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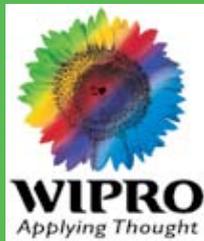
Special Report

GREEN EVOLUTION: MANAGING THE RISKS, REAPING THE BENEFITS



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The Initiative for Global Environmental Leadership (IGEL) and Knowledge@Wharton have partnered to create this special report on business and the environment. We are most grateful to Wipro and the Xerox Foundation for supporting collaboration and funding of this edition.



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Green Evolution: Managing the Risks, Reaping the Benefits

Many sustainability efforts can more than pay for themselves, both financially and with image-building benefits, according to an increasing number of organizations. Some of the most fertile areas of potential payback involve lowering energy and water use, and adopting product lifecycle analyses. Each offers ways to cut costs while reducing greenhouse gas emissions and oil dependency. At the country level, meanwhile, solid progress continues in reducing emissions, even without the headline-grabbing, internationally binding agreements of the sort that failed to emerge from the recent environmental conference in Copenhagen. To deliver on the promise, however, most sustainability initiatives require a long-term, strategic view and some initial investment. One of the most glitzy examples of this may be the headlong rush now underway by small, independent carmakers to develop the first widely accepted electric car.

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Many organizations are reaping financial and image-enhancing benefits by adopting product lifecycle analysis policies aimed at boosting sustainability efforts. Successful initiatives, with significant downstream payoff, will flourish in companies that embrace comprehensive lifecycle analysis as a key strategic guideline, and that supply management and financial resources to make it work. There are no universally accepted standards for product lifecycle analysis, however, so results are somewhat subjective and, therefore, not always quantifiable.

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The recent COP15 environmental conference in Copenhagen was disappointing, but even without internationally binding commitments, many countries are willing to cut carbon emissions significantly. Watch for breakthrough country-based pledges to underpin future negotiations, while in the U.S., progress may come via cap and trade. More corporations, meantime, are beginning to act even before a coming new wave of regulations gets enacted. Duke Energy CEO James E. Rogers, for example, said recently: "It's not going to be cheap, it's not going to be easy, and it's not going to be quick, but we've got to work on the transition now." Yet, for all the apparent momentum, analysts see a big gap between Copenhagen's emissions goals and national commitments.



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Water is a unique resource because, in most parts of the world, it holds little value despite its essential contribution to human survival. That may be about to change. Watch for the price of water to rise over the next few years, perhaps even doubling or tripling in the U.S., for example. In other parts of the world, companies are seeing increasing threats to crucial water supplies, such as the revocation of operating licenses due to challenges from communities with competing water interests. Yet, business can view these challenges as opportunities to cut spending through water conservation and re-use, according to experts at Wharton and elsewhere.

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Most organizations could reap significant cost savings with energy efficiencies that can slash energy bills and reduce tax obligations while reducing greenhouse gas emissions. The key to successfully tapping the bulk of those savings is to methodically search for opportunities within the organization and be willing to take a strategic, long-term view. For organizations willing to make the initial investments in time, and sometimes in hardware, the payoff can be compelling.

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Some of those Silicon Valley garages that became famous as the early home for tech start-ups such as Apple are back to housing cars once more. This time, however, the techies are tinkering with electric vehicles rather than PCs. And Silicon Valley is not alone in its quest to roll back auto greenhouse gas emissions and reduce oil dependency. Many small, independent electric carmakers in the U.S. and also in Europe look poised to take on the world's largest auto manufacturers and command a significant share of the world auto business in just a few years.



The Business Case for Lifecycle Analysis and Building a Green Supply Chain

For many corporations and large institutions operating in today's difficult business climate, lifecycle analysis — recognizing a product's environmental impact from raw materials to disposal, and planning accordingly — is no longer simply a way to dress up corporate reports. It has been successfully integrated into a profitable approach to doing business. And as society increasingly puts a price on pollution (through the cap and trade emissions trading, such as has been adopted in Europe and is under consideration in the U.S.), companies have found that using the lifecycle approach cuts waste out of the system, reduces costs and helps prepare for a tougher regulatory climate.

Lifecycle analysis, judiciously applied, can help a company recognize lost opportunities for increasing profitability. Can manufacturing byproducts be reused, recycled or resold? Can waste be taken out of the system? Can water use be reduced and air pollution controlled, thus eliminating cleanup costs and possible regulatory exposure?

Closely aligned to lifecycle analysis is the emerging concept of green supply chain management, which in some cases requires suppliers to meet stringent codes of conduct and materials disclosure. Companies that ignore the environmental impact of their supply chain (counting only direct effects) may be failing to account for more than 75% of the greenhouse gas emissions produced in manufacturing processes, say researchers at Carnegie Mellon University. A Timberland assessment of the climate impact of its leather boots, for example, found that 80% could be attributed to its suppliers (and especially to cows, which produce the powerful global warming gas methane).

Lifecycle analysis and greening the supply chain are separate processes, but taken together they can support an effective environmental makeover.

Both types of green reform were under discussion last year at an [Initiative for Global Environmental Leadership](#) (IGEL) at a Penn/Wharton conference in Philadelphia titled [Integrative Thinking about Lifecycle Analysis: Promises and Limitations](#).

"Some 40% of jobs are in supply chain companies," says Patrick Penfield, a professor of supply chain management at Syracuse University's Whitman School of Management. "So we have to start there in identifying processes that produce no waste and ways of making products that can be recycled at the end of their life. The assumption used to be simply buying from the supplier with the lowest cost, but we now know that was wrong."

Lifecycle analysis, judiciously applied, can help a company recognize lost opportunities for increasing profitability.

[Stanley L. Laskowski](#), a lecturer for the University of Pennsylvania's master of environmental studies program, teaches lifecycle analysis and greening the supply chain in his management classes. "More and more companies are realizing considerable savings from convincing all their suppliers to be greener, and lifecycle analysis is one way to do that," he says.

[William W. Braham](#), a Penn professor of architecture, noted that the university architect's office has started thinking long-term by calculating total 30-year "cost of ownership" analysis of the school's new buildings. Going further, he said the university is also trying to reduce energy use beyond the building itself, including everything from lab appliances (which are not necessarily [Energy](#)

Star” certified) to student use of handheld devices. “Part of the challenge in a large and complex institution without centralized purchasing is finding ways to reach all the way down the supply chain. It doesn’t necessarily mean doing with less, but, as an example, figuring out a way to regulate tens of thousands of computers to go on a power-down schedule when not in use.”

Many companies already see lifecycle analysis as “the right thing to do” and potentially a sound business decision. But the motivation to make lifecycle investments often comes from a committed CEO who recognizes “an ethical responsibility to manage that issue because it will affect future generations, including his or her own grandchildren,” said [Eric W. Orts](#), a professor of legal studies and business ethics at Wharton, and director of IGEL.

Lifecycle analysis isn’t applicable to every manufacturing process. And, even when its ultimate application would unquestionably save money, the useful lessons can be thwarted by practical realities. That’s because, in many cases, investing in green has higher initial costs.

Lifecycle Analysis: A Brief History

Lifecycle analysis is not new, but its widespread application in business is relatively recent. Its roots go back 40 years to early energy audits and other attempts to quantify resource costs and their environmental consequences.

According to the [U.S. Environmental Protection Agency \(EPA\)](#), one of the first lifecycle analyses was presented at the World Energy Conference in 1963, and it looked at the energy burden of chemicals and chemical intermediates. The 1972 publication of the book *Limits to Growth* spurred lifecycle analysis by advancing the concept that raw materials and energy resources were finite and threatened.

Jim Fava, managing director of Five Winds International, a Philadelphia-based sustainability solutions consulting company with operations in the U.S., Germany, Sweden and Canada, describes lifecycle analysis as a logical progression from the nascent ecology movement of the 1960s and the Superfund cleanups of the 1980s to the preventive approach pioneered in the 1990s.

“For 40 years, we’ve been moving away from producing chemicals that are highly persistent in the environment to alternatives that break down quickly,” Fava said. “And that set the stage in the

1990s to realize that the direction we had to take was not only dealing with hazardous waste and making chemicals greener, but understanding the impacts on energy and water use — and analyzing products over their entire lifecycle.” Fava describes reductions in packaging waste ([the Green Dot program](#) is now mandated in the European Union) as the kind of initiative that grew out of lifecycle analysis.

The EPA used lifecycle analysis in the 1970s to take a closer look at hazardous waste management issues. The agency’s Resource and Environmental Profile Analysis (REPA) also helped when, in 1990, the Council for Solid Waste Solutions evaluated the energy consumption and environmental performance of paper versus plastic grocery bags (and later disposable versus cloth diapers). But according to Mary Ann Curran, a lifecycle expert in the systems analysis branch of the EPA, the agency has no plans to regulate lifecycle work or require companies to conduct product analyses.

Pushing Improvements through the Supply Chain: Benefits and Challenges

For some companies, lifecycle and supply-chain analysis has led to deep changes in how they do business. The world’s largest retailer is one company leading the way, especially in its work with suppliers.

Laskowski says that Walmart is a “great example” of a company using lifecycle analysis to force change down its supply chain — in its case mostly in China. For huge companies like Walmart, the supply chain — consisting of every company, individual and resource involved in a product’s lifecycle — can be quite long. Walmart has 66,000 suppliers in 70 countries and nearly 100,000 stock-keeping units (SKUs). “Greening” that complex chain may take many forms. For example, suppliers can set up recycling systems, reduce waste production, limit energy and resource use, switch to environmentally preferable materials and cut back on emissions.

Walmart, which works closely with the [Environmental Defense Fund \(EDF\)](#) on sustainability issues, pays \$12 billion a year to its Chinese suppliers, almost 10% of China’s exports to the U.S. So, Chinese companies listened closely when, in late 2008, Walmart summoned a thousand of its suppliers to a meeting in Beijing. Walmart told them they must have 95% of their production in factories with high environmental and social-practice ratings by 2012. Matt Kistler, who heads up global sustainability at Walmart, points out that the company’s environmental footprint is

expressed primarily through its supply chain — and that the company has an opportunity to build what he calls “a world-class, better quality, better value supply chain.”

Walmart’s supply-chain work in China will not be without challenges. U.S. imports from China have grown from \$80 billion to \$273 billion in 10 years but, in the last few years, a series of scandals involving tainted goods (including lead in children’s toys) has raised questions about the safety of those imports. Tougher environmental rules for suppliers will need to mesh with U.S. regulations that, for example, now require third-party certification of low lead levels in imported products.

According to Andrew Hutson, who is project manager for corporate partnerships at EDF and is based near the company’s headquarters in Bentonville, Ark., “Walmart understands there are deep problems with suppliers not meeting existing Chinese environmental regulations. China has big product safety issues, and the company is trying to get a better handle on its supply chain to handle this problem.”

For some companies working closely with suppliers, the challenge is how far to go. Few companies could top the commitment of furniture maker Herman Miller, which for its environmentally friendly Mirra chair, built a materials database based on a survey of suppliers who were asked to identify every single ingredient in the components they provided. As Daniel C. Esty and Andrew S. Winston describe in their book *Green to Gold*, the company declined to do business with suppliers who refused to comply. The database ultimately identified 800 materials, and assigned each a color code from green (good) to red (problematic).

Herman Miller can now say with confidence exactly what went into making its Mirra chairs. And that knowledge has helped the company achieve remarkable results — both for the environment and for its business. Today, Herman Miller has 400 people working directly or indirectly on environmental initiatives, and says in [its 2009 environmental report](#) that in the 15 years since setting green goals it has reduced hazardous waste by 95.4% and landfill waste by 88%. Its customers obviously approve: More than half its annual sales come from products using “design for the environment” principles, the company said.

“Thinking green” also helped the company save nearly \$4.6 million by moving into newly designed LEED Gold-certified buildings, the company noted in 2007.

