

2010 IBM and the Environment Report

Committed to environmental
leadership across all of IBM's
business activities



IBM AND THE ENVIRONMENT

IBM has long maintained an unwavering commitment to environmental protection, which was formalized by a corporate environmental policy in 1971. The policy calls for IBM to be an environmental leader across all of our business activities, from our research, operations and products to the services and solutions we provide our clients to help them be more protective of the environment.

This section of IBM’s Corporate Responsibility Report describes IBM’s programs and performance in the following environmental areas:

A Commitment to Environmental Leadership	3	Energy and Climate Programs	36
		A Five-Part Strategy	36
		Conserving Energy	37
		CO ₂ Emissions Reduction	42
		PFC Emissions Reduction	43
		Renewable Energy	45
		Voluntary Climate Partnerships	46
		Transportation and Logistics	47
		Initiatives	
		Energy and Climate Protection in the Supply Chain	48
Global Governance and Management System	4	Remediation	52
Global Environmental Management System	4		
Stakeholder Engagement	7	Audits and Compliance	53
Voluntary Partnerships and Initiatives	8	Accidental Releases	53
Environmental Investment and Return	9	Fines and Penalties	54
Process Stewardship	12	Awards and Recognition	55
Environmentally Preferable Substances and Materials	12	Internal Recognition	55
Nanotechnology	15	External Recognition	56
Pollution Prevention	17	Summary of IBM’s Environmental Performance	59
Hazardous Waste	17		
Nonhazardous Waste	19	IBM Environmental Affairs Policy	62
Chemical Use and Management	20		
Water Conservation	23		
Product Stewardship	25		
Fundamentals	25		
Driving Product Design	25		
Managing Compliance Data	26		
Product Stewardship Goals and Performance	27		
Product Energy Efficiency	28		
Product Recycling and Reuse	32		
Product Packaging	33		
Product Safety	35		

A Commitment to Environmental Leadership

IBM's longstanding commitment to environmental leadership arises from two key aspects of its business:

- The intersection of the company's operations and products with the environment, and
- The enabling aspects of IBM's innovation, technology and expertise.

IBM's operations can affect the environment in a number of ways. For example, the chemicals needed for research, development and manufacturing must be properly managed from selection and purchase through storage, use and disposal. The company's data center operations are generally energy-intensive, and some of its manufacturing processes use a considerable amount of energy, water or both. IBM continually looks for ways to reduce consumption of these and other resources.

IBM designs its products to be energy-efficient, utilize environmentally preferable materials, and be capable of being reused, recycled or disposed of safely at the end of their useful lives. And as IBM incorporates more purchased parts and components into its products, the company's requirements for its suppliers' overall environmental responsibility and the environmental attributes of the goods those suppliers provide to IBM are important as well.

IBM applies its own innovative technology to develop solutions that can help our company and our clients be more efficient and protective of the environment. We also bring that technology to help the world discover leading edge solutions to some of the world's most demanding scientific and environmental problems.



Icon of Progress:
Corporate Leadership
in Environmental
Responsibility

Explore IBM's continued Leadership in protecting the environment.

Global Governance and Management System

Global Environmental Management System

IBM's corporate environmental affairs policy calls for environmental affairs leadership in all of the company's business activities.

The policy objectives range from workplace safety, pollution prevention and energy conservation to product design for the environment, continual improvement and the application of IBM's expertise to help address some of the world's most pressing environmental problems. The policy can be found at www.ibm.com/environment/policy.

The policy is supported by corporate directives that govern IBM's conduct and operations worldwide. These directives cover areas such as pollution prevention, chemical and waste management, energy conservation and climate protection, environmental evaluation of suppliers, product stewardship, and incident prevention and reporting.

IBM's commitment to environmental protection is implemented through its global environmental management system (EMS).

Employee and Management Responsibility

Every employee is expected to follow the corporate environmental affairs policy and its directives and report any environmental, health or safety concern to IBM management. Managers are expected to take prompt action when faced with a potential violation of the policy or directives.

In addition, all employees are required by the company's [Business Conduct Guidelines](#) to comply with environmental laws and with IBM's own environmental programs.

IBM executives are responsible for the environmental performance of their organizations. Site location executives are responsible for the environmental performance of their sites.

IBM's environmental programs and performance are reviewed annually by the Directors and Corporate Governance Committee of IBM's Board. Formed in 1993, the Charter for this committee established its responsibility for reviewing IBM's position and practices on significant issues of corporate public responsibility, including protection of the environment.

Environmental Goals

Environmental goals are an important part of IBM's EMS. The company maintains environmental goals covering the range of its environmental programs, including climate protection, energy and water conservation, pollution prevention, waste management and product stewardship. These goals and IBM's performance against them are discussed in their respective sections of this report, and are provided in the listing of IBM's environmental [Key Performance Indicators](#).

ISO 14001 Environmental Management System Standard

Over a decade ago, IBM became the first major company in the world to earn a single global registration to ISO 14001. The company achieved this credential within just one year of the finalization of the standard.

The initial registration covered IBM's manufacturing, product design and hardware development operations across its business units worldwide. IBM has since expanded its global [ISO 14001](#) registration to include its research locations that use chemicals, several country organizations with their non-manufacturing locations, its product development function, and its Global Asset Recovery Services.

As its business model evolves to include more services offerings, IBM updates its EMS to appropriately address environmental opportunities and challenges in the services area.

More information about IBM's EMS and programs supporting its environmental objectives may be found at www.ibm.com/ibm/environment/.

Public Disclosure

IBM's Corporate Policy on Environmental Affairs also calls for the company to publicly disclose information on its environmental programs and performance. This report marks IBM's 21st consecutive year of annual corporate environmental reporting. IBM also participates in a number of other voluntary reporting programs, such as the Carbon Disclosure Project. More about IBM's environmental reporting may be found at www.ibm.com/ibm/environment/annual.

Environmental Evaluations of Suppliers

IBM has long been committed to doing business with environmentally responsible suppliers and was an early leader in providing requirements addressing this topic in its global EMS.

- **1972**

IBM established a corporate directive requiring the environmental evaluation of suppliers of hazardous waste services.

- **1980**

IBM expanded its environmental evaluations of suppliers by establishing a second corporate directive which required the environmental evaluation of certain production-related suppliers.

- **1991**

IBM further expanded its environmental evaluations of suppliers, adding a requirement that its product recycling and product disposal suppliers be evaluated.

- **2002**

Nongovernmental organizations raised a concern about electronic waste being exported to some non-OECD countries. Though IBM confirmed that it was not shipping electronic waste products to non-OECD countries, IBM added a requirement to assess its suppliers and certain subcontractors they may use to handle recycling and/or disposal operations in non-OECD countries.

In 2010, IBM again expanded its supplier requirements. To help its suppliers build their own capability to succeed in this area, IBM established a requirement that all its first-tier suppliers establish a management system to address their social and environmental responsibilities. These suppliers are required to:

- Define, deploy and sustain a management system that addresses their intersections with their employees, society and the environment;
- Measure performance and establish voluntary, quantifiable environmental goals;
- Publicly disclose results associated with these voluntary environmental goals and other environmental aspects of their management systems; and
- Cascade these requirements to their suppliers who perform work that is material to the products, parts and/or services being supplied to IBM.

More information on these new supplier requirements may be found in the [Supply Chain section](#) of this report and on IBM's [Supply chain environmental responsibility](#) website.

Stakeholder Engagement

IBM has a variety of outreach programs through which it engages with various groups and individuals on the subject of the environment. The company's community environmental outreach programs range from open houses and emergency preparedness drills with local organizations to the support of and participation in local environmental projects and environmental education efforts.

IBM also has ongoing dialogues with many stakeholders, including socially responsible investors and other shareholders, environmental nongovernmental organizations (eNGOs), governments, employees and others on a range of environmental issues. These dialogues are valuable, as they allow the company to share ideas and obtain feedback about its programs, activities and performance.

Another example of engagement is collaborative innovation. IBM believes integrating different minds and different perspectives can accelerate new solutions to longstanding problems. Since 2001, one way the company has embraced this ideal is through IBM's Jams, an online technology that enables global conversations on strategic business and societal issues across industries, disciplines, stakeholders and national borders. For example, in 2010, IBM brought together 1,600 business executives, government officials, nongovernmental organization (NGO) leaders, journalists, analysts and environmental experts from more than 60 countries for the company's Eco-Efficiency Jam—a two-day online, interactive discussion of the opportunities for continued advancement of eco-efficiency. The IBM Institute for Business Value wrote a report from the Jam—"The emergence of the eco-efficient economy"—and it can be found [here](#).

1,600
*business executives,
government
officials,
nongovernmental
organization (NGO)
leaders, journalists,
analysts and
environmental
experts from more
than 60 countries
took part in IBM's
Eco-Efficiency Jam.*

In April 2011, IBM held the "Start Jam", which brought together hundreds of leaders from the U.K. and Ireland to explore how businesses can put sustainability at the heart of their strategies. Start Jam builds on the success of the IBM Summit at Start, a nine-day business summit held in September 2010 in association with Start—a national initiative inspired by HRH The Prince of Wales to promote and celebrate sustainable living. The objective was to move forward from the examination of the value and importance of sustainability in business to the questions around how to affect the strategic and cultural changes required to drive a genuine transformation in sustainability.

The Jam thus focused on the "How!"—How to influence consumer behaviors; how to build the right skills; how to optimize resources; and so on. Discussion threads were driven to focus on actions, collaborations, projects and commitments.

As part of its ongoing commitment to the social exchange of best practice ideas, IBM will summarize the key findings and highlight the creative ideas generated by Start Jam to share with participants.

The Eco-Patent Commons

The Eco-Patent Commons is a unique opportunity for global business to make a difference—sharing innovation to foster sustainable development. The Commons is an online collection of environmentally beneficial patents pledged by companies for free use by anyone. It was designed to facilitate the use of existing innovation that is protective of the environment and encourage collaboration for new innovation.

The Eco-Patent Commons was initiated by IBM and the World Business Council for Sustainable Development and launched in January 2008 with Nokia, Pitney Bowes and Sony. Since then, eight additional companies have joined the Commons including Bosch, Dow, DuPont, Fuji Xerox, Hewlett-Packard, Ricoh, Tasei and Xerox.

Examples of the environmental benefits of patents that may be pledged to the Eco-Patent Commons include:

- Energy conservation or improved energy or fuel efficiency
- Pollution prevention (source reduction, waste reduction)
- Use of environmentally preferable materials or substances
- Water or materials use reduction
- Increased recycling opportunity

To date, the 12 member companies have pledged more than 100 patents to the Eco-Patent Commons, 28 of which were pledged by IBM.

For more information, to join the Commons or to view pledged patents, visit the [Eco-Patent Commons](#) website.

Voluntary Partnerships and Initiatives

IBM is strongly committed to participation in voluntary programs and has joined a number of voluntary initiatives and partnerships with governmental and nongovernmental organizations.

Some governmental examples include the U.S. Environmental Protection Agency's (EPA) ENERGY STAR[®], SmartWaySM and WasteWise programs, and the OECD Committee on Industry, Innovation and Entrepreneurship.

Partnerships with eNGOs include, among others: charter membership in the World Wildlife Fund's Climate Savers program; charter membership in the Chicago Climate Exchange[®]; and membership in the Pew Center on Global Climate Change. IBM also works with and supports organizations such as The Conservation Fund, the Environmental Law Institute, the World Environment Center and the World Resources Institute. In addition, IBM is a founding

member of The Green GridSM and a member of the World Business Council for Sustainable Development (WBCSD). In 2010, IBM became a founding member of the WBCSD Water Leadership Group. The WBCSD Water Leadership Group is focused on the development of new approaches to sustainable water management to achieve cost-effective, credible and operational outcomes around company water use, impacts assessment, measurement and reporting.

A more complete listing of IBM's voluntary partnerships and initiatives can be found on IBM's [Voluntary initiatives](#) page.

IBM has partnered with the Wildlife Habitat Council (WHC) to manage many of its properties in ways that enhance habitats. Seven IBM sites (Armonk, New York; Boulder, Colorado; Research Triangle Park, North Carolina; Rochester, Minnesota; two locations in San Jose, California; and Toronto, Canada) have had their land management and wildlife habitat programs certified by the WHC.

IBM also encourages its employees to support environmental efforts. For example, through its Matching Grants program, the company matches contributions made by U.S. employees to a wide variety of environmental organizations ranging from international organizations such as The Nature Conservancy and the World Wildlife Fund to smaller groups dedicated to preserving lands and habitats in local communities.

In addition, IBM employees can support environmental organizations in their local communities through IBM's On Demand Community (ODC) program. ODC is a first-of-its-kind global initiative to encourage and sustain corporate philanthropy through volunteerism. It provides IBM employees and retirees with a rich set of IBM technology tools they can use to help schools and the nonprofit community organizations in which they volunteer, including environmental organizations. The program combines the expertise, interests and skills of IBMers with the power of the company's innovative technologies and solutions to help nonprofit organizations more effectively address community needs.

Environmental Investment and Return

IBM tracks its environmental spending (capital and expense) related to the operation of its facilities worldwide, as well as environmental spending associated with its corporate operations and site remediation efforts. In 2010, the total costs associated with these operations were \$103.1 million.

Over the past five years, IBM has spent \$108 million in capital and \$517.6 million in operating expense to build, maintain and upgrade the infrastructure for environmental protection at its plants and labs, and to manage its worldwide environmental programs.

