bank and other actors are accused of being unresponsive to the rapid growth needs of the South (Davidson and Sokona, 2002; Karekezi and Kithyoma, 2002). A related challenge of PV's class interests has raised questions about the technology's multinational corporate owners and offered doubts about successful indigenization of solar cell manufacturing (Able-Thomas, 1995; Guru, 2002: 27; Bio-Energy Association of Sri Lanka, 2004: 20). Regardless of one's position on these debates, it is refreshing to at least see solar energy's possible political and economic interests considered.

But PV's advocates have not embraced the opportunities created by its rural examiners to seriously investigate the political economy of solar energy. The bulk of solar research addresses engineering problems, with a modest social inquiry focused on issues of technological transition in which solar electricity applications are to find their way into use with as little social resistance or challenge as possible. A green politics that is largely unscarred by conflict is, and for a long time has been, anticipated to characterize an emergent Solar Society (Henderson, 1988; Ikeda and Henderson, 2004). Likewise, solar economics is thought to be consensual as non-renewable options become too expensive and PV cells, by comparison, too cheap to be refused their logical role (see, for example, Henderson, 1995, 1996; Rifkin, 2003). It seems that a solarized social order is inevitable for its proponents, with technological breakthrough and economic cost the principal determinants of when it will arrive.

In this regard, ironically, Small-is-Beautiful Solar shares with Big Wind the aspiration to re-order the energy regime without changing society. Despite modern society's technological, economic, and political addiction to large-scale, cheap energy systems that solar energy cannot mimic, most PV proponents hope to revolutionize the technological foundation of modernity, without disturbing its social base. A new professional cadre of solar architects and engineers are exhorted to find innovative ways of embedding PV technology in the skin of buildings (Strong, 1999; Benemann, Chehab, and Schaar-Gabriel, 2001), while transportation engineers and urban planners are to coordinate in launching "smart growth" communities where vehicles are powered by hydrogen derived from PV-powered electrolysis to move about in communities optimized for "location efficiency" (Ogden, 1999; Holtzclaw et al., 2002). The wildly oversized ecological footprint of urban societies (Rees and Wackernagel, 1996) is unquestioned as PV decorates its structure.

These tools for erecting a Solar Society intend to halt anthropogenic changes to the chemistry of the atmosphere, rain, and soil mantle while enabling unlimited economic growth. In the Solar Society of tomorrow, we will make what we want, in the amounts we desire, without worry, because all of its energy is derived from the benign, renewable radiation supplied by our galaxy's sun. Compared to Big Wind, PV may cost more but it promises to deliver an equivalent social result (minus the avian and landscape threats of the former) and, just possibly, with a technical elegance that surpasses the clunky mechanicalness of turbines propelled by wind. In this respect, Solar Society makes its peace with modernity by leaving undisturbed the latter's cornucopian dreams[19] and, likewise, poses no serious challenge to the social and political structures of the modern era.

At this precise point, inequality and conflict can only be conceived in Solar Society as the results of willful meanness and greed. While the solar variety of technological politics guiding society may be relatively minimalist—no towering new monuments or spectacular devices are planned—it would be no less committed to the ideals of technique in shaping social experience and its self-assessment. Similarly, its economics would warmly embrace a form of consumptive capitalism, although with cleaner inputs (and possibly throughputs) than before.

While the discussion here of sustainable energy advocacy has concentrated on its wind- and solar-animated versions, we believe that strategies anticipating significant roles for geothermal, biomass, micro-hydro, and hydrogen harvested from factories fueled by renewables anticipate variants of the social narratives depicted for the two currently most prominent renewable energy options. The aim of producing more with advancing ecological efficiency in order to consume more with equally advancing consumerist satisfaction underpins the sustainable energy future in a way that would seamlessly tie it to the modernization project.[20]

Democratic Authoritarian Impulses and Uncritical Capitalist Assumptions

When measured in social and political-economic terms, the current energy discourse appears impoverished. Many of its leading voices proclaim great things will issue from the adoption of their strategies (conventional or sustainable), yet inquiry into the social and political-economic interests that power promises of greatness by either camp is mostly absent. In reply, some participants may petition for a progressive middle ground, acknowledging that energy regimes are only part of larger institutional formations that organize political and economic power. It is true that the political economy of energy is only a component of systemic power in the modern order, but it hardly follows that pragmatism toward energy policy and politics is the reasonable social response. Advocates of energy strategies associate their contributions with distinct pathways of social development and define the choice of energy strategy as central to the types of future(s) that can unfold. Therefore, acceptance of appeals for pragmatist assessments of energy proposals, that hardly envision incremental consequences, would indulge a form of self-deception rather than represent a serious discursive position.

An extensive social analysis of energy regimes of the type that Mumford (1934; 1966; 1970), Nye (1999), and others have envisioned is overdue. The preceding examinations of the two strategies potentiate conclusions about both the governance ideology and the political economy of modernist energy transitions that, by design, leave modernism undisturbed (except, perhaps, for its environmental performance).

