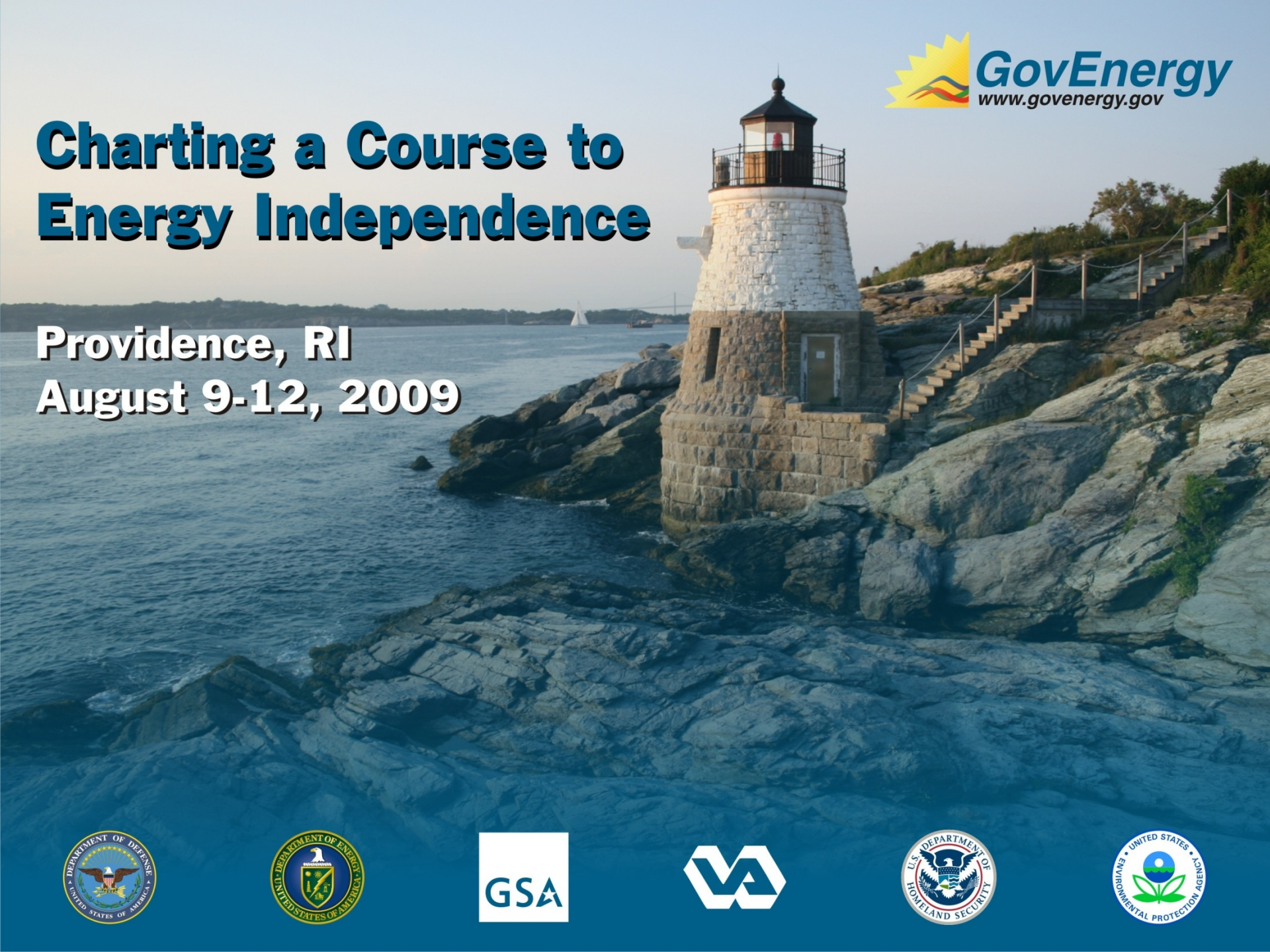
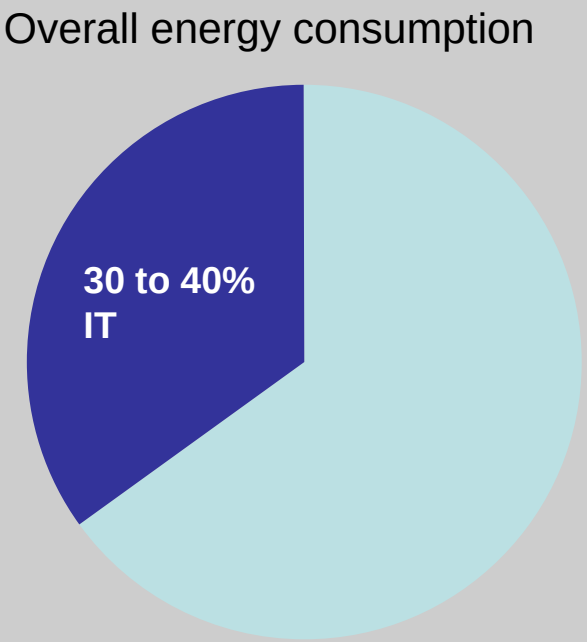