\$138 million

estimated
environmental
savings and cost
avoidance
worldwide in 2010.

Environmental Capital and Expenses Worldwide

(\$ in millions)

	2006	2007	2008	2009	2010
Capital	\$19.5	\$30.0	\$31.7	\$14.3	\$12.5
Expense*	\$105.2	\$108.2	\$111.3	\$102.3	\$90.6
Total	\$124.7	\$138.2	\$143.0	\$116.6	\$103.1

*IBM has restated its worldwide environmental expenses for the period 2006–2009 due to a discovery that some environmental expenses were inadvertently omitted from 2006–2009 environmental reports.

IBM also estimates the savings which have resulted from its commitment to environmental leadership. These include savings from energy, material and water conservation; recycling; packaging improvement initiatives; reductions in chemical use and waste; and process improvements from pollution prevention. Ongoing savings from the previous years' initiatives are not carried over in this comparison, yielding very conservative estimates.

IBM also realizes savings through the avoidance of costs that likely would occur in the absence of its environmental management system. These savings are not measurable in the same way that expenses are, but avoiding these environmental costs does result in savings for IBM, and a reasonable attempt has been made to estimate them. In 2010, IBM's estimated environmental savings and cost avoidance worldwide totaled \$138 million.

IBM's experience has shown that annual savings from its focus on pollution prevention and design for the environment consistently exceed environmental expenses, thus demonstrating the value of proactive environmental programs and performance.

2010 Environmental Expenses Worldwide*

(\$ in millions)

Personnel	\$29.8
Consultant fees	3.4
Laboratory fees	1.8
Permit fees	0.7
Waste treatment and disposal	8.8
Water and wastewater management operations	10.2
Air emission control operations	1.2
Groundwater protection operations	1.1
Other environmental systems operations	3.0
Waste and materials recycling	2.5
Superfund and former IBM site remediation	21.0
Miscellaneous/other	7.1
Total	\$90.6

* Does not include the environmental expenses attributed to product development, procurement and customer fulfillment for complying with product environmental laws and regulations. Also does not include costs attributed to take back and recycling of used electronic products to comply with electronic product recycling legislation.

2010 Estimated Environmental Savings and Cost Avoidance Worldwide

(\$ in millions)

Location pollution prevention operations*	\$39.0
Corporate operations*	5.6
Packaging improvements	8.8
Environmentally preferable materials usage	0.2
Energy conservation and cost avoidance	47.5
Superfund and site remediation efficiencies	9.5
Spill remediation cost avoidance**	5.6
Compliance cost efficiency***	18.1
Potential fines, penalty and litigation avoidance****	3.7
Total	\$138.0

* Savings or costs avoided by having internal professional staff and tools versus using external consultants and tools.

** These savings are estimates based upon certain assumptions. The figure for spill remediation cost avoidance is estimated considering IBM's actual experience with remediation costs.

*** Compliance cost efficiency considers costs avoided through proactive efforts to stay ahead of environmental regulations and requirements.

**** The estimation for the avoidance of potential fines, penalties and litigation does not include cost avoidance of potential business interruption or fines related to noncompliance with product environmental laws and regulations (e.g., E.U. REACH or RoHS requirements).

Process Stewardship

Environmentally Preferable Substances and Materials

Among its objectives, IBM's environmental policy calls for the company to use development and manufacturing processes and provide products that are protective of the environment. As an integral part of its EMS supporting this objective, IBM routinely and consistently monitors and manages the substances it uses in its manufacturing and development processes and in its products.

The company's precautionary approach includes the careful scientific review and assessment of certain substances prior to their use in IBM processes and products. In specific instances, IBM has chosen to proactively prohibit, restrict or substitute substances used in IBM processes and products when the weight of scientific evidence determines a potential adverse effect upon human health or the environment, even when law permits the use of the substance.

In addition, IBM conducts scientific assessments of existing approved substances when new processes or major modifications to existing processes are being developed. The objective of these scientific assessments is to identify potential substitutes that may be environmentally preferable. IBM believes that the same scientific rigor is required when investigating the human health and environmental effects of potential substitutes as was given to the investigation of the substance in use.

The following provides a sampling of IBM's early leadership in prohibiting or restricting many substances of concern from its processes and products before regulatory requirements were imposed:

- **Chlorofluorocarbons (CFCs)**

In 1989, IBM became the first major information technology (IT) manufacturer to announce a phase-out of CFCs, a Class I ozone-depleting substance, from its products and manufacturing and development processes.

- **Class I and II ozone-depleting substances**

IBM completed the phase-out of Class I ozone-depleting substances in 1993. Subsequently, IBM eliminated Class II ozone-depleting substances from its products and processes in 1995.

- **Trichloroethene (TCE), ethylene-based glycol ethers and dichloromethane**
Examples of other chemicals that IBM voluntarily prohibited from its manufacturing processes include TCE in the late 1980s, ethylene-based glycol ethers in the mid-1990s and dichloromethane in 2003.
- **Polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs)**
IBM prohibited PBBs and PBDEs from its product designs in the early 1990s and then extended the prohibition to purchased commodities through its procurement specifications in 1993.
- **Cadmium**
IBM prohibited the use of cadmium in inks, dyes, pigments and paints in 1993; in plastics and plating in 1994; and in CRT monitors along with nickel cadmium batteries in the mid-1990s.
- **Polyvinyl chloride (PVC) and tetrabromobisphenol A (TBBPA)**
IBM ceased the specification of PVC in its IT system enclosures in 2000 and prohibited the use of TBBPA as an additive flame retardant in IT system enclosures for newly released products in 2007.
- **Specific perfluorinated compounds (perfluorooctane sulfonate [PFOS] and perfluorooctanoic acid [PFOA])**
IBM prohibited the compounds' use in the development of new materials in 2005, in new manufacturing applications in 2007, and eliminated the use of PFOS and PFOA in manufacturing, development and research processes as of January 31, 2010.

A table summarizing IBM's voluntary material prohibitions and restrictions from 1978 through 2010 may be found on our [Materials use](#) page.

IBM's restrictions on specific substances and other environmental requirements for its products are identified in the company's [Engineering Specification: Baseline Environmental Requirements for Supplier Deliverables to IBM](#).

IBM Innovation and Leadership in "Green" Chemicals

In early 2010, IBM became the first in its industry to eliminate all known uses of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) from its semiconductor manufacturing processes. IBM scientists also developed and patented several alternative PFAS-free (fluorine-free) photo acid generators in 2010.

In 2002, the U.S. Environmental Protection Agency placed restrictions on new applications for PFOS compounds due to scientific evidence showing that PFOS was persistent and bioaccumulative in the environment. However, PFOS compounds continued to be permitted by the EPA “as a component of a photoresist substance, including a photo acid generator or surfactant, or as a component of antireflective coating, used in a photolithography process to produce semiconductors or similar components of electronic or other miniaturized devices” since the semiconductor manufacturing industry demonstrated limited release and exposure.

Nevertheless, due to increasing concerns around the environmental impact of these compounds, IBM began a staged phase-out of PFOS and PFOA in 2003, a plan that required the work of dozens of IBM scientists and engineers, IBM partners and suppliers.

Developing alternatives for these chemicals was an ambitious technological challenge. The transition to the new formulations had to be implemented and qualified across a large array of processes without impacting customer product delivery commitments. IBM’s semiconductor fabricators located in Essex Junction, Vermont, and Hopewell Junction, New York, conducted multi-year qualifications of substitute manufacturing process chemicals to eliminate the use of both PFOS and PFOA compounds.

IBM prohibited the compounds’ use in the development of new materials in 2005 and in new manufacturing applications in 2007. IBM successfully eliminated PFOS and PFOA compounds in its wet etch processes at the end of 2008 and eliminated them from its photolithography processes as of January 31, 2010.

Although other semiconductor companies are working to this goal, to our knowledge, IBM is the only company in the world to have completely eliminated PFOS and PFOA compounds from semiconductor manufacturing.

As a continuation of this effort, IBM researchers announced another industry first in February 2010: development of new PFAS-free (fluorine-free) compounds for use as photo acid generators (PAGs) in 193-nm photoresists. The PAG is one of several components of a system of chemicals used in the photolithography process to transfer circuit patterns onto semiconductor wafers. This materials innovation is an example of “green chemistry” in action: applying molecular design to invent new, more environmentally benign compounds.

With two patent applications and one issued patent, IBM is currently in the process of engaging with photoresist supplier companies to commercialize its new materials innovation.

Nanotechnology

Nanotechnology is the application of scientific and engineering principles to make and utilize very small things (dimensions of roughly 1 to 100 nanometers). An important aspect of nanotechnology is creating materials where their unique properties enable novel and useful application.

Nanotechnology is already part of a wide variety of products—from cosmetics and sunscreens to paints, clothing and golf equipment. It can make products lighter, stronger, cleaner, less expensive and more precise, and has been critical to advancements in the IT industry.

IBM has been a pioneer in nanotechnology. Its scientists won a Nobel Prize for inventing the scanning tunneling microscope (STM), devised methods to manipulate individual atoms for the first time, developed logic circuits using carbon nanotubes and incorporated subnanometer material layers into commercially mass-produced hard disk drive recording heads and magnetic disk coatings.

The company was one of the first to create safe work practices, and health and safety training for its employees working with nanoparticles. In addition, IBM, along with ISMI (International SEMATECH Manufacturing Initiative) and other semiconductor companies, will be participating in a collaborative study with NIOSH (National Institute for Occupational Safety and Health) and the College of Nanoscale Science and Engineering (CNSE) of the University at Albany-SUNY to monitor potential workplace exposure to nanoparticles during chemical mechanical planarization (CMP) operation and maintenance.

IBM's current nanotechnology research aims to devise new atom- and molecular-scale structures and methods for enhancing information technologies, as well as discovering and understanding their scientific foundations.

During 2010, IBM researchers developed a breakthrough technique that for the first time gives scientists the ability to record, study and “visualize” the extremely fast spin of electrons inside individual atoms. Similar to how a high-speed video camera captures each flap of a hummingbird's wing, scientists at IBM's Almaden Research Center are using the Scanning Tunneling Microscope like a high-speed camera to record the behavior of individual atoms at a speed about 100,000 times faster than previously possible. This new technique could be a valuable tool to study solar cells, quantum computing and storage-class memory at the nanoscale.

IBM's nanotechnology and nanoscience research and development involve interactions and collaborations with partners around the world.



Icon of Progress: Scanning Tunneling Microscope

Discover how IBM researchers Gerd Binnig and Heinrich Rohrer broke new ground with their invention of the scanning tunneling microscope.

Two environment-related examples:

- The Saudi Arabian national research and development organization, King Abdulaziz City for Science and Technology (KACST), has established a Nanotechnology Center of Excellence in association with IBM Research that will explore and develop breakthroughs in applying molecular-scale engineering to critical energy and sustainable resource issues. Under this multi-year agreement, Saudi scientists and engineers are working side by side with IBM scientists and engineers on advanced nanoscience and nanotechnology programs in the fields of solar energy, water desalination and petrochemical applications such as recyclable materials.
- IBM and the government of Egypt signed an agreement to establish the Egypt-IBM Nanotechnology Research Center as a sustainable world-class center in Egypt. Egypt is working with IBM on several initial projects in the following nanotechnology focus areas: Thin Film Silicon Photovoltaics; Spin-On Carbon-Based Electrodes for Thin Film Photovoltaics; Energy Recovery from Concentrated Photovoltaic for Desalination; and Computational Modeling and Simulation.

Pollution Prevention

Hazardous Waste

The best way to prevent pollution is to reduce the generation of waste at its source. This has been a basic philosophy behind IBM's pollution prevention program since 1971. Where possible, IBM redesigns processes to eliminate or reduce chemical use and substitutes more environmentally preferable chemicals. Chemicals needed for research, development and manufacturing must be properly managed, from selection and purchase through storage, use and disposal.

IBM developed a methodology to correlate the hazardous waste generated from its manufacturing operations to its production in 1992 and expanded its use to IBM sites worldwide in 1993. The company established a goal based on this methodology in 1995. That goal: to continually reduce the waste generated from IBM's manufacturing operations relative to production.

This goal covers approximately 90 percent of the hazardous waste generated by IBM, which currently comes from three manufacturing sites.

In 2010, IBM's hazardous waste generation indexed to output decreased 21.6 percent. This significant year-over-year decrease was largely attributable to process changes during the transition to lower line width microprocessor technologies that drove an increase in hazardous waste indexed to output in 2009 and source reduction projects in our manufacturing lines in 2010.

For waste that is generated, IBM focuses on preventing pollution through a comprehensive, proactive waste management program. Of the total amount of hazardous waste IBM generated worldwide in 2010, 49 percent was recycled and 29.7 percent was sent to landfills. Of the total amount sent to landfills, 97 percent was sludge from industrial wastewater treatment plants. Local government regulations required disposition of this sludge in secure hazardous waste landfills.

Hazardous Waste Generation

21.6% Decrease

Goal

Achieve year-to-year reduction in hazardous waste generation from IBM's manufacturing processes indexed to output.

Result

In 2010, IBM's hazardous waste generation indexed to output decreased by 21.6% (714 metric tons).

