AIA Provider:
Colorado Green Building Guild
Provider Number: 50111120

Office Efficiency: Get Plugged In

AIA Course Number: EW10.15.14

Speaker: Geoff Overland

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Continuing Education Units (CEUs) and Course Evaluation

Sign-in Sheets:

There will be two sign-in sheets passed around. PLEASE WRITE LEGIBLY!

- General sheet – everyone should sign.
- AIA – sign this only if you are a member of AIA and would like CEUs.

For the AIA sheet, if you do not fill in your ID#, it is your responsibility to email it to the CGBG within 3 business days.

Certificates of Completion:

If you need a Certificate of Completion, please check the appropriate box on the general sign-in sheet.

Course Evaluations:

If you would like to fill out a course evaluation form, please email the CGBG within 3 business days to request one.

The Colorado Green Building Guild (CGBG) is the Provider for this course:

Email: julie.nelson@bgbg.org

Course Description

Office information technology (IT) and data center energy use is estimated to consume 3 percent of all electricity on the grid, and some experts project it to double every five years moving forward. Implementing energy efficiency measures to help address this growth are more important than ever—not only to mitigate energy demands, but also to improve data center reliability and redundancy.

Effectively communicating with sophisticated and risk-averse IT and facility leaders is critical to implementing efficiency measures in these facilities; when they understand how energy efficiency can help achieve unimpeded uptime and an improved bottom line, the benefits reach utilities, trade allies and customers alike.

With the many ways to conserve IT and data center energy, it is key to help IT and facility leaders understand where to begin. There is an interactive relationship between IT and electrical and cooling equipment, and a best practices approach to IT and data center efficiency provides those leaders with a road map to achieve the most significant and cost-effective savings.

Through case studies of large and small IT and data center projects, this presentation will demonstrate the significant results that are being achieved when this process is effectively communicated and implemented by IT and facility departments.

Learning Objectives

At the end of the this course, participants will be able to:

.. implement a best practices approach to IT and data center energy efficiency.

.. understand the interactive relationship between IT and electrical and cooling equipment.

.. successfully communicate and implement these strategies with IT and facility departments.

.. understand the various tools and techniques available for IT and data center energy conservation through discussion of various case studies..

