



***Energy Efficiency
for Green Data Centers***
**IBM Consolidating for Green
Green IT Trends**



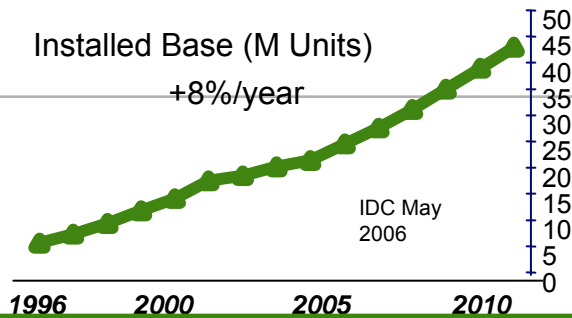
Jan. 25, 2008

David F. Anderson PE Green Consultant / Wizard

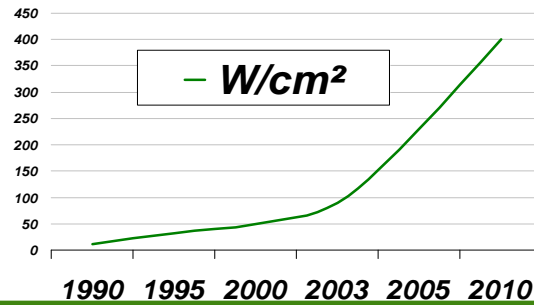
dfa@us.ibm.com (845) 435-6168

<http://www-128.ibm.com/developerworks/spaces/greenmainframe>

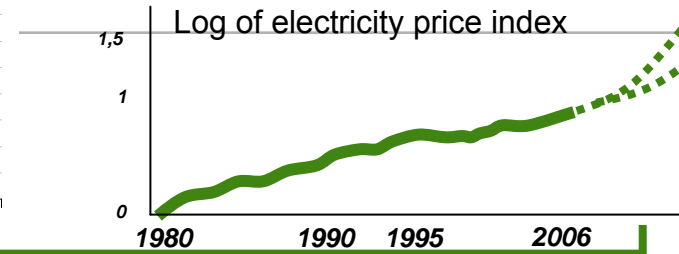
Increased number of servers



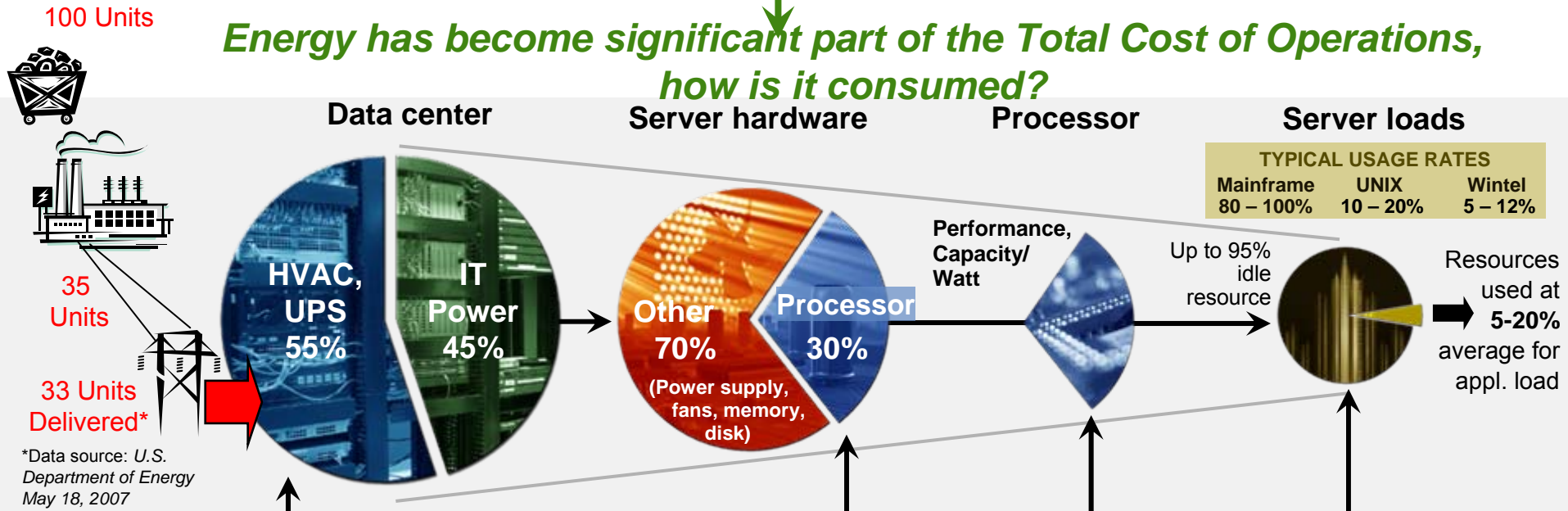
Increased processor consumption



Increased cost of electricity



Energy has become significant part of the Total Cost of Operations, how is it consumed?

