Greening Industrial Facilities : A Sustainable Approach to Addressing Energy Concerns

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"Controlling the amount of increasingly costly oil, natural gas and water used in manufacturing has become a strategic factor in determining whether or not your manufacturing business remains competitive in the global economy." *— NAM president John Engler*

Introduction

The prices for natural gas and oil-based products have risen significantly in recent years, making it more costly for U.S.-based manufacturers to be profitable and compete globally. A poll taken at the September 2004 meeting of the National Association of Manufacturers (NAM) board of directors revealed that 93 percent of directors from small and medium manufacturing companies believe that higher energy prices are having a negative impact on their bottom line. Furthermore, a recent study by the NAM and the Manufacturers Alliance found that U.S. companies have a 22 percent unit cost disadvantage compared with overseas competitors in a number of non-production areas, including energy.

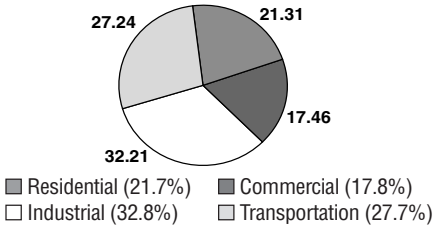
Energy is the biggest consideration in analyzing potential savings in manufacturing facilities since the industrial sector currently accounts for about one-third of all U.S. energy consumption at an annual cost of more than $120 billion. NAM says that external outlays related to energy prices (in addition to taxes, litigation, health care, and regulation) have added 22.4 percent to production costs. In addition, according to one analysis, "deregulation, security concerns, and a fragile transmission infrastructure are increasing energy price volatility, with negative financial impact on some companies. Those that more tightly control and aggressively reduce energy consumption can minimize exposure to such volatility."

The United States uses energy much more efficiently today than it did 50 years ago. Improvements in energy efficiency in the manufacturing sector have helped the country to be 46 percent more efficient in energy use per unit of GDP versus 30 years ago. While gross domestic product has risen 161 percent since 1970, total energy usage has increased only 41 percent.

Yet even with the dramatic increase in energy efficiency, overall energy consumption has risen. Manufacturers have increased their electricity consumption on average between from 3 percent and 16 percent, depending on the sector. The usage of natural gas has also risen between 25 percent and 41 percent, although oil consumption went up only slightly.

Despite the general overall improvements, high energy prices today can still be devastating to manufacturers. According to National Association of Manufacturers president John Engler, "Controlling the amount of increasingly costly oil, natural gas and water used in manufacturing has become a strategic factor in determining whether or not your manufacturing business remains competitive in the global economy."

2003 U.S. Energy Consumption by Sector and Source
Quadrillion Btu per Year



A growing number of manufacturers are now looking at how sustainable, or "green," buildings can save energy, but can also help to conserve water and other resources while improving productivity and enhancing a company's public image.

By investing in sustainable buildings, a number of leading manufacturers are already improving bottom-line business performance and creating long-term shareholder value through integrated financial, environmental and social strategies and measurements that are valued on Wall Street.

Manufacturing Sector Inputs for Heat, Power, and Electricity Generation by End Use

Industrial Sector End Use Category	Trillion Btu	Percent of Total Direct End Use
Direct End Use	**7,655**	
All Process Uses	**6,325**	82.6%
Process Heating	4,055	53.0%
Machine Drive	1,691	22.1%
Electrochemical Processes	298	3.9%
Process Cooling and Refrigeration	210	2.7%
Other Process Uses	69	0.9%
All Non-Process Uses	**1,330**	17.4%
Facility Heating, Ventilation, and Air Conditioning	692	9.0%
Facility Lighting	211	2.8%
Conventional Electricity Generation	243	3.2%
Other Facility Support	96	1.3%
Onsite Transportation	69	0.9%
Other Non-Process Uses	3	0.0%
Indirect End Use (Boiler Fuel)	**3,635**	
End Use Not Reported	**157**	
Total	**11,447**	

Defining Sustainability

In 1983, the United Nations Commission on Environment and Development defined sustainable developments as those that "meet present needs without compromising the ability of future generations to meet their needs." As the idea has come into business terminology, sustainability has developed into the "triple bottom line," defining benefits beyond economic value to include positive social and environmental impacts too.

