U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

FEMP Federal Energy Management Program

Small Data Centers, Large Energy Savings: an Introduction for Owners and Operators

March 29, 2017

Steve Greenberg, P.E.

Lawrence Berkeley National Laboratory (LBNL)

Small Data Center Webinar

Welcome! This webinar will cover information from the guide “Small Data Centers, Big Energy Savings: An Introduction for Owners and Operators” and additional resources to help save energy in small data centers.

To join the online meeting:
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Before We Begin

- Please do NOT put the call on hold
- All lines have been muted, to be unmuted or to ask a question, please go to your meeting controls panel and raise your hand
- To submit questions through the chat box, click the chat button and type in the dialogue box at the bottom right. Please, select if you want your comment to go to the entire group or Elena Meehan to prompt a question to the presenter.
- Slides will be posted at datacenterworkshop.lbl.gov
- Attendees can receive a certificate of completion by filling out an evaluation form; link provided at the end of the presentation.

Agenda

- Why small data centers are important
- Simplest Measures
  - Turn off unused servers
  - Improve server power management
  - Improve air management
  - Increase temperature setpoints toward the high end of the ASHRAE range
  - Turn off active humidity control
  - Minimize UPS requirements
- Still simple, a little more work
  - Refresh the oldest IT equipment with new high-efficiency equipment
  - Consolidate and virtualize applications

(continued)

Agenda, con't

- Higher-level investment, but very cost-effective
  - Move to higher-efficiency internal or external data center or to the cloud
  - Implement IT and infrastructure power monitoring
  - Install Variable-Speed Drives on cooling system fans
  - Install rack and/or row-level cooling
  - Use air-side economizer
  - Implement dedicated room cooling (vs. using central building cooling)
- Training for IT and Facility Staff
- Resources

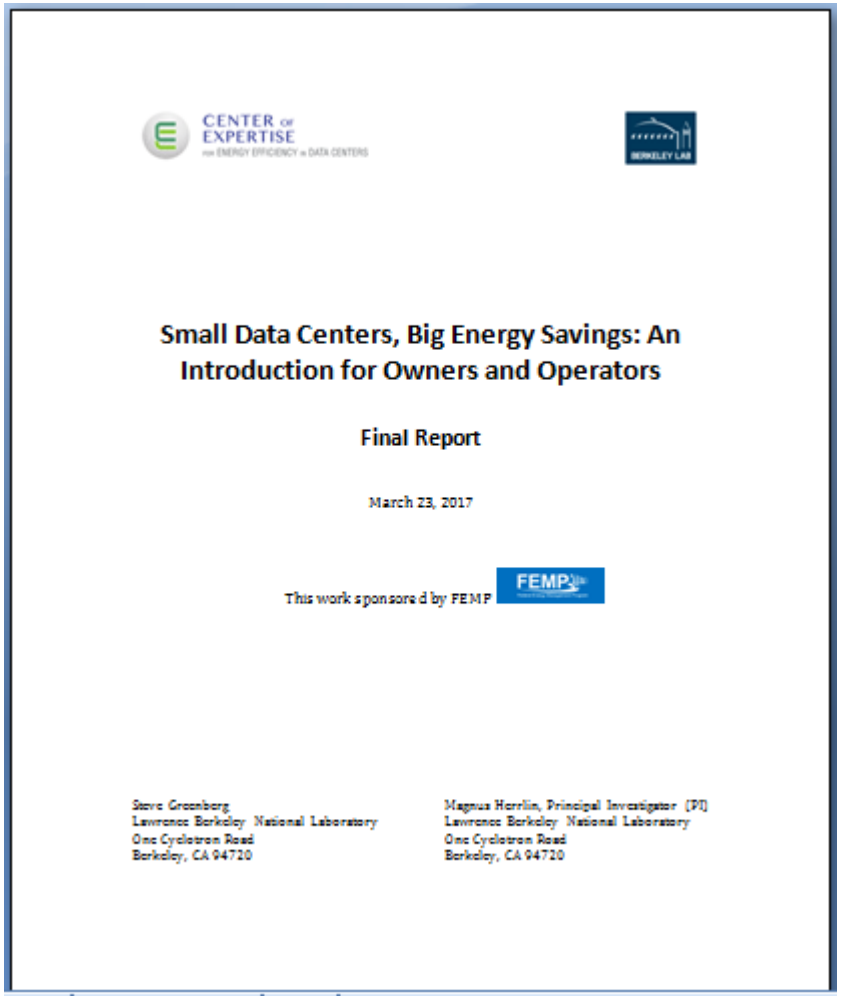
Agenda –

- **Why small data centers are important**

Why Small Data Centers are Important

- Definition: “Small” is less than 5000 square feet of computer floor
- Have most of the total servers
- Use 40 billion kWh/yr
- Have challenges
- Have large energy-saving opportunities (20 – 40%)
- Guide:

datacenters.lbl.gov/resources/small-data-centers-big-energy-savings



CENTER OF EXPERTISE FOR ENERGY EFFICIENCY IN DATA CENTERS

BERKELEY LAB

Small Data Centers, Big Energy Savings: An Introduction for Owners and Operators

Final Report

March 23, 2017

This work sponsored by FEMP

FEMP

Steve Greenberg
Lawrence Berkeley National Laboratory
One Cyclotron Road
Berkeley, CA 94720