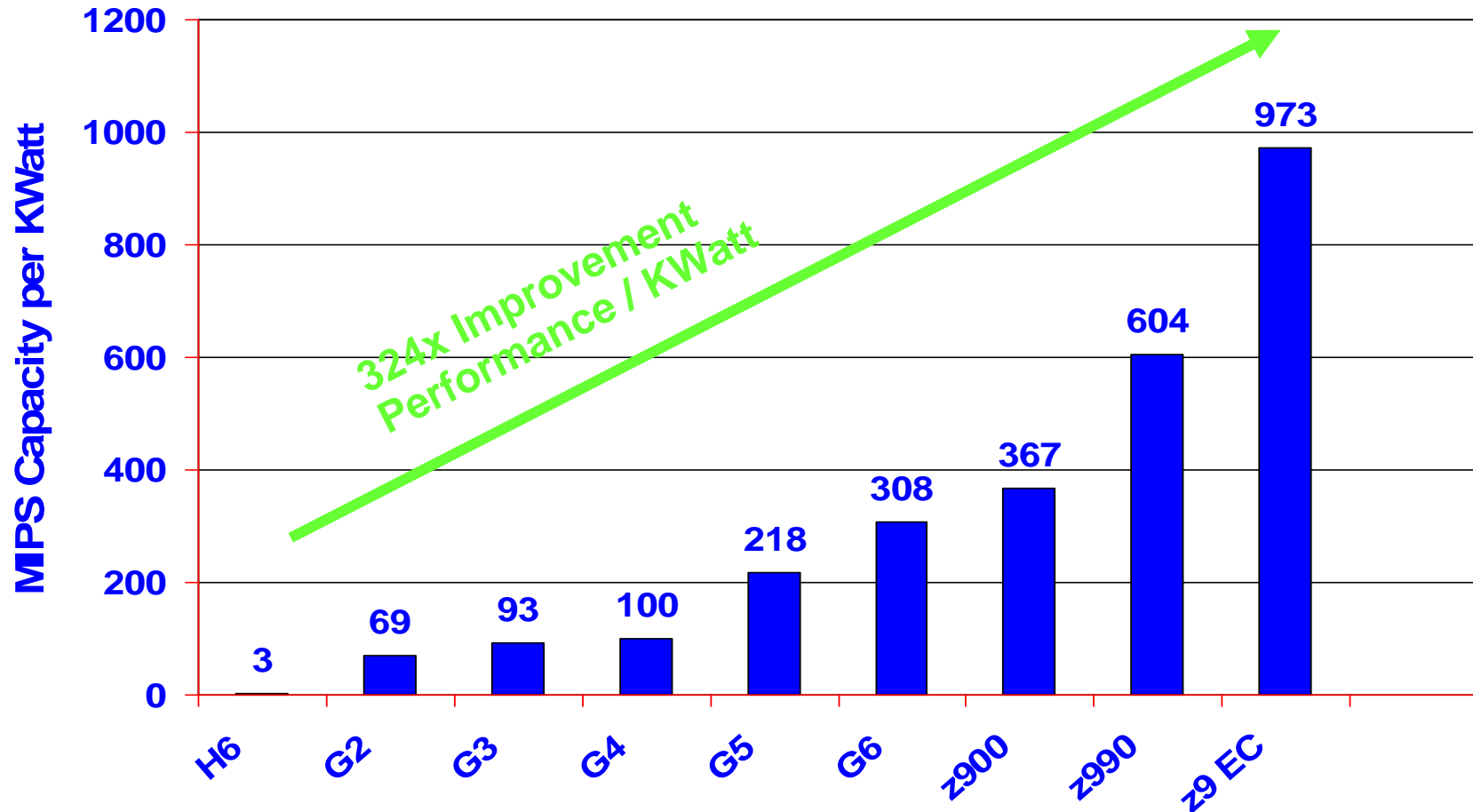


How to improve efficiency

<p>Reduce cooling/UPS needs vs. energy going in servers, capture heat at source (Potential gain 10%)</p> <p><i>More efficient cooling and energy supply</i></p>	<p>Higher efficiency infrastructure, power management' (≥ 3yrs older is good target)</p> <p><i>Better server hardware design</i></p>	<p>Reduce