GovEnergy
www.govenergy.gov
Charting a Course to Energy Independence
Providence, RI
August 9-12, 2009
GSA

# Data centers are energy hogs

- IT represents 30 to 40% of a company's energy consumption
- Cost expected to increase from $18.5 billion in 2005 to $250 billion by 2012*
- In 2006, electricity consumed by servers in US data centers represented about 1.5 percent of national electricity use . . . for a total electricity cost of about $4.5 billion**

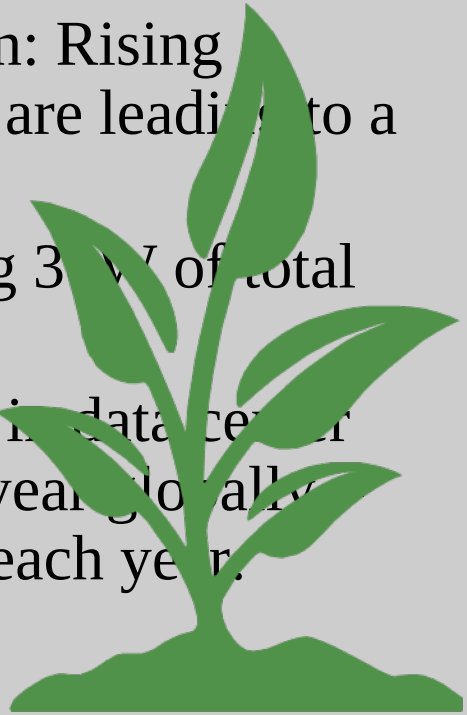



*CIO of Sun Microsystems

** EPA Report to Congress

# Why go green?

- Reliability is no longer linked to energy consumption
- IT rolls over hardware every 3 to 5-years; opportunity to take advantage of new architectures
- 50% potential reduction in energy consumption: Rising energy spend and growing capacity constraints are leading to a crisis in data center business models.
- The industry can not continue of a path of using 3W of total power to provide 1.5W of useful computing.
- Carbon Footprint reduction: Projected increase in data center carbon footprint equates to 20Mt of CO2e per year globally equivalent to four new coal fired power plants each year.
- Demonstrate leadership in sustainability



# Biggest opportunity is existing data centers

# Low Cost Energy Savings Strategies

- Correctly set the temperature and RH set control points on cooling units.
  - Cold intake air causes water condensate inside computer hardware
  - Cooling unit setpoint should be cold aisle temperature plus difference between cold and hot aisle.
  - Desirable unit leaving temperature may be 70-72 degrees.
- Decrease cooling based on heat load.
  - *Uptime Institute research shows the average computer room has three times more cooling running than required by actual heat load.*
  - Computer rooms with excessive cooling have highest percentage of hot spots.
  - Increase stability and quality while saving energy.
- Insure cooling units are capable of delivering rated capacity
  - Inspect installation and perform regular maintenance on units
  - Perform computer room tune up
  - Change controls on cooling unit for blower to turn off if cooling fails to avoid pumping increasingly hot air into space

