



Climate Change Strategies Help Companies Stay Ahead of the Curve

A growing number of companies are learning that implementing sustainable business practices isn't just good for the environment. It also can be good for the bottom line, says Andrew J. Hoffman, associate director of the University of Michigan's Erb Institute for Global Sustainable Enterprise and author of the report *Getting Ahead of the Curve: Corporate Strategies That Address Climate Change*.

Hoffman's report, a "how-to" manual for companies interested in developing effective climate strategies, was released last fall and featured at the national conference, *Corporate Strategies That Address Climate Change*, sponsored by the Pew Center on Global Climate Change and the Erb Institute on November 10, 2006 in Ann Arbor.

"Companies with a history of climate-related activity are shifting their strategies from a focus on risk management and bottom-line protection to an emphasis on business opportunities and top-line enhancements," said Hoffman, the Holcim

(US) Professor of Sustainable Enterprise at the Ross School and School of Natural Resources and Environment.

"Firms that incorporate climate change into their core business strategies will be in the best position to take advantage of emerging opportunities and gain competitive advantage in a changing market environment," Hoffman said. "Sustainable climate strategies cannot be an add-on to business as usual; they must be integrated with a company's core business activities."

Hoffman's report is based on a 31-company survey and six in-depth case studies of Alcoa, Duke Energy (formerly Cinergy), DuPont, The Shell Group, Swiss Re and Whirlpool Corp. It offers eight steps clustered into three stages that describe the various components of a climate-related strategy. Steps include measuring a company's greenhouse gas emissions, gauging how operations and sales may be affected by climate change, evaluating options for reducing emis-

Left to right, the Erb Institute's Andrew Hoffman, Winston Hickox, Rosina Bierbaum and The Pew Center's Truman Semans.

U-M School of Natural Resources Dean Rosina Bierbaum, second from left, and Professor Tom Lyon, center, discuss climate change with attendees of the 2006 conference.

sions, setting targets to reduce emissions, developing financial mechanisms to support climate programs, getting employee buy-in, formulating a policy strategy and managing external relations.

According to Hoffman, nearly all of the companies surveyed — mostly large, publicly held multinational corporations — believe that government regulation is imminent, and about 87 percent believe federal standards will take effect before 2015.

Hoffman's report presents "lessons learned" at each step of a climate-strategy development process. Taken together,



Whirlpool Corporation's J.B. Hoyt, Kevin Leahy of Duke Energy and Swiss Re's Mark Way.

four overarching themes emerge: Ensure strategic timing, establish appropriate levels of commitment, influence policy development and create business opportunities.

Hoffman said the companies in the report identified three key drivers that "will hasten the transformation to a carbon-constrained world." These include the establishment of regulations, rising energy prices and growing interest within the investment community.

"The prospect of greenhouse gas controls is already altering existing markets and creating new ones, changing the business environment in ways that are real and yet still fluid," said Hoffman. "As in any market transition, there are risks and opportunities, and there will be winners and losers. All companies will be affected to varying degrees and all have a managerial and fiduciary obligation to at least assess their business exposure to decide whether climate-related action is prudent.

"The companies in this report believe a proactive approach is necessary to prepare for the coming market transformation and that doing nothing means missing myriad near-term financial opportunities and setting themselves up for long-term political, operational and financial challenges. The rules of the game are changing, and companies ignore these changes at their peril."