The Technique of Modern Energy Governance

While moderns usually declare strong preferences for democratic governance, their preoccupation with technique and efficiency may preclude the achievement of such ambitions, or require changes in the meaning of democracy that are so extensive as to raise doubts about its coherence. A veneration of technical monuments typifies both conventional and sustainable energy strategies and reflects a shared belief in technological advance as commensurate with, and even a cause of, contemporary social progress. The modern proclivity to search for human destiny in the march of scientific discovery has led some to warn of a technological politics (Ellul, 1997a, 1997b, 1997c; Winner, 1977, 1986) in which social values are sublimated by the objective norms of technical success (e.g., the celebration of efficiency in all things). In this politics, technology and its use become the end of society and members have the responsibility, as rational beings, to learn from the technical milieu what should be valorized. An encroaching *autonomy of technique* (Ellul, 1964: 133 – 146) replaces critical thinking about modern life with an awed sense and acceptance of its inevitable reality.

From dreams of endless energy provided by Green Fossil Fuels and Giant Power, to the utopian promises of Big Wind and Small-Is-Beautiful Solar, technical excellence powers modernist energy transitions. Refinement of technical accomplishments and/or technological revolutions are conceived to drive social transformation, despite the unending inequality that has accompanied two centuries of modern energy's social project. As one observer has noted (Roszak, 1972: 479), the "great paradox of the technological mystique

[is] its remarkable ability to grow strong by chronic failure. While the treachery of our technology may provide many occasions for disenchantment, the sum total of failures has the effect of increasing dependence on technical expertise." Even the vanguard of a sustainable energy transition seems swayed by the magnetism of technical acumen, leading to the result that enthusiast and critic alike embrace a strain of technological politics.

Necessarily, the elevation of technique in both strategies to authoritative status vests political power in experts most familiar with energy technologies and systems. Such a governance structure derives from the democratic-authoritarian bargain described by Mumford (1964). Governance "by the people" consists of authorizing qualified experts to assist political leaders in finding the efficient, modern solution. In the narratives of both conventional and sustainable energy, citizens are empowered to consume the products of the energy regime while largely divesting themselves of authority to govern its operations.

Indeed, systems of the sort envisioned by advocates of conventional and sustainable strategies are not governable in a democratic manner. Mumford suggests (1964: 1) that the classical idea of democracy includes "a group of related ideas and practices... [including] communal self-government... unimpeded access to the common store of knowledge, protection against arbitrary external controls, and a sense of moral responsibility for behavior that affects the whole community." Modern conventional and sustainable energy strategies invest in external controls, authorize abstract, depersonalized interactions of suppliers and demanders, and celebrate economic growth and technical excellence without end. Their social consequences are relegated in both paradigms to the status of problems-to-be-solved, rather than being recognized as the emblems of modernist politics. As a result, modernist democratic practice becomes imbued with an authoritarian quality, which "deliberately eliminates the whole human personality, ignores the historic process, [and] overplays the role of abstract intelligence, and makes control over physical nature, ultimately control over man himself, the chief purpose of existence" (Mumford, 1964: 5). Meaningful democratic governance is willingly sacrificed for an energy transition that is regarded as scientifically and technologically unassailable.

Triumphant Energy Capitalism

Where the power to govern is not vested in experts, it is given over to market forces in both the conventional and sustainable energy programs. Just as the transitions envisioned in the two paradigms are alike in their technical preoccupations and governance ideologies, they are also alike in their political-economic commitments. Specifically, modernist energy transitions operate in, and evolve from, a capitalist political economy. Huber and Mills (2005) are convinced that conventional techno-fixes will expand productivity and increase prosperity to levels that will erase the current distortions of inequality. Expectably, conventional energy's aspirations present little threat to the current energy political economy; indeed, the aim is to reinforce and deepen the current infrastructure in order to minimize costs and sustain economic growth. The existing alliance of government and business interests is judged to have produced social success and, with a few environmental correctives that amount to the modernization of ecosystem performance, the conventional energy project fervently anticipates an intact energy capitalism that willingly invests in its own perpetuation.

While advocates of sustainable energy openly doubt the viability of the conventional program and emphasize its social and environmental failings, there is little indication that capitalist organization of the energy system is faulted or would be significantly changed with the ascendance of a renewables-based regime. The modern cornucopia will be powered by the profits of a redirected market economy that diffuses technologies whose energy sources are available to all and are found everywhere. The sustainable energy project, according to its architects, aims to harness nature's 'services' with technologies and distributed generation designs that can sustain the same impulses of growth and consumption that underpin the social project of conventional energy. Neither its corporate character, nor the class interests that propel capitalism's advance, are seriously questioned. The only glaring difference with the conventional energy regime is the effort to modernize social relations with nature.

In sum, conventional and sustainable energy strategies are mostly quiet about matters of concentration of wealth and privilege that are the legacy of energy capitalism, although both are vocal about support for changes consistent with middle class values and lifestyles. We are left to wonder why such steadfast reluctance exists to engaging problems of political economy. Does it stem from a lack of understanding? Is it reflective of a measure of satisfaction with the existing order? Or is there a fear that critical inquiry might jeopardize strategic victories or diminish the central role of 'energy' in the movement's quest?

Transition without Change: A Failing Discourse

After more than thirty years of contested discourse, the major 'energy futures' under consideration appear committed to the prevailing systems of governance and political economy that animate late modernity. The new technologies—conventional or sustainable—that will govern the energy sector and accumulate capital might be described as *centaurian technics*[21] in which the crude efficiency of the fossil energy era is bestowed a new sheen by high technologies and modernized ecosystems: capitalism without smoky cities, contaminated industrial landscapes, or an excessively carbonized atmosphere. Emerging energy solutions are poised to realize a postmodern transition (Roosevelt, 2002), but their shared commitment to capitalist political economy and the democratic-authoritarian bargain lend credence to Jameson's assessment (1991) of postmodernism as the "cultural logic of late capitalism."