Magnus Herrlin, Principal Investigator (PI)
Lawrence Berkeley National Laboratory
One Cyclotron Road
Berkeley, CA 94720

Agenda

- **Simplest Measures**
  - **Turn off unused servers**
  - **Improve server power management**
  - **Improve air management**
  - **Increase temperature setpoints toward the high end of the ASHRAE range**
  - **Turn off active humidity control**
  - **Minimize UPS requirements**

Turn off unused servers

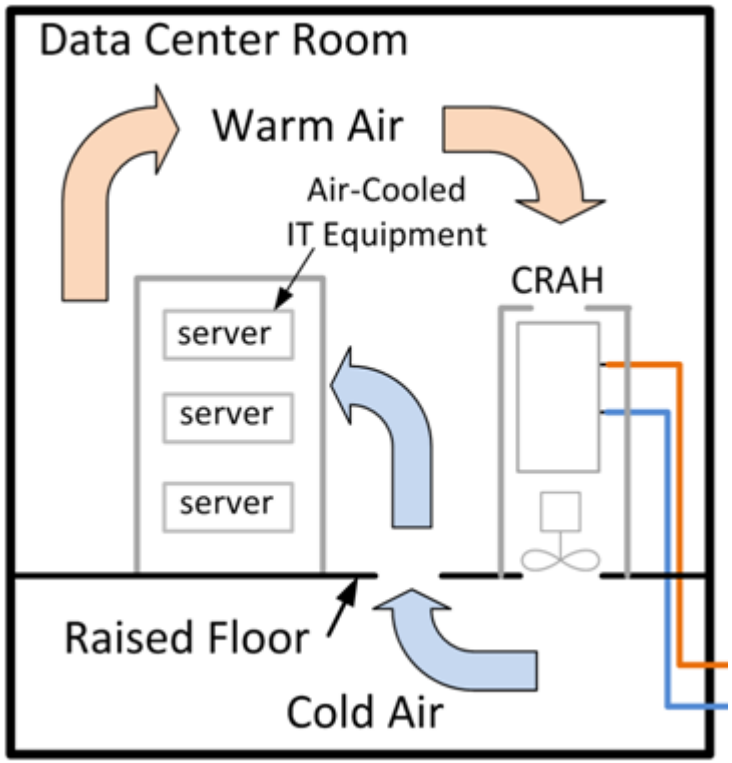
- Known as “comatose” or “zombie” servers: they do no useful work, but use
  - Power
  - Space
  - Cooling
- Estimated 20-30% of servers are comatose
- An idle server uses ~50% of full-load power and ~75% of one loaded at 25%
- Establish and maintain a list of what’s running on each machine
- Shut down unused servers

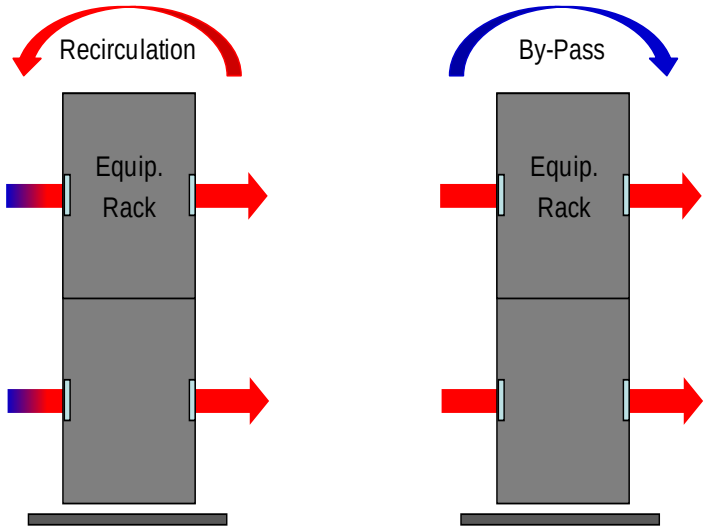
Improve server power management

- Most servers are shipped with power management turned on
- Most servers in use have power management turned off
- Check power management settings and enable
  - Processor
  - OS/hypervisor
  - BIOS