# Low Cost Energy Savings Strategies

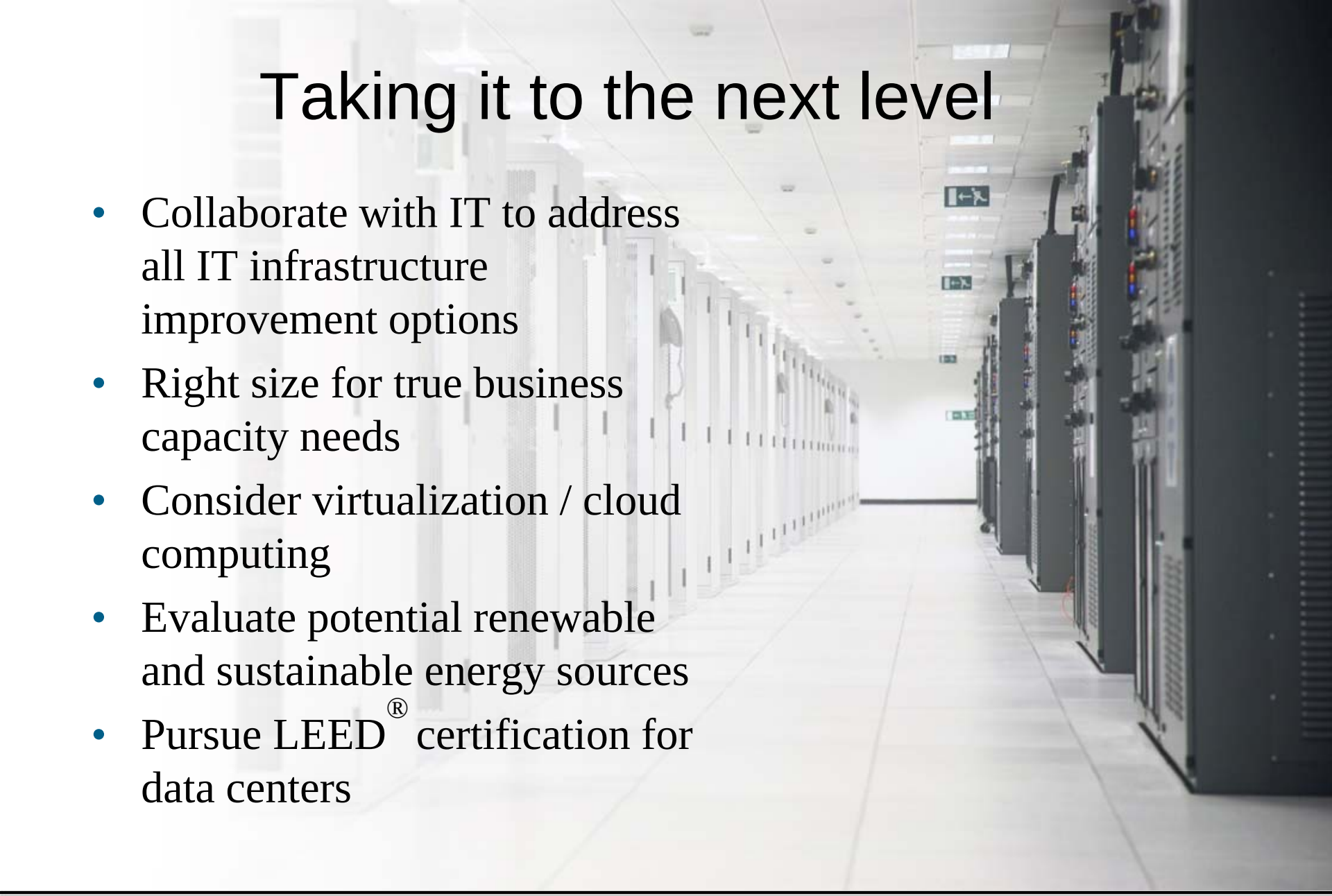
- Deliver cold air where it is needed most.
  - *Computer rooms with raised floors waste over 60% of available cold air.*
  - Carefully place perforated tiles in cold aisle and seal cable cutouts
  - Maintain at least 10 degree difference between hot and cold aisles
  - Small difference signals air mixing, reduced cooling capacity and efficiency
- Minimize outside air, humidification, and dehumidification
  - Design requirements are for equipment, not people.
  - *Up to 30% of adjacent units may be simultaneously humidifying and dehumidifying wasting energy and posing water leakage risk.*
  - Proper engineering and calibration of cooling unit sensors can eliminate this issue
- Increase Data Center Temperature
  - Check specifications on equipment to determine maximum temperatures for proper functioning. New units are guaranteed to run at temperatures in excess of 100 degrees.
- Lighting Controls
  - Occupancy sensors to eliminate or minimize lighting to emergency lighting levels when data center is unoccupied.