CLEAResult

Realizing IT and data center energy efficiency

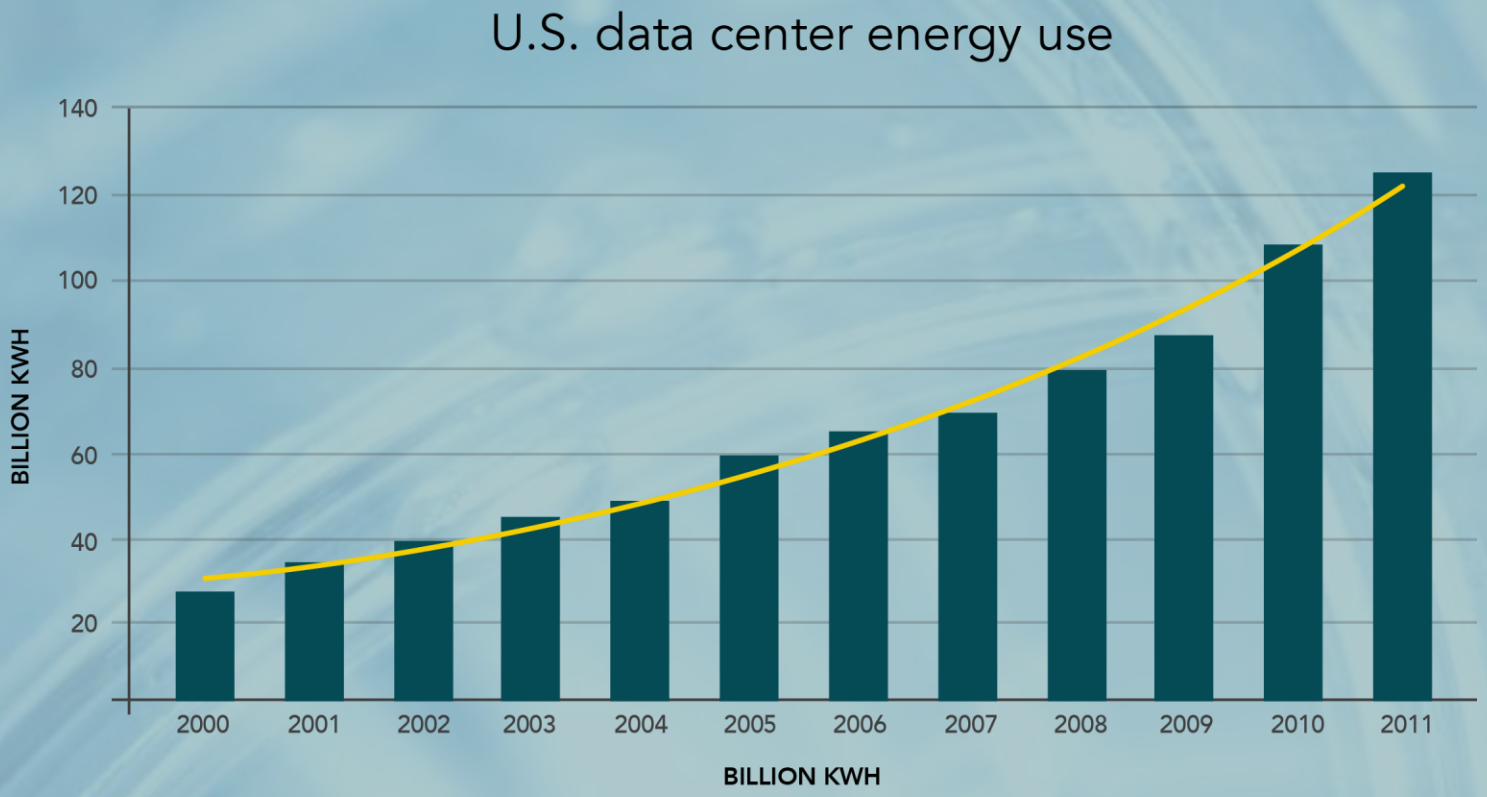
July 15, 2015

We change the way people use energy

Today’s agenda

1. IT and Data Center Energy Trends
2. Components and Systems
3. Interactive Effects
4. Efficiency Measures
5. Project Examples
6. Summary
7. Q&A

IT and Data Center Energy Trends



DID YOU KNOW?

*U.S. data centers consume a growing portion of the U.S. energy/electricity supply due to growing demand for the services they provide. Data centers used **61 billion kWh** of electricity in 2006, representing **1.5%** of all U.S. electricity consumption and double the amount consumed in 2000. Based on current trends, energy consumed by data centers will continue to grow by **12%** per year.*

Market barriers and opportunities

Barriers	Opportunities
• Risk averse culture • Redundancy requirements • Disconnect between IT and Facilities • Difficulty in determining efficiency • Trade ally motivation	• Education & information • Improve redundancy and reliability plus free up trapped capacity • Facilitate IT/Facilities dialogue • Opportunity for utilities to incentivize measures and add to programs portfolio

Market assessment

- Estimated server distribution
  - Significant opportunity in mid-size data centers

Table A4-2: Projected U.S. Installed Base of Volume Servers by Space Type, Historical Trends Scenario, 2007 to 2011