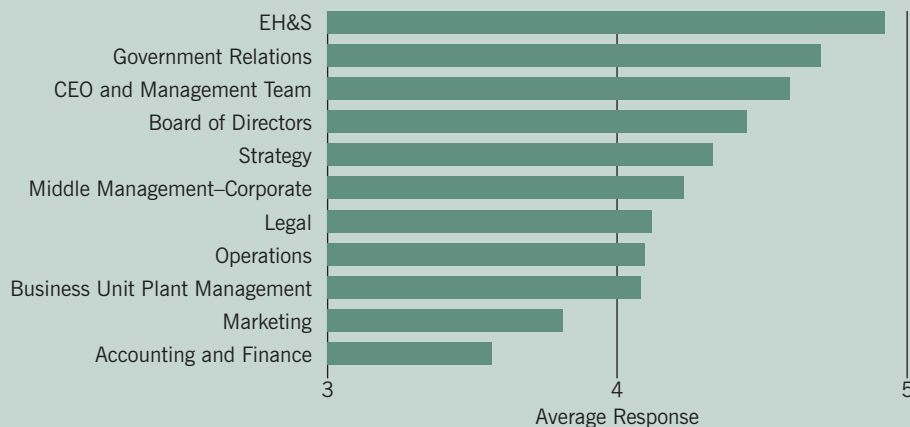


Representatives of the six firms featured in the report were among the conference participants, as were keynote speakers Winston Hickox, senior portfolio manager for the California Public Employees' Retirement System, who discussed "Motivating Climate-Related Strategies: A View from the Investment Community," and Bill Townsend, deputy CEO of Holcim (US) Inc., who talked

about "Linking Climate and Business Strategy." The conference was designed to help companies consider the range of available options for developing a climate strategy and to help financial analysts identify benchmarks for industry best practices on the issue.

To see videos of conference presentations, visit <http://www.erb.umich.edu/News-and-Events/Nov10webcast.htm>.

ORGANIZATIONAL RESISTANCE AND BUY-IN FOR CLIMATE-RELATED STRATEGIES



What positions and/or departments within your company are significantly involved in the IMPLEMENTATION of your strategy, and what is their level of BUY-IN OR RESISTANCE toward your corporate climate-related strategy? (Rank their level of buy-in: 1=Resist; 3=Neutral; 5=Embrace, Leave blank if uninvolved.) Total Respondents: 26

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Bean Counters, Not Tree Huggers

ANDREW J. HOFFMAN

Andrew J. Hoffman, the Holcim (US) Professor of Sustainable Enterprise at the University of Michigan, holds joint appointments at the Ross School and the School of Natural Resources and Environment. He also is associate director of the Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise. Hoffman has published more than 50 articles and four books, including *From Heresy to Dogma*, winner of the 2001 Rachel Carson Prize from the Society for Social Studies of Science, and the Pew Center on Global Climate Change report *Getting Ahead of the Curve: Corporate Strategies That Address Climate Change*, which was released last October. In this *Dividend* viewpoint, Hoffman writes about how enterprising businesses and policymakers are responding to climate change.

Looking for proof that climate change is happening? Stop looking for receding glaciers, rising sea levels or increasing storm severity and start looking at the changing marketplace. Some business associations and lobbyists still dispute the science of climate change, but businesses, many of which remain agnostic about the science, are focusing on the undeniable economics of the problem. Companies are already incurring significant costs associated with climate change and have forecast much more. Accordingly, they are adopting strategies to address the issue.

First, companies are developing *adaptation* strategies to respond to the physical effects that climate change imposes on their operations. For example, Diavik Diamond Mines Inc. relies on ice bridges to move equipment and materials through the northern regions of Canada. Last winter, however, the ice never thickened enough to allow transport of the heaviest trucks. So Diavik absorbed the additional costs of shipping materials by helicopter. Continued warming will disproportionately affect other vulnerable sectors such as agriculture, fisheries, forestry, health-care, insurance, real estate and tourism, as well as offshore energy infrastructure such as oil rigs and pipelines, prompting many in those sectors to explore their own adaptation strategies.

Second, we see the growing prevalence of *mitigation* strategies. To date, more

than 60 corporations with net revenues of roughly \$1.5 trillion have voluntarily set reduction targets for their greenhouse gas emissions. While there is certainly some public relations value in professing concern for the environment, voluntary reductions are based on the need to create and protect shareholder value. The intersection of fiduciary responsibility and climate risk is coming into focus, particularly around the “materiality” of greenhouse gas emissions under the Sarbanes-Oxley Act of 2002, which some believe creates new climate-related legal risks for companies and their directors. This possibility is not just hypothetical: Eight states and New York City have filed a lawsuit against five of the nation’s largest power companies demanding that they cut carbon dioxide emissions. Some insurance companies are beginning to rethink their policies for directors and officers accordingly.