Improve air management

- Cool supply air *ideally* gets from cooling equipment to the IT inlet without mixing with hot discharge air
- Hot discharge air *ideally* returns from the IT exhaust to the cooling equipment without mixing with the cool supply air





Improve air management, con't

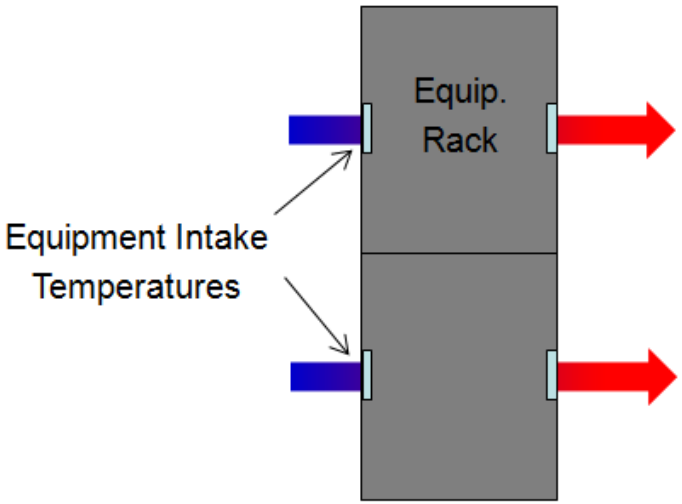
- Clear the desired air path (abandoned and cluttered cables, e.g.)
- Block the undesired air paths
  - Within and between racks
  - Cable and conduit cutouts from under floor and into ceiling plenum
  - Rack tops and row ends

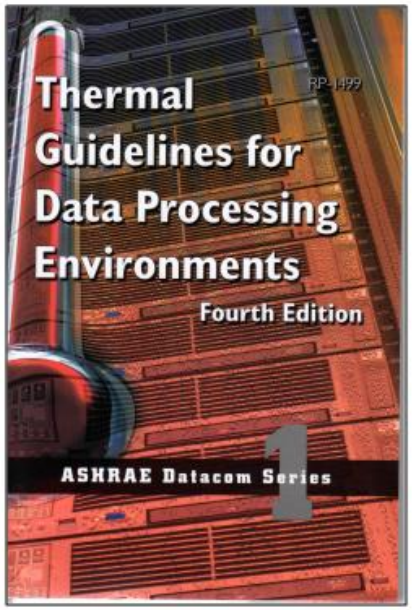
Pictures courtesy of ANCIS Incorporated

- Allows increased supply air temperature
- Allows reduced air flow

Increase air temperature setpoints toward the high end of the ASHRAE range

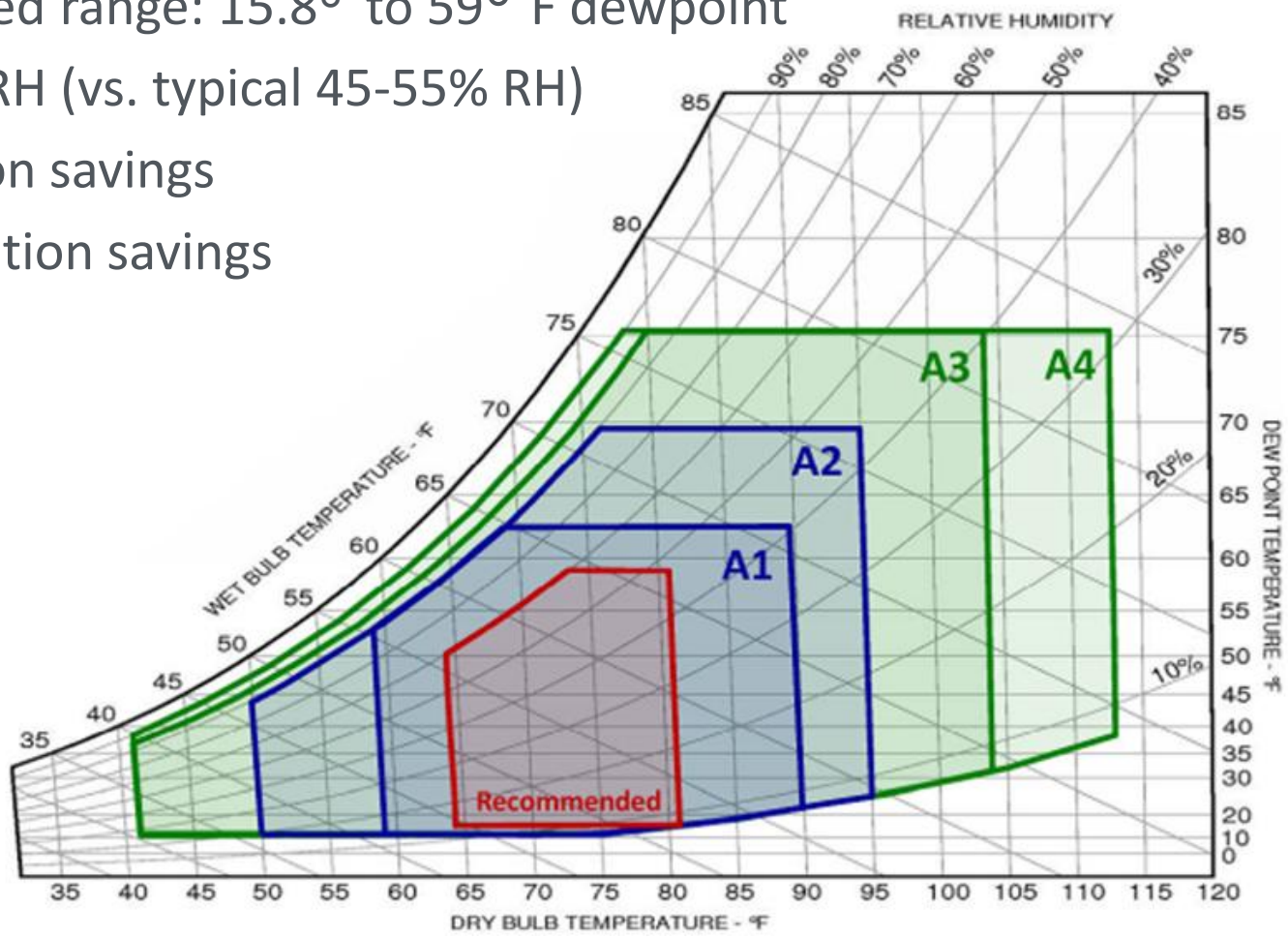
- IT inlet temperature is what matters
- ASHRAE recommended range (rounded): 65 to 80° F;
  Allowable (A1) range: 59 to 90° F
- NOT the same as CRAC or CRAH setpoint (especially for units controlled on return air)
- Ensure good air management first
- Enables savings in chiller or CRAC compressor energy