Hazardous Waste Management Worldwide

2010 Quantities: 8,400 Metric Tons

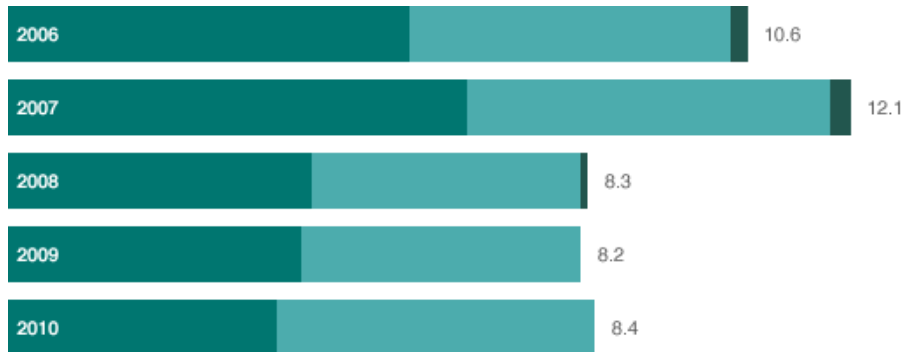
- 49.3% Recycled
- 29.7% Landfill
- 18.6% Aqueous and Other Treatment
- 2.4% Incineration



IBM’s total hazardous waste generation has decreased by 21 percent over the past five years, and has decreased by 96.3 percent since the 1987 base year of this metric.

Hazardous Waste Quantities Worldwide

Metric Tons x 1,000



- Closed Loop + On-site Recycling (annual throughput)
- Off-site Recycling
- Treatment, Incineration, Landfill

Nonhazardous Waste

IBM also has focused for decades on preventing the generation of nonhazardous waste and recycling that which is generated. Nonhazardous waste includes waste such as paper, metals, plastics, deionized resins and nonhazardous chemicals.

IBM established its first goal to recycle nonhazardous waste streams in 1988. The goal has since developed on two fronts. The first included not only traditional dry waste streams, but also nonhazardous chemical wastes and end-of-life IT product waste from IBM’s own operations as well as IBM-owned equipment that is returned by external customers at the end of a lease. The second was to include nonhazardous wastes generated by IBM administrative, manufacturing and research operations in IBM owned, managed and leased locations meeting certain criteria.

In 2010, IBM generated 71,100 metric tons of nonhazardous waste. This represents a decrease of 10.2 percent when compared to 2009 volumes. The reduction was primarily due to a decrease in construction activities/projects, which is reflected directly in the amounts of nonhazardous construction debris and soil generated by IBM.

Nonhazardous Waste Recycling

75% Goal

79% Result

Goal

Send an average of 75% of the nonhazardous waste generated at locations managed by IBM to be recycled.

Result

In 2010, IBM sent 79% of its nonhazardous waste to be recycled.

Nonhazardous Waste Generated and Recycled Worldwide

Metric Tons x 1,000

Year	2006	2007	2008	2009	2010
Total recycled	102	84	62	60	56
Total generated	134	107	82	79	71
Percent recycled*	76%	78%	76%	76%	79%

* Percent recycled versus goal of 67% (2006) and 75% (2007–2010)

IBM’s source reduction and waste prevention projects not only help protect the environment, they also provide a financial benefit. In 2010, these programs prevented the generation of over 4,300 metric tons of nonhazardous waste, generated \$6.3 million in revenues from the sale of recyclable materials and accounted for \$7.0 million in cost savings and cost avoidance.

Chemical Use and Management

Under the U.S. Superfund Amendments and Reauthorization Act (SARA) of 1986 and the U.S. Pollution Prevention Act (PPA) of 1990, companies are required to file an annual inventory of routine releases to the environment and off-site transfers of waste for treatment and disposal in addition to recycling, treatment and energy recovery activities (collectively known as “reportable quantities”) for more than 600 chemicals listed on the U.S. Toxics Release Inventory (TRI) list.

IBM’s operations rely on the use of some chemicals on the TRI list.

International Performance Measure

IBM has used TRI reportable quantities as a metric to track the environmental performance of its operations globally since 1993. One of IBM’s objectives continues to be identifying opportunities to minimize its TRI releases to the environment. In 2010, IBM sites worldwide used 18 of the TRI-listed chemicals in amounts greater than the reporting threshold of 10,000 pounds (4.54 metric tons) of use per year.

The company’s total reportable quantities associated with chemicals on the U.S. TRI list decreased by 1.8 percent (63 metric tons) in 2010, compared to 2009.

IBM’s 2010 total reportable releases to the environment and waste transferred off-site for treatment and disposal from its worldwide operations amounted to 514 metric tons, an increase of 29 metric tons from 2009.

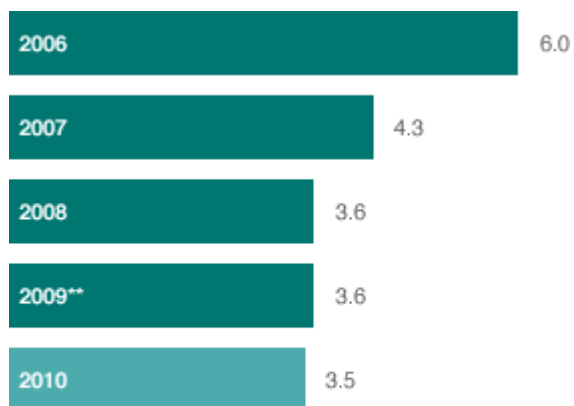
This small increase was primarily due to nitrate compounds discharged to one of our manufacturing site’s wastewater treatment plant. It was triggered by a ramp up of production and is expected to drop in early 2011. The increase in nitrate compounds represented 62 percent of the total releases to environment and waste transferred off-site for treatment and disposal in 2010.

63 metric tons

less TRI-listed chemicals were used by IBM in 2010 as compared to 2009.

Worldwide Reportable Quantities* Associated with Chemicals on the U.S. Toxic Release Inventory List

Reportable Quantities in Metric Tons x 1,000



* As defined by U.S. SARA Section 313 and PPA.

** Data for 2009 has been revised.

2010 Worldwide Reportable Quantities* Associated with Chemicals on the U.S. Toxic Release Inventory List

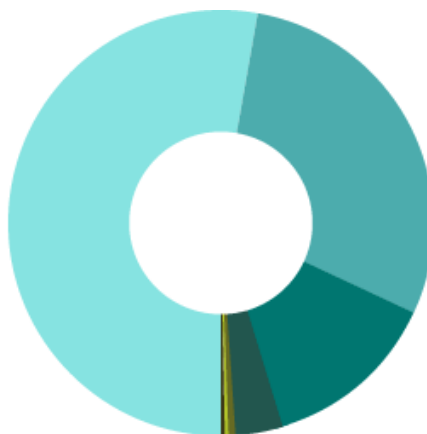
Chemical	Metric Tons
Sulfuric acid (aerosol only)	1,227
Xylene	832
Nitrate compound	495
Ethylbenzene	179
Nitric acid	154
Hydrogen flouride	153
n-methyl-2-pyrrolidone	122
All others	339
Total	3,501

* As defined by U.S. SARA Section 313 and PPA.

Total Releases, Treatment and Off-Site Transfers of Chemicals on the U.S. Toxic Release Inventory List* 2010

3,655 Metric Tons

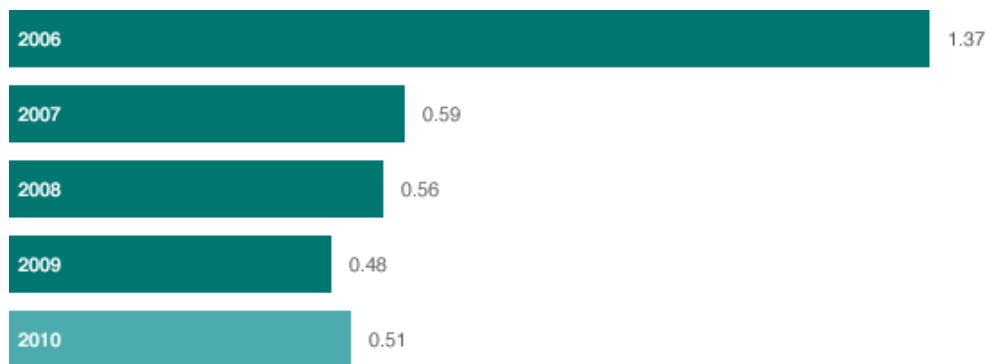
- 52.8% On-site Treatment
- 29.3% Off-site Recycling
- 13.2% Release to Water
- 3.8% Off-site Energy Recovery
- 0.4% Release to Air
- 0.4% Off-site Disposal
- 0.1% Off-site Treatment
- 0.0% On-site Recycling
- 0.0% Discharge to Public Treatment Works
- 0.0% Released to Land



*As defined by U.S. SARA Section 313 and PPA. Includes recycling, treatment, energy recovery, releases and off-site transfers for treatment and disposal.

Total Releases to Environment & Wastes Transferred Off-Site for Treatment and Disposal Worldwide*

Metric Tons x 1,000



*Includes releases and off-site transfers for treatment and disposal, as defined by U.S. SARA Section 313 and PPA.

Water Conservation

IBM's evaluation of water use at its worldwide facilities shows that microelectronics operations are the company's most water-intensive ones. For example, in 2010, IBM's microelectronics manufacturing operations represented 82 percent (nearly 9,800 thousand cubic meters [TCMs]) of the total water used (approximately 11,900 TCMs) at IBM's manufacturing operations and laboratories worldwide.

Though IBM's microelectronics operations are not located in areas of water scarcity, in 2000, IBM established an annual water savings goal of 2 percent of total annual water usage in its microelectronics manufacturing operations, based on the water usage of the previous year and measured as an average over a rolling five-year period. The goal measures annual water conservation activities from actual year-over-year reductions from conservation savings projects, reuse (e.g., from the ultra-pure water process for semiconductor manufacturing) and recycling (e.g., from treated wastewater).

In 2010, annual water conservation for the microelectronics manufacturing operations from reduction, reuse and recycling activities was 710 TCMs of water. Of the 710 TCMs of water, 590 TCMs (6 percent of the total water used at IBM's microelectronics manufacturing operations) was provided through on-site water reuse, and wastewater and groundwater recycling projects. Conservation savings projects avoided the use of another 120 TCMs.



Video: Smarter Water Management

Meeting the challenges of a global water crisis means changing the way our water management systems work.

Water Conservation in Microelectronics Manufacturing Operations

2% Goal

2.8% Result

Goal

To achieve an annual water savings equal to 2 percent of total annual water usage in its microelectronics manufacturing operations, based on the water usage of the previous year and measured as an average over a rolling five-year period.

Result

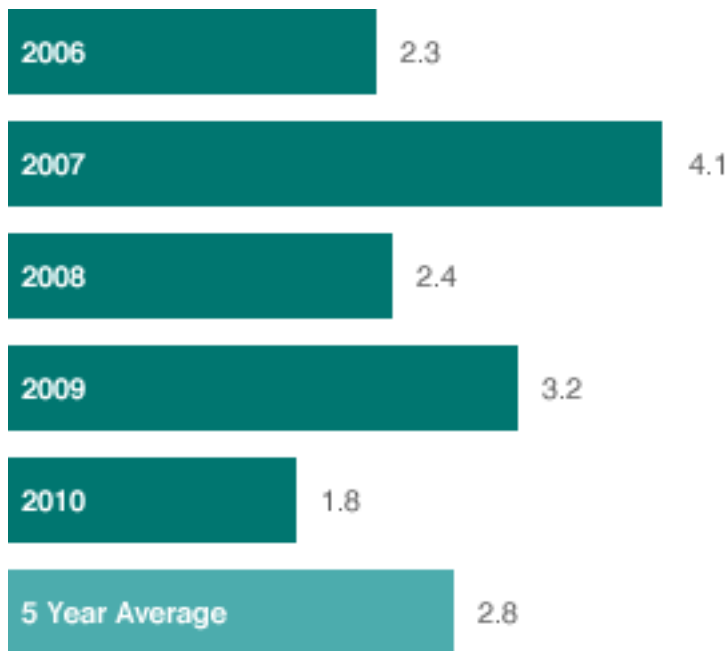
As of year-end 2010, IBM's microelectronics manufacturing operations had achieved an average annual water savings of 2.8 percent over the past five years versus the 2 percent goal.

These new water conservation and ongoing reuse and recycling initiatives in IBM's microelectronics manufacturing operations achieved an annual 1.8 percent savings in water use in 2010. The avoided withdrawals were achieved through ongoing efficiency enhancements that reduced water usage in designated operations. Over the past five years, new water conservation and recycling initiatives at IBM's microelectronics manufacturing operations have achieved an average 2.8 percent savings versus the 2 percent goal.

Despite this conservation activity, total annual water withdrawals for these operations increased by 3 percent or 325 TCMs from 2009, primarily due to expanded production at the facilities. The total accumulated conservation activities over the past five-year period avoided withdrawals of 8,885 TCMs of water resource.

Annual Water Savings in Microelectronics Manufacturing Operations

Savings as Percentage of Previous Year's Total Water Use



Product Stewardship

IBM's Product Stewardship program was established in 1991 as a proactive and strategic approach to the company's environmental design and management of products. The program's mission is to develop, manufacture and market products that are increasingly energy efficient; can be upgraded and reused to extend product life; incorporate recycled content and environmentally preferable materials and finishes; and can be recycled and disposed of safely.

