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In November 2004, President Vladimir Putin signed legislation that established Russia as the 126th country to ratify the Kyoto Treaty to control the emission of greenhouse gases (GHG). More importantly, Russia's ratification cleared the required threshold to allow the Treaty to go into force early in 2005. However, economic uncertainties have prompted American policymakers to withdraw U.S. involvement in the Kyoto Treaty.[1] The decision not to ratify rests on the fact that the Treaty does not include the participation of developing countries and also that the costs of compliance would damage the U.S. economy. In the first case, if China, Brazil, and India are not included in the solution, many believe that efforts by the developed world could be eclipsed and become futile. In the second case, some economic models predict a drag on GDP of nearly two percent (while other models predict an equal-sized boost.[2])

Whether one agrees or disagrees with the rationale to withdraw from Kyoto, one thing is certain. While many within the business community dislike the Kyoto Protocol, viewing it as a suboptimal mechanism for bringing about a business solution to this problem, policymakers have created what businesses dislike even more—uncertainty. Companies need a clear picture of future market environments in order to make strategic decisions; and the decision not to ratify the Kyoto Treaty has only made the future market environment cloudier.

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However, some U.S. companies also see an opportunity in the present situation. They are taking advantage of the lack of a mandatory U.S. GHG emission reduction program to set targets at their own pace and in their own way; a way that fits with their own strategic objectives. Often, these companies have chosen to initiate voluntary GHG reduction programs by drawing on the expertise of: industry associations (such as the Business Roundtable); non-profit organizations (such as Environmental Defense, the World Resources Institute, and the Pew Center on Global Climate Change); and the federal government (such as the Climate Leaders Program). To date, as many as sixty corporations,[3] with net revenues of roughly $1.5 trillion,[4] have set reduction targets. Hundreds more are considering such steps.

In point of fact, many of these companies are agnostic about the science of climate change or the social responsibility of protecting the global climate. The reasons that they are making these emission reductions are decidedly strategic. They are searching for ways to be prepared for the long term, should GHG emission reductions become mandatory, while at the same time attempting to reap near-term economic and strategic benefits should that future not emerge or be delayed. At a time when even some industry groups are pushing for corporate action on climate change—notably, the Conference Board warned that "businesses that ignore the debate over climate change do so at their peril"[5]—many forward thinking U.S. companies have decided that it is in their best interests to hedge their strategic bets, preparing for either scenario.

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Business Logic and Voluntary Greenhouse Gas Reductions

The strategic reasons for adopting voluntary GHG reductions are as varied as the companies that are undertaking them. These companies range in size from $350 million in annual sales to $186 billion. Some are multinational corporations, others are primarily U.S.-based in their market scope. Some are public, others are private, and still others are government owned. They are from industry sectors as diverse as oil, pharmaceuticals, and financial services. Some have adopted modest goals (e.g., one percent reduction in GHGs per year over four years) while others have adopted more aggressive goals (e.g., twenty-five percent reduction from 1990 levels by 2011).[6] Some are relative newcomers in their efforts[7] while others have been working on them for years.[8]

Understanding these initiatives requires shifting our view of controls on GHG emissions from a strictly environmental issue driven by regulatory or social pressures to a strategic issue driven by market pressures. Greenhouse gas controls represent a market transition, one not unlike those that have occurred in the past where consumer needs change or technology advances. In such circumstances, companies face new competitive environments where some will decline

while others rise to fill their place. The typewriter industry was virtually eliminated by the computer in the early 1980s; the compact disc replaced the phonograph album in the mid-1980s; and the 1984 dissolution of the Bell System wrought structural changes in the telecommunications industry.[9]

Climate change will present such a transition. However, unlike these other market shifts, climate change represents a transition of a fairly new and unusual kind. In regions where Kyoto is ratified, it amounts to the establishment of a new worldwide market in pollution, pollution credits, capital, and emissions abatement technology. Companies that will find advantage in the emerging climate change market transition are adept at: reducing their GHG emissions by altering products or processes; trading in emission credits so as to capitalize on this new commodity market; or marketing new management skills or technologies that produce less greenhouse gases. In regions where Kyoto remains unratified, companies may still find themselves in an altered landscape, as their competitors, suppliers, buyers, consumers, investors, and governments adopt concerns for GHG reductions either because they operate in ratified regions or because they see a proactive stance in GHG reductions as wise business strategy.

In either case, the key to financially successful emissions reductions requires an assessment of a company's strategic positioning vis-à-vis GHG emissions. To do this, companies must ask new kinds of questions and undertake new kinds of analyses. How energy efficient are your operations? How much carbon dioxide and other greenhouse gases does your company produce? Do you know the available technologies or alternatives for reducing those emissions? Do you know how to engage in commodity trading of GHG emissions? These questions are unfamiliar to most corporations and many companies simply do not know their potential exposure and strategic positioning on this issue.

However, as in any such market transition, there are great opportunities and grave implications. There will be winners and losers; those with an interest in resisting or trying to delay such a market transformation and those who will try to capitalize on it. The difference between these two groups lies in a careful cost/benefit analysis of doing something versus doing nothing. Not all companies will benefit from GHG reductions and voluntary reduction programs must be based on sound business logic. They must have a bottom-line rationale or such efforts will be financially unsustainable.

How companies have presently sought strategic benefits from voluntary GHG reductions cluster in seven different categories:

- operational improvement,
- anticipating and influencing climate change regulations,
- accessing new sources of capital,
- improving risk management,
- elevating corporate reputation,
- identifying new market opportunities, and
- enhancing human resource management.[10]

In the on-going debate over whether it "pays to be gree,"[11] the question of vulnerability under a climate change protocol needs to be reframed. This requires identifying for whom being green can pay and, secondly, how and when they can make that happen.[12]

Operational Improvement

Within the environmental management literature, there is a great deal of research in the area of pollution prevention. This work has revolved around dematerialization of production processes,[13] optimization of supply chain logistics, developing more efficient manufacturing processes,[14] utilizing green materials and processes, shifting from products to services in the marketplace[15] and linking companies together within their industrial ecologies.[16] One recurrent theme that runs through these literatures is the identification of managerial and operational biases that shield managers from identifying such opportunities.[17] Traditionally, environmental protection has not been seen as a profit-making opportunity within firms. However, when environmental issues are viewed from the perspective of strategic opportunities and framed in traditional economic terms of net present value, return on investment, or return on equity, these opportunities become more visible.

