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ORGANISATIONS AND GLOBAL WARMING

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Introduction

This essay examines the two biggest environmental polluters, the oil and coal industries, and the possibilities of renewable energy that could replace them. I see the masters of these organisations, CEOs and top officials in the case of corporations, and state leaders in the case of command economies such as China or Saudi Arabia, as responding to near-term demands and interests at the expense of long-term ones, thus endangering the planet. In the case of democratic nations, the firms seek to manipulate public opinion to ignore warnings about their emissions, and government representatives and officials to forestall changes that would threaten their interests. Meanwhile, because of their success in the areas of public opinion and legislation, there is insufficient funding for promising energy alternatives that are carbon-free.

The challenge is unprecedented: to stabilize pollution by 2030 or even 2050, private organisations such as oil and gas producers, that account for most of our greenhouse gases, need to stop dumping them into the atmosphere thus reducing the profit goals of executives and shareholders and raising prices for consumers.. National organisations that pollute (national oil and coal companies in China for example) are to reduce the standard of living of their citizens, and risk disorder, insurgencies and political revolts. It is unlikely they will voluntarily curtail their freedom to pollute to save the planet from a distant catastrophe. The prospects for greatly increased efficiency and renewable, non-polluting energy sources are distant and slim. In two or three decades we

may reach the tipping point where irreversible changes cascade in an ecological calamity, and even with extraordinary determination, doing away with the major polluting energy sources in such a short time seems impossible.

There are less dire scenarios. For example, in a 2008 testimony before two congressional committees, Thomas Fingar, Chairman of the National Intelligence Council, summarizes expert testimony that estimates a minimal impact on global economic growth to 2030; and the US in particular, ‘on balance will benefit slightly from climate change over the next few decades, largely due to increased agricultural yields’ (Fingar 2008). Predictions from economist William Nordhaus, are similar: the US will cope over the next 100 years, though many poor nations will suffer greatly. The current ‘social cost’ of our emissions he estimates to be only \$150.00 per person per year; a carbon tax of \$30 a ton would raise gas prices in the US by only 9 cents a gallon, and involve only a 10% increase in electric utility costs. Presumably the market will then exist for developing and using non-emitting energy sources. Since a carbon tax would generate \$50 billion of revenue in the US it could fund the R and D necessary for reducing emissions (Nordhaus 2009). Others are far less optimistic about continuing historical growth rates. This essay will not discuss these competing models and predictions. Instead, it will examine the role of organisations in global warming.

Formal organisations, public and private, are at the heart of this problem. In rich, democratic nations, we will see how they shape public attitudes towards global warming and the need to minimize their contribution, and how their influence on government leads to weak policies. Their influence in non-democratic nations, where the state controls the polluting organisations, is obvious.. This is a ‘power’ and a ‘materialist’ view of organisations that recognizes, but gives second-place to, ‘neo-institutionalist’ and ‘cultural’ views.

An emphasis upon the role of organisations is different from some other explanations of our failure to even slow emissions. One is the complexity/manageability issue. (See chapter by Welsh in this volume). The complexity of the problem (and the environment) is indeed enormous and may be beyond our capacities. But I hold that when

there is wide agreement on the causation and remedies of major problems, societies have *sometimes* responded remarkably well; even Jared Diamond's *Collapse* has a few examples (Diamond 2005). Citizens willingly make sacrifices, as in wartime; even some corporations during World War II have foregone maximum profits in the national interest. Thus mammoth projects of great complexity and uncertainty have succeeded (e.g. putting a man on the moon; the acceptance by US citizens of the costs and hardships of their role in World War II).

While the complexity of the climate change challenge and of its management is unprecedented, I do not think that this is the most important impediment. If the political and economic power of the major polluters were substantially diminished, democratic states would emerge stronger and could impose the necessary hardships and finance renewable energy initiatives, of which there are many promising ones. It is possible that if the US led the way in drastically reducing emissions, and gave the technologies (e.g. the still-untested capture and sequestration of CO₂ from coal plants) to developing economies, command economies could be cajoled, or even forced with economic weapons, to follow suit.

Another viewpoint is that not enough is known about the dynamics and threat of atmospheric pollution. The evidence of the human source of global warming is however overwhelming (see chapter by Pittock in this volume). More persuasive is the view that the public is simply uninformed about the magnitude of the threat to future generations, but I will suggest that, while true, this is neither decisive nor inevitable. The lack of correct information, I will argue, is at least partly the result of the efforts of large polluting organisations. It is hard to make distant threats salient and we can suffer from 'fear overload' (Weber 2006), but powerful organisations can exploit these cognitive limits.

The problem also defies a 'national culture' explanation. The cultures involved in inaction are simply too diverse, and their approaches to climate change cannot be fully explained on cultural grounds. Concern with environmental quality is not limited to the rich countries with 'post-materialist' values. Even a political structure viewpoint,

while useful in contrasting efforts of Europe and the US (Pulver 2007), does not illuminate the inaction of command economies such as China, or even of a democracy such as Norway, which is not likely to internalize the pollution costs of the major source of its substantial prosperity.

Finally, while it is tempting to cite everyone's self-interest as the cause, greed arguments cannot be disproved; most behaviour is motivated, so even sacrifices can be seen as another form of self-interest. Social structures shape interests, and it is these that should be examined. A key part of social structure is large, for-profit or government-controlled organisations. Even the outlier case of Norway, where there is widespread social responsibility, can be seen as having a social structure that does not preclude a massive denial of their large contribution to global warming (Editors 2009; Norgaard 2006).