With nearly 400,000 manufacturing facilities in North America – most built decades ago – manufacturing companies are finding that a sustainable, green approach to buildings brings superior financial results while minimizing the impact on ecosystems and providing for the greater needs of society.

Here are the main points to consider:

- **A sustainable approach is good for business.** With record oil prices and high natural gas prices, companies are looking for ways to reduce energy costs and consumption, which in turn, reduces harmful emissions. Green buildings and plants employing sustainable practices are more profitable because they can reduce risk, make companies and organizations more efficient and productive and advance them technologically. They also help to ensure the reliability of equipment and manufacturing processes, which reduce equipment and process failures and production delays.
- **Sustainability is increasingly demanded**. Almost 50 state, city and county governments have adopted policies requiring or encouraging the use of green buildings. And while the U.S. did not endorse the 1997 Kyoto Protocol, which aims to reduce GHG emissions by 2012 by 5.2 percent compared with 1990 levels, 158 U.S. mayors have signed an agreement saying they will strive to meet or beat the Kyoto Protocol targets in their own communities. The protocol also affects American businesses that have manufacturing plants in the 126 countries that have signed it. U.S. manufacturers may lose their ability to operate factories or sell products in those countries that have ratified the treaty – or they'll be less competitive than their foreign counterparts because they won't have implemented efficient technologies and strategies.

For this paper, we are focusing discussion on sustainable manufacturing facilities themselves and not the manufacturing processes. The internal processes of industrial facilities differ tremendously because of the wide range of the products they produce. The machinery in a plant that makes computer chips is profoundly different from one that produces chocolate chips.

However manufacturing plants – from walls, windows and water use to compressed air and waste management – have many similarities. In the drive to improve profit margins, manufacturers sometimes ignore their physical plants, or worse, neglect them. As a general rule, old facilities use old heating and ventilating equipment, which consumes significantly more energy than new plants with new equipment.

By deferring systems upgrades, manufacturers literally watch profits seep out of joints, drip from pipes, and evaporate into thin air. The result: expensive maintenance budgets, high utility bills, people working in uncomfortable and unproductive spaces, and higher levels of harmful emissions in the communities where these facilities reside. A focus on energy management through sustainable green buildings can work to solve many of these problems while delivering multiple benefits, including a better bottom line.

Keeping Facilities Cost Competitive through Green Buildings

According to the United States Green Building Council (USGBC), a green building is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. The USGBC developed the Leadership in Energy and Environmental Design, or LEED™ rating in 1999. A LEED rating recognizes green buildings that meet certain objectives, such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment, often with reduced cost to the building owner.

In the six years since its inception, the number of LEED-certified buildings has dramatically increased, representing about five percent of the new construction market. Membership in the USGBC also has exploded, increasing five-fold to more than 5,200 members since 2001. As of April 2005, the USGBC had close to 200 certified projects and some 1,800 registered (waiting for review and certification). The USGBC certifies both new construction (LEED-NC) and existing buildings (LEED-EB).

"LEED for Existing Buildings provides an effective framework for increasing the sustainability of industrial facilities, and we expect a growing number of manufacturing companies to use LEED-EB as a tool to increase the sustainability of all the buildings in their portfolios," according to Michael Arny, president of the non-profit Leonardo Academy and chair of the LEED-EB Committee of the USGBC. "A number of existing industrial facilities have already paved the way for others by earning certification under the USGBC's LEED-EB program, including General Dynamics, Janssen Pharmaceutica and the Knoll Lubin Manufacturing Facility."

Manufacturers are looking at these sustainable green buildings to both reduce costs and meet growing social demands. Toyota Motor Corp. is planning an $800 million manufacturing plant in San Antonio that will be one of the most environmentally friendly automotive manufacturing plants in the world. Its North American manufacturing headquarters in Erlanger, Ky. won the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Award for excellence in energy management, and its south campus in Torrance, Calif. already has been awarded LEED certification.

Vastly improved technology is available to make facilities more sustainable. Lighting alone is helping companies save energy and provide a more productive workplace. For instance, Quad/Graphics is the largest privately held printer of magazines, catalogs, books and other commercial products in the western hemisphere. It expects to save more than $2 million per year and 3.5 MW of base load electrical capacity through lighting improvements in its nine U.S. locations.