Finally, *competitive* strategies underlie all good management decisions. More and more companies are shifting their responses to climate change from a focus on risk management and bottom-line protection to an emphasis on new business opportunities and top-line enhancements. For some, this means plans to alter existing technologies and capitalize on emerging markets for existing products. For example, Alcoa has developed a new process technology that improves operations while reducing greenhouse gas

emissions from the smelting process. Looking ahead, the company sees an opportunity in recycling because aluminum produced from recycled materials requires only five percent of the energy needed to make primary aluminum. That means a 20-fold reduction in greenhouse gas emissions and a reduction in operating costs. Additionally, as automakers face pressure to improve gas mileage, they are likely to buy more aluminum and less steel in an effort to lighten their vehicles.

For others, competitive climate strategies can involve an alteration of the core business model. DuPont has identified its most promising growth markets in new bio-based materials that employ renewable resources instead of traditional petrochemical feedstocks. This year, the company announced a partnership with BP to develop, produce and market a next generation of bio-fuels. The first product to market will be biobutanol, which is targeted for introduction in 2007 in the United Kingdom as a gasoline bio-component that offers better fuel economy than gasoline-ethanol blends and has a higher tolerance to water contamination than ethanol. In the next few decades, Dupont hopes that over 60 percent of its business will stem from the use of biology to reduce fossil fuels.



The most ambitious climate strategies involve efforts to develop clean, green technologies. In 2005, global investment in wind power and solar power reached \$11.8 billion and \$11.2 billion respectively, up 47 percent and 55 percent from 2004. Announcing a set-aside of \$100 million for investments in cleaner energy, transportation and air and water technologies, venture capitalist John Doerr of Kleiner Perkins Caulfield & Byers said, "This field of greentech could be the largest economic opportunity of the 21st century." Wall Street stalwarts such as Goldman Sachs, Bank of America, JPMorgan Chase & Co. and Citigroup are seeing the opportunity as well, adopting guidelines for lending and asset management aimed at promoting clean-energy technologies. How large is the magnitude of the costs related to climate change? A recent report by Sir Nicholas Stern, former chief economist for the World Bank, states that mitigation costs could rise as much as 3.5 percent of GDP, but the economic benefits of early action to curb greenhouse gases would far outweigh the costs, eventually by as much as \$2.5 trillion a year.

Corporate lobbyists and avowedly pro-business politicians love to talk about the invisible hand of the market, but the fact is that companies know they need rational regulation in order to develop and execute an effective mix of adaptation, mitigation and competitive strategies. Individual states are already acting. California's recent landmark legislation to require a 25 percent cut in industrial greenhouse gases by 2020 is only one of many state-level standards. Much like the events preceding the formation of the Environmental Protection Agency in 1970, a growing patchwork quilt of state and regional regulation is motivating many corporations to support a national climate policy.

Naturally, businesses want a seat at the table when that policy is defined. Policies, by their nature, entail choices that favor certain actions, companies and industries over others. But this much is certain: The debate about whether or not climate change is occurring is over. The market shift proves the climate shift. The bean counters are now moving faster than the tree huggers. They're just waiting for the federal government to catch up and help them write the new rules. ☒

Alumni & Energy

At the White House

As a Presidential Management Fellow, **Richard Chandler**, MBA/MS '04, advises White House policy officials on U.S. energy policy, including the direction of the Department of Energy and other federal agencies that regulate energy.

"I am responsible for formulating the budget for programs dealing with energy as part of President Bush's annual budget submission to Congress. I review and clear legislative proposals and testimony for senior officials as well as perform policy, economic, program management and regulatory analyses."

Chandler also has worked with the U.S. House of Representatives' Committee on Science Energy Subcommittee and helped draft proposed legislation to promote renewable energy and energy efficiency.