What does an organizational perspective entail that makes the other perspectives dependent variables? To be brief and superficial, in modern societies formal organisations, public and private, shape every step of our lives.. We live in a society of organisations; organisations shape our culture, our politics, and even our cognitive processes (Perrow 1991). No significant endeavour by individuals or groups can proceed independent of them. Organisations are always to some degree centralized. Thus leaders, even if they are elected or are rotated, will have an interest in maintaining and increasing the power of the organization over other organisations and citizens, and an interest in maintaining their individual power.

We use the benign term 'leadership' to characterize this behaviour. Organisations are tools in the hands of their masters, imperfect and recalcitrant tools to be sure, but nevertheless tools (Perrow 1986). In the US, corporations are increasingly shaped by demands of large shareholders, but they too are organisations, such as mutual funds and pension funds. They can shape the incentives of the CEOs that head corporations in favour of short-term stock prices at the expense of other stakeholders.

The characteristics of organisational structure have been related to other toxic emissions, though not to greenhouse gases per se. Donald Grant and colleagues have

found that toxic emissions in the chemical industry increase with the size of the corporation and with the number of subsidiaries (Grant and Jones 2003; Grant, Jones and Bergesen 2002). Prechel et al examine the changes in regulations in the 1990s that brought about changes in organisational structure, encouraging corporate pollution in a number of industries that are required to self-report their toxic emissions. The multi-layered subsidiary organisational form, that became popular, allowed new sources of financing through stock issues rather than bank debt, contributions to political action committees that can influence legislation, a low rate of return on equity (a disincentive to installing pollution controls), large payouts to stockholders and large stock options for managers. All of these were associated with higher rates of toxic emissions. The imposition of penalties had no effect (Prechel and Zheng 2009).

There are at least three exceptions to privileging organisations in the global warming debacle. First, millions of small farmers in the world have cattle for milk and beef, and have pigs. They contribute greatly to the methane gas that pollutes the atmosphere. Second, carbon soot may constitute 18% of greenhouse gases, and most comes from third world family stoves. Third, the values of property rights and individual autonomy in democratic nations can destroy the common good. One example is the difficulty of repairing the bayous of Louisiana to reduce hurricane damage. Thousands of private owners would have to give up their property to create the water-diversion systems and natural growth that would protect cities such as New Orleans. Organisations other than oil and coal companies contribute also, for example the entrepreneurs who organize rain forest destruction, and the wood products industry that buys the wood. But we will focus upon oil and coal companies.

It is organisations that do most of the polluting, not governments or politics or culture or economics or our psychology (Perrow 1997). But to understand what organisations can do, we have to examine their effects upon the public and government. Organisations need some acquiescence from the public, even in command economies. If the public in democratic nations minimizes or denies the threat, it will be much harder to find representatives in government to support mitigation legislation and state investments

in alternative energy forms.

The public

The influence of oil companies upon public attitudes is covered in other chapters in more detail so just the highlights will be mentioned here. First, surveys have indicated that it is not just the rich nations that have the 'post-materialist' view of being more concerned with the environment because they are no longer preoccupied with basic needs; citizens of poor nations are also alarmed about environmental destruction in general and global warming in particular. Indeed, one study found the citizens of poor nations more willing to make economic sacrifices for environmental protection; the poor seemed richer in spirit than the rich (Brechin 1999)! Contrast this with the view of the Chief Economist of the World Bank in 1991, Lawrence Summers. He recommended that there be more migration of dirty industries to the less developed countries because the health costs of pollution for workers in the dirty industries will be less (being low-paid, their value is less), that the environmental effects will be less because these nations are 'under-polluted,' and because the demand for a clean environment only rises with a nation's wealth, as poverty can keep the demand low (Dunlap and York 2008: 530).

Public attitudes in the rich nations show a rising concern with global warming, but the polls can be deceptive. Their sponsors craft questions to fit their preferences. For example, a poll by Zogby taken for the National Wildlife Federation, which has a vested interest in showing there is public disquiet, asked about concern for global warming (it was high) but failed to ask if the respondents thought humans caused it. A non-sponsored poll by the Pew Foundation was more careful. Asked how important they saw 19 issues, the US, the largest contributor to global warming, had the lowest concern about global warming among 15 industrialized nations (only 19% were very concerned). Even China was higher. Perhaps most alarming, the poll asked something that few polls ask. Among those that say there is solid evidence of global warming, *only 41% attribute the warming to human activity*. (Twenty-one percent chose 'natural patterns' and 8% did not know.)

(Centre, 2006). This means that *only 29% of those polled believed both that there was warming and that humans were responsible*. Given this result, the prospects for an aroused citizenry demanding things like the carbon taxes that will reduce their present wealth are dim.

Since the mid 1990s, oil and gas corporations have funded expensive public relations programs that deny that humans cause global warming. For example the American Enterprise Institute (AEI), an ExxonMobil-funded think tank with close links to the Bush administration, offered payments of \$10,000 for articles that emphasize the shortcomings of an alarming report from the UN's Intergovernmental Panel on Climate Change (IPCC) (Sample 2007). Their efforts appear to have been successful among Republican voters. In 1997 the difference between self-identified Democrats and Republican respondents to a Gallup poll asking whether global warming was happening was only four percentage points; 52% of Democrats and 48% of Republicans thought it was happening. By 2008 the four point difference increased to 34%. Concern with global warming among Republicans has actually *declined* over the last decade, and their belief that it was being exaggerated rose from 37% to 59%. This was a key message of the conservative think tanks, in part funded by oil and coal interests, their efforts widely represented in the mass media. The role of corporations in shaping public opinion and the influence of conservative think tanks funded by them has been well studied (McCright and Dunlap 2003, Jacques, Dunlap and Freeman 2008). The consequences for global warming are discouraging.