Fundamentals

IBM's product stewardship objectives and requirements are implemented through IBM's Environmental Management System (EMS), internal standards, product specifications and other requirements in IBM's Integrated Product Development process. Product environmental attributes such as energy efficiency, materials content, chemical emissions testing, design for recycling, end-of-life management plans and packaging data must be documented and reviewed in IBM's Product Environmental Profile (PEP) tool at various checkpoints during the development process. Compliance management tools like the [Product Content Declaration for IBM Suppliers](#) support the assessments required for a complete PEP prior to product release. IBM's design and compliance controls, including a specification for [Baseline Environmental Requirements for Supplier Deliverables to IBM](#), Product Content Declarations, and compliance assessment protocols are managed through an interdisciplinary team with representatives from all IBM organizations that design, manufacture, procure, deliver and service IBM's product offerings. The team's activities are coordinated by IBM's Center of Excellence for Product Environmental Compliance.

Driving Product Design

In 2010, IBM's product development and supply chain organizations reviewed all products that are expected to be available beyond 2012 in order to investigate their use of lead (Pb) in certain solder applications defined in exemptions under the European Union's Restriction of Hazardous Substances (RoHS) Directive (2002/95/EC). Unlike less complex consumer products, IBM still relies on the use of lead in certain solders for its unique high-end, mission-critical mainframe computer servers. With the goal to eliminate these uses long before the expiration of the relevant exemptions, IBM worked with its suppliers during the year to jointly define transition plans for affected parts. This process included education of suppliers on the technical aspects of the current exemptions as well as on comprehensive changes to the exemption definitions that were published in the European Commission's September

2010 revision of the RoHS Directive Annex. Through its initiatives to further eliminate lead from its products, IBM continues to spur capability in the global supply chain to redesign current lead-based applications.

IBM continues to investigate alternatives to polyvinyl chloride (PVC) plastic for wire and cable applications. In 2010, working with the High Density Packaging User Group (HDPUG) project on halogen-free cables, IBM's materials experts examined prototypes developed by several compounders, but deficiencies in flame retardant performance and moldability remain to be solved for some applications. IBM will continue work to identify and evaluate more environmentally preferable materials for these applications.

Managing Compliance Data

Assessing the compliance of products to environmental regulations around the world demands a robust management system for product data requirements. Particularly challenging is the frequency of changes in those data requirements. For example, new substance disclosure or reporting requirements tied to the European Union's Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) Directive (EC 1907/2006) must be vetted with the supply chain as often as every six months. In 2010, IBM developed, tested and implemented a new supply chain communication tool to automate notifications of requirement changes to suppliers and track their responses. In addition to communicating new requirements relative to REACH substance regulations, IBM used the tool to inform 650 suppliers of the RoHS exemption roadmap strategies, IBM's Supplier Conduct Principles and other improvements in IBM's product compliance data collection process.

IBM product compliance reporting for global markets is facilitated by an IT solution called the Environmental Reporting Tool (ERT), developed by IBM as a system for collecting and organizing information and data required to meet all compliance activities for worldwide environmental regulations. ERT monitors regulatory submissions and deadlines, automatically alerts activity owners of scheduled responsibilities and extracts data through interfaces to other repositories to create actual submission forms for a myriad of environmental reports, registrations and product take-back plans required to conduct IBM business in various geographies around the world. As an example, ERT provided a central dashboard for IBM's global team working on worldwide battery requirements. The tool manages documentation related to the development and deployment of supplier requirements, manufacturing processes, end-user communication, registration, reporting, product take-back processes and management plans. IBM's ERT was recognized with a 2011 Progressive Manufacturing 100 (PM100) Award in the Data & Integration Mastery category.

2010 Product Stewardship Goals and Performance

<p>Recycled Plastics</p>	<p>The recycled content of plastics used in IBM's products can range from 25 to 100 percent by weight of the commercial resin. In 2010, 31.5 percent of the total weight of plastic resins procured by IBM and its suppliers through IBM's corporate contracts for use in IBM's products had recycled content ranging from 25 to 100 percent. Comparing only the weight of the recycled fraction to the total weight of plastics (virgin and recycled) purchased, 11.5 percent of IBM's total weight of plastic purchases in 2010 was recycled plastic versus the corporate goal of 5 percent recycle.</p>
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<p>Use of Landfills</p>	<p>IBM's product end-of-life management operations worldwide processed over 36,600 metric tons of end-of-life products and product waste, and sent only 0.6 percent of the total to landfills or to incineration facilities for treatment, versus IBM's corporate goal of minimizing its combined landfill and incineration rate to no more than 3 percent of the total amount processed.</p>
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Product Energy Efficiency

<p>Servers*</p>	<p>IBM System p[®]: IBM released four models of Power Systems[™] servers for which previous models or generations existed. These new servers provide reductions of 58 to 70 percent in the typical power consumption per unit of relative performance compared to their previous generation system.</p> <p>IBM System x[®]: The six System x servers announced in 2010 for which comparison models existed provide reductions in watts/MTOPS** (the Japan Energy Saving Law metric) of 87 to 98 percent over the previous generation server.</p> <p>IBM System z[®]: The new IBM zEnterprise[™] 196 (z196) offers 74 percent more capacity per kilowatt for the air cooled version and 86 percent for the water cooled version, than its predecessor, the System z10, while using the same amount of electricity.</p>
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**Point-of-Sale
Terminals***

In 2010, IBM introduced the SurePOS™ 700, which delivers a 56 percent reduction in the maximum power consumption of the system per composite theoretical performance (CTP) over its previous generation model. It also provides a 98 percent reduction in power use when the system is idle.

Storage Subsystems*

Two new storage systems having previous generation models were released in 2010. They deliver 88 percent and 85 percent more storage capacity per watt of power consumed than their predecessor models.

** IBM's product energy goal is to continually improve the computing power delivered for each kilowatt-hour (kWh) of electricity used with each new generation or model of a product.*

*** MTOPS-million theoretical operations per second is a calculation of machine operations based on a specified formula.*

Product Energy Efficiency

Product energy efficiency has long been one of IBM's environment and climate protection objectives. It was formalized as one of the company's corporate objectives when IBM's Product Stewardship program was established in 1991. IBM has initiated and invested in innovations and integrated solutions through collaboration between IBM's Research and Product Development teams. These teams have also combined hardware and software innovations to improve the energy efficiency of IT equipment and data centers.

In addition to its internal focus, IBM continues to actively assist in the development of external product energy efficiency standards. As it did in 1992 when the company helped to develop and was a charter member of the U.S. Environmental Protection Agency (EPA) ENERGY STAR® Computer program, IBM is currently participating in the development of the ENERGY STAR specifications for server and storage devices, providing technical assistance and equipment operating data to assist in the development of criteria.

In 2009, the U.S. EPA finalized ENERGY STAR program requirements for computer servers. As of April 2011, IBM had qualified 10 server product families to the ENERGY STAR requirements—four System p and six System x enterprise server systems. These servers meet the U.S. EPA's requirements for power supply efficiency, idle power limits or power management capability, and data reporting. IBM is currently working to qualify other

enterprise server systems to the ENERGY STAR requirements. A list of IBM ENERGY STAR qualified servers may be found on the [IBM and ENERGY STAR](#) page.

New Advancements for Increased Product Energy Efficiency Performance

The following are examples of new IBM technologies, software and solutions that have enabled the increased energy efficiency of IBM's servers and storage products:

- IBM engineers have utilized power management capabilities provided by the x86 and POWER7[®] processors and memory and I/O components to reduce the power drawn by the server when no workload is present (idle power) by 20 to 50 percent when compared to the power used by the system at full workload.
- Storage systems are utilizing various software-based data management capabilities such as Easy Tier[™], thin provisioning and storage virtualization which can reduce the number of terabytes required to accomplish a given storage task.
- Many IBM products are incorporating high efficiency power supplies, with the x3850 X5 server utilizing an 80 PLUS[®] Platinum power supply, the highest power supply efficiency designation currently achievable under the 80 PLUS program.
- IBM continues to innovate in semiconductor, hard drive, storage and networking technologies, utilizing virtualization and other software solutions to improve server and storage system performance for each unit of power consumed by the equipment and reduce the quantity of equipment required to deliver a specified set of workloads.

High Performance Computers (HPC)

IBM has a full menu of HPC systems: the Productive, Easy-to-Use, Reliable, Computing System (PERCS), IBM System Blue Gene[®], iDataPlex[®], and the Roadrunner supercomputer programs. IBM's supercomputer solutions are prevalent on both the TOP500[®] and Green500[™] supercomputer lists. Today, eight of the top 20 most energy efficient supercomputers in the world are built on IBM high-performance computing technologies, with the Blue Gene/Q prototype supercomputer leading the November 2010 Green500 List. Technologies developed through IBM's HPC development efforts are leveraged across the entire IBM Systems and Technology Group product line to improve performance and energy efficiency.

8 of the top 20

most energy efficient supercomputers in the world are built on IBM high-performance computing technologies.

Blue Gene has been identified as a leader in “green” supercomputing for available solutions every year from 2007 through 2010. Blue Gene®/P, converted from an air cooled (previous generation Blue Gene system) to a hydro-air cooled system, delivers a 9-percent savings on total data center power. The relative cooling cost for a Blue Gene/P system decreased by 50 percent.

Blue Gene’s speed and expandability have enabled business and science to address a wide range of complex problems and make more informed decisions—not just in the life sciences, but also in astronomy, climate, simulations, modeling and many other areas. Blue Gene continues its leadership performance in a space-saving, power-efficient package for the most performance demanding applications.

The IBM iDataPlex system was designed to meet the needs of high-performance, large-scale Internet and cloud computing workloads at up to 40-percent lower energy consumption than 1U industry standard servers and BladeCenter® servers. Reduced energy use is achieved due to significantly lower air flow requirements and shared cooling fans, high-efficiency power supplies and a double-wide water cooled IBM Rear Door Heat eXchanger solution that can absorb 100 percent of the heat generated by the rack and virtually eliminate the need for air conditioning. The iDataPlex system is also designed for material efficiency and longevity, with a server motherboard into which upgrade cartridges can be inserted to easily utilize new technologies.

Solutions

IBM offers a variety of software and system solutions that enable companies, governments and other entities to improve the energy efficiency of their operations and systems. IBM has responded to climate change, energy management and operational efficiency opportunities with a suite of offerings from products to services to help clients plan and develop greenhouse gas (GHG) inventory processes and management strategies to improve the efficiency of their data centers, buildings, core business processes, logistics and other operations. Three examples of IBM’s suite of “intelligent” products and services are described below.

Route Planning and Goods Management

IBM hardware and software solutions, including ILOG® Supply Chain Applications and IBM WebSphere® Sensor and Business Events, can be combined to solve complex planning, scheduling or logistics management problems while tying these operations to corporate objectives to reduce costs, increase revenues, improve service quality and reduce environmental impact. Using these capabilities:

100%

of server heat absorbed by the water-cooled IBM Rear Door Heat exchanger, virtually eliminating the need for air conditioning.



Smarter Buildings

Discover how IBM is working to redesign buildings from the earth up.

- Two clients optimized their supply chain networks, one removing 4,000 truckloads of goods off the road annually and the other realizing a 23 percent reduction in logistics costs and a 15 percent reduction in logistics driven CO₂ emissions.
- A third client reduced annual transport mileage growth, and attendant fuel use and GHG emissions by two percentage points.

Vehicle to Grid Charging and Storage

This solution involves developing the hardware and software components of the infrastructure system required to facilitate large-scale adoption of electric vehicles. IBM is working with partners in utilities, automobile manufacturers, academics and governments to determine the outline of the infrastructure system required to enable large-scale adoption of electric vehicles. IBM's activities include research and development work in vehicle telematics, embedded software, battery performance, network security, roaming and transaction management, smart grid integration, network optimization, renewables charging dispatch and infrastructure planning.

Details of IBM's efforts to develop the infrastructure required to support electric cars and renewable energy generation can be found on our [Smart Grid](#) page.

Energy Efficient Buildings

Green Sigma™ is an IBM solution that applies Lean Six Sigma principles and practices to energy, water, waste and GHG emissions throughout a company's operations—transportation systems, data centers and IT systems, manufacturing and distribution centers, office facilities, retail space, research and development sites. It combines real-time metering and monitoring with advanced analytics and dashboards that allow clients to make better decisions that improve efficiency, lower costs and reduce environmental impact.

The smarter buildings solution—which combines the company's software, research and services expertise together with industry-leading business partners—enables IBM and its clients to better achieve the following:

- Manage energy use, lower costs and decrease emissions by monitoring and analyzing heat, air conditioning and power consumption;
- Maintain equipment proactively, identifying emerging problems and trends to prevent breakdowns and confirm that critical assets will work as needed; and

Lower maintenance and building management costs and extend asset life through preventive maintenance, greater insight into asset conditions and automated notification when assets are performing outside of specifications.

Product Recycling and Reuse

As part of its product end-of-life management (PELM) activities, IBM began offering product take-back programs in Europe in 1989 and has extended and enhanced them over the years. IBM's Global Asset Recovery Services organization offers Asset Recovery Solutions to commercial customers in countries where IBM does business, including:

- Management of data security and disk overwrite services
- Worldwide remarketing network for product resale
- State-of-the-art refurbishing and recycling capability for IT equipment
- Optional logistic services such as packing and transportation

In addition, in many countries and individual U.S. states, IBM offers solutions to household consumers for the end-of-life management of computer equipment, either through voluntary IBM initiatives or programs in which the company participates.

