

Green Infrastructure with IBM Systems

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Businesses are under increasing pressure



to reduce cost, improve service, and demonstrate environmentally responsible practices.



- Economic downturn requires doing more with the same.
- Transience in price and demand for energy worldwide.
- Growing concerns about the effects of climate change.
- Increasingly empowered and interconnected customers.

IBM is delivering a breadth and depth of capabilities to help organizations meet these challenges



Drive for more effectiveness

Especially in light of today's challenges



41%

of data center managers claim their data centers will max out their energy capacity within one to two years³

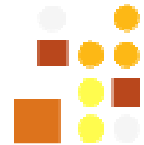
80%

of digital data is now unstructured⁴ and requires greater effort to transform it into usable intelligence

Processor power doubles every 18 months, but up to

85%

of this power often sits idle²



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The need for progress is clear.



2X

IT energy use has been doubling every 5 years.

It's estimated that data centers consume more energy than the country of Mexico.

170 billion

170 billion kWh wasted yearly due to insufficient power usage information.

Buildings account for 40% of energy consumed of which 30% is wasted.

3 out of 100

From 100 units of energy, on average 3 units used for productive computing.

60% of CAPEX in a data center build is mechanical-electrical-cooling, 75% of OPEX over time is energy related.



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**6,6 Billion new trees needed
to clear CO2 emitted by data centers
each year.**



We need Smarter Systems for a Smarter Planet

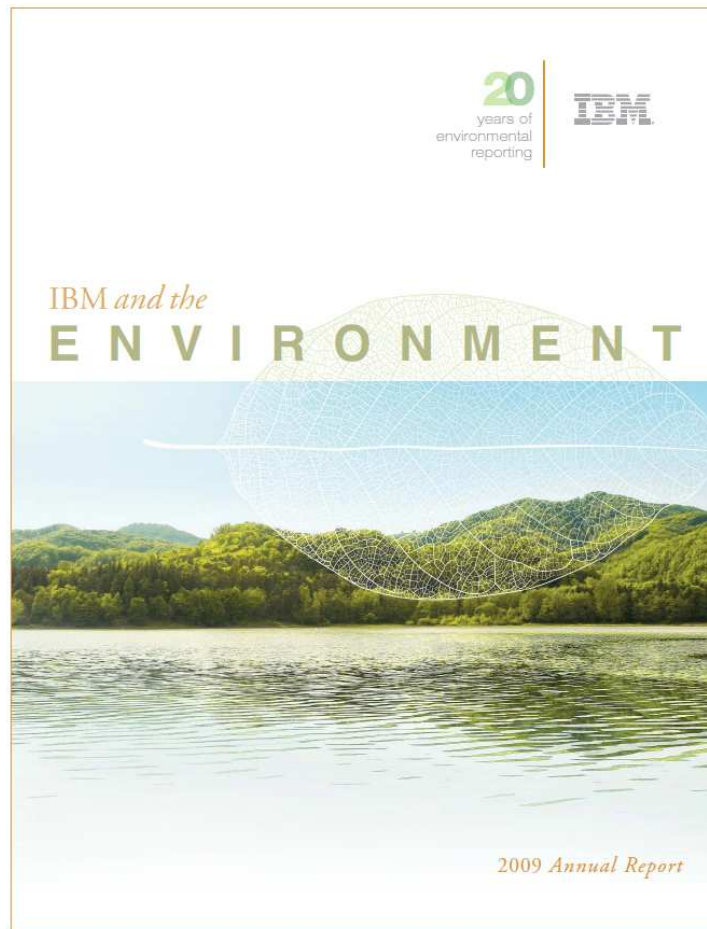


Intentionally designing integrated systems that redefine performance and optimize resources to deliver the highest possible value.



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IBM and the Environment



IBM and the
ENVIRONMENT

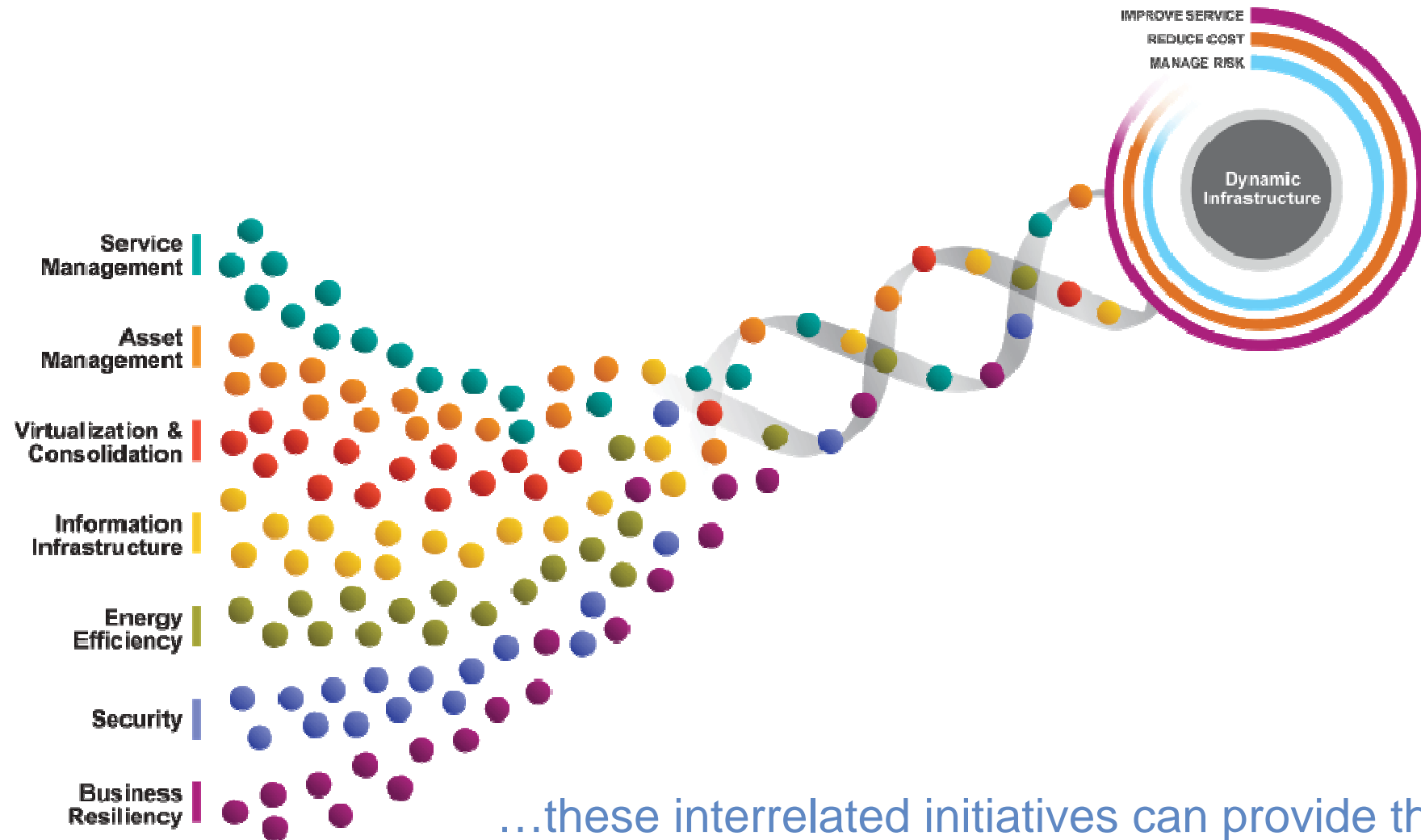
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A dynamic infrastructure is a journey...

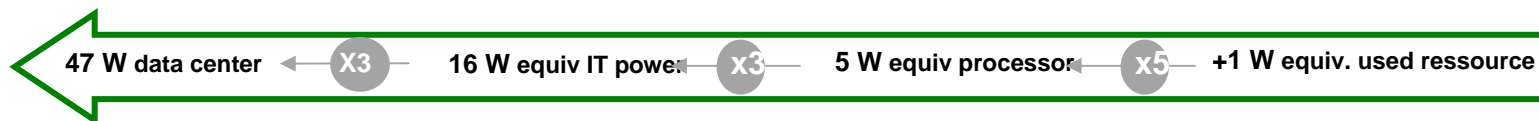
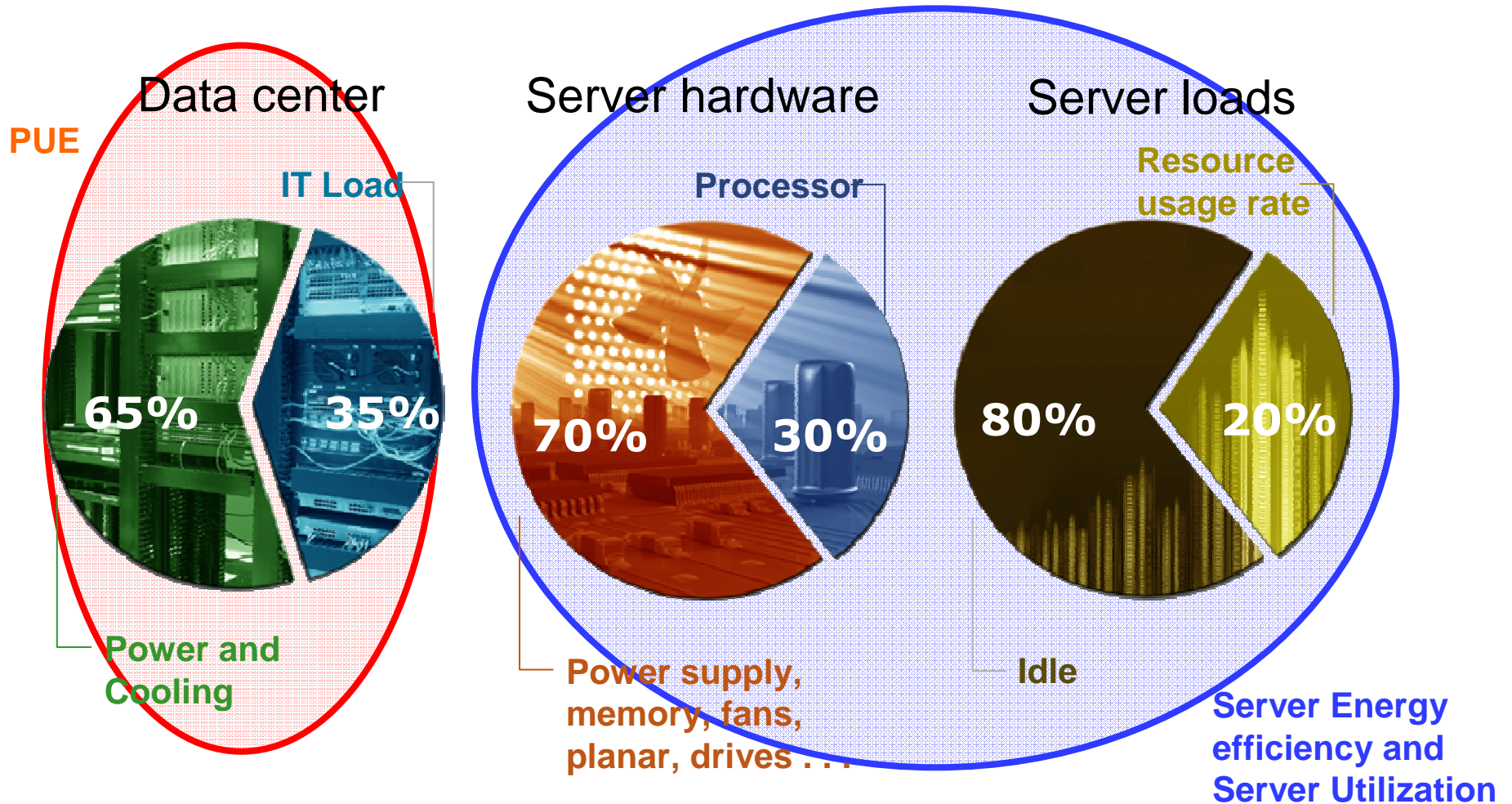