Development of other new technologies – from highly efficient windows to computerized management systems that control buildings – provides even more ways to save energy and money.

Sustainable, Whole-Building Design Lowers Life-Cycle Costs

Whether developing a new facility or upgrading an existing one, the LEED focus on design is central to success. Construction costs on average represent only 11 percent of the total cost to build, operate, and maintain a facility over a typical 40-year lifecycle. Yet decisions made in the construction phase, often based simply on the lowest bid, can end up increasing operating costs over the life of the building, ultimately costing much more than was saved up front.

Minimal increases in upfront costs of about two percent to support green design would, on average, result in life cycle savings of 20 percent of total construction costs – more than 10 times the initial investment, according to an October 2003 report to California's Sustainable Building Task Force. The financial benefits of green design are between $50 and $70 per square foot in a LEED building, more than 10 times the additional cost associated with building green, according to the task force. Those benefits were found to be in lower energy, waste and water costs, lower environmental and emissions costs, and lower operational and maintenance costs and increased productivity and health.

One study of dozens of LEED-registered buildings indicates that many projects achieve sustainable design within their initial budget, or with very small supplemental funding. For instance,

A report from the American Council for an Energy Efficient Economy listed the many benefits of sustainable buildings:

- Reduce, reuse, recycle, resell waste
- Recover usable materials from wastes
- Reduce solvent evaporation
- Reduce emissions
- Eliminate solvents use
- Eliminate release of hazardous sludge
- Reduce energy use
- Produce a renewable source of energy
- Reduce transportation
- Increase production efficiency
- Reduce operations downtime
- Increase productivity
- Reduce failure rates
- Reduce operating expenses
- Reduce water usage
- Reduce disposal costs
- Reduce chemical treatment liability
- Reduce sewage expenses
- Increase sales
- Reduce capital costs
- Improve product quality
- Increase plant capacity
- Reduce space requirements
- Preserve and increase jobs
- Reduce noise level
- Re-use brownfield site
- Free up capacity at municipal treatment plants

Making Business Sense of Energy Efficiency and Pollution Prevention – http://aceee.org/p2/intro.htm

NRG Systems built a 46,000 square foot manufacturing facility and office building in Hinesburg, Vermont. The $8 million building is powered primarily by renewable energy and uses one-third as much energy as a conventional building. Water-saving devices, such as dual-flushing toilets and faucet aerators, save more than 100,000 gallons of water per year. The cost of building to green standards was $13.81 per square foot or 8.21 percent more. But NRG expects these additional costs to be paid for in five years.

According to the Rocky Mountain Institute (RMI), a sustainability think-tank, this type of whole-system design in new and existing buildings also may reveal opportunities for

downsizing, combining, or eliminating some building energy systems. Companies also may find major opportunities for capturing synergies between different kinds of savings, and obtaining multiple benefits from single expenditures, thus achieving cost savings that would not emerge from a measure-by-measure analysis. The resulting savings will be larger and cheaper than are normally expected or obtained.

Designers of a 70,000-sq. ft, two-story expansion to a Harley-Davidson manufacturing plant in Wauwatosa, WI, promised to get LEED certification at no extra cost by investing in design elements that more than offset any initial costs of sustainable construction.

"When we spent additional money in one area, we made sure we saved an equal amount of money somewhere else. For example, the structure's central light well admits daylight deep into the interior. We increased the quality of the building envelope enough to reduce the size of the heating and cooling system. This also reduces the operating cost for the client for heating and cooling the building. We gained LEED points in both areas, and benefited twice by the initial investment," says Tim Peckham, construction manager.

Measuring ROI

Another key element of LEED is benchmarking – measuring the initial status, marking progress towards goals, reporting on outcomes and adjusting strategies to meet goals. LEED requires benchmarking, through EPA's ENERGY STAR® program for LEED-EB where it applies and through ASHRAE/IESNA Standard 90.1 methodology for LEED-NC.

The measurement helps prove return on investment to management. "LEED-EB is based on the facility management mantra that you can't manage what you don't measure. It requires the measurement and management of energy use, water use and waste production. It also encourages increased levels of sub-metering to provide the information needed to guide ongoing operations," according to Arny.