In 2010, IBM's PELM operations worldwide processed over 36,600 metric tons of end-of-life products and product waste. This represents 50 percent of the estimated 73,000 metric tons of new IBM IT equipment manufactured and sold in 2010.

Product End-of-Life Management Operations

2010: Percentage by Weight



Product End-of-Life Management (PELM)

3% Goal: not to exceed

0.6% Result

Goal

Reuse or recycle end-of-life products such that the amount of product waste sent by IBM's PELM operations to landfills or to incineration for treatment does not exceed a combined 3 percent of the total amount processed.

Result

In 2010, IBM's PELM operations sent only 0.6 percent to landfills or to incineration facilities for treatment.

IBM's PELM operations reused or recycled 96.5 percent of the total amount of product and product waste they processed.

Since 1995, when IBM first began including in its annual corporate environmental report the volumes of product waste it collects and recycles, IBM has documented the collection and recovery of approximately 1.8 billion pounds (over 807,000 metric tons) of product and product waste worldwide through year-end 2010.

1.8 Billion pounds of product and product waste worldwide collected by IBM since 1995.

Packaging

IBM has had a program focused on the environmental attributes of its product packaging since the late 1980s. Under the program, IBM packaging engineers design solutions that minimize toxic substances and packaging waste by specifying nontoxic materials and inks. They also keep packaging to a minimum while continuing to provide protection to the product being shipped to clients, and collaborate with suppliers to use recycled and recyclable materials and promote reuse.

IBM's environmental requirements for packaging are included in its Environmental Packaging Guidelines, first published in 1990 and updated as needed over the years. Key elements of IBM's Packaging Guidelines have also been embedded in various engineering specifications and procurement documents, which extend their reach beyond IBM to include its supply chain and other business partners. These documents may be found on our [Information for suppliers](#) page.

In 2010, the integrated worldwide packaging engineering team saved 842 metric tons of packaging material from the implementation of 38 packaging redesign projects worldwide. These projects delivered an annual cost savings of \$8.8 million. The following highlights a few of the projects implemented in 2010:

- IBM System Storage® DS3000 package redesign project: After an audit of the package design for this product, IBM's packaging engineers determined that it could be redesigned to reduce its size and weight. In 2010, the package was redesigned to hold eight units per pallet, rather than the original one. This redesign assessment project eliminated the use of an estimated 300 metric tons of corrugated fiberboard and wood annually and saves \$450,000 in annual transportation costs.

300 Metric tons of corrugated fiberboard and wood per year eliminated from IBM System Storage DS3000 packaging in 2010.

- IBM Retail Store Systems 4800 logic unit packaging reduction project: The package for the 4800 logic unit was redesigned to utilize several units per pallet, versus the traditional one unit per pallet, for our Latin America and Mexican markets. The result was a considerable decrease in overall package size and weight per unit shipped. This project saved \$1.3 million annually in materials and transportation costs, while saving an estimated 70 metric tons of packaging materials annually.
- IBM Green Sigma™ DOX power packaging reuse project: In the past, IBM's suppliers and IBM manufacturing sites had different packaging solutions for each step in the manufacturing process, which resulted in additional operational costs and wasted material. IBM packaging engineers designed a package and process that would eliminate the need to use separate packaging solutions for each manufacturing step in the supply chain. The result was an efficient, robust and reusable package that eliminated over 90 metric tons of packaging materials annually from the waste stream while achieving a cost reduction of \$355,000 annually.

In 2010, the IBM packaging team also implemented 19 packaging design projects with its suppliers. The resulting packaging solutions reduced the packaging materials from incoming parts by 204 metric tons and saved \$1.7 million in both material and transportation costs. Examples may be found on our [Protective product packaging](#) page.

When suppliers apply the design improvements achieved through collaboration with IBM to packaging designs for other customers, the environmental benefits and cost savings can be far-reaching.

Voluntary Environmental Goal for Packaging Materials

IBM's voluntary environmental goal for packaging materials states that paper-/wood-based packaging directly acquired by the company will be procured from suppliers who source from sustainably managed forests where such sources exist.

In 2002, when IBM first established this goal, sufficient quantities of sustainable sourced packaging materials were not yet available for much of the company's needs. With a continued focus on this objective by IBM and its suppliers over the years, in 2010, 99 percent of the paper-/wood-based packaging IBM procured came from suppliers who contractually warranted that the source was derived from forests managed in an ecologically sound and sustainable manner.

Product Safety

IBM's product safety requirements are included in various steps of the product development, manufacture and test process, and include the supply chain for both IBM hardware and solutions. Required reviews by IBM Product Safety Review Boards assure that product and project managers comply with applicable standards and national regulations, and obtain third-party certifications where required.

Programs for continual improvement include internal and third-party assessment of IBM's products' safety design and process implementation. These assessment results are continually fed back into the evaluation and planning cycle. This process is augmented by incident management tools that provide effective capture and manage any product safety-related incident or customer complaint.

IBM plays a leading role in the development of national, regional and international standards for product safety for information technology products.

Energy and Climate Programs

IBM recognizes climate change as a serious concern that warrants meaningful action on a global basis to stabilize the atmospheric concentration of greenhouse gases (GHGs). IBM believes all sectors of society, economy and government worldwide must participate in solutions to climate change.

View IBM's [Position and policy](#) on climate change.

IBM has been a leader in addressing climate change through its energy conservation and climate protection programs for decades. The company's leadership has been defined by its:

- Longstanding global commitment
- Comprehensive and multifaceted programs—covering the company's operations, products and services
- Leading-edge innovations and client solutions
- Significant results, both early and ongoing, benefiting IBM, its clients and the world

A Five-Part Strategy

IBM has a five-part strategy to reduce GHG emissions:

1. Designing, building, updating and operating facilities and manufacturing operations that optimize their use of energy and materials and minimize GHG emissions
2. Purchasing electricity generated from low CO₂-emitting and renewable energy-generating sources where feasible
3. Minimizing the use and emissions of perfluorocompounds (PFCs—a family of GHGs) in semiconductor manufacturing
4. Reducing employee commuting and business travel
5. Increasing the efficiency of IBM's logistics operations

In addition, in the area of hardware and software products and services, IBM's strategy includes designing energy efficient products and providing its clients with energy efficient solutions that also help protect the climate.

The company does not have plans to use emissions offsets to become “carbon neutral” for all or part of its operations. IBM’s efforts to reduce its GHG emissions are focused on delivering results in the areas where the company can make the greatest positive impact on climate protection—by devoting its available resources to actions, products and solutions that actually increase energy efficiency and reduce GHG emissions for both the company and its clients, rather than offset them.

Conserving Energy

IBM’s commitment to energy conservation dates back to 1974 and has continued, unabated, over the intervening years. Energy conservation is a major component of IBM’s comprehensive, multifaceted climate protection program because the release of CO₂ by utility companies powering the company’s facilities, or from the use of fuel for heating or cooling, represents the greatest potential climate impact associated with IBM’s operations.

In 2010, IBM’s energy conservation projects across the company delivered savings equal to 5.7 percent of its total energy use versus the corporate goal of 3.5 percent. These projects avoided the consumption of 272,000 megawatt-hours (MWh) of electricity and 352,000 million BTUs of fuel oil and natural gas, representing the avoidance of more than 139,000 metric tons of CO₂ emissions. The conservation projects also saved \$29.7 million in energy expense. These strong results are due to the increased, across-the-board focus on energy demand reduction, efficiency and the implementation of standard, global energy conservation strategies for facility operating systems.

IBM’s energy conservation goal recognizes only identified projects that actually reduce or avoid the consumption of energy in its operations. Reductions in energy consumption from downsizings, the sale of operations and cost avoidance actions, such as fuel switching and off-peak load shifting, are not included in the energy conservation goal. Moreover, the above results are conservative in that they include only the first year’s savings from the conservation projects. Ongoing conservation savings beyond the first year are not included in the tally. Accordingly, the total energy savings and CO₂ emissions avoidance from these conservation actions is actually greater than this simple summation of the annual results.

Between 1990 and 2010, IBM saved 5.4 billion kWh of electricity consumption, avoided nearly 3.6 million metric tons of CO₂ emissions (equal to 52 percent of the company’s 1990 global CO₂ emissions) and saved \$399 million through its annual energy conservation actions.

Energy Conservation

3.5% Goal

5.7% Result

Goal

Achieve annual energy conservation savings equal to 3.5 percent of IBM’s total energy use.

Result

In 2010, IBM’s energy conservation projects across the company delivered savings equal to 5.7 percent of its total energy use.

5.4 billion kWh

of electricity consumption—and nearly 3.6 million metric tons of CO₂ emissions—saved by IBM through its annual energy conservation actions between 1990 and 2010, resulting in a savings of \$399 million.

Electricity and Fuel Use and Related CO₂ Emissions

Scope 1 and 2 CO₂ Emissions

Year	Electricity and Fuel Use (thousand MMBTU)	CO ₂ (EST) (metric tons x 1,000)
2006	22,491	2,420
2007	23,638	2,541
2008	22,443	2,502
2009	21,507	2,436
2010	21,622	2,156

IBM uses the greenhouse gas reporting protocol developed by the World Resources Institute and the World Business Council for Sustainable Development to gather and report its CO₂ emissions.

CO₂ emissions data includes the CO₂ avoidance associated with IBM’s purchases of renewable energy.

IBM’s global energy management program leverages the expertise of more than 40 IBM energy management professionals deployed around the world. The team has created best practices checklists that set minimum expectations for building systems and operations including controls and equipment for lighting, HVAC, central utility plants (CUPs), compressed air, data center and IT systems, cafeterias and office systems. All sites using more than 2,000 MWh/year of energy must complete the checklists, perform a gap analysis and develop an energy conservation implementation plan a minimum of every three years. The program is buttressed by several enterprise-level databases that collect and store energy use data, conservation project results and completed checklists enabling monthly metrics reporting to the management team. The continuous review of energy use and conservation results has driven the strong results noted above.

IBM uses a full range of energy efficiency initiatives in achieving its results. In 2010, more than 2,100 energy conservation projects were completed at 299 IBM locations around the world. Some examples:

- 208 locations implemented projects to match building lighting and occupancy schedules or install more efficient lighting systems, reducing 17,200 MWh of electricity use and saving \$1.9 million.
- 165 locations modified HVAC systems or operating schedules to reduce 40,300 MWh of electricity use and 83,000 MMBTU of fuel use, and save \$4.9 million.

40,300 MWh
of electricity use
and 83,000
MMBTU of fuel use
saved by modifying
HVAC systems or
operating schedules
at IBM locations in
2010, saving \$4.9
million.

- 19 locations had continuous commissioning projects that delivered reductions of 11,200 MWh of electricity use and 86,800 MMBTU of fuel use, and savings of \$1.6 million.

The IBM team is also implementing innovative, leading-edge technologies that enable real-time management of energy use.

- IBM is deploying its Smarter Building technologies to increase the energy efficiency of its own facilities. The company is expanding its use of data monitoring and analytics, using “plug-in” analytics to collect sensor and operating data for analyzing both individual events and system trends. This information is then used to optimize building energy use. In 2010, IBM deployed this solution at its Armonk, New York, headquarters and selected buildings at its Rochester, Minnesota, site. It is expected to yield between 5 percent and 8 percent in annualized energy cost reduction at the buildings in which it is deployed. These results are particularly impressive for the Rochester location given its energy conservation history, having already delivered energy savings through conservation actions of between 5 percent and 6 percent of the site’s energy use each year over the past 10 years. IBM has plans to install Smarter Building solutions at additional locations during 2011 and 2012.
- IBM implemented an Advanced Water Management solution at its semiconductor manufacturing facility in Burlington, Vermont. It utilizes an automated data system, Statistical Process Control (SPC), to transform large amounts of data into manageable useful information. The application of Advanced Water Management techniques has resulted in an energy savings of over 5,000 MWh/year.

Data Centers

IBM takes a holistic approach to managing its data center portfolio, building new, high-efficiency data center space where it needs to expand its raised floor inventory to meet the needs of existing and new customers, and retrofitting and improving existing data center space to better utilize and derive more workload from its existing space, equipment, and energy resources. These efforts are accomplished through the following initiatives:

1. Building new high-efficiency data center space. IBM’s most recent data center expansions in the U.S. have achieved LEED® certification and use state-of-the-art design and system techniques to enable Power Usage Effectiveness (PUE, the ratio of the total power required at the data center divided by the power required to operate the IT equipment) measurements of 1.4 when the data center is fully populated.
2. Implementing best practices and thermal monitoring programs at its existing data centers to optimize cooling delivery and minimize energy use and cost.

3. Virtualizing and consolidating existing workloads for its internal operations and customer accounts. Virtualizing workloads allows a single server to support multiple applications or images, making use of the full capabilities of state-of-the-art IT equipment and executing more workload in less space with less energy.

IBM manages a diverse portfolio of data centers, consisting of both IBM and IBM-managed customer facilities all over the world. IBM also operates additional raised floor space to support its internal operations as well as design and test centers for its System and Technology Group and Software Group.



Video: A Super Efficient Data Center

The data center at Syracuse University measures air velocity, power, flow rates and voltages to not only serve as a production data center, but as a testing ground for future data center technologies.