...these interrelated initiatives can provide the DNA needed to thrive in a smarter planet.



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Opportunities for optimization

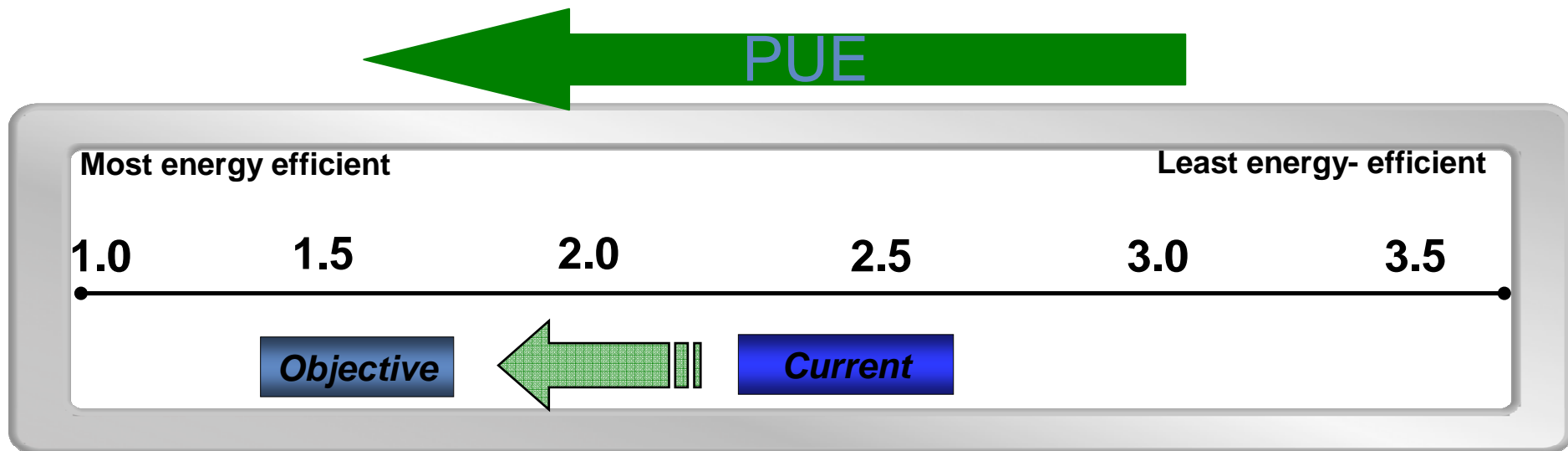


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What is a Green Data Center?



- PUE (Power Usage Effectiveness) can be used as a metric for Data Center energy efficiency
 - Compares total power used by the data center to the power used by the technology
 - Provides a marketplace comparison
 - Demonstrates range of opportunity improvement

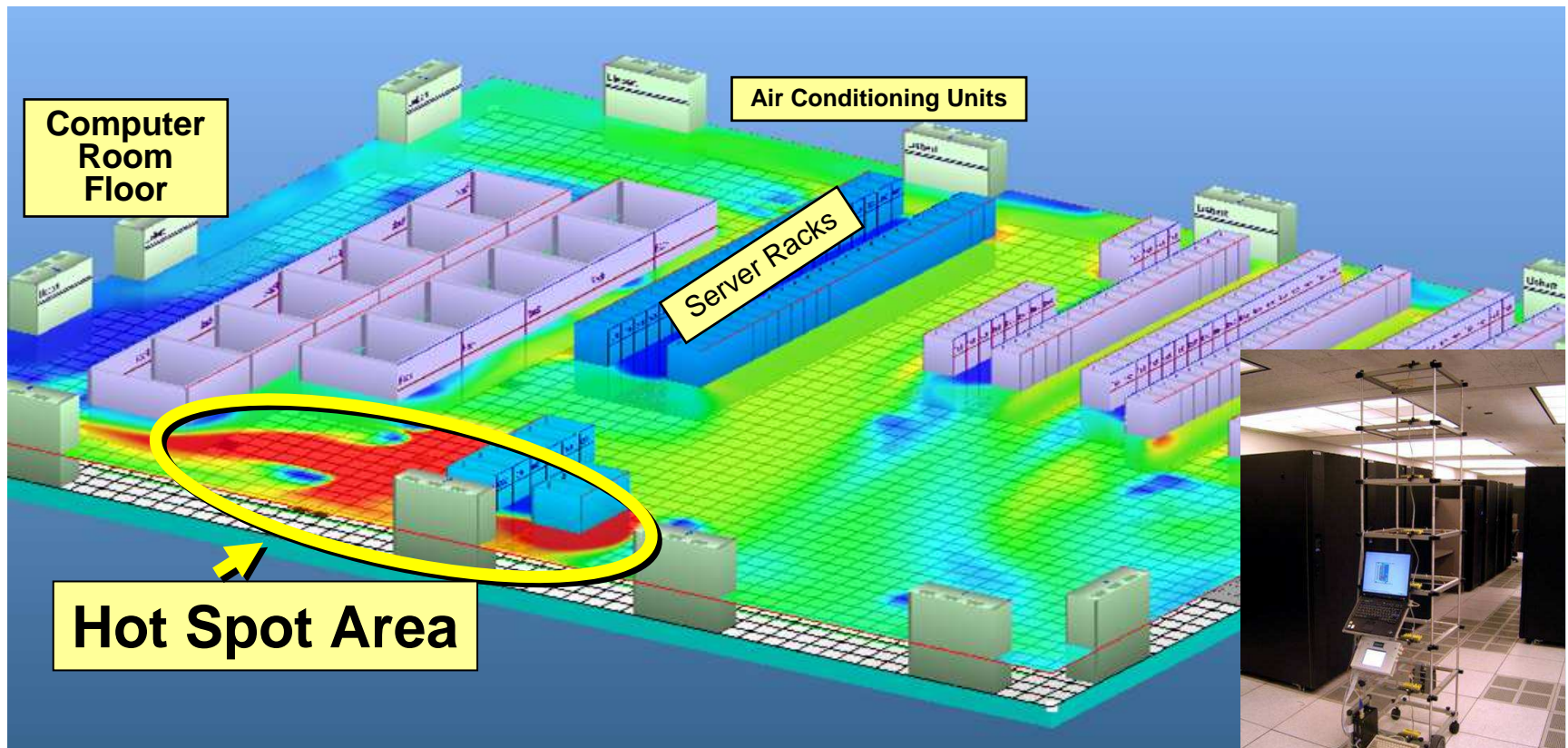


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Green Infrastructure with IBM Systems

