Profit from Effective Greenhouse Gas Management — A Six-Step Plan

Follow this procedure for evaluating the strategic importance of greenhouse gas (GHG) issues to your firm and developing a corporate strategy for managing GHGs.

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THE KYOTO PROTOCOL, THE SUBJECT OF intense political and scientific debate throughout the world since its introduction in 1997, is now poised to enter into force. The Protocol establishes a "double trigger," requiring both ratification by 55 governments (which was met in 2002) and that the ratifying governments represent at least 55% of the developed nations' 1990 carbon dioxide emissions. Although the U.S. and Australia have stated that they will not ratify it, by the end of February 2003, the Protocol had been ratified by 101 governments representing 43.9% of the developed countries' 1990 CO_2 emissions. To enter into force, the Protocol needs only to be ratified by the Russian Federation, whose Parliament at presstime was expected to act by mid-2003. With the Federation's additional 17.4%, the final 55% requirement will have been met.

Important strategic choices and opportunities now confront firms in their management of greenhouse gases (GHGs), not only those that have a global presence or are seeking to expand internationally, but also U.S. companies seeking to identify and take advantage of prospects for the creation and sale of tradable GHG emission allowances. Effective management of GHG emissions could mean thousands, perhaps millions, of dollars, both in avoided cost and additional revenue. How firms respond may be crucial to their realizing the benefits of these new opportunities and thereby gaining competitive advantage. This article outlines a proactive six-step approach for the management of GHG emissions.

The GHG problem

Greenhouse gases affect the balance between radiant energy from the sun and energy emitted back into space from the earth. GHGs in the air absorb some of the outgoing energy from the earth, trapping it and warming the lower atmosphere and the earth's surface. Some GHGs, such as water vapor, carbon dioxide, methane, nitrous oxide and ozone, occur naturally in the atmosphere. Certain human activities, however, may add to the levels of these gases and contribute other, non-naturally occurring ones, such as hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. GHGs allow the earth to retain enough heat from the sun to support life. At issue has been whether emissions of GHGs from human activities are causing an increase in the amount of heat retained in the atmosphere, thus gradually warming the earth beyond what otherwise would occur.

With scientific consensus emerging that human activities are a contributing factor to global warming, the Kyoto Protocol was adopted by the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto in 1997 *(1)*. The Protocol commits 38 developed countries to reducing their combined emissions of six key GHGs by 2008–2012. Individual reduction targets *(2)* relative to 1990 emission levels are 8% for Switzerland, most Central and East European states, and the European Union (which has distributed different rates among its members), and 6% for Canada, Hungary, Japan and

Poland; Russia, New Zealand and Ukraine are to stabilize emissions; Norway and Iceland could increase emissions by up to 1% and 10%, respectively. The U.S. had originally agreed to a reduction of 7% and Australia to an increase of no more than 8%, although both now plan to not ratify the Protocol.

Table 1 lists the six GHGs covered by the Protocol, along with major anthropogenic (man-made) sources and global warming potentials *(3, 4)*. Global warming potential (GWP) is expressed relative to CO_2, which has a reference point of one. For example, methane is 21 times as potent a global warming gas as CO_2, while N_2O is 310 times as potent. The contributions of the various GHGs from anthropogenic sources to global warming in the U.S. during 2000 (based on the emissions of individual GHGs expressed as CO_2 equivalents) are shown in Figure 1 *(4)*. CO_2 was by far the dominant contributor, at 83% of the total for all GHGs, followed by CH_4 at 9%, N_2O at 6%, and HFCs, PFCs and SF_6 at 2%.

Of the CO_2 emissions, 96% was from the energy sector (predominantly from fuel combustion), 3% from industrial processes (iron and steel, cement, ammonia, lime, aluminum, soda ash and others), and 0.4% from waste incineration. Of the CH_4 emissions, 38% was from the waste sector (mainly solid waste disposal on land), 35% from the energy sector (primarily fugitive emissions from fuels), and 26% from agriculture (mostly from enteric fermentation, followed by manure management). Of the N_2O emissions, 74% was from the agriculture sector (principally from agricultural soils management), 17% from the energy sector (mostly mobile sources), and 7% from industrial processes (mainly nitric acid, followed by adipic acid). Of the HFCs, PFCs and SF_6 emissions, 88% was from industrial processes (largely the production and consumption of halocarbons and SF_6), followed by 12% from the energy sector (fugitive emissions from electrical transmission and distribution).