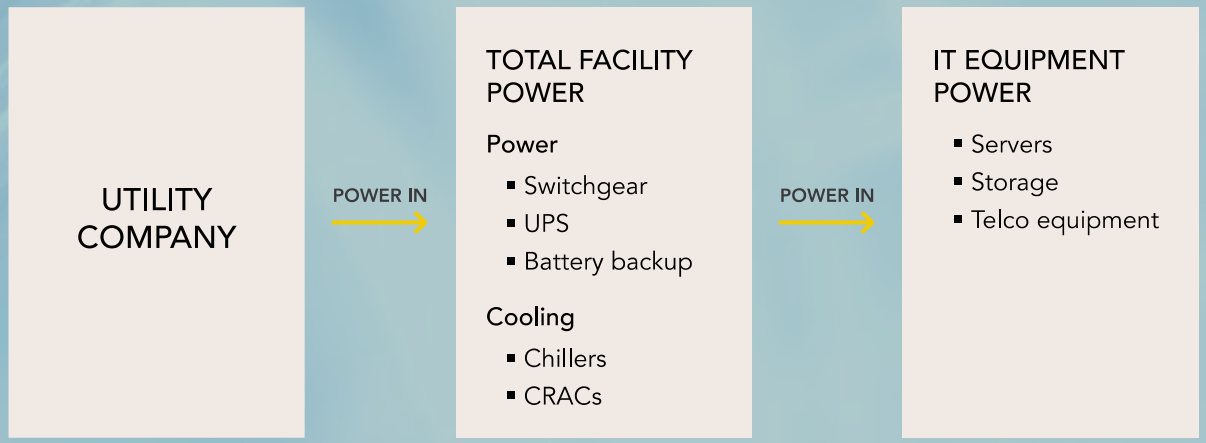
Volume servers in:	2007	2008	2009	2010	2011	Of 2011 total
Server closets	1,873,00	1,971,000	2,079,000	2,190,000	2,271,000	12%
Server rooms	2,408,000	2,731,000	3,088,000	3,745,000	3,918,000	56%
Localized data centers	2,067,000	2,351,000	2,655,000	3,005,000	3,385,000	
Mid-tier data centers	1,867,000	2,123,000	2,407,000	2,714,000	3,057,000	
Enterprise-class data centers	3,652,000	4,154,000	4,709,000	5,310,000	5,980,000	32%
Total volume	**11,867,000**	**13,330,000**	**14,948,000**	**16,964,000**	**18,611,000**	**100%**

EPA report to Congress on Server and Data Center Energy Efficiency - 2007

Data center benchmarks

- Power Usage Effectiveness (PUE)
  - Total facility power/IT equipment power
- Data Center Infrastructure Efficiency (DCiE)
  - IT equipment power/total facility power

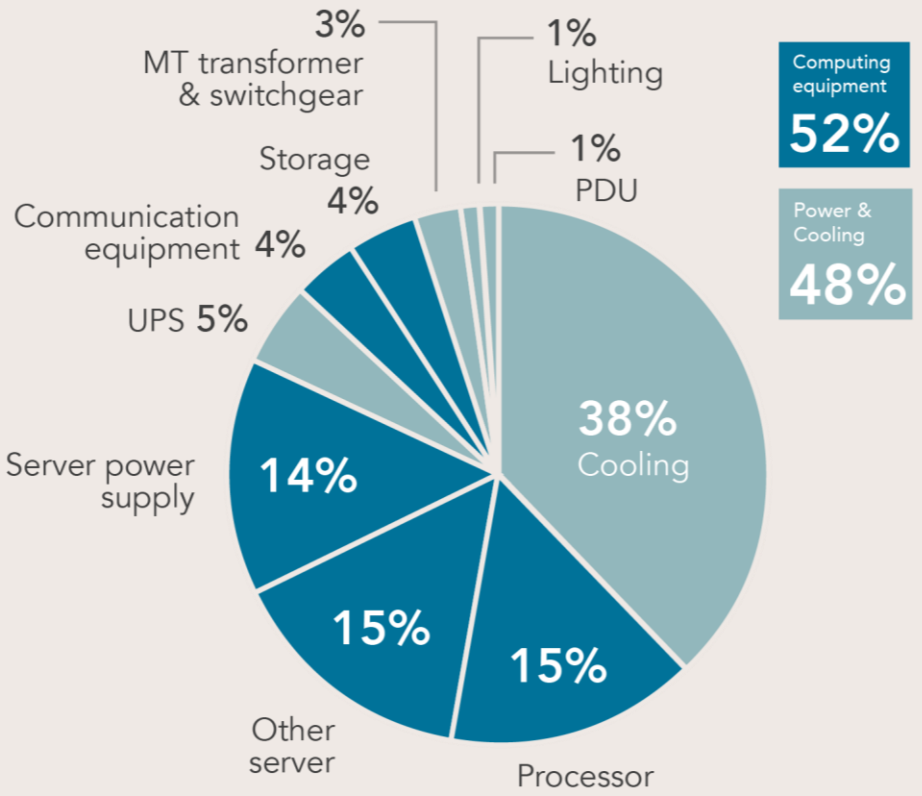
Power Usage Effectiveness



Data center energy usage

Equipment category	Energy consumption
Computing	588 kW
Lighting	10 kW
UPS & distribution losses	72 kW
Cooling power draw for computing & UPS losses	429 kW*
Building switchgear/MV transformer/other losses	28 kW
TOTAL POWER DRAW	1,127 kW