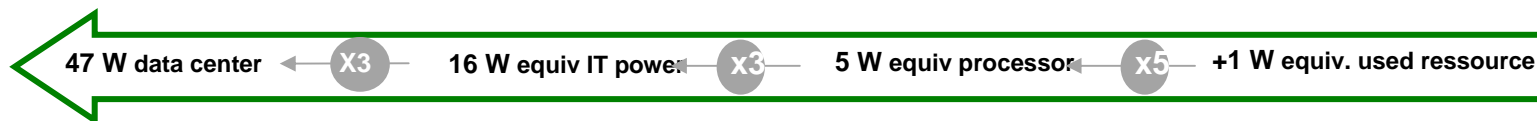
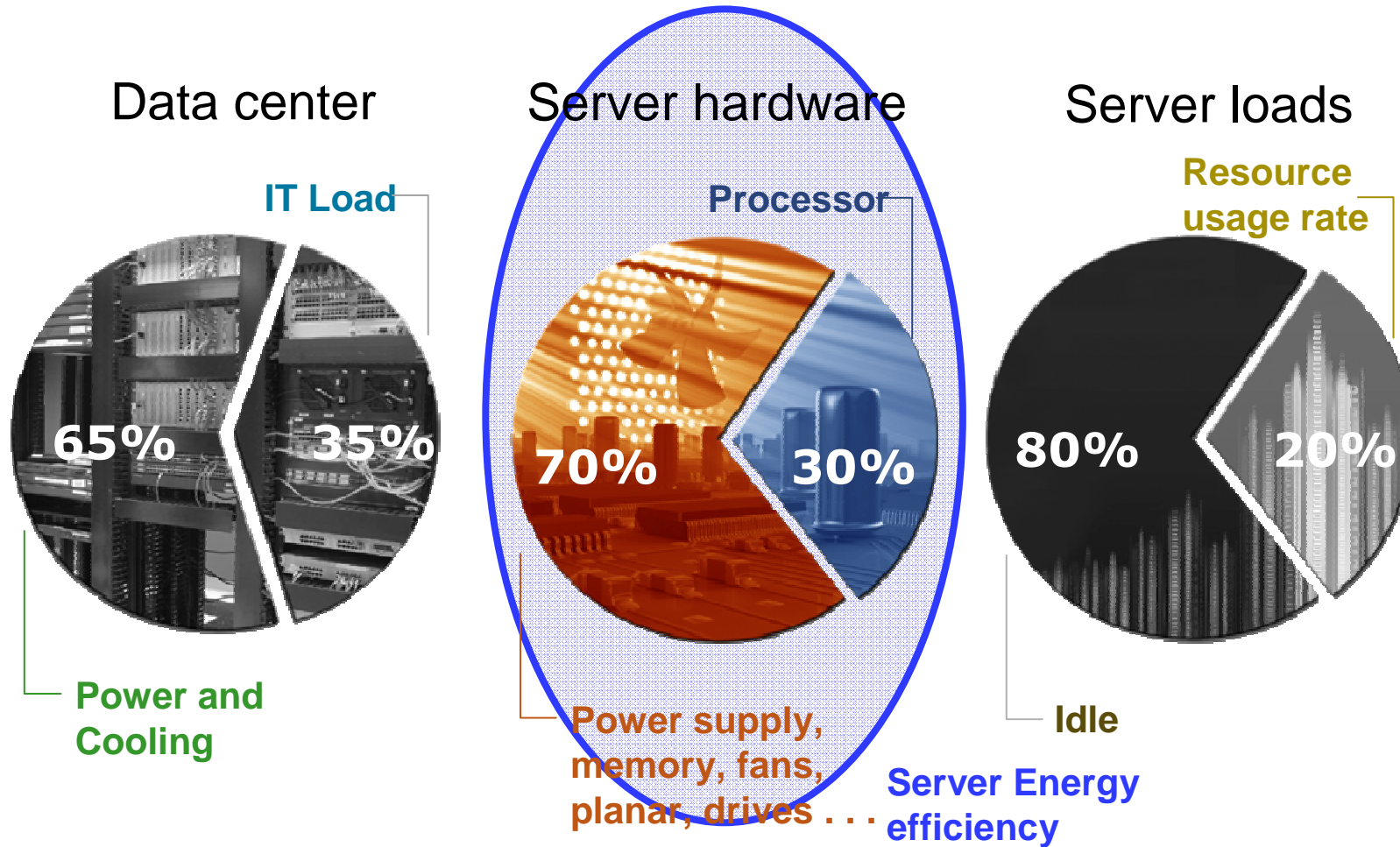


- How to improve PUE ?
 - Data Centre redesign – modeling - *Eliminating Hot Spots in Datacenter*



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Opportunities for optimization



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Servers Designed for Leadership Energy Efficiency.



Choice of platforms so you can optimize for your application workloads

IBM System z10

- Advanced Virtualization supporting the highest utilization rates.
- Modular and efficient design.

Over 80% savings in energy costs for consolidation.



IBM POWER Systems

- More Work per Watt with POWER7 and EnergyScale technology.
- Virtualization leadership.

Up to 70-90% energy cost reductions versus Sun.



New generation of x86 servers deliver 2X performance in the same energy envelope

IBM System x

- Scalability up to 96 cores.
- Performance per Watt leadership.



Up to 67% less power than competitive equivalents.

IBM BladeCenter

- Energy efficient consolidation platform.
- Broad set of chassis, blade, and I/O options.



Up to 36% better performance per watt than Dell.

IBM iDataPlex

- Designed for optimal energy efficiency supporting HPC and Web 2.0 workloads.



Cuts energy costs 40% compared to competitive rack servers.



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IBM Recommendations for Green Storage



Optimize Storage to reduce overall costs and drive green benefits

✦ Implement the right Storage **Tiering** strategy and **Information Lifecycle Management**

✦ Leverage Storage **Virtualization** to improve utilization and management

✦ Reduce the amount of data you need to store with **De-duplication** and other features



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IBM System Storage is Energy Efficient.

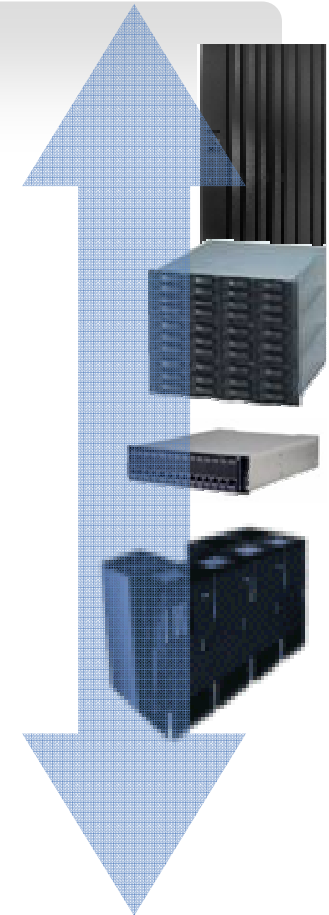


Optimize Storage to reduce overall costs and drive green benefits.

IBM has the broadest portfolio of **tiered disk** and **tape** options and **information lifecycle management** capabilities to **optimize** where data resides in the storage hierarchy.

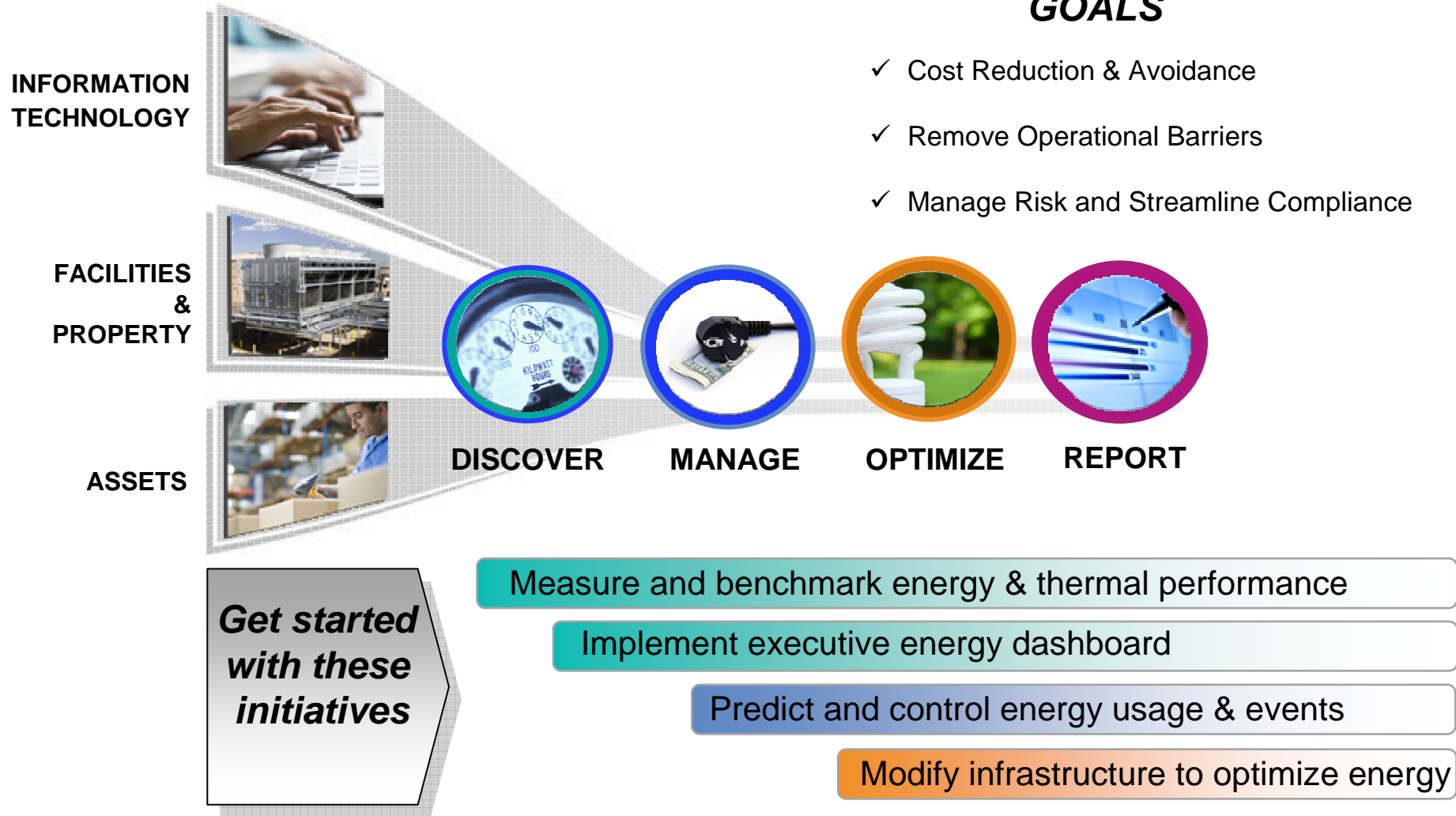
- Services to help you assess, design, and implement the right Tiering strategy, ILM policies, and Backup/Recovery/Archiving practices.
- Disk portfolio featuring: XIV, DS8000, DS5000
- Storage virtualization portfolio: SVC
- Tape portfolio featuring: TS3500, TS1130, and LTO
- Tape virtualization portfolio: ProtecTIER

*The **TCO benefits** of an effectively tiered storage solution can be **3X** or more compared to an all enterprise disk solution.*



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A Practical Approach to Energy Management



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- **Systems Director – Active Energy Manager across all IBM servers**

- **Power Capping**

- Allocates a maximum power level a system can use without having to worry about power usage above the maximum point
- AEM will throttle the processor to use less power, which slows down the server, if the system starts to consume more than the maximum level set
- This feature can come into play if it gets too warm in the data center as setting the cap will ensure that the system will not use more than that cap value thus reducing power and thermal usage