In the same line of reasoning, what follows are examples of reductions in GHG emissions that can at times expose opportunities for process optimization that can lower energy costs, reduce material utilization rates, minimize emissions or lower costs of transportation.[18] The key to transferring the opportunities mentioned here into other contexts and settings is careful consideration of the economic costs and benefits of such efforts as they relate to specific internal hurdle rates and the opportunity costs of conducting these initiatives versus other available initiatives.

Energy Cost Reductions

Cinergy, one of the nation's largest coal-fired electric utilities has pledged to cut its emissions of carbon dioxide by five percent by 2010 to 2012 (despite expected annual electricity growth of two percent per year). With present output at 67 million tons per year, the company plans to spend $21 million on the initiative, two-thirds of which will go towards upgrading the efficiency of the company's plants.[19]

Other companies have more experience in programs similar to Cinergy's and have documented the economic benefits with a track record of success. Ontario Power Generation, one of North America's largest electricity generators, has exceeded its goal of cutting emissions to 1990 levels by 2000 by reducing the use of its own energy. The company is also one of its own largest consumers; its 60 hydroelectric dams, 6 nuclear reactors, and 3 fossil fuel plants consume as much electricity in a year as a community of 500,000. As a result, the utility cut its internal needs by more than 2,000 gigawatts per hour and in the process reduced GHG emissions by 2.5 million tons a year, saving $90 million in energy costs.[20] BP, one of the early movers in the area of GHG reductions, has surpassed

its Kyoto target and claims to have saved $650 million by reducing energy waste.[21]

These energy use reductions come from sources both complex and as simple as lighting upgrades. The U.S. Environmental Protection Agency (EPA) estimates that efficient lighting could reduce the nation's electricity demand by more than ten percent, resulting in a net savings of $17 billion and a reduction of 202 million metric tons of carbon dioxide emissions. Of the thousands of corporations, hospitals, schools, utilities, and state and local governments that have signed on to the EPA's Green Lights program, the average internal rate of return on investments in lighting upgrades is roughly twenty-eight percent;[22] a number that surpasses the internal hurdle rate of many corporate investments. However, such initiatives are often overlooked because companies do not look to lighting upgrades as a high profile source of strategic advantage.

Those companies that see opportunity in lighting and other efficiency upgrades have realized benefits. Canadian First Place, for example, invested $6.5 million in more energy efficient heating and lighting equipment that cut GHG emissions by 27,000 tons per year. The project is expected to pay for itself in 3 years.[23] The Hudson Bay Company claims that its new stores are designed to consume twenty-five percent less energy than if they were built to current building code. Overall, the company claims to have saved $41 million (Canadian) on annual energy expenses by installing energy efficient heating and lighting systems (with a two-year payoff).[24] In the U.S., where lighting accounts for up to twenty percent of electricity use, these examples offer a glimpse of efficiency opportunities that may await companies that seek them.

Operational Cost Reductions

Beyond the economic benefits of energy efficiency, some companies have realized operational cost improvements as well. An assessment of GHG emissions and opportunities for their reduction often exposes new insights into taken-for-granted or under-studied operational parameters. For example, according to the International Air Transport Association, airlines could reduce greenhouse gas emissions and save up to $1 billion per year in operating and fuel costs if every flight was shortened by one minute.[25] With this logic, Lufthansa has spaced out its Frankfurt flights to reduce congestion and circling time, thereby reducing jet engine emissions and saving $60 million per year. European air traffic control has reduced emissions and saved 300,000 tons of fuel per year ($154 million at 2004 prices) by moving planes to higher altitudes where they cruise with more efficiency.[26]

Alcoa, similarly, has realized economic benefits from its attention to its aluminum smelting operations, creating efficiencies and yield improvements that come from better process control and management.[27] Similarly BP saved $1 million by reducing the flaring of gas emissions at its refineries and was able to reduce another 500,000 tons of carbon dioxide equivalent in methane by replacing pneumatic valves with electronic ones in pipelines. By selling the

saved methane, another powerful GHG, rather than venting it, the project realized a sixty-seven percent return.[28]

Other industrial sectors are searching for similar gains from better management practices. Encouraged under President Bush's Climate VISION (Voluntary Innovative Sector Initiatives: Opportunities Now) program[29] twelve industrial sectors pledged to voluntarily reduce emission intensity ranging from three to eighteen percent by 2012, as compared to 1990 levels.[30] These reductions will come from some attention to basic operational activities. Major oil companies, for example, have agreed to scour pipelines and oil fields for leaking methane. Coal companies have promised to expand efforts to capture methane and other greenhouse gases escaping from mines.[31]

Energy Cost Reductions from Transportation

Some companies' operations focus more on the transportation or distribution of goods. PHH Arval, one of the country's largest fleet management companies, has begun to help its clients better understand the carbon dioxide emissions from their fleets, and in the process reduce their transportation costs. According to President and CEO George Kilroy, the three most important considerations for his clients are depreciation costs, fuel costs, and maintenance. By altering the types of vehicles they use in their fleets, as well as better management practices, corporations can reduce fuel costs and receive GHG reduction credits to be applied towards their overall goals. A fleet of 1,000 vehicles, for example, produces an estimated 14,000 tons of GHG emissions. By shifting from full-size to mid-size cars, from SUVs to mid-size, or by introducing hybrids into the fleet, these emissions could be reduced by as much as one-third. To aid in this direction and offer the most benefit to its clients, PHH Arval has now augmented its selection template to allow companies to choose its fleet allocation based not only on concerns such as cost and safety, but also on "green ratings" created by the American Council for an Energy-Efficient Economy. Given the nearly 3.1 million cars and trucks in corporate fleets in the United States, PHH Arval estimates that carbon dioxide reduction potential could reach 2.5 million tons with a fuel cost reduction of as much as ten percent.[32]

Other companies are taking similar steps to reduce the environmental impact of their fleets. FedEx, for example, has taken steps towards shifting its fleet from diesel to hybrid diesel-electric engines.[33] Beginning in July 2003, the company began operating twenty of the new vehicles as a test. Although the capital costs of such vehicles are higher, the fuel costs are fifty percent lower—while carbon dioxide emissions are reduced by thirty-three percent, particulate emissions are lowered by ninety percent, and nitrogen dioxide emissions are lowered by seventy-five percent. If the test fleet is (economically and environmentally) successful, the company hopes to shift its entire fleet of 30,000 vehicles over to hybrids in the next 10 years. The United Parcel Service has also taken steps on alternative fuel vehicles, beginning tests on the first delivery truck powered by hydrogen fuel cells as an addition to its present fleet of 1,000 natural gas powered vans, which produce less carbon dioxide and particulates.