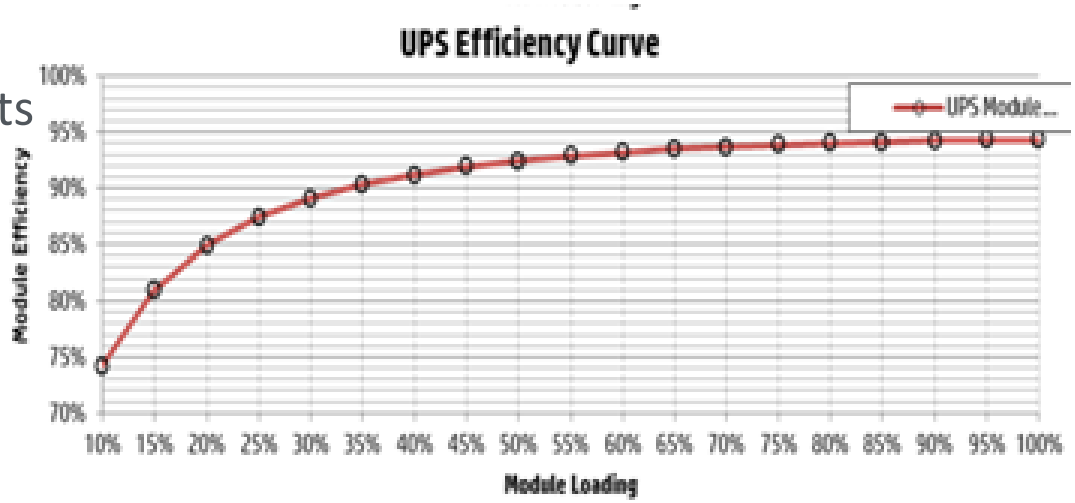
Turn off active humidity control

- Wider ASHRAE range means little if any control required
- Recommended range: 15.8° to 59° F dewpoint and 60% RH (vs. typical 45-55% RH)
- Humidification savings
- Dehumidification savings
- Often both



Minimize Uninterruptible Power Supply (UPS) requirements

- Unnecessary redundancy leads to inefficiency
- Many applications can be shut down and restarted without adverse effects
- Critical applications should be considered for moving to a larger data center or the cloud
- Analyze UPS needs
  - Minimize number and size
  - Use ENERGY STAR UPS units
  - Use Eco-mode