- **Power Savings Mode**

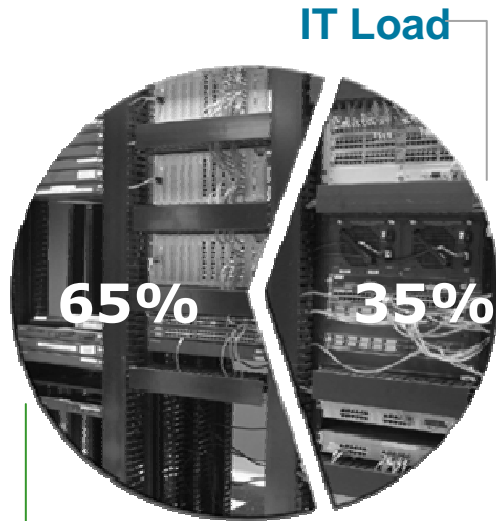
- Enables a system to save up to 30% of normal CPU power usage
- Power savings is enabled via an on/off switch which can be scheduled during times of low utilization
- Occurs automatically based on processor utilization



Opportunities for optimization

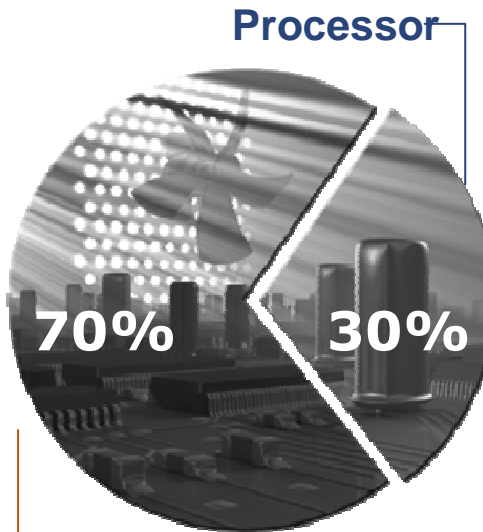


Data center



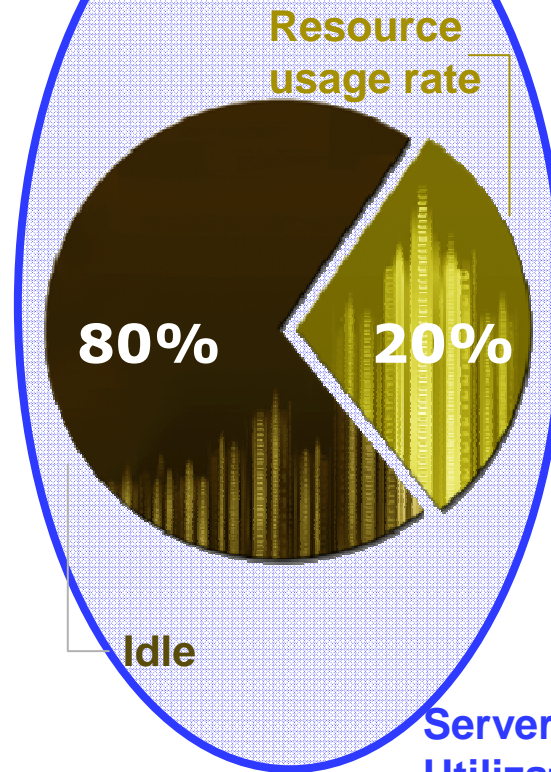
Power and Cooling

Server hardware

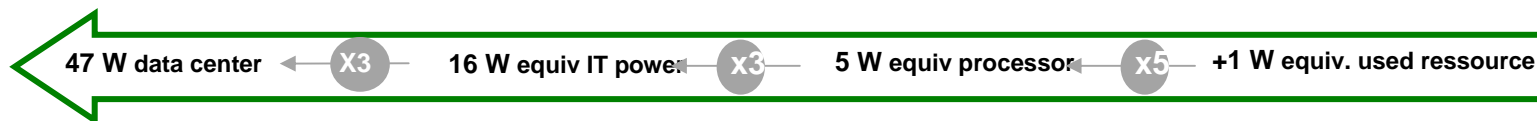


Power supply, memory, fans, planar, drives . . .

Server loads



Server Utilization

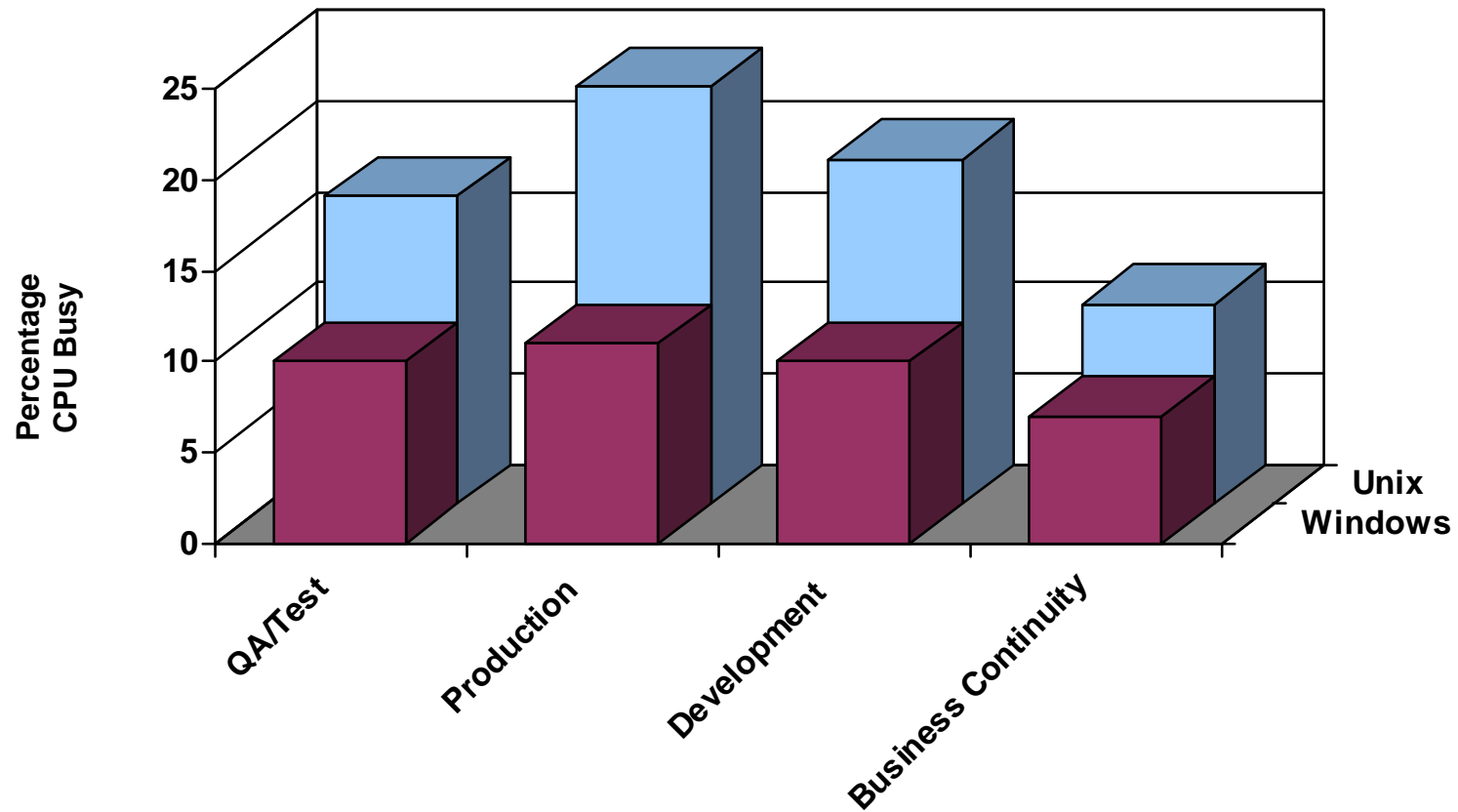


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Server Utilization At A Large Financial Institution



Average Server Utilization by Class
Jan-08



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Utilization Of Distributed Servers

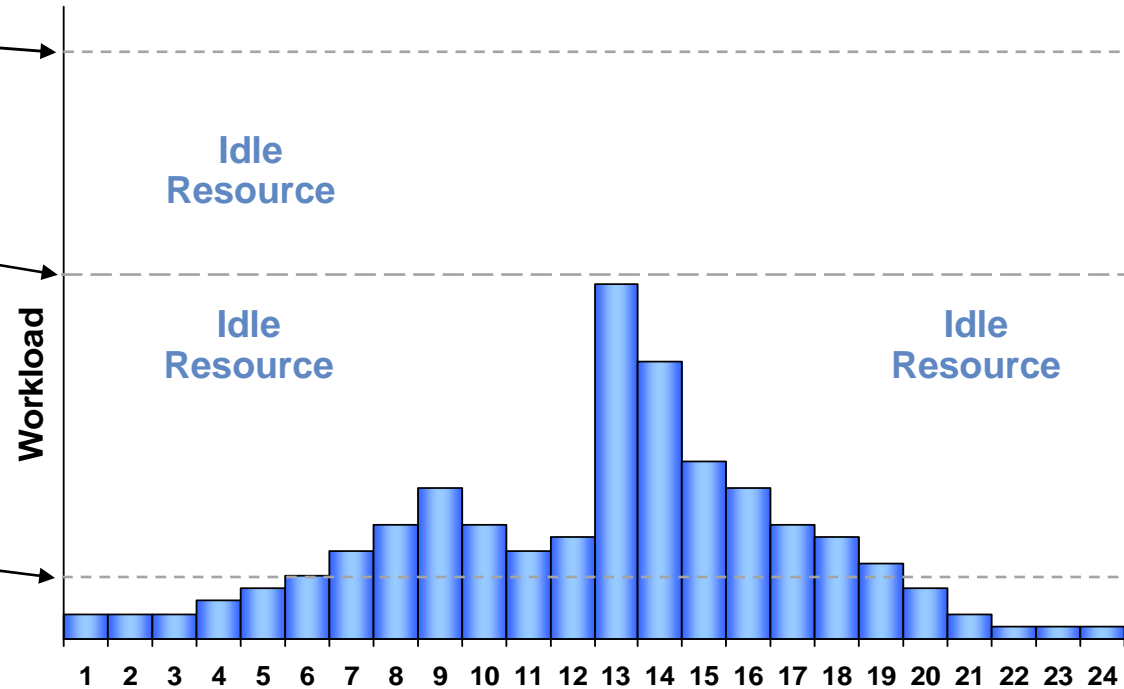


Provision for expected growth

Provision capacity for peak workload



Average utilization



Server dedicated to one application

- Typical utilization of Windows Servers <5%
- Typical utilization of UNIX Servers 15 – 20%
- Typical utilization of System z Servers 70 – 100%