Not all transportation improvements require technological solutions. The Beer Store (owned by Labatt, Molson, and Sleeman) found that it could cut $17,000 a year in annual fuel costs and 114 tons in carbon dioxide emissions by changing the behavior of its delivery truck drivers. In a pilot project in London, Ontario, the company cut the drivers' idling time in half, or about 3,000 hours per year and increased fuel efficiency by fourteen percent. One simple step towards this goal was to dispel the myth that drivers needed to idle their truck for five minutes at the end of the day to avoid damaging the diesel engine.[34]

Energy Cost Reductions Shared across Sectors and Regions

The economic benefits of GHG reductions do not always accrue to one company but can also be more broadly distributed. This has led more than 130 U.S. cities—discharging about fifteen percent of the nation's GHG emissions—to reduce their GHG emissions under the Cities for Climate Protection campaign. Denver, Minneapolis/St. Paul, and Miami/Dade County, for example, have all committed to reducing their emissions twenty percent below 1988 levels by 2005.[35]

While these initiatives are relatively new, other cities have established a track record in this area. Copenhagen, for example, has reduced its emission by twenty-two percent based on 1990 levels.[36] Some cities have measured the benefits in economic terms. In Toronto, for example, where buildings generate up to seventy percent of the city's greenhouse gases,[37] the Toronto Better Buildings Partnership has retrofitted 467 buildings, resulting in a reduction of $19 million in annual operating costs; the creation of 3,800 person-years of employment; $126 million in economic activity; and a decrease in carbon dioxide emissions by 132,000 tons per year.[38] The direct investment for these gains was $126 million, while the return on investment averaged fourteen percent per year and the simple payback period averaged about seven years.[39] Calgary has exceeded its reduction target while staying fifty percent under budget. Net costs to taxpayers are anticipated to be zero. Canadian officials report that efforts by municipalities alone could make up for twenty-five percent of Canada's Kyoto goal.[40]

However, the solutions and the economic benefits can go further if one considers other important factors. Urban temperatures often run as much as 5°F higher than surrounding suburbs. One sixth of U.S. electricity consumption goes to cool buildings at a cost of roughly $40 billion. Energy reductions in urban heat islands have significant economic costs in terms of energy use and also medical costs. High temperatures convert nitrogen oxides and volatile organic compounds from cars and smokestacks into ozone, a main ingredient for smog. Ozone is estimated to be responsible for about $3 billion in health-related costs each year in the Los Angeles basin alone. However, through the use of lighter colors for roofs and pavement and the planting of urban trees, temperatures, energy use, and smog could all be reduced. The DOE estimates that such initiatives in Los Angeles could lower the average summer afternoon temperature by 5°F, cutting the need for air conditioning by eighteen percent for a savings of $175 million per year and reducing carbon dioxide emissions in the process.

This initiative would also reduce smog levels, for additional savings of $360 million in smog-related expenses.[41] Houston is looking at planting more greenery as a way to reduce the "urban heat island" and reduce carbon dioxide and smog levels as well as air-conditioning use.[42]

Anticipating and Influencing Climate Change Regulations

While regulatory compliance is typically viewed as a cost of doing business, the regulatory terrain of climate change is complex and emerging on many levels. In order to think strategically about climate change regulations, business managers must have a multi-pronged approach. They must be aware of developments in policy standards at the international, national, and regional levels; they must be prepared to respond if and when those standards emerge; and, finally, they must assess whether they can have an influence on the form of what those standards might be.

Emerging Policies on the International Level

Even before the Kyoto Treaty was ratified by the requisite number of countries to go into force, many countries decided to commit themselves to reducing their GHG emissions. Central to the Kyoto Treaty and all related national programs is an emissions trading scheme. Some countries have established these schemes as a way to develop and perfect the necessary procedures before they become necessary. Others have taken that final step and put their trading schemes into force. According to the World Bank's Prototype Carbon Fund, these early programs have yielded between $350 and $500 million in carbon trades between 1996 and 2002.[43] Britain introduced the world's first organized trading system in 2001[44] and the world's first sizeable spot market in the trading of greenhouse gases in 2002.[45] In December 2002, the Slovak Republic announced the first trade of a government quota under the regime set up by Kyoto—the sale of GHG emission allowances to a Japanese group.[46] The European Union's GHG emissions trading scheme will be introduced in January 2005.[47] Canada has announced plans to soon follow with its own cap and trade program.[48] The ranks of countries developing GHG trading schemes continue to grow. In 2002, even China announced that it would ratify Kyoto.[49]

Given such developments, multinational corporations face practical strategic reasons to become familiar with internal GHG measurements, reduction strategies, and external trading schemes, given that at least some of their operations will likely find themselves in a regulated regime. However, to be a strategic player in GHG reductions will require a familiarity in GHG emissions measurement and commodity trading, two relatively new areas of expertise. As a result, some companies have created internal GHG trading systems to prepare themselves for potential future regulations. Alcoa, the world's largest aluminum producer has started an internal system for curbing GHG emissions from its businesses around the world.[50] Similarly, Motorola and Waste Management have all adopted internal cap and trade schemes under the assumption that the regulation of greenhouse gases is inevitable.[51] BP and Shell have both been long-

time developers of internal emissions trading schemes (and both have ended those initiatives due to organized trading pursuant to the British and EU Trading Directives).

Emerging Policies on the National Level

Companies whose operations do not take them beyond U.S. borders may also need to assess their vulnerability to a GHG reduction scheme. As many as forty-five bills have been put forward in Congress to control GHG emissions in some shape or fashion. Most recently, a bill proposed by Senators McCain and Lieberman would have required U.S. power plants and industries to reduce GHG emissions to 2000 levels by 2010 and then make further reductions to 1990 levels by 2016. It also proposed a trading mechanism as well as a program to offer credits to farmers who sequester carbon in soil.[52] While the bill was defeated, it is significant that the vote was 55-43 against adoption. The last time the Senate voted on such a bill was in 1997 when they voted 95-0 to reject the Kyoto Protocol.[53] Bills proposing regulatory schemes will likely evolve towards a form that will satisfy policy makers. Towards that end, the bill's sponsors vow to press on and have been able to gain bipartisan as well as industry and NGO support for their efforts.