According to energy innovator and author Amory Lovins in his book, Natural Capitalism, "A business that ignores measurement will inevitably fall behind in making useful and cost-saving discoveries – like the chemical company that for decades had been unwittingly running a forty-kilowatt electric heater under its parking lot year-round to melt snow. Nobody remembered or noticed the device until measurement found that the energy books didn't balance, and the wiring was traced to track down the discrepancy. Many manufacturing firms are unwittingly experiencing similar financial drains in their compressed-air systems: You can walk through their plants listening to the money hissing out of the compressed air systems. Improved air system maintenance and hardware typically yield savings approaching 50 percent with six-month paybacks. But if nobody pays attention, bad housekeeping persists. It typically gets fixed only when someone wanders in on a weekend, notices the compressor turning on to replenish pressure being lost through leaks, and happens to wonder why the compressor is working at all when nobody else is."

Pulling together facility data for all the plants in an owner's portfolio into a user-friendly format allows management to assess daily performance levels and look at which facilities have the most pressing need for improvements. Then the building owner can track whether the improvements instituted are helping, which helps prove ROI and determine future investments.

"The bottom line is that your buildings may be good looking and comfortable, but until you start measuring their actual performance, you do not really know how they are doing, and you can't start managing their performance. LEED-EB provides a structured way to measure and improve the performance of your buildings on an ongoing basis," Arny says.

LEED Certification Elements

Whether for a new or existing building, the LEED certification process was developed and tested over several years by a multifaceted group of building owners, facility managers, architects, engineers, builders, academicians and others. Its key elements include:

Site Selection – A facility's location can affect many sustainable elements such as transportation, storm water management, and even lighting requirements. In addition, a building's envelope – walls, foundation, roof and windows – can significantly determine how much energy will be needed to heat and cool it. Energy usage in medium-sized office buildings can vary 10 to 50 percent based on window configurations and solar orientation alone. Increasingly, businesses are also taking into account the transportation needs of employees and the distribution requirements for goods and services. As a result, siting a facility in or near population centers – rather than in outlying suburbs – is a growing trend, according to Business for Social Responsibility.

By integrating natural resources, human health, and community concerns into site selection, building design, materials and construction, manufacturers can have buildings that are cleaner and healthier for employees and better for the environment. For existing buildings, this can mean innovative ways to consider its site and applications of living roofs, changing out windows, providing transportation options for workers or planting more trees to provide shade.

Ford Motor Company's Rouge Center is home to assembly, stamping, tool and die, frame and engine plants for a variety of Ford vehicles. It's where the fabled Mustang has been produced since its introduction in 1964. A $2 billion revitalization of the Rouge Center has converted the historic production site into a lean, flexible manufacturing operation, capable of producing nine different Ford vehicle models.

In addition to incorporating just-in-time manufacturing principles and improved safety features, renovations to the Rouge Center are helping re-establish the connection between industry and nature. Among the improvements:

- Rooftop monitors and skylights bathe production floors with natural light, cutting the need for artificial illumination in half on sunny days
- A 10-acre living roof of Sedum plants over the assembly plant absorbs rainwater and CO_2, releases oxygen, and provides insulation that cuts heating and cooling costs by 5% while doubling the useful life of the roof
- A natural stream and wetland system cleanses an estimated 330 million gallons of storm water runoff annually before it's released into the nearby Rouge River
- 20 additional acres of green space have been created using natural vegetation and designs that are sensitive to wildlife
- As a result, the Rouge Center has been certified as a wildlife habitat by the Wildlife Habitat Council

These and other environmentally sustainable features were designed to be cost-effective. The financial payback will take years to measure, but Ford is already reaping intangible, indirect benefits such as increased employee satisfaction and stronger relationships between the company, workers and surrounding communities.

Energy Use – To address energy *supply* issues, NAM advocates enacting energy legislation to "increase the reliability and affordability of electricity, facilitate adequate and economical supplies of natural gas, and encourage further research and development in new energy technology." But as a bridge to new supplies of energy, manufacturers can reduce energy *demand* through energy efficiency retrofits and effective building and equipment maintenance. The rapidly increasing world demand for energy driven by economic growth in developing countries will continue to drive up the benefits of increased energy efficiency for manufacturers regardless of the expansion of the energy supply.