Meeting Climate Goals

Because of regulation and ethical commitment, Sweden’s Volvo has focused its lifecycle analysis work on reducing greenhouse gas emissions. It has invested in wind power, built a biofuel plant to produce electricity and heat, and opened the first carbon-neutral auto plant in Belgium in 2007. Carbon-dioxide emissions were reduced by 14,000 tons annually. “We gain knowledge of a product’s environmental impact over its entire life by conducting Lifecycle Analysis,” Volvo [said in its 2008 Sustainability Report](#).

According to Volvo CEO Leif Johansson in that report, “What can be good for the company in purely commercial terms can be good for the environment, and what is good for the environment is also good for our own and our customers’ competitiveness.” By the end of 2008, 96% of the workforce at Volvo Group production plants had met ISO 14001 global environmental management system standards.

Today, Volvo faces new challenges with its likely acquisition by the Chinese automaker Geely Automobile. Will the relatively new carmaker (launched in 1986, initially to make refrigerators) change Volvo’s long-established corporate culture? “From what we can see, Geely has no plans to change anything,” said Volvo spokesman Dan Johnston. “I can’t imagine they would take one of our core values and not follow it.”

Xerox, the world’s largest distributor of cut-sheet paper, is committed to reducing company-wide greenhouse emissions 25% from 2002 levels by 2012. Catherine Reeves, Xerox’s manager of environmental management operations, said the company “applies lifecycle analysis to families of low- and high-volume products, such as multi-functional devices. It helps prioritize design efforts and channel resources.”

The company’s climate commitment requires a re-examination of all its business practices. In the late 1990s, Xerox developed new and stronger standards for its paper suppliers and entered into a partnership with [The Nature Conservancy](#) to develop science-based tools and practices to advance sustainable forestry. That means sourcing fiber harvested using guidelines from groups like the Forestry Stewardship Council, and whitening paper with elemental chlorine-free bleaching.

Xerox’s products are expected to offer environmental savings to end users. According

to the company, its solid ink printers, which use crayon-like non-toxic ink sticks rather than conventional toner cartridges, reduce printer-related waste by 90% (when compared to a typical color laser printer). The printers also come with a free download of GreenPrint software designed to dramatically reduce wasted pages.

“Every one of our innovations ended up either saving us money or creating new markets and new revenue,” says Xerox chairman Anne Mulcahy and CEO Ursula Burns in a 2009 letter to shareholders. “We found, in other words, that we don’t have to choose between the environment and profit. We can do both.”

Xerox’s work shows that supply chain efforts can sometimes flow uphill. As part of a collaboration begun in 2004, Xerox performed a paper audit for Dow Chemical, one of its largest industrial clients, and found that Dow had 16,000 printers producing 480 million pages per year. Xerox and Dow worked to get the company down to 5,500 printers — reducing printing costs an estimated \$20 million to \$30 million over five years, and dramatically reducing environmental impact. Xerox also launched a [Sustainability Calculator](#) which, when applied to a single sector of Northrop Grumman’s operations, saved 27% in energy costs, 26% in climate emissions and 33% in solid waste.

The Value of Water

Lifecycle analysis is vital for helping protect an increasingly scarce resource: clean water. Indeed, more than a billion people have no reliable access to safe drinking water. Piet Klop, a senior fellow at the [World Resources Institute](#), said at the IGEL conference that water has been traditionally undervalued and under-priced, with the result that major water shortages could characterize the 21st century.

Industry, a major water user, needs to lead in conservation. At Dow Chemical, lifecycle analysis has helped cut water use per pound of product by 35%. Anne Wallin, director of Dow’s lifecycle assessment expert group, says the company is working with local governments in the Netherlands to reuse wastewater. Every gallon is used three times, according to Wallin, and that also reduces energy use for water purification by 65% (the equivalent of cutting 5,000 tons of carbon dioxide annually).

Strengthening Ties with Customers

A new awareness about lifecycle analysis has led some companies to share results with consumers.

The environmentally friendly clothing company Patagonia conducted lifecycle analysis of its key fabrics as far back as 1991. It discovered that, contrary to expectations, petroleum-based polyester and nylon were not the worst environmental offenders — in some cases, cotton and wool were worse.

Today, Patagonia operates an interactive website called [the Footprint Chronicles](#) that allows customers to track their purchases from resource extraction to manufacturing, sales and disposal. For instance, a pullover whose materials were sourced in Asia is fully recyclable and made in a factory that meets strong fair labor and environmental standards. But the company also admits that the jacket uses some non-recycled content, and is treated with water repellent containing a chemical “that is now persistent in the environment.”

In effect, Patagonia has made its lifecycle analysis public, with the attendant marketing benefits important to a green-themed company (the Chronicles [won a 2009 “people’s voice” Webby Award](#)). But Patagonia says the Footprint process also helped it improve bottom line performance by revealing, for instance, that transportation was only 1% of overall energy use. That led Patagonia to turn its attention to reducing energy consumption on the shop floor, rather than in the extended supply chain.

Walmart has taken a similar path, working with [Conservation International](#) on a lifecycle initiative for its Love, Earth jewelry line. Consumers [can use the Internet](#) to trace the path of their gold and silver jewelry from mine to store. The program helps the company’s ongoing work to green its image, including publicity for [a 10-point criteria list for sustainable jewelry sourcing](#).

For some companies, lifecycle analysis has been a long-term commitment that has paid dividends. The recyclable carpet manufacturer Interface, founded by chairman and CEO Ray C. Anderson in 1973, shifted to a sustainable strategy in the 1990s. Says Anderson: Green thinking has helped the company’s bottom line — and vastly improved its standing with the public. “Costs are down, not up, dispelling a myth and exposing the false choice between the economy and the environment....The goodwill in the marketplace generated by our focus on sustainability far exceeds that which any amount of advertising or marketing expenditure could have generated.”

Interface has set a goal of zero environmental impact by 2020. To help achieve it, Interface uses lifecycle analysis to assess the carbon footprint of its

products. Footprint reductions help support product certifications. The tool is vital for “what if” planning at the company, and has led to new products being scrapped and others developed, says Erin Meezan, Interface’s vice president of sustainability.

Getting Started

For companies eager to make environmental stewardship part of their business, lifecycle analysis is a good starting point, because it creates a useful guide to identifying opportunities for reducing waste and saving money. Susan Svoboda, manager of the University of Michigan Corporate Environmental Management Program, says that a complete lifecycle analysis [would include three components](#):

- **lifecycle inventory** — a measure of energy and raw material use, air emissions, water pollution and solid waste generated;
- **lifecycle impact assessment** — an evaluation of the likely environmental and human health effects of the inventory; and
- **lifecycle improvement analysis** — a report on opportunities to reduce or eliminate environmental impact across the lifecycle.

By the end of the IGEL conference, a consensus had emerged that lifecycle analysis, to be effective, must be a key strategic guideline applied from the top down. Visionary leaders need to adopt it as an integral component of their management portfolio for sustainability and corporate growth.

To succeed, supply chain reforms need to be communicated effectively at all levels — with company leaders explaining not only how the changes will be implemented, but also why they are being undertaken. Appointing an environmental manager charged with those responsibilities can help ensure a rigorous process with necessary follow-up. Without that step, suppliers could resent — and resist — a top-down, unfunded management mandate.

Corporate environmental programs must be designed to comply with (and anticipate) emerging regulations, both domestic and global, or fast-track retrofitting and retooling costs to meet those new requirements could be substantial. It is ultimately far more cost-effective to build in vanguard green innovations than it is to fast-track retooling programs after the fact in an effort to comply with pending legislation. An example would be an auto company that designed future product exhaust systems to accommodate a supplier’s catalytic converter, only to learn that it no longer met

environmental performance targets (either internal or through regulation). Redesigning the system and finding another supplier on short notice would undoubtedly be costly.

Workshop discussions at the IGEL conference led to some agreement that sustainable development, including lifecycle analysis, needs to be integrated into the everyday thinking of business managers. And sustainable thinking must be part of early-stage product planning, much as safety and risk management are routinely incorporated now. Company environmental plans should include a timeline with specific milestone goals, participants said, and a single point of accountability to ensure compliance. A study of regulatory trends should be part of the planning process. The timeline can start with low-hanging fruit and conclude with stretch goals — such as Interface’s “zero impact by 2020” plan.

There are pitfalls, to be sure. Companies need to understand the limitations of lifecycle analysis. There are no universally accepted standards, so analysis results inevitably are somewhat subjective and, therefore, not absolutely quantifiable. [Noam Lior](#), professor of mechanical engineering and applied mechanics at Penn’s School of Engineering and Applied Science, points out that managers need to recognize that limitation, while also working toward more precise measurement protocols.

Many recent approaches to lifecycle analysis try to account for the uncertainty inherent in a process with so many variables. According to the *Journal of Industrial Ecology*, [uncertainty limits the use of lifecycle analysis in making environmental decisions](#). To increase confidence in the process, the EPA recommends using qualifying uncertainty analysis, and the Office of Management and Budget urges inclusion of uncertainty discussions in regulatory analyses.

Going into lifecycle analysis with eyes open is critical, but the payoff — in environmental benefits, marketing and bottom-line savings — can be substantial. Sustainable development with significant downstream payoff will flourish in companies that embrace it as a key strategic guideline, and devote management and financial resources to making it work. 🌱



Global Warming: Challenges, Opportunities and a Message of 'Be Prepared'

Although the global COP15 talks in Copenhagen last December ended in a weak, non-binding international agreement that dashed immediate hopes for a muscular successor to the Kyoto protocols, the fact that the talks were held at all produced momentum for many countries — including big players such as India and China — to make significant commitments on their own.

Despite the delays in enacting a global treaty, efforts to reduce greenhouse gases are already underway and will increasingly affect global markets. What's more, there is likely to be far-ranging regulation domestically and internationally, even in the absence of a final political breakthrough in Washington. Also, smaller "climate contracts" involving nations, NGOs and large companies are likely to be important drivers in reducing emissions in the long run, according to [Eric W. Orts](#), professor of legal studies and business ethics at Wharton, who also is the director of the [Initiative for Global Environmental Leadership](#) (IGEL) at Penn/Wharton.

"NGOs and large companies are likely to be important drivers in reducing emissions in the long run."

—Eric W. Orts, professor of legal studies and business ethics, Wharton
Director of the Initiative for Global Environmental Leadership (IGEL)

The Copenhagen talks left few observers pleased with the process or the results. Although the parties affirmed that climate change "is one of the greatest challenges of our time" and reiterated the need to hold global temperature increases below 2 degrees Celsius (3.6 degrees Fahrenheit) from pre-industrial levels, they set no timetables or rules for the major mitigation needed to meet that ambitious target. An analysis by the Sustainability Institute found a large gap between the goals expressed at Copenhagen and actual national climate commitments. The present course would lead to warming of 7 degrees Fahrenheit by 2100, the group said.

"It was badly organized, and until President Obama arrived very little progress was evident," said COP15 attendee [Paul R. Kleindorfer](#), professor emeritus at Wharton and professor of sustainable development at INSEAD in France. "Obama showed great leadership skills, but only small steps were taken, and not much progress was made on the North-South divide." The U.S. Senate has still not come close to passing comprehensive climate legislation, despite the passage of an amended [Waxman-Markey climate and energy bill](#) in the House June 26. And third world nations, which represent the greatest growing threat to global warming, are justifiably concerned that efforts to reduce greenhouse gases could limit their economic development and ability to eliminate poverty.

But U.S. executive branch efforts are substantial. President Obama's initiatives are already reshaping the business environment (especially the energy and auto industries), and states are either acting alone or forming regional compacts to combat climate change.

And myriad efforts are underway abroad — especially in Europe but in the third world, too. In the run-up to Copenhagen, many nations made commitments. According to Andrew Light, a senior fellow at the Center for American Progress, if the 17 largest economies meet the climate commitments already on the table, then the world would be 65% of the way toward the emission reductions required by 2020 to limit the global temperature rise to the 3.6-degree Fahrenheit increase referenced in the [Copenhagen Accord](#).

Climate Change in the Developing World

China recently surpassed the U.S. as the world's biggest carbon dioxide (CO₂) emitter (though the U.S. remains the leader in per-capita emissions, with China far behind). India is also rapidly increasing both economic activity and climate emissions. But there is no easy path to substantial reductions by these large emitters given their view that industrial nations are responsible for most of the CO₂ now in the atmosphere.