Agenda

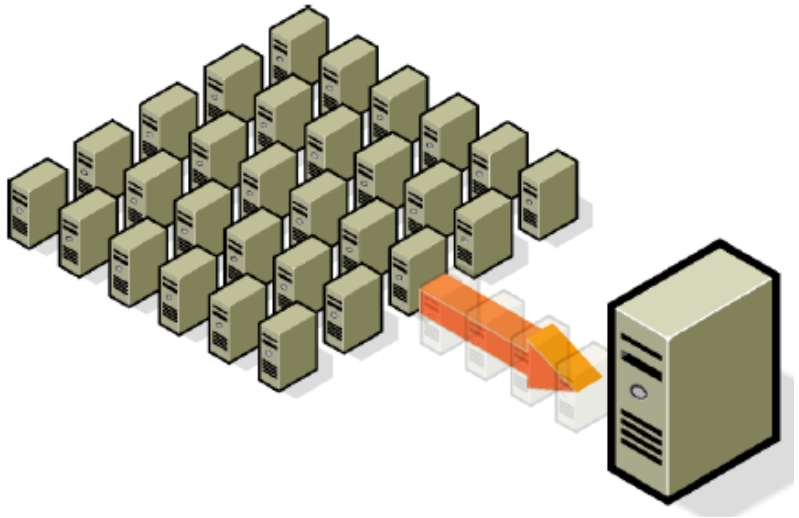
- **Still simple, a little more work**
  - **Refresh the oldest IT equipment with new high-efficiency equipment**
  - **Consolidate and virtualize applications**

Refresh the oldest IT equipment with new high-efficiency equipment

- New equipment more powerful and more computing per watt plus better power management
- More virtualization potential
- Energy and software cost savings typically justifies a faster refresh rate
- ENERGY STAR
  - Servers
  - Networking
  - Storage
- Solid-state drives (vs. hard disks)
- 80-Plus power supplies (beyond ENERGY STAR requirement)

Consolidate and virtualize applications

- Most servers operate with very low utilization (5-15% on average)
- Servers at typical loads use roughly 75% of average peak power
- Big opportunities for virtualization and consolidation
- Energy savings from power and cooling reductions
- Space savings



Agenda, con't

- **Higher-level investment, but very cost-effective**
  - **Move to higher-efficiency internal or external data center or to the cloud**
  - **Implement IT and infrastructure power monitoring**
  - **Install Variable-Speed Drives on cooling system fans**
  - **Install rack and/or row-level cooling**
  - **Use air-side economizer**
  - **Implement dedicated room cooling (vs. using central building cooling)**

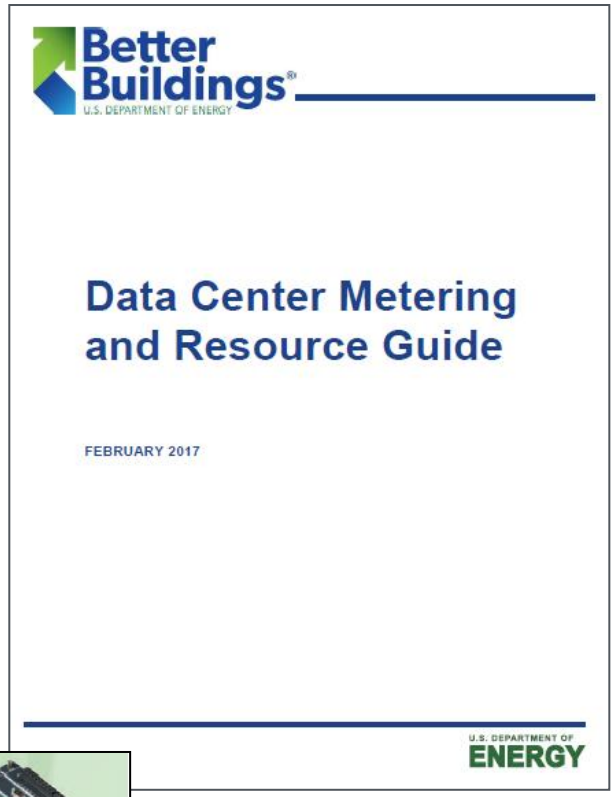
Move to higher-efficiency internal or external data center or to the cloud

- Energy savings typically possible by moving applications or machines to
  - Larger data center
  - Co-location center
  - The cloud
- Better security
- Better redundancy
- Better efficiency
- In evaluating, consider
  - Mandates
  - Moving cost
  - Total ongoing cost of staying vs. moving

Implement IT and infrastructure power monitoring

- Doesn't save energy by itself, but it informs the process
- Track performance of power and cooling systems and monitor IT
- Power Usage Effectiveness (PUE) as a metric
  - Ratio of total data center energy to IT energy
  - Over 2—large opportunity
  - Under 1.5—good
  - Under 1.2--excellent
- Data Center Metering and Resource Guide
  - Guide and webinar slides at
    datacenters.lbl.gov/resources/data-center-metering-and-resource-guide

