



Getting Data Center Energy Management Started with Profiler Tools

9/20/2016

Magnus Herrlin, LBNL
Kevin Jarcho, Kentah

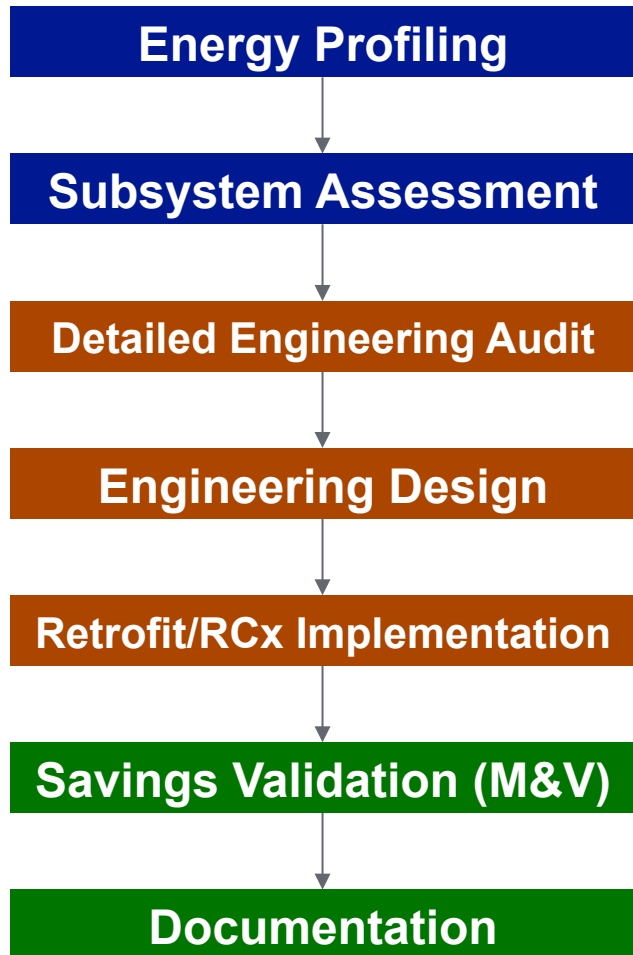
Before We Begin

- 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 via chat, click the chat button in the top right of your screen and a text box will appear in the bottom right. Please select to send your message to Elena Meehan, enter text, and press enter.
- 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

- Energy Management
- Profiling and Subsystem Assessment
- Data Center Profiler (DC Pro)Tools
- Live Demo
- Resources
- Questions

Energy Management



Data center profiling provides an initial assessment of how energy is used in your data center and sub-system assessments provide more detailed insight. Both activities are conducted by agency staff or consultants.

Audits, design, and the implementation of energy efficiency measures are facilitated by engineering firms and contractors.

Measurement and Verification (M&V) is conducted by site personnel and engineering firms to confirm and track performance. M&V is key for continuous improvement.

Data Center Profiler (DC Pro) Tools

- DC Pro and PUE Estimator
- Early stage scoping tools
- Free, secure, web-based
- On the Center of Expertise for Energy Efficiency in Data Centers website (CoE)
- datacenters.lbl.gov