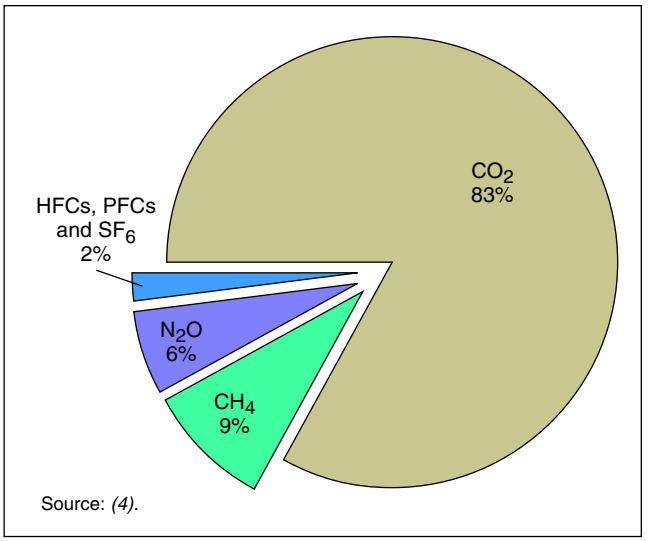

Figure 1. U.S. greenhouse gas emissions in 2000 by gas (expressed as CO_2 equivalents).

Table 1. Greenhouse gases, major anthropogenic sources, and global warming potential.

Greenhouse Gas	Major Sources	Global Warming Potential
Carbon Dioxide (CO_2)	Fossil fuel combustion, certain manufacturing processes, and waste combustion	1
Methane (CH_4)	Agriculture, waste (e.g., landfill gas), gas distribution, and coal mining	21
Nitrous Oxide (N_2O)	Agriculture, transportation, and nitric and adipic acid production	310
Hydrofluorocarbons (HFCs)	Refrigerants, foam blowing, and fire fighting	140 to 9,800
Perfluorocarbons (PFCs)	Electronics manufacturing, refrigerants, and aluminum smelting	4,800 to 9,200
Sulfur Hexafluoride (SF_6)	High-voltage switch gear, magnesium smelting, gas-filled training shoes	23,900

Source: *(3, 4)*.

Strategic issues

Effective GHG management is important to a corporation for several reasons. First, the Kyoto Protocol's entry into force will result in binding requirements for the reduction of GHG emissions in countries ratifying the Protocol. Those countries will achieve their emission reduction targets (which must be met by 2008–2012) by apportioning required reductions among their industrial sectors, and ultimately among individual companies. Reductions may also be coming in the U.S. and Australia — many companies in those countries believe that it is only a matter of time until they, too, will have to meet GHG reduction requirements.

Domestic programs for the management of GHG emissions in the U.S. may include voluntary or incentive-based national and/or state regulatory requirements. For example, the Bush Administration has outlined a voluntary effort to slow the rate of growth in GHG emissions, including the Climate Leaders Program, which encourages companies to develop long-term climate strategies. More recently, legislation introduced in the Senate, if adopted, would establish a U.S. system for capping GHG emissions and creating tradable GHG allowances.

In addition, effective GHG management may make sound business sense in the form of additional bottom-line revenue (*e.g.,* through creation and sale of tradable GHG allowances) or cost savings (*e.g.,* from increased energy efficiency). Since most GHG emissions come from energy production, large energy users may find that measures taken to reduce energy use not only allow creation and sale of GHG allowances, but also yield significant cost savings. The stakes may be high, especially for a multinational firm that has operations in countries already beginning to impose GHG reduction requirements and that is in an industrial sector subject to annual allowances or a carbon or energy tax. Also, reducing GHGs can enhance corporate reputation, which may in turn provide a competitive advantage, particularly for consumer-oriented firms.

GHG issues may be especially important for companies planning mergers or acquisitions. Environmental due-diligence audits performed for such transactions should include an assessment of GHG emissions and reduction requirements. GHG "assets" (tradable GHG allowances due to high emissions and below-average costs for reducing them) may add to the firm's value, while GHG "liabilities" (high emissions and above-average costs of reduction) may reduce its value.