Emerging Policies on the State Level

Regardless of federal-level standards, companies are facing an increasingly complex set of standards that vary by state. In July 2002, California Governor Gray Davis signed the nation's first bill to regulate GHG emissions from automobiles by the 2008 model year.[54] Since California is the largest car market in the U.S., this could alter auto fleets nationwide. Further, on the initiative of New York Governor George Pataki, ten Northeast states announced a plan for a regional system that would go into effect in April 2005 to limit carbon dioxide emissions from power plants in a cap and trade scheme.[55] The six New England states have also adopted a plan to reduce their overall GHG emissions ten percent below 1990 levels by 2010—a more aggressive approach than Kyoto.[56] Moving beyond non-binding commitments, Maine's Governor signed a law in June 2003 with an aggressive plan to cut carbon dioxide to 1990 levels by 2010.[57] New Jersey has pledged to reduce statewide emissions by three and one-half percent from 1990 levels by 2005[58] and has also signed agreements with its largest utility and all fifty-six colleges and universities to reduce emissions below 1990 levels.[59] Washington has recently announced its intent to join Oregon and California in pursuing climate change reductions on the west coast.

Given these multiple developments, it is clear that even domestic companies will face uncertain regulatory landscapes with regards to climate change. So, whether it is the variety of international standards that multinational corporations must face or the variety of state-level standards that multinational and domestic companies must face, one strategy behind voluntary GHG reductions comes down to the operating benefits of normalizing operations across regional contexts. Maintaining multiple systems for dealing with carbon dioxide

emissions can create an economic drag on the balance sheet while uniform operating standards (as well as internal trading schemes) can help improve the economics of a GHG reduction plan.

Influencing Future Regulations

Climate change strategy can also involve more than simply forecasting or reacting to regulatory changes. It can also involve being proactive in influencing policies that benefit a company's particular climate change positioning.[60] At the most basic level, companies that have taken early steps on voluntary reductions in GHG emissions may find it advantageous to compel other, less-committed competitors to follow suit. Whether these competitors are ill-prepared for such regulations or operationally limited in the extent to which they can comply, the enactment of new emissions laws can shift the market environment, creating opportunities for those that are most prepared and able. For example, Alcoa, one company with extremely aggressive GHG reduction goals, has been lobbying the federal government to adopt GHG requirements. Testifying in a Senate subcommittee in early 2003, Randy Overby, President of Alcoa's energy business stated: "Rather than further debate the science, we have decided that the risk of significant climate change is an issue of vital importance requiring action."[61] In another example, Xcel Energy was able to work with the Minnesota legislature to promote recent changes in Minnesota law that will allow utilities to gain the economic benefits of recovering costs of their voluntary emissions reduction programs.[62]

In markets where GHG reduction goals are being established, competitive advantage can accrue to the company that can influence those standards in favor of their own operations. For example, emissions trading can be accomplished through multiple methods of measuring, quantifying, and exchanging credits. How these schemes actually become set by regulation will cause some companies to adapt to a new set of protocols where others may find that their own internal programs are already consistent with these schemes. If a company can influence the final form of such programs to match their own internally developed schemes, they will not have to make operational changes to comply while their competitors will have to adapt to their already running programs. They are, in effect, setting their own programs as the government mandated industry standard. BP, for example, has more than five years of experience in emissions trading, having launched an experimental intra-company market in 1998 that allows business units to buy and sell credits amongst themselves. BP's expertise in cap and trade earned the company an advisory role in designing the British GHG Emissions Trading System.[63] Similarly, Shell's experience with their own emissions trading desk allowed them an advisory role in developing the EU's Trading Directive, due to go into effect in 2005. These programs bear distinct elements that reflect these company's specific experiences and expertise in GHG trading.

Accessing New Sources of Capital

Directly related to the issue of GHG trading schemes is the availability of capital. In many such schemes, governments are introducing financial incentives to reduce GHGs. The first trade in the British spot market involved an auction for £215 million in financial incentives from the government.[64] It is estimated that the reduction would have cost £247 million in the absence of trading[65] and the thirty-four companies that bought the credits (including Shell, BP, DuPont, ICI, Blue Circle, Tesco, British Airways and the Natural History Museum) agreed to cut their emissions by more than four million tons over five years in return for £53.37 per ton.[66] One of the participants, DuPont (which took over ICI's nylon producing plan in Wilton, Cleveland, UK) reduced emissions of nitrous oxide, a GHG that is 310 times more potent than carbon dioxide, by developing a process that safely broke down the compound into nitrogen and oxygen which can be safely released into the atmosphere. The abatement equipment cost £6 million, and the company hopes to receive £26.7 million from the British government in compensation.[67] Since then, the company installed the technology into its plants worldwide, cutting GHG emissions by 60 million tons a year.[68] In similar examples, the Dutch government has been paying about $10 a ton for GHG reductions in its recent market-trading scheme. The World Bank's Prototype Carbon Fund will give credits to companies that help developing countries shift to technology that reduces carbon dioxide emissions. The credits would be valid and tradable financial instruments.

Becoming even more creative, some jurisdictions are holding "reverse auctions," where a national or local agency declares that they have a fixed amount of money to "buy" GHG reductions. Entities such as companies, power stations, and farmers bid on how much GHG they can deliver at that price. The agency then sorts the bids and takes the most cost-effective ones in terms of GHG reductions for the price.[69] So, the company that is able to generate GHG reductions at the lowest price stands to yield dividends for its efforts.

Those dividends could come from governments at the outset, but will likely come more from interfirm trading as the Kyoto Treaty goes into effect. How much money is at stake? Richard Sandor, chairman of the Chicago Climate Exchange, estimates the market could be as large as the existing $5 billion annual market for sulfur dioxide.[70] The World Bank foresees a $10 billion market in GHG emissions by 2006.[71] CO2e.com estimates the range from $10 billion to $3 trillion by 2010.[72] Others estimate it could be as large as $100 billion per year after the treaty goes into effect.[73]

There are, of course, contingencies on these size estimates that must be weighed into any climate change strategy. One contingency is the inclusion of carbon sinks and the exclusion of trade ceilings, which send conflicting signals through the market. Demand for carbon is bolstered (prices raised) by the Kyoto Protocol's lack of an explicit ceiling on the number of credits that countries can buy to meet their targets. Also, demand is reduced (prices lowered) because Russia, Japan, and Canada have been awarded substantial allowances from the carbon stored in forests towards their emissions reductions.[74] Other

contingencies rest on who participates. According to the research group, Climate Strategies, the market will be about $9 billion with the assumption that the EU, Japan, Canada, Australia, and New Zealand are potential buyers of credits. The size of this market would increase substantially if the U.S. were to join the group of potential buyers. The right to emit one metric ton of carbon dioxide now sells for $3 to $8 according to Jack Cogen, chief executive at Natsource. If American companies do finally join, the price of permits will go up.[75]

However, until they do, the absence of U.S. participation from the market for credits can limit strategic benefits for domestic interests. Many American companies will find it hard to buy or sell credits with companies under the Kyoto regime.[76] For example, Canada, which had been buying large volumes of American emissions reductions in recent years, scaled back since it became clear the American reductions would not be compliant with Kyoto.[77] If the U.S. does not ratify the treaty, credits sold to companies in participating countries could not be counted towards their Kyoto targets.[78] To hedge this bet, companies have been searching ways for registering their reductions, such as through the Department of Energy's GHG registry.