consumption @ chip level (Cap power usage)</p> <p><i>Advanced processor design + process</i></p>	<p>Reduce idle/unused capacity which still consumes energy (Utilization 5 to 20 % gain)</p> <p><i>Enhance resource usage rate (consolidation/virtualization)</i></p>
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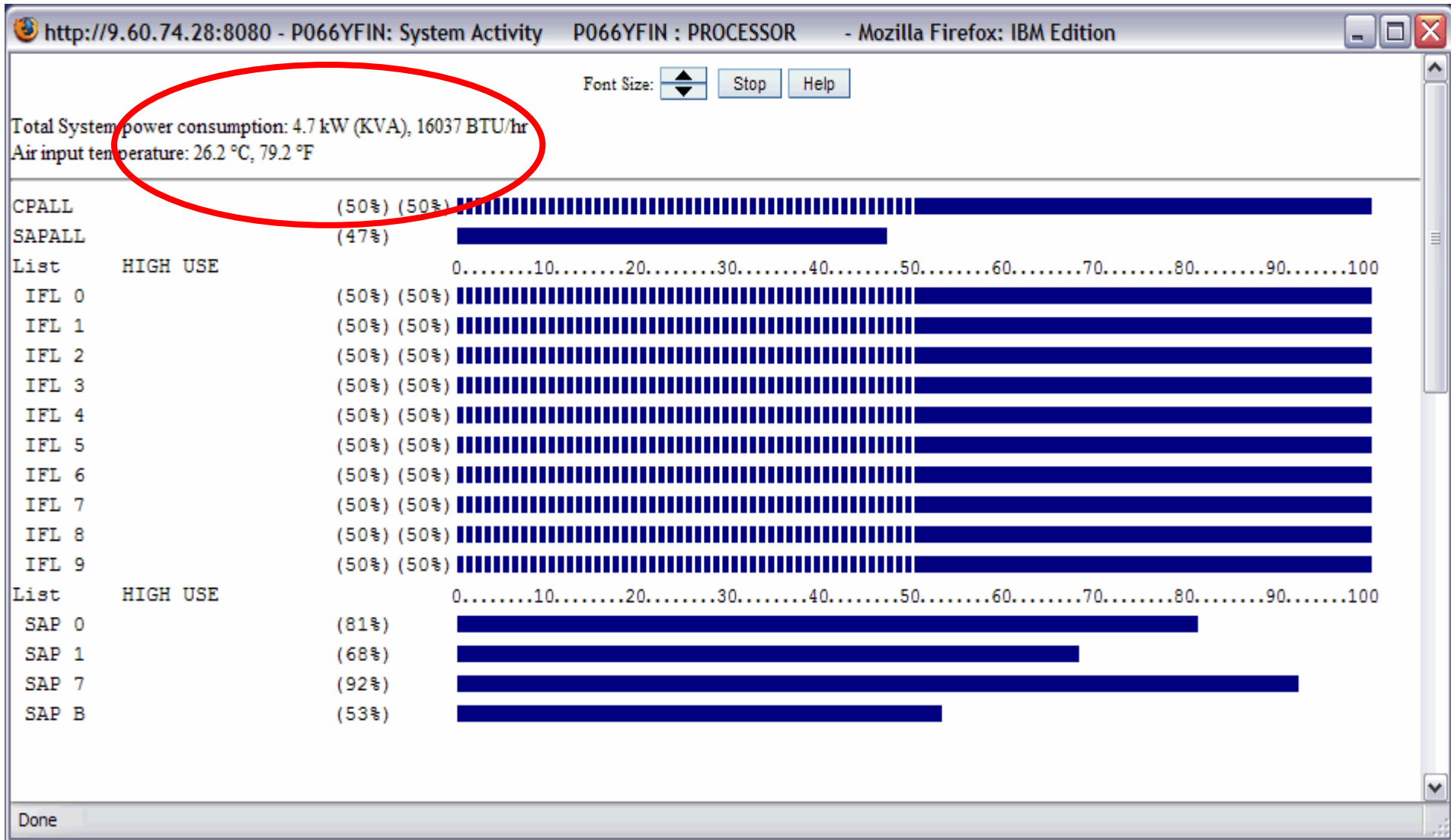
System z Efficiency Gains