Big Oil. The US leads the world in carbon dioxide emissions and 44% of these are from the burning of petroleum products in gasoline, heating oil, kerosene, diesel products, aviation fuels, and heavy fuels. The contributors to this deserve some scrutiny, then we will examine an even bigger source of pollution, coal.

When we think of big oil companies contribution to global warming we think of Exxon, BP, Shell and so on who are responsible for a significant proportion. But 77% of the world's proven reserves are in the hands of *national* oil companies.. Western oil

companies now control less than 10% of the world's oil and gas resource base (Jaffe and Soligo 2007). The 'Big Five' independent oil companies (BP, Chevron, ConocoPhillips, ExxonMobil, and Royal Dutch Shell) represent only about 20% of the world production that is not OPEC. Big polluters that they are, they are no match for the OPEC and other non-OPEC countries. There is no evidence that these others are ready to even acknowledge their responsibility for global warming (Jaffe and Soligo 2007: 3, 11).

But the independent oil companies are in states with democratic governance where their responsibility for pollution can be assessed and steps taken to reduce oil consumption. Their profits could be used to increase efficiency and reduce emissions in production and to invest in renewable energy. They have done little to none of these; they have not even invested much in exploration, which should be in their long-term interest, though not in the planet's.

Instead, in recent decades, they have consolidated; cut back upon exploration; contributed to price rises; used their extravagant profits to increase shareholder value; spent almost nothing upon renewables even in the face of projected declines in availability; and have managed to increase government subsidies.

Concentration. The production and distribution of petroleum products by independent oil companies has become highly concentrated. In 1993 the five largest oil refiners controlled one third of the American market, by 2005 they controlled 55%, and the largest 10 refiners controlled 81.4% (Editors 2007). A report by the James Baker III Institute of Public Policy at Rice University in Houston Texas examines the exploration issue. Several of the world's largest oil companies merged in 1998, arguing for the need to cut costs, enhance efficiency and grow capital strength to tackle the massive spending requirements for multibillion dollar mega projects in places like Russia, Venezuela, and Saudi Arabia. However their spending patterns since the mergers failed to show any appreciable increase in exploration spending. Since the smaller publicly traded American oil firms have a superior record for reserve replacement and exploration activity, 'There appears to be a level of consolidation that suggests that firms can become too large to exploit

effectively the kinds of reserves currently available for private capital' (Jaffe and Soligo 2007: 17).

This is in contrast to the 1970s and 1980s when strong independent oil companies' exploration spending spurred a large increase in non-OPEC production, promoting diversity of supply and enhancing US energy security for two decades (13).

A report by a congressional staff committee was similarly concerned. Between 2003 and 2006, a period of record profits, Exxon increased its buybacks of stock 500% while increasing its explorations expenditures by only 30%. Oil companies are producing oil on only 20% of the continental shelf, and only 28% of the federal land for which they have drilling rights. But in 2006, the big five, while repurchasing stock for \$60 billion, spent only \$10 billion on exploration of new oil fields (Staff 2008). For the earth's health, oil exploration should be curtailed; we do not need more CO₂ in our atmosphere. I cite their focus on short-run profits and shareholder value, rather than on the long-term profits from exploration, to demonstrate the short sightedness of their strategy.

Price rises. Consolidation and declining exploration, as well as deregulated market speculation has contributed to the rising price of gasoline. But another contribution has been their decision to not increase refining capacity while increasing profits on refining. Margins for US oil refiners have been at record highs. In 1999, US oil refiners enjoyed an 18.9-cent margin for every gallon refined from crude oil. By 2005, they posted a 48.8 cent margin for every gallon of gasoline refined, a 158 percent jump (Editors 2007). Exxon estimates that the market for oil will peak in 2020, and therefore it says it would not be wise to invest in new refining capacity (Slocum 2006). The capacity shortage drives up prices and profits. (Again, higher oil prices reduce consumption, so we should favour that.).

Where the profits go. How large are the profits, and if they do not go to exploration and refinery capacity, where do they go? Exxon Mobile is the world's largest publicly traded company and the most profitable; in 2005 it netted \$36 billion (Editors 2007). Upon the

recent retirement of CEO Lee Raymond, who helped the profit picture through acquisitions and divesting the company of nearly all of its alternative energy holdings, he was lavishly rewarded with over \$686 million in compensation, and his retirement package was worth nearly \$400 million (Editors 2007). Despite the huge profits of Exxon and the other majors, the stock market has not been all that sanguine about the independent oil companies, despite their stock price increase of 113% between 2002 and 2007. The national oil companies stock rose fully 513% (Jaffe and Soligo 2007: 32).

What did the world's most profitable publicly traded company do with its profits? The same thing that the other four giant oil companies did : paid huge dividends and repurchased their stock. Profits can be invested internally to further the growth of a company (oil exploration, alternative energy sources) or to make the company more efficient. But it can be used instead to repurchase shares in the open market, thus increasing shareholder value, and this is what Exxon and the other major oil companies have done. (Making shareholder value the primary goal of executives and the major stockholders, such as pension funds, is only about 20 years old. For a brief review of its development and citations to the literature, see Perrow (2009)). Buybacks for the five major oil companies went from under \$10 billion a year in 2003 to nearly \$60 billion a year in 2006. (As noted, only \$10 billion went to exploration.) Exxon was the biggest repurchaser in 2007, totalling \$31.8 billion in buybacks.