Improving Risk Management

Greenhouse gas reductions can become an opportunity to reduce financial risks. According to the Coalition for Environmentally Responsible Economies, there are presently $7.4 trillion of corporate assets that could be threatened by climate change.[79] This leads the group to conclude that corporate board members and senior executives (as well as institutional investors) can no longer ignore such costs and would be negligent in their fiscal responsibilities should they do so. These risks can be categorized into two types.

Natural Consequences

The first category is the risks associated with the damages and remediation due to climate change itself (as a result of droughts, floods, and hurricanes). In the U.S., these damages have been on the rise. In 1998, weather-related disasters such as fires, floods, storms, and droughts caused approximately $89 billion in economic losses globally. This surpassed the previous record of $60 billion in 1996.[80] And some insurers are worrying that climate change could cause substantial losses in the years ahead. While the economic costs have not been totally calculated yet, the hurricane damages of 2004 stand to break another record.

In the face of such developments, Swiss Re, a large multinational insurance company, reported that "the more quickly and radically the global climate changes, the more extreme weather patterns could cause damage which not only pose a threat to individual citizens, families, and enterprises, but could also jeopardize whole cities and branches of the economy and—on a global scale—entire states and social systems. In brief: damage which had better not be risked because it can no longer be handled."[81] Even the Pentagon has speculated that climate change could have serious economic implications by causing droughts,

TABLE 1. Estimated Annual Costs (in billions of dollars) If Atmospheric Carbon Dioxide Concentrations Double by 2050 (as is widely expected)[a]

	United States	European Union	Former Soviet Union	China	World
Coastal Protection and Losses[b]	$8.1	$5.3	$2.4	$0.7	$49.7
Other Ecosystems	$7.4	$9.8	$2.3	$2.2	$40.5
Agriculture and Forestry	$8.4	$9.9	$6.8	$7.8	$42.5
Energy Industry	$6.9	$7.0	−$0.7	$0.7	$0.7
Water Management	$13.7	$14.0	$3.0	$1.6	$46.7
Human Casualties and Dislocations	$17.1	$22.9	$4.1	$5.5	$86.3
Air Pollution	$6.4	$3.5	$2.1	$0.2	$15.4
Total	**$68.0**	**$72.4**	**$20.0**	**$18.7**	**$304.2**
Share of GDP	**1.4%**	**1.6%**	**0.8%**	**6.1%**	**1.5%**

a. A. Cortese, "As the Earth Warms, Will Companies Pay?" *The New York Times*, August 18, 2002, pp. 3, 6.
b. Includes losses to fishing industry and damage from tropical storms.

which cripple farms and devastate forests—in some scenarios even destabilizing present geo-political arrangements.[82] Swiss Re estimates that global warming could cost $300 billion annually by 2050 in weather damage, pollution, industrial and agricultural losses, and other expenses. These costs vary by region of the world (as shown in Table 1) and by sector. Real estate, for example, will be affected more by coastal flooding while timber and farming will be affected more by droughts.

Financial Consequences

The second category of risk is that associated with the costs of greenhouse emissions under a mandatory GHG mitigation scheme. Companies could face unexpected expenses with regulations, fines, taxes, and caps on products and processes that produce greenhouse gases. Some estimate the total exposure to carbon dioxide controls of the electricity utility industry alone at more than $60 billion annually.[83] Therefore, many feel that they must prepare their companies today for any regulations tomorrow. Cinergy, for example, has seventy-five percent of its physical assets and as much as ninety-seven percent of its energy generation coming from coal (the rest coming from natural gas). To ignore the possibility of carbon restrictions would be fiscally irresponsible. To protect its assets, the company has decided to make reductions today based on their assessment of where policy may head using barometers such as the McCain-Leiberman bill that was voted down in Congress.[84]

Such business realities have led to a push for more public disclosure on GHG liabilities. In May 2002, the Rockefeller Philanthropy Advisors organized the Carbon Disclosure Project, mobilizing $4 trillion in institutional investors to petition 500 large corporations to quantify their GHG emissions. They estimate

that share prices could fall as much as forty percent for heavy carbon-emitting industries and twenty-nine percent for banks without adequate carbon risk management strategies.[85] In response to this type of concern, DuPont, BP, and Ford have begun to address risk from climate change in their annual reports and SEC filings.

Others have suggested that corporate officers may be held accountable for failing to protect their companies from climate-related risk. In 2002, a shareholder resolution sought to reduce the duties of Lee Raymond, Chairman and CEO of Exxon-Mobil, because of his position that climate change was not a problem for the company. The resolution got a surprising twenty percent supporting vote. This is not the only such resolution. In the 2003 proxy season, there were as many as nineteen resolutions filed regarding climate change issues, two-thirds of which received more than twenty percent supporting votes, including GE (twenty-two percent), American Standard (twenty-nine percent), Eastman Chemical Co. (twenty-nine percent), and AEP (twenty-seven percent).[86] Directors at Swiss Re see future shareholder actions as a clear liability issue for corporate managements and boards.

Elevating Corporate Reputation

Greenhouse gas reductions may be an opportunity to enhance a corporation's reputation. This can have important benefits with a variety of constituencies, including, but not limited to: voters who influence future policy; jurors who sit in judgment on legal cases; investors who consider environmental strategies in making investments; communities who influence a company's ability to expand or site new facilities; reporters who write stories about a company's initiatives; employees who work for a company; activists who decide to protest a company's operations; and consumers who purchase a company's products or services.

However, gaining reputational advantage from climate change is difficult given the public's uncertain thinking on the issue. On the one hand, a Zogby poll found that seventy-five percent of 1,200 Americans polled supported the idea of requiring major industries to reduce their GHG emissions.[87] On the other hand, an NEETF survey found that most Americans are fairly illiterate when it comes to environmental issues. For example, a majority of the public think (incorrectly) that the majority of U.S. energy is produced in non-air polluting ways such as hydroelectric power and only one in three sees coal burning as an issue.[88] (In actuality, coal is the primary source of electric power in this country, producing more than fifty percent of the energy mix and nearly eighty percent of the carbon dioxide within the energy sector.[89] The U.S. alternative power sector produces only about ten percent of the U.S. energy needs.)

