Data Center Energy Efficiency

Going Green

Brian Canney
IBM Global Services Offering Executive
Agenda

- Why is IBM discussing data centers?
- Going Green…… What is it?
- Data Center Energy Usage
- Power and Cooling Issues
- Power and Cooling Roadmap for Efficiency
- Data Center Strategy
- How Can IBM Help
- Visit IBM at Datacenter Dynamics
Why is IBM Discussing Data Centers?

**Deep expertise**
- Designed and built:
  - + 2.8 million m² of client raised floor
  - + 100 IBM datacenters - 560,000 m² in production
  - + 100 IBM business recovery centers to house in crisis clients
  - 4 of 5 top DC and/or ECC in China and 5 largest banks in China
  - Largest HD datacenter for Telecom Services provider in India
  - Plans and installs 50 and 100 sq m data centers in 8 - 12 weeks

**Global strength**
- Strong local presence around the globe
- Deep emerging country teams … China/India/Egypt etc.
- Dedicated team of 500+ experts globally

**Technology depth**
- We have learned what works … because we use it
- Leading provider of server and storage technologies
- One of largest users of HP, SUN, EMC etc.
IBM Data Center and Facilities Strategy Services

We help you identify your requirements, capabilities and capacities, and define your optimal green, energy efficient and high-resiliency options.

IBM IT Facilities Assessment, Design and Construction Services
Providing capabilities to design and build new data centers or optimize existing ones.

IBM IT Facilities Consolidation and Relocation Services
Helping you leverage savings and redundancy through consolidation and relocation, leveraging IBM local presence around the globe to minimize risk.

IBM Specialized Facilities Services
Providing leadership requirements, design and construction for state-of-the-art clean rooms, intelligent/green buildings and trading floors.
Green Project

The design, construction, and operation of green projects minimize the use of **energy**, water, and materials while cutting waste and improving health and air quality. Reduce, reuse, and recycle are key strategies for a Green Building.
Data Center Energy Usage

- Typical data centers designed for 1kW – 3kW rack densities
- Blade server centric data centers can have 20kW+ rack densities
- Worldwide, the electricity consumption for data center servers in 2005 was equivalent to 14 - 1,000-megawatt power plants
  - In the USA in 2005, data center energy usage was 45,000,000,000kWh
- Energy consumed by data center servers and related infrastructure equipment worldwide doubled between 2000 and 2005
- **Worldwide server installations:**
  - 2000: 14.1 million servers
  - 2005: 27.3 million servers
- **Total Worldwide electric bill for servers and related infrastructure equipment: $7.2 billion (2005)**
Benefits of Going Green

When going Green, organizations will realize major benefits

- In addition to meeting regulations, requirements and standards, benefits include:
  - Credit as a good corporate citizen helping the environment
  - Major energy cost savings / avoid potential energy use penalties

- Both are byproducts of each other
- Both result in large payoffs for the organization
What is IBM Doing?

- IBM is focused on Green Data Centers and Intelligent Buildings
  - IBM locations:
    - Avoided nearly 9 million metric tons of CO$_2$ emissions through energy conservation between 1990 and 2005, a 40% reduction in our worldwide CO$_2$ emissions.
    - IBM Building 101, Austin, TX USA - one of the 10 greenest workplaces in the world
    - IBM Amagi Building, Shizuoka prefecture, Japan - the only 100% green power education facility in Japan
    - IBM Hakozaki office - Heat pump using heat source of river water
    - IBM Osaka-Nanko Data Center - Gas cogeneration system
    - IBM Japan HQ Building - Inverter lighting, Green Management
    - IBM Iikura office of IBM Japan - Remote minute control of Air Conditioning

- IBM is applying “Green” knowledge and skills to customer solutions
  - Mabuchi Motor Co., Ltd. - Double skin, Heat store in body, Roof gardening
    - Ecological building/facilities design for comfortable space and energy/resource saving
    - 13% reduction of life cycle cost and 22% reduction of life cycle CO$_2$
The cost structure and organizational dynamics of data centers are changing

“Twenty-nine percent in a recent research study say power and cooling issues have affected server purchases”

Ziff Davis

What is the greatest facility problem with your primary data center?