Subsidies. One of the reasons for the profitability of US oil firms is the generosity of the US government, where the oil lobby is very powerful. In 2005 President Bush signed a new energy bill that included \$5 billion in *new* financial subsidies for the oil companies. Legislation passed in 2008 will provide \$18.5 billion in subsidies over the next 10 years for this fabulously rich industry (Staff 2008). In addition, the US Government allocated \$150 billion of the 2008 \$700 billion bailout money to extracting oil from the shale in the Rocky Mountains, a hugely water intensive program that one critic said would use all the water currently being used by Colorado (Slocum 2006).

Renewable energy. European-headquartered British Petroleum, along with Royal Dutch Shell, are praised for their efforts in this direction. But BP also put most of its profits into buybacks and dividends, reserving 2% for research on solar, wind, hydrogen, and natural gas. (It is rich in natural gas resources, so its investments there and in hydrogen are not in renewable energy, making the 2% figure even less impressive.) Small as 2% of profits is, it is much greater than Exxon, whose only significant contribution to renewable energy is a grant announced in 2008 of \$10 million a year for 10 years to Stanford University; this is \$100 million out of its \$60 billion in profits. Its expenditures on renewable energy are less than three hundredths of one percent of its annual profits. Its current renewable energy advertising campaign costs ten times as much as its investment in renewable energy (Staff 2008).

The oil strategy. David Levy and Ans Kolk in a 2002 article on oil multinationals' response to climate change dutifully note the minor – one could say trivial – renewable energy response of the big oil firms and conclude with the following observations. The big oil companies no longer perceived climate change as a serious business threat. Exxon was more explicit about regulations.

Several US managers acknowledged that adopting an adversarial stance concerning climate change did not cost them much credibility with regulators; one Exxon manager stated 'they cannot ignore us anyway; we are the big elephant at the table'' (Levy and Kolk 2002: 291).

They did not expect renewables to pose a threat before mid-century, because of their high cost and the inability of the existing infrastructure to cope with them. The outlook for core oil and gas businesses would be strong in the next decades and oil would remain the primary fuel for transportation.

Any improvements in fuel efficiency would be more than offset by growth in

vehicle sales and miles travelled, particularly in developing countries, while radical technologies such as fuel cells still faced many costs and technical barriers (Levy and Kolk 2002: 295).

Air transportation was also growing rapidly. All this reduced the stakes and removed the need for more aggressive conservative political action or investments in technological advances. Big oil felt that the highly flexible Kyoto mechanisms provided only weak constraints on emissions.

As a result, there are few rewards for proactively taking the risk of being a technological first mover, and a resistant strategy that aggressively challenges policy may not be worth the cost in political and social legitimacy (Levy and Kolk 2002: 296).

Of course it is depressing to read that the oil companies do not feel threatened. Given their power and their continued emissions, their mammoth externality is likely to go on well beyond the possible tipping point.

Coal

Despite the concern about oil, ecologist Kenneth Calderia of Stanford University, speaking at the 2008 annual meeting of the American Geophysical Union, said that coal was the real problem. If the world stopped using oil it would buy us only about 10 years before coal emissions again warmed the planet to dangerous levels. Oil is only a bit player; burning coal to generate electricity is the real global warming culprit. Even replacing oil with liquefied coal – one of the ‘solutions’ offered by coal companies – would only make a two-year difference, he said (Madrigal 2008). Since 44% of US emissions are from petroleum products, this seems hard to believe. Nevertheless, coal is the most carbon intensive of all fossil fuels, emitting more than twice as much carbon

dioxide per unit of energy as natural gas (Goodell 2006). If we are to have any limits on CO₂, coal should be the largest target. The industry argues that the consequences of global warming will be modest and we have plenty of time. Meanwhile anything that delays action will benefit the industry. The industry argues that we are running out of oil and gas, but the US has self sufficient coal supplies for at least 250 years. Meanwhile, the industry that is the greatest threat to our atmosphere is growing and prospering.

Coal generates about 50% of the electricity used in the US but accounts for 93% of the CO₂ from electric power, which in turn is one-third of all of our CO₂ emissions. A spokesman for the Natural Resources Defence Council testified that it takes 10 years and around \$1 billion to build a one Gigawatt plant (Hawkins 2005). We have mainly built power plants using cheaper natural gas rather than coal in the last two decades (Staff 2007). The increase in energy demands and the rising price of natural gas prompted plans to build 151 coal-fired plants in the US. However, in the last 2-½ years, plans for 83 of these plants have been voluntarily withdrawn or denied permits by state regulators (Warner 2009). China is building one a week. The Department of Energy estimates that by 2030 electricity demand in the US will increase by approximately 40% and much of it met by coal. New plants will have a lifespan of 40 to 60 years. Any carbon tax that we might enact will probably have to grandfather the new plants, exempting them from emission taxes, given our demand for power, and the power of the coal industry and their shareholders. They will be, even with the best current technology (scrubbers, gasification, etc.), high CO₂ emitters for decades.