The opportunities in improving reputation through voluntary GHG initiatives lie in engaging constituencies that are important for your company's success. For example, McDonalds engaged with critics from Greenpeace to offset costly protests and image problems over its use of refrigerants that contribute to global warming. The company convened a "refrigeration summit" with activists,

government experts, and suppliers to explore less polluting activities. In January 2003, a McDonalds in Denmark became what the company says is the world's first fast food restaurant that uses refrigerants that do not contain Freon or hydroflourocarbons.[90] Similarly, Cinergy plans to achieve its carbon dioxide reduction goal of five percent by 2010 to 2012 by working with its customer base, creating incentive programs to reduce consumer demand during hot months,[91] and in the process gained valuable customer goodwill.

The benefits of such initiatives and reputation management, while difficult to quantify, are not lost on large corporate sectors that see the reputation of the entire industry as superseding that of a single company. The International Aluminum Institute claims that the industry has cut GHG emissions in some cases by forty percent between 1990 and 2000 and perflourocarbons by sixty-five percent between 1990 and 2001. The industry has attempted to present a greener image by touting that more than a quarter of aluminum demand is met by recycling, which uses only five percent of the energy needed to make primary aluminum. The motivation for such efforts is often to satisfy or neutralize conflicting interests that may impinge on industry operations.[92]

BP has benefited from avoiding such conflicting interests by its highly visible embracement of climate change as a strategic initiative. When John Browne first articulated his vision for the company in 1997, the oil industry ranked at the bottom of most public opinion polls since the early 1990s.[93] In the wake of his announcements and the efforts that followed, the company enjoys high public approval ratings that now translate into more understanding treatment from environmental activists, the government, and the press (reporters have been less critical of the company's stands on issues such as drilling in ANWR).

Identifying New Market Opportunities

Greenhouse gas reductions can expose important information and insights for guiding new strategic directions. By measuring environmental costs and risks associated with product or process lines and remaining alert to changes in consumer preference, media attention, community concerns, and regulatory program trends, companies can exit increasingly risky business areas in favor of more secure options. This can manifest itself in a number of ways.

For example, certain product markets offer opportunities to reduce carbon load and improve market performance. One area with a great deal of activity is biomaterials, which shift the raw material for synthetics away from fossil fuels. DuPont wants to generate twenty-five percent of its revenues from renewable resources by 2010 (the figure in 2003 was fourteen percent). To do this, the company hopes to divest its large, oil-based textiles and interiors unit (which makes nylon, polyester, and Lycra) and instead make clothes from other sources (such as Sorona, a new stretchable fabric made from corn).[94] Cargill Dow LLC is also seeking to make "bio-material" products such as T-shirts, socks, milk bottles, and auto parts out of cornstarch. The company makes a product called NatureWorks PLA, which Coca-Cola is using to make soft drink cups, McDonalds is

using for salad containers, and Pacific Coast Feather is using to fill pillows and comforters. This reduces dependence on oil (an allied driver of climate strategy), reduces GHG production, eliminates toxic materials from the ecosystem, and reduces associated regulatory burdens. The farm bill passed by the House in 2002 authorizes $5 million in 2002 and $14 million a year from 2003 to 2007 to fund biomass research and make grants to build "biorefineries." Almost all the world's major chemical makers are investing in biomass research to some degree, including BASF AG, Celanese AG, Chevron Texaco Corp., DSM NV, DuPont, and Dow Chemical.[95]

Increased activity in GHG reductions could create new markets or enhance existing ones for companies and industries. For example, there is an entire service and technology sector that specializes in GHG (and other pollution) reduction technologies. Environmental industries in Canada employed more than 120,000 people and had 1997 sales in excess of $20 billion, representing just over two percent of Canada's GDP.[96] In the United States, there are 45,000 firms in the environmental technology sector. That sector enjoyed a $186 billion U.S. market in 1997,[97] while the global market was estimated at $468 billion.[98] (The other two major markets include Western Europe at $137 billion and Japan at $89 billion.)[99] Some estimates see the sector for new energy technologies growing to between $10 and $20 trillion by 2025.[100] However, with the U.S. abstention from Kyoto, there is concern over limited market access for U.S. clean technologies and the development of this growing industry.

Further, government policy on GHG emissions could alter market environments, creating opportunities for some and problems for others. For example, one clear area where new strategic opportunities may emerge is in the development of large-scale alternative energy schemes. A half dozen states including Illinois, Nevada, and Texas have enacted laws to require increasing portions of electricity come from renewable sources.[101] Texas's renewable energy standard has resulted in a massive wind power construction boom.[102] In September 2003, California, Oregon, and Washington announced that they will buy cars that emit low levels of carbon dioxide for the use by state employees.[103] The Dutch government has earmarked one million GHG credits for wind farm projects planned by Meridian Energy and TrustPower.[104] Japan and Germany are heavily funding solar roofs to stimulate the market for photovoltaics. France is subsidizing energy audits and counseling people to travel less. Austria is committed to having seventy-eight percent of energy generation from renewables, Sweden sixty percent, Portugal thirty-nine percent, and Finland, Spain, and Denmark over twenty-five percent. Iceland, rich in thermal energy, has become the first country in the world to make a commitment towards becoming a hydrogen economy and extract energy from water.[105]

One brand new market that could be created by GHG trading is carbon sequestration. An average acre of cropland sequesters about 74 tons of carbon. Through no-tillage farming techniques, which trap and store more carbon, the same acre could sequester between 200 and 1,000 pounds more per year. The price for this activity in the U.S. could be somewhere around $10 an acre. A

carbon market in Europe has already set the price at $8.90 a ton and farmers have been thus far contracted to generate 9,000 tons of carbon every year. While it is unclear exactly how much carbon dioxide could be offset by no-tillage farming,[106] experts suggest that farmers who sequester carbon through "no-till" techniques could reduce total carbon dioxide emissions by twenty percent per year. They could then sell those credits on a commodity market.[107]