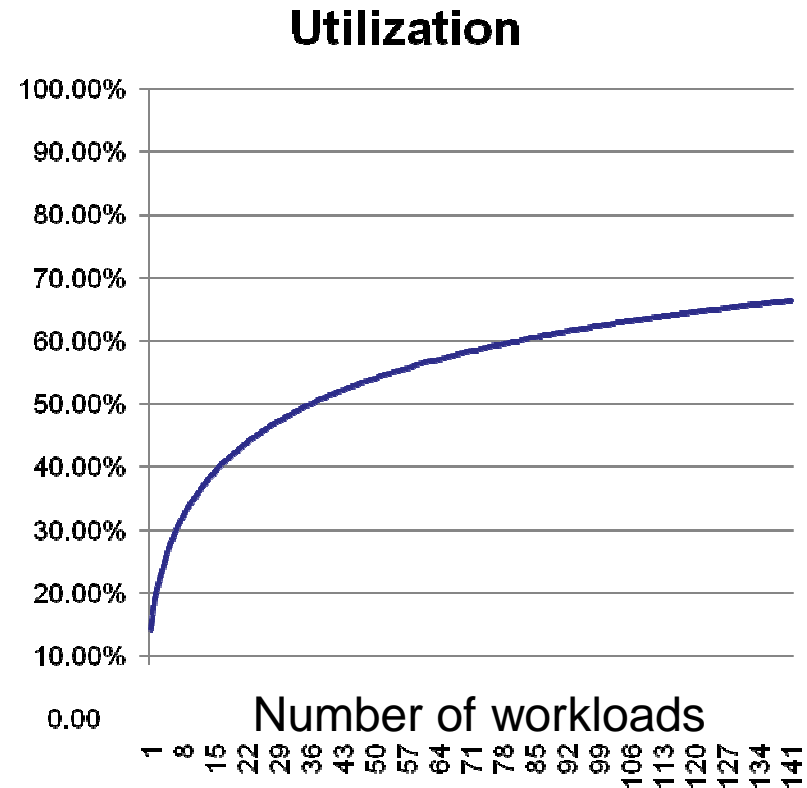


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Statistics Can Work In Our Favor



- When the number of workloads is small
 - To guarantee that work will complete within “specified” time requires more excess capacity
- When the number of workloads is large
 - Combination of arriving workloads is more statistically predictable
 - Higher predictability means lower excess capacity required to meet the specified response times



- When many applications are brought from single application servers to a centralized server, wasted utilization can be squeezed out of the datacenter



An Experiment



How combining Workloads on a Shared Server statistically improves utilization

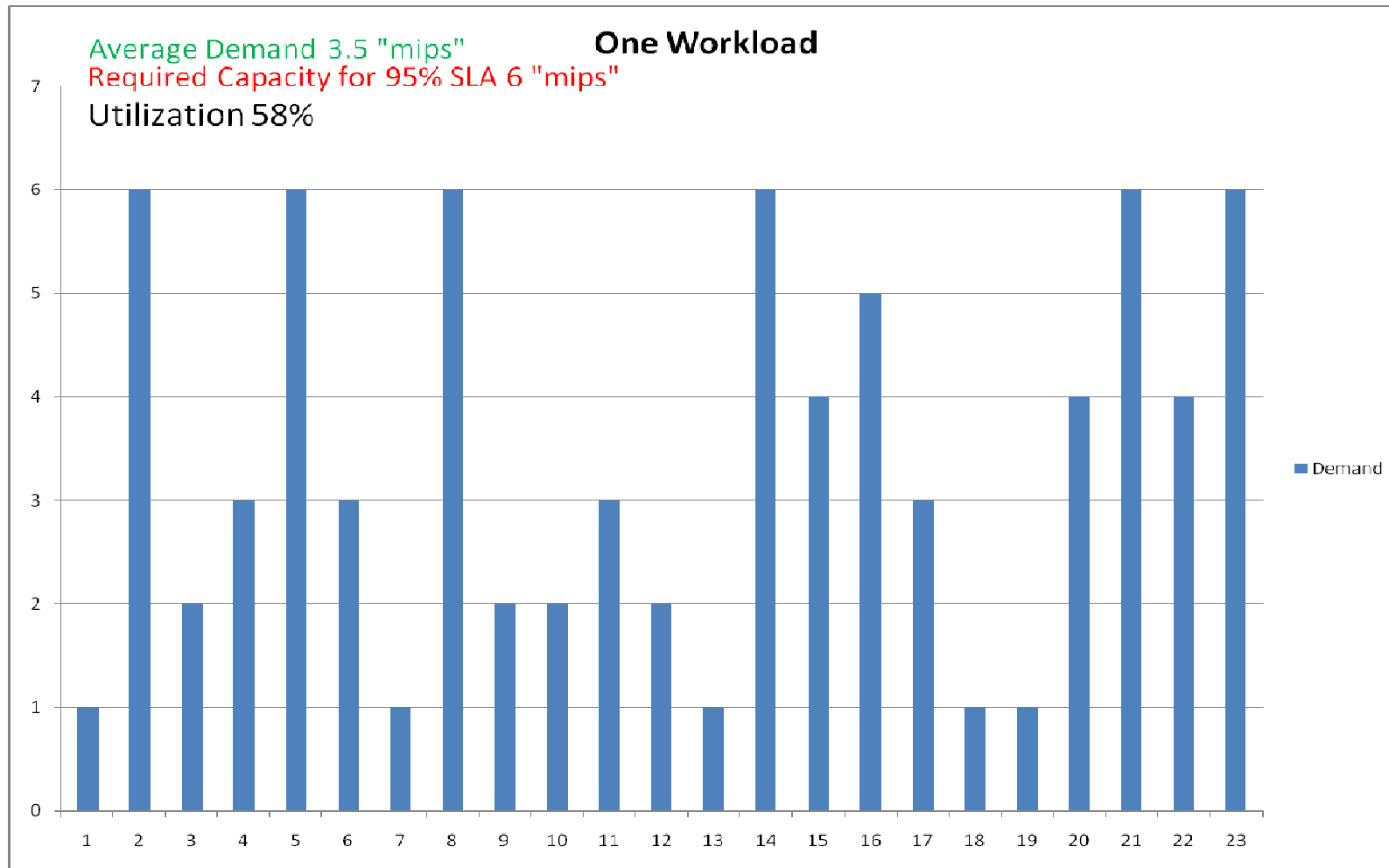
- Group 1
 - Take 1 die and roll it 10 times. Count the number of times you get a 1, 2, 3, 6
 - Plot your results on a histogram
- Group 2
 - Take 9 dice and roll them 10 times. On each roll get the total value on the 10 dice. Count the number of times you get a 9,10, 11, 12,, 30, 31, ... 54.
 - Plot your results on a histogram.
- What do we see about the “predictability” of the result of a “roll”? (Let’s roll the dice with a computer.)



After Rolling 1 Die (1 Workload)



The Distribution Would Look Like This

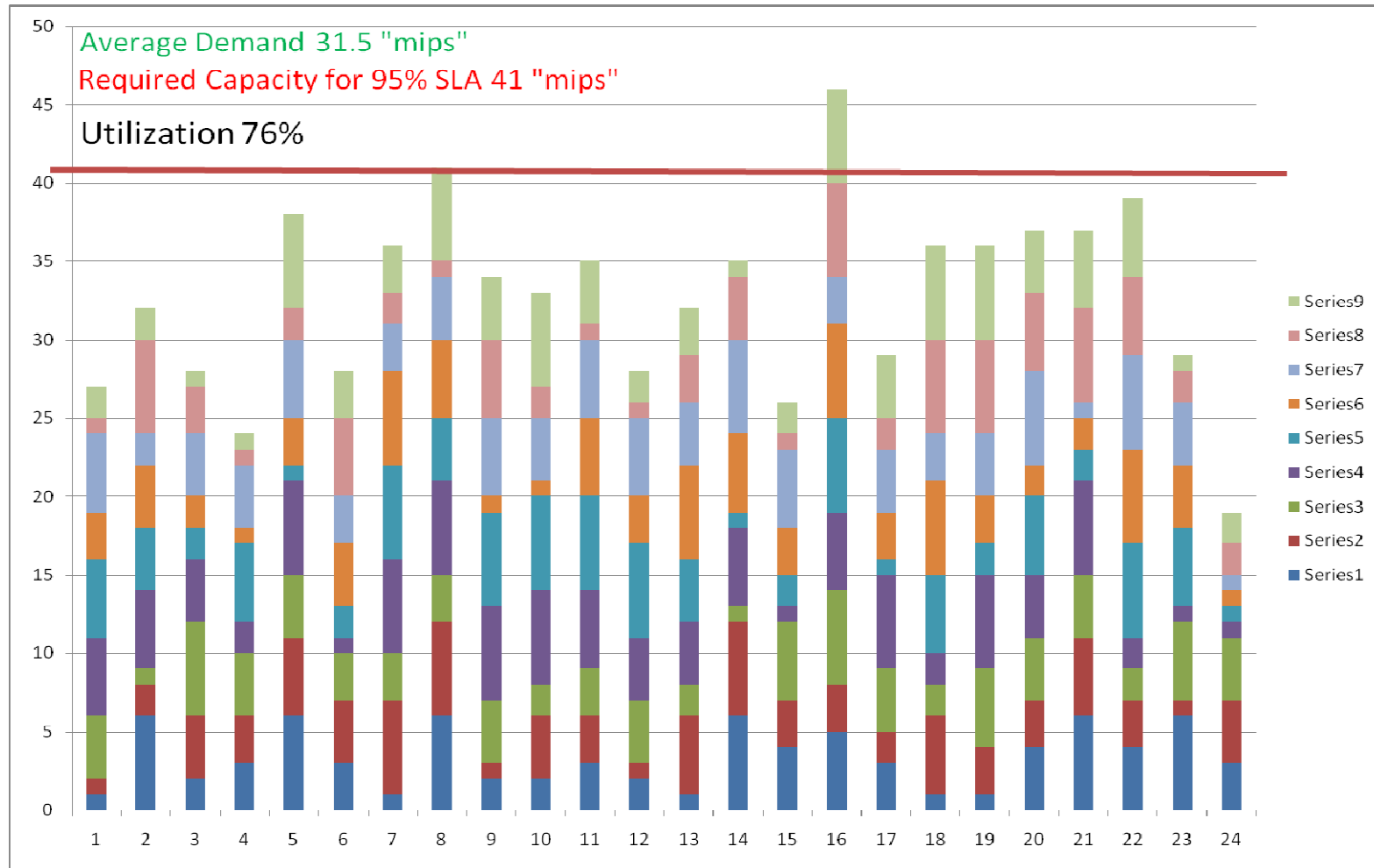


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After Rolling 9 Dice (9 Workloads)