"There is a clear attempt to shift the burden and the responsibility to the emerging markets," said R.K. Pachauri, chairman of the Intergovernmental Panel on Climate Change (IPCC), in an interview. "But it's also a fact that these are countries that still have significant poverty, particularly India: There are 400 million people who do not have access to electricity there. So, to impose anything [that gets] in the way of eliminating poverty and creating development opportunity, in my view, is not even ethically correct."

Still, on the brink of the Copenhagen talks, the Indian government said it would commit by 2020 to reducing its "carbon intensity" (the amount of CO₂ released per unit of economic output) by 20% to 25% compared to 2005 levels. That would reduce overall emissions, but it would substantially reduce the rate of emissions' growth. The Chinese similarly announced a larger, 40% to 45% carbon intensity reduction.

China's commitment alone, if realized, would account for 25% of the 3.8-gigaton CO₂ reduction the world needs to limit the global warming increase to 3.6 degrees Fahrenheit, said Fatih Birol, chief economist at the International Energy Agency (IEA). But such large reductions are only theoretical, and could cost \$400 billion in Chinese energy sector investment, said the IEA. An important sticking point is verification. Developing countries could meet their carbon intensity goals by reporting

increased economic growth, without actually taking any specific mitigation actions. Efforts to establish third-party monitoring became a major battleground in Copenhagen.

Now, there is a growing acknowledgement that climate change will affect rich and poor countries alike, and that the industrialized nations need to break a stalemate that has hampered negotiations (and led to climate conference walkouts) by agreeing to contribute to the cost of compliance in the developing world. Jairam Ramesh, the Indian environment minister, said bluntly in announcing the new targets that his country would not agree to legally binding emissions reductions — but might go further if outside economic aid is forthcoming.

Ramesh must have been encouraged by an emerging consensus among leading Group of Eight (G8) countries to support a \$10 billion annual fund by 2012 to offset climate effects and pay for mitigation efforts in the most vulnerable developing countries. British Prime Minister Gordon Brown put a specific amount on the table — \$1.3 billion over three years.

President Obama has also committed the U.S. to making unspecified contributions to the fund, declaring, "Providing this assistance is not only a humanitarian imperative — it's an investment in our common security, as no climate change accord can succeed if it does not help all countries reduce their emissions." During the conference, Energy Secretary Steven Chu put a specific dollar amount, \$350 million, on a fund for clean energy technology assistance for the developing world. John Podesta, president and CEO of the Center for American Progress and also co-chair of the Obama transition team, called the administration's commitment "a game changer."

Another effective and growing third-world regulatory strategy to counter global warming is preventing deforestation (because trees act as "carbon sinks"). Annie Petsonk, international counsel at the Environmental Defense Fund (EDF), sees the prospects for a global anti-deforestation agreement as promising. Like the plan to compensate developing nations for climate mitigation costs, the agreement would provide payments for local communities that agree not to log their forests.

A recent *Science* study of 286 Amazonian communities revealed that local short-term

economic gains from deforestation are quickly reversed. And the article estimated that the bill for reversing Brazilian deforestation could be relatively small: a \$7 billion to \$18 billion outlay beyond the country's current budget, resulting in a 2% to 5% reduction in global carbon emissions.

"Even if everything else stalls out, REDD [the United Nations initiative Reducing Emissions From Deforestation in Developing Countries] could actually move forward," Peterson said. "It connects very well with the provisions of the U.S. Waxman-Markey bill, and there is openness in many quarters to both market- and non-market financing to reduce emissions from deforestation."

Unfortunately, an IEA analysis in mid-February concluded that global climate pledges made so far would "fall short" of the Copenhagen Accord goal of holding temperature increases below 3.6 degrees Fahrenheit. And the prospects of attaining a legally binding agreement at the forthcoming UN conference in Cancun, Mexico were dimmed appreciably by the resignation, in February, of respected UN climate chief Yvo deBoer. According to *The New York Times*, de Boer "did not directly link his decision to step down to the chaos at Copenhagen. But he was known to be frustrated and exhausted by the meeting's failures."

Possible Executive Action in the U.S

The U.S. Supreme Court ruled in the 2007 *Massachusetts v. EPA* (Environmental Protection Agency) case that carbon dioxide (the principal global warming gas) may be designated a pollutant under the Clean Air Act, and that the EPA has the authority to regulate it. That historic ruling was followed by a final endangerment finding from the EPA itself December 7, clearing the way for the Obama Administration to issue emission-reducing executive orders or move forward with administrative rulemaking under the Clean Air Act. In May, shortly after that finding was first proposed, President Obama announced (with leading automakers and environmentalists by his side) historic federal EPA rules (35.5 miles per gallon by 2016) to regulate fuel economy and climate emissions.

Dan Becker, director of the Safe Climate Campaign, said that the Supreme Court ruling gave President Obama a mandate to curtail global warming, even in the absence of legislation from Congress. "He can act with a stroke of his pen," Becker said. "He can issue executive orders right now, without waiting for Congress."

President Obama went into the Copenhagen talks with the 17% greenhouse gas reductions by 2020 that was passed in the House version of the Waxman-Markey legislation. Senate action, expected soon (with final Congressional action by the summer), could arrive at lower percentages.

Michael Oppenheimer, professor of geophysics and international affairs at Princeton's Woodrow Wilson School, points out that international agreements have lengthy ratification periods, and he agrees that executive orders are a potent tool for quicker action. "The President can only go so far without Congressional action," Oppenheimer said. "On the other hand, the administration can and has done some things through executive power without waiting for Congress, such as the fuel economy/ climate standards. In the next few months, there is likely to be an interesting series of actions on the executive level that, though clearly not internationally binding, are part of a dance toward a domestic and global policy on climate. It's a multi-layered, complex situation, with progress having to come on many fronts at once."

One such order could aim at reducing emissions from coal-burning power plants. Becker said that converting just 100 of the largest coal plants to natural gas would reduce U.S. emissions by 15%.

Cap and Trade: Effective Reform or Bureaucratic Nightmare?

There is considerable uncertainty over the dimensions of a U.S. energy and climate bill — if it does pass. Although a carbon tax would be easiest to administer, it is very unlikely to win political approval. And some are concerned that a more politically palatable (but also much more complex) cap and trade system, as included in the Waxman-Markey legislation, would be susceptible to manipulation.

Carbon taxes have many proponents because they are relatively straightforward, according to [Noam Lior](#), professor of mechanical engineering and applied mechanics at Penn's School of Engineering and Applied Science, and an IGEL faculty member. "A carbon tax would be the simplest approach, but it is socially and politically difficult," he says.

Lior praises the effectiveness of the Clean Air and Water Acts (passed in the early 1970s under then-President Richard Nixon), and offers a simple analogy in support of environmental regulation and enforcement: "We all know and accept that if you

toss even a gum wrapper out of your car window, you're subject to a \$500 fine." The emissions from smokestacks cause local air pollution and aggravate global warming, and the cheapest forms of generation — notably coal — are also the dirtiest. Lior says that regulation needs to change that equation. "We have to go to some kind of mechanism that encourages a transition from a high-carbon energy economy," he said.

Robert Giegengack, professor emeritus in the department of earth and environmental science at Penn and also IGEL faculty member, agrees. "The only way to be truly successful is with a very significant progressive tax on carbon." Giegengack believes that the main alternative, cap and trade, will "create an enormous bureaucracy."

Under cap and trade, governments set a limit on the total amount of pollution that can be emitted into the atmosphere, then distribute permits to companies that allow a set amount of emissions per company under that cap. If a company exceeds the pollution limits of the emissions credits it holds (thus facing fines), it can buy more credits on the open market from other, environmentally better-performing companies. Thus, the desired level of total emissions can be reached when some companies — which for various reasons find it easier to reduce emissions — sell their excess emissions credits to offset the emissions released by companies that find it more difficult to do so. This all takes place through an emissions-market mechanism.

According to Giegengack, "Economists, lawyers and politicians will jockey for position and, inevitably, set the cap too high. With every carbon credit transaction, two lawyers will be engaged. Cap and trade will do for lawyers what corn ethanol did for farmers. And it will have no more effect on CO₂ emissions than corn ethanol."

Lior shares some of those concerns, but is more optimistic about the long-term benefits. "Cap and trade does have some negatives, in that higher costs for business will be passed on to consumers in the form of higher energy prices," he said. "In the long term, that's OK, because it will reduce energy use and emissions, and because competition will come in with lower prices." Some of that competition will come from renewable energy, which gains a business advantage under cap and trade. A problem with any form of government intervention, Lior said, is that "people immediately find loopholes in the legislation and use it negatively for their own

benefits — as was seen in the Enron scandal. And how do you monitor complaints? How many more bureaucrats do you create?"

Despite these qualms, the political momentum is behind carbon trading (which, in avoiding use of the word "tax," appeals as a free-market solution). "Cap and trade is the way the world is moving," said Orts. "We can debate the policy merits of cap and trade versus carbon taxes, and I have some concerns about how it will operate, but it is the main mechanism lined up to pass."

Cap and trade has already been enacted in Europe, with mixed results. According to the World Resources Institute, by 2007 some 65% of the companies participating in the European trading system were making investment decisions based on having a carbon price — "precisely the response needed." But, according to *The New York Times*, "The European Union started with a high-minded ecological goal: encouraging companies to cut their greenhouse gases by making them pay for each ton of carbon dioxide they emitted into the atmosphere. But that plan unleashed a lobbying free-for-all that led politicians to dole out favors to various industries, undermining the environmental goals. [I]t is becoming clear that [the] system has so far produced little noticeable benefit to the climate — but generated a multibillion-dollar windfall for some of the continent's biggest polluters."

Cap and Trade in the US

Cap and trade is underway in the U.S. without federal action. A 10-state compact, the Regional Greenhouse Gas Initiative (RGGI), is aimed at reducing emissions from power plants in the Northeast and Mid-Atlantic states. It began trading in early 2009, and aims to reduce plant-based CO₂ emissions 10% by 2018. California, the second-largest emitter after Texas, is also launching a regional cap and trade effort to begin in 2012.

But **Cary Coglianese**, a Penn law professor and director of the law school's [Penn Program on Regulation](#), is convinced that these localized programs are counter-productive. "Regional and state initiatives are complicating the ability of the federal government and the international community to address climate change," he said. "One problem is that people will see these efforts and decide that there's no need for a national program, and that's a mistake." Some 20 to 25 states have climate change legislation, Coglianese said.

A 2008 *Connecticut Law Review* article Coglianesse wrote with Jocelyn D'Ambrosio concludes "Whatever the merits of decentralized experimentalism in other contexts, it is not well-suited for reducing global emissions of carbon dioxide and other greenhouse gases. Perhaps not all global problems require a comprehensive, global solution — but reversing the trajectory and effects of greenhouse gas emissions most assuredly does."

Coglianesse also said the most effective form of cap and trade would focus on the smaller number of "upstream" sources (such as power plants, oil and gas companies, mining operations and refineries) rather than the myriad "downstream" point-of-use emissions at the smokestack level. "All of our cars, our office buildings, our homes, are carbon emitting, so it's much easier focus on a few thousand production sources.

Another approach to pricing carbon comes from James Hansen, the prominent climate scientist who heads the NASA Goddard Institute for Space Studies. A critic of cap and trade, Hansen proposes an alternative entitled "fee and dividend" — a gradually rising tax on carbon would be imposed and collected at the "port of entry" for fossil fuels (including oil, gas and coal). The fees, expressed in a uniform cost per ton of CO₂, would be returned to the public in the form of dividends (and offsetting inevitable energy price increases passed on to them). "As time goes on," Hansen said, "fossil fuel use would collapse."