In the end, the entrepreneurial question in GHG reductions is: How can one generate carbon credits at the lowest cost and sell them at the highest price? Texana Timber has found an answer to this question using rice paddies. The Texas-based company has always practiced sustainable forestry on its modest timber holdings but has begun to use its expertise in forestry economics to venture into a sequestration strategy that creates multiple environmental and economic benefits. In order to gain credits for carbon sequestration, timber must be planted on land that has been vacant for thirteen years (the stipulation called "additionality" makes the foresting of vacant land, such as cattle-grazing fields, more economically viable). In order to maximize this carbon benefit, Texana doesn't acquire just any land, the company acquires and converts rice fields into stands of new trees. This creates credits for both carbon sequestered in the trees and methane averted by ceasing rice production. Further, the rice fields have the added operational benefits of being heavily fertilized and the ability to be diked for flooding to maintain growth in times of drought. They have the added environmental benefit of creating habitat for wildlife. The company has taken this strategy and begun to offer it as a service, courting investors and partners. These companies—in need of carbon credits to achieve reduction goals—provide capital to acquire the land. Texana repays the capital with interest and gives the company the carbon credits. In exchange, Texana retains the land and the timber revenue. The key to the success of this economic model, says CEO Jack Fields, is vigorous accounting and verification systems, and he has retained a forestry economist and a leading biologist from Rice University to develop such systems.[108]

Enhancing Human Resource Management

Often overlooked and under-rated, the core of all these strategies lies in the engagement of a company's workforce. While technological and economic activity may be the direct cause climate change, it is the culture of the organization that guides the development of solutions to that activity.[109] Amory Lovins, of the Rocky Mountain Institute, speaks often of the cultural elements of climate change strategies:

> "There is some very good news about the climate problem: we do not need to worry about how the climate science turns out or whether this is a real problem or not because we ought to do the same things about it anyway just to save money. The obstacles to achieving this profitable resolution are not technological or economic. Rather, they are cultural and procedural. They are what economists call 'market failures'—the silly rules and practices that do not mean anyone is dumb, but rather that the normal way we do things does not let us use energy in a way that saves money. Obsolete rules-of-thumb used throughout engineering

practice are typically wrong by half to one order of magnitude compared with whole system life-cycle optimization, because they're optimizing a little piece of the system and therefore pessimizing the whole system. Most of our building design is 'infectious repetitis,' not real engineering or architecture at all—partly because architects and engineers are rewarded for what they spend, not for what they save. Similarly our utilities, in almost every jurisdiction, are rewarded for selling more energy and penalized for cutting your bill. We have split incentives between builders and buyers of equipment or buildings, and between landlords and tenants. If you invest to save energy in your operations or home, you probably want your money back about ten times as fast as utilities want their money back from building power plants. This ten-fold difference in discount rate is equivalent to about a ten-fold price distortion."[110]

The organizational message in Mr. Lovins' point is two fold. First, realizing the strategic benefits in GHG reductions requires a change in the structure and culture of the organization. Companies must engage workers as partners in identifying and enacting strategies for reducing their GHG emissions. For example, Ontario Power Generation challenged employees to come up with GHG solutions, yielding suggestions that cut its internal energy needs by more than 2,000 gigawatts per hour and saving $90 million in energy costs.[111] The Beer Store engaged their truck drivers in identifying ways to reduce GHG emissions through things such as idling time, speed, and transmission shifting patterns. Then it provided an education program that taught drivers how to drive more fuel efficiently.[112] PHH Arval offers client seminars to teach about the benefits of automobile fleet allocation with respect to carbon dioxide emissions.

Second, the adoption of greenhouse emissions strategies can improve the morale of the company and thereby increase the retention rates of skilled workers, lower the costs of recruiting and training new ones, and attract and retain higher caliber applicants. An analysis by the Pew Center on Global Climate Change found that GHG reductions motivated employees and drove innovation within companies studied.[113] In short, GHG reductions can be an opportunity to increase workplace productivity. Novo Nordisk, a Danish pharmaceuticals company, has seen its turnover rate drop to five percent, half the industry average, since it initiated its "Values in Action" program as a way to infuse sustainability principles into its strategy.[114] The outdoor company Patagonia claims to have 5,000 applicants for each opening, due in large part to its strong environmental and social mission. Such organizational initiatives are difficult to quantify in economic terms, yet they are real.

Conclusion

Many today are asking whether it "pays to be green." However, the question is too simple in its presentation. It is synonymous with asking whether it pays to innovate. The question is the wrong one. The correct question asks whether there exists an economic opportunity for your company to be green vis-à-vis your competitors and then asks how and when that opportunity can best be achieved. Today, many companies still see climate change as a scientific

or social issue. Yet, the reality is that it is becoming strategic in nature. As international requirements under the Kyoto Protocol begin to emerge and the U.S. continues to sit on the sidelines, it is wise business strategy to use this period to reflect on whether your company can benefit from a voluntary reduction program that can mesh with its strategic objectives. Controls on GHG emissions represent a market transition; one that will affect companies differentially. It will yield winners and losers. Some industries will be at greater risk than others. Thus, the issue pits those with an interest in resisting and trying to delay GHG reductions against those who will try to capitalize on them. In order to realize the extent to which your company will be on the winning or losing side—whether you should be embracing or resisting voluntary GHG reductions—comes down to an understanding of your GHG exposure. It will be based on the answers to questions with which most corporate managers are as yet unfamiliar (see Table 2). These questions force managers to reassess the depth of their knowledge about their operations, the development of policy, new sources of capital, risk management, reputation enhancement, strategic direction, and the cultures of their organizations.

The opportunities and risks exposed by this type of assessment will be determined by the rules of GHG mitigation and trading that get established. For example, how will reduction targets be allocated under a climate change treaty? Will they be based on the magnitude of GHG emissions or on a normalized GHG intensity measure such as CO_2 per BTU or CO_2 per dollar of shipments as listed in Table 3? Will they be based on the fuel mix as listed in Table 4? Or will there be some other measure? Beyond the exact measure, will suppliers be solely responsible for GHG reductions or will consumers share the load? These questions will have direct bearing on who will win and who will lose in a climate change market transition.

Beyond such regulatory factors, there are more specific contextual circumstances that are relevant towards determining who will most likely benefit from voluntary GHG reductions. For example, companies contemplating operational changes now may be more inclined to incorporate GHG reductions in their decision-making than companies with a great deal of existing operating assets, particularly if those assets are relatively new and have many years of operating life remaining. Each year, U.S. industry spends more than $700 billion on new plants and equipment. Managers must evaluate the investment profitability based on an expected useful lifespan. For new facilities, should a company include greenhouse gas reduction technologies in the initial design or take a chance on leaving them out with the anticipated contingency of retrofitting or buying credits later to keep it open? If the decision is to install new technologies, should they choose technologies that go beyond any anticipated emission standards and allow the company to create a surplus of permits for sale or use elsewhere in the company? Based on regulatory forecasting and an economic analysis of the cost and benefits, many companies may decide that it is too risky to omit greenhouse gas reduction equipment in new plant construction projects should Kyoto or some Kyoto-type factors come into force.

