IBM Global Technology Services

Think Green – Think Ahead: Double IT capacity or Half operational costs and Be Environmentally responsible

Steven Sams, Vice President
Site and Facilities Services

Messages

- **Energy efficiency is a global issue with significant impact today — and will have an even greater impact in the future**
- **IBM Project Big Green is defining leadership in data center energy efficiency**
- **Real solutions are available today**
- **We are deploying these capabilities with our clients and within IBM**
- **We can help you decide how to get started**

Data centers are at a tipping point and energy use and cost is the driver

Increased Computing Demand

- **Between 2000 and 2010 sever installations will grow by 6x and storage by 69x. Wintel and Unix server utilization low – 3 to 30% –** *IBM / Consultant studies*
- **Per square foot, annual data center energy costs are 10 to 30 times more than those of a typical office building.** [2] *- William Tschudi, March 2006*

Changing Cost Dynamics

- **Data centers have doubled their energy use in the past five years.** [3] *- Koomey, February 2007*
- **US commercial electrical costs increased by 10% from 2005-06.** [4] **-** *EPA Monthly Forecast, 2007*

Data Center Lifecycle Mismatch

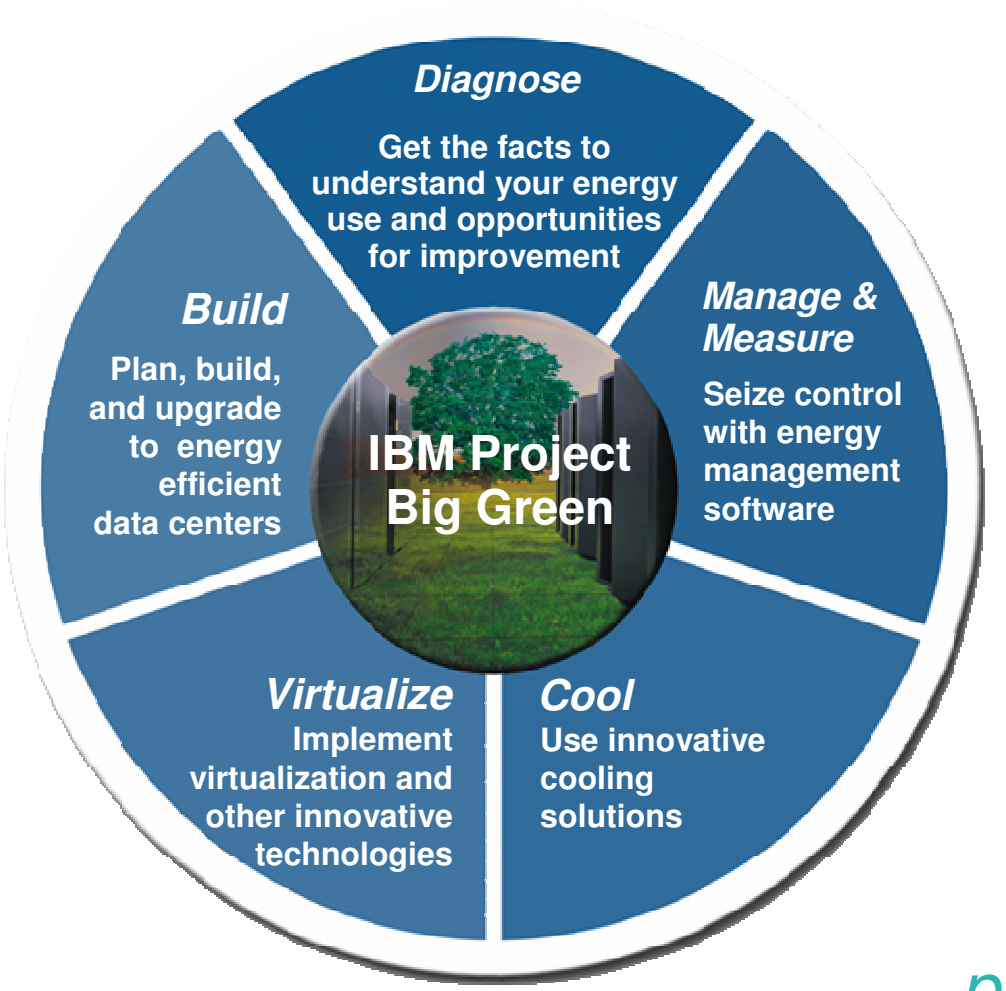
- **"Eighty-seven percent of data centers were built before 2001"** [5]
- **"Twenty-nine percent of clients identified" data center capability affected server purchases** "- *Ziff Davis*

1. Gartner, *Data Center Power and Cooling Scenario Through 2015*, Rakesh Kumar, March 2007.
2. William Tschudi, March 2006.
3. Koomey, February 2007.
4. *EPA Monthly Forecast*, 2007.
5. Nemertes Research, Architecting and Managing the 21st Century Data Center, Johna Till Johnson, 2006.

Think Green: *What is the role of the CIO?*

What is your choice?

Five building blocks provide the tools to operational savings and business growth.



Double your IT capacity

- In the same energy footprint

Reduce operational costs

- 40-50% energy savings
- $1.3M / yr savings

Positive environmental impact

- 1,300 less cars or 3.5M less pounds of coal

Going green impacts the pocketbook and the planet.

Where does the energy go?