STERIS Corporation, of Mentor, Ohio, is a leading provider of infection and contamination prevention products and services for healthcare, pharmaceutical, scientific, government, research and industrial facilities. As the result of an intensive effort to improve energy efficiency at the company's nine North American facilities, STERIS now realizes significant savings in energy costs. Facility improvements have included:

- Additional insulation
- Upgrades or replacements of HVAC, steam or compressed air systems
- Lighting retrofits
- Installation or upgrades of building management systems

Costs savings from these and other improvements total nearly $1 million annually.

Materials and Resources – Manufacturing facilities generate waste in many forms — water, greenhouse gas emissions, heavy metals, chemicals and more. And though it varies by industry and location, they generally operate under a fairly heavy regulatory burden regarding waste recovery and remediation. This can hurt cost competitiveness in three ways:

- Handling large amounts of waste is costly
- Keeping people on staff with the expertise to ensure that waste is handled in accordance with regulations, and to process the paperwork, is also costly
- There can be significant liabilities associated with employees' handling this type of waste.

According to the U.S. EPA, industrial facilities in the U.S. generate and dispose of nearly 7.6 billion tons of industrial solid waste annually. Reusing, reducing, or source prevention of waste cuts down raw materials costs and reduces disposal costs. Every manufacturing process is different, but just considering the waste can provide both revenue and savings. Henry Ford demonstrated this in the 1920's when he developed a process for turning oak wood scraps from Model T frame, wheel and dashboard production into charcoal briquettes. Today, Toyota Motor Company says reducing landfill waste by 95 percent saves the company $1.2 million annually.

As a member of the Johnson & Johnson family of companies, Janssen Pharmaceutica manufactures and markets prescription drugs. The company's 475,000 square foot facility in Titusville, New Jersey became the first facility in the state to receive LEED-EB certification. In the process, Janssen adopted a number of sustainable waste management practices. Among them:

- Responsibly managing construction waste on the site during renovation and expansion of the facilities
- An aggressive recycling program that diverts 40% of waste generated on the site from landfills
- Elimination of disposable cafeteria items

Janssen incorporated additional sustainable features into the facility's design to maximize energy efficiency, reduce water usage, respect the natural environment and increase worker comfort. These and other sustainable initiatives generate significant ongoing costs savings, while demonstrating Janssen's commitment to protect and improve the environment in communities where employees live and work.

Indoor environmental quality – The manufacturing sector employs 14.3 million Americans, and health care coverage is provided to 85 percent of those workers, so employee health is important. Studies show improved indoor environments could produce annual productivity gains of as much as $168 billion in the U.S. It also can reduce the risk of claims for workers compensation or lawsuits for what has been called "sick building syndrome." A study by the Lawrence Berkeley National Laboratory indicates that buildings with good overall environmental quality can reduce the rate of respiratory disease, allergy, asthma, sick building symptoms, and enhance worker performance. The potential financial benefits of improving indoor environments are eight to 14 times the cost investment.

Another study from the Rocky Mountain Institute shows that productivity gains of 6 to 16 percent, including decreased absenteeism and improved quality of work, have been reported from energy-efficient design. Since companies spend an average of 70 times as much on employee salaries as on energy, an increase of just one percent in productivity can result in savings that exceed the company's entire energy bill.

Green building strategies include paying attention to indoor air quality, ventilating, lighting, thermal comfort and acoustics. In addition, companies can adopt "green cleaning" products and techniques to keep their facilities clean.

Furniture maker Herman Miller's manufacturing facility in Holland, Michigan is called "The Greenhouse." Indoor plants, extensive outdoor views to a prairie landscape, day-lighting throughout the facility and even wooden animals create inviting surroundings for employees and visitors. Operable windows let in an abundance of fresh air – up to five times as much as required by codes – to produce an indoor environment that is both comfortable and safe.

Other sustainable features of the building include:

- Lighting exceeds energy efficiency guidelines
- An average of only 16 pounds of landfill waste is produced each day – more than 97% of solid waste is recycled
- Storm water runoff irrigates landscaping that is made up of native plantings that eliminate the need for fertilizers, herbicides or even lawn-mowing

Herman Miller believes these features have contributed to increases in on-time delivery and product quality. The company expects productivity gains will more than offset the costs of incorporating sustainability into the facility design.