# Reduce Reuse Recycle

The EPA estimates that of the 1,918,500 to 2,172,600 tons of electronic goods disposed of in 2005, approximately 60% were IT related assets like desktops, laptops, monitors, and keyboards, and only 15% to 20% were recycled. Due to the presence of toxic chemicals in IT equipment, improper disposal or recycling of e-waste can pollute the earth's ecological systems and in turn expose humans to health risks.

Recycle or sell existing and purchase refurbished critical infrastructure equipment.

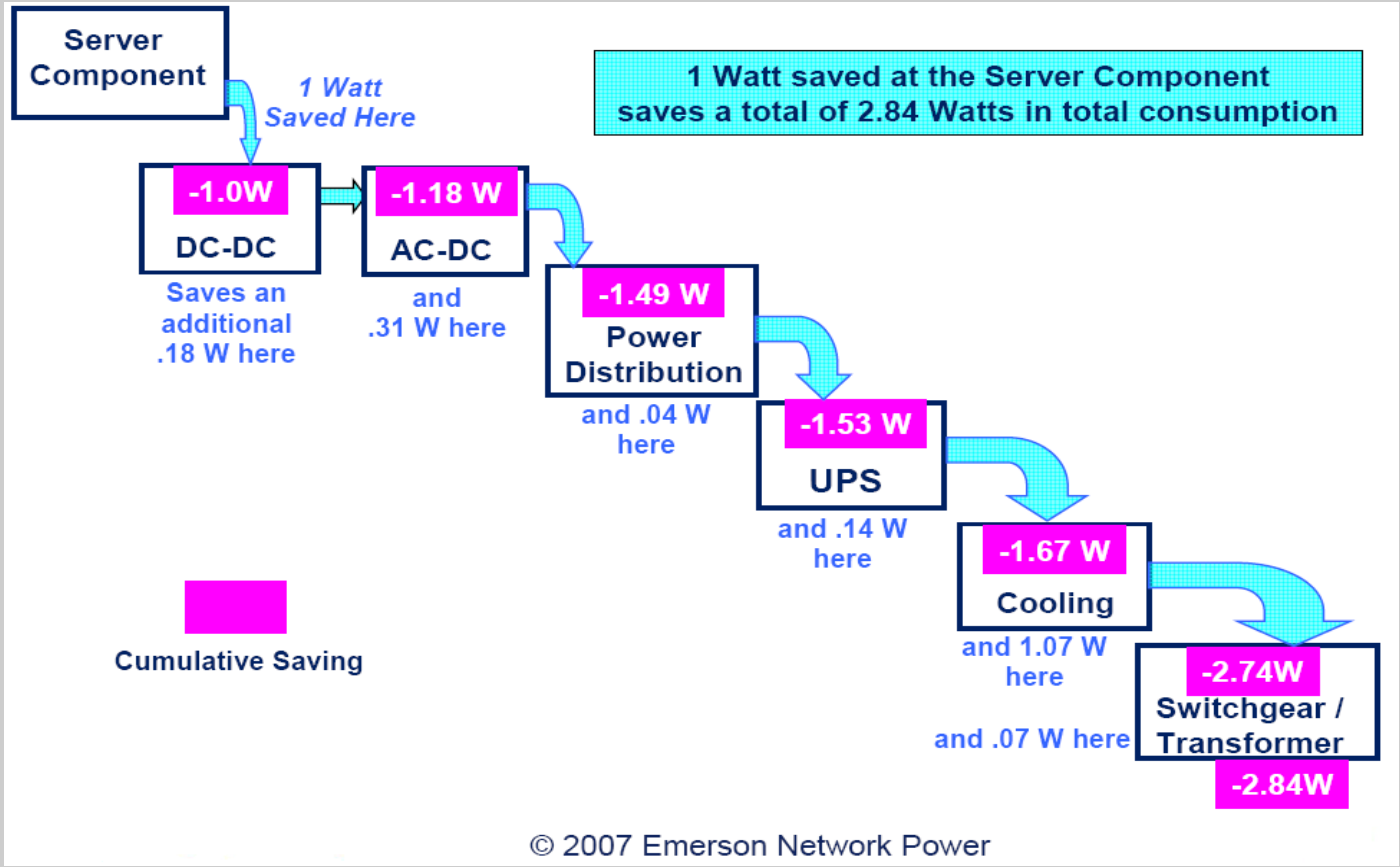
# Taking it to the next level



- Collaborate with IT to address all IT infrastructure improvement options
- Right size for true business capacity needs
- Consider virtualization / cloud computing
- Evaluate potential renewable and sustainable energy sources
- Pursue LEED® certification for data centers

# The Cascade Effect

The most effective way to reduce Data Center power consumption is to reduce the power demand of the IT equipment.



# Opportunity to reduce power consumption

**IT hardware choices**

**30%**

**Operational best practices**

**11%**

**Power and cooling product efficiencies**

**11%**

*Based upon a 5,000 square foot data center with legacy systems