The politics of big coal. For a brief moment after Bush's election in 2000 things looked bad for the coal industry. Bush had campaigned on a promise to reduce CO₂ emissions, and he appointed Christie Whitman as the EPA administrator. In the first month of the new presidency she gave interviews saying that the president declared the science on global warming good and that reducing CO₂ had to be discussed (Goodell 2006:192). She might be forgiven for this description of the new Republican president's opinion, since many of America's landmark environmental laws have been passed by Republicans – the

Clean Air Act, Endangered Species Act, Toxic Substances Control Act, and the acid rain and amendments to the Clean Air Act (1986). But it was a misstatement. These legislative acts were low hurdles for business and did not strike at the heart of the energy sector; reducing CO₂ would be a high hurdle.

Coal had been identified as a major environmental threat as early as 1977 in a National Academy of Science report, and a worldwide coal industry conference seventeen years ago, in 1993, warned its members of a coming crackdown on CO₂ emissions. (It has yet to materialize.) A coal industry association, the Western Fuels Association, began a public-relations campaign about this time. This, along with similar campaigns sponsored by oil companies, must have helped reduce the percentage of US citizens who, responding to polls, worried about global warming 'a great deal,' from 35% in 1991 to 22% in 1997, the year the US Senate voted 95 -0 against joining the Kyoto Protocol. So in 2001 the industry demanded that Bush's pledge to reduce CO₂ be revoked. All the heavies weighed in, including the Edison Electric Institute, and Vice President Richard Cheney and his energy committee in the White House. It worked.

Peabody Energy. According to Jeff Goodell, the author of *Big Coal*, 'the reversal of Bush's campaign pledge removed the most significant obstacle to the coal industry's future, and to Peabody's' (Goodell 2006, 200). Peabody Energy is the world's largest private sector coal company. In the 2000 election Peabody's holding company gave \$846,000 to federal campaigns, 98% of which went to the Republican Party. Five days after the administration's energy plan was released in 2001 Peabody went public with an initial public offering that raised more than \$430 million for the company, and announced plans to build a new 1500 MW coal-fired power plant. Construction started in 2005 in Illinois. Despite using the latest technology available, it will have only a marginal impact upon emissions compared to a similar size plant built 30 years before.

According to its web site accessed in February 2009, Peabody Energy had revenues in 2008 of \$6.59 billion and unprecedented profits of nearly one billion dollars. With all this money it doubled its shares-buyback goal to \$1 billion, just as oil companies

were doing (it was a good time to do so; its shares were cheap, having declined 55% in 2008 with the recession). It received 5 awards related to environmental stewardship and sustainability. These awards are often suspect. For example, it gave universities a tiny \$10 million for research and development, having previously given only one million over five years. (Numbers such as million and billion are so large that we forget that while one million seconds is less than 12 days; a billion seconds is almost 32 years! A contribution of one million dollars over five years is infinitesimally small compared to a nearly one billion dollars in profit in just one year).

Clean coal? An industry-financed group, the American Coalition for Clean Coal Electricity, spent \$38 million in 2008 informing Americans that there is the promise of ‘clean,’ or carbon-free, coal. Environmental groups call this ‘the dirty lie.’ The newest, unproven technology is known as Carbon Capture and Storage (CCS). It could double the cost of electricity generated from coal. CO₂ is compressed to a supercritical liquid and piped to a suitable geological site, perhaps hundreds of miles away, to an injection well. After injection it seeps into the surrounding rock; a caprock or impermeable layer prevents its escape. Piping and sequestering has been used extensively in small amounts to improve recovery of oil and gas fields. But as yet there has been no demonstration project that links what are called Integrated Gasification Combined Cycle (IGCC) plants to sequestering facilities. The Integrated Gasification Combined Cycle (IGCC) plants (one is being built) cost 20% to 25% more to build than conventional state-of-the-art coal plants using supercritical pulverized coal technology. In addition, add-on capture technology will add another 25% to 40% in cost compared to plants without Carbon Capture and Storage (CCS) capability (Berlin and Sussman 2007). An MIT study estimates the cost of testing sequestration at five large experimental plants to be ‘under’ \$1 billion, and take ten years. Later the study calls for three experimental Integrated Gasification Combined Cycle (IGCC) plants that would each cost (not including acquisition of CO₂) about \$15 million/year for a ten-year period (Katzer 2007).

Neither Integrated Gasification Combined Cycle nor other coal technologies have

been demonstrated with Carbon Capture and Storage (CCS). Another promising technology uses the captured CO₂ to feed algae, 70% of which can be turned into oil and the rest into fertilizer or drugs, but it needs sunlight, which is not constant, only 40% of the CO₂ can be captured, and the demonstration on a large scale seems decades away (Schrag 2008). Because of the diversity of coal characteristics, e.g. heat, sulphur, water, and ash content, multiple technologies may have to be deployed for capture and storage, and the geology must be suitable. As yet, there is no operational experience with carbon capture from coal plants and certainly not with an integrated sequestration operation. There is no economic incentive for private firms to undertake such projects. The technological uncertainty is a barrier, but more important, there is no carbon tax or assurance of government assistance. The 2005 Energy Act did not require that federal assistance be limited to plants with capture and storage, so, in the absence of charges on CO₂ emissions, they turned to pulverized coal plants since the cost is lower. If a carbon tax comes in, however, all these plants would have to be retrofitted at huge, perhaps unsustainable costs.