**Cooling load assumes chilled water based cooling system*
Emerson Network Power



IT Energy Outside Data Center

- Estimates are equal or greater than data center energy
- Energy consuming equipment
- Energy efficiency versus conservation
- Equipment utilization

IT Energy Outside Data Center

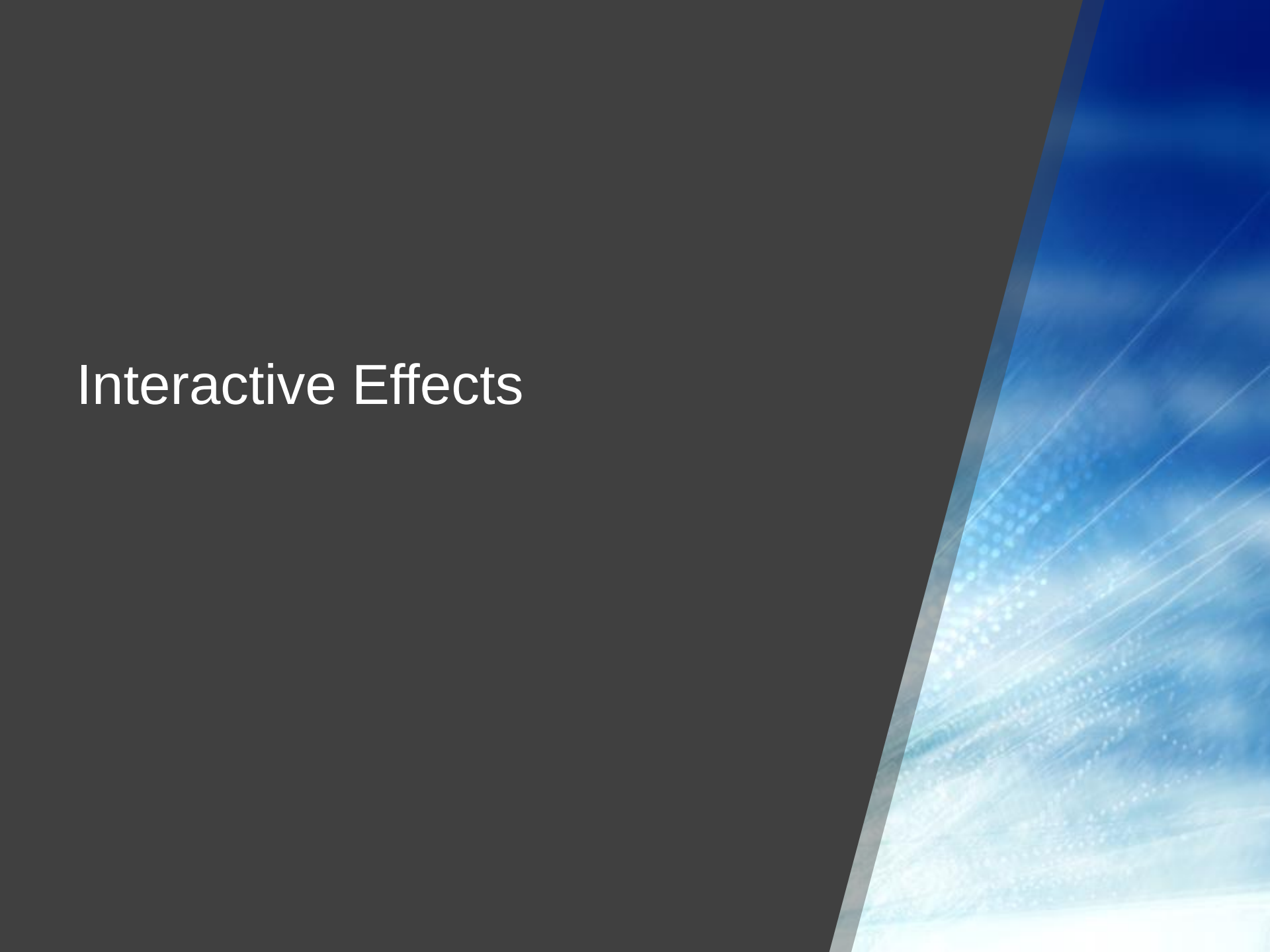
Desktop Energy

- Computer with monitor(s)
- Laptops & Thin clients
- Local printers
- Scanners
- Fax machines
- External hard drives
- Power strips
- iPods