The Distribution Would Look Like This

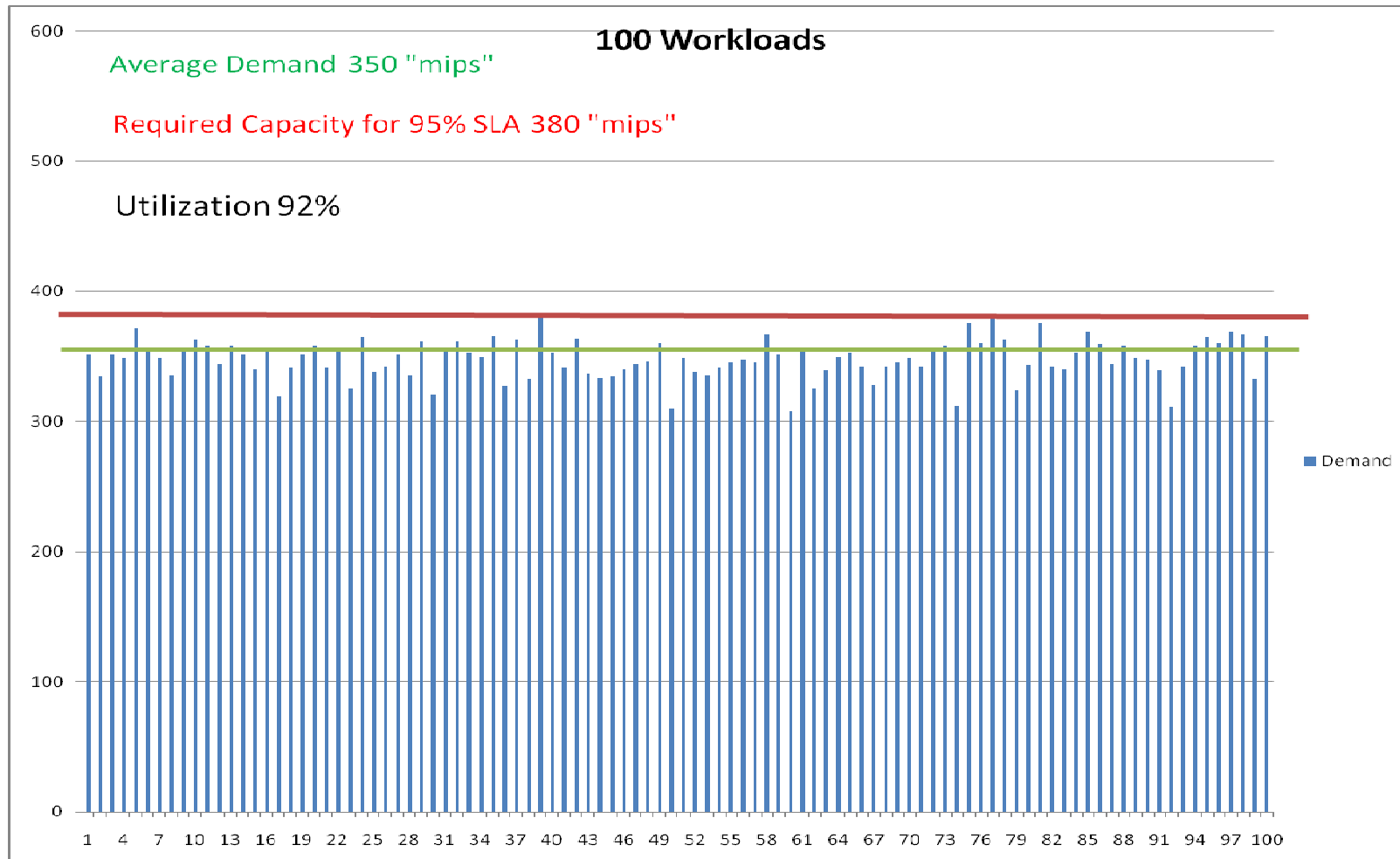


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After Rolling 100 Dice (100 Workloads)

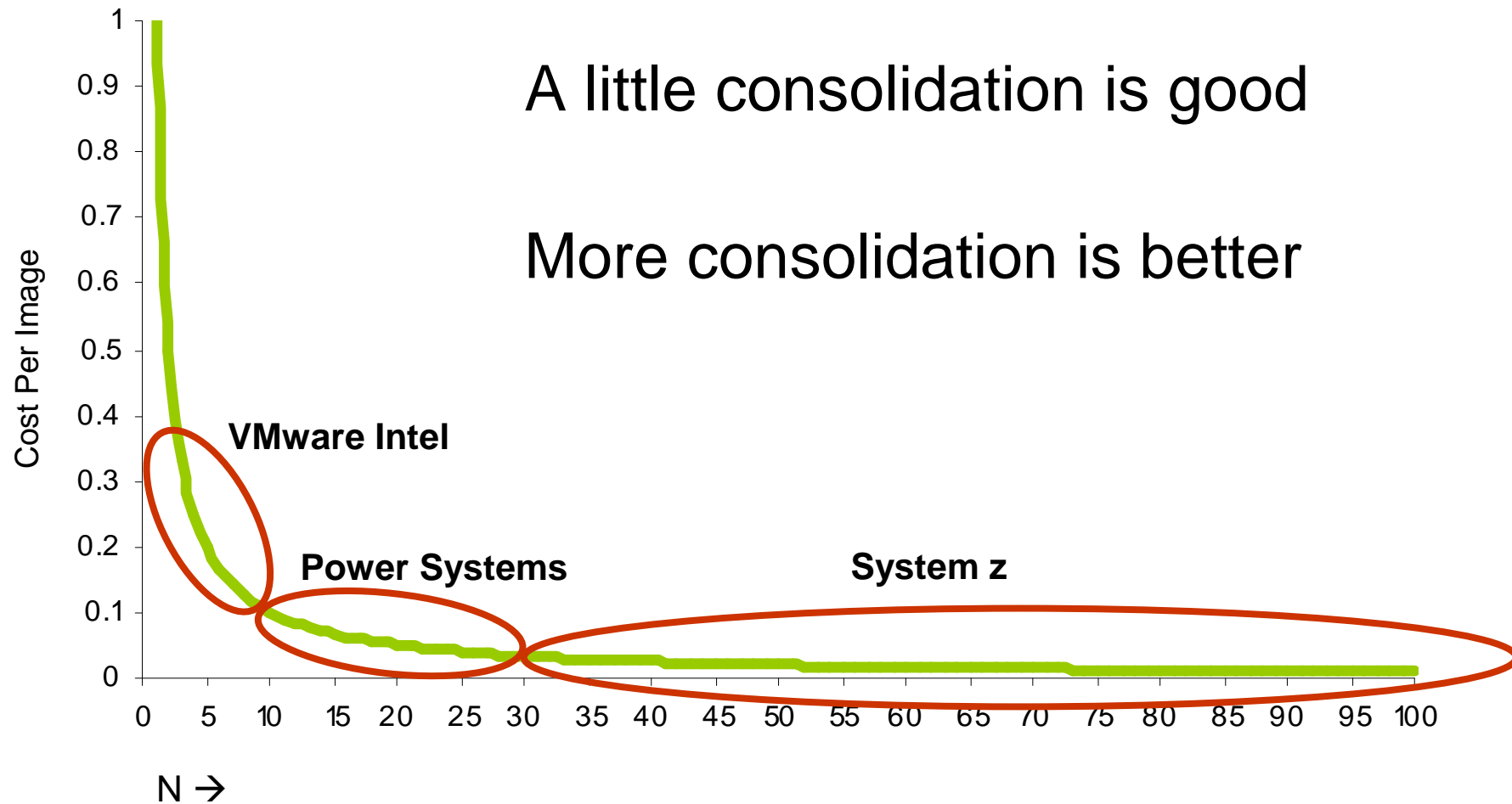


The Distribution Would Look Like This



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Observed Consolidation Ratios of Linux images



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Consolidate More and Spend Less with IBM System z

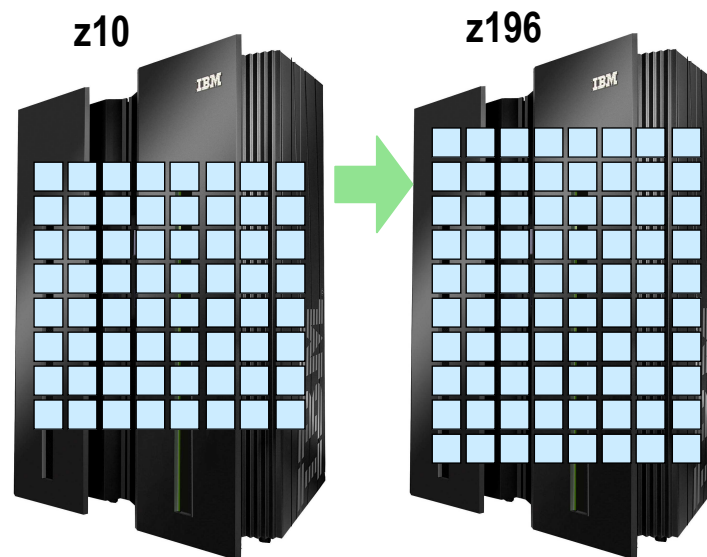
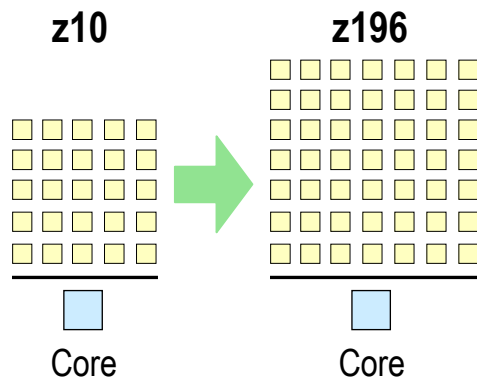


Increasing the Economic Appeal of Linux on z/VM Server Consolidation and IT Optimization

- z196 delivers an even greater level of server consolidation **density** and **scalability** with Linux and z/VM.