New Data Center Construction

IBM's new data centers in Boulder, Colorado, and Raleigh, North Carolina, utilize state-of-the-art technologies and are designed to operate at PUE of 1.4 when fully populated with IT equipment. The data centers are designed to accommodate high density IT equipment and utilize free cooling, variable speed fans and pumping systems. They also have the capability to install direct liquid cool systems on high-power density equipment, as well as high efficiency Uninterruptable Power Systems (UPS) and chiller systems.

Existing Data Centers

In 2010, 290 projects at 90 existing data center locations reduced energy use by over 32,000 MWh, saving more than \$3.2 million.

- IBM upgraded data center equipment and implemented data center best practices, including blocking cable openings, rebalancing air flow and shutting down air conditioning units, all of which generated 16,800 MWh of savings in IBM's existing data centers. IBM's Measurement and Management Technology, a thermal monitoring management system, was installed at five data centers, with installations underway or planned over the next 18 months for the remainder of the company's owned and leased strategic data centers. This innovative technology

from IBM Research produces a real-time three dimensional thermal map of the detailed heat sources and sinks within a data center, allowing for accurate identification and mitigation of data center hot spots, adjustment of cooling delivery as systems are removed and added, and increased data center operating temperatures, with attendant reductions in cooling requirements. Continuous thermal monitoring and the future use of analytics can further improve data center energy management beyond that achieved with the implementation of best practices alone.

- IBM implemented 16 water-side free cooling projects, which utilize the temperature of the outside air rather than chiller systems to cool the chilled water, saving more than 16,000 MWh of electricity use. Most of those projects were installed at locations with data center operations.

Server and Storage Virtualization and Consolidation

IBM is utilizing virtualization technologies to consolidate multiple workloads from servers and storage systems with low utilization onto single systems, reducing energy use by more than 75,000 MWh in 2010. More than 28,000 images or applications were moved from single use servers to virtualized servers, utilizing existing, high capability systems to consolidate workloads or installing new systems and virtualizing several server or storage systems of workload on the new system. These projects increase the utilization of the virtualized server and storage systems, deliver more workload with less energy consumption, and reduce the quantity of IT equipment and the data center floor space required to perform a given workload. These projects also free up data center space for business growth or new business opportunities.

Cloud Computing

Over the course of 2010, IBM continued to reap the benefits of cloud computing to its data centers. Cloud computing is an efficient model for providing IT services. It allows IBM to better balance workloads, adjust power consumption and virtualize infrastructure in data centers to better align processing needs with power consumption. The result is balanced energy demands to help avoid high peak energy use and allow consolidation of workload on the minimum number of highly utilized servers, so unneeded equipment can be put to sleep or turned off. Through the introduction of an optimized infrastructure, the number of systems and networks in the data center can be reduced and optimized, cost efficiency improved and energy efficiency enhanced. IBM has established a globally integrated cloud delivery network with centers in Singapore, Germany, Canada and the U.S., along with 13 global cloud labs.

The benefits of cloud computing are demonstrated by IBM's Technology Adoption Program (TAP), which supports the company's software development community. For example, leveraging cloud computing, TAP

IBM Cloud Computing

IBM is helping clients excel in cloud computing, providing secure and reliable Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) solutions.

by nearly 90 percent. That translated into annual hardware savings of \$1.3 million and energy savings of more than 500 MWh per year.

Voluntary Data Center Energy Efficiency Initiatives

IBM supported efforts by the U.S. EPA and the European Commission Directorate General Joint Research Centre—Institute for Energy to encourage improvements and innovations in data center energy efficiency. IBM has provided input, recommendations and data center energy use data to support the development of both the European Union Code of Conduct on Data Centres Energy Efficiency (CoC) and the U.S. EPA ENERGY STAR® Rating for data centers. These programs set operating criteria or metrics that inform and encourage data center operators and owners to reduce energy consumption in a cost-effective manner while enabling operators to maintain the mission-critical function of data centers. IBM registered all or parts of three data center operations to the EU CoC and is working to qualify one or more U.S. data center locations to the ENERGY STAR data center rating program.

CO₂ Emissions Reduction

In 2010, IBM's procurement of renewable energy and significant energy conservation results were the primary factors for an 11.5 percent reduction in its energy-related CO₂ emissions over 2009. The company's procurement of renewable energy equaled 11.2 percent of IBM's total 2010 electricity use.

As of year-end 2010, the company's energy conservation results and procurement of renewable energy resulted in a 16.7 percent reduction in IBM's energy-related CO₂ emissions from the 2005 base year of this goal.

The reductions have been achieved through the following initiatives outlined below. In addition, improvements in the CO₂ emissions profile of the electricity that IBM purchased also had a favorable albeit limited impact on the company's performance.

- IBM's energy conservation efforts have reduced or avoided a total of 1.1 million MWh of electricity and 2.4 million MMBTU of fuel use (based on one-year savings associated with conservation projects) from 2006 to 2010, which represents a reduction in IBM's electricity and fuel use of 3.5 percent and 22 percent, respectively, against the 2005 baseline use adjusted for acquisitions and divestitures.
- IBM purchased 561,000 MWh of electricity generated from renewable sources in 2010, resulting in an avoidance of 247,000 metric tons of CO₂ emissions associated with the generation of the electricity used by IBM. IBM contracts for these purchases through programs sponsored by suppliers or the responsible utility.

- IBM has reduced its fuel use by 20 percent against the adjusted 2005 baseline. A portion of the reduction is weather-related, due to milder winters in some regions, and the remainder has resulted from projects to optimize boiler operation and reduce heating and humidification demand at facilities through room specification changes and time-of-day heating and ventilation settings.

The 16.7 percent reduction in CO₂ emissions in 2010 surpasses IBM's 2012 goal of a 12 percent reduction over the 2005 base year. These results were achieved through the commitment and execution of the business units responsible for IBM's operational energy use. Because each of the factors cited as keys to this achievement will change as IBM grows its businesses, enters into new contracts for electricity and continues its focus on energy conservation, the company will continue to work to sustain its performance against its year-end 2012 goal.

CO₂ Emissions Reduction

Metric Tons x 1,000



*2005 emissions baseline adjusted for acquisitions and divestitures of operations.

PFC Emissions Reduction

IBM releases some perfluorocompounds (PFCs) from its semiconductor manufacturing operations. Although the releases are in relatively small amounts (in CO₂ equivalents, when compared to IBM's indirect CO₂ emissions), IBM was the first semiconductor manufacturer to set a numeric reduction target for PFCs in 1998 and has set an absolute reduction goal through 2010.

IBM has achieved its PFC emissions reduction goal, reducing its PFC emissions by 36.5 percent against the 1995 baseline. These reductions have been achieved through IBM's long-term focus on using process chemistries which utilize PFC gases with lower global warming potentials. The Burlington, Vermont, facility has been an industry leader in developing and

CO₂ Emissions Reduction

12% Goal

16.7%

Result

Goal

Between 1990 and 2005, IBM's energy conservation actions reduced or avoided CO₂ emissions by an amount equal to 40 percent of its 1990 emissions. To further extend this achievement, IBM set itself an aggressive "2nd generation" goal: to reduce the CO₂ emissions associated with IBM's energy use 12 percent between 2005 and 2012 through energy conservation and the procurement of renewable energy.

Result

As of year-end 2010, the company's energy conservation results and procurement of renewable energy resulted in a 16.7 percent reduction in IBM's energy-related CO₂ emissions from the 2005 base year of this goal.

implementing process substitutions using PFCs with lower global warming potential such as NF_3 and C_4F_8 for its 200mm semiconductor manufacturing processes. The East Fishkill, New York, 300mm semiconductor manufacturing facility almost exclusively uses NF_3 for its chamber clean processes and abates the majority of its PFC emissions.

PFC emissions increased year-to-year, primarily due to increased manufacturing volumes in 2010 compared to 2009. Some of the increases in emissions during 2010 were mitigated by further conversion of some C_2F_6 based process cleans to C_4F_8 process cleans; C_4F_8 has a lower global warming potential than C_2F_6 .

PFC Emissions Reduction

In Carbon Dioxide Equivalent



IBM also has begun tracking two other materials: 1) nitrous oxide (N_2O), which is used in the manufacture of semiconductors; and 2) heat transfer fluids that are used in tool-specific chiller units associated with manufacturing processes.

- IBM emitted 17,400 metric tons of CO_2e of nitrous oxide, which has a lower global warming potential than the PFC gases from its semiconductor operations.
- Chiller systems at the IBM semiconductor operations used 18,300 pounds of heat transfer fluids. These materials are released as fugitive emissions and had a CO_2e of 32,000 metric tons.

IBM has been replacing some of the heat transfer fluid-based chiller units with solid-state chiller units as an energy conservation measure. These chillers use solid-state components and heat to alternately excite and unexcite electrons to trap and release heat energy. The new style chiller replaced an old Freon-based chiller that used more electricity. Each replacement reduces electricity use by 40 MWh/year and eliminates the fugitive loss of the heat transfer fluids.

PFC Emissions Reduction

25% Goal

36.5%

Result

Goal

To reduce PFC emissions from semiconductor manufacturing 25 percent by 2010 against a base year of 1995.

Result

As of year-end 2010, IBM's emissions were 36.5 percent below the 1995 baseline amount of 381,000 metric tons of CO_2 equivalent.

Renewable Energy

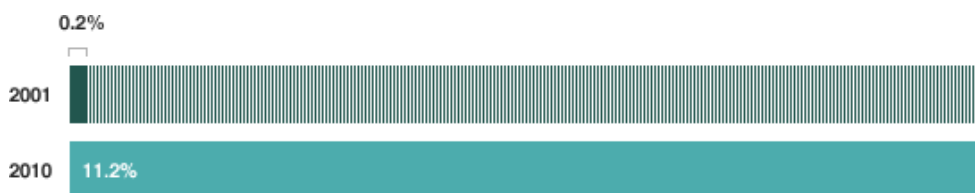
In 2010, IBM purchased 561 million kWh of renewable energy. These purchases represented 11.2 percent of the company's global electricity usage and a CO₂ emissions avoidance of 247,000 metric tons. IBM continued to contract for renewable energy purchases in Australia, Japan, Austria, Belgium, Denmark, Finland, Netherlands, Sweden, Switzerland, the United Kingdom and the United States in 2010. Purchases of electricity generated from renewable resources increased in Australia, Finland, Sweden and Switzerland.

IBM's energy conservation efforts and its procurement of renewable energy in 2010 combined to avoid the emissions of more than 390,000 metric tons of CO₂.

390,000
metric tons
of CO₂ emissions
avoided through
IBM's energy
conservation efforts
and procurement of
renewable energy in
2010.

Renewable Energy Procured

Percentage of Total Electricity



Research to Advance Solar Energy

In addition to procuring renewable energy for its own use, IBM is working to further the availability and affordability of renewable energy by investing in IT-related research and development. One focus area is advancing solar technology:

- New solar cell manufacturing approach:**
In February 2010, IBM announced it had built a solar cell in which the key layer that absorbs most of the light for conversion into electricity is made entirely of readily available elements and is manufactured using a combination of solution and nanoparticle-based approaches, rather than the popular, but expensive, vacuum-based technique. This solar cell set a new world record for efficiency and holds the potential for producing low-cost energy that can be used widely and commercially.
- Ultra-high concentrator photovoltaic technology:**
In April 2010, IBM announced that it is collaborating with the King Abdulaziz City for Science and Technology (KACST), Saudi Arabia's national research and development organization, on a research project aimed at creating a water desalination plant powered by solar

electricity, which could significantly reduce water and energy costs. A new, energy efficient desalination plant with an expected production capacity of 30,000 cubic meters per day will be powered with the ultra-high concentrator photovoltaic (UHCPV) technology that is being jointly developed by IBM and KACST. This technology is capable of operating a CPV system at a concentration greater than 1,500 suns. Inside the plant, the desalination process will hinge on another IBM-KACST jointly developed technology, a nanomembrane that filters out salts as well as potential toxins in water while using less energy than other forms of water purification.

- **Climate Modeling:**

In October 2010, IBM and Universiti Brunei Darussalam (UBD) announced an agreement to collaborate on climate modeling research that will investigate the impact of climate change on flood forecasting, crop yields, renewable energy and the health of rainforests in southeast Asia. The collaboration will help Universiti Brunei Darussalam accelerate its research capabilities in biodiversity, energy and agrotechnology. The university will acquire an IBM Blue Gene[®] supercomputer—the first of its kind in the region—to provide high-performance computing power for the collaborative work.

Researchers from UBD and IBM will work together to develop climate models based on regional climate data. The new hydrological models will be incorporated into the weather models to enable flood forecasting and predict climatic impact on the rainforests.

Voluntary Climate Partnerships

IBM was a charter member of the Chicago Climate Exchange (CCX), a voluntary emissions reporting and trading system with binding commitments for GHG emissions reduction by its member companies. IBM's participation in CCX covered Scopes 1 and 2 GHG emissions from the company's operations in Canada, Mexico and the U.S.

Over its eight-year participation in CCX (2010 was the final year for the CCX program), IBM reduced its GHG emissions 19.9 percent against the 1998–2001 CCX baseline, compared to the commitment of a 6 percent reduction by 2010. CCX provided an effective means to document and verify GHG emissions reduction activities for IBM's North American operations.

IBM continued its participation in the World Wildlife Fund's Climate Savers program in 2010, working toward the committed reduction goal: Between 1990 and 2005, IBM reduced or avoided CO₂ emissions by an amount equivalent to 40 percent of its 1990 emissions through its global energy conservation program. To extend this achievement, IBM intends to reduce CO₂ emissions associated with its operational energy (electricity and fuel) use

by 12 percent between 2005 and 2012 through energy conservation and the purchase of renewable energy.