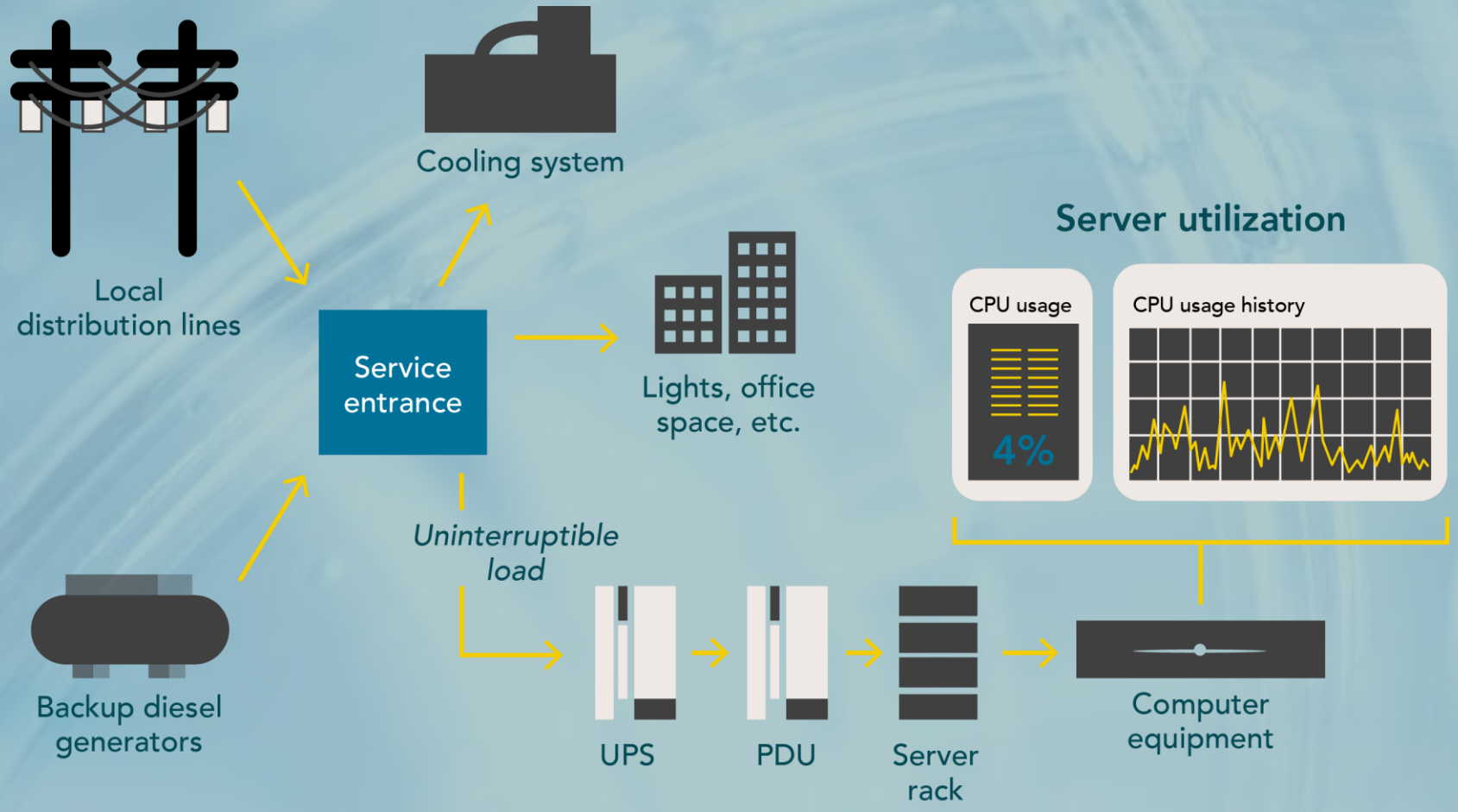
Network Energy

- Network printers
- Duplication devices
- Network switches
- Network routers
- Access points
- Phone systems
- Remote location servers
- Security cameras
- Fire walls

Interactive Effects



Systems overview



Data center lighting system

- Lights controlled on building EMCS
  - On all day with no or limited occupancy

Uninterruptable power supply

- UPS downstream from transformer, transfer switches, switchgear
- Potential spot for measuring IT load
  - UPS1 = 97.00 kW
  - UPS2 = 82.24 kW