Before joining the White House Office of Management and Budget, Chandler worked on energy and environmental issues for Green Mountain Energy Co., Booz Allen & Hamilton, Weyerhaeuser, Solar Electric Light Fund and the University of Michigan's Center for Sustainable Systems. Formerly an investment banker for Salomon Smith Barney in New York City, Chandler also has consulted with the World Bank on water and sanitation financing issues.

"My current position affords me the opportunity to shape energy policy and to gain executive skills needed to improve how organizations are managed. By meeting with technical experts, Congressional staffers, White House policy officials, leaders of nonprofits and corporate executives, I learn about new energy technologies and issues that impact the energy sector."

Chandler, who earned a BS degree in economics from the University of Pennsylvania's Wharton School, says, "The program at the Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise helped me continue to build the technical, financial and analytical skills needed to evaluate various energy technologies. In addition, the multidisciplinary nature of the Erb program has given me a well-rounded perspective on problem solving." ☒

Mary Jo Frank



EILEEN COLTON

Developing Technology



TOM WEIS

Environmentalist **Matthew Johnson**, MBA/MS '01, came to believe in the power of markets to bring about change while working in New York in the mid-1990s. "Global warming and other environmental issues were just beginning to come to the attention of the public, and I was looking for a way to make a positive impact on issues that I felt were important." The Philadelphia native majored in environmental policy at the University of North Carolina, where he earned a bachelor's degree, and worked a summer at the Environmental Protection Agency.

"I think that business is the best way to get things done quickly," says Johnson, director of business development for Gaia Power Technologies, "and I believe that we will all benefit if the market can quickly drive adaptation of environmentally friendly

and energy-efficient technologies." In addition to identifying long-term markets for Gaia Power Technologies' main product, a turnkey energy storage system called the PowerTower, Johnson's responsibilities include strategy development, direct sales and management of government R&D contracts.

"The PowerTower is a plug and play system. In the past you would buy batteries from one source, power electronics from another and cables from yet another. We package it in one box so all the components can be dropped into a building in a

single system," explains Johnson.

Gaia Power Technologies, founded in 2002, helps businesses reduce energy bills by using stored energy instead of purchasing power during times of peak power consumption. A major coffee retail chain is testing the PowerTower in some of its New York City stores.

The PowerTower also is capable of replacing fossil-fuel burning generators. The PowerTower is cleaner than generators that burn diesel fuel or gasoline and helps utilities reduce carbon emissions, says Johnson. Utilities can use one or more PowerTowers to meet demand peaks instead of firing up their peaking power plants, usually older plants that often are dirtier and less efficient than modern plants. Individual consumers also can install a PowerTower, instead of a generator, as a

clean backup power solution.

The firm also offers proprietary software that helps utilities increase the value of renewable energy. "An inherent weakness of solar and wind power is that you don't know when they will be available," Johnson says. "With a PowerTower unit on a house, the utility can store renewable energy in batteries and use our software to tap into stored renewable energy during peak use times."

The PowerTower costs \$10,000-\$12,000 installed and has no fuel or maintenance costs, unlike generators, says Johnson, who also notes that a growing number of municipalities are placing restrictions on generators due to pollution concerns.

Though he had no ties to Michigan, Johnson chose the Ross School because of the Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise. "At the time not many schools were combining environmental studies and business," he says.

Prior to moving to Gaia Power Technologies, Johnson was assistant vice president for electricity and distributed generation at Sentech, a clean energy consultancy based in Washington, D.C.

"The Erb Institute and the Ross School gave me the confidence and skills to overcome any problem that is thrown at me, which is important today, especially working for a small company. When I sell a system, I might have to help install it and follow up with customer service, all things that at one time would have been out of my normal comfort sphere. Now I know I'll be able to deal with it."

In their spare time, Johnson and his wife **Megan DeYoung**, MBA/MS '02, who also graduated from the Erb program and works as a senior associate on corporate responsibility issues for PricewaterhouseCoopers, like to explore New York City, where they live and work.