The data center energy challenge affects both the physical data center and the IT infrastructure

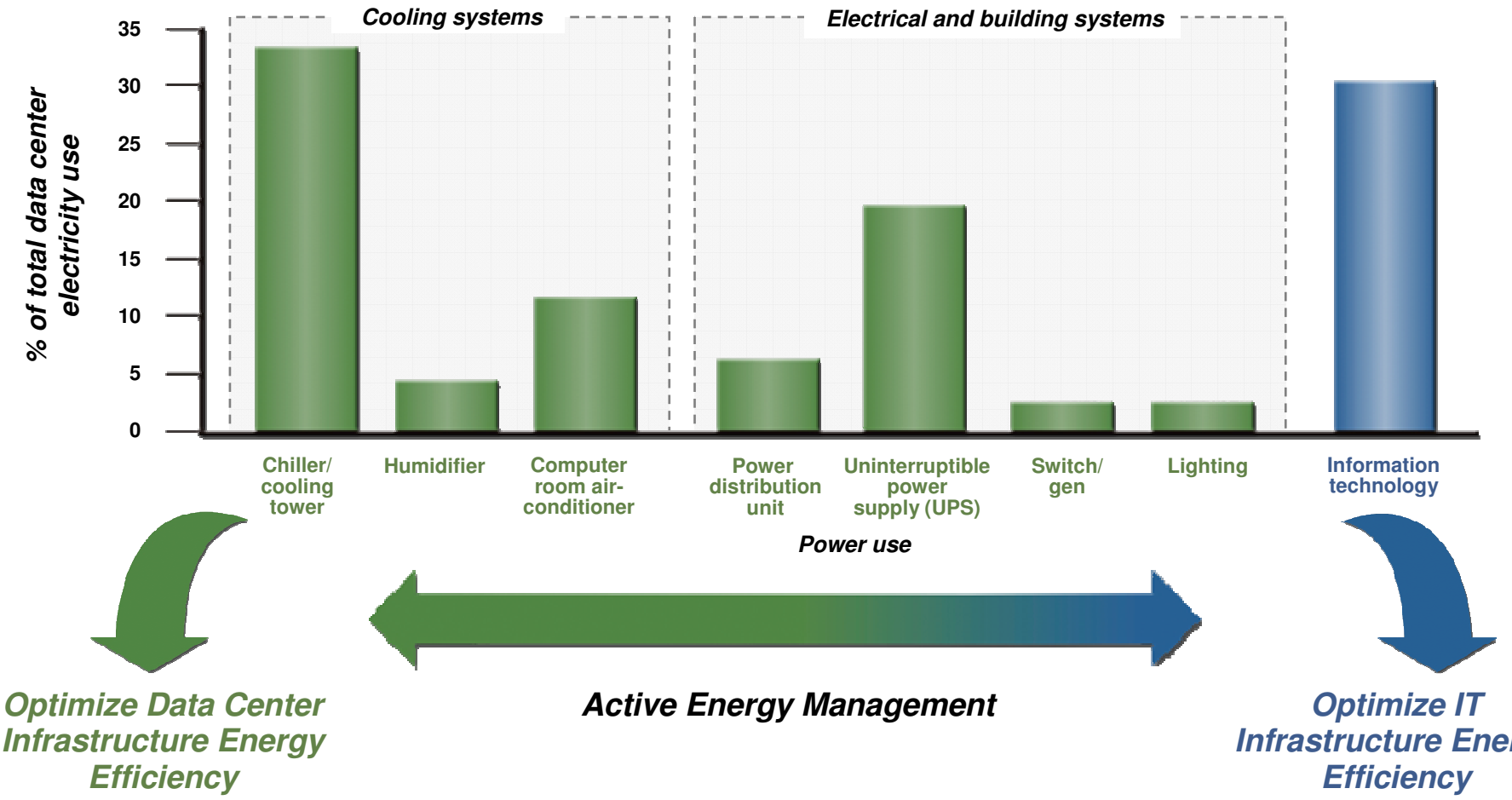


Chart and data source: American Power Conversion Corporation (APC) white paper, Implementing Energy Efficient Data Centers, #114, by Neil Rasmussen, 2006.

How energy efficient is your data center?

Use a simple "MPG" equivalent for data center energy efficiency to find out where you are today

Diagnose – Data Center Energy Efficiency Assessment

Provide facts to reduce energy consumption by 53% annually

Client requirements

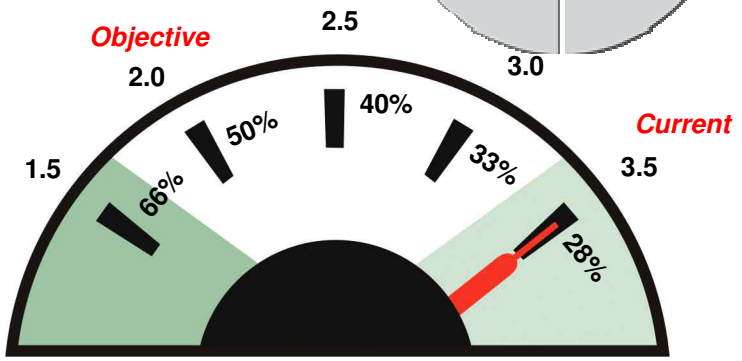
- Support IT growth with an existing 500 sq meter center
- Improve data center energy efficiency & reduce costs

Solution

- Comprehensive, fact-based analysis
- Evaluate cooling system components, electrical systems and other building systems
- Provide baseline metric (MPG) for data center energy efficiency
- Deliver roadmap of cost justified recommendations