Hansen's op-ed produced a [strong response](#) from *The New York Times* columnist Paul Krugman, who charged that Hansen "really hasn't made any effort to understand the economics of emissions control." According to Krugman, both carbon taxes and cap and trade ultimately produce the same result. "The only difference is the nature of uncertainty over the aggregate outcome," he wrote. "If you use a tax, you know what the price of emissions will be, but you don't know the quantity of emissions; if you use a cap, you know the quantity but not the price." Ultimately, Krugman favors cap and trade because it is "the only form of action against greenhouse gas emissions we have any chance of taking before catastrophe becomes inevitable."

Orts also emphasizes the benefits of focusing on major sources of greenhouse gases. While he supports an international treaty, he adds that a top-down approach may not ultimately be as effective as a profusion of what he calls "climate

contracts" — independent reduction agreements potentially between NGOs and large companies (Walmart's "greening the supply chain" work in partnership with the EDF is an example) or between major countries. "If China and the U.S. are put together that's 40% of total greenhouse gas and 25% of world population," Orts said. "We need a range of different climate contracts that get us to what Malcolm Gladwell calls a 'tipping point' (in his book, *The Tipping Point*).

Having seen the impasse in Copenhagen, Kleindorfer agrees that side agreements not necessarily involving all of the 192 countries present at the conference can produce highly significant results. "There are 30 nations that produce 90% of the world's emissions, and they can play a fundamental role," he said. "Those 30 with the primary responsibility for our current emissions can take on an urgent agenda for 2010, which is laying down common rules and agreeing on carbon pricing."

Climate change also must be put in perspective among many pressing environmental problems, says Giegengack. Other issues — specifically clean water scarcity and human population growth — do not get as much attention as climate change, but might have larger effects on long-term sustainability, he notes.

An Uncertain Business Climate: Some Solutions

Regulation of carbon through global, national and local action on the legislative and executive level is a virtually certainty. But business values clarity, consistency and certainty, and the specifics of emissions control are far from clear today.

Kleindorfer points to the "clear and present danger" of Western companies attempting to limit their carbon output getting "blindsided" by competing companies, in China and other parts of the developing world, with no such limits. "I'm concerned about the possible effects on our manufacturing base. This is an elephant in the room for business." One method of equalizing carbon costs is with a border tax applied by climate-conscious countries to imports from nations without a global warming plan, though a *Financial Times* editorial in December warned that such tariffs could spark "the biggest trade war since the Great Depression."

H. Jeffrey Leonard, president of the Global Environment Fund, a private equity investment

management firm, was a speaker at the [2009 Wharton Energy Conference](#). “There’s a huge amount of uncertainty right now,” he said. “And until that uncertainty is reduced it will continue to dramatically affect the long-term capital investment climate.” Investment in renewable energy startup companies, for instance, was strong from 2005 to 2007, he said, but then “fell off a cliff,” not only because of the recession but also because of Congress’ erratic and short-term extension of tax credits.

Wind energy production tax credits, for example, were repeatedly given last-minute one-year extensions until the stimulus bill earlier in 2009 extended them for three years. Senator Charles Grassley (R-Iowa) has proposed an extension through 2016 that would include credits for energy from biomass. “Getting these tax incentives extended is important to help businesses secure the loans they need to make the investments necessary to create jobs,” Grassley said.

According to Leonard, “A price on carbon is inevitable. The proposed cap and trade system has gotten people talking, but there could be unintended consequences. It scares the living daylights out of me to have a process that can be gamed as much as cap and trade.” Leonard, who is on the board of India’s Reva Electric Car Company, points out the rapidly changing price of petroleum is as much a factor in business investment reticence as unknowns about federal legislation. For that reason, he supports a federally mandated floor price for gasoline. Such a program, by raising taxes automatically when gas prices fall, would encourage investment in renewable energy

Daniel Sperling, director of the Institute of Transportation Studies at the University of California, Davis, and co-author of *Two Billion Cars: Driving Toward Sustainability*, advocates a \$3.50 price floor for gasoline. “If the price goes above \$3.50, then the tax disappears,” he said. Revenue from this variable tax would subsidize loan guarantees to auto companies, which in return would be required to produce set numbers of fuel-efficient, low-carbon vehicles.

Business Commitments: Not Just Window Dressing

Many companies have gained business and marketing advantages by offering short- and long-term CO₂ reduction plans. Their motivations

vary, and in some cases may be more complex than public statements allow. All are ahead of regulation, but most admit that regulation is coming and that companies need to be ready for it.

Emissions reduction strategies are also a key component of the environmental progress reports that many companies now issue regularly, and that help shape corporate image. Here’s a sampling of such commitments from companies that are part of the EPA Climate Partners program:

Alcoa said it would reduce emissions 4% from 2008 to 2013. “Aluminum production is especially energy intensive, and thus is a significant producer of CO₂,” it said in an online statement, noting that estimated worldwide emissions from primary aluminum production at 230 million metric tons per year amounts to 1% of the planet’s annual anthropogenic greenhouse production.

Anheuser Busch promised to cut emissions 5% from 2005 to 2010 (a goal reached in 2009), and has pledged 15% cuts from 2008 to 2013. The company, with a 48.4% share of U.S. beer sales, claims over the past five years to have cut energy use in company breweries by 8% per barrel.

Dell announced it would reduce global emissions 15% per dollar revenue from 2007 to 2012, and would achieve net-zero global emissions by the end of 2008 (a goal it reached) and maintain that level through 2012.

Frito-Lay said it would cut U.S. emissions 14% per pound of production from 2002 to 2010. It is part of the way towards that goal: From 2002 to 2005, it made 7.2% per pound of product reductions. Frito-Lay had earlier reduced greenhouse emissions 14% between 1994 and 2004. According to the company, environmental improvements (including emissions reductions) made in that period saved Frito-Lay \$55 million in 2008.

General Electric launched its “ecomagination” initiative in 2005, and committed to reducing operational greenhouse gas emissions by 1% from a 2004 baseline through 2012. Without that action, GE said greenhouse emissions were predicted to rise as much as 30% by 2012. GE also said it would cut greenhouse emission intensity 30% as of 2008 on an emissions per dollar revenue basis. The third commitment (collectively they are known as “1-30-30”) is to improve energy efficiency 30%

by 2012. GE said it reduced worldwide greenhouse gas emissions 13% in 2008 compared to 2004. Greenhouse gas intensity dropped 41% in the same period, and energy intensity 37%, putting the company on track to reach its goals.

General Motors pledged in 2007 to reduce CO2 emissions from its North American operations 40% by 2010. GM was one of the first automakers to voluntarily release information on its greenhouse gas emissions (dating to 1990).

Intel pledged to reduce emissions 30% per production unit from 2004 to 2010. Since 2000, the company says it has reduced use of perfluorinated compounds (PFCs, powerful greenhouse gases with a long life in the atmosphere) by 56% in absolute terms. It has also launched 250 energy conservation projects since 2001, and according to the EPA is the number one purchaser of green power in the U.S.

Pfizer said it would cut emissions 20% between 2007 and 2012, and reached an initial goal of a 43% reduction per million dollars of revenue between 2000 and 2007.

The 700 leaders who attended the World Business Summit on Climate Change last May pledged their support for reductions by 2020 and 2050 that would limit temperature rise to two degrees Celsius compared to pre-industrial levels.

It is, of course, easier to issue non-binding declarations in world forums than it is to carry out actual large emission reductions. As Duke Energy CEO James E. Rogers, who attended the summit, noted, "It's not going to be cheap, it's not going to be easy and it's not going to be quick, but we've got to work on the transition now." He pointed out that companies need to "talk honestly about what these targets mean. What does it mean for a company like ours? We'll have to retire and replace or radically transform every one of our power plants. We're the third-largest emitter of CO2 in the U.S.; we're heavily reliant on coal. Can we do that? And if we can't do that, we will have failed."

Drawing Conclusions

The COP15 conference showed that, even without internationally binding commitments, countries on both sides of the development divide are willing to make large cuts in carbon intensity and actual emissions compared to earlier baselines. Breakthrough pledges will be the basis for future

negotiations. Corporations, with various motives, have also shown willingness to act without national regulation in the countries where they operate.

The climate lesson for business in 2010 is that the world is no longer denying the reality of global warming, and is actively seeking to apply the brakes to runaway emissions. Companies that emit carbon dioxide will have to pay for the privilege, and climate mitigation will be written into the DNA of doing business.

Although the impact of an emerging climate policy on international business is not yet clear, it would be a mistake for companies to delay action on reducing greenhouse gases in the name of holding down costs in a troubled economy. Proactive companies will not only be ready to profit under a cap and trade system (should one be enacted), but they will be positioned for the business challenges that are inevitable in what some have called "the environmental century."

Global Commitments: Tentative and Conditional

The ambitious country-specific targets below, many of them non-binding and set at various levels of government, are based on news reports and "[An Overview of Greenhouse Gas \(GHG\) Control Policies in Various Countries](#)," published by the [Congressional Research Service](#) on November 30, 2009. Many of the countries listed made commitments under the Kyoto protocols, but failed to meet the targets. The list is as follows:

Australia — by 2020, 25% emission reductions below 2000 levels (but contingent on a world agreement that stabilizes CO2 levels at 450 parts per million in the atmosphere);

Canada — by 2020, a 20% emission reduction from 2006 levels; by 2050, a 60% to 70% reduction;

China — by 2020, a 40% to 45% carbon intensity reduction (compared to 2005 levels);

France — by 2050, a 75% reduction from 1990 levels;

Germany — by 2040, a 40% reduction from 1990 levels;

India — by 2020, a reduction in "carbon intensity" by 20% to 25% compared to 2005 levels;

Korea — by 2020, a 4% reduction from 2005 levels;

Mexico — by 2050, a 50% reduction below 2000 levels, contingent on international financial assistance and a world agreement on stabilizing CO2 concentrations at 450 parts per million in the atmosphere;

Russia — by 2020, a 40% reduction from 2007 levels;

United Kingdom — by 2020, a 34% reduction from 1990 levels; and,

U.S. — by 2020, a 17% reduction below 2005 levels — the target in the version of the Waxman-Markey bill that passed the House of Representatives last June. The Senate has not acted, but a measure calling for 20% cuts passed a Senate committee.





Faced With a Growing Supply Crisis, Business Re-evaluates a Precious Resource

Although there are few areas of total agreement in international relations, the concept of water as a fundamental human right — not a tradable commodity — was ratified in 2002 by the United Nations Committee on Economic, Social and Cultural Rights. And that's one big reason the prospect of privatizing water has been met with deep suspicion globally.

The U.S. has 60,000 local water systems, many of them small, but today only 15% are owned by investors, *BusinessWeek* reports. Yet privatization has some momentum. Veteran petroleum billionaire T. Boone Pickens, for example, believes that “water is the new oil,” and is staking a claim in this \$400 to \$500 billion global industry.

“Water is the new oil.”

—T. Boone Pickens

Pickens has bought up land in Texas on top of the vast Ogallala aquifer. His plan, in which he has invested at least \$100 million, is to sell as much as 65 billion gallons of water per year to cities in Texas. In a recent interview, Pickens — who is now the largest landowner in remote Roberts County — said he is probably as good a steward for this millions-of-years-old resource as any public agency. But there are many who would disagree with him.

Water scarcity and water quality are among the top environmental issues of the 21st century. According to the United Nations, one in seven people today, an estimated 894 million globally, do not have access to the five to 13 gallons of safe fresh water per week that is considered the minimum necessary to meet

basic human needs. “By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions,” the agency says.

Water access issues are made more difficult by global climate change, which increases drought and flood frequency, degrades water quality by affecting temperature and flow rates, and threatens coastal aquifers. A study by the U.S. Geological Survey, for instance, found that warming of 3.6 degrees Fahrenheit would seriously damage the ability of the Colorado River basin to supply the water and hydropower that much of the southwestern United States depends on.

The UN believes that earth's population is likely to exceed nine billion by 2050, according to Robert Giegengack, professor emeritus in the department of earth and environmental science at Penn and a faculty member at the Initiative for Global Environmental Leadership (IGEL) at Penn/Wharton. But that in itself does not necessarily pose an insurmountable obstacle to clean water access. “Even at 10 billion there is enough water, if we were to use it responsibly,” he says. “The problem is that we act as if the supply was unlimited.”