Nevertheless, the Centre for American Progress report claims that experts are confident that large-scale sequestration will be safe, feasible and cost-effective, and cite the MIT study as evidence (Berlin and Sussman 2007: 13). I do not read the MIT report that way. Feasibility is not guaranteed, nor is the permanence of sequestration in suitable sites (escaping CO₂ would kill people). Cost-effectiveness is questionable, and it takes 10 to 15 years, and even more with integrated capture and storage facilities, to cover the return on investments and start making profits. Will executives and shareholders tolerate this delay? An organisational analysis suggests not..

Duke Energy. It appears to be even hard to get the best current technology installed. Duke Energy in North Carolina is a poster-child for responsible actions by a coal company. It calls for mandatory greenhouse gas reductions from power plants, advocates a cap-and-trade system, is building the nation's largest solar farm, and has bought a wind power company. But an advocacy group, Environmental Defence sued it when it balked

at installing modern air pollution controls on old coal-fired plants. According to Environmental Defence:

Our suit against Duke Energy, the country's third-largest power company, centered on its costly renovations to 30 coal-fired electric generating units at eight power plants in North Carolina and South Carolina. Many of these facilities had been operated sporadically or not at all and were due to be retired and replaced. Instead, Duke Energy extensively rebuilt them, resulting in significant increases in particulate- and smog-forming pollution, but did not obtain permits nor install pollution control equipment as required by law.' (Staff 2007)

The US Supreme Court agreed with them, reversing a lower court ruling that was in favour of Duke. In a 9-0 ruling in 2007, it sent the issue back to the lower courts. Duke Energy also planned to build two huge coal plants in south-western North Carolina, but the courts allowed only one, and environmentalists are still protesting that. The estimated 240 million tons of carbon dioxide that will be generated over the 40-year life of the 800-megawatt plant, known as Cliffside, will probably never be captured, when or if injection technology becomes viable. In North and South Carolina, where Duke operates, the underground rock is too porous to contain any gas.

The future of coal. Organisations count on the new Obama presidency as well. President Obama, who has pledged to spend \$150 billion over 10 years to combat climate change and create 'green' jobs, hasn't said how much of that should go to clean-coal technology. It would take a substantial percentage. (Just to upgrade our power grid to incorporate the additional energy sources that we need will cost an estimated \$100 billion, experts estimate!) Obama's Energy Secretary Steven Chu had called coal his 'worst nightmare' in a 2007 speech when he was a professor at Berkeley. At his Senate confirmation hearing on Jan. 13, 2009, Chu said coal is a 'great natural resource' that the 'the US, with its great technological leadership, should rise to the occasion to develop it' (Whitten 2009). It appears that the government will have to commit so many billions to get clean coal that

efficiency in energy production and use, and renewable energy sources seem like the more reasonable alternatives. But as we will now see, renewables too have dismal prospects. Energy efficiency is more promising, since it increases profits while reducing harm, but its returns are dwarfed by the prospect of increasing energy demand and usage in growing world economies.

Renewables and efficiency

The world has a very long way to go. According to an MIT study, only 0.4% of global energy demand is met by geothermal, solar and wind (hydroelectric is not included) (Katzner 2007). Increasing that ten-fold would only make a hardly discernible impact upon the global problem, and even that appears to be beyond our grasp. Statistics vary, but it is estimated that renewables, including hydroelectric, account for about seven percent of US energy. Without hydro, renewables are about 4% (Administration 2007). But for a number of groups and experts, efficiency and renewables are a mantra.

Andrew Hoffman, the author of a book on how the chemical industry cleaned up its act in response to public pressure (Hoffman 1997), is busy writing books and pamphlets on the economic opportunities for business and industry in adaptation to climate change (Hoffman 2006; Hoffman and Woody 2008). Management guru Michael Porter headed up a special section of the *Harvard Business Review*, warning firms that if they do not seize the opportunity to cash in on the renewable energy field they will lose their businesses.

Companies that persist in treating climate change solely as a corporate social responsibility issue, rather than a business problem, will risk the greatest consequences... the effects of climate on companies' operations are now so tangible and certain that the issue is best addressed with the tools of the strategist, not the philanthropist' (Porter and Reinhardt 2007: 22).

A Yale scholar claims the US is in the midst of a 'revolution' where business is embracing

the profit potential of a burgeoning green consumer movement. Society's desire for action will create a huge demand for reducing carbon-content products (Conroy 2007). Thus US academics are calling upon the source of the problem, profit-maximizing free market capitalism, to cure the problem.

The Environmental Defence Fund and other liberal non-profit organisations are trumpeting the potential of a variety of renewable energy sources (Krupp and Horn 2008). There are thrilling accounts of breakthroughs in every conceivable area of renewable energy sources, from algae to tides, to laser-bombarded hydrogen pellets, and incredibly deep drilling with hot water to tap the earth's heat. There are new discoveries in the wind and solar energy promising more efficiency, and there are small wind and solar farms in operation around the world. But the projects in actual operation lack scale and lack funds. As we have seen with the two biggest polluters, oil and coal, their announced energy-saving and renewable energy plans and advances are a trivial part of their profits or their investments. Channelling dividends and stock buy-backs into renewable energy would have a sizeable impact upon the renewable field, but an unfortunate one on their stock prices and our US 401k plans.

A key to innovations in the US is the interest of venture capital firms in efficiency and renewables; they can finance the thousands of inventors with the promising ideas more efficiently than government grants and the showcase projects of oil and coal firms. But as fascinating and exciting as the projects are, a book that enthusiastically reviews dozens of nascent ventures also notes that the biggest obstacle is inadequate funding. Until there is a carbon tax imposed, these investments are too risky for scaling up with private capital (Krupp and Horn 2008). Even a glossy master plan for competitive business strategies in this area notes that US venture capitalist firms spent only 9% of their investments on clean-energy projects in 2006, a mere \$2.4 billion, the cost of two state-of-the-art coal plants (Hoffman and Woody 2008 88).