Differences in ecological commitments between conventional and sustainable energy strategies still demarcate a battleground that, we agree, is important—even fundamental. But so also are the common aspirations of the two camps. Each sublimates social considerations in favor of a politics of more-is-better, and each regards the advance of energy capitalism with a sense of inevitability and triumph. Conventional and sustainable energy visions equally presume that a social order governed by a 'democratic' ideal of cornucopia, marked by economic plenty, and delivered by technological marvels will eventually lance the wounds of poverty and inequality and start the healing process. Consequently, silence on questions of governance and social justice is studiously observed by both proposals. Likewise, both agree to, or demur on, the question of capitalism's sustainability.[22] Nothing is said on these questions because, apparently, nothing needs to be.

If the above assessment of the contemporary energy discourse is correct, then the enterprise is not at a crossroad; rather, it has reached a point of acquiescence to things as they are. Building an inquiry into energy as a social project will require the recovery of a critical voice that can interrogate, rather than concede, the discourse's current moorings in technological politics and capitalist political economy. A fertile direction in this regard is to investigate an energy-society order in which energy systems evolve in response to social values and goals, and not simply according to the dictates of technique, prices, or capital. Initial interest in renewable energy by the sustainability camp no doubt emanated, at least in part, from the fact that its fuel price is non-existent and that capitalization of systems to collect renewable sources need not involve the extravagant, convoluted corporate forms that manage the conventional energy regime. But forgotten, or misunderstood, in the attraction of renewable energy have been the *social* origins of such emergent possibilities. Communities exist today who address energy needs outside the global marketplace: they are often rural in character and organize energy services that are immune to oil price spikes and do not require water heated to between 550º and 900º Fahrenheit (300º and 500º Celsius) (the typical temperatures in nuclear reactors). No energy bills are sent or paid and governance of the serving infrastructure is based on local (rather than distantly developed professional) knowledge. Needless to say, sustainability is embodied in the lifeworld of these communities, unlike the modern strategy that hopes to design sustainability into its technology and economics so as *not* to seriously change its otherwise unsustainable way of life.

Predictably, modern society will underscore its wealth and technical acumen as evidence of its superiority over alternatives. But smugness cannot overcome the fact that energy-society relations are evident in which the bribe of democratic-authoritarianism and the unsustainability of energy capitalism are successfully declined. In 1928, Mahatma Gandhi (cited in Gandhi, 1965: 52) explained why the democratic-authoritarian bargain and Western capitalism should be rejected:

> God forbid that India should ever take to industrialization after the manner of the West. The economic imperialism of a single tiny island kingdom (England) is today keeping the world in chains. If an entire nation of 300 million took to similar economic exploitation, it would strip the world bare like locusts. Unless the capitalists of India help to avert that tragedy by becoming trustees of the welfare of the masses and by devoting their talents not to amassing wealth for themselves but to the service of the masses in an altruistic spirit, they will end either by destroying the masses or being destroyed by them.

As Gandhi's remark reveals, social inequality resides not in access to electric light and other accoutrements of modernity, but in a world order that places efficiency and wealth above life-affirming ways of life. This is our social problem, our energy problem, our ecological problem, and, generally, our political-economic problem.

The challenge of a social inquiry into energy-society relations awaits.

Notes

1. The authors wish to thank four dear colleagues for their counsel in the preparation of this chapter: Young-Doo Wang, Cecilia Martinez, Leigh Glover, and Kristen Hughes.
2. Climate change is caused by increasing atmospheric concentrations of greenhouse gases due primarily to the combustion of fossil fuels. Climate change is also among the leading causes of biodiversity loss, causing extinction at latitudinal and elevational extremes (Chapin et al., 2000).
3. For a discussion of the role of energy in the Iraq and Darfur conflicts, see Klare (2002a) and Gidley (2005).
4. The modest literature vowing to examine the relationship between energy and society mostly amounts to a project of technological literacy (see, e.g., Cassedy and Grossman, 1998; Schobert, 2001; Tester et al., 2005). Technological literacy is certainly important to the engagement of energy-society relations, but a social analysis limited to the literacy project is insufficient. A departure from the literacy objective is the collaboration of Jose Goldemberg, Thomas B. Johansson, Amulya K. N. Reddy, and Robert H. Williams (1987; see also Johansson and Goldemberg, 2002; Goldemberg, 2003), who organized a volume replete with social analyses of energy systems (although a substantial part of the book also intends to improve its readers' understanding of the scientific and technical features of energy systems). Interestingly, this volume, *Energy for a Sustainable World*, focused on energy needs and conflicts in developing countries and, thereby, was able to direct attention toward the social dimensions of energy production, distribution, and use. A

minority of scholars and activists has pursued this approach; some have contributed to this volume.