From 350 watts/MIPS to ~1 watt/ MIPS



Example: System Activity Display

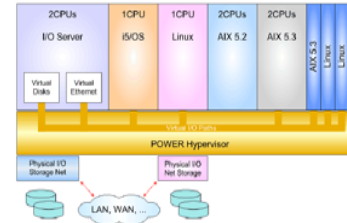
z9 EC, model S18, all IFL machine running 100%



Evolution of data center energy efficiency

- Consolidate many centers into fewer
- Reduce infrastructure complexity
- Improve facilities management
- Reduce staffing requirements
- Improve business resilience (manage fewer things better)
- Improve operational costs

- Consolidate many servers into fewer on physical resource boundaries
- Reduce system management complexity
- Reduce physical footprints

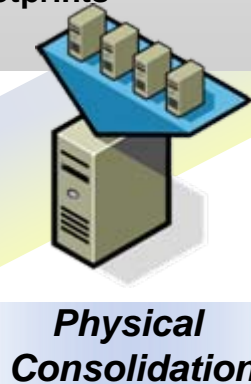


Application Integration

Virtualization

- Remove physical resource boundaries
- Increased hardware utilization
- Allocate less than physical boundary
- Reduce software licensing costs

- Migrate many applications into fewer images
- Simplify IT environment
- Reduction of operations resources
- Improve application specific monitoring and tuning



Physical Consolidation



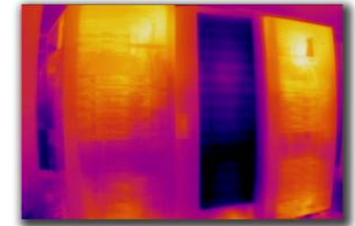
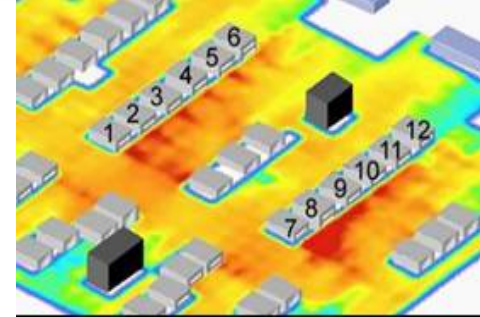
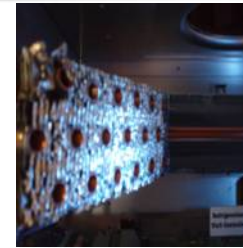
Centralization