Remembering New York's warm temperatures last winter, Johnson says, "I'm definitely concerned about global warming. Seventy degrees in January is odd. I don't think our government has taken climate change very seriously. It is good to see that some businesses are." ❑

Mary Jo Frank

Alumni & Energy

At the EPA

Adual degree has paid off for **Carey Bylin**, MBA/MS '04, whose career combines her professional goal of using business skills to protect the environment along with her personal interests, a desire to travel and fluency in Spanish.

Bylin is program manager for the U.S. Environmental Protection Agency (EPA) Climate Change Division's Natural Gas STAR Program, a voluntary partnership between oil and gas companies and government to reduce methane emissions.

Methane is a greenhouse gas that contributes to global warming, second only to carbon dioxide. Methane is also the primary component of natural gas, making it a valuable clean energy source. While methane emissions come from a variety of sources, including landfills and livestock, the majority of anthropogenic (man-made) emissions result from oil and natural gas production, processing, transmission and distribution.

Bylin works with companies to show how participating in the Natural Gas STAR Program provides economic, social and environmental benefits for all partners. The program promotes best management practices and knowledge sharing about cost-effective technologies.

"The voluntary partnership suits their bottom line and creates a positive impact by reducing emissions," Bylin said. "It also addresses the mindset that business and environmental goals are mutually exclusive."

On the economic side, capturing natural gas emissions gives a company more product for market while the cost of natural gas is steadily rising. It also helps companies that have had to adapt to more stringent state emissions regulations in California and the Northeast.

The Natural Gas STAR program was founded in 1993 and now has 110 partners, representing more than 50 percent of the oil and gas industry. Current partners represent the production, processing, transmission and distribution sectors of the industry and include energy giants Exxon Mobil Corp. and BP.


The EPA is expanding its program internationally and in 2006 launched Natural Gas STAR International. As part of that effort, Bylin recently traveled to Colombia and Ecuador, where she met

with private and state-owned companies and government agencies.

Bylin's concern for the environment began in earnest while working at the Boston Consulting Group, where she was part of a committee that promoted volunteerism among employees. At that point, she says, a lightbulb went off, and she realized that strategy and consulting skills could be leveraged to promote environmental conservation. Bylin decided to pursue a dual degree in business and environmental studies and chose the Ross School because the program is "more comprehensive than that of any other school."

She encourages students in the dual degree program to make the most out of

summer internships and work with a variety of organizations, including corporations, government agencies and nonprofits. Through the Erb Institute, Bylin worked on a sustainability tool for farmers sponsored by Ben & Jerry's and an analysis for Dow Chemical of business opportunities from capturing and using methane emissions in India.

"The dual degree program at Ross is driving real change," she says. "You can see your work is having an effect on the environment and business." 

Adrienne Losh



Harnessing the Wind

Mark Tholke, MBA/MS '03, has found a career doing something he loves: Promoting a product that is fundamentally and environmentally sustainable, wind power. A 100-megawatt wind farm can cleanly power 35,000 homes per year.

Tholke, a California native, spent hours outdoors as a child and later worked as a camp counselor. After graduating from the University of California, Santa Cruz, he worked as a research assistant and was asked to do research for his boss' presentation on climate change. Worried by what he had learned, Tholke's career path became clear.

His decision to study at the Ross School of Business was wholly driven by its dual degree program with the School of Natural Resources and Environment (SNRE). He says the Ross School provided him the core tools to operate in the business environment, and SNRE gave him an understanding of the role of policy and policy implementation.


"Much of renewable energy is based on policy," says Tholke. "Policy sets the rules and framework in determining what we do as a business. The role of policy cannot be underestimated."

As regional project development manager at enXco Inc., an affiliate of EDF Energies Nouvelles, Tholke oversees the various components of developing and building large-scale wind energy projects

in California and the Southwest. Building a wind farm involves managing permits, conducting technical wind studies, transmission studies and negotiating with utility companies.