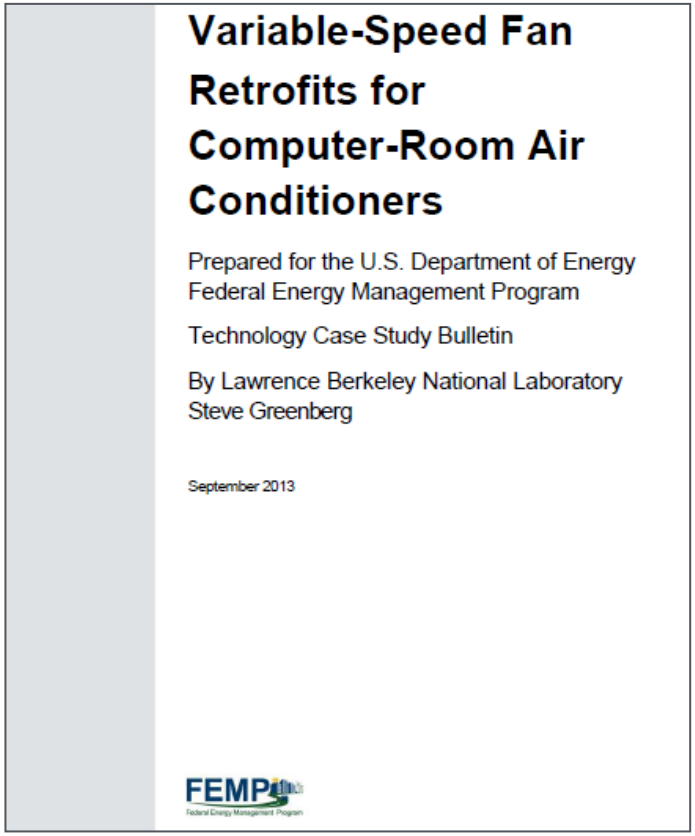
    datacenters.lbl.gov/resources/data-center-metering-and-power-usage



Install Variable-Speed Drives on cooling system fans

- CRACs or CRAHs typically have constant-speed fans
- Air flows are typically higher than needed, especially once air management is improved
- 20% air flow reduction results in ~50% savings in fan energy
- 22-32% overall cooling system savings in FEMP case studies:

datacenters.lbl.gov/resources/variable-speed-fan-retrofits-computer-room-air-conditioners

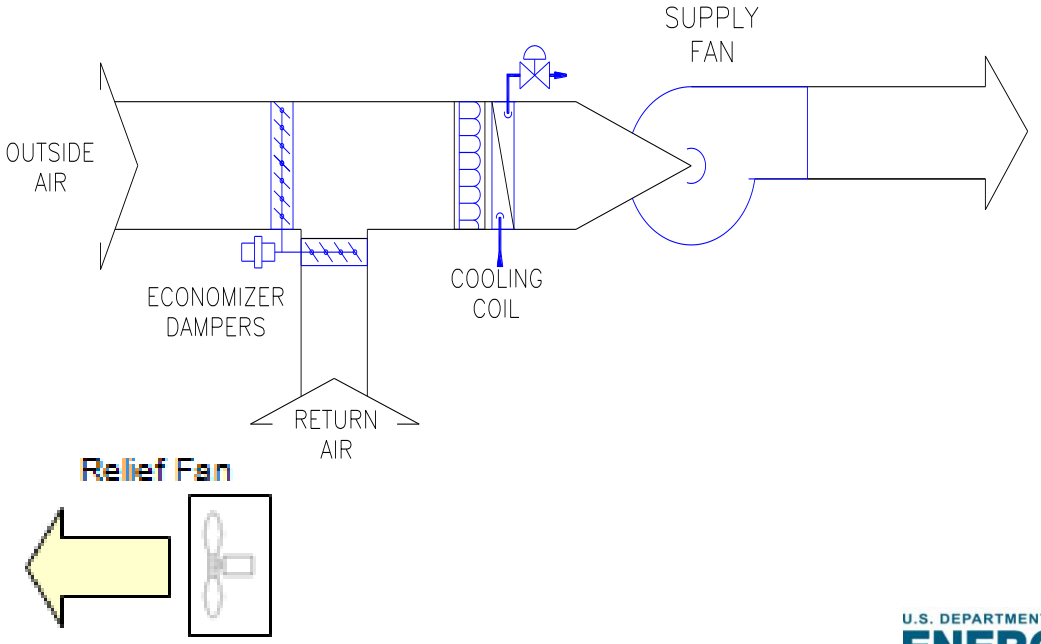


Install rack and/or row-level cooling

- Applicable when racks are being replaced or newly installed
- Moves cooling closer to the heat source
- Various types
  - In-rack
  - In-row
  - Rear-door (shown)
- Less overall heat removal
- Enables higher chilled water temperature