Benefits

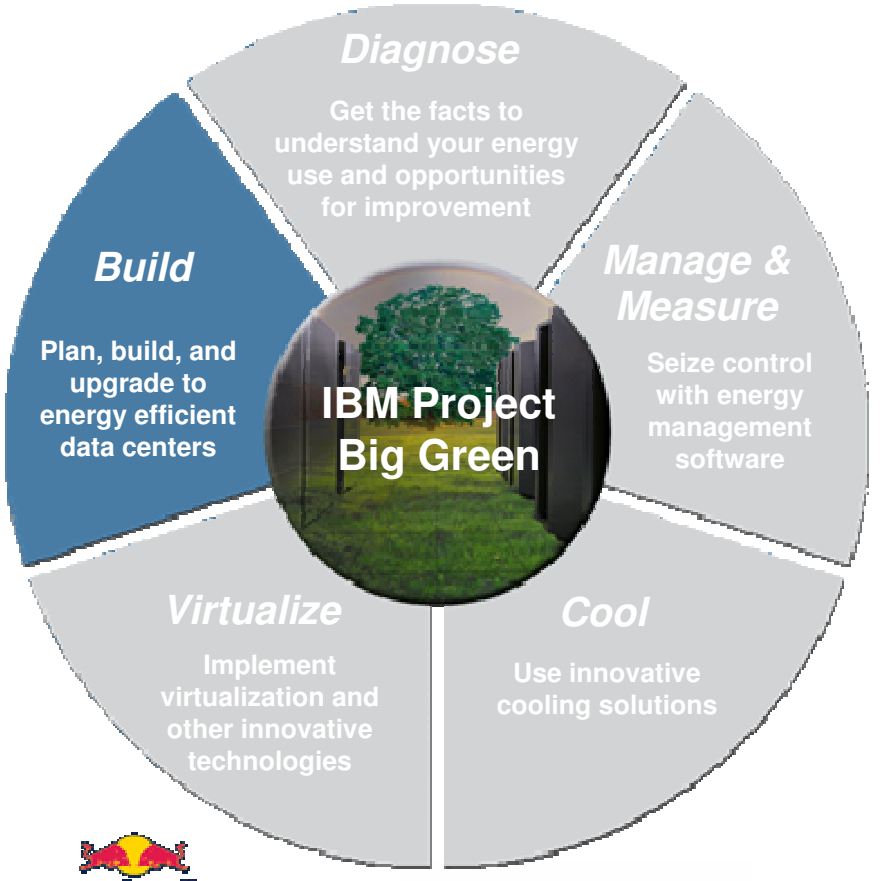
- Up to 53% annual energy savings
- 40% annual savings on actions with < 2 year payback
- $125-170K annual energy savings



Improvements	Cost ($K)	Payback
Reduce recirculation & bypass of cooling air	< 5	< 1 year
Increase CRAC air discharge temperature	< 5	<1 year
Adjust indoor temperature & relative humidity	< 3	<1 year
Turn off CRAC's where no IT equipment load	< 1	immediate
Improve UPS efficiency	40-140	1-2 years
Consider transferring IT loads to two PDUs	Varies	varies
Implement occupancy sensor light controls	< 5	1.5 years
Variable speed fans	200	6 years
Variable speed scroll compressors	300	18 years
Total	**60 - 700**	**1 To 18 years**

Build – plan, build and upgrade to energy efficient data centers

- **IBM and our clients are seeing results from data center builds**
  - $180M reduction in annual operating expenses from consolidating 38 to 2 data centers and improving business resilience (China)
  - $7.2 M USD in annual operational savings for consolidating 4 centers into one 380 square meter data center (Germany)



Boehringer Ingelheim
中国工商银行 INDUSTRIAL AND COMMERCIAL BANK OF CHINA
LAS VEGAS REVIEW-JOURNAL
bharti building telecom building partnerships
SWEDISH MEDICAL CENTER
Red Bull Racing
STIHL

Build - Scalable Modular Data Center-Bryant University

Rapid deployment of a traditional data center at 20% less cost than a traditional data center raised floor

Client requirements

- Decentralized IT infrastructure was costly, inefficient and increasingly unable to scale to growing demands for IT services
- Needed to consolidate to an enterprise-class data center

Solution

- Implemented an IBM Scalable Modular Data Center solution with advanced InfraStruXure® architecture from IBM Alliance Partner APC
- Standardized on IBM BladeCenter® for virtualized Microsoft® Windows® and Linux®
- Saves on power and cooling costs; can provision new virtual servers in < 1 day

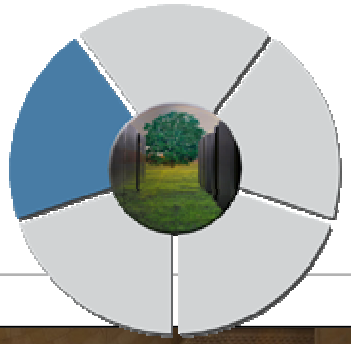
Benefits

- Reduced physical servers from 75 to 40
- 40 to 50 percent reduction in floor space requirements
- Contributed to reduced carbon footprint and reduced power consumption/cooling

"The bulk of the installation was completed within just 4 days. The quality of the engineering work and project management from IBM was outstanding" - Rich Siedzik, Director of Computer and Telecommunication Services, Bryant University

"We consulted several vendors and it was clear that IBM had the edge in terms of innovative ideas" – Art Gloster, Bryant University CIO

Build - Supercomputing Center- MareNorstrum



Leadership power and cooling design to support #1 supercomputing data center in Europe

Client requirements

- Build the #1 supercomputing data center in Europe
- Install 2,560 blades - 94.21 terra flops
- 4 months - construction start to functional center
- Support 2-3 generations of technology changes

Solution

- Build it in only 160 square meters
- Design the power and cooling within the constraints of an 18th-century church
- Support state-of-the-art, high-density IT equipment
- Provide flexible design to allow for technology upgrades
- And … make it beautiful