According to Tholke, the biggest challenge to renewable energy is that the market is a non-level playing field. The renewable energy industry relies on subsidies and inconsistent policies. He believes that fossil fuel industries should be responsible for carrying the full cost of liability insurance and waste clean-up. If these industries would pay their fair share, wind energy no longer would have to rely on subsidies.

In 10 years, Tholke predicts, wind energy will no longer be a novelty. Today, wind power is approximately two percent of the energy market; in 10 years, it may be approaching five percent to seven percent.

Since Tholke graduated, job opportunities with a large environmental component have been on the increase. "I'd bet my career this is not a fad," says Tholke. He advises students "who have a high risk tolerance to join a solar start-up. For those who do not, join a larger company and secure a role that focuses on renewable fuels." 

Adrienne Losh



Alumni & Energy

Developing the Market



Achieving a clean energy future requires both new technologies and a sense of excitement, opportunity and conviction among individuals, asserts **Jennifer Layke**, MBA/MS '97, director of business engagement and deputy director for the World Resources Institute's (WRI) Climate and Energy Program, which has an annual budget of \$2.5 million.

Layke, who focuses on energy policy, climate change and corporate strategy worldwide, founded WRI's Green Power Market Development Group, a partnership with 12 major U.S. businesses, including Alcoa, General Motors Corp. and DuPont (www.thegreenpowergroup.org). For over five years, the Green Power Group companies have led U.S. corporate purchasing of renewable energy with the largest private contracts for on-site solar power and support for grid-based wind power, according to the U.S. Environmental Protection Agency (EPA).

The world has been slow to acknowledge the need for alternative energy because conventional sources are cheap, she says. "We have aspirations around cheap energy. We've focused innovation elsewhere, on breakthroughs in electronics and consumer products. If we had that kind of entrepreneurship around energy, we would see dramatic changes.

"The marketing side is critical. U.S. consumers do have choices, including buying green electricity in a number of states. There is nothing to keep individuals from greening up their electrical consumption except becoming familiar with how to do it."

WRI's Green Power Market series includes guides to walk managers through different technologies. The U.S. government

also runs a Green Power Network, which informs consumers about where they can purchase renewable certificates. And firms that believe energy reduction is both good strategy and good public relations are computing their greenhouse gas emissions and sharing the information through organizations such as the California Climate Action Registry, the Carbon Disclosure Project, the EPA's Climate Leaders Program and the Department of Energy 1605(b) registry.

Firms and investors also are buying and trading carbon credits through groups such as the Chicago Climate Exchange and other private sellers. Layke explains how carbon offsets works: "Let's say a school has an old boiler and a company like WRI wants to offset its emissions impact from travel, energy and paper use. We contract with a broker who finds enough investors to invest in a new energy-efficient boiler for the school. The school gets the energy savings and the investors can claim environmental improvement. Although we continue to use electricity and paper, we are lowering the impact of our operations."

Unfortunately, Layke says, the United States is no longer at the forefront of developing green technologies, largely because public policy doesn't offer sufficient incentive. "We haven't demonstrated the will to tackle energy issues. We have so much coal, plus we've focused on other areas of the economy."

Germany and Japan are in the vanguard, Japan for solar power and Germany for wind energy. Both have created conditions and built markets that make solar and wind energy profitable, she notes. With the lack of technological support for photovoltaic arrays, a technology that uses solar cells to convert the sun's energy into electricity,

the United States has given much of its competitive advantage to other countries with more progressive energy policies.

But public perception and policymakers are changing, according to Layke. "We're at a tipping point. In the next several years, we'll define the vision of the energy infrastructure and emissions path we'll be on," she predicts. In fact, President Bush's 2007 State of the Union address signaled an interest in making biofuel technology one area for U.S. leadership.