Use an air-side economizer

- Uses outside air when conditions are suitable
- Needs outside wall or roof
- Can be
  - air-handling unit
  - CRAC or CRAH with outside air capability
  - Exhaust fan with inlet air
- Large energy savings from reduced operation of cooling compressor



Implement dedicated room cooling (vs. using central building cooling)

- Dedicated unit allows main building system and plant to operate on normally occupied schedule instead of continuously
- Use high-efficiency unit (high SEER)
- Specify outside-air economizer
- Control based on IT inlet temperature

Agenda, con’t

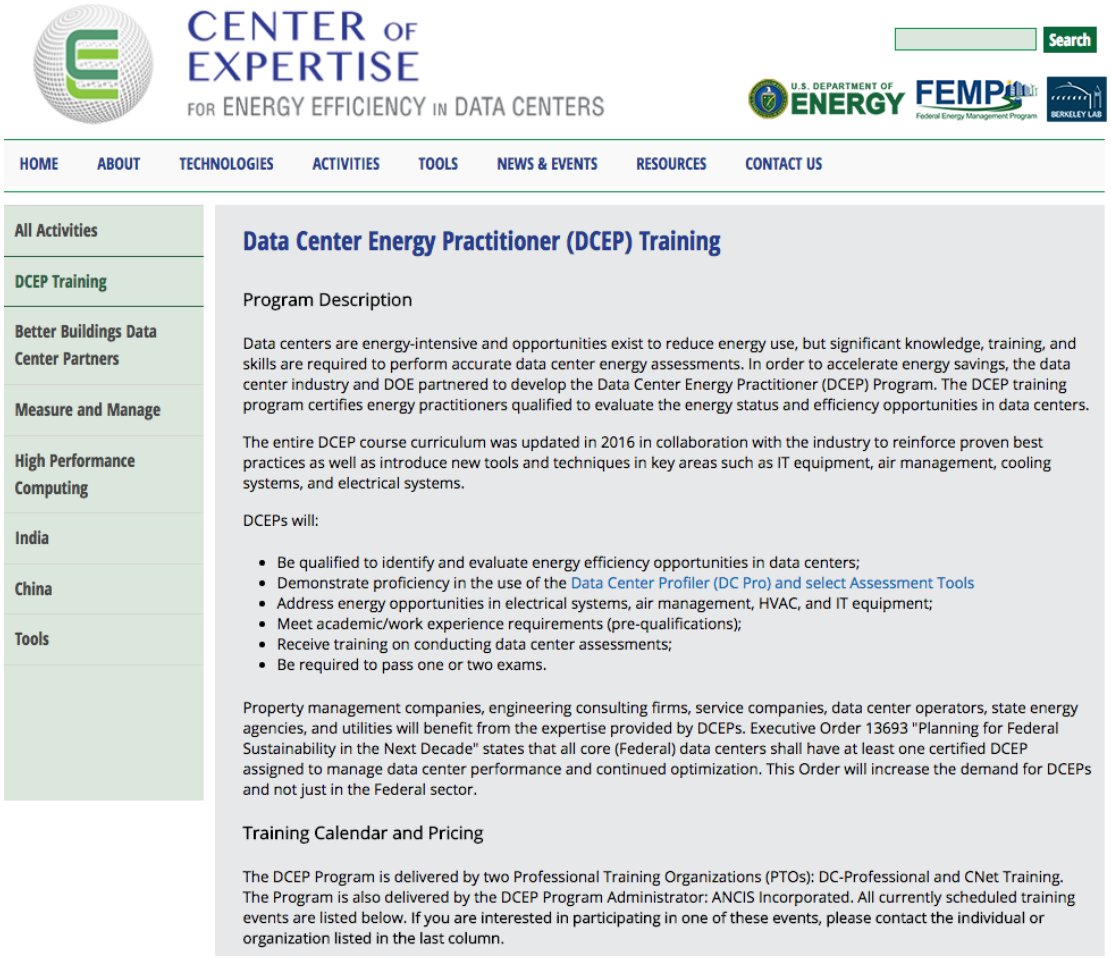
- **Training for IT and Facility Staff**

Training

- Utility companies
- ASHRAE: www.ashrae.org
- FEMP: http://eere.energy.gov/femp/training
- Center of Expertise for Energy Efficiency in Data Centers
- Data Center Energy Practitioner
  - Required by the Data Center Optimization Initiative