Benefits

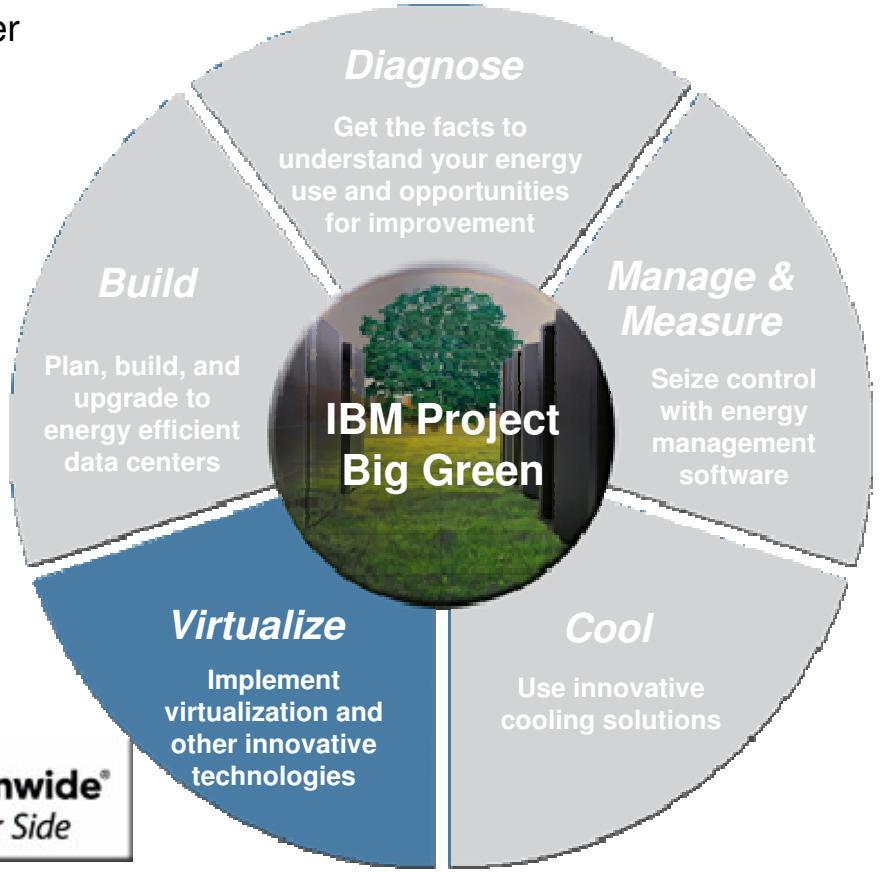
- Supports 21KW/rack (40 W/sq meter) of cooling
- Flexibility for the future – supercomputing performance upgrade underway
- World's most beautiful supercomputing center
- On our third system upgrade in the same facility

Virtualize – Implement virtualization and other innovative technologies

- **IBM and our clients are seeing results from virtualization of servers and storage**
  - Double storage utilization with SAN Volume Controller
  - Up to 10:1 are typical server consolidation results[1]

"Energy efficiency is the number one priority for PG&E as we work with our customers to meet our environmental goals. We're thrilled to partner with IBM to pilot energy efficiency innovations that can help our customers save money and protect the environment by further reducing their energy use."

Brad Whitcomb,
VP, Customer Products & Services,
PG&E



1. Gartner, *Toolkit: The Impact of Virtualization on Data Center Facilities*, G00148020, June 2007.

Virtualize – Accelerator for Rationalization at UPMC

Maximize service level and mitigate costs by saving $18-22M over 3 years with Wintel, Unix and storage virtualization

Client requirements

- Server growth 4x in 5 years – data center chaos
- Centralize IT services and consolidate data centers
- Free up space to produce revenue – more hospital beds

Solution

- Wintel and Unix virtualization
- Reducing from 40 storage databases to two centralized SAN arrays
- Consolidating 1,000 physical servers to 300 IBM servers (multiple platforms)

Benefits: $18-22M savings over 3 years

- Virtualization saved $9.8M in first five months
- Utilization rates increasing from 3% to 80% per server
- Server capacity increase by 150%
- Maintained flat infrastructure support staff
- Create hospital space

UPMC | University of Pittsburgh Medical Center

"These accomplishments help position UPMC as a leader in the adoption of server virtualization technology among health care provider organizations…will fundamentally alter how IT is deployed and managed in the industry"

- Health Industry Insights, IDC, January 2007

Virtualize - IBM Data Centers

Improve operational efficiency and risk management while reducing energy usage by 80%

Client requirements

- Needed to reduce systems management complexity
- Needed to increase stability, availability, and provide world-class security
- Improve operational costs and energy efficiency

Solution

- Consolidate 3,900 servers to 33 System z mainframes
- Migrate servers delivering largest savings first
- Eliminate assets with lowest utilization first
- Aggregate by customer work portfolio to leverage strong customer buy-in
- Focus on freeing up raised floor space
- Provision new applications to the mainframe

Benefits

- Annual energy usage reduced by 80%
- Total floor space reduced by 85%

Initial priority for consolidation to Linux on System z

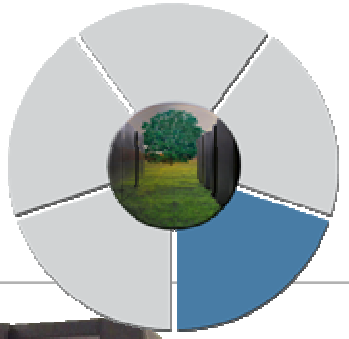
DB2

Lotus

WebSphere

SAP

Cool – University Supercomputer Center



Innovative design using IBM cooling technologies to support highest computational performance and save $780K in costs

Client requirements

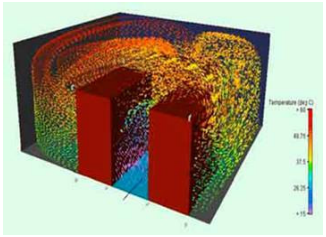
- Highest possible computational performance
- Address heat output from ultra-dense blade servers
- Limited by budget and floor space