5. See, e.g., Amory Lovins' promise of a "natural capitalism" energized by the wind and sun, and his forecast of a "negawatt" revolution caused by investment in energy efficiency (Lovins and Gadgil, 1991; Lovins, 1996; Hawken, Lovins, and Lovins, 2000: 279).
6. On the one hand, Scheer (2002) is confident about the prospects of a market- and technology-led transition to a socially equitable, sustainable energy future, displaying optimism that techno-economic fixes are sufficient to solve social problems. In this instance, he does not offer a *social* analysis of sustainable energy development. On the other hand, he has written an in-depth, insightful *social* critique of the fossil fuel-based energy regime that, interestingly, challenges the premises of economic and technological optimism cited by its supporters.
7. In his 1983 article, "Present Tense Technology: Technology's Politics," David Noble evaluated the social capacity for a critical perspective on technology given the futurist orientation of technological politics.
8. Taken from the title of their 1986 argument, Byrne and Rich offer an analysis of the conventional energy regime's uninterrupted belief in the prospects for energy abundance.
9. Consider, for example, the proposal to mine oil in the Arctic National Wildlife Refuge (see www.anwr.org).
10. The oil spread to five National Wildlife Refuges and three National Parks, covering an area of 900 square miles and washing hundreds of miles of shoreline with a black tide. The estimate of bird kills was 100,000, including 150 bald eagles. Approximately 1,000 sea otters were also lost. Debris from the clean up of the oil spill was in excess of 50,000 tons (Byrne et al., 2002).
11. However, architects of the fossil fuel regime are quick to point out the unreasonably high cost of solar energy systems (see, for example, Huber and Mills, 2005).
12. Similarly, much of the uranium in the U.S. is mined on Native American lands (Martinez and Poupart, 2002: 138 – 139; Byrne and Hoffman, 2002: 105).
13. Huber and Mills (2005: 157) suggest that renewable energy deployment for emissions abatement requires so much land set aside for sufficiently large amounts of wind and solar energy to be collected that this would preempt floral carbon sequestration, resulting in little or no net carbon reduction. Further, they argue that floral carbon sequestration is more efficient than renewable energy-based carbon mitigation.
14. Researchers long ago showed the error in thinking that nuclear power is a cost-effective method of reducing carbon emissions (Keepin and Kats, 1988).
15. The U.S. Energy Policy Act of 2005 exhibits the logic of policy harmonization, calling for massive incentives to the energy majors in order for them to find additional supplies of fossil fuels needed to secure American economic growth for the foreseeable future. The carbon problem is left to sort itself out. Recent efforts in the European Union to incentivize carbon reductions *and* secure energy supply is another example (European Union, 2005). While different and consequential in many respects, both rely heavily on the ideas and tools of energy neoliberalism.
16. The Institute for Local Self-Reliance, a Minnesota non-profit organization, suggests that "technological innovations are making it increasingly possible to think about a more decentralized and environmentally benign energy system. Democratic energy means an energy system where the consumer can become a producer, where power plants are located near where the energy is consumed, and where the decisions about the structure of the energy system is made in large part by those who will feel the impact of those decisions" (www.newrules.org/de).

17. Vilfredo Pareto's (1906: 261, emphasis in original) definition is interesting: "We will say that the members of a collectivity enjoy *maximium ophelimity* in a certain position when it is impossible to find a way of moving from that position very slightly in such a manner that the ophelimity enjoyed by each of the individuals of that collectivity increases or decreases. That is to say, any small displacement in departing from that position necessarily has the effect of increasing the ophelimity which certain individuals enjoy, and decreasing that which others enjoy, of being agreeable to some, and disagreeable to others."
18. E. F. Schumacher (1973) argued for the superiority of human-scale industry and economics, opposing blind commitment to economies of scale and suggesting that small can be beautiful.
19. See Byrne and Yun (1999) and Byrne and Glover (2005) for a general discussion of this neoliberal dream state.
20. Albeit, the sustainable energy strategy (compared to its conventional energy competitor) embraces the task of modernizing ecology-society relations in a manner not achievable by fossil fuels and nuclear power.
21. For this insight we are indebted to Albert Borgmann (1992: 86), who writes of recent developments in information technologies: "To prosper, instrumental hyperreality must retain the shape of a centaur. The refined part must remain attached to the crude part."
22. See O'Connor (1994) for an analysis of capitalism's (un)sustainability.

References

Able-Thomas, U. (1995). Technology Transfer of Photovoltaic Systems to Developing Countries (pp. 14).

Agbemabiese, L., and Byrne, J. (2005). Commodification of Ghana's Volta River: An Example of Ellul's Autonomy of Technique. *Bulletin of Science, Technology, and Society, 25*(1), 17 - 25.

Allerdice, A., and Rogers, J. H. (2000). *Renewable Energy for Microenterprise*. Boulder, CO: National Renewable Energy Laboratory.

American Wind Energy Association. (2005, August 9). Energy Policy Act Signed by President Improves Market Access for Wind Power. Retrieved on October, 14 2005. Available at www.awea.org.

Bazin, M. (1986). The Technological Mystique and Third World Options. *Monthly Review, July/August*, 98 - 109.

Beck, U. (1992). From Industrial Society to the Risk Society: Questions of Survival, Social Structure, and Ecological Enlightenment. *Theory, Culture, and Society, 9*(1), 97 - 123.

Benemann, J., Chehab, O., and Schaar-Gabriel, E. (2001, March). Building-integrated PV Modules. *Solar Energy Materials and Solar Cells,* 345 - 355.

Bergeron, K. D. (2002). *Tritium on Ice: The Dangerous Alliance of Nuclear Weapons and Nuclear Power*. Cambridge, MA: MIT Press.