Run more virtual servers per core

Configure more cores per System



(1) Calculations based on specific solution offering components using IBM and client experiences. Results can vary.



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Smarter Virtualization with z/VM



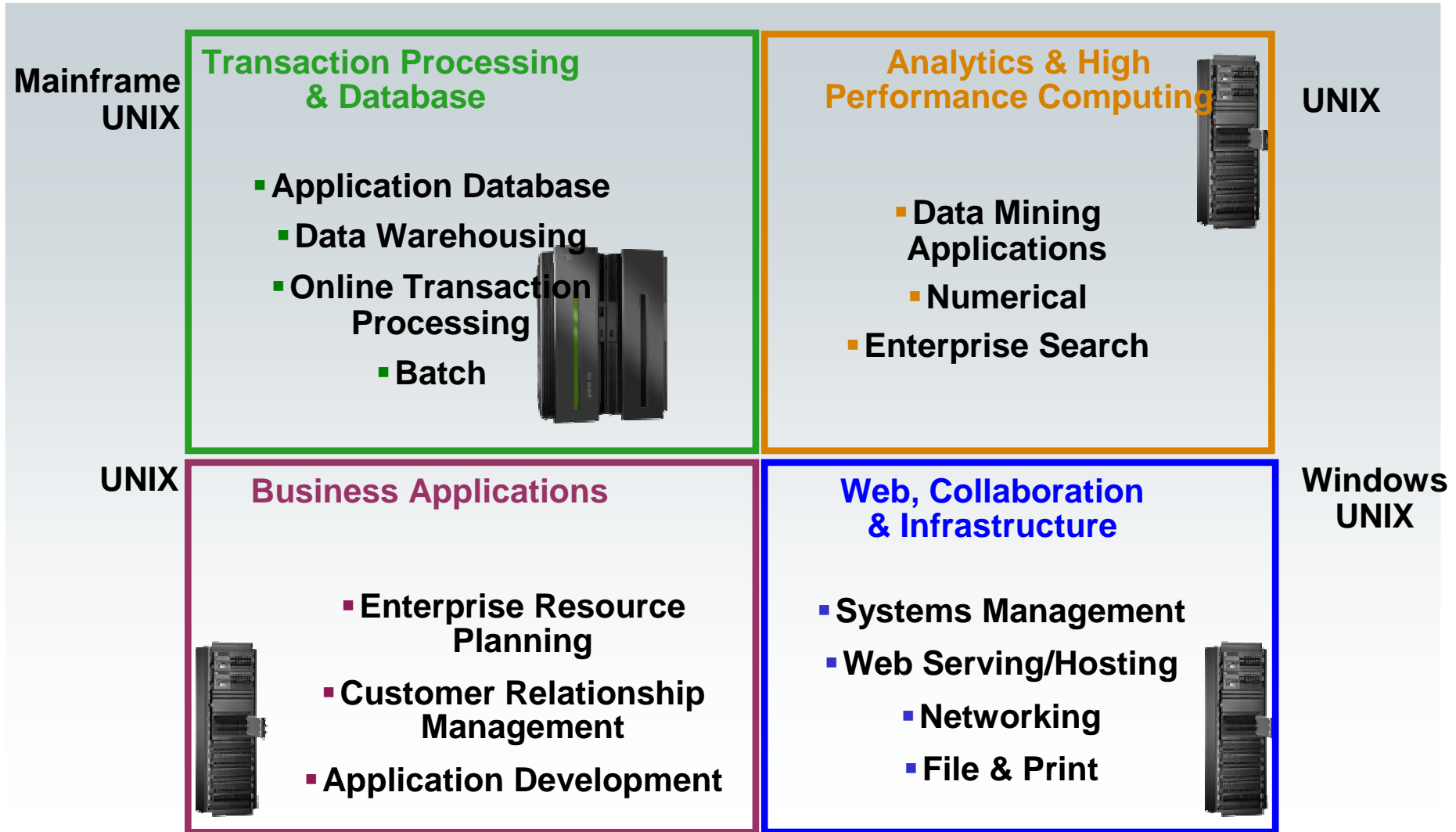
Why Run Linux on System z instead of Power or x86?

- Do more with less
 - **Consolidate more servers, more networks, more applications, and more data than any other platform**
 - **Achieve nearly 100% utilization of system resources nearly 100% of the time**
 - Enjoy the highest levels of resource sharing, I/O bandwidth, system availability, and staff productivity
- Reduce costs on a bigger scale
 - **Consolidation density saves on power and floor space**
 - **Extreme over-commitment of system resources saves on software license fees *and* helps absorb workload spikes**
 - Minimize hardware needed for business continuance and disaster recovery (e.g., CBU processors)
- Manage growth and complexity
 - Exploit extensive z/VM facilities for life cycle management: *provisioning, monitoring, workload mgmt, capacity planning, security, charge back, patching, backup, recovery, more...*
 - Add hardware resources to an already-running system without disruption – the epitome of Dynamic Infrastructure
 - Tightly integrate Linux and z/VM with z/OS for disaster recovery (e.g., GDPS/PPRC Multiplatform Resiliency)
 - Co-residency with z/OS (leveraging HiperSockets for network-intensive applications)



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Workload Optimization Requires Multiple Platforms

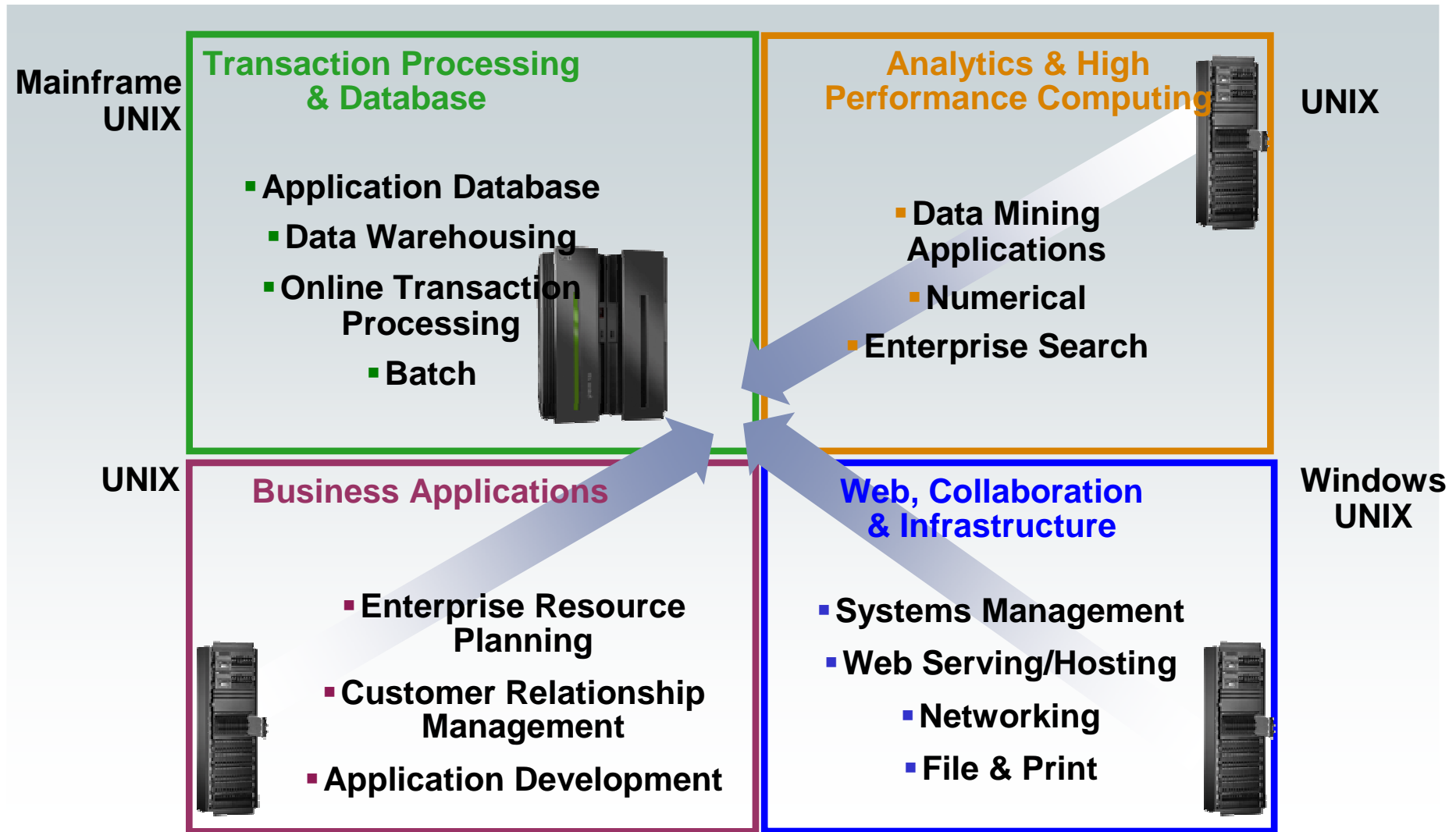


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zEnterprise for New Workloads ...