IBM consolidates its own data centers for large savings

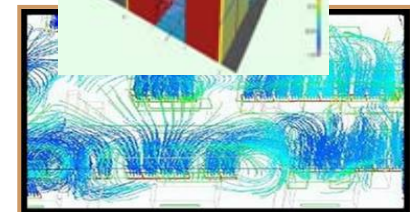
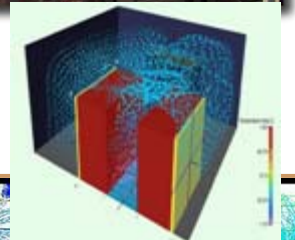


Other Companies will follow IBM's lead and use IBM technologies

- 92% less hardware using System z
 - +80% energy reduction
 - +85% space reduction
- Why is System z so much better?
 - Design Point is to run many applications at high utilization rates
 - It's the hardware!
 - Highly Efficient power supplies
 - Variable speed fans
 - Fewer components can do more work
 - Modular Refrigeration Unit
 - Leading Virtualization
 - Leading Utilization
 - Leading RAS



Cool



Your IT Cost may vary:
Workload consolidation using Linux on a mainframe may result in over 40% IT Cost savings

IBM offerings 2008

Aimed at all aspects of energy efficiency

Energy Solutions

- Data Center Stored Cooling Solution
- Optimized Airflow Assessment for Cabling
- Scalable Modular Data Center
- Data Center Relocation and Consolidation Data Center Facilities Design

Energy Assessments

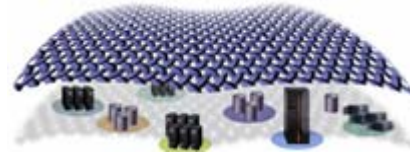
- Data Center Energy Efficiency Assessment
- Accelerator for Rationalization
- IBM Optimization and Integration Services: Server Consolidation
- Server and Storage Power/Cooling Trends and Data Center Best Practices
- Data Center Thermal Analysis and Optimization Facilities Integration
- Data Center Health Audit for IT

Energy Management

Tivoli

PowerExecutive/ AEM
For trending and capping

Tivoli Provisioning and Monitoring *Actively moving workloads and power up/down resources and aligning workloads*



Virtualization on IBM Systems and IBM System Storage drives utilization up and annual power cost down

Energy Technology

BladeCenter®
Open, Easy, Green



IBM power supplies
Measurement built in

IBM System Storage™
Increases utilization and energy efficient ILM

X-Architecture™
System x designed for efficiency

Rear Door Heat Exchanger
Thermal management innovation

Power Architecture™
Processor efficiency management for System i and System p

IBM z/Architecture™
System z™ lean and green leadership

IBM Blue Gene
#1 efficient system in Green 500 list

If you can't remember 30 Green solutions remember these 3

- Consolidation / Virtualization
- Exploitation of new energy efficient Technologies
- Active Energy Management (AEM)

Roadmap for Energy Efficiency in Data Centers -Advice from EPA

Scenario / Percent Energy Savings

IT Equipment

Site Infrastructure (Power and Cooling)

Improved operation

20%

- 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

45%

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

55%

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

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Information Management

Tivoli software

WebSphere software

Tivoli software

WebSphere software

Lotus software

Information Management

Rational software

System Z plays a major role across most aspects:

- space, energy efficiency, virtualisation, hardware, software etc
- the ECM server consolidation 'Big Green' forecast savings
 - 80% energy
 - 85% on space
 - plus HR savings

System z software

- Reduce consumption
- Maximize efficiency
- Automate utility Management
- Reduce Expenses
- Monitor



How can you help to Green Data Centers/ - help save Costs and maybe the Earth?