Bergeron, K. D., and Zimmerman, A. D. (2006). Nuclear Power in an Age of Global Terrorism. In J. Byrne, L. Glover and N. J. Toly (Eds.), *Transforming Power: Energy, Environment, and Society in Conflict*. New Brunswick, NJ and London: Transaction Publishers.

Bio-Energy Association of Sri Lanka. (2004). *The Dendro Option for Future Energy Security of Sri Lanka*. Colombo: Bio-Energy Association of Sri Lanka.

Borgmann, A. (1992). *Crossing the Postmodern Divide*. Chicago, Il: University of Chicago Press.

Bosshard, P. (2006). The World Bank's Support for Large Dams: A Case of Institutional Amnesia? In J. Byrne, L. Glover and N. J. Toly (Eds.), *Transforming Power: Energy, Environment, and Society in Conflict*. New Brunswick, NJ and London: Transaction Publishers.

Brown, L. (2004). *Europe Leading World into Age of Wind Energy*. Retrieved October 10, 2005. Available at www.earth-policy.org/Updates/Update37.htm.

Brown, L. (2003). *Plan B: Rescuing a Planet Under Stress and a Civilization in Trouble*. New York: W. W. Norton and Company.

Bureau of Reclamation. (2005a). *Glen Canyon Powerplant*. Retrieved October 10, 2005. Available at www.usbr.gov.

Bureau of Reclamation. (2005b). World's Largest Dam by Volume. Retrieved October 13, 2005. Available at www.usbr.gov.

Byrne, J., and Glover, L. (2005). Ellul and the Weather. *Bulletin of Science, Technology, and Society, 25*(1): 4 – 16.

Byrne, J., Glover, L., Lee, H., Wang, Y.-D., and Yu, J.-M. (2004). Electricity Reform at a Crossroads: Problems in South Korea's Power Liberalization Strategy. *Pacific Affairs, 77*(3), 493 - 516.

Byrne, J., Glover, L., and Martinez, C. (2002). The Production of Unequal Nature. In J. Byrne, L. Glover and C. Martinez (Eds.), *Environmental Justice: Discourses in International Political Economy* (Vol. 8, pp. 230 - 256). New Brunswick, NJ and London: Transaction Publishers.

Byrne, J., and Hoffman, S. (2002). A 'Necessary Sacrifice:' Industrialization and American Indian Lands. In J. Byrne, L. Glover and C. Martinez (Eds.), *Environmental Justice: Discourses in International Political Economy* (pp. 97 - 118). New Brunswick, NJ and London: Transaction Publishers.

Byrne, J., and Hoffman, S. (1996). The Ideology of Progress and the Globalization of Nuclear Power. In J. Byrne and S. Hoffman (Eds.), *Governing the Atom: The Politics of Risk* (Vol. 7, pp. 11 – 46). New Brunswick, NJ and London: Transaction Publishers.

Byrne, J., and Hoffman, S. (1992). Nuclear Optimism and the Technological Imperative: A Study of the Pacific Northwest Electric Network. *Bulletin of Science, Technology, and Society 11*, 63 – 77.

Byrne, J., and Hoffman, S. (1988). Nuclear Power and Technological Authoritarianism. *Bulletin of Science, Technology, and Society 7*, 658 – 671.

Byrne, J., and Rich, D. (1986). In Search of the Abundant Energy Machine. In J. Byrne and D. Rich (Eds.), *The Politics of Energy Research and Development* (Vol. 3, pp. 141 – 160). New Brunswick, NJ and London: Transaction Publishers.

Byrne, J., and Yun, S.-J. (1999). Efficient Global Warming: Contradictions in Liberal Democratic Responses to Global Environmental Problems. *Bulletin of Science, Technology, and Society, 19*(6), 493 - 500.

Chapin III, F. S., Zavaleta, E. S., Eviner, V. T., Naylor, R. L., Vitousek, P. M., Reynolds, H. L., et al. (2000). Consequences of Changing Biodiversity. *Nature, 405*(11 May 2000), 234 - 242.

Cassedy, E. S., and Grossman, P. Z. (1998). *Introduction to Energy: Resources, Technology, and Society*. Cambridge: Cambridge University Press.

Davidson, O., and Sokona, Y. (2002). *Think Bigger, Act Faster: A New Sustainable Energy Path for African Development*. Cape Town: EDRC.

Department of the Interior (U.S.). (2002). OCS Oil Spill Facts. Washington, DC: Department of the Interior Minerals Management Service.

Diesendorf, M. (2006). Can geosequestration save the coal industry? In J. Byrne, L. Glover and N. J. Toly (Eds.), *Transforming Power: Energy, Environment, and Society in Conflict*. New Brunswick, NJ and London: Transaction Publishers.