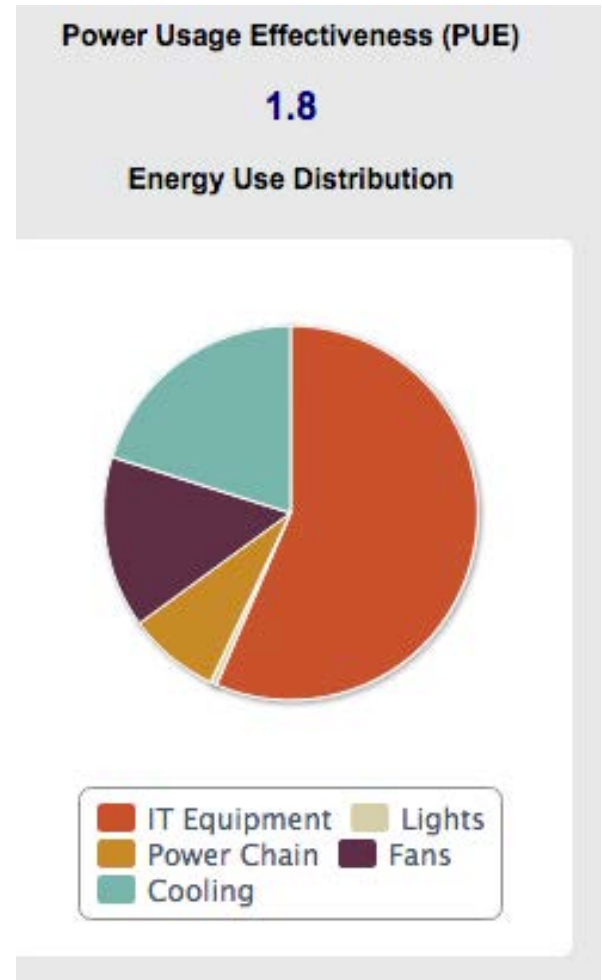


DC Pro Tools - Background

- Sponsored by the U.S. Department of Energy (DOE)
- Hosted by Lawrence Berkeley National Lab (LBNL, Berkeley Lab)
- Core development team
 - LBNL
 - ANCIS Incorporated
 - Integral Group
 - Hewlett Packard
 - Taylor Engineering
 - Kentah (software)
- Wide array of reviewers
 - Data center owners
 - Design professionals
 - Product manufacturers

DC Pro Tools – DC Pro & PUE Estimator

- DC Pro (V4, 2016)
 - Estimates current and potential PUE and energy use distribution
 - Tailored recommended actions to start an improvement process
 - Requires a login, saves data
- PUE Estimator (V1, 2016)
 - Quick, simplified version of DC Pro
 - Only asks questions that affect PUE
 - Does not provide potential PUE or recommended actions
 - No login, doesn't save data
- datacenters.lbl.gov/dcpro



DC Pro Tools – DC Pro

INPUTS

- General Facility Description
- Environmental Conditions
- System information
 - IT
 - Air Management
 - Cooling
 - Power
 - Lighting

The screenshot shows the '1. Data Center General Information' form in the DC Pro Tools application. The form is titled 'Information' and '1. Data Center General Information'. It contains the following fields and options:

- Profile Name:** Baseline
- Organization:** Test Agency
- State/Region:** Colorado (dropdown menu)
- County:** Boulder (dropdown menu)
- Climate Zone:** 5B

There are two buttons at the bottom: 'Previous Section' and 'Next Section'. To the right of the form, there is a note: 'Give the current profile a unique name. Use the date to help organize multiple assessments in a datacenter (e.g., "Case #1, 2008-05-31"). You can choose your climate zone manually by checking this box: ☐

Below the form, there is a list of sections:

- 2.1 Energy Use Systems - Energy Management
- 2.2 Energy Use Systems - IT Equipment
- 2.3 Energy Use Systems - Environmental Conditions
- 2.4 Energy Use Systems - Air Management
- 2.5 Energy Use Systems - Cooling
- 2.6 Energy Use Systems - IT Equipment Power Chain
- 2.7 Energy Use Systems - Lighting
- 3. Results
- 4. Recommended Tasks

OUTPUTS

- Current PUE
- Potential PUE
- Current Energy Use Distribution
- Potential Energy Use Distribution
- Recommended tasks for improvement

DC Pro Tools – DC Pro Outputs

	A	B	C
1	Current PUE: 1.8		
2			
3	Potential PUE: 1.2		
4			
5	Energy Use Distribution	Current Energy Use	Potential Energy Use
6		%	%
7	IT Equipment	56.3	83.5
8	Lights	0.6	0.1
9	Power Chain	10.3	1.7
10	Fans	13.8	6.4
11	Cooling	19.1	8.3
12	Task	Description	
13	Configure equipment in straight lineups (rows) for hot/cold aisles and cable management	Since straight equipment lineups are generally a prerequisite to alternating hot and cold aisles, it should have a very high priority. Straight lineups also allow structured cable management.	
14	Use appropriate overhead diffusers	The generally high pressure drops across the end devices (diffusers) and low pressure losses in the distribution system (ductwork) promote high air stability. Stability means that the system can be balanced successfully and that external disturbances have limited impact on that balance. In addition, the diffusers should have characteristics promoting penetration of the supply air into the cold aisles.	
15	Use adequate ratio system flow to rack flow (target 1.0 or RTI=100%)	Ideally, the total flow rate of air delivered by the cooling equipment fans is equal to the total flow rate of the IT equipment fans, and no air bypasses the racks or recirculates in the racks. When balancing the data center air flow, aim for this ideal.	

Excel and PDF

DC Pro Tools - PUE Estimator

INPUTS

- One input screen
- Only questions needed to estimate PUE

PUE Estimator

Clicking on a ? will give you more information about the selected row.

You can choose your climate zone manually by checking this box: ☐
(Required for data centers located outside the United States)

* State/Region: Alabama

* County: Autauga

Climate Zone: 3A

Determined by entries above.