Creative and entrepreneurial opportunities for the creation and sale of tradable GHG allowances exist for several reasons. First, such opportunities are worldwide, since reduction of GHGs by a ton of CO_2 equivalents in one part of the world is regarded as having essentially the same beneficial effect on global warming as the same reduction anywhere else. Second, different GHGs have different effects on global warming (Table 1), so the effect of reducing most GHGs will be greater than a reduction of a comparable tonnage of CO_2. Thus, differences in global warming potential may give rise to non-intuitive opportunities involving the trading of GHG allowances among different greenhouse gases. For example, producing electricity by burning CH_4 at a landfill may create a potential GHG allowance by converting a higher-GWP compound, CH_4, into a lower-GWP one, CO_2.

The six-step GHG management plan

Companies that have (or might have) significant GHG emissions should take steps now to determine the importance of GHG issues and, if warranted, to develop an optimal corporate strategy for GHG management. A firm's strategic position will depend on whether it has GHG assets or liabilities and whether it will be a buyer or seller of tradable GHG allowances. If it can reduce its GHG emissions for less than the price of GHG allowances, it is a seller of such credits, whereas if its cost for GHG reduction is higher than the price of GHG allowances, it is a buyer.

Currently, information about the price of allowances is limited and uncertain. Unlike most U.S. emissions trading programs, there is no requirement to publish allowance prices. Price information is closely held, which is one reason brokers are needed, since they have more pricing information than others.

However, initial judgments about a firm's position may still be possible. For example, if a company is currently a large emitter of GHG emissions, it may find it financially attractive to buy GHG allowances to offset its emissions, making it a potential buyer of such allowances. Conversely, if a firm's operations can consume or sequester carbon, it may be a possible seller.

Of course, prior to the establishment of formal trading programs, firms might still buy or sell GHG allowances through private two-party contracts or other mechanisms.

Step 1: Gather and evaluate basic GHG information

First, obtain and evaluate basic information about GHG issues, including:

- background on specific GHGs and their respective global warming potentials
- regulatory requirements in the countries and local jurisdictions in which the firm's facilities are located and in which its products are marketed
- industrial processes and other activities most likely to be significant sources and sinks of GHGs; for many firms, GHG emissions are mainly associated with energy use, but they may also be generated during manufacturing or use of products by consumers
- voluntary initiatives and/or organizations in which participation may be beneficial, such as the Bush Administration's Climate Leaders Program (www.epa.gov/climateleaders), the Chicago Climate Exchange (www.chicagoclimatex.com), the Pew Center's Business Environmental Leadership Council (www.pewclimate.org/belc/index.cfm), the World Wildlife Fund's Climate Savers Program (www.panda.org), the U.S. Dept. of Energy's Section 1605(b) voluntary GHG reporting program (www.eia.doe.gov/oiaf/1605/background.html), the Global Environmental Management Initiative (www.gemi.org), the Business Roundtable's greenhouse gas program (www.brtable.org), and the California Climate Action Registry (www.climateregistry.org)
- actions currently being taken by competitors and other manufacturers of related products to aid in benchmarking.

Step 2: Conduct a screening-level GHG audit

Using the information from Step 1, make an initial determination of the significance of GHG issues and identify the areas of greatest importance. To do this, conduct a screening-level GHG audit that considers such factors as facility type, operational scale, primary industrial processes, and other relevant data. Facility-specific GHG analyses should be conducted where GHG issues are expected to be important, particularly for operations in countries where GHG emissions reduction requirements are in place or imminent.

A GHG audit involves the following steps:

1. Assemble information for each facility on such factors as location (country and regional or local jurisdiction), operational scale, energy usage, industrial processes or other activities that might be sources or sinks of GHGs, and identify any projects currently being considered to address GHG emissions.

2. Analyze the information to identify those sites at which GHG emissions might be important, considering such key factors as the amount of energy used and the presence and operational scale of major industrial processes known to be significant sources or sinks of GHGs.

3. Rate each facility (for example, on a scale of 1–5) with respect to the likely importance of GHG issues, considering such factors as the amount of energy used and opportunities for reducing energy usage, the presence and operational scale of major GHG-related industrial processes, the applicability and stringency of national and/or local GHG regulations, the imminence of regulatory action, the order-of-magnitude scale of possible costs, the precedence of prior regulatory actions regarding similar facilities, and a qualitative assessment of future liability and uncertainties.

4. Rank the facilities according to their GHG rating, and identify those for which GHG management is likely to be important.