Dubash, N. (2002). *Power Politics: Equity and Environment in Electricity Reform.* Washington, DC: World Resources Institute.
Dubash, N., and Williams, J. (2006). The Political Economy of Electricity Liberalization. In J. Byrne, N. Toly, and L. Glover (Eds.), *Tranforming Power: Energy, Environment, and Society in Conflict*. New Brunswick, NJ and London: Transaction Publishers.
Ellul, J. (1997a). Chronicle of the Problems of Civilization: I. By Way of a Brief Preface (M. Dawn, Trans.). In M. Dawn (Ed.), *Sources and Trajectories: Eight Early Articles by Jacques Ellul That Set the Stage* (pp. 10 - 28). Grand Rapids, MI: Wm. B. Eerdmans Publishing Co.
Ellul, J. (1997b). Needed: A New Karl Marx! (Problems of Civilization II) (M. Dawn, Trans.). In M. Dawn (Ed.), *Sources and Trajectories: Eight Early Articles by Jacques Ellul that Set the Stage* (pp. 29 - 48). Grand Rapids, MI: Wm. B. Eerdmans Publishing Co.
Ellul, J. (1997c). Political Realism (Problems of Civilization III) (M. Dawn, Trans.). In M. Dawn (Ed.), *Sources and Trajectories: Eight Early Articles by Jacques Ellul that Set the Stage* (pp. 49 - 91). Grand Rapids, MI: Wm. B. Eerdmans Publishing Co.
Ellul, J. (1964). *The Technological Society* (J. Wilkinson, Trans.). New York: Vintage Books.
Energy Policy Project of the Ford Foundation. (1974a). *Exploring Energy Choices.* Washington, DC: Ford Foundation.
Energy Policy Project of the Ford Foundation. (1974b). *A Time to Choose*. Washington, DC: Ford Foundation.
European Union. (2005). The Energy Dimension of Climate Change. Retrieved on October 14, 2005. http://europa.eu.int/pol/ener/index_en.htm.
Federal Energy Regulatory Commission (U.S.). (2005). Existing and Proposed North American LNG Terminals. Washington, DC: Federal Energy Regulatory Commission.
Gandhi, M. K. (1965). *My Picture of Free India*. Bombay: Pearl Publications.
Gidley, R. (2005, June 17). Oil Discovery Adds New Twist to Darfur Tragedy. *Reuters*.
Gill, D. A., and Picou, J. S. (1996). The Day the Water Died: Cultural Impacts of the Exxon Valdez Oil Spill. In J. S. Picou (Ed.), *The Exxon Valdez Disaster: Readings on a Modern Social Problem* (pp. 167 - 187). Dubuque, Iowa: Kendall/Hunt Publishing Company.
Goldemberg, Jose. (2003). Energy and Sustainable Development. In J. G. Speth (Ed.), *Worlds Apart: Globalization and the Environment* (pp. 53 – 65). Washington, DC: Island Press.
Goldemberg, J., Johansson, T. B., Reddy, A. K. N., and Williams, Robert H. (1987). *Energy for a Sustainable World*. Washington, DC: World Resources Institute.
Guru, S. (2002). *Renewable Energy Sources in India: Is It Viable?* New Delhi: Julian Simon Center for Policy Research.
Hawken, P., Lovins, A. B., and Lovins, L. H. (2000). *Natural Capitalism: Creating the Next Industrial Revolution*. Boston, MA: Back Bay Books.
Henderson, H. (1996). *Building a Win-Win World: Life Beyond Global Economic Warfare*. San Francisco, CA: Berrett-Koehler Publishers.
Henderson, H. (1995). *Paradigms in Progress: Life Beyond Economics*. San Francisco, CA: Berrett-Koehler Publishers.
Henderson, H. (1988). *The Politics of the Solar Age*. Indianapolis, Indiana: Knowledge Systems.
Hightower, M., Gritzo, L., Luketa-Hamlin, A., Covan, J., Tieszen, S., Wellman, G., et al. (2004). *Guidance on Risk Analysis and Safety Implications of a Large Liquefied*

Natural Gas (LNG) Spill Over Water. Albuquerque, New Mexico and Berkeley, CA: Sandia National Laboratories.

Hoffman, S. (2002). Powering Injustice: Hydroelectric Development in Northern Manitoba. In J. Byrne, L. Glover and C. Martinez (Eds.), *Environmental Justice: Discourses in International Political Economy* (pp. 147 - 170). New Brunswick, NJ and London: Transaction Publishers.

Holtzclaw, J., Clear, R., Dittmar, H., Goldstein, D., and Haas, P. (2002). Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use - Studies in Chicago, Los Angeles, and San Francisco. *Transportation Planning and Technology, 25*(1), 1 - 27.

Huber, P. W., and Mills, M. P. (2005). *The Bottomless Well: The Twilight of Fuel, The Virtue of Waste, and Why We Will Never Run Out of Energy*. New York: Basic Books.

Ikeda, D., and Henderson, H. (2004). *Planetary Citizenship: Your Values, Beliefs, and Actions Can Shape a Sustainable World.* Santa Monica, CA: Middleway Press.

Institute for Local Self-Reliance. (2005). Democratic Energy. Retrieved on October 19, 2005. Available at www.newrules.org/de.

Jaccard, M. (2005) *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy*. Cambridge: Cambridge University Press.

Jameson, F. (1991). *Postmodernism: Or the Cultural Logic of Late Capitalism*. Raleigh, NC: Duke University Press.

Johansson, T. B., and Goldemberg, J. (2002). *Energy for Sustainable Development: A Policy Agenda*. New York: United Nations Environment Program.

Karekezi, S., and Kithyoma, W. (2002). Renewable Energy Strategies for Rural Africa: Is a PV-Led Renewable Energy Strategy the Right Approach for Providing Modern Energy to the Rural Poor of sub-Saharan Africa. *Energy Policy*(30), 1071-1086.

Keepin, B., and Kats, G. (1988). Greenhouse Warming: Comparative Analysis of Nuclear and Efficiency Abatement Strategies. *Energy Policy 16*(6), 538 – 561.