Server racks and IT equipment

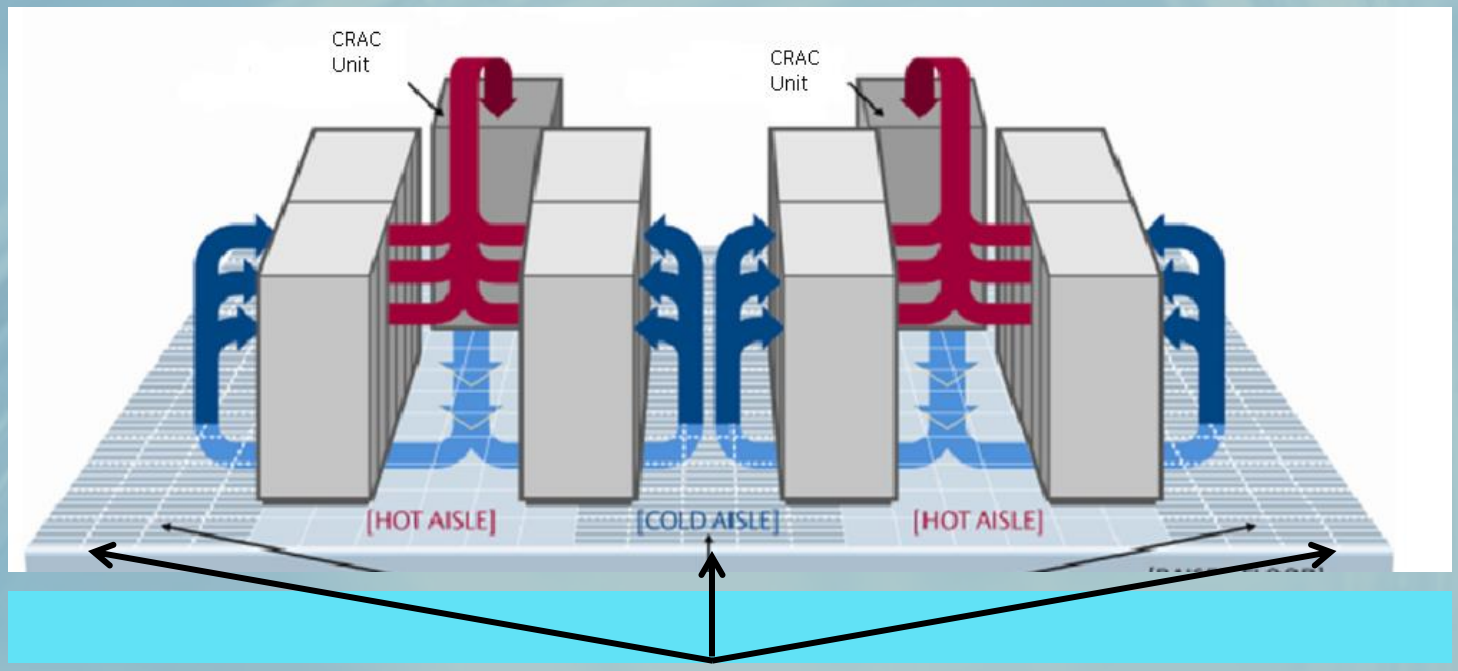
- Accounting, manufacturing, and distribution systems
- Data warehousing
- Email, intranet, and custom applications
- Network and telephone communications

Cooling system

- Computer Room Air Conditioner (CRAC)
- Computer Room Air Handler (CRAH)

Raised floor air distribution

- Management of airflow is important
- Hot and cold aisles



IT temperature requirements

- ASHRAE recommended temperatures
  - 68 ºF to 76 ºF
- ASHRAE allowable temperatures
  - 64 ºF to 81 ºF
- Server temperature technical specifications
  - 50 ºF to 95 ºF

Efficiency Measures

Potential Savings

- 20 – 40% savings possible
- Aggressive strategies – better than 50% savings
- Short paybacks – one to three years common
- Soft savings potential
  - Extend equipment life
  - Improve reliability
  - Increase redundancy
  - Free trapped capacity