5. Summarize GHG-related regulatory requirements for countries and localities where facilities likely to have significant GHG issues are located, and determine the specific requirements applicable to those facilities.

6. Prepare an assessment of the expected overall importance of GHG issues to the firm, pointing out any key uncertainties in the audit results.

To aid in identifying which facilities warrant more-refined GHG analyses, consider the industrial sectors commonly associated with significant GHG emissions or sinks. As shown in Figure 2 *(4),* fuel combustion is the greatest contributor to GHG emissions, accounting for a total of 82% of CO_2 equivalents; the largest portion of that (35% of the total) is from energy industries, followed by transportation (26%). GHG emissions inventory source and sink categories are listed in Table 2 *(5).*

Step 3: Develop a GHG emissions inventory

Using the GHG audit results from Step 2, develop quantitative GHG emissions inventories for those facilities and processes with a high GHG importance. This may be done using emission factors, which are rates expressed as mass units of emissions per unit of time per unit of energy input or industrial activity (*e.g.,* kg/yr per million Btu of heat input or per m.t. of production). Emissions are estimated by multiplying the emission factor by the appropriate measure of industrial activity (*e.g.,* tons of product manufactured).

Emission factors are available from many sources. The Intergovernmental Panel on Climate Change's (IPCC) Database on Greenhouse Gas Emission Factors (EFDB) *(5),* which was produced by the IPCC National Greenhouse Gas Inventories Program (IPCC-NGGIP), is one of the most comprehensive. It contains emission factors for the source and sink categories listed in Table 2 and other parameters, as well as background documentation and technical references that can be used for estimating GHG emissions and removals. The Australian Greenhouse Office (www.greenhouse.gov.au) is another source of emission factors, as is the U.K.'s Institute of Environmental Management and Assessment (IEMA; www.iema.net), which offers a downloadable emissions calculator spreadsheet. In addition, although primarily for estimating emissions of compounds other than GHGs, the U.S. Environmental Protection Agency's AP-42 emission factor compilation *(6)* provides GHG emission factors for some industrial processes. Finally, industry consortia are developing procedures to estimate GHG emissions for their industries (*e.g.,* Ref. 7 for the oil and gas industry).

Each GHG affects heat absorption in the atmosphere differently. To account for these differences, the emissions of each GHG (GHG_i) are weighted by their respective global warming potentials (GWP_i) and summed, and total emissions are expressed as CO_2 equivalents (CO_2Eq):

$$CO_2Eq = \Sigma(GHG_i \times GWP_i)$$

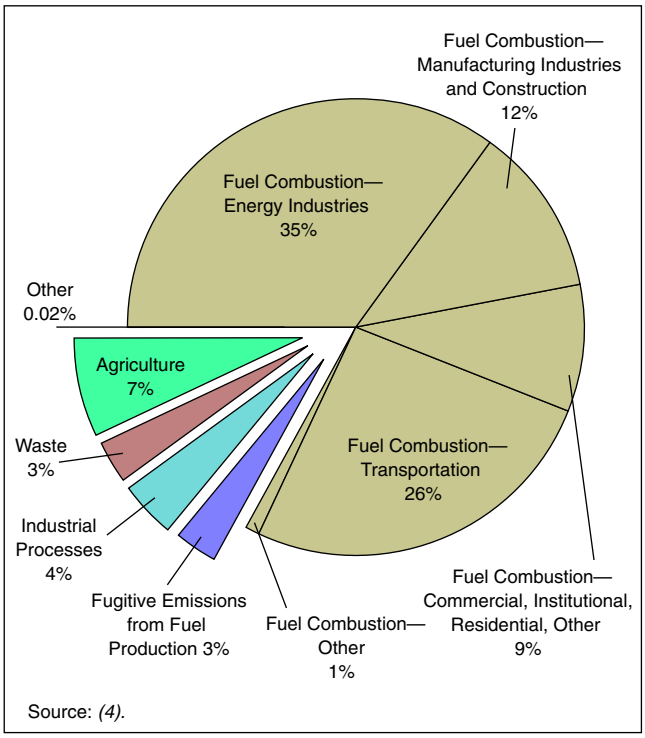

Figure 2. Contributions of various industrial sectors to U.S. greenhouse gas emissions in 2000.

Table 2. Source categories for greenhouse gas emissions inventories.