Klare, M. T. (2006). The Globalization of the Carter Doctrine. In J. Byrne and N. J. Toly (Eds.), *Transforming Power: Energy, Environment, and Society in Conflict*. New Brunswick, NJ and London: Transaction Publishers.

Klare, M. T. (2004). *Blood and Oil: The Dangers and Consequences of America's Growing Dependency on Imported Petroleum.* New York: Metropolitan Books.

Klare, M. T. (2002a, October 7). Oiling the Wheels of War. *The Nation*.

Klare, M. T. (2002b). *Resource Wars: The New Landscape of Global Conflict*. New York: Owl Books.

Kumar, K. (2005). *From Post-Industrial to Post-Modern Society: New Themes of the Contemporary World.* Malden, MA: Blackwell.

Kumar, K. (1988). *The Rise of Modern Society: Aspects of the Social and Political Development of the West*. Oxford: Blackwell.

Kumar, K. (1978). *Prophecy and Progress: The Sociology of Industrial and Post-Industrial Society*. New York: Penguin Books.

Lee, T. (Forthcoming). The Clash Between Globalization and Indigenous Livelihoods: The Case of the U'wa in Colombia. *Bulletin of Science, Technology, and Society*.

Lovins, A. B. (2005, September). More Profit with Less Carbon. *Scientific American,* 74 - 83.

Lovins, A. B. (1996). Negawatts: Twelve Transitions, Eight Improvements, and One Distraction. *Energy Policy, 24*(4), 331 - 343.

Lovins, A. B. (1981). *Energy/War: Breaking the Nuclear Link: A Prescription for Non-Proliferation*. New York: Harper Collins Publishers.

Lovins, A. B. (1979). *Soft Energy Paths: Toward a Durable Peace*. San Francisco, CA: Harper Collins Publishers.
Lovins, A. B., Datta, E. K., Feiler, T., Rabago, K. R., Swisher, J. N., Lehmann, A., et al. (2002). *Small is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*. Snowmass, CO: Rocky Mountain Institute.
Lovins, A. B., and Gadgil, A. (1991). *The Negawatt Revolution: Electric Efficiency and Asian Development*. Snowmass, CO: Rocky Mountain Institute.
Lovins, L. H., and Lovins, A. B. (2000). Harnessing Corporate Power to Heal the Planet. In *The World and I*. Washington, DC: Washington Times Corporation.
Marcuse, H. (1964). *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society*. Boston, MA: Beacon Press.
Martinez, C., and Poupart, J. (2002). The Circle of Life: Preserving American Indian Traditions and Facing the Nuclear Challenge. In J. Byrne, L. Glover and C. Martinez (Eds.), *Environmental Justice: Discourses in International Political Economy* (pp. 119 - 146). New Brunswick, NJ and London: Transaction Publishers.
Martinot, E., A. Chaurey, D. Lew, J. R. Moreira, and N. Wamukonya. (2002). Renewable energy markets in developing countries. *Annual Review of Energy and the Environment* 27, 309 - 348.
Martinot, E., and K. Reiche. (2000). Regulatory approaches to rural electrification and renewable energy: case studies from six developing countries. Washington, DC: World Bank.
McCully, P. (2001). *Silenced Rivers: The Ecology and Politics of Large Dams*. New York: Zed Books.
Medvedev, Z. (1992). *The Legacy of Chernobyl*. New York: W. W. Norton and Company.
Mumford, L. (1970). *The Pentagon of Power: The Myth of the Machine, Volume Two*. New York: Harcourt Brace Jovanovich, Inc.
Mumford, L. (1966). *Technics and Human Development: The Myth of the Machine, Volume One*. New York: Harcourt Brace Jovanovich, Inc.
Mumford, L. (1964). Authoritarian and Democratic Technics. In *Technology and Culture* (Vol. 5, pp. 1 - 8). Chicago, IL: University of Chicago Press.
Mumford, L. (1961). *The City in History: Its Origins, Its Transformations, and Its Prospects*. New York: Harcourt Brace Jovanovich, Inc.
Mumford, L. (1934). *Technics and Civilization*. New York: Harcourt Brace & Company. *New York Times*. (1955, August 7).
Nahajima, W. andVandenburg, W.H. (2005) A Failing Grade for the German End-of-Life Vehicles Take-Back System. Bulletin of Science, Technology and Society, 2512), 170-186.
New York Times. (1954, September 17).
Noble, D. F. (1983). Present Tense Technology: Technology's Politics. *Democracy, 3*(2), 8 - 24.
Nye, D. E. (1999). *Consuming Power: A Social History of American Energies*. Cambridge, MA: MIT Press.
Occidental Petroleum Corporation. (2005, April 4). Bringing New Energy to Energy Solutions. *Wall Street Journal*, R13.
O'Connor, M. (1994) *On the Misadventures of Capitalist Nature.* In M. O'Connor (Ed.), *Is Capitalism Sustainable?* (pp. 125-151) New Yrok: Guliand Press.
Ogden, J. M. (1999). Prospects for Building a Hydrogen Energy Infrastructure. *Annual Review of Energy and Environment, 24*: 227 – 279.
Oil Spill Intelligence Report. (2001). Oil Spills more than 10 Million Gallons.
Okubo, N. (2005). *PV-based Electrification for Sustainable Rural Livelihoods: A Case Study of Implementation Strategies in the Dominican Republic*. Unpublished The-

sis. Newark, DE: Center for Energy and Environmental Policy, University of Delaware.