- Excessive heat
- Insufficient power
- Insufficient raised floor
- Excessive facility cost
- Poor location
- None of the above

Gartner 2006

“Power and cooling costs will increase to more than one-third of the total IT budget”

Robert Frances Group, January 2006
The IT industry has been focused on energy efficiency of the chip … Solving the remaining 97% of the data center energy challenge requires solutions for both the data center and information technology

One large company’s data centers use the power equivalent to the entire country of Sri Lanka - 6Bn kWh

20,000,000 People!
Challenges

- Energy use is a large and increasing cost
- Customers have no idea what the overall energy efficiency of their data centers are
- There is currently no simple approach for customers to evaluate and compare their overall energy efficiency
- Customers cannot identify or prioritize opportunity for energy efficient investments based on a financial return

*Without facts, solutions and the ability to compare capabilities, progress will be difficult*
Four business issues that resonate with our clients

1. **Power and Cooling – Reducing Energy Requirements**
   - Power is becoming the largest single data center operating cost
   - Blade servers use 20-45% less power and cooling than 1U technologies
   - The typical 15 year old data center has the potential for large improvements in power and cooling efficiency
   - Current data center design and builds may limit ability to use new efficient technologies

2. **Business Resiliency**
   - Data and application requirements may drive demand for new data centers
   - Legacy data centers may not have the design, build, infrastructure or location characteristics to support emerging regulatory and business requirements

3. **Data Center Cost**
   - Consolidating current data centers typically yields major cost savings
   - Server consolidation may reduce the need for multiple data centers

4. **Going Global**
   - Clients are building new data centers to be closer to their operating geographies and realize significant cost savings associated with global delivery
   - Data center re-deployment often follows Merger & Acquisition activity
Power and Cooling - Customer Challenges

- Existing data centers cannot accommodate **current technology** requirements. Data center layouts and operational procedures may not be designed to support high density technologies. Understanding the technology is increasingly important in data center design and management.

- **Thermal events** are increasing as a source of technology failure.

- In many cases the **organizational model** with independent facilities/real estate and information technology organizations inhibits understanding and addressing the energy and energy cost challenges

- Most clients **lack** the scale to develop **in-house experts** but are still hesitant to reach out to the external community. Current facilities are generally **sub-optimized**

- Clients do not have the power and cooling **facts**
  - Thermal and power loads
  - Overall data center energy efficiency
  - Energy use by major component

- There had been **no comparison standard** for energy efficiency
  - Green Grid has introduced Power Usage Effectiveness (PUE) and Data Center Efficiency (DCE)
  - They create a benchmark for data center energy efficiency
“cart” with sensors (thermal, humidity, flow (TBA), noise), which is mounted in a defined 3D pattern is rolled thru data center while data logging and tracking the position

- completely networked cart
- position tracking system
- 120 sensors
- customer location deployable
- 6000 square feet in one hour
- 11 W power consumption
- run time: 8 hours on more battery
- future generations will be motorized & more sensors and more compact
Cooling – Hot Aisle/Cold Aisle Approach

Simple concept, not many data centers employ it.
Implementation roadmap for power and cooling efficiency

- Optimize under floor air flow
- Implement Hot Aisle/Cold Aisle
- Optimize room air flow
- Power and cooling management systems
- Energy efficient / virtualize Server and Storage technology
MareNostrum – Barcelona Super Computing Centre

Client Requirements
- Build #1 super computing center in Europe to focus on computational, earth and life sciences
- Location - Torre Girona Chapel – 1,650 sq ft
- Install 2,560 blades - 94.21 terra fols
- 4 months - construction start to functional center
- Create a scalable, flexible environment

Solution
- Raised floor with design to accommodate high flow requirements
- Cooling capacity and redundancy to meeting high performance requirements
- Cooling water storage tanks