TABLE 2. Questions for Exploring the Strategic Dimensions of Voluntary Greenhouse Gas Reductions

Operational Improvement

- What is the energy efficiency of your operations, and can you improve it?
- Do you know how to measure your company's production of carbon dioxide and other greenhouse gases (methane, nitrous oxide, hydrofluorocarbons, perfluorcarbons, and sulfur hexafluoride)?
- Do you know the available technologies or alternatives for reducing emissions and the cost/benefit trade-offs associated with each?

Anticipating and Influencing Climate Change Regulations

- Do you know how to monitor and forecast the development of GHG regulations at the state, federal and international levels?
- Can you influence the form of those regulations?

Accessing New Sources of Capital

- Do you know how to conduct commodity trading of GHG emissions and are you aware of government subsidies for efforts to reduce GHG emissions?

Improving Risk Management

- Are any of your operations at risk due to the natural consequences of climate change and do you know the financial implications of that exposure?
- Do you know how to quantify your emissions and the financial liabilities they may incur should a GHG reduction scheme go into force?

Elevating Corporate Reputation

- How is your company's market reputation improved or harmed by its posture towards GHG reductions?
- Do you have good relations with key constituencies that care about that posture?

Identifying New Market Opportunities

- Are there alternative product or process lines that you could be exploring that will become more attractive as GHG reduction programs proliferate?
- Are there products or services (including GHG credits) that your company can sell to other companies who have decided to embark on voluntary GHG reduction programs?

Enhancing Human Resource Management

- Are your employees concerned about GHG emissions?
- Would voluntary reduction initiatives improve morale, increase the retention rates of skilled workers, lower the costs of recruiting and training new ones, or attract and retain higher caliber applicants?

Further, companies that are heavy emitters may see a benefit by avoiding GHG reductions because they will not have to buy pollution permits or invest in new technology. Looking more deeply, a more important question may be whether the company is near the limits of efficiency in its operations. In reality, it is the most energy-and carbon-inefficient companies that have the most potential for environmental and economic gain (depending on the price of permits and the cost of reductions). The entire question boils down to how GHG emission reductions affect the cost of their operations vis-à-vis their competitors.

Utilities that can recover costs of operational changes will be more likely to adopt GHG reduction programs than those that cannot, as the uncertainty of the return on investment is minimized. Those that are more heavily invested in

TABLE 3. Carbon Dioxide Emissions from Consumption of Energy: Total Emissions and Intensity Measures by U.S. Industry Sector, 1998[a]

Major Group[b]	CO_2 Emissions (Million Metric Tons)	CO_2 Intensity (Million Metric Tons per Quadrillion BTU Consumed)	CO_2 Intensity (Metric Tons per Million $ of Shipments)
Petroleum & Coal (324)	322.5	42.6	2,337.5
Chemicals (325)	327.6	45.4	786.1
Primary Metals (331)	256.8	70.5	1,546.2
Paper (322)	119.3	37.0	769.8
Food (311)	86.5	59.0	202.0
Wood Products (321)	19.4	29.8	213.3
Total Manufacturing	**1,513.2**	**50.7**	**388.0**

a. Energy Information Administration, *Annual Energy Review 2003* (Washington, D.C.: Dept. of Energy, 2000), Table 12.4.
b. The North American Industry Classification System Code (in parentheses).

TABLE 4. Carbon Dioxide Emissions from Consumption of Energy: Fuel Type and U.S. Industry Sector, 1998[a] (million metric tons)

Major Group[b]	Coal	Natural Gas	Petroleum	Electricity[c]	Other[d]
Petroleum & Coal (324)	0.0	53.2	175.0	24.5	69.8
Chemicals (325)	28.7	125.2	56.6	112.2	4.9
Primary Metals (331)	94.6	49.3	3.3	06.0	3.6
Paper (322)	25.8	30.9	15.2	46.7	0.7
Food (311)	12.2	30.0	2.8	41.4	0.1
Wood Products (321)	0.2	3.9	1.2	14.0	0.2
Total Manufacturing	**198.6**	**374.2**	**268.6**	**590.4**	**81.4**

a. Energy Information Administration (2000).
b. The North American Industry Classification System Code (in parentheses).
c. Carbon dioxide emitted from energy inputs used to produce electricity (including associated losses), derived by calculating the manufacturing sector share of the electric power sector's total carbon dioxide emissions based upon the weighted share of electricity retail sales (receipts by) the manufacturing sector.
d. Includes all other types of energy that respondents indicated were consumed or allocated, such as asphalt for road oil, lubricants, naptha, waxes, and miscellaneous nonfuel products.

natural gas may be more inclined than those heavily invested in coal. (Those companies that are more invested in nuclear or renewable energy sources will also be more likely to support mandatory GHG controls as they will raise the costs for their fossil fuel burning competitors.) Companies that exist in mature markets with little opportunity for process or product substitutes will be more likely to resist GHG reductions than those in evolving markets where alternatives are available for achieving reduction goals. Those companies that supply

industry sectors that embrace GHG reductions will hold a more favorable view of GHG reductions than those that service the more resistant fields.

These are just a few variables by which winners and losers may be decided; those for which the proposition that it can pay to be green is more feasible. Once that determination is made, it is important to consider how companies can build on their strategic opportunities, multiplying benefits through multiple efforts. Consider, for example, the FedEx hybrid delivery truck. If the company shifts its entire fleet to this type of drive train, it can possibly reduce both transport operations costs and carbon dioxide emissions. Then it could sell its reduction credits on the open market at a profit or use them to offset any reductions that must be made in other areas of operations (such as air transport). In both cases, there are distinct financial benefits. Further, there will be a simultaneous reduction in particulate and sulfur dioxide emissions, which would yield advantages should new emission standards for diesel trucks be promulgated by the EPA. Going further still, the company could hasten the development of such regulations by lobbying the government with proof that emissions reductions are technically feasible. Finally, the company may find a boost in morale from drivers who derive personal satisfaction from driving such trucks and they may find a boost in demand from consumers who may wish to do business with a company that takes such progressive steps. Of course, the strategic analysis would not be complete without considering the potential dangers if the company finished shifting its entire fleet to hybrid and an alternative technology, such as fuel cells, were to make a break through. These are the dangers in any market and technology transition. (Although it is important to note that unless the hydrogen for the fuel cell is created from something other than fossil fuels, the change in GHG emissions may not be negative).

The future is uncertain both in terms of U.S. involvement in Kyoto and the strategic implications of GHG reductions. It is time for more sophisticated strategic thinking in a GHG market of pollution, credits, capital, and abatement technology.

Notes

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