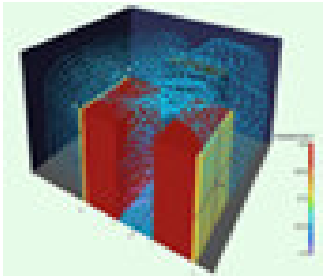
Solution

- IBM System Cluster 1350 with 1,000 IBM BladeCenter® LS20 nodes each with four AMD Opteron cores
- Combines standard air conditioning and IBM Rear Door Heat eXchanger
- Unique data center design with open floor titles on cold aisles and directional baffles

Benefits

- Maximum LINPACK performance of 8.5 TFlops
- Saved an estimated $780,000 in total data center costs
  - 10-15% reduction in operating costs
  - 55% reduction in air conditioning requirements
  - 50% lower airflow requirements for less disruption and less noise





"Our innovative data center design, allied with the IBM technologies, enabled us to pack a huge amount of computing power in a compact space….more cost effective and environmentally friendly than a traditional design while offering the same compute power." – Major US university

Cool - Data Center Stored Cooling-IBM Bromont

Implement innovative cooling technology to reduce operational costs from the largest data center energy user by 45%

Client requirements

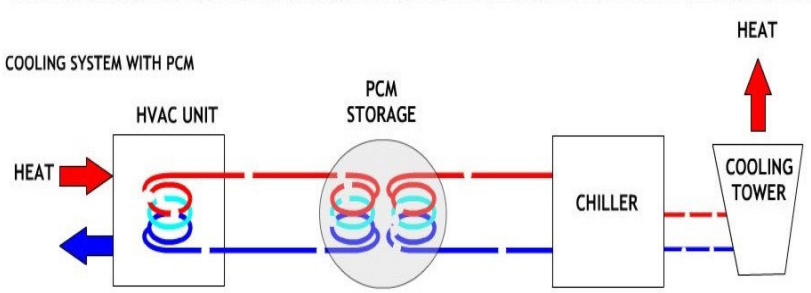
- Identify and attach the largest areas of energy consumption
- Reduce energy consumption and operating costs of chiller plant supporting Bromont (Quebec, Canada) site

Solution

- Install “Cool Battery”
- Increase chiller utilization by storing cold for use throughout the day
- Leverage environment - free cooling

Benefits

- Reduced chiller plant energy cost by 45%
  - Over 5.3 million kwhr per year
  - Demand reduction of approximately 1 MW
- Avoided need to install additional chiller
- Environmentally-friendly, non-toxic, no-maintenance



Manage and Measure

Seize control with energy management software

Measure/Trend Power use

- **Help control power consumption**
- **Provide energy billing metrics**

Allocate or cap power

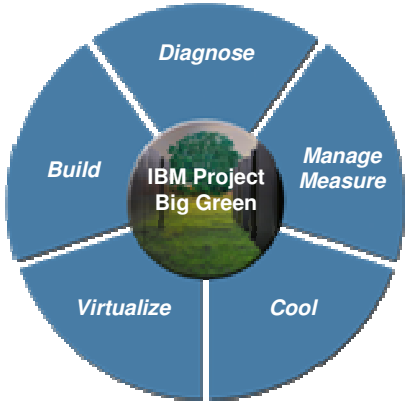
- **Use power history and service levels to optimize energy use**

Automate energy management

- **"Cruise control" for power consumption of servers**
- **Service level automation**
- **Energy optimization automation**

IBM Systems Director Active Energy Manager

Benefits of a Green Data Center



	From	To
Financial 	Rising global energy prices	Ability to accurately view baseline energy cost
	Squeeze on IT budgets	Cost savings from more efficient energy use
	Constraints on IT growth	Reduce power and cooling issues as inhibitor to business growth
Operational 	High density server systems	More computing performance per kilowatt
	Exploding power & cooling cost	Shift to have more energy used by IT than physical infrastructure
	Aging data centers	Extend the life of existing data centers
Environmental 	Corporate social responsibility	Meaningful energy conservation and reduced CO_2 emissions
	Limited "green" public image	Improve "green" public image
	Improve employee moral	Positive impact linking corporate social responsibility and personal values