# Reduce Power Consumption through Intelligent Equipment Choices

Based upon a 5,000 SF data center with legacy systems

| | Strategy | Initial Data Center | Optimized Data Center | Saving (kW) | % | |
|---|---|---|---|---|---|---|
| 1. | Low power processor | 91W / Processor (Average) | 70 W / Processor | 111 | 10% | 30% |
| 2. | Higher efficiency power supplies | AC-DC →79% DC-DC →85% | AC-DC →90% DC-DC →88% | 124 | 11% | |
| 3. | Server power management | Power Consumption: 80% of full load when idle | 45% of full load when idle | 86 | 8% | |
| 4. | Blade servers | All Rack-mount | 20% Blades | 7 | 1% | |
| 5. | Server Virtualization | No virtualization | 20% Servers Virtualized | 86 | 8% | 11% |
| 6. | Power distribution Architecture | 208V AC | 415V AC provides 240V single phase | 20 | 2% | |
| 7. | Implement cooling best practices | Hot aisle – Cold aisle | Optimized Cold Aisle & Chilled Water Temp, No Mixing of Hot & Cold Air | 15 | 1% | |
| 8. | Variable Capacity Cooling | Fixed Capacity Cooling | Variable Capacity Refrigeration & Airflow | 49 | 4% | 11% |
| 9. | High Density Supplemental Cooling | Floormount Cooling only | Floormount plus supplemental cooling | 72 | 6% | |
| 10. | Monitoring and Optimization | No coordination between cooling units | Cooling units work as a team | 15 | 1% | |