Training, con't

Data Center Energy Practitioner Program

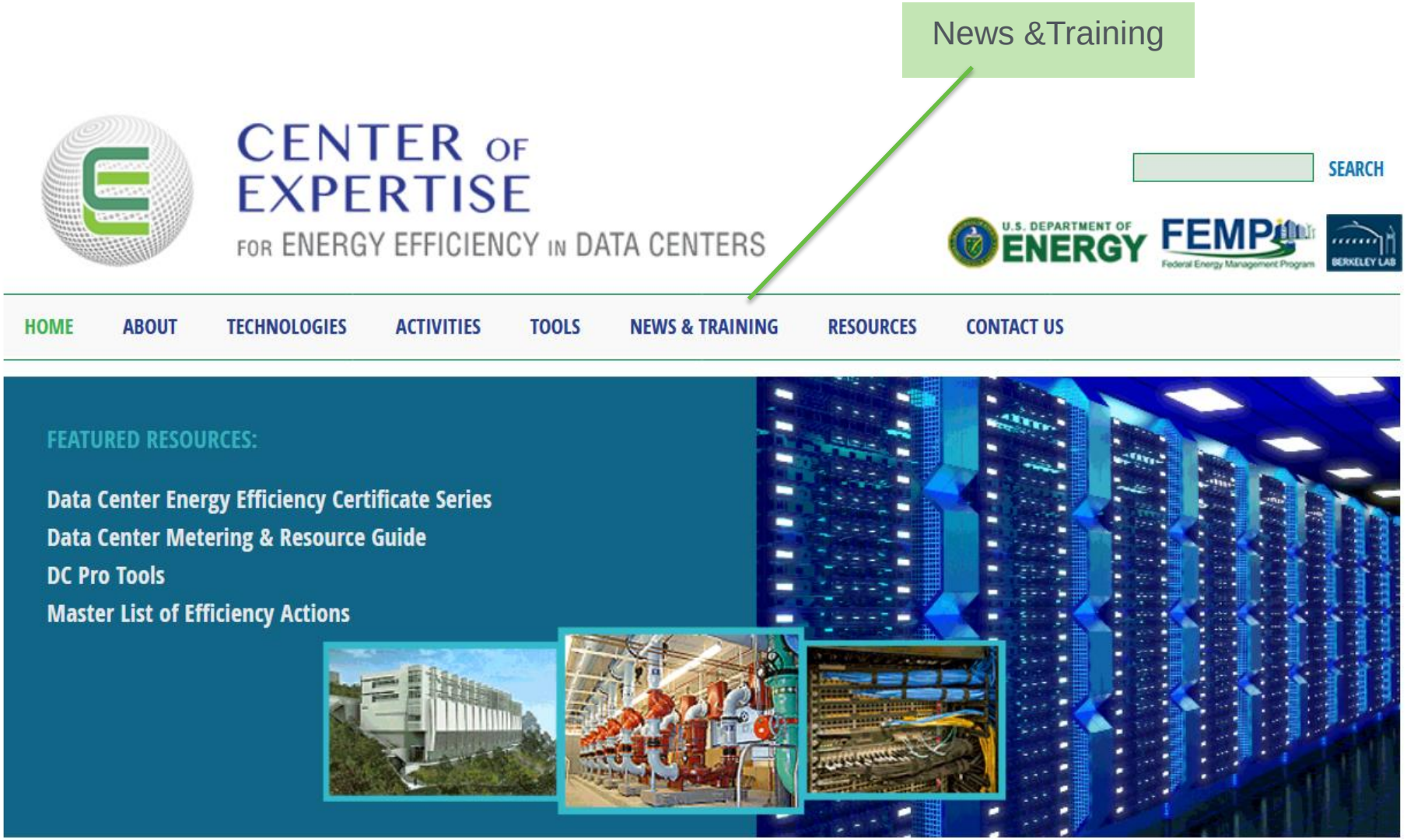


datacenters.lbl.gov/dcep

Agenda, con’t

- **Resources**

Center of Expertise for Energy Efficiency in Data Centers



datacenters.lbl.gov

Center of Expertise for Energy Efficiency in Data Centers, cont.

More Resources

- Small Data Centers
  datacenters.lbl.gov/resources/small-data-centers-big-energy-savings
- DOE Air Management Tool datacenters.lbl.gov/Tools
- Humidity Control in Data Centers
  datacenters.lbl.gov/resources/Humidity-Control-Data-Centers
- Data Center Metering and Resource Guide
  datacenters.lbl.gov/resources/data-center-metering-and-resource-guide
- Data Center Optimization Initiative (OMB) https://datacenters.cio.gov/
- ENERGY STAR Equipment: energystar.gov/products/office_equipment/

Training Certificate

In order to receive a certificate of completion, you **must** fill out the FEMP webinar evaluation form.

Access the FEMP webinar evaluation form by clicking on The **"Take the Evaluation and Get a Certificate"** button on the webinar course portal page.

https://fempcentral.energy.gov/Training/EventRegistration/EvaluationForm.aspx

For logistical questions related to the webinar or evaluation, please email Elena Meehan: Elena.Meehan@ee.doe.gov

Questions?

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- For content-related questions after the webinar, please use the Contact Us form on the Center of Expertise website: datacenters.lbl.gov/contact