Under Climate Savers, IBM has also committed to improving the energy efficiency and energy utilization of its internal and clients' data centers through activities and offerings for data center best practices, measurement and monitoring programs, and virtualization and consolidation programs. Activities in support of this commitment are detailed in the [Data Centers](#) section.

Though the U.S. EPA discontinued the Climate Leaders program in 2010, IBM intends to meet the second generation GHG reduction commitment it set under the Climate Leaders program: To reduce total global GHG emissions by 7 percent from 2005 to 2012. IBM achieved its initial goal by reducing total global energy-related GHG emissions by an average of 6 percent per year and PFC emissions by 58 percent from 2000 to 2005.

Transportation and Logistics Initiatives

Employee Commuting and Leased/Rental Vehicles

IBM has been active in promoting programs that reduce the commute to work for its employees. Key contributors to this effort are IBM's two flexible work programs:

- Work-at-home: Enables many employees to work from a home office
- Mobile employees: Enables many other employees to work from home a designated number of days each week

In 2010, more than 122,000 employees (29 percent) globally participated in one of these two programs, which not only helps employees balance their work and personal responsibilities, but also benefits the environment. In the U.S. alone, IBM's work-at-home program conserved approximately 6.2 million gallons of fuel and avoided more than 48,000 metric tons of CO₂ emissions in 2010.

IBM joined the reconstituted U.S. Best Workplaces for CommutersSM (BWC) program in 2009. Currently, 22 IBM locations are registered as BWC sites which represent more than 60 percent of the company's U.S. employees. Many locations actively work with their local or regional transit commissions to integrate IBM's programs with regional programs to increase commuting options for the company's employees.

Globally, many IBM locations provide support for the use of public transit systems, including shuttles from locations to mass transit stations, and alternate transportation or "loaner" cars for business trips during the workday. Where IBM provides leased vehicles for employees, the company continues its effort to move to more fuel-efficient vehicles. Standard guidelines for smaller

6.2 million

gallons of fuel conserved and 48,000 metric tons of CO₂ emissions avoided by IBM's work-at-home program in the U.S. in 2010.

engine sizes and lower emissions have been established for leased vehicles globally. These guidelines are the framework for selecting car models offered under IBM car plans which reduces average car emission levels as the car fleets renew.

Business Travel

In 2010, IBM expanded the use of collaboration tools, both internally and externally, to reduce our impact on the environment. As a company, we conducted more than 790,000 online meetings and exchanged more than 10 billion instant messages. Collaborating in this fashion is fundamental to IBM and has allowed us to save on travel costs and impacts, boost productivity by connecting our global workforce 24/7, and avoid CO₂ emissions. We also have increased our use of video conferencing to help reduce the need for travel and improve team interactions. In addition to more than 400 video-equipped IBM rooms globally, we completed work on an IBM Sametime[®] desktop video pilot to extend video capability to employees' desktops. Expansion of this capability is planned for 2011.

790,000

meetings held virtually via IBM Web conferencing tools.

Efficiency of Logistics

IBM is reducing the CO₂ emissions associated with transporting its products through the efficient design of its packaging, working with suppliers on their packaging designs and optimizing logistics. In the area of logistics, IBM has been an active member of the U.S. EPA's SmartWaySM Transport Partnership since 2006.

100%

of IBM's shipped goods within the U.S. and to Canada and Mexico went through a SmartWay logistics provider.

SmartWay is a voluntary initiative to improve fuel efficiency and reduce GHG emissions associated with logistics operations.

Since 2009, 100 percent of IBM's spend for shipping goods within the U.S. and from the U.S. to Canada and Mexico went through a SmartWay logistics provider. IBM also voluntarily applies specific SmartWay requirements to its distribution operations globally.

IBM's packaging programs also help reduce transport-associated CO₂ emissions by reducing the volume and weight of the company's product shipments through innovative packaging design. Accomplishments in this area are discussed in the [Product Stewardship](#) section of this report.

Energy and Climate Protection in the Supply Chain

IBM is also focusing on the energy and climate programs of its suppliers to understand where they are with regard to having energy conservation and GHG reduction programs and to encourage their action and leadership in climate protection.

The following are two specific initiatives the company has undertaken in this area:

- IBM has been an active participant in the Electronics Industry Citizenship Coalition (EICC) environmental working group. This group is requesting that suppliers providing parts to EICC members disclose their operational energy use and GHG emissions to EICC through a spreadsheet tool developed by EICC, by responding to a Carbon Disclosure Project (CDP) Questionnaire, or through a company Global Reporting Initiative (GRI) report. Companies in the electronics industry share many suppliers and the EICC GHG emissions disclosure process is expected to provide efficiency associated with information disclosure. Where companies are not currently reporting through the CDP or GRI process, the EICC “spreadsheet reporting tool” offers a simplified, structured method for EICC members and their suppliers to inventory and disclose their energy use and GHG emissions, and their associated reduction plans. As companies gain an understanding of their energy use and GHG emissions we believe they are more likely to take actions to improve their performance. Member companies of EICC have also developed education modules to assist suppliers in developing their energy use and GHG emissions inventories.
- Through the CDP’s Supply Chain program, IBM and other participating companies are focused on how suppliers are addressing climate change and working to reduce GHG emissions. As a participant in the program, IBM invited 131 of its suppliers to respond to the CDP’s Supplier Questionnaire in 2010. These 131 suppliers represented a cross-section of IBM’s supplier expenditures with services, general and production-related suppliers, including such suppliers as third-party data centers, logistic suppliers and rental car companies, all of which have higher levels of energy use and associated GHG emissions.

Of the 131 IBM suppliers that received questionnaires, 113 responded. This 86 percent response rate exceeded the 71 percent average response rate for the companies participating in this CDP program. The following are highlights of the findings from the responding suppliers:

- 71 percent report Scope 1 GHG emissions.
- 71 percent report Scope 2 GHG emissions.
- 67 percent have a board committee or other executive body responsible for climate change.
- 45 percent have a GHG emissions reduction target in place.

IBM continues to participate in this endeavor because the company wants to work with suppliers who are responsible for the majority of IBM’s spend to gain an understanding of their operational impacts and assess where they are with regard to having a GHG emissions

inventory and reduction plan. Survey responses showed that about one-third of production suppliers had reduction plans, and about one-half of non-production suppliers had plans.

In 2011, IBM is focusing on working with its total supply base to assist suppliers in developing and implementing a corporate responsibility and environmental management system, whereby all of IBM's more than 27,000 suppliers are now required to assess and identify their significant environmental intersections, implement measurements and improvement targets for those areas, and provide public disclosure of the related programs and results. To complement this management system initiative, as well as enhance trend analysis on the supply base, IBM will again participate in the CDP Supply Chain Program in 2011. Approximately 107 suppliers, primarily those suppliers that responded to the 2010 questionnaire, will receive requests to participate.

IBM's Position on the Determination of Scope 3 GHG Emissions

Gross approximations of Scope 3 GHG emissions can help entities recognize where the greatest amounts of GHGs may occur during the lifecycle of a general product or service on a macro level. This can be helpful when assessing what phases of a general product's evolution, use and disposal are ripe for improved energy efficiency and innovation. However, IBM does not assert on a micro level what the Scope 3 GHG emissions are from the operations of its suppliers and external distribution partners in their work that is specific to IBM, or associated with the use of its products and services. The necessary estimating assumptions and corresponding variability simply do not allow for adequate credibility, let alone calculations that could be perceived as deterministic.

Like many manufacturers, IBM has thousands of suppliers around the world. They are in all types of businesses and very few, if any, work solely for IBM. Furthermore, the sources of energy used by these suppliers vary, and IBM does not believe it could determine a credible estimate or apportionment of the energy used by these suppliers that would be associated with the products or services provided to IBM versus that associated with products or services provided to other companies and customers. In addition, IBM's specific scope of business with any given supplier remains dynamic, as it is driven by business need.

Moreover, one company's asserted Scope 3 emissions are another company's Scope 1 and Scope 2 emissions. Since the ultimate goal for climate protection is for global societies to achieve demonstrable reductions in actual GHG emissions, IBM believes real results in GHG emissions reduction are directly achieved when each enterprise takes responsibility to address its own emissions and improve its energy efficiency. This is reinforced by IBM's recent announcement that all of its first-tier suppliers will be expected to develop a management system, inventory their key environmental impacts including GHG emissions and develop reduction plans for those key impacts.

In 2010, IBM collaborated with researchers at Carnegie Mellon University (CMU) on a case study to investigate the uncertainty and variability associated with calculation of the GHG emissions associated with the life cycle of a rack-mount server product (also referred to as the server's "carbon footprint"). IBM provided CMU with technical details and information regarding the IBM server product evaluated by the study.

In addition to highlighting the high level of uncertainty in product carbon footprint calculations (+/- 35 percent for the product selected), the results of the study verified that GHG emissions associated with the operation of the server dominated the full life cycle carbon footprint. This "use phase" of the server accounted for an estimated 94 percent of the total GHG emissions associated with the product. It reconfirmed the importance of IBM's ongoing efforts to increase the energy efficiency of its server products and the data centers where servers are used.

Coalition for Energy and Environmental Leadership in Leased Space

IBM's leased space represents another area of its supply chain in which the company believes it can make a difference. Along with DuPont, Fluor Corporation, Pitney Bowes Inc. and the Switzer Group, IBM formed a coalition to drive an increase in the availability of competitively priced leased space that also provides energy efficiency and other environmental attributes. In 2010, Interpublic Group, Lenovo and MasterCard joined the Coalition. By joining together, the Coalition hopes to make more environmentally sustainable leased spaces increasingly the standard rather than the exception in the marketplace.

To aid in accomplishing its objective, the Coalition developed a baseline Environmental and Energy Efficiency Attributes Checklist. It addresses requirements in four areas: sustainable site management, water efficiency, energy efficiency, and materials and resources.

Members of the Coalition commit to:

- Make the Environmental and Energy Efficiency Attributes Checklist a standard part of their requests for proposal (RFPs) for new leases and lease renewals for office space in the U.S.,
- Include the providers' response as a factor in making lease decisions, and
- Develop appropriate metrics to measure progress.

Actions under this initiative are intended to complement, not replace, individual companies' activities for improving building environmental and energy efficiency such as those pursuant to the U.S. Green Building Council's LEED® green building certification program.

Remediation

When groundwater contamination was first discovered at one of IBM's sites in 1977, the company initiated groundwater monitoring at all of its manufacturing and development locations worldwide. Today, IBM has 2,755 monitoring and 110 extraction wells at various sites around the world.

In 2010, 14,706 pounds of solvents from past contamination were extracted while remediating, controlling and containing groundwater at seven currently operating sites and 10 former sites in three countries. At four of these sites, an additional 794 pounds of solvents were removed by soil vapor extraction or other methods. IBM also has financial responsibility for remediation at three other former sites.

As a result of the U.S. Superfund law, IBM is involved in cleanup operations at some non-IBM sites in the U.S. The Superfund law creates a retroactive responsibility for certain past actions even though they may have been technically and legally acceptable at the time.

As of year-end 2010, IBM had received notification (through federal, state or private party) of its potential liability at 110 sites, since the beginning of the U.S. Superfund program back in 1980. Of these, 57 are on the U.S. National Priority List. At the majority of the 110 sites, it has been determined that IBM either never had liability or has resolved liability. As a result, IBM believes it may presently have potential liability at only 14 sites.

When investigation and/or remediation at an IBM location or an off-site facility is probable, and its costs can be reasonably estimated, IBM establishes accruals for loss contingency. Estimated costs connected with closure activities (such as removing and restoring chemical storage facilities) are accrued when the decision to close down a facility is made. As of December 31, 2010, the total accrual amount was \$262 million.

Audits and Compliance

IBM measures its environmental performance against both external and internal requirements. Every year, and more frequently for some, IBM's manufacturing, hardware development and research sites and organizations, such as Product Development, Global Real Estate Operations, Global Asset Recovery Services, Global Logistics and Global Service Environmental Compliance, complete a comprehensive self-assessment. Each year, certain sites are audited for environmental, health and safety compliance by IBM's Corporate Internal Audit staff. Audit results are communicated to top management. Follow-up, accountability and actions are clearly delineated.

In addition, as part of IBM's single, global registration to ISO 14001, approximately 20 sites or registered entities are audited annually by an independent ISO 14001 registrar. The company's manufacturing, hardware development and chemical-using research sites are audited, by either the Corporate Internal Audit team or the external ISO 14001 registrar, at least once every two years.

Accidental Releases

IBM sites around the world report environmental incidents and accidental releases to IBM management through the company's Environmental Incident Reporting System (EIRS). Every event meeting IBM's environmental incident reporting criteria, which equals or surpasses legal reporting requirements, must be reported through EIRS.

Each IBM location must have a documented incident prevention program (including provisions for preventing environmental incidents or their recurrence) and reporting procedure.

In 2010, a total of 14 accidental releases related to IBM operations were reported through EIRS. Of these, four were to air, six to land, two to water, and two to both land and water.

The releases to the air included three refrigerants and one particulate matter, which was a wet residue left on fans after a cleaning activity.

The releases to land included one of treated industrial wastewater, one of untreated industrial wastewater, and one each of antifreeze, fuel oil, condensate water and oil.