1. Energy
- 1A. Fuel Combustion Activities
  - 1A1. Energy Industries
    Public electricity and heat production; Petroleum refining; Manufacture of solid fuels; Other energy industries
  - 1A2. Manufacturing Industries and Construction
    Iron and steel; Non-ferrous metals; Chemicals; Pulp, paper and print; Food processing; Beverages and tobacco; Other
  - 1A3. Transport
    Civil aviation; Road; Railways; Navigation; Pipeline; Off-road
  - 1A4. Other Sectors
    Commercial and institutional; Residential; Agriculture, forestry and fishing
  - 1A5. Other
    Stationary; Mobile
- 1B. Fugitive Emissions from Fuels
  Solid fuels; Oil exploration, production, transport, refining, storage and distribution; Natural gas production and distribution; oil and gas venting and flaring

2. Industrial Processes
- 2A. Mineral Products
  Cement production; Lime production; Limestone and dolomite use; Soda ash production and use; Asphalt roofing; Road paving with asphalt; Other
- 2B. Chemical Industry
  Ammonia production; Nitric acid production; Adipic acid prodution; Carbide production; Other
- 2C. Metal Production
  Iron and steel; Ferroalloys; Aluminum; Sulfur hexafluoride used in aluminum and magnesium foundries
- 2D. Other Production
  Pulp and paper; Food and drink
- 2E. Production of Halocarbons and Sulfur Hexafluoride
- 2F. Consumption of Halocarbons and Sulfur Hexafluoride
- 2G. Other

3. Solvent and Other Product Use
- 3A. Paint Application
- 3B. Degreasing and Dry Cleaning
- 3C. Chemical Product Manufacture and Processing
- 3D. Other

4. Agriculture
- 4A. Enteric Fermentation
  Cattle; Buffalo; Sheep; Goats; Camels and llamas; Horses; Mules and asses; Swine; Poultry; Other
- 4B. Manure Management
  Cattle; Buffalo; Sheep; Goats; Camels and llamas; Horses; Mules and asses; Swine; Poultry; Anaerobic; Liquid systems; Solid storage and dry lot; Other
- 4C. Rice Cultivation
  Irrigated; Rainfed; Deep water; Other
- 4D. Agricultural Soils
- 4E. Prescribed Burning of Savannas
- 4F. Field Burning of Agricultural Residues
  Cereals; Pulse; Tuber and root; Sugar cane; Other
- 4G. Other

5. Land-Use Change and Forestry
- 5A. Changes in Forest and Other Woody Biomass Stocks
- 5B. Forest and Grassland Conversion
- 5C. Abandonment of Managed Lands
- 5D. CO_2 Emissions and Removals from Soil
- 5E. Other

6. Waste
- 6A. Solid Waste Disposal on Land
- 6B. Wastewater Handling
- 6C. Waste Incineration
- 6D. Other

7. Other

Source: *(5)*.

The emissions inventory should be prepared to conform with appropriate protocols, such as the Greenhouse Gas Protocol Initiative (GHG Protocol) issued by the World Resources Institute and the World Business Council for Sustainable Development *(8),* which may be emerging as the most widely accepted guidance document on the subject. The GHG Protocol defines three classes of emissions:

• Scope 1 — direct GHG emissions from sources that are owned or controlled by the reporting company, *e.g.,* emissions from stacks, manufacturing processes and vents, and from company-owned or controlled vehicles

• Scope 2 — indirect GHG emissions from imports of electricity, heat or steam

• Scope 3 — other indirect GHG emissions that are a consequence of the activities of the reporting company, but which occur from sources owned or controlled by another company, *e.g.,* contract manufacturing, employee travel on scheduled flights, and emissions occurring during the product use phase.

Additional considerations in the preparation of the emissions inventory are the timeframe for the inventory, the metrics for reporting, and the possible need for verification. Although the Kyoto Protocol set the baseline year at 1990, the GHG Protocol is flexible in this regard, so data availability and any specific regulatory requirements that apply should guide this selection. In addition, the inventory should include a forward-looking component and incorporate a forecast of future GHG emissions over a 5- to 10-yr timeframe (or whatever alternative horizon is consistent with the firm's planning procedures).

For reporting and communicating GHG emissions data, the most common metrics are an absolute measure of mass of CO_2 equivalents, or a normalized metric of emissions per unit of revenue or unit of production. Many companies will find a normalized metric based on production units the most useful measure because it avoids penalties for growth in product output over time.