- Reduce waste and inefficiencies
- Power down resources when not in use
- Push Utilization levels to manageable limits
- Include Energy Consumption in Business Case
- Take a Holistic approach to System Evaluations
- Conduct a “Green Assessment”
 - Green Initiative
- Build a roadmap to an Optimized IT Infrastructure
 - Create a plan from which tactical decisions can be made
 - Leverage IBM OIT Offerings



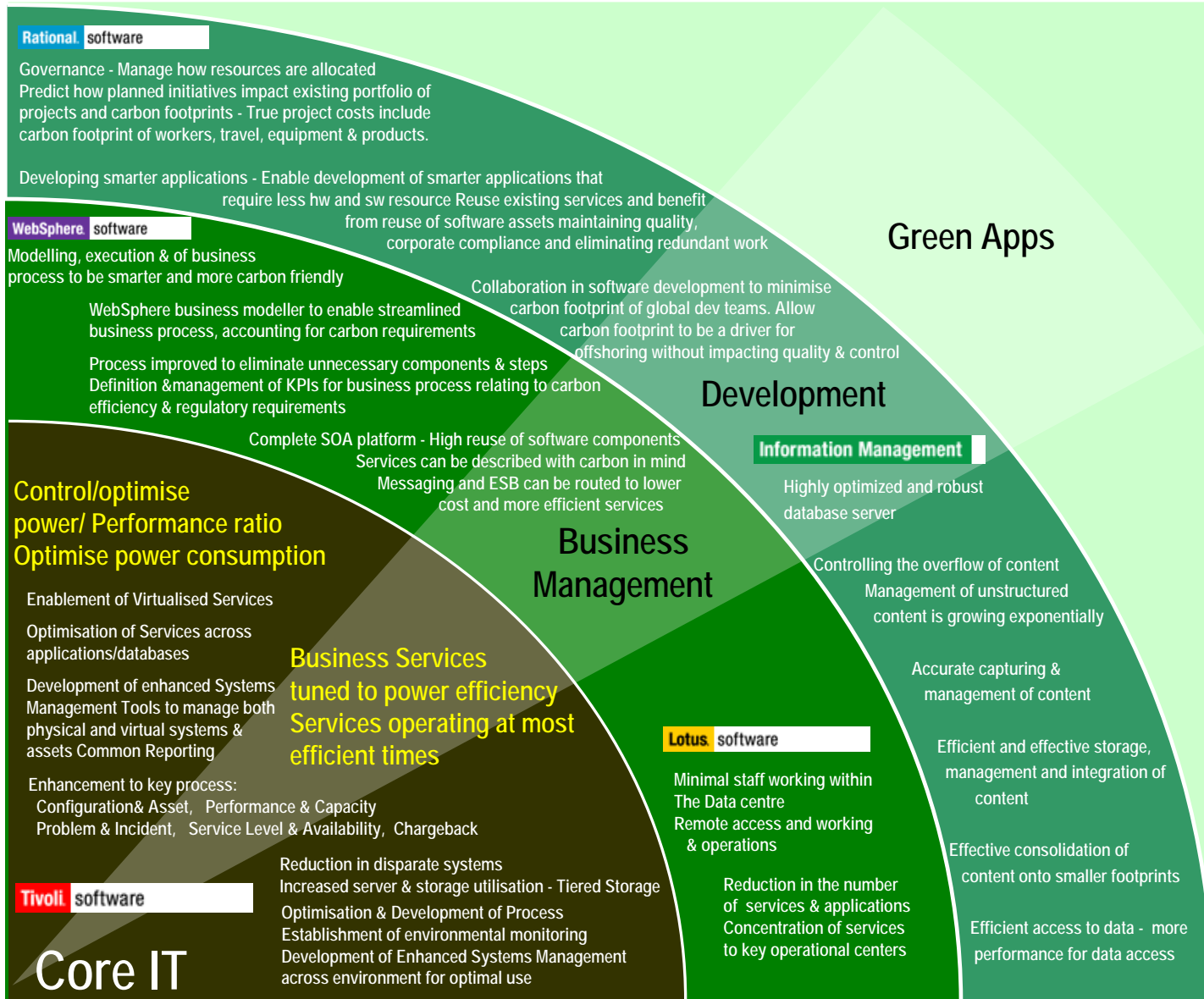
Green Wizard advice / Additional Charts

Prepare for 2008 and be part of the Green Army

- **You and the world needs Green solutions**
 - You will add value by integrating Green into how you do business
- **Green is more than energy efficient hardware**
 - Services
 - Software perspectives (some follow)