# Consider all aspects of IT Infrastructure

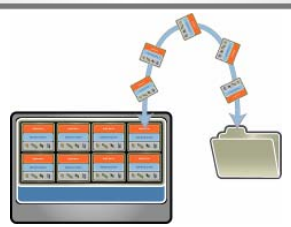
- Data center equipment
  - Power distribution
  - HVAC&R equipment
  - Lighting
- IT assets within the data center
  - Servers
  - Storage
  - Network Gear
  - Monitors, etc.
  - Determine data center power usage effectiveness ratio
  - Determine data center infrastructure efficiency ratio
- IT Assets outside the data center
  - PC’s
  - Telephone Systems
  - Office equipment

# Virtualization

## Partitioning

Via the Virtualization Layer, share resources for multiple virtual machines on a single physical server

## Encapsulation

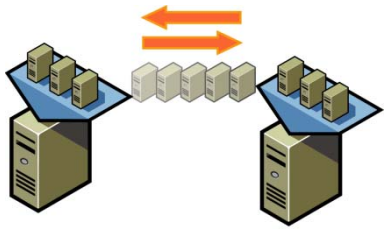


Entire virtual machine is saved in files and can be migrated by moving and copying the files

## Isolation

Each virtual machine is isolated from other virtual machines on the same physical server

## Hardware Independence



Run a virtual machine on any physical server – via the virtualization layer

# Virtual Infrastructure Solutions

**Server Consolidation and Containment** – Reduce capital and operating expenses by using virtualization to consolidate existing servers and contain future datacenter growth. Client examples of 8:1 and 10:1 ratios.

**Business Continuity** – Increase availability and improve disaster recovery by using virtual infrastructure to reduce downtime and implement simpler, cost-effective recovery

**Development and Test Optimization**– Rapidly provision and re-provision test and development servers; store libraries of pre-configured test machines

**Desktop Manageability & Security** – Provide secure, managed desktop environments to ensure safe, managed access to enterprise resources

# Cloud computing

- Outsourcing IT: hardware, software and desktop
- Networking large groups of servers
- Subscription versus investment in equipment
- Tens of trillions of computations per second

# The benefits of cloud computing

- Reduced IT costs
- Flexible sourcing of hardware and software
- Faster deployment of new IT capabilities
- Continuous upgrades for mission critical systems software
- No need to house, manage or maintain hardware/software infrastructure
- Increased speed, security and efficiency

# Renewable and sustainable energy sources

- DC Power Plants
- Geothermal
- Wind power
- Fuel Cells
- Photovoltaic power
- Bio fuels
- Hydro Power
- Cogeneration

# LEED® for data centers

- Site credit
- Water credit
- Energy credit
- Materials credit
- Indoor environmental quality (IEQ) credit
- Innovation credits

# Green Data Center Strategies

- **Site Selection**
  - Utilize existing facilities that can be retrofitted to meet Data Center requirements
  - If the facility can not be located on a brownfield site, situate the facility on a site where the surrounding environment can be preserved or mitigated
  - Utilize sustainable water source (rainwater, storm water or large bodies of water) for cooling
- **Site work**
  - Utilize trees, berms and boulders for perimeter security rather than fences
  - Low or no irrigation landscaping elements including native and adapted plantings
- **Architectural**
  - Energy efficient building envelope coupled with sun shading landscaping
  - High Solar Reflectance Index roof materials or green roof that does not require watering
  - Use of day light harvesting and automated dimming in office areas, occupancy sensors
  - Use of renewable, reclaimed, recycled, VOC free, and locally manufactured materials
- **Electrical Systems**
  - Maximum utilization of higher voltage distribution within the facility to reduce electrical material, space and electrical losses
  - High Efficiency Electrical Equipment: UPS, Transformers
  - “Right size” equipment
- **Mechanical Systems**
  - High Efficiency Chillers, Variable Frequency Drives on fan motors and pumps
  - Increased chilled water supply temperature to reduce energy consumption
  - Optimum IT rack layout and cooling systems for High Density IT equipment areas
  - “Right size” equipment
  - Active Data Center pressurization controls
  - Optimize controls systems for redundancy requirements
- **Equipment**
  - Reduced power consumption of IT equipment through Virtualization, Power Utilization Efficiency