Recommendations

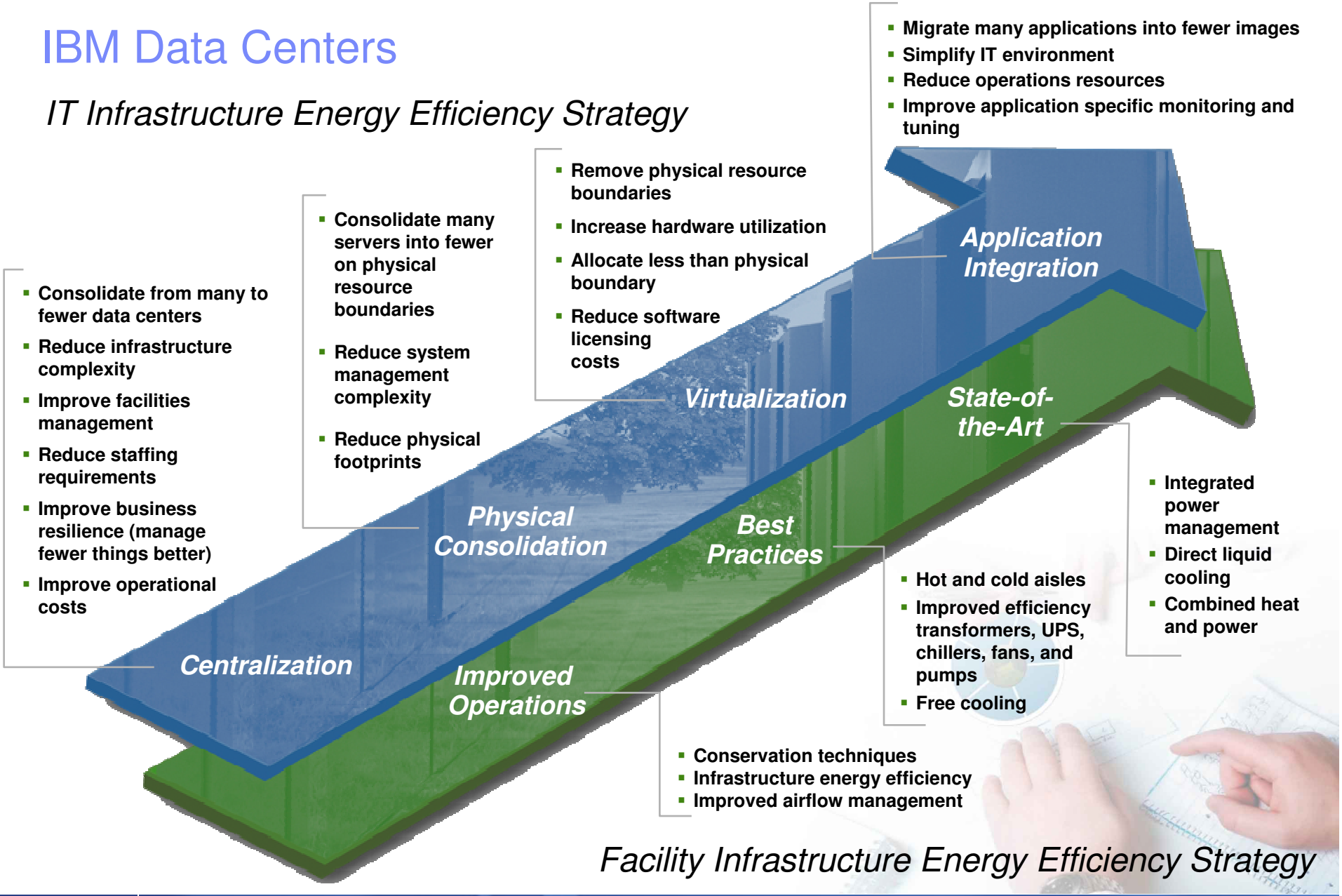
- **CIO's should take pro-active leadership to enable business growth and reduce operational costs**
- **Start by getting the facts on energy usage**
- **Implement immediate payback items today**
- **Leverage IBM experience in energy efficiency and resiliency**
  - Deep experience and global breadth
  - Client and internal expertise
  - Deliver business resilience and operational savings
  - Leadership in hardware, software and services

Thank You




IBM Data Centers

IT Infrastructure Energy Efficiency Strategy



Facility Infrastructure Energy Efficiency Strategy

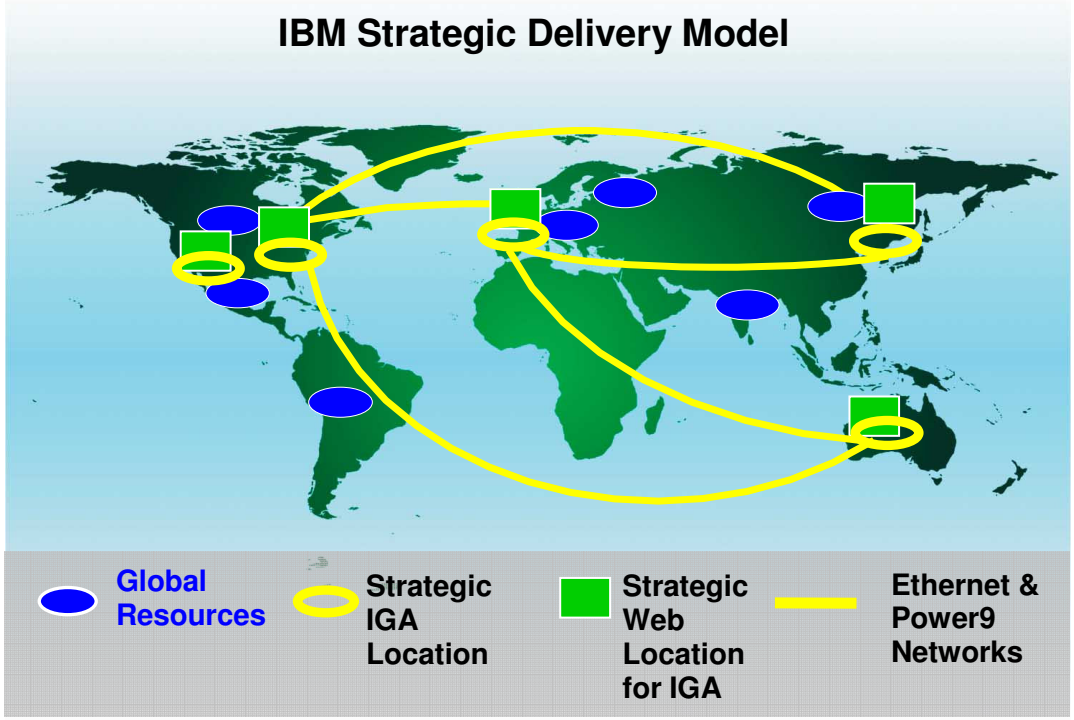
Environmental Protection Agency Report to Congress

Scenario / Percent Energy Savings	IT Equipment	Site Infrastructure (Power and Cooling)
Improved operation	• Continue current trends for server consolidation • Eliminate unused servers • Adopt "energy-efficient" servers to modest level • Enable power management on 100% of applicable servers • Assume modest decline in energy use of enterprise storage equipment	30% improvement in infrastructure energy efficiency from improved airflow management
Best practice	All measures above plus: • Consolidate servers to moderate extent • Aggressively adopt "energy-efficient" servers • Assume moderate storage consolidation	Up to 70% improvement in infrastructure energy efficiency from all measures in "Improved operation" scenario, plus: • Improved transformers and uninterruptible power supplies • Improved efficiency chillers, fans, and pumps • Free cooling
State-of-the-art	All measures above plus: • Aggressively consolidate servers • Aggressively consolidate storage • Enable power management at data center level of applications, servers, and equipment for networking and storage	Up to 80% improvement in infrastructure energy efficiency, due to all measures in "Best practice" scenario, plus: • Direct liquid cooling • Combined heat and power