IT Measures

- Conservation measures
- Energy efficient procurement practices – example
- PC/Server power management – more details
- Smart power strips
- Energy reduction strategies
  - Server virtualization – more details
  - Desktop virtualization with thin or zero clients
  - Efficient data storage

Procurement Example

- 80 Plus power supply certification
- Typical added cost of 80 Plus power supply $5.00
- Typical simple energy savings of $63.00

$$\text{Energy}: \frac{15\text{w} \times 2.0\text{PUE} \times \$0.08/\text{kw} \times 8{,}760\text{hrs/yr}}{1{,}000\text{w/kW}} \times 3\text{yrs} \approx \$63$$

PC Power Management

- 176 kWh average annual savings per device
  - At $0.08 per kWh = $14.08 annually saved
- 107 projects to control 62,392 desktops
  - $878,479 annual energy savings
- Low Carbon IT Pledge
  - www.energystar.gov/lowcarbonIT

Server Virtualization

- 9-to-1 average consolidation ratio
- 3,500 kWh average annual savings per server
  - At $0.08 per kWh = $280 annually saved
- 148 projects applied with 1,876 servers approved
  - $525,280 annual energy savings

Data Center Measures

- Operational and maintenance (O&M) improvements
- HVAC
  - Airflow management
  - Airside and waterside economizers
  - In-row cooling
- Power
  - UPS measures – Retrofit and efficiency upgrades

Airflow management

- Setup hot and cold aisles
- Avoid covering cold aisle floor vent tiles
- Avoid separating racks
- Fill all open rack slots with blanking panels
- Fill holes in the floor
- Addressed floor congestion

Hot and cold aisle containment

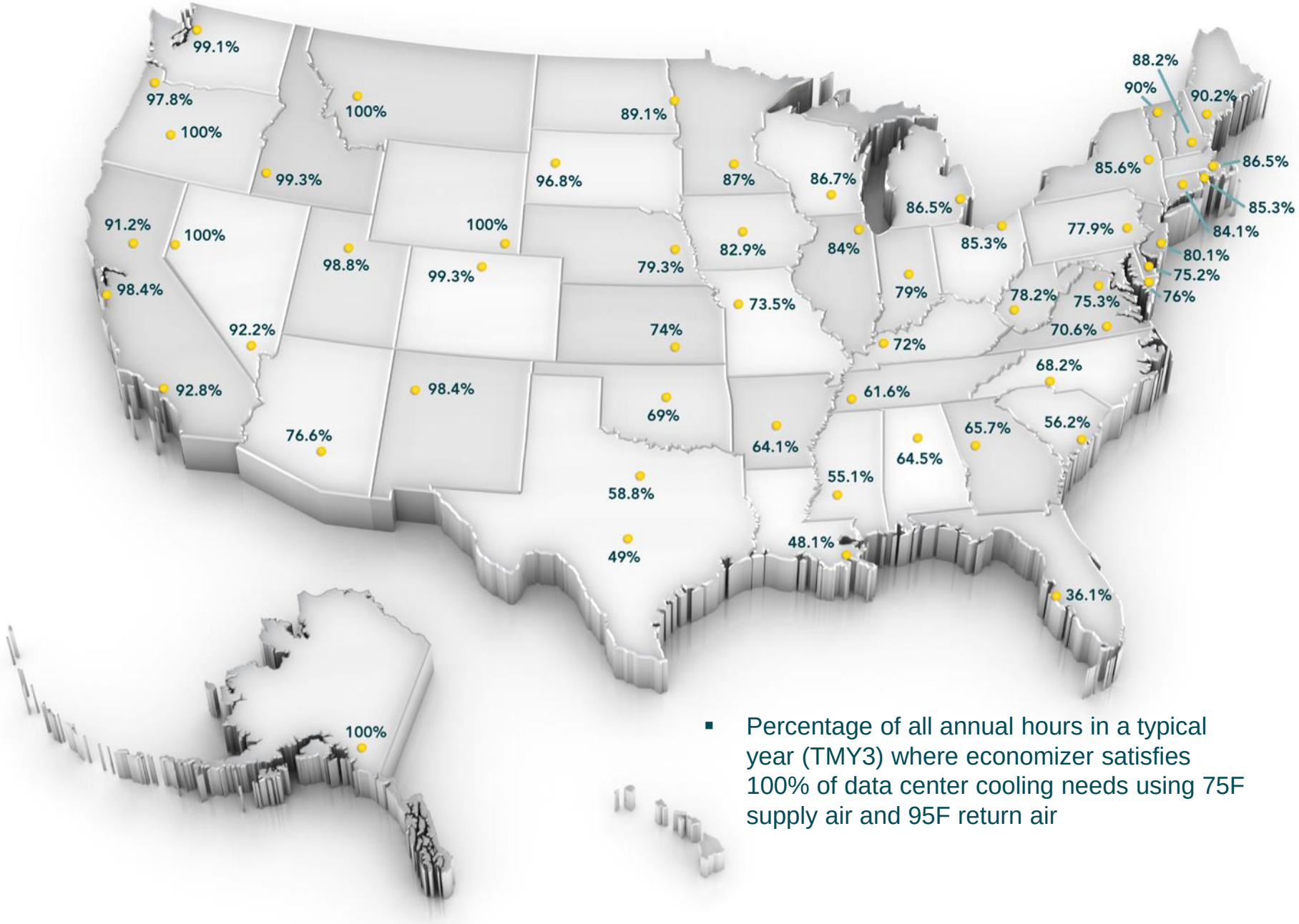
- Consider completely closing hot and cold aisle
  - Eliminates mixing and allows turning of airflow
  - Promotes warmer return temperatures to CRAC units
- Seal aisles with metal, Plexiglas or plastic
- Use sliding door or curtain access