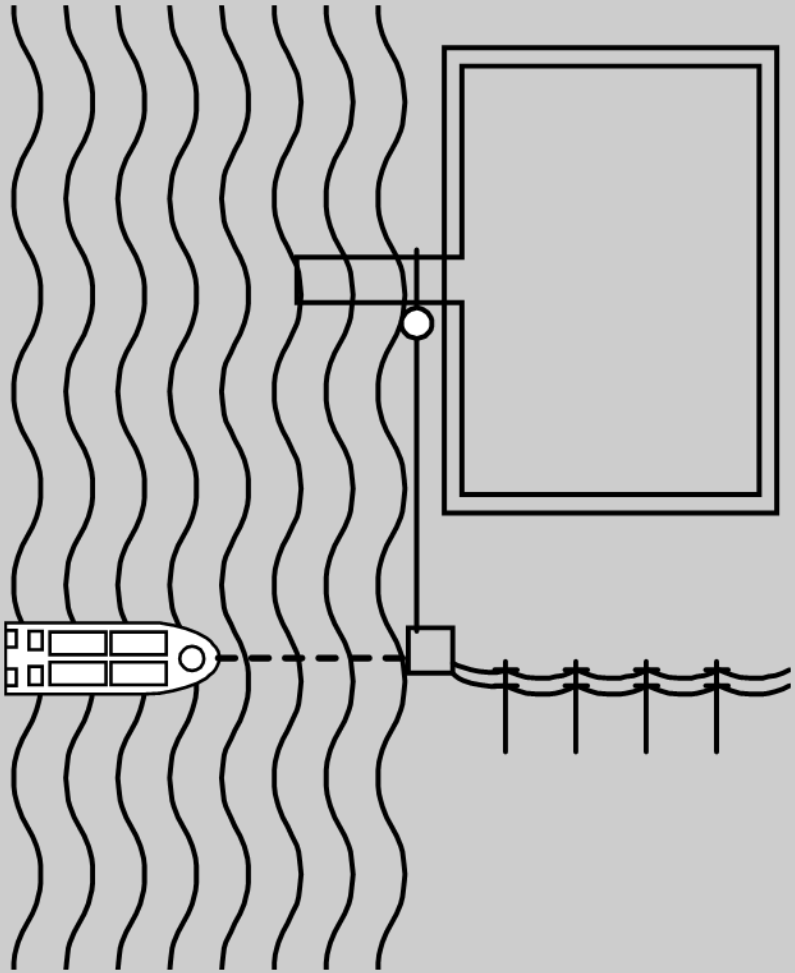
# Trend setters

Microsoft

- 8 million gallons of recycled water per month for cooling
- Solar panels on roof
- In talks to participate in CPS Energy's Windtricity Program using up to 50 MW of power making it CPS Energy's largest customer
- Charges business units by the amount of power they use in data centers rather than space
- Recycling programs to reduce waste

# The data center of the future

- Google
  - Water-based data center that uses ocean surface waves to power and cool the facility



# Right steps in the right order

1) Measure and monitor existing energy usage and cost impacts

2) Analyze impacts and relative value of packages of efficiency levers to optimize existing facilities to save energy and increase capacity

- Improve computation efficiency
- Improve equipment and facility utilization
- Improve IT equipment efficiency
- Improve power distribution and cooling infrastructure efficiency

3) Design radically energy efficient, green new data centers right-sized for true business capacity needs

# A look to the future

- The focus on green buildings and data centers continues to increase at a rapid pace and sustainability initiatives will continue to hold a growing level of prominence within corporate business goals
- Energy conservation is a national priority, and will continue to be under the Obama administration, providing additional motivation for companies to follow suit
- The financial downturn that has touched most countries worldwide has not dispelled the corporate commitment to sustainability, but it is targeted at energy as the best delivery solution.