The releases to water included one of turbid water and one of water containing food particles and grease from a kitchen.

The releases to both land and water included one of untreated sanitary wastewater and one of hydraulic fluid.

The root cause was investigated for all releases, and corrective actions were taken as appropriate. None of the releases were of a duration or concentration to cause long-term environmental impact.

Fines and Penalties

One significant measure of a company’s environmental performance is its record of fines and penalties.

In 2010, IBM received 116 successful agency visits worldwide with no fines being assessed.

Over the past five years, IBM has paid three fines for a total amount of \$31,000.

116

successful agency visits worldwide in 2010 with no fines being assessed.

Fines and Penalties Worldwide (\$ in thousands)					
	2006	2007	2008	2009	2010
Number	0	1	0	2	0
Fines	\$0.0	\$1.0	\$0.0	\$30.0	\$0.0

Awards and Recognition

Internal Recognition

Chairman's Environmental Award Program

IBM established the Chairman's Environmental Award Program in 1991 to encourage leadership and recognize achievement and progress in environmental affairs on the part of IBM's organizations.

Similar to the past three years, the 2010 Award Program focused on energy conservation and energy efficiency across IBM's operations, products and services, and the competition continued to be among major business units.

The recipient was selected based on degree of leadership, results, and innovation and integration with regard to their programs and initiatives in the areas of energy conservation and energy efficiency. IBM Systems and Technology Group received the 2010 IBM Chairman's Environmental Award.



IBM Chairman Sam Palmisano (right) presents the 2010 IBM Chairman's Environmental Award to Rod Adkins, Senior Vice President, IBM Systems and Technology Group.

The Systems and Technology Group (STG) has global responsibility for developing IBM systems hardware and operating systems software solutions as well as designing and manufacturing semiconductor technology for IBM systems and OEM clients. STG's operations include 37 laboratories in nine U.S. states and 17 countries around the globe.

The selection of STG for the 2010 Chairman's Environmental Award recognizes the organization's outstanding leadership, innovation and results in energy efficiency and conservation as demonstrated by a comprehensive focus across its products and operations.

Energy efficiency results in STG's product lines from processors to high-performance computing products include:

- Enhanced power management functions in new server POWER7[®] and x86 processors, memory and I/O subsystems.
- Innovative data management such as Easy Tier[™] storage, data compression, data de-duplication, and thin provisioning supporting storage energy efficiency.
- Low-power "sleep" mode for Retail Store Systems.
- The first in the industry to qualify a 4-processor socket server to the new U.S. EPA ENERGY STAR[®] criteria for servers.
- The IBM System Blue Gene[®] family of supercomputers achieved computing excellence with breakthroughs in energy efficiency, winning the National Medal of Technology.

In data center energy efficiency initiatives, STG:

- Moved Measurement & Management Technologies (MMT) from Research to a data center thermal analysis customer service offering.
- Partnered with Syracuse University to deploy a new data center with innovative energy-saving features.
- Developed and offered Active Energy Management capabilities for IBM products.

In addition, STG achieved exceptional operational energy efficiency in its microelectronics manufacturing operations, significantly contributing to IBM's overall energy conservation results over the last three years.

External Recognition

- **#1 Green Ranking, Newsweek**

IBM ranked #1 in the *Newsweek* "Green Ranking" of the biggest publicly traded companies in developed and emerging world markets. The criteria include environmental impact, green policies and reputation.

- **Green500 List, The Green500[™]**

IBM was ranked #1 in the latest Supercomputing Green500 List announced by Green500.org. The Green500 ranks the top 500 supercomputers in the world by energy efficiency. The list shows that 13 of the top 25 most energy efficient supercomputers in the world are built on IBM high-performance computing technology. IBM also holds over half of the top 100 positions on this list.

- **Low-Carbon & Environmental Leadership, Gartner/World Wildlife Fund**

IBM was ranked #1 in all-around performance and was in the top 3 in all five categories in Gartner/World Wildlife Fund's recent "Low-Carbon & Environmental Leadership Findings Report." The report evaluated 28 ICT companies on their all-around performance, transformation by IT, transformation of IT, internal environmental performance and supply chain.

- **ISM Award for Excellence in Supply Management, Institute for Supply Management**

IBM received the ISM Award for Excellence in Supply Management (the "R. Gene Richter Award") from the Institute for Supply Management in the Sustainability category for 2011. The award recognized IBM for three initiatives including its Center of Excellence for Environmental Compliance/Social and Environmental Management System, Supply Chain Social Responsibility Initiative and Green ISC Initiative.

- **PM100 Awards**

Three of the eight 2011 Progressive Manufacturing 100 (PM100) Awards IBM received related to its environmental leadership. The awards recognized IBM for its Supply Chain Environmental and Corporate Responsibility Management System Requirement, its Center of Excellence (CoE) for Product Environmental Compliance, and its Environmental Reporting Tool (ERT). The PM100 Awards recognize companies from around the world that have achieved significant breakthroughs in innovation, the use of advanced technologies and the effective management of their businesses.

- **LEED® Gold Certification, U.S.**

In 2010, IBM's new, 60,000 square foot, Leadership Data Center in Research Triangle Park, North Carolina, became the company's first LEED(R) Gold certified data center. Other IBM LEED certified facilities include its Boulder, Colorado Data Center (LEED Silver) and its LEED Gold Certification for Commercial Interiors for its leased office space known as the Bay Area Lab in Foster City, California.

- **Advanced Enterprise Award, China**

IBM International System and Technology Company (ISTC), Shenzhen, China, received an Advanced Enterprise Award from the Shenzhen Waste Reduction Action Program in 2010. The award is part of a voluntary program that encourages enterprises to reduce their waste volumes versus production.

- **Class of Excellence Wastewi\$e Label Award, Hong Kong**

IBM Hong Kong received the Class of Excellence Wastewi\$e Label Award in August 2010 in the Hong Kong Awards for Environmental Excellence program. The Wastewi\$e Label is a recognition scheme established to encourage Hong Kong businesses and organizations in adopting measures to reduce the amount of waste generated within their establishments or generated through the services and products they provide; and recognize their waste reduction efforts.

- **Environmental Excellence Award, Philippines**

In the Philippines, at the 9th Asian Corporate Social Responsibility (CSR) Awards, IBM received the Excellence Award in the Environment Excellence category for IBM's Corporate Service Corps, which helped create Interactive Flood Maps in support of a Smarter Philippines project.

- **Most Valuable Pollution Prevention Awards, National Pollution Prevention Roundtable**

IBM received two 2010 Most Valuable Pollution Prevention (MVP2) Awards from the National Pollution Prevention Roundtable: one for the elimination of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) compounds from the company's chip manufacturing processes in Burlington, VT and East Fishkill, NY, and one for chemical usage reductions at IBM's 300mm manufacturing facility in East Fishkill. This is the second year in a row and the third time in four years that IBM has received an MVP2 Award.

- **Vermont Governor's Awards, U.S.**

IBM Burlington, Vermont, received two 2010 Vermont Governor's Awards for Environmental Excellence & Pollution Prevention under the Environmental Excellence in Resource Conservation category for its "Solid Waste and Packaging Reductions at the IBM Burlington Facility" and "Cooling Load Reduction by Free Cooling in Cold Weather." This marked 17 consecutive years that IBM has been recognized with at least one of these awards—which is every year the competition has been held.

- **Distinguished Service Citation, U.S.**

IBM Burlington received a Distinguished Service Citation in the business/professional organization category of the 2010 Keep America Beautiful National Awards for Waste Reduction and Recycling for its solid waste and packaging reduction initiatives.

- **Distinction Award, Canada**

IBM Canada's Bromont site received the 2011 Distinction Award in the category of Energy Efficiency. The award was presented to IBM by the Agency for Energy Efficiency of Quebec and the Federation of Quebec Chambers of Commerce.

- **Excellence in Environmental Engineering Award, U.S.**

IBM East Fishkill received a 2011 Excellence in Environmental Engineering Award in the small projects category from the American Academy of Environmental Engineers (AAEE) for the catalytic reduction of hydrogen peroxide in ammonia wastewater.

Summary of IBM's Environmental Performance

IBM maintains goals covering the range of its environmental programs, including climate protection, energy and water conservation, pollution prevention, waste management and product stewardship. These goals and our performance against them are discussed in the Environment section of the online IBM Corporate Responsibility Report. The goals identified here as “KPIs” are based on stakeholder interest and materiality. IBM considers all of its goals to be important metrics of the company’s performance against its commitment to environmental protection.

IBM’s goal is to achieve annual energy conservation savings equal to 3.5 percent of IBM’s total energy use. IBM again achieved this goal in 2010, attaining a 5.7 percent savings from energy conservation projects.

	2006	2007	2008	2009	2010
Energy Conservation					
As % of total electricity use	3.9	3.8	6.1	5.4	5.7
Renewable Energy Procured					
As % of total electricity use	7.3	8.5	8.6	11.3	11.2

Between 1990 and 2005, IBM’s energy conservation actions reduced or avoided CO₂ emissions by an amount equal to 40 percent of its 1990 emissions. To further extend this achievement, IBM set an aggressive “2nd generation” goal: to reduce the CO₂ emissions associated with IBM’s energy use by 12 percent between 2005 and 2012 through energy conservation and the procurement of renewable energy.

As of year-end 2010, IBM’s energy conservation results and procurement of renewable energy yielded a 16.7 percent reduction in its energy-related CO₂ emissions since 2005.

	2006	2007	2008	2009	2010
CO₂ Emissions Reduction					
% reduction against the 2005 base year	—	+2.0	-1.6	-5.7	-16.7
Product Energy Efficiency	Please visit our Product Energy Efficiency section				

	2006	2007	2008	2009	2010
Recycled Plastics					
% of total plastics procured through IBM contracts for use in its products that is recycle —against annual goal of 5%	11.7	10.6	10.3	13.2	11.5

IBM’s goal is to reuse or recycle end-of-life IT products such that the amount of product waste sent by IBM’s Product End-of-Life Management (PELM) operations to landfills or incineration for treatment does not exceed a combined 3 percent of the total amount processed.

In 2010, IBM’s PELM operations sent only 0.6 percent of the total processed to landfill or incineration facilities for treatment.

	2006	2007	2008	2009	2010
Product End-of-Life Management					
% of total processed sent by these operations to landfill or incineration for treatment	1.1	0.8	0.6	0.5	0.6

IBM’s goal is to achieve year-to-year reduction in hazardous waste generated from IBM’s manufacturing processes indexed to output. IBM’s hazardous waste generation indexed to output decreased by 21.6 percent in 2010.

	2006	2007	2008	2009	2010
Hazardous Waste Reduction (%)	-8.1	-8.4	-10.9	+8.4	-21.6
Nonhazardous Waste Recycling					
% recycled of total generated against an annual goal of 67% (in 2006) and 75% (2007-2010)	76	78	76	76	79

IBM's goal is to achieve annual water savings equal to 2 percent of total annual water usage in microelectronics manufacturing operations, based on the water usage of the previous year and measured as an average over a rolling five-year period. In 2010, new water conservation and ongoing reuse and recycling initiatives in IBM's microelectronics operations achieved an annual 1.8 percent savings in water use, resulting in a rolling five-year average of a 2.8 percent savings versus the 2 percent goal.

	2006	2007	2008	2009	2010
Water Conservation (%)	7.0	6.0	4.6	3.1	2.8

IBM ENVIRONMENTAL AFFAIRS POLICY

IBM is committed to environmental affairs leadership in all of its business activities. IBM has had long-standing corporate policies of providing a safe and healthful workplace, protecting the environment, and conserving energy and natural resources, which were formalized in 1967, 1971 and 1974, respectively. They have served the environment and our business well over the years and provide the foundation for the following corporate policy objectives:

- Provide a safe and healthful workplace and ensure that personnel are properly trained and have appropriate safety and emergency equipment.
- Be an environmentally responsible neighbor in the communities where we operate, and act promptly and responsibly to correct incidents or conditions that endanger health, safety or the environment. Report them to authorities promptly and inform affected parties as appropriate.
- Conserve natural resources by reusing and recycling materials, purchasing recycled materials, and using recyclable packaging and other materials.
- Develop, manufacture and market products that are safe for their intended use, efficient in their use of energy, protective of the environment, and that can be reused, recycled or disposed of safely.
- Use development and manufacturing processes that do not adversely affect the environment, including developing and improving operations and technologies to minimize waste; prevent air, water, and other pollution; minimize health and safety risks; and dispose of waste safely and responsibly.
- Ensure the responsible use of energy throughout our business, including conserving energy, improving energy efficiency, and giving preference to renewable over nonrenewable energy sources when feasible.
- Participate in efforts to improve environmental protection and understanding around the world and share appropriate pollution prevention technology, knowledge and methods.
- Utilize IBM products, services and expertise around the world to assist in the development of solutions to environmental problems.
- Meet or exceed all applicable government requirements and voluntary requirements to which IBM subscribes. Set and adhere to stringent requirements of our own no matter where in the world the company does business.
- Strive to continually improve IBM's environmental management system and performance, and periodically issue progress reports to the general public.
- Conduct rigorous audits and self-assessments of IBM's compliance with this policy, measure progress of IBM's environmental affairs performance, and report periodically to the Board of Directors.

Every employee and every contractor on IBM premises is expected to follow this policy and to report any environmental, health or safety concern to IBM management. Managers are expected to take prompt action.