Benefits
- Supports 21KW/rack (400 W/sq ft) of cooling
- Flexibility for the future – supercomputing performance upgrade underway
- World’s most beautiful supercomputing center

Courtesy of Barcelona Supercomputing Center – www.bsc.es
Implementation roadmap for power and cooling efficiency

- Optimize under floor air flow
- Implement Hot Aisle/Cold Aisle
- Optimize room air flow
- Energy efficient / virtualize Server and Storage technology
- Power and cooling management systems
- Supplemental Cooling Devices
Center for the Study of Systems Biology - Georgia Tech Razor Supercomputer

Client requirements
- Create predictive tools for protein structure and function in cancer research.
- 1,000 – 1,340 blades - 8.5 terra flops
- Showcase facility with limited budget
- Limited budget

Solution
- Raised floor plenum cleared of blockages
- Physical separation of hot and cold streams
- Special floor tile design for maximum flow
- IBM Rear Door Heat eXchanger to remove 55% of heat load from the installation

Benefits
- Affordable supercomputing environment
- Cooling capability increased to 5-10 times the rest of the data center
- Capable of 23KW/rack (400 W/sq ft)
- Showcase environment – minimal air flow and noise
Implementation roadmap for power and cooling efficiency

- Optimize under floor air flow
- Implement Hot Aisle/Cold Aisle
- Energy efficient / virtualize Server and Storage technology
- Upgrade/ Right size Infrastructure
- Power and cooling management systems
- Supplemental Cooling Devices
- Enclosed racking systems
- Implement off peak cooling
Financial Services – High Density Computing Deployment

Client requirements
- High density blade deployment for compute intensive financial applications
- Limited floor space and limited power availability
- High availability and resiliency
- Cost and energy efficient

Solution
- 2,100 blades in 1,100 sq ft
- IBM Integrated Rack Solution for High Density
- Integrated networking, power management and environmental monitoring

Benefits
- Center enclosed cold aisle layout enables 600 Watts /sq ft or 25KW/rack
- Significant reduction in data center size and number of air conditioning units – cooling efficiency increased by 40-60%
- Reduction of 15-25% in space needed for cabling; improves air flow distribution
Cost and Resiliency - Customer Challenges

- Resiliency will continue to be the number one driver in data center design
  - Current environments are not optimized for resiliency across the corporation (location, recovery and backup plans, etc.)

- Many large clients discover they have multiple data centers around the world that may have not been part of an overall plan
  - Acquisitions
  - Independent geographic or divisional expansion

- The impact of more than 3 data centers is large
  - Cost
  - Inconsistent operational procedures / quality
  - Reduced overall resiliency

- Operational cost are shifting
  - Technology costs declining
  - Power costs increasing

- May have temporary/transitional requirements or demand spikes
Data Center Strategy Delivers Resiliency with Optimal Cost

Critical elements in corporate data center resiliency
Having a data center strategy is critical! A robust and scaleable methodology is based on business drivers, industry best practices, and current technology capabilities.

**The How To…**

**The How…**

**The Where…**

**The Cost..**
Data Center Strategy Delivers Resiliency with Optimal Cost

Critical elements in corporate data center resiliency

Number of Data Centers

Cost Impact

High

Low
A Major Chinese Bank Had Significant Cost Savings in a Major Consolidation of Data Centers

Client requirements
- Top 10 bank in world with 27,000 branches and 40M transactions a day
- Reduce time to market of new applications by optimizing existing work across 36 data centers
- Reduce overall costs
- Improve consistency, resiliency and security

Solution
- Consolidate 36 mainframe data centers into one production center plus one BCRS center
- Enterprise Command Center established to manage and control all data center facilities

Benefits
- $180 million annual savings
- Significant reduction in time to market of new banking services
- Highly secure environment
- 99.95% availability achieved
Client requirements
- German business travel firm with 600 travel agents
- Improve the efficiency of four data center locations that had grown without an overall plan
- Reduce real estate expense and staffing costs while improving resiliency, security and staff productivity