Giegengack adds that the actual cost of protecting human populations from dirty water is very low: Americans spend \$16 billion on bottled water annually, for example. Three years of that spending would solve Africa's seemingly intractable clean water delivery problems.

But saving water can be profitable. Businesses can see water challenges as opportunities to reduce spending through water conservation and re-use, says Stan Laskowski, a former Environmental Protection Agency (EPA) administrator, lecturer in

the department of earth and environmental science at Penn, and founder of the [Philadelphia Global Water Initiative](#).

Adam Smith was apparently the first to note the paradox that water has incredibly high “value in use” and yet virtually no “value in exchange.” All living things need water to survive, as does the current world economy. (In the U.S., electric power plants alone account for 39% of freshwater withdrawals.) And yet water is chronically undervalued. According to “Water: A Global Innovation Outlook Report,” underwritten by IBM, “In many parts of the world, water is free. There may be costs associated with procuring, distributing and treating it. But the resource itself — arguably the most important resource on the planet — has no price.”

The Twin Challenges of Managing Water

Without a market value, the invisible hand of the marketplace is incapable of solving the water shortage problem. Pickens is betting that eventually — and sooner rather than later — the growing imbalance between water supply and demand will lead to privatization. But according to [Witold J. Henisz](#), a management professor at Wharton, “Water scarcity is both an engineering problem, and a social and political one. The public views access to clean water as a basic right, but regulating it effectively is often beyond the means of local, state and federal governments. Many NGOs find the idea of privatizing water problematic, and any pricing of it would have to make some allowance for providing access to people as a basic human need, regardless of income.”

The challenge for businesses is to think long-term about water-related risks at a time when they face far more immediate and costly issues. According to Mary Buzby, director of environmental technology at Merck, “Water is cheap or free now to business, so you can’t talk about return on investment as you can with energy. And unless you can demonstrate return on investment to the financial sector, it won’t happen. How do you move from today’s water value to tomorrow’s risk?”

The other challenge business faces is the localized nature of water problems. Unlike greenhouse gases, water issues cannot be tackled on a global basis. [Frederick N. Scatena](#), who chairs the earth and environmental science department at Penn, pointed out recently that, “There are clear differences in how we manage water resources in Pennsylvania, where it is abundant, and Arizona, where it is not. Air pollution

gets distributed around the country, but water is different.” Saving water in Maine does nothing to relieve shortages in the southwest or in Africa.

The Risks to Business

Despite these challenges, businesses are increasingly facing up to the growing risks, which include:

- Revocation of operating licenses, due to increasing regulation and/or community pressure. Coca-Cola, for instance, had to close a plant in India when its heavy water use came into conflict with local agricultural needs. Because of this risk, many companies are now factoring in water availability when deciding where to locate new facilities.
- The high likelihood of rising water costs in the near future. U.S. water prices could double or triple in the next few years, according to Neil Berlant, manager of the PFW Water Fund, which focuses solely on water stocks. Among U.S. water stresses are the need for up to \$1 trillion to repair crumbling public infrastructure.
- Political instability caused by disputes over water. Wharton’s Henisz cites the case of the state-controlled Cochabamba waterworks in Bolivia. When the international consortium Aguas del Tunari (including the American company Bechtel, Italian utility Edison and the British firm International Water Limited) proposed to take over the waterworks, the selling point was that they could extend water availability to all the people of Cochabamba. But the Aguas proposal also included a 35% water rate hike to an average fee of \$20 a month, which was more than many residents spent on food. Uproar over the plan led to the so-called Water Revolt in 2000, and helped elevate a prominent dissident, Evo Morales, to the presidency of Bolivia.

According to a 2007 report prepared in collaboration with J.P. Morgan, the [World Resources Institute](#) (WRI) identified the energy production, semiconductor manufacturing and food and beverage industries as particularly vulnerable to water risk. More recently, in 2009, “[Water Scarcity and Climate Change: Growing Risks for Businesses and Investors](#),” a joint report by CERES and the Pacific Institute, looks at risks to water-intensive industries. These include:

High-Tech: Eleven of the 14 largest semiconductor factories globally are in the Asian-Pacific region, which is facing severe water quality risks. The industry is very demanding: Together, Intel and

Texas Instruments used 11 billion gallons in 2007 to make silicon chips.

Beverage: Both Pepsi and Coca-Cola lost access to ground water in the Indian state of Kerala because of competition engendered by drought conditions.

Agriculture: 70% of global water use is for agriculture, with up to 90% in developing countries with rapidly growing populations (and increasing water demand). Much of the world's crop and grazing land is in semi-arid regions threatened by climate change. An example is the increasingly stressed Ogallala aquifer, which provides water for 27% of irrigated land in the U.S. (including three major grain states — Texas, Kansas and Nebraska). In some parts of the aquifer, the water table has declined more than 100 feet. A loss of predicted rainfall affecting Ogallala is a further stressor.

Apparel: Cotton is hugely water-intensive, requiring 25 cubic meters for the amount of fabric needed to make an average t-shirt. Cotton is commonly grown in areas requiring intense irrigation, including the San Joaquin Valley in California, Egypt, Pakistan and Uzbekistan (the world's second largest cotton exporter).

Biotechnology and pharmaceuticals: There is increasing concern about leaks of chemicals and microbials into the wastewater released into natural water resources as part of manufacturing processes.

Of necessity, these industries are becoming proactive.

The 'Year of Water': Businesses Take Action, Wharton Shapes an Agenda

As part of Penn President Amy Gutmann's Climate Action Plan, the 2010-2011 academic year will be designated the "Year of Water" at the University of Pennsylvania. In December 2009, IGEL held a forum entitled "Faced With a Growing Supply Crisis, Business Re-evaluates a Precious Resource: Identifying Research Opportunities," which brought together 60 leaders from government and academia, as well as representatives from such water-concerned companies as PepsiCo, IBM, Merck, DuPont, GE, Dow and Exelon.

The forum identified several key areas of research (some of which are currently being explored by IGEL) that would contribute significantly to knowledge in the field and help business leaders make informed decisions about water. In addition,

meeting participants shared what their own and other companies are already doing.

Jim Fava, managing director of the management consulting firm Five Winds International, quoted the chairman of Nestlé S.A., Peter Brabeck-Letmathe, as saying that "water will run out long before oil does." Water supply is of more than academic interest to Nestlé, because it is the world's largest bottled water company, using by its own admission some 0.0009% of the global freshwater draw. The company says it conducts detailed assessments of its bottled water sites, including quality reports, water level measurements and rainfall data.

Water scarcity and privatization issues were brought home to Nestlé in 2008 when protests erupted in Maine over the withdrawal of water from natural, underground water sources (aquifers) by Poland Spring, a Nestlé Waters brand. According to former Maine state representative Jim Wilfong, founder of a group called H2O for Me, "This is a giant filtration system that has developed over millions of years and one that could not easily be replaced."

Companies are beginning to closely examine potential manufacturing sites for water availability, Fava says. And in regions of scarcity, they are developing water-responsible practices. Among the companies working to reduce water use, he says, are SABMiller, a major South African-brewer, which has released its own water footprint, and Merck, which has reduced its draw by more than 30%.

According to Merck's Buzby, a speaker at the forum, the company identified 22% of its 30% water reduction goals from existing plants, and closed a further two to reach its goal. Buzby also cites growing concern in the scientific community that some drugs, or combinations of them, entering the water supply can cause human health problems "because water, unlike most specific foods, is consumed in sizable amounts every day."

General Electric, which was represented at the Wharton forum, has partnered with the World Resources Institute (WRI) and Goldman Sachs to produce the [Water Risk Index](#), which, when launched this spring, will be a tool for financial analysts. According to Piet Klop, acting director for the markets and enterprise program at WRI, "Many companies have produced water footprints for their companies, but without context it is just a lot of numbers. The Water Risk Index will look at such issues as water scarcity, regulatory restraints and the predictability of water resource management."

The Index will be distilled from publicly available data, aggregating 20 weighted factors. “In many regions around the world, water scarcity from climate change and pollution is starting to impact a company’s performance, yet few analysts account for water-related risks,” says Jonathan Lash, WRI’s president. “WRI hopes that investors will begin ‘pricing in’ these under-appreciated risks, driving investments to support more hydrologically efficient designs and technologies.”

Additional Tools

There are other tools for business, including the [Corporate Water Gauge](#) developed by the Center for Sustainable Innovation (CSI), which measures water use against such factors as local precipitation, topographical features, watershed boundaries and population data.

Also at the Wharton forum, Liese Dallbauman, senior manager of water stewardship at PepsiCo International, said, “When we look at footprinting our water use, the upstream use is huge.” Most of Pepsi’s water impact is not at its plants, she noted, but in the upstream agriculture that produces ingredients. According to Dallbauman, PepsiCo’s “direct seeding” work with Indian rice paddies has saved 30% to 40% of water use there, and has also sharply reduced production of methane — a potent global warming gas.

Scatena identifies Coca-Cola as another company that has stepped up, “because water is a big part of their industry.” In 2006, Coca-Cola provided start-up support for the Global Water Challenge (GWC), which works to meet international water challenges. One of its first programs, “Water for Schools,” has brought safe drinking water to thousands of students in western Kenya. More recently, it mobilized to provide disaster relief in Haiti.

Coca-Cola, which produces 3,000 beverage products around the world and uses 76 billion gallons of water annually (the average American uses 25,000), also partnered with the World Wildlife Fund, beginning in 2007, to conserve freshwater resources in manufacturing operations and the company’s agricultural supply chain. And it has funded Business for Social Responsibility and the Pacific Institute in a joint study titled [“At the Crest of a Wave: A Proactive Approach to Corporate Water Strategy.”](#)

Coke’s CEO, Mukhtar Kent, told *Forbes* that he considers himself to be the company’s chief sustainability officer. “I have not appointed another

one and never will,” he said. “That’s me.” Among the company’s goals: A plan to go “water neutral” — returning to the countries it operates in as much water as it takes out.

Municipalities, too, are stepping up to conserve water. Singapore, on the southern tip of the Malay Peninsula, lacked a natural water resource of its own and had a legacy of flooding and river pollution in the 1960s and 1970s.

Singapore’s answer is [NEWater](#), ultra-clean reclaimed water purified using membrane technologies. Because it is highly purified, NEWater is a valuable resource for local water fabrication, electronics and power generation industries — and its availability frees up potable water for home use. As described in “Water: A Global Innovation Outlook Report,” NEWater now meets up to 30% of Singapore’s water needs. Conservation measures in Singapore have also dramatically reduced per capita domestic water needs.

Water Reform for Business: Planning and Implementation

Concern about water use by business and industry is leading to new paradigms for management and conservation. And it is sparking a movement to re-evaluate outdated pricing mechanisms that have traditionally undervalued the world’s most precious resource.

As a first step, many companies have begun [“footprinting” their water use](#) — offering public reports that detail and total corporate demand. But many are now realizing, according to the “Crest of a Wave” report, that they need to go further and develop plans to, among other things, better manage water through the supply chain, invest in the restoration of at-risk watersheds, and form collaborations to manage water resources over time.

The “Crest of a Wave” study concludes: “In the next two to five years, companies will need to adapt to availability concerns such as water stress and flooding; quality concerns, including increasingly contaminated surface and groundwater; and access concerns, specifically competition (real or perceived) with other water users.”

The study argues for a corporate water strategy that starts with a comprehensive footprint, including not only direct operations, but also downstream supply chains and upstream product use and disposal. Step two is an assessment of water-related risks, which

might include potential flooding and shortages, demand trends, and the impact of company water use and runoff on local communities. In step three, the company establishes a corporate water policy, forms strategic goals and develops management plans.

With that done, companies can move to put theory into practice and innovate with such strategies as:

- Create an ability to automatically shut off water flow at the end of the production cycle and at the end of employee shifts.
- Install water-efficient fixtures and water meters, including separate meters for large operations, and use water-efficiency labeling where possible.
- Begin a leak detection and repair program in restrooms and shower facilities, kitchens and food preparation facilities, and wash-down areas.
- Investigate alternatives to water-based cleaning (e.g., brooms instead of mops).
- Encourage employees to make conservation suggestions and implement the best of them.