With Mainframe Qualities of Service



Three fundamentals of energy management



Measure/Trend Power Consumption

- Determine the power being consumed now
- Trending energy and thermals over extended periods of time



Allocate Power Correctly

- Power consumed is a function of the HW configuration, environment, application mix and system utilization.
- Allocate power based on past history using power measurements
- Rightsizing of power and cooling allocations
- Enables deployment of more servers within the physical limits of a data center

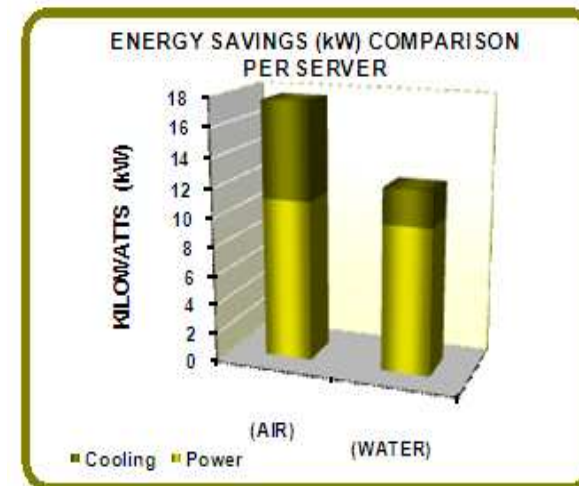
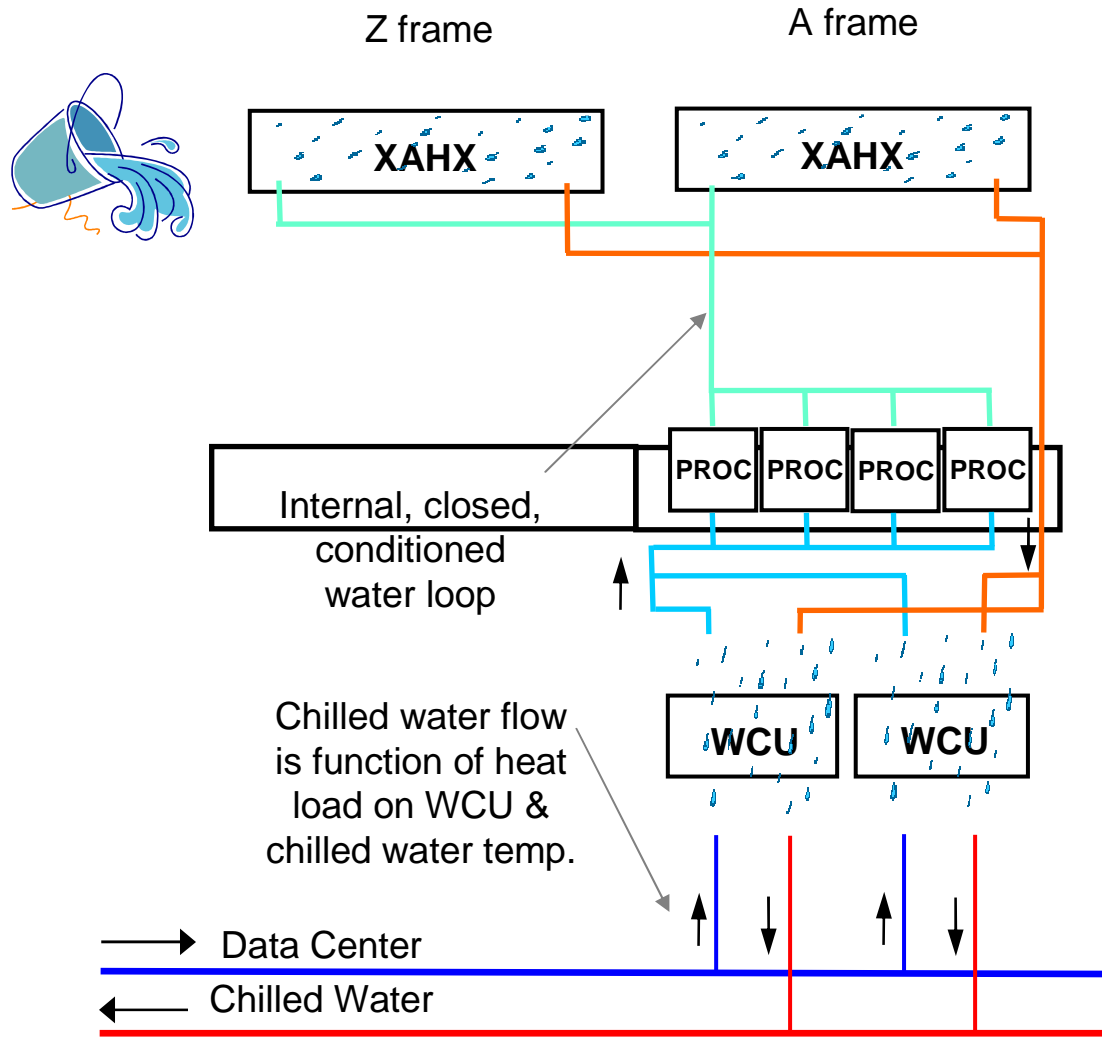


Reduce power consumed

- Reduce power in periods of low utilization to limit energy cost
- Allows reduction of power budget to either
 - Reduce energy footprint of data center
 - Dynamically increase power budget other system(s)



z196 Water cooling option



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- Server consolidation & virtualization optimizes server utilization
 - All IBM servers allow consolidation projects and support Linux (even natively).
 - Mega consolidation project
 - IBM has been consolidating more than 3,900 distributed servers onto just 33 Enterprise Servers running Linux. **This drove HUGE savings... including an 80 percent reduction in energy consumption over five years.**
 - zEnterprise System is the coolest server in the green DataCentre



Server consolidation example



The Bank of New Zealand reduces their datacenter footprint by 30%, heat output by 33%, carbon footprint by 39%, and expects a 20% ROI

Business Challenge

- A datacenter with 200 Sun servers was at capacity
- Bank of New Zealand needed to grow, reduce emissions and costs, become more open, and seeks to become carbon neutral by 2010

Solution

- Consolidate 200 Sun servers into just one IBM System z10 mainframe running Red Hat Enterprise Linux

Benefits

- Bank of New Zealand reduced power consumption by close to 40%, heat output by 33%
- Just one administrator needed for 200 virtual servers
- New environments are deployed in minutes, not days

“Deploying IBM mainframes with Red Hat Enterprise Linux to address our carbon footprint and cost savings concerns was a very big deal, especially at the senior management level.”

*Lyle Johnston
Infrastructure Architect
Bank of New Zealand*



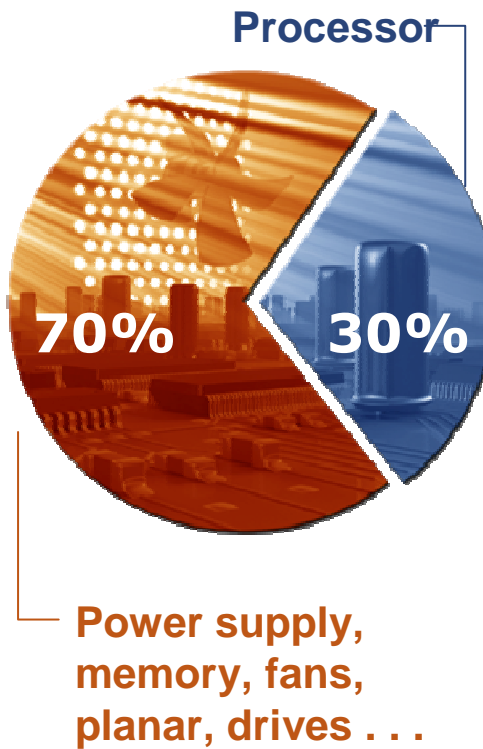
Opportunities for optimization



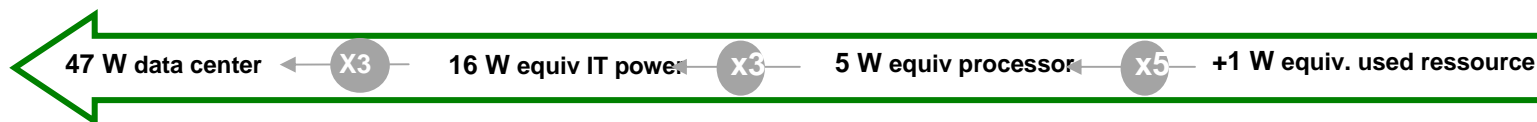
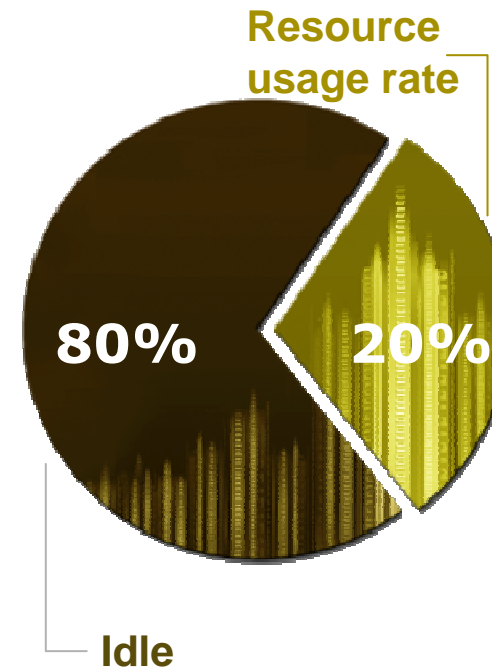
Data center



Server hardware



Server loads



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IBM is helping clients as they focus across the infrastructure...



Data Center

- Thermal and energy assessments
- Rationalize and consolidate
- Energy efficient data center design
- Innovative cooling techniques

Energy Management

- Measure, collect
- Monitor, trend, manage
- Track, verify, report for compliance
- Earn energy efficiency certificates

IT Equipment

- Energy efficient product designs
- Workload optimized systems
- Active energy management
- Virtualization of server, storage, network, application, & desktop
- Tiered storage
- Energy efficiency IT assessments

Property and Facilities

- Instrumentation of assets for power, temperature, layout, and problem identification
- Intelligent lifecycle management solutions
- Sustainable facilities analysis for emissions and waste generation

Data and Applications

- De-duplication and compression
- Lifecycle management, retention and archiving



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