The need to conduct a formal verification of the inventory, either by self-verification or third-party auditing, will depend on what the inventory is to be used for. To date, a relatively small proportion of firms compiling GHG inventories have sought independent third-party verification. The exceptions are those involved in emissions trading or in national or international emissions reduction projects, some of which require verification. As emissions trading becomes more widespread, verification will likely become a more important part of the inventory process.

Step 4: Identify alternative GHG emissions reduction measures and costs

Based on the quantitative GHG emissions estimates developed in Step 3, identify more precisely the important sources of GHG emissions, update the assessment of the firm's most important GHG issues, and refine the list of facilities to be included for further analyses. For each facility and process, conduct a control technology or production modification analysis to identify, characterize and compare alternative GHG emissions reduction measures. Such an analysis involves the following steps:

1. Identify alternative control technology options, by facility and by key GHG-emitting process.

2. Assess their engineering and practical feasibility.

3. Analyze their potential capital and operating costs.

4. Consider any applicable government levies or rebates.

5. Determine an overall ranking of the alternatives, identifying the preferred choices and summarizing the supporting reasoning.

At many facilities, the analyses may be directed at energy efficiency projects, for which net unit costs (annualized capital costs, plus fixed and marginal costs, minus the value of energy savings) should be evaluated. Some projects may have a negative cost, meaning they are cost-effective in their own right, absent any considerations of GHG reductions; other projects may have a net cost that is considered acceptable relative to other benefits (*e.g.,* meeting corporate GHG reduction targets or future regulatory requirements). The analyses may also include a review of alternative sources of electricity (*e.g.,* in deregulated energy markets, purchasing power from renewable or other low emission sources) or GHG emissions reduction projects (*e.g.,* use of alternative control measures for fugitive emissions, alternative fuels for facility heat sources, or alternative vehicle fuels).

Step 5: Determine the value of GHG emissions trading

A key consideration under the Kyoto Protocol and certain domestic regulatory programs (in the U.K., for example) is the use of emissions trading to meet GHG reduction targets. GHG emissions trading allows one party with relatively high costs for GHG emissions reduction to pay another party with lower unit costs to reduce GHG emissions on its behalf. For an individual firm, this means determining whether GHG emissions reduction costs are higher or lower than the market price of GHG allowances. This determination is complicated by the variable costs of emissions reduction, by the increase in the incremental cost of abatement as the emissions reduction target is increased, by the uncertainty in market prices for CO_2 emission allowances, and by the infancy of the GHG trading market in general.

Therefore, investment decisions should be made conservatively. It is important to consider the commercial and legal risks associated with any GHG emissions trading, especially in the absence of a regulatory framework in the U.S. or fully established international programs. Before deciding to acquire or sell GHG allowances, a full and careful analysis should be done to address the likelihood that tradable GHG allowances will be recognized as such under

future international or domestic trading programs, as well as the value that can reasonably be assigned to such allowances. Formal decision analysis techniques may be useful in quantifying risks and uncertainty.

Based on the technology and cost analyses from Step 4, determine whether GHG emissions trading is of value and whether the firm is a buyer or seller of tradable GHG allowances. This determination will depend on such factors as whether the firm is a large emitter of GHG emissions, the cost of emissions reduction, and whether the firm consumes or sequesters carbon. Another important factor is the company's liability for reducing GHG emissions and the price of potential GHG allowances under a future GHG emissions trading regime. In the U.S., at least, these factors can currently be ascertained only with reference to recent informal trades between buyers and sellers of GHG allowances. Because the U.S. is in the early stages of such trades (as are many other countries), such market determinations are inherently uncertain.

Nevertheless, in many cases, the buyer-seller determination may be straightforward, with GHG emissions so substantial and unavoidable, and reduction costs so obviously high, that the firm would clearly be a buyer of GHG allowances. Otherwise, the buyer-seller question can be evaluated across a range of potential trading allowance market prices to determine the likely buyer-seller status as a function of various possible market configurations and prices.

Finally, because of the evolving nature of the trading market and allowance prices, plan to revisit and, if necessary, update the buyer-seller determination periodically.

Step 6: Develop an optimal corporate GHG strategy

An important part of developing a written corporate strategy for managing GHGs is the preparation of a GHG balance sheet, on which GHG assets are compared with GHG liabilities. Cost information from Step 5 and consideration of regulatory drivers should be used in developing this balance sheet. Because uncertainty in the market price of tradable GHG allowances and the company's GHG reduction costs may make a definitive calculation of assets difficult, the balance sheet can include a parametric analysis of a range of scenarios.