Solution
- Consolidate from 4 locations to a new 3,800 sq ft central data center
- Relocated 200 systems over three weekends
- No disruption of business operations

Benefits
- $4.7 million annual savings in staff
- $2.5 million annual savings from space reduction
- $3.75 million in equipment expense
- Improved data security
- 99% data availability achieved
Data Center Strategy Delivers Resiliency with Optimal Cost

Critical elements in corporate data center resiliency

- Number of Data Centers
  - High Cost Impact
- Resiliency design Tier 1-4
- Site Location
  - Geological
  - Meteorological, Geopolitical
  - Infrastructure, Cost
  - Potential for trauma
- Change management systems
We would like to help solve your challenges

1. We have deep and diverse engineering skills … solving the most challenging problems

2. Our experience is customer centric … deploying leadership offerings and methodologies

3. We are global ….. Not just in name but in local deployment

4. We have strong partnerships with the leading data center technology providers around the world … to leverage leading solutions for you
In October we announced five new global offerings to help our clients with critical needs

- **High Density Computing Data Center Readiness Assessment**
  Helps clients benefit from high density computing by assessing: their capacity and capability within their existing data centers, the gaps that could jeopardize continuous operations, and the actions to resolve identified concerns

- **Thermal Analysis for High Density Computing**
  Identifies and resolves heat-related problems within existing data centers and provides options for cost savings and future expansions

- **Integrated Rack Solution for High Density Computing**
  Helps clients design, deploy and manage resilient, flexible, modular racking solution to support new technologies within new and existing environments

- **Scalable Modular Data Center**
  Install a new data center quickly using modular solutions. The capability can be installed in nearly any working environment and provides ready power, cooling, security and monitoring for a turnkey data center environment

- **Data Center Global Consolidation and Relocation Enablement**
  Provides a consistent, repeatable, phased management approach to help clients implement a data center relocation/consolidation by leveraging local IBM site and facilities expertise around the globe

- **Watch this space for more IBM Energy Efficiency announcements**
Explosive Server Installations

- **Worldwide server installations:**
  - 2000: 14.1 million servers
  - 2005: 27.3 million servers

- **Where are they being installed?**
- **How are they being powered?**
- **How are they being cooled?**

- Most existing data centers were not designed for the servers of today
  - Organizations are seeing:
    - Heat loads exceeding cooling capacity
    - Power densities exceeding design points
    - Lack of server security
    - Lack of rack space
Scalable Modular Data Center

Description:
Data center solution that provides ready racking, power, cooling, security, and monitoring. Fast deployment, cost-effective, and installable in virtually any working environment.

Advantages:
• Lower cost and quicker to install
• Scalable modular design for easy capacity growth of UPS and air conditioning as needed
• Efficient UPS system – saves energy
• In Row Cooling – closely coupled to load
• Reduced number of single-points-of-failure
• Single computing environment for all applications
• Reduced maintenance costs and complexity of computing environment

Design / Implementation:
▪ Design / Install in about 8 – 12 weeks
▪ 50 m² – 100 m² - flexible
▪ Complete turn-key solution from planning to design to install and start-up
▪ Flexibility to expand and add racks and infrastructure as needed
▪ Infrastructure can be relocated if needed
▪ Raised floor not required
Scalable Modular Data Center

Situation
• The client needed to consolidate 3 smaller data centers and wanted a modular design to be able to grow with their changing business requirements

Solution
• Single point of contact for consulting, design, technology and project implementation
• Pre-configured solution of IBM p series blade servers, storage devices and infrastructure including power, cooling and management architecture

Benefit
• Quicker Installation and lower operational costs
• Position for future growth with modular environment
• Protect investment with components that can move as clients needs change

“The two have all the knowledge experts that we need”
-Richard Siedzik, director of computer and telecommunications services
Please Visit IBM at Datacenter Dynamics!!!