Water Efficiency – Even though industrial water use is falling, it is estimated to account for approximately nine percent of total water use. Water reuse and efficiency measures reduce water supply and disposal costs and decrease the energy needed to pump, heat or chill water. That's especially true for manufacturers in locations with high water demand and low supply. For instance, non-potable water can be used for landscape irrigation, toilet and urinal flushing, custodial purposes, and building systems. Utility savings, though dependent on local water costs, can save thousands of dollars per year, resulting in rapid payback on water conservation infrastructure.

Steelcase is the largest furniture manufacturer in the U.S. and a company that made protecting the environment a core consideration when it built a new manufacturing facility in Grand Rapids, Michigan. Among the water efficiency measures built into the facility's design:

- Low-flow faucets and fixtures use 34% less water
- A new cooling tower reduces wasteful drift and evaporation
- Roof and groundwater runoff is collected in holding ponds to irrigate landscaping

Other sustainable features include:

- Energy efficient lighting fixtures
- Bicycle lock-up areas, showers and electric refueling stations to encourage employees to use environmental transportation options
- An extensive recycling program that achieves a recycling rate of at least 75%

As a result of these and other measures, the Steelcase plant was the first manufacturing facility in the world to receive LEED certification.

Beyond Buildings: Cost-Effective Strategies

The whole-building LEED process allows company owners to take a long-term view of facility budgets and develop other innovative, cost-effective strategies thus overcoming the erroneous perception that sustainable buildings must cost more. These may include:

Performance Contracts – In conjunction with an energy service company or other service provider, owners can self-fund improvements through performance contracts. Under such contracts, the provider commits to delivering a certain

annual dollar amount of savings on energy and operations when it makes mechanical, electrical, lighting, and building improvements. Plant owners do not spend capital on the improvements. Rather, for the period of the contract to implement sustainable technologies — usually five to 10 years — the money saved on operations and energy is used to cover the capital costs.

Process Energy – While this paper has focused on industrial buildings, a growing number of companies are finding a huge return on investment by looking at process energy. In partnership with the U.S. Department of Energy's Industrial Technologies Program, Georgia Pacific completed a plant-wide assessment at its Crossett, Ark., facility in 2002 and identified $9.6 million in potential annual savings. With only 30% of the projects completed, Georgia Pacific has captured annual savings of $3.9 million related to energy reductions.

Six Sigma – Manufacturers such as 3M are using Six Sigma processes to address energy efficiency and assure return on investment. 3M's Brownwood, Texas facility recently completed a Six Sigma project that improved the operation of the thermal oxidizer, while minimizing the amount of natural gas the unit uses. The project saved $212,000 in the first year alone and also saved 6,808 million BTUs of energy. This project has become a model that other plants are using to optimize their operations. It also has improved lighting in more than 25 million square feet of office, lab, manufacturing and warehouse space for energy savings of $4.5 million. In 2004, 3M was named ENERGY STAR® Partner of the Year by the EPA and the U.S. Department of Energy.

Utility Bill Management – For the average industrial building owner, processing costs, late fees, and missed billings represent 1–2 percent of the total utility cost. A comprehensive approach to multiple facilities through LEED can include a utility bill payment service, which can cut the cost to process a utility bill from an industry average of $20–$50 per invoice to $6 per invoice.

Greenhouse Gas Emissions Trading – A good utility-bill pay package also can generate reports on GHG emissions, which may be mandated in some areas or provide revenue through future trades of emissions credits. Global trading of GHG emission credits may reach $10 billion by 2007, according to Point Carbon, an Oslo-based research company. Dupont began cutting CO_2 emissions at its plants in the early 1990s and over the past decade has cut GHG emissions by 50 percent and plans further reductions. More than 50 million dollars has been invested in the clean-up operation, but the company has already offset the cost of the CO_2 reduction by selling polluting competitors, especially in Great Britain, its rights of emissions as well as the technology they needed.