For further reading, see [“Ebb without Flow: Water May Be the New Oil in a Thirsty Global Economy.”](#)





Energy Efficiency for Business: Catching the Low-hanging Fruit, Preparing for the Future

In 2008, Emily Reyna of the University of Michigan was a member of the first class of MBA students installed as summer interns at major corporations — part of the inaugural year of the Environmental Defense Fund's (EDF) Climate Corps Program. Her mission: Ferret out the low-hanging fruit of energy waste, and offer creative solutions to reduce costs and improve environmental performance. EDF estimates that no-cost or low-cost energy-efficiency measures can save \$40,000 a year for every 50,000 square feet in office space.

Reyna was assigned to Cisco Systems research and development labs in San Jose, Ca., (one of 1,500 labs the company operates worldwide). She came up with a host of ideas to improve air-flow management — hot/cold aisles, blanking panels on racked components and servers to prevent unnecessary heat buildup, improved monitoring, and more efficient cooling. Her most significant discovery, she says, was already in use at a Cisco lab in North Carolina. “They had installed Power Distribution Units, or PDUs, which enable lab managers to monitor and control energy use within the lab environment and can be programmed to shut down equipment when idle or not in use,” Reyna says.

Since forgetting to shut equipment off was a chronic problem, PDUs enabled the lab to reduce energy use 25% over six months. Reyna crunched numbers for Cisco company-wide and found it could save \$8 million a year and reduce overall greenhouse gas emissions by 3%. “A lot of times, the IT folks that purchase the equipment are not the same employees who manage power and pay energy bills,” says Reyna, who saw part of her job as “breaking down the barriers to energy efficiency” that are often present at large companies. “I had

a fantastic time at Cisco and learned a great deal about energy efficiency.”

Energy Waste ... and Opportunity

There's nothing unique about Cisco Systems. Most corporations are wasting huge amounts of energy because of practices that are “the way we've always done it.” But increasingly, companies worldwide are making changes and realizing dramatic savings.

Most corporations are wasting huge amounts of energy because of practices that are “the way we've always done it.”

Paul R. Kleindorfer, professor emeritus at Wharton and professor of sustainable development at INSEAD in France, was a consultant to a project launched by a branch of American pharmaceutical giant Pfizer at a plant in the “green” German city of Freiburg.

With a goal of reducing carbon emissions by 40%, enterprising chief engineer Michael Becker mapped out 50 plant projects that included everything from insulating windows to installing a biomass boiler that burns wood pellet waste from local timber industries to produce heat and process steam. The boiler alone reduced carbon emissions by 7,000 tons per year and resulted in six-figure savings in annual heating costs.

The Pfizer plant also installed geothermal heat exchangers to provide cooling in summer and heat in winter. “They're getting about 75% of their total

energy needs from these new systems,” Kleindorfer says. “And they’re eliminating imported fossil fuels in favor of sourcing biomass and geothermal within 30 miles of the plant.”

By striving for carbon neutrality, Pfizer’s Freiburg operation would set itself up for profiting by selling the carbon certificates that are the currency of European cap-and-trade systems, according to Kleindorfer. “Pfizer’s approach is particularly good, but there are literally thousands of projects like this all over Europe. It’s not inconsequential for a company to save 20% to 30% on energy costs, and it’s even more important for energy-intensive industries such as cement, steel and aluminum.”

Some of the most effective energy-efficiency projects are business-to-business partnerships. For instance, the Commonwealth Edison utility teamed with the Ford Motor Company to save more than a million kilowatt-hours of electricity (worth almost \$100,000 annually) at a two million square-foot stamping plant in Chicago Heights, Ill. The project included upgrading more than 1,000 lighting fixtures and installing another 1,000 occupancy sensors. Gloria Georger, the Ford plant’s manager, told Commonwealth Edison that the benefits extended beyond saving electricity. “The improvements to our lighting provided a better working environment for our employees,” she says. “As a result, we see an increase in productivity.”

In developing countries where energy is expensive, companies seeking a competitive advantage have already picked much of the low-hanging fruit, says [Ulku G. Oktem](#), a chemical engineer and Wharton adjunct professor of operations and information management. Currently teaching at Bahcesehir University in Istanbul, Turkey, as well as at Wharton, Oktem cites the examples of Turkish escalators, which incorporate motion sensors to operate only when people approach them, and classrooms with lights that automatically cycle off. “It is far more common to see things like that there,” she says. “People seem to be conscious of saving energy.” Because of this experience, she believes that western companies operating in the third world need to involve local people in their energy-efficiency improvement programs. “Rather than being imposed top down,” she says, “the programs need to incorporate local knowledge, customs and behaviors.”

Oktem also points out that “a lot of low-hanging fruit in product design and development,” citing both Xerox and Mattel as companies that have

improved environmental performance with leading-edge product design and other innovations.

According to Mattel’s 2009 Global Citizenship Report, installation of an evaporative air cooler on a paint line saved 130,000 kilowatt-hours of electricity. Replacing hydraulic injection molding with electric molding saved \$100,000 in annual energy costs. Improvements in the U.S. distribution system reduced electricity use 30% by, among other things, using skylights instead of artificial light in warehouses and reducing the use of supplemental lighting.

Close to Home: Saving Energy at the University of Pennsylvania

Emily Schiller, a 2009 MBA graduate of Wharton, is associate director of [sustainable initiatives](#) at Wharton. The school’s recent environmental innovations include, in 2004, the launching of a three-bin recycling program (expanded in 2008), which has increased the school’s overall recycling rate from 18% to 25%, and default two-sided (known as duplex) printing, which saves 2.4 million sheets of paper a year.

Schiller says her Wharton energy-efficiency work has focused on four categories: HVAC, lighting, green IT and behavioral changes. At Wharton’s Jon M. Huntsman Hall, for instance, Schiller’s team found that the set points for the HVAC system brought in more outside air than was necessary for good air quality. The HVAC project is currently under review and may be able to provide savings of \$200,000 a year, Schiller says.

“Lighting is also huge,” Schiller adds. “There are thousands of light bulbs just in Huntsman Hall, and we’ve changed them all to high-efficiency fluorescents and LEDs.” More than 500 public computers at Wharton now go to “sleep” after an hour of sitting idle, saving \$8,000 a year.

And a search is on at Wharton for “vampire” or “phantom” loads — devices from coffeemakers and microwaves to “sleeping” computers — that use significant amounts of “standby” electricity even when not in use. This secret power use accounts for 6% of electricity consumption nationally, and Schiller says that one way to reduce this power drain would be to unplug these appliances at the end of the workday, over the weekend and on holidays. “Anything with an LED light uses power, and in my office I’ve agreed to reset all the clocks,” Schiller says.

In a recent four-month period, Wharton has identified \$92,000 in energy savings, which helps realize goals set by University of Pennsylvania President Amy Gutmann's [Climate Action Plan](#), which aims to achieve a 5% reduction in energy use this year, and a 17% reduction by 2014. To reduce emissions further, the plan aims to motivate more than half of the university community to walk, bike or use carpools.

Recapturing Energy Waste with Cogeneration and More

Reducing a company's energy profile starts with eliminating the kind of waste symbolized by oil refiners venting off and burning valuable methane gas. "The lowest-hanging fruit is the avoidance of waste," says [Noam Lior](#), professor of mechanical engineering and applied mechanics at Penn and a faculty advisor with the [Initiative for Global Environmental Leadership](#) (IGEL) at Penn/Wharton. "We started looking at that in the 1970s when it was common for steam vents to blow all winter and people to leave windows open because it got so warm. Unfortunately, companies have sometimes decided it was easier to throw away energy than find ways to use it. But this kind of waste is easy to detect and cheap to fix."

In a process known as "cogeneration" (also called combined heat and power, or CHP), waste heat or steam can be captured from a manufacturing process and used to create electricity that can either be reused or sold. Your car is a good example of cogeneration efficiency, because the engine both drives an alternator to create electricity and generates waste heat, which can be diverted to heat the car's interior.

Power plants typically vent waste heat into the environment through cooling towers or other means, but Con Edison offers an example of impressive energy recapture. From five electric plants, it takes 30 billion pounds of steam heated to 350 degrees Fahrenheit and uses it to heat 100,000 buildings in Manhattan, creating the world's largest "steam district." Waste heat and steam can also be used in absorption chillers to produce cooling. For Con Ed, it's hardly a new business: The steam system, which now incorporates 105 miles of mains and service pipes, began service in 1882. In the peak winter period, the system provides 10 million pounds of steam per hour. And steam is a profitable business, providing 6% of Con Ed's revenue.

Lior recommends that corporations conduct thorough operational audits to determine where they are wasting energy. The audit can identify possible secondary uses for that generated energy and ways to eliminate it with more efficient equipment.

Tips for Action: Don't Overlook the Obvious

Kate Robertson, an energy efficiency specialist at the EDF, says the group's Climate Corps Program offers a "fresh pair of eyes" to ask questions about potential energy savings "that seem silly, but are so basic nobody thought to ask them." One Texas company, she says, achieved big savings by simply turning off boilers that were no longer being used. Since the company's exposure is limited to paying the 10-week salary of the MBA students who become de facto energy-efficiency assistants, savings can be substantial.

In a summer, Robertson says, a Corps student can go through operations, printing, lighting and refrigeration — with the latter often presenting major opportunities for savings. "A company may not have a clear idea of what they're paying for refrigeration," she says. "They're used to paying the bills and moving on. But an energy audit can lead to replacing 20-year-old refrigeration units so that, in just one year, the company will save enough money to buy new computers."

Commercial buildings account for 17% of global warming pollution in the U.S., and asset value rises \$3 for every \$1 invested in energy efficiency, the EDF reports. The California Energy Commission recommends energy audits as possibly "the best investment you can make for your business." Among the Commission's other tips for businesses to save energy:

- Whenever possible, do not use large equipment during the peak hours of 3 p.m. to 7 p.m.
- Turn equipment and lights off after hours (putting computers into "sleep" mode). Motion detector controls can pay for themselves in two years.
- Set summertime workspace thermostats to 78 degrees Fahrenheit during work times, and 85 degrees after hours. (This can save 2% in air-conditioning costs for every degree that the thermostat is raised.) Ceiling fans can also make it seem at least four degrees cooler in workspaces.
- Install window films, solar screens or awnings on south- and west-facing windows.

- Use Energy Star-certified appliances (up to 30% more efficient than standard models) when possible.
- Replace incandescent bulbs with long-lasting compact fluorescent lights (CFLs) that use 75% less electricity to produce the same amount of illumination. CFLs also can last 10,000 hours compared to 1,000 hours for an incandescent bulb. Replacing a single 100-watt incandescent with a 25-watt CFL can save \$90 over the latter's lifetime. Exit signs using incandescent or fluorescent lights can be replaced with very energy-efficient LED lights.

Innovative Financing for Energy Improvements

Eric W. Orts, director of IGEL and a professor of legal studies and business ethics, says energy-efficiency improvements offer “a basic, steady return, not the kind of blockbuster return that can result from a research and development investment.” As a result, companies are often tempted to invest for near-term profit at the expense of long-term energy savings.

Howard Kunreuther, Wharton professor of decision sciences and public policy, and co-director of Wharton's Risk Management and Decision Processes Center, points out that companies may defer energy-efficiency improvements that pay off over a number of years “because they have short-term horizons. If the payback is in 15 years, and the decision makers expect to move on before that, they worry that they won't get credit for the savings but will get the blame for the added costs.”

Performance contracts are one way to overcome this problem. Many solar companies, for instance, will now install photovoltaic panels on a company's buildings at no cost, charging only for the electricity purchased at a discount in a long-term contract.

Tom Rooney, CEO of major player SPG Solar, recently signed a contract with the Irvine Unified School District in California to install four megawatts of solar panels on 21 building roofs by the end of 2010. “There's zero hassle and zero dollars down for them, but it saves \$17 million over 20 years in electricity costs,” Rooney says. The solar system will produce 6.6 million kilowatt-hours of electricity annually, 45% of the school district's demand, he says.