Perhaps a carbon tax is not indispensable.. The US could greatly raise the tax on gasoline, use some of the proceeds to give tax breaks to low income families, and most of it as tax credits for renewable energy. One member of a venture capital firm emailed me in

2008 that the issue for venture capital is ‘certainty’ in revenues, which can be either from long-term contracts or from tax benefits.

The economics of alternative energy don’t make it competitive with \$40 oil and probably not even \$100 oil. So it is up to the Government to put in place some set of tax credits or price guarantees to get users of energy sufficiently comfortable with long-term prices to enter into a long-term contract. Combining those revenues with tax credits can then make an investment economic, and of course as you built more the unit cost comes down.

Most social scientists are more optimistic and less materialistic. Social movements, for example, could capitalize upon the public opinion support for renewables, and encourage entrepreneurial activity in that area. A study of the early US wind power sector from 1978 to 1992 claims to find just that. From a finding that in states where the Sierra Club was strong, more firms qualified as wind power vendors, they jump to the conclusion that environmental groups directly increased entrepreneurial activity, and the groups also increased the likelihood of regulative structures that supported wind power. It hardly shows, as they claim, that the social movements changed cognitive frameworks, norms and values (Sine and Lee forthcoming).

There is distinct caressing of the lucky rabbit’s foot in much of the organisational response to climate change literature. In an editorial to a special issue of the *European Management Journal* the editors offer a sunny conclusion: ‘Taken as a whole, the articles in this special issue clearly show that companies have dramatically transformed their attitudes and reactions towards climate change compared to 1997’ (Kolk and Hoffmann 2007: 414). But their own summary of the articles shows something quite different. The articles, they say, speak of ‘slow and fragmented results with respect to mitigating climate change’, companies ‘conform to a fragmented and weak policy regime’ the ‘indicators expose highly ambiguous responses of businesses towards climate change’, and business attempts to ‘counter climate change is limited,’ especially considering the

planned investment in large-scale power plants.

The problem does not appear to be self-interest or short term shareholder value for these scholars, but ‘a weak policy framework and regulatory and market uncertainty.’ In conclusion, the editors write: ‘they seem to struggle finding appropriate responses, with some of them questioning whether the changes under way are sufficient and adequate.’ The articles are unfailingly, if sometimes only guardedly, optimistic but they offer no evidence for the ‘dramatic transformation’ that companies in Australia, North America, and Europe are advertised to have underway. Climate change scientist Roger Pielke Jr. calls these ‘dangerous assumptions’ (Pielke Jr., Wigley and Green 2008).

The Energy Department’s R and D expenditures have declined dramatically. Adjusting for inflation, in 2008 the energy department spent less than a quarter of what it did 30 years before on R and D for oil, coal, nuclear energy, and renewable energy, according to an editorial in *Nature* (Editors 2008). Presidential leadership will have to do more than the Sierra Club, wind farm entrepreneurs, and corporate ‘transformations’ have done to reverse this decline in government investment, and the initial moves of the Obama administration are certainly encouraging, but the 75% budget increase comes to a understaffed, marginalized Energy Department primarily concerned with nuclear weapons and their toxic legacy (Alvarez 2009).

It is interesting that the US renewable industry has a significant competitor from the oil-rich Gulf States. With vastly more profits than even Western oil and coal companies, they are investing heavily in renewables, often by funding US universities that cannot get grant money from our venture capitalists or our government (Rosenthal 2009). Major emitters, as nations, they see what Michael Porter sees – a vast economic opportunity should the world get serious about taxing or capping greenhouse gas emissions. Will it?

Carbon tax, cap and trade

Under the Kyoto treaty the wealthier nations of Europe and Japan have to stay within government limits for emitting greenhouse gases. They can buy credits for offsetting their own emissions if they pay poorer nations to reduce theirs, which is supposedly cheaper to do. This is the Clean Development Mechanism (CDM) used in the Kyoto treaty. (Putting a cap on emissions and trading excesses is used in the European Union treaty, and some small nascent ones in North America.) Here is an example of the Clean Development Mechanism (CDM)'s dysfunctionality:

A large rusting chemical factory in south-eastern China has emissions of just one of its waste gases in a year that are equivalent to the emissions from a million American cars driven 12,000 miles (Bradsher 2005). It can be cleaned up with an incinerator that costs \$5 million, much less than the cost of cleaning up emissions from a million cars or other sources of pollution. But foreign companies will pay China 100 times this cost - \$500 million – because this high price is set in a market in Europe.

The huge profits from that will be divided by the chemical factory's owners, a Chinese government energy fund, and the consultants and bankers who put together the deal from a mansion in the wealthy Mayfair district of London (Bradsher 2005).

China is doing well with the emissions trading funds, collecting almost half of them, with India, Brazil and South Korea getting most of the rest (See chapter by Bo and Lang, in this volume, for a somewhat different take on China's use of these funds). Countries in sub-Saharan Africa were supposed to be the big beneficiaries of emissions trading, but are receiving almost nothing. Another party that benefits, the companies arranging these emission deals, defends these perverse actions. An official of one of them, a firm in Washington DC, said that since an outright ban on emissions or regulations alone might never happen, at least some disposal of the waste gas is taking place despite the admittedly high administrative costs, so it is better than nothing. In small projects involving less than a quarter of a million dollars worth of credits, the administrative costs

of such deal makers, consultants and lawyers are such that they can exceed the cost of the credits themselves (Bradsher 2005). Organisational interests count. As Michael Porter might say, forget the humanitarian impulses, global warming is an economic opportunity.