In general, a corporate GHG strategy should include the following:

- alignment with corporate business goals
- emissions reduction targets for GHGs
- third-party verification of the GHG emissions baseline and emissions reductions, if necessary
- the use of alternative energy sources for industrial operations and transportation, where appropriate
- emissions trading, particularly as it relates to capitalizing on energy efficiency improvements
- a mechanism to monitor performance against objectives and targets set under the strategy
- participation in voluntary organizations that might provide market benefits and/or experience in emissions trading activities.

Given the rapidly changing regulatory, technological and economic conditions that affect GHG management, the corporate strategy should be updated periodically to reflect new developments.

GHG emissions trading

Trading of GHG emission allowances has been growing and should accelerate rapidly with the entry into force of the Kyoto Protocol. Although the GHG trading market is not yet global, local markets are emerging. Two, one in the U.K. and one in Denmark, are government-regulated. In addition, the E.U. plans to establish a trading market in 2005.

In the U.S., several new emissions trading programs have emerged recently. A private consortium of some of the U.S.'s largest companies has established the Chicago Climate Exchange, a voluntary cap-and-trade program for reducing GHG emissions. The 14 founding members include American Electric Power, DuPont, Ford, International Paper, Motorola, and the City of Chicago. Participants made a legally binding commitment to reduce GHG emissions by 4% as a group over the next four years. Exchange members will receive credit for emissions reductions above 4%, and can sell or trade these allowances to other member companies. In doing so, participants intend to generate a currency of emission allowances that they anticipate will become internationally tradable. The Business Roundtable, which represents about 150 companies mostly in the U.S., announced that its members have each agreed to measure their annual GHG emissions, publicly report the total, and reduce them by a certain amount. Similar commitments have been made by participants in the Climate Leaders Program, under which they must set an aggressive corporate-wide GHG reduction target goal, develop a corporate-wide inventory, and report and publicize their accomplishments through the program. In return, the EPA provides technical assistance and verification guidance, and opportunities for favorable publicity. To date, 35 corporations have enrolled as charter members.

Despite the early stages of markets, the volume of trading is increasing rapidly. According to the World Bank, trading volume could double in 2003, up to nearly $400 million. It estimates that, since the first trade in 1996, permits for about 200 million m.t. of CO_2 equivalents have been exchanged between parties, involving several hundred transactions, many during 2002 in the U.K (which initiated its market in April 2001).

To date, the supply of GHG allowances has exceeded demand. This has kept prices lower than many expected, primarily due to the lack of regulatory drivers forcing com-

panies to reduce emissions or purchase allowances. Recent prices for vintage 2002 allowances are £4.80 ($2.90) for the U.K. market. Prices listed on CO2e.com (a subsidiary of the Cantor Fitzgerald Group) range from $2 offers to purchase (bids) to $1.70–$8.00 offers to sell. As the Kyoto Protocol enters into force, the number of buyers is expected to increase and prices are likely to rise.

A recent addition to emissions trading in general and GHG trading in particular is the use of derivatives such as options. An option is the right, but not the obligation, to buy (a call option) or sell (a put option) an asset in the future at an agreed upon price (the strike price). Options can, therefore, be effectively used to manage price risks for a premium that is a small fraction of the price of the underlying allowances. Many of the contracts that are being entered into are forward contracts, where a contract is signed for the delivery of a given quantity of a given vintage of GHG allowances, and payment is made upon delivery. In order for a seller to get paid up front, a significant discount will be required to cover the interest on the funds, as well as regulatory and technical risks associated with executing the trade well ahead of the vintage of the allowances. In some cases, an insurance policy is needed to satisfy the buyer that it will receive what it has paid for. Not many companies provide insurance for GHG allowances, but some policies are available and more providers will likely start to offer such coverage.

Final thoughts

Firms that emit significant amounts of GHGs will have to confront the management of those gases, if they have not yet done so. By taking a proactive stance, companies may be able to discover and take advantage of new and potentially profitable opportunities worth thousands, perhaps millions, of dollars. How firms behave now is crucial to determining not just their future compliance with coming regulations, but also their ability to realize the benefits of available opportunities and to gain competitive advantage. CEP

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