Another way for companies to overcome the long-term pay-back nature of many energy saving investments, Kunreuther says, is with internal

processes that apportion the costs of upgrades over time. “It's better not to charge the whole cost in the first year, because it will look negative,” he says. “The time horizon needs to be longer.” Another approach, he added, is loans offered by utilities and other companies that provide upfront energy-efficiency upgrades that can be amortized over a number of years.

To make energy investment more attractive, some organizations have looked at Energy Service Companies (ESCOs). In an ESCO strategy, a company (Honeywell International is an example) creates an energy performance contract with a client and installs energy-saving upgrades. The client pays back the upfront investment, over seven to 20 years, with the savings in energy costs. The World Bank created the first ESCO companies in China in 1997, and it's become a popular tool for funding energy efficiency in developing countries. The ESCO industry is worth \$6 billion annually in the U.S., and industry groups say that figure could triple in the next few years because of Obama Administration energy-efficiency spending.

The ESCO industry was launched in the 1970s in response to rising energy prices from the Arab oil embargo (1973) and the Iranian Revolution (1979). The National Association of Energy Service Companies says that \$20 billion has been invested in ESCO projects to date, with \$7 billion going directly to labor employment.

In an increasingly unpredictable world, long-range contingency planning makes growing sense — particularly where energy is concerned. The Global Business Network, which specializes in helping companies cope with mounting uncertainty — “whether it's uncertainty about their future, the future of their industry or the future of the world at large,” — offers a four-point program towards what it calls “energy success,” as follows:

- Master the fundamentals of energy efficiency, building an energy-savings oriented corporate culture through executive leadership and appointment of an energy director who can set aggressive goals.
- Take a longer and broader view of investments and strategic decisions — including locating facilities and making acquisitions — with energy costs, use and supply in mind.
- Look for business transformation opportunities in the way your company procures and uses energy.

Be innovative in looking for and publicizing new energy technology products and services. Frame energy as a lever for positive growth, not simply as a cost.

- Prepare contingent strategies involving substantial and sustained swings in energy prices and supply, as well as available incentives for energy efficiency and reductions in greenhouse gas emissions. Actively manage exposure to risks. Corporate leaders can take personal action through their companies, their boards and their broader industries.

Tax Incentives: Money on the Table

Companies can gain considerable federal tax relief for making energy-efficiency improvements. Here are some major incentives available, according to the American Council for an Energy-Efficient Economy (ACEEE) and [Business.gov](#):

- As part of the U.S. Energy Policy Act of 2005, commercial buildings that save at least 50% of heating and cooling energy costs [are eligible for a \\$1.80 per square foot deduction through 2013](#) (on whole buildings), and 60 cents per square foot per system on lighting, HVAC and other areas. For lighting improvements, there is a sliding scale that starts with 30 cents per square foot for 25% savings. Installation of combined heat and power (CHP) units are eligible for a 10% investment tax credit on the first 15 megawatts installed.
- On-site renewables are also eligible for credits. Solar photovoltaic (PV) is eligible for 30% credits up to \$2,000 through 2016. Fuel cells qualify for 30% credits up to \$3,000 per kilowatt through the same cutoff date. On-site small wind installations of 100-kilowatt capacity or less qualify for a 30% credit up to \$4,000. And geothermal heat pumps that meet Energy Star specifics are eligible for 30% credits up to \$2,000.
- Some vehicles, including hybrid, alternative fuel and plug-in electrics, and heavy-duty trucks, are also eligible for tax breaks. The incentives range from \$2,200 for a not particularly fuel-efficient Cadillac Escalade hybrid to just \$650 on four-wheel-drive Ford Escape hybrid models. Credits are not available on the popular Toyota Prius or Camry hybrid because they have exceeded sales ceilings.

Sustainable Business: Agendas for Action

“It won’t matter a hoot if companies believe or don’t believe in climate change,” Kleindorfer says. “These energy challenges will run right over the top of you if you don’t get ready.” For this reason, Kleindorfer advises companies (especially those with manufacturing as part of the portfolio) that “measuring the energy content of products delivered across the supply chain” can be a good first step to both reduce costs and prepare for future voluntary and involuntary mandates.

While detailed energy and water use reporting is not generally required in the U.S., to wear the prestigious [Nordic Eco-Label](#), Kleindorfer points out, Scandinavian producers are required to disclose the chemical, energy and water content of their products — an impossible task without the kind of supply chain reform and monitoring currently underway at companies such as Walmart.

The best way to deal with change is to seize control of it, which explains why several business coalitions have organized to create a unified lobbying force for energy efficiency. Businesses for Innovative Climate and Energy Policy (BICEP) includes Nike, Starbucks, Gap, Symantec, Stonyfield Farm, North Face, eBay, Ben & Jerry’s, Levi Strauss, Sun Microsystems and Timberland. Last March, the group released an agenda that included reducing greenhouse emissions 25% below 1990 levels by 2020, and 80% below 1990 levels by 2050. It also calls for an economy-wide cap and trade system that auctions 100% of its carbon credits, stimulating green job growth, and limiting construction of new coal plants to those that can capture and store CO₂.

BICEP members “believe that climate change will impact all sectors of the economy,” the group says. “It’s important for us to realize that there is a direct risk to our companies,” states Starbucks Director of Environmental Impact Jim Hanna about the need for BICEP. “It wasn’t altruism.”

The U.S. Climate Action Partnership includes EDF, the Natural Resources Defense Council, Alcoa, Dow, General Electric, PepsiCo and General Motors. Its agenda is similar but less aggressive than BICEP’s — its cap-and-trade program would give away most of its carbon credits, not auction them.

The international [Climate Solutions Business](#)

Coalition (CLBC) was founded “to provide a global private sector voice in favor of urgent and ambitious action on climate change.” Its members include the Business Council for Sustainable Energy, the Carbon Markets & Investors Association, the Global Wind Energy Council and the International Council for Sustainable Energy.

CLBC supports:

- The creation of a global price on carbon emissions via strong targets and international offset mechanisms.
- Business certainty by the provision of medium-term and long-term targets.
- Reform of existing offset mechanisms to scale up reductions and increase geographic distribution of financial and technological resource flows.

Although a binding international climate change treaty has not been enacted, and there is considerable uncertainty about energy prices and availability in the near- and long-term, the trends are clear: Business needs to be preparing for a future that will reward energy efficiency in more ways than one. 🌱





Electric Cars: How Long Is the Road to a Plug-in Revolution?

In 1900, when there were only a few thousand motor vehicles registered in the U.S., the public could choose from steam, electric or gasoline automobiles, all with passionate partisans, industrial backers and embryonic infrastructures. There was no clear winner.

An impassioned race for market share ensued, with electric vehicles (EVs) initially having the upper hand because they were quiet and didn't require a crank to start. But gasoline soon took the lead because it offered greater range. And when Charles Kettering of General Motors invented the self-starter for Cadillacs in 1911, it was all over.

But today the EV is making a major comeback and there are strong parallels to the start-up culture that produced the personal computer. The EV promises much — deliverance from foreign oil, a path to reaching ambitious greenhouse gas emission targets, and ultimately a far better automobile than we have today. Even President Obama has embraced the EV, with a call for a million plug-in hybrid cars on American roads by 2015. But many hurdles remain before battery-powered cars can dominate the road.

The PC evolution happened faster. In 1976, a very young Steve Jobs, Steve Wozniak and Mike Markkula formed Apple in a Silicon Valley garage. They scrounged together 50 very basic personal computers from spare parts, then used the money to make improvements in the design, including a keyboard and a better display. Soon they were on their way to the Apple II and, by 1984, the McIntosh.

The Valley became the launching pad for thousands of digital dreams.

In 2010, Silicon Valley is again playing host to a revolution in technology, though this time the entrepreneurs aren't making computers, they are building surprisingly sophisticated zero-emission EVs. The garages that housed embryonic PCs now house cars again, but they are powered by very light lithium-ion (li-ion) batteries.

Even President Obama has embraced the EV, with a call for a million plug-in hybrid cars on American roads by 2015.

The big story is the rise of small, nimble and independent electric carmakers that appear poised to command a significant share of the world auto business in just a few years. **Tesla Motors**, which recently built its 1,000th high-performance battery-powered Roadster, is headed by the young South African-born billionaire Elon Musk (shown above), who made his fortune as a co-founder of PayPal. He holds two degrees from the University of Pennsylvania, including an undergraduate degree in economics from Wharton. The company's sports cars sell for more than \$100,000 although the more sober (but still very fast) \$50,000 Model S sedan is on the horizon for 2011.

Tesla Motors recently announced an IPO, seeking to raise \$100 million. Musk told Knowledge@Wharton [in an interview last May](#), “As far as new companies go, the car business is such a capital-intensive [one]. It doesn’t lend itself to start-ups very well. You need to operate with incredible capital efficiency if you are going to be a start-up and succeed. Tesla has done a good job in that respect, though it certainly could have done a much better job.”

In its IPO filing, Tesla (which was briefly profitable in 2008) said that it lost \$31.5 million in the first nine months of 2009, through September 30. This was down from a loss of \$57.3 million in the same period of 2008, it said. Revenue in those nine months last year was \$93.4 million. Musk has attributed the losses to its fast-paced development of the Model S. The company hopes to sell 20,000 of them a year.

Henrik Fisker is a charismatic Danish-born former BMW designer who is also going the high-performance route with the Fisker Karma, an \$87,900 plug-in hybrid with supercar performance and 50 miles of all-electric range. The Karma will initially be produced in Finland and sell probably half its production in Europe.

Both Fisker (\$528 million) and Tesla (\$465 million) received Department of Energy loans to build EV capacity in the U.S. Fisker is using its funding to set up a base in Delaware (on the site of a former General Motors plant) for a second, smaller car known as Project Nina. Tesla is investing in a new California plant to produce the Model S.

Other independent contenders include:

Bright Automotive. The company makes a plug-in hybrid commercial van and has customers like Coca-Cola and Frito-Lay lined up. Bright’s unique Idea vehicle is marketed as a solution for low-cost fleet operation. Bright CEO John Waters had a hand in designing the battery pack for the ill-fated General Motors EV-1 — the first modern EV from a commercial carmaker.

Brammo. The design-conscious company is selling an electric motorcycle in Best Buy stores. Brammo’s Enertia is an \$8,000 carbon fiber-based urban commuter bike with a 50-mph top speed and a 40-mile range. CEO Craig Bramscher started Dream Media, which created databases for giants like Sony, Warner Brothers and Fox.

Coda. This battery-powered carmaker sources the platform for its 100-mile electric sedan from China,

where it also has a joint operating agreement with a prominent battery supplier. Coda, which will obtain most of its electric powertrain from western companies, has backing from a complement of Goldman Sachs veterans, including Henry Paulson, former CEO for Goldman and former Treasury Secretary. The Coda, priced around \$40,000, will be available initially in California at the end of 2010.

Think Global. Think, a Norwegian contender, has an interesting history and was owned by Ford from 1999 to 2003. It’s small, two-seat City sedan is designed for urban commuting. Right now it has a beachhead in Europe, but the company is taking aim at the global market. Think recently announced a U.S. factory in economically depressed Elkhart, Ind. With Bright also located there, as well as the major battery player Ener1, Indiana is shaping up as a second Detroit.

These upstarts say they can compete with the best from Detroit, Tokyo and Stuttgart. But they won’t have a clear field. Mainstream automakers are also readying fleets of battery-powered cars. There are a range of credible EVs from America’s embattled Big Three carmakers, including The [Chevrolet Volt](#) (which uses a gas engine not connected to the wheels to supply power for an electric motor), a [battery electric Focus](#) and plug-in hybrid from Ford, and a range of cars from Chrysler’s ENVI division (whose future is somewhat clouded by the company’s bankruptcy and subsequent emergence). In the past, Big Three electric cars were mostly window-dressing: They appeared at car shows, and revolved on stands, yet somehow never actually reached production. Today these are the cars that could save Detroit.