The European Union's experiment with cap and trade has not been successful either. Started in 2004, emissions rose 0.4% in 2006 and another 0.7% in 2007. However it has generated a multibillion-dollar windfall for some of the biggest polluters. RWE, a major German power company and Europe's largest carbon emitter received a windfall of about \$6.4 billion in the first three years of the system, and in addition raised utility rates for its customers far more than was allowable (Kanter and Mouawad 2008).

A new program was passed on December 17, 2008. Supposedly it commits the Union's 27 countries to reduce greenhouse gases by 20% below 1990 levels by the end of the next decade. Critics pointed out that the new program will probably reduce emissions in Europe by as little as 4% between now and 2020. The rest of the cuts are expected to take place outside of Europe, where monitoring and verification are very difficult. A Greenpeace spokesman said 'haphazardly planting trees in Africa so we can continue spewing out carbon emissions in Europe is not the solution to climate change' (Cronin 2008). An article in *Nature* points out that power companies will get 'windfall profits' because of the free allocations they will receive, meanwhile legally raising their prices to reflect what they would be were the allocations not free (Schiermeier 2008).

A fairly scathing report by the US Government Accountability Office noted the poor performance of the European and the Kyoto cap and trade programs. Among other things they noted the lack of monitoring abilities and verification. For most programs these are based upon self-reports by the industry involved. There is a lack of accurate emissions data, and despite a 'rigorous screening process' credits were awarded for projects that would have occurred anyway without trading emission rights. Substantial wealth is being redistributed, it ominously notes (GAO 2008).

One commentary notes a perverse incentive in the case of the European program. Germany's renewable energy companies are very successful; 15% of the country's electricity comes from solar, wind or biomass facilities. But this does not reduce

emissions because the EU trading system sets only the total amount of CO₂ that industry and power companies can emit, regardless of how much renewable energy is produced. The renewables generate unused certificates, which can be sold to coal companies in countries such as Poland or Slovakia, which can emit more greenhouse gases than originally planned and remain less efficient. This could be prevented if certificates were taken off the market every time a renewable source such as wind turbines came on line. But 'if the state went back to the companies and took away the certificates they had been allotted there would be an uproar' that 'no politician could withstand.' The promise of renewables must also be weighed against cheaper measures. It costs a lot to build wind and solar facilities, or to install scrubbers in coal plants; other measures such as renovating buildings are much cheaper (Walderman 2009).

There is one cap and trade program for CO₂ emissions in operation in the U.S that began in January 2009 (others are currently in the formative stages). The Regional Greenhouse Gas Initiative (RGGI) is a cap-and-trade program incorporating 10 north-eastern and Mid-Atlantic states, in which CO₂ emitting power plants are required to purchase emission allowances from their state in annual auctions (and may subsequently trade allowances should any plant's emissions grow or decrease in the interim). The initiative's designers hope to avoid many of the pitfalls of other cap-and-trade efforts by assigning permits through auction, to avoid the windfall profits and gaming that have plagued Kyoto and the EU carbon market (Holt et al. 2007). While it is too early to evaluate the Initiative's success, the reluctance of Pennsylvania (a large north-eastern polluter heavily reliant on coal plants) to join the program does not bode well for its impact. The Regional Greenhouse Gas Initiative is a beginning, but a small one.

The biggest obstacle with cap and trade and carbon tax programs is rarely discussed. If renewable energy sources reduce the demand for coal and oil in a particular country it would reduce coal and oil prices worldwide. Developing nations could then afford to import more coal and oil to increase the welfare of their citizens with cheaper energy. Emissions would not decline (Sinn 2007). In fact, emissions could rise as there would be no incentive for the less developed nations to reduce emissions. Without a

worldwide accord that includes all nations of any substantial size, the establishment of renewable energy sources is not likely to reduce emissions.

Conclusions

We possess the knowledge and technology to stabilize our emissions of greenhouse gases within a few years, though we may have already passed the ‘tipping point.’ We would need iron clad regulations in the nations that make up roughly 80% of the world’s population. These regulations would appear to substantially lower the standard of living in the industrialised nations for at least several decades, though economists disagree on this. (See chapter by Lawn in this volume). They would also probably slow or even reverse the improvements in standards of living for the poorer nations. The so-called ‘political will’ of the populations in these nations would have to be mobilized to force their governments to invest in policies that will favour future generations at the expense of the present one, a rare but not inconceivable event. These governments then would have to drastically change the goals of private corporations where they exist in the democratic industrialized nations, as well as the nation’s own goals.

It may be too late. Most estimates of the accumulation of greenhouse gases have been too low, new data indicates. And there are examples of unexpected interactions that have grave implications. I will conclude with a predicted one: Canada’s giant boreal forests used to suck up an estimated 55 million or more tons of CO₂ annually. but the exploding beetle population, caused by global warming, is killing the trees, and their death releases up to 245 million tons of the CO₂ that they had previously sequestered. Russia’s massive boreal forest expanse is also hard hit by global warming, and wildfires have risen dramatically (Clayton 2009).

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