- Which aisle should you contain?

Economizers

- Airside
  - Requires additional OA louvers, return and exhaust duct systems and controls
  - Direct impact on computer room environment
- Waterside
  - Requires additional heat exchanger, piping, valves and controls
  - Can be tricky to operate in freezing and sub-freezing temperatures

Free cooling opportunities



- Percentage of all annual hours in a typical year (TMY3) where economizer satisfies 100% of data center cooling needs using 75F supply air and 95F return air

Efficiency Measures

Cooling

- Airflow management
- Free cooling – air or water
- Environmental conditions
- Centralized air handlers
- Low pressure drop systems
- Fan efficiency
- Cooling plant optimization
- Close-coupled cooling
- Direct liquid cooling
- Right sizing/redundancy
- Heat recovery

Electrical

- UPS, transformer efficiency
- High voltage distribution
- Premium efficiency motors
- Direct Current power
- Standby generation
- Right sizing/ redundancy
- Lighting – efficiency and controls
- On-site generation

IT

- Power supply efficiency
- Standby/sleep power modes
- IT equipment fans
- Virtualization
- Load shifting
- Multiuser computing
- Storage
- ENERGY STAR

Project Examples

Cloud Impact

3 Users in Small Office

Customer sold server and replaced with the cloud

$2,000-$4,000/yr

Customer estimated financial impact

IT Behavior Changes

Kill-A-Watt
Used Kill-A-Watt meter to monitor all IT equipment

Informed
Discussed findings at internal staff meetings

Empowered with monitoring
Employees took action to deliver savings

Results
Lowest monthly utility bill ever!

Low Carbon IT Champion

2,900 Computers
Computers enter standby state after 30 minutes of inactivity

$76,500
EPA estimated annual energy savings

3,520 tons of Carbon
3 year reduction in Carbon footprint

725 acres of trees
To absorb that much carbon naturally

Corporate data center – Phase I

4,181,200 kWh
annual facility electric consumption

2.4→1.6
PUE

93%
reduction in mechanical cooling and fan energy

42%
energy reduction for facility

1,780,000 kWh
savings

98%
annual free cooling

Corporate data center – Phase II

2,401,200 kWh
annual facility electric consumption

1.6→1.10
PUE

95%
reduction in UPS energy losses

21.4%
energy reduction for facility

515,412 kWh
savings

Large colocation project

7,545,322 kWh
M&V savings

1.73→1.36
PUE

28%
energy reduction for facility

661.1 kW
summer peak reduction

Mid-tier data center

3,115,932 kWh
annual facility electric consumption

1.88→1.29
PUE

992,077 kWh
M&V savings

97%
annual free cooling

Summary

- Underserved area of efficiency
- Cost effective with short paybacks
- Proven and sustained energy savings

Q&A

Connect with us.

Learn how CLEAResult can help you change the way you use energy.

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This concludes The American Institute of Architects Continuing Education Systems Course

Provider: Colorado Green Building Guild

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