Source: EPA Response to Congress for Public Law 109-431, 08/07/07

IBM Data Center Global Expertise

A decade of managing 8M square feet of data centers around the world



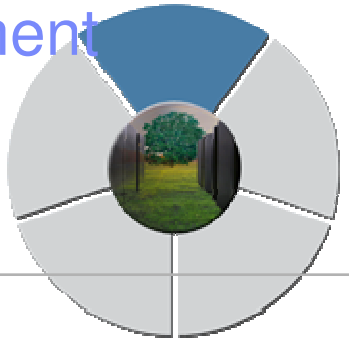
TECHNOLOGY

IBM Metrics	1997	Today
CIOs	128	1
Host data centers	155	7
Web hosting centers	80	5
Network	31	1
Applications	15,000	4,700

Plus…Deep experience in helping our clients data center challenges

- Significant services deployment capability: over 3,300 resources for server, storage and data centers
- Global breadth: built >30M square feet of data centers; top 5 Chinese banks; India & Egypt telecomm
- Leverage experience from managing and deploying over 200,000 servers in over 400 centers

Diagnose – Data Center Energy Efficiency Assessment - IBM Lexington



Extend useful life of an 84K square foot center with 15% energy savings from physical infrastructure efficiencies

Client requirements

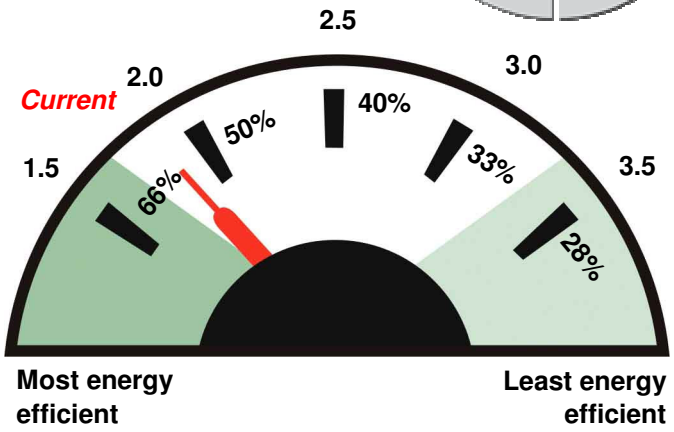
- Not able to grow energy and cooling capacity in existing 8400 sq meter data center
- Need to reduce energy used by physical infrastructure to grow IT equipment

Solution

- Comprehensive, fact-based analysis
- Evaluate cooling system components, electrical systems and other building systems
- Provide baseline metric (MPG) for data center energy efficiency
- Deliver roadmap of cost justified recommendations

Estimated Benefits

- 15% annual energy savings from physical infrastructure
- $55-65K annual energy savings in an efficient center
- All investments have < 2 year payback



Improvements	Cost ($K)	Payback
Air management improvements: floor gaps, blanking plates, tile placement	< 5	< 1 year
Align servers using hot / cold aisle techniques	<10	< 1 year
Increase chilled water temperatures	< 5	<1 year
Increase supply air temperatures from CRAC's	< 3	<1 year
Re-commission water side economizer for "free cooling"	~ 50 to 100	< 2 years
Total	**75 - 125**	**< 2 years**

Build - Data Center Expansion- IBM Boulder

Add 7200 square meters to a highly resilient center to include energy efficiency as a design point

IT Related

Design / Build

- Economies of scale – 30000 sq meters
- Power Density - 90 watts / sf (modular to 140)
- Best Practices Equipment Layout
- No Single Points of Failure
- Tier 3 design point

Operate

- Virtualized High Utilization Workload
- Demand modeling for future requirements
- Three dimensional space and power billing
- Low Green Grid PUE metric
- Integrated Power Management Software
- Liquid cooled equipment
- Low long term TCO

Facilities Related

Cooling

- Free cooling > 50%
- Chiller water Pumping/Air handling units variable speed drives
- DC CRAC Motors

Electrical

- Modular power density expansion options

Other building systems

- Energy Efficient Lighting
- High “R” Value Insulation

Industry Related

LEED Certification Objective

Energy Management Programs ($700K)

- Power Company Rebates
- Government Incentives
- Renewable Energy Certificates

Environmental Programs

- Wind Power Generation (1,000 MW)
- Reduced CO_2 emissions

Virtualize - IBM Data Centers

Improved operational costs up to 70% with aggressive distributed platform virtualization