According to Britta Gross, General Motors’ director of global energy systems and infrastructure commercialization, the company will roll the Volt out in three regions — California, Michigan and Washington, D.C. — starting in November 2010. “We’re planning to scale up as quickly as we can, then expand nationally within several years, she says.

The EV revolution is international. The Japanese, assisted by co-ownership of Asian battery makers, are true leaders in the field. Toyota is fielding a small electric city car with 100-mile range, and also a hydrogen-powered fuel-cell car by 2015. Honda is committed to electrifying most of its fleet with batteries and hybrid drivetrains. Nissan, in addition to bringing out the [Leaf](#), its first battery car, late this year, is pioneering EV charging by signing up

cities around the world as partners. The company is creating the infrastructure for its cars to succeed in the marketplace.

“Zero emission vehicles will change the way people use their cars,” says Carlos Tavares, the chairman of Nissan Americas. “The power will come to you: You’ll be able to charge in your garage, in parking lots and in shopping malls. We’ve been working on battery technology since 1992, and it has taken us this long to reach the maturity we have today. The Leaf will offer zero emission at about the same cost as operating a gasoline car — you won’t have to be green to buy one.”

Nissan’s Leaf also benefits from modern communications technology: Owners will be able to pre-heat and pre-cool their vehicles from their cell phones and computers, as well as choose their charging times the same way people today record TV shows.

Potential Roadblocks

Expect some potholes in the road to electrifying the automobile. According to [John Paul MacDuffie](#), a management professor at Wharton, “It’s likely to be a somewhat slow road, though whether it will also be a bumpy one is a judgment call at this point. We will definitely see a lot of ups and downs in EV interest due to fuel prices. One issue is that, aside from a \$7,500 federal tax credit, we lack steady federal incentives, which would be smart to provide as a way of helping people make these purchases.”

MacDuffie believes it could be decades before the world’s roads finally relinquish the internal-combustion engine. “I think we will have a mix for a long time, with no obvious dominant winners,” he says. “We could see another 10% to 15% efficiency improvement in gasoline cars. It’s not clear from where we are right now what will be in that mix in 20 to 30 years. For instance, hybrids appear to have the upper hand now, but plug-in electrics could cruise along steadily, and then suddenly proliferate after reaching a tipping point.”

The world’s major automakers still treat EVs as “a fringe part of their business,” MacDuffie says. “But it’s very likely we will reach a point where it’s impossible to be a credible automaker unless an EV is in your portfolio — and maybe we’re already there. But EVs present a challenge: Automakers aren’t used to what appears to be a slow buildup in the marketplace, with the big growth period in the marketplace still a long way away.”

EVs won’t work without a place to plug them in, which is one reason Nissan’s partnership with municipalities to develop public infrastructure is important. Entrepreneurs have also emerged, including the Israeli-born Shai Agassi, whose company Better Place has helped make modern EVs possible with an ambitious plan to wire whole countries, including Israel and Denmark, for EVs. Although some parts of Agassi’s plan — specifically the idea that cars could have swappable battery packs for long trips — are unlikely to be realized, his broad vision has been invaluable.

In [an interview](#) with Knowledge@Wharton last August, Agassi says, “[T]his is one of the most exciting times in this industry. We will have a billion electric cars on the road sometime around 2025 because we will have a billion people [driving] and there’s no way they can be [driving] gasoline cars. Between now and 2025, a billion new cars need to be added and there will not be any industry that will be more exciting than this one....You’re looking at a \$20 trillion industry rising up from nothing today within the span of 10 to 15 years.”

Other charging companies include [Coulomb Technologies](#), which has sold 2,000 charging stations since its founding in 2007 and is fielding orders from Boston, Chicago, New York and Europe; and [ECOTALITY](#), based in Scottsdale, Az., which is wiring several American cities, but is also looking much farther afield — to China, the first American company to expand there. “The Chinese are likely to get there first,” says CEO Jonathan Read. “They’re racing us at breakneck speed. We used to have an arms race with the Chinese — now it’s an EV race.”

Crystal Balls: The EV’s Varied Timetable

The prognosis for electric cars ranges from very optimistic to skeptical. Merrill Lynch believes that there could be a \$70 billion lithium-ion battery market by 2020, “requiring significant manufacturing scale and a 30% to 50% reduction in cost.” Since li-ion batteries are at the heart of almost all EVs, that price reduction is crucial. One reason that even small EVs are priced near \$40,000 is the current \$10,000 to \$15,000 cost of their battery packs.

Among the pessimists is the Boston Consulting Group (BCG). The idea with economies of scale is that as companies build more battery vehicles, the cost of the packs will come down dramatically. But [a BCG report says that isn’t likely](#) — at least in the near term. “Although electric-car battery costs are expected to fall sharply over the

coming decade, they are unlikely to drop enough to spark widespread adoption of fully electric vehicles without a major breakthrough in battery technology,” According to the report. The firm thinks that car companies will still be paying \$8,000 for relatively small 20-kilowatt-hour packs in 2020, and that their target of \$250 per kilowatt is impractical. Right now, batteries cost between \$1,000 and \$1,200 per kilowatt.

According to Xavier Mosquet, the Detroit-based leader of BCG’s global automotive practice, \$400 per kilowatt is more likely. And since about half of battery costs are fixed — not sensitive to quantity discounts — he says huge breakthroughs are unlikely without radical changes in materials. High prices like that make it harder for EVs to compete with gas cars on cost. According to Mosquet, oil would have to go to \$350 a barrel (it’s now around \$82) for payback in three years.

Despite all these hurdles, BCG still predicts that 26% of new cars (14 million vehicles) sold in 2020 in the major developed markets (China, Japan, the U.S. and Western Europe) will have electric or hybrid powertrains. Hybrids will be the biggest part of that mix at 11 million. Only 1.5 million will be fully electric, the company says. Meanwhile, the electric battery market will reach \$25 billion. “The burgeoning market will be about triple the size of today’s entire lithium-ion battery market for consumer applications such as laptop computers and cell phones,” says Mosquet.

Contrary to other more expansive visions, BCG says battery cars in 2020 may be concentrated — used as part of commercial fleets and as commuter cars. Also somewhat pessimistic is the conclusion by the federal National Research Council that high battery costs will make it difficult for plug-in hybrid vehicles (imagine a Prius with a larger battery pack and wall-charging capability) to enter the mainstream.

“It is possible that breakthroughs in battery technology will greatly lower the cost,” the report says. “At this point, however, it is not clear what sorts of breakthroughs might become commercially viable. Furthermore, even if they occur within the next decade, they are unlikely to have much impact before 2030, because it takes many years to get large numbers of vehicles incorporating new technology on the road.” According to the report, the maximum practical scenario, requiring some breakthroughs, would put 40 million plug-in hybrids on the road by 2030. More realistic, the study says,

is 13 million. Neither figure is all that encouraging when there are 300 million cars on our highways.

The Electrification Coalition took issue with the NRC report, which, it says, “contains battery costs and technology assumptions that are well beyond the range of current industry data. These estimates ultimately provide the basis for a broader analysis that is fundamentally flawed in numerous ways.”

The Coalition, formed late in 2009, brings together such players as Carlos Ghosn, the head of the Renault-Nissan Alliance (and a major supporter of EVs), David Vieau, CEO of the battery supplier (to Fisker, Chrysler and others) A123 Systems, Frederick Smith, chairman of FedEx Corp., and David Crane, CEO of NRG Energy. Its vision is far more expansive than NRC’s: “By 2040,” says its Electrification Roadmap, “75% of light-duty vehicle miles traveled in the U.S. should be electric miles. As a result, oil consumption in the light-duty fleet would be reduced by more than 75% and U.S. crude oil imports could effectively be reduced to zero.”

The Roadmap was prepared with the help of global management consulting firm PRTM, which projects that li-ion battery cost reductions of more than 50% by 2020 are possible without technology breakthroughs (assuming that 10% of new vehicles sold by that date are electric, which would support economy-of-scale reduction).

According to Oliver Hazimeh, the director of PRTM’s global e-Mobility Practice, “We look at what is happening in the marketplace and see the electrification of the automotive powertrain. It is no longer a question of ‘is it happening?’, but a question of ‘when and where?’” By 2020, Hazimeh says, “electric miles could be cheaper than oil miles. We see that ownership and costs associated with EVs will be on par with gasoline engines by that time.”

It may be that PRTM’s forecasts are too optimistic and NRC’s too dire. But given the many variables that will affect EV sales, confident speculation is difficult. Few analysts predicted Toyota’s current fall from grace, for example.

Lessons for Business: Betting on EVs

EVs face very uncertain prospects in the market. According to [2009 survey data from Pike Research](#), 48% of Americans are willing to consider a plug-in hybrid vehicle that can achieve 40 miles on batteries alone. But here’s the heart of the matter: In the same survey, a solid 83% say they would consider such

a car if it cost no more than 10% more than their current car. Achieving that kind of price parity would be very difficult, given high battery costs.

A similar pattern influenced General Motors' decision to produce the EV-1. The company was encouraged by the number of "handwavers" who say they would consider leasing the car, but in the end only 600 (in California and Arizona) actually did.

That's why, as Wharton's MacDuffie points out, fuel prices loom so large in estimating how EVs will fare when they enter showrooms at the end of this year. A few points to consider:

- Escalating fuel prices are a tonic for the sale of fuel-efficient cars and, likely, EVs. A 2009 survey for Cars.com found that "40% of car shoppers say they would consider purchasing a new fuel-efficient car right away if gas were over \$4 a gallon." When the price was only slightly less (\$3.75), only 29% said they would make the switch. SUV sales dropped precipitously when gas did actually reach \$4 a gallon, but they rebounded when prices dropped. Given this, a federal fuel tax or a price floor for gasoline (both politically impossible in the U.S. Congress) would provide a more stable sales environment for EVs.
- The \$7,500 federal tax credit for purchasers of battery vehicles and plug-in hybrids is essential for their early adoption. Carmakers such as Fisker, Tesla and Nissan often quote the cost of their new vehicles inclusive of that rebate (and sometimes minus the batteries, too). But will that generous rebate remain in place as the market share for EVs escalates? Darryl Siry, a former Tesla marketing executive who now blogs for *Wired*, has called for the tax credit to be transformed into a permanent \$7,500 cash rebate at the time of purchase. Siry adds, "The tax credit also should be structured so a commercial entity can claim it if they purchase the battery pack for the purpose of leasing it back to a consumer." Such incentives helped make the federal "Cash for Clunkers" program a major success.
- The U.S. could lose the battery race to Asia. It's unlikely that the U.S. will establish a beachhead for li-ion manufacturing without federal subsidies, given the far-cheaper production costs in China, Korea and Japan. But strategic federal Department of Energy loans are in place, and they are jump-starting nascent industries in economically depressed regions, including Michigan and Indiana. Last April, for instance, Michigan found itself with \$1.7 billion in federal

battery largesse. Among the companies building battery plants there are Massachusetts-based **A123**, Korea's LG Chem, a joint venture involving Dow Chemical and Kokam America, and Johnson Controls-Saft.

- Electric cars don't use fossil fuels directly, and require less fossil fuel energy than internal combustion engines. But their batteries require significant amounts of lithium, which is not (like hydrogen for instance) in virtually unlimited supply. Principal lithium suppliers include China and Bolivia (with the latter having as much as 5.4 million tons, 10 times more than the U.S.) The next-largest supply is in Chile (three million tons). Estimates of the size of the lithium battery market vary widely, from 54,000 tons to 500,000. Given that, it's clear that the U.S. can't rely on its domestic supply alone. So, in a way, the U.S. will remain dependent on "foreign fuel." Lithium supply is probably a bigger issue than the more frequently raised questions about environmental battery disposal. Automakers have lithium recycling plans in place, and reuse of auto batteries for stationary power applications is also being actively investigated.

The major automakers and start-ups may be competitors, but they agree that the electrification of the automobile is inevitable. How fast that will happen — and which companies will emerge as technology winners — is still very much undecided.



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