O'Toole, J. (1978). *Energy and Social Change*. Cambridge, MA: MIT Press.

Parfit, M. (2005, August). Future Power: Where Will the World Get its Next Energy Fix? *National Geographic, 208,* 2 - 31.

Perrow, C. (1984). *Normal Accidents: Living with High Risk Technologies*. New York: Basic Books.

Pollitt, Michael G. (1995). Ownership and Performance in Electric Utilities : The International Evidence on Privatization and Efficiency. Oxford, Oxford University Press.

Power Technology. (2005). Three Gorges Dam Hydroelectric Power Plant, China. Retrieved on October 13, 2005. Available at www.power-technology.com.

Rees, W., and Wackernagel, M. (1996). Urban Ecological Footprints: Why Cities Cannot be Sustainable – And Why They are a Key to Sustainability. *Environmental Impact Assessment Review*, *16*: 223-248.

Reisner, M. (1993). *Cadillac Desert: The American West and Its Disappearing Water*. New York: Penguin.

Rifkin, J. (2003). *The Hydrogen Economy*. New York: Tarcher.

Roberts, J. T., and Thanos, N. D. (2003). Indigenous Peoples, Development Megaprojects, and Internet Resistance. In *Trouble in Paradise: Globalization and Environmental Crises in Latin America* (pp. 165 - 191). New York: Routledge.

Roosevelt, M. (2002, August 26). The Winds of Change. *Time*.

Roszak, T. (1972). *Where the Wasteland Ends: Politics and Transcendence in Postindustrial Society*. Garden City: Doubleday.

Sant, R. W. (1979). *The Least-Cost Energy Strategy*. Pittsburgh, PA: Carnegie Mellon University Press.

Sawin, J. (2004). *Mainstreaming Renewable Energy in the 21st Century*. Washington, DC: Worldwatch Institute.

Scheer, H. (2002). *The Solar Economy: Renewable Energy for a Sustainable Future*. London: Earthscan.

Schobert, H. H. (2001). *Energy and Society: An Introduction.* New York: Taylor and Francis Group.

Schumacher, E. F. (1973). *Small Is Beautiful: Economics as if People Mattered*. New York: Harper and Row.

Silberman, S. (2001, July). The Energy Web. *Wired, 9.07*.

Smil, V. (2003). *Energy at the Crossroads: Global Perspectives and Uncertainties*. Cambridge, MA: MIT Press.

Strong, S. (1999). New Photovoltaic Products Are Integrated into the Building Skin. *Architectural Record, 187*(12), 229.

Testa, K. (2004, February 16). Are Natural Gas Ships 'Boat Bombs' for Terror? *Associated Press*.

Tester, J. W., Drake, E. M., Golay, M. W., Driscoll, M. J., and Peters, W. A. (2005). *Sustainable Energy: Choosing Among Options*. Cambridge, MA: MIT Press.

The Economist. (2005, September 29). The Power of Spin. *The Economist*.

The Economist. (1986, March 29). The Charm of Nuclear Power. *The Economist*.

Toly, N. J. (2005). A Tale of Two Regimes: Instrumentality and Commons Access. *Bulletin of Science, Technology, and Society, 25*(1), 26 – 36.

Tompkins, J. (2005, October 1). Wind Power Reconsidered. *Popular Science*.

Totten, M., Pandya, S. I., and Janson-Smith, T. (2003). Biodiversity, Climate, and the Kyoto Protocol: Risks and Opportunities. *Frontiers in Ecology and the Environment, 1*(5), 262 - 270.

Uranium Information Center. (2005). Australia's Uranium. Retrieved October 14, 2005. Available at www.uic.com.au.
Vaitheeswaran, V. (2003). *Power to the People: How the Coming Energy Revolution Will Transform an Industry, Change Our Lives, and Maybe Even Save the Planet*. New York: Farrar, Straus and Giroux.
Vanderburg, W. H. (2005). *Living in the Labyrinth of Technology*. Toronto: University of Toronto Press.
Victor, D. G. (2005). *The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming*. Princeton, NJ: Princeton University Press.
Weinberg, A. (1985). *The Second Nuclear Era: A New Start for Nuclear Power*. New York: Praeger.
Weinberg, A. (1972). Social Institutions and Nuclear Energy. *Science, 177*: 27 – 34.
Winner, L. (1986). *The Whale and the Reactor*. Chicago, IL: University of Chicago Press.
Winner, L. (1977). *Autonomous Technology: Technics Out-of-Control as a Theme in Political Thought*. Cambridge, MA: The MIT Press.
World Bank (2004a). Power's Promise: Electricity Reforms in Eastern Europe and Central Asia. Washington, DC: World Bank.
World Bank (2004b). *Sustainable Energy: Less Poverty, More Profits*. Washington, DC: World Bank.
World Bank (2003). *Private Sector Development in the Electric Power Sector*. Washington, DC: Operations Evaluation Department, World Bank.
World Bank (1993). *The World Bank's Role in the Electric Power Sector : Policies for Effective Institutional, Regulatory, and Financial Reform*. Washington, DC, World Bank.
Worster, D. (1992). *Rivers of Empire: Water, Aridity, and the Growth of the American West*. Oxford: Oxford University Press.
Yergin, D., and Stoppard, M. (2003). The Next Prize. *Foreign Affairs, 82*(6): 110 – 121.