Key Impact Areas

- Main Menu
- Operations Management
- IT Operations
- Operations Strategy
- Facilities Management
- Architecture
- Development
- Development Management
- Business Management Requirement
- Business Requirement Definition
- Business Requirement Strategy



↑
 Products and Services
 Shift from cost to CO₂ optimization



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Tivoli software

Tivoli software
WebSphere software
Lotus software
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Rational software

Operations
Management

Key player in the Green Agenda with the Active Energy strategy

- Smart management of IT and Facilities devices
- Visualization of infrastructure and facilities events into a single portal / dashboard

IT Operations

Operations
Strategy

Strong virtualization platform with the provisioning suite

- Provisioning products integrate with virtualization technology like VMWare, IBM Total Storage solutions, most hardware & software vendors, to provide single manager of managers approach
- Broad support for storage virtualization with Tivoli Productivity Centre and SVC

Facilities
Management

Architecture

Development

Development
Management

Charge back capability for services used

- Full chargeback suite for usage and accounting of services

Business
Management
Requirement

Complete management of converged assets

- Management of the enterprise and IT assets within a single platform
- Service Catalogue for recording possible carbon usage against services

Business
Requirement
Definition

Business
Requirement
Strategy



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WebSphere software

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Modelling, execution and management of business process to be smarter and more carbon friendly

- WebSphere business modeller to enable streamlined business process, accounting for carbon requirements
- Understand how process can be improved to eliminate unnecessary components and steps
- Definition and management of KPIs for business process relating to carbon efficiency and regulatory requirements

Complete SOA platform

- High reuse of software components
- Services can be described with carbon in mind
- Messaging and ESB can be routed to lower cost and more efficient services

Highly optimized and robust solution

- Runs more efficiently therefore less hardware required

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Lotus software

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Collaborative working

IT Operations

- Lowering the need to travel with collaborative working
- Increasing global communication with organisations
- Easy creation of collaborative medium like discussion databases, dashboards, and people-driven applications
- Helping to model and streamline work methods, collaboration, activities and social networking to remove the necessity to travel

Operations
Strategy

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Development

Lowering the footprint for messaging services

- Lotus Notes dramatically lower footprint than equivalent Microsoft Exchange environment

Development
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Business
Management
Requirement

A personal portal view of "Green" metrics and activities

- WebSphere Portal & Dashboards provide the means to make green strategies, information and projects relevant to individuals daily work.
- A portal provides the means for employees to contribute ideas and collaborate on green topics and problems.

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Information Management

Highly optimized and robust database server

- Runs more efficiently therefore less hardware required

Controlling the overflow of content

- Management of unstructured content is growing exponentially
- Accurate capturing and management of content
- Efficient and effective storage, management and integration of content

Effective consolidation of content onto smaller footprints

Efficient access to data, providing more performance for data access

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Operations Management

Governance, PPM, and carbon footprint

- Manage how resources are allocated
- Predict how planned initiatives impact existing portfolio of projects and carbon footprints
- See whether skills and assets are being optimised for carbon efficiency
- Improve measurement of return on investment decisions
- Manage and make carbon footprint requirements
- True project costs include carbon footprint of workers, travel, equipment and products.

IT Operations

Operations Strategy

Facilities Management

Developing smarter applications

- Enable development of smarter applications that require less hw and sw resource
- Broad support for development of SOA applications
- Develop code with carbon usage in mind
- Reuse existing services and benefit from reuse of software assets maintaining quality, corporate compliance and eliminating redundant work with Rational Asset Manager

Architecture

Development

Development Management

Business Management Requirement

Collaboration in software development and carbon footprint

- Enable globally distributed development teams and minimise carbon footprint
- Allow carbon footprint to be a driver for off-shoring without impacting quality and control

Business Requirement Definition

Business Requirement Strategy