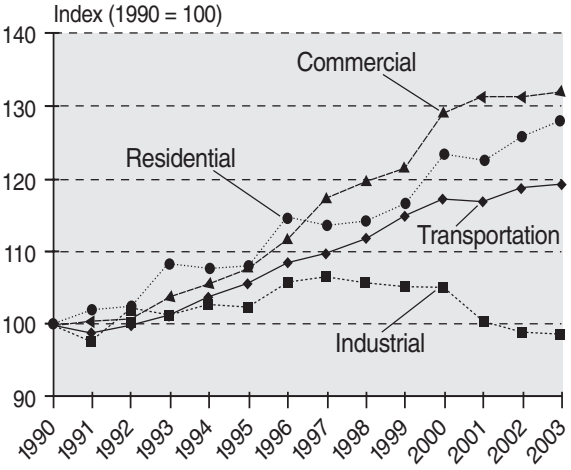
Employee Education – In addition to technological and operational solutions, some companies are finding that involving employees in the process helps increase sustainable savings. In 1998 Owens Corning instituted a worldwide internal campaign, "Mission: Possible." Through creative procurement, energy efficiency and employee engagement, the company reduced energy costs by 20 percent, increased productivity 18% and found other ways to provide $35 million in savings related to energy costs. Owens Corning's "Ideas of the Month" program alone recognized at least 36 separate energy saving ideas at 10 locations, with annual savings in excess of $2.5 million.

Sustaining the Future

Manufacturers are under increasing pressure to compete globally in a world that is increasingly concerned about climate change. General Electric, for example, is doubling its research funds for technologies that reduce energy use, pollution and emissions tied to global warming.

In addition, the growing presence of corporate responsibility in daily business operations is being driven by a variety of factors, such as the erosion of trust in large corporations, the globalization of business, the corporate governance movement, the rise in importance of socially responsible funds and sheer competitive pressures, according to a 2005 report from Oracle and *The Economist*.

U.S. Carbon Dioxide Emissions by Sector, 1990-2003



Note: Sectoral emissions include both direct emissions and emissions attributable to purchased electricity.

One-quarter of all global Fortune 500 companies now produce some type of sustainability report that charts their environmental and social efforts. And the *Eighth Annual PricewaterhouseCoopers Global CEO Survey* indicates that CEOs worldwide think it is well worth the effort. Of more than 1,300 CEOs who responded to the survey, 43 percent consider governance, risk management and compliance a value driver and source of competitive advantage, and 56 percent believe that it has a positive effect on reputation and brand.

With concern about energy costs and availability, pressure from shareholders to improve margins and external demands likely to increase in the future, there's a strong rationale for owners to look at their facilities for ways to improve cost competitiveness. Sustainable green buildings won't solve all problems, but they can help manufacturers address economic, technology and workforce issues in an effort to provide global competitiveness.

About the Authors

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As Director of Energy and Environmental Affairs for the Controls Group of Johnson Controls, vonPaumgartten is a member of the senior management team. He develops business opportunities while leveraging the energy efficiency and environmental record of Johnson Controls. vonPaumgartten manages Johnson Controls High Performance Green Buildings business, which includes structures that are designed, built, renovated, operated, or reused in an ecological and resource-efficient manner.

A former officer of the Board of Directors for the U.S. Green Building Council (USGBC) from 1998 thru 2004, vonPaumgartten also served as treasurer and on the executive committee from 2002-2004 of the USGBC. In addition, he currently serves on the Leadership in Energy and Environmental Design (LEED) Steering Committee and is chairman of the USGBC's marketing committee. vonPaumgartten also is active in the formation and activities of the Alliance for Sustainable Built Environments (ASBE), a coalition of suppliers of sustainable products and services. He is a member of the Executive Council of the Energy Efficiency Forum, co-sponsored by Johnson Controls and the U.S. Energy Association, and is on the board of the Energy Services Coalition. vonPaumgartten recently was named a juror for the 2005 World Environment Center Gold Medal for Achievement in Sustainable Development. Johnson Controls won the award in 2004, using its green building efforts as its Signature Contribution.

Dave Love

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Love graduated from Illinois State University in 1977 with a degree in business marketing. He joined Johnson Controls in 1986 after working at Barber Colman as a sales engineer. He has received Energy Awards from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) and was instrumental in helping Ameritech (now part of SBC) become an EPA Green Lights Partner in 1997. He has spoken and written about energy efficiency, environmental control systems, demand-side services and predictive maintenance for numerous audiences and publications.

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