Layke points to other encouraging signs, including increased interest among investors and large companies that have adopted renewable energy as part of their portfolios. "We have major investors moving into the energy space. G.E. purchased Enron Wind. Goldman Sachs recently took a stake in a wind development company." In response to rising natural gas prices, Austin Energy took out a contract for wind power at a fixed price and passed the savings on to customers, including FedEx Kinkos and IBM.

"Energy suppliers are putting together entire packages, and the prices are almost the same as conventional forms of energy although the marginal returns can vary." Citigroup, for example, asked a supplier to include some green sources in its energy mix.

The market is ripe for a variety of new contracts, structures and products, comments Layke. In many states, green pricing programs are more expensive because utilities limit themselves to local resources instead of looking broadly across the market. "It is not in the utility's interest to have green sources be a large portion of its market. Utilities are not interested in a mass market unless that market is willing to pay more for green energy."

Layke agrees with former Vice President Al Gore, who said the United States energy sector needs what distributed technology provided for household computers: the infrastructure to allow new technologies to be deployed. “We would see costs come down significantly with increased demand and modular designs,” she predicts.

The next big challenge then would be to deploy the new energy technologies globally. “China is putting up coal-fueled plants at an alarming rate. Although the plants are raising China’s standard of living, the health impact on the country is serious,” notes Layke.

“If the United States doesn’t deal with demands for electricity in China and India, we’re not going to have a healthy and safe environment; air pollution travels and global warming gas pollution affects us all. The United States, which put most of the emissions into the air to date, must exert leadership going forward.”

Business can provide the technologies, Layke says, but will only do so if there is a market signal that they are needed. “We look to business to provide the lowest-cost solutions. We look to government to support experiments and the initial diffusion of technology. We must change an aging energy sector and challenge the people in that sector to learn new skills and manage differently.”

According to Layke, many utilities face new investment decisions right now and need to know what their risks will be if they invest in conventional coal technologies in the next few years. In January, WRI, 10 large corporations and three other leading environmental groups announced a framework for climate change policy in the United States that would help guide the private sector and the government to make investments in clean technology (see www.US-CAP.org).

Before earning master’s degrees from the Ross School and the School of Natural Resources and the Environment through the Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise, Layke received an AB degree in Asian studies and political science from Pitzer College in Claremont, California. She also worked as a consultant with the World Bank and the EPA on technology transfer under the Montreal Protocol. ☑

Mary Jo Frank

Green Energy Glossary

Carbon Credits—Carbon credits, measured units of certified emission reductions (CERs), are certificates awarded to countries that successfully reduce the emissions that cause global warming. Each CER is equivalent to one metric ton of carbon dioxide reduction. Developed countries can cut down their level of emissions or borrow or buy carbon credits from developing countries. The idea of carbon credits grew out of the Kyoto Protocol.

Green Tags—Green tags, also known as Renewable Energy Credits or Tradable Renewable Certificates, represent the environmental benefits of generating electricity from renewable energy sources. Green tags function as a nongovernmental subsidy on pollution-free electricity generators. In states that have a green-tag program, green energy providers such as wind farms are credited with one green tag for every 1000kW of electricity they produce. A certifying agency gives each green tag a unique identification number to make sure it is not double-counted. The green energy is then fed into the electrical grid, and the accompanying green tag can be sold on the open market.

Greenhouse Effect—The greenhouse effect is the process by which the absorption of infrared radiation by an atmosphere warms a planet. Without greenhouse gases, the Earth’s surface would be up to 30° C cooler. In addition to the Earth, Mars, Venus and other celestial bodies with atmospheres (such as Titan) have greenhouse effects. The term “greenhouse effect” may refer either to the natural greenhouse effect, due to naturally occurring greenhouse gases, or to the enhanced greenhouse effect resulting from gases emitted as a result of human activities.

Greenhouse Gases—Greenhouse gases are gaseous components of the atmosphere that contribute to the greenhouse effect. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases.

Kyoto Protocol—The Kyoto Protocol, an international agreement among 141 countries, aims to reduce the greenhouse gas emission by 5.2 percent below the 1990 levels by 2012. ☑