Client requirements

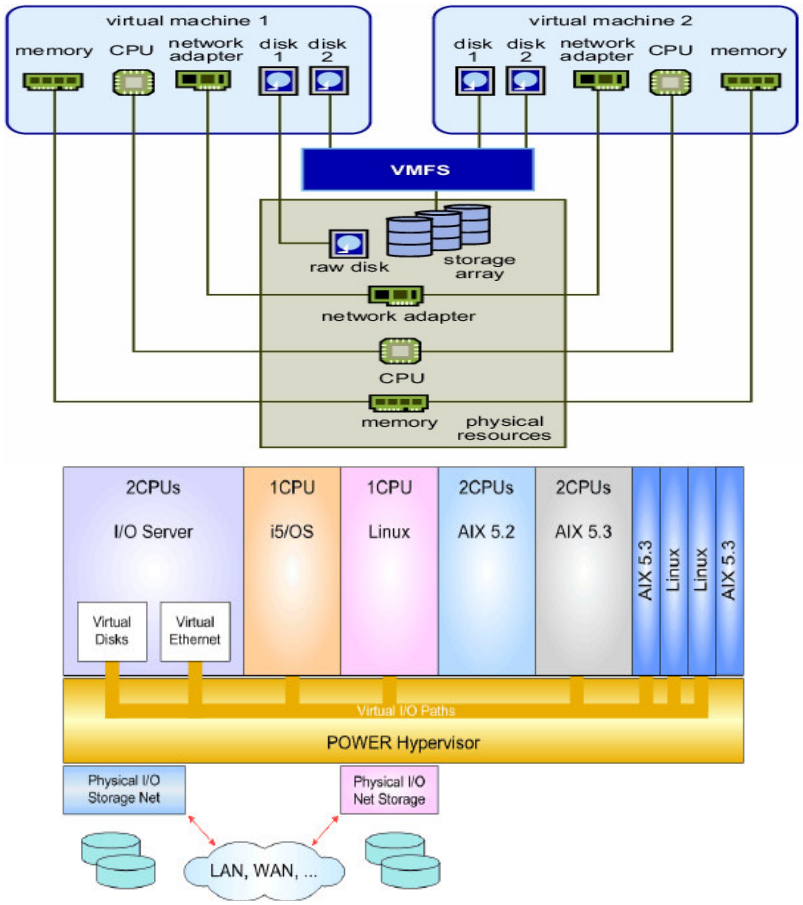
- Improve IT equipment utilization
- Reduce IT hardware requirements

Solution

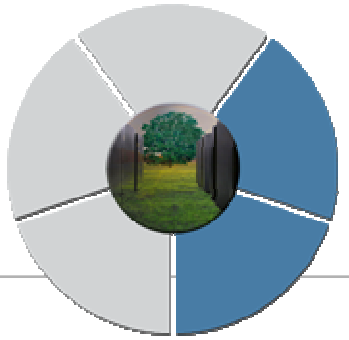
- Advanced POWER Virtualization (APV) and VMWare
- Reduced number of physical servers
  - Wintel from 11,000 to 1,500
  - Unix from 8,500 to 1,500
- Three times improvement in server utilization
- Formed a Virtualization Center of Excellence to implement best practices across geographies

Benefits

- Operational savings of up to 70%
  - Space, power and cooling, maintenance, software support and personnel costs



Manage, Measure & Cool - IBM Southbury



Implement IBM Energy Management Solution and IBM Rear Door Heat eXchanger for 10-30% energy savings

Client requirements

- Improve how to meter, control, and cap power usage
- Actively moving workloads and power up/down resources

Solution

- Power density of 200 watts per square foot
- Use of 2-3 “Thermal Zones” for targeted power and cooling
- Power and thermal meters to measure baseline and changes
- Rack based thermal cooling

Expected Benefits

- Integrated Facilities and IT solution
- Rack Level Cooling Improves Efficiency 20-30%
- Match Cooling Load to Heat Load: 10-30% Savings
- Combined Air and Water or Refrigerant Cooling
- Reduces Equipment Costs/More Flexible Facility

IBM PowerExecutive

Environmental responsibility is a core IBM value

New Goal Announced!

Further extend IBM's early accomplishments by reducing CO_2 emissions associated with IBM's energy use 12% from 2005 to 2012 via energy conservation, use of renewable energy, and/or funding CO_2 emissions reductions with Renewable Energy Certificates or comparable instruments.

Awards & Recognition

BEST Workplaces for Commuters℠ — FORTUNE 500 Top 20 2004, 2005, 2006

ENERGY STAR — 1998, 1999, 2001

CLIMATE LEADERS U.S. Environmental Protection Agency — 2005

WWF climate savers — 2005

USEPA Climate Protection Award 1998 and 2006

The Climate Group 2005

Green Power Purchaser Award 2006

Environmental Efforts at Big Blue

Computer Program Charter Member 1992 — ENERGY STAR

Charter Member 2000 — WWF climate savers

CCX Chicago Climate Exchange — Charter member 2003

SmartWay Transport Partnership

PEW CENTER Global CLIMATE CHANGE — Business Environmental Leadership Council

CLIMATE LEADERS U.S. Environmental Protection Agency — Charter Member 2002

WRI Green Power Market Development Group Charter member 2000

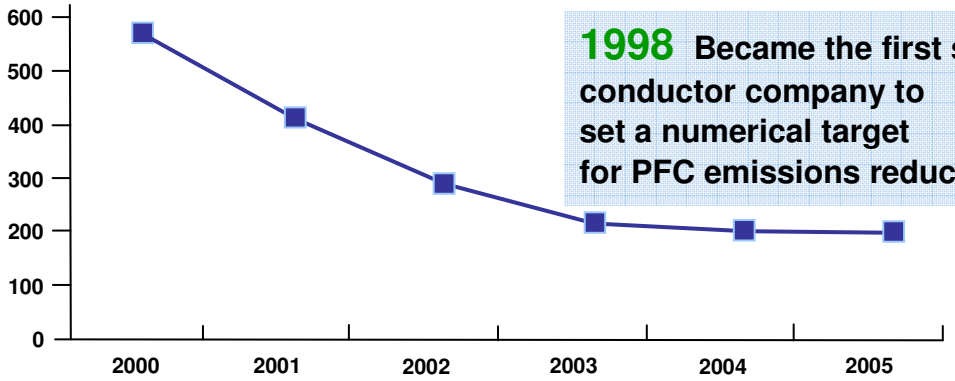
ClimateVISION — 1605(b) voluntary emissions reporting since 1995

CARBON DISCLOSURE PROJECT — Since inception

Long History

40%

Between 1990 and 2005, IBM's global energy conservation actions reduced or avoided CO_2 emissions by an amount equal to 40% of its 1990 emissions.



1998 Became the first semi-conductor company to set a numerical target for PFC emissions reduction

58%