* What is a typical (average) air temperature leaving the cooling coils (supply)? --Select One--

* What is a typical (average) air temperature entering the cooling coils (return)? --Select One--

* Do you have active, working humidification controls? Yes No

* Do you have active, working dehumidification controls? Yes No

* Does the CRAC/CRAH/AHU have a free cooling coil (water side economizer)? Yes No

* Is there air-side free cooling? Yes No

* Cooling System Type? --Select One--

* Is there an Uninterruptible Power Supply (UPS)? Yes No

If a UPS exists but is not used, answer No.

Calculate PUE Print Estimate

OUTPUTS

- Current PUE
- Current Energy Use Distribution

DC Pro Tools – PUE Estimator Outputs

	A	B
1	PUE: 1.4	
2		
3		
4	Energy Use Distribution	%
5	IT Equipment	69
6	Lights	0.7
7	Power Chain	1.4
8	Fans	20.3
9	Cooling	8.6
10		
11		
12		

Excel and PDF

Live Demo: DC Pro Tools

Tools > 1.Data Center Profiler Tools

DC Pro Tools

CENTER OF EXPERTISE
FOR ENERGY EFFICIENCY IN DATA CENTERS

U.S. DEPARTMENT OF ENERGY **FEMP**
Federal Energy Management Program

SEARCH

HOME ABOUT TECHNOLOGIES ACTIVITIES **TOOLS** NEWS & EVENTS RESOURCES CONTACT US

FEATURED RESOURCES:

- U.S. Data Center Energy Usage Report
- Data Center Metering & Resource Guide
- DC Pro Tools**
- Master List of Efficiency Actions

The Department of Energy-led Center of Expertise for Energy Efficiency in Data Centers (CoE) demonstrates national leadership in decreasing the energy use of data centers. Through the supply of technical support, tools, best practices, analyses, and the introduction of technologies, CoE assists federal agencies and other organizations implement data center energy efficiency projects. The CoE, located at the Lawrence Berkeley National Lab, partners with key public and private stakeholders to further efficiency efforts.

Better Buildings Data Center Partners
There are over 34 data center partners reducing energy use through the Better Buildings Challenge or Data Center Accelerator. Partners increase data center energy efficiency and share the results. DOE provides support and recognition.

Data Center Energy Practitioner (DCEP) Training
The data center industry and DOE partnered to develop the DCEP training program that certifies energy practitioners qualified to evaluate the energy status and efficiency opportunities in data centers. Course content was updated June 2016.

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Web Master | Disclaimer

CoE website: datacenters.lbl.gov

Live Demo: DC Pro Tools – Access

Data Center Profiler (DC Pro) Tools

[\[Log In \]](#)

The Data Center Profiler (DC Pro) and the PUE Estimator are “early stage” scoping tools designed for data center owners and operators to diagnose how energy use is distributed in their data center and determine ways to save energy and money. Both DC Pro and the PUE Estimator estimate Power Usage Effectiveness (PUE), the industry standard for understanding and improving the energy efficiency of data center infrastructure systems. Results from the tools can be exported as stand-alone reports or included in other reporting material.

DC Pro also recommends specific tasks to help users start an improvement process. Detailed assessments of sub-systems are beyond the scope of these profiling tools, but dedicated assessment tools (e.g., Air Management and IT Electrical Power Chain) are available in the Tools section of this website.



DC PRO

A comprehensive “early stage” data center profiling tool

- Estimates PUE as well as a breakdown of the current and potential energy use distribution
- Provides a tailored list of best practice recommendations
- Exports results to PDF or Excel



PUE ESTIMATOR

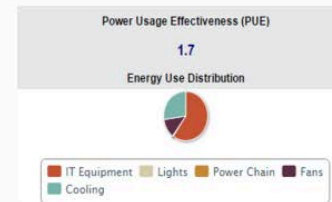
A quick calculator that generates Power Usage Effectiveness (PUE)

- Only asks questions required to estimate PUE
- Uses same algorithm as DC Pro
- Exports results to PDF or Excel

RESOURCES

- [Calculation Reference Manual](#)
- [Data Center Master List of Efficiency Actions](#)
- [DC Pro Full List of Questions](#)
- [DC Pro User's Manual \(Also includes Full List of Questions\)](#)
- [PUE Estimator Full List of Questions](#)
- [PUE Estimator User's Manual \(Also includes Full List of Questions\)](#)

To access the archived DC Pro V3, click [here](#). Please note that data entered into V3 has already been migrated into the current version of DC Pro.



GET STARTED



[Log in or Register to begin using DC Pro](#)



[Access the PUE Estimator \(no login required\)](#)

Log in or Register for DC Pro

Access the PUE Estimator

Resources

DC Pro Tools Homepage: datacenters.lbl.gov/dcpro

Live Demo: PUE Estimator – Input Data

PUE Estimator

Clicking on a ? will give you more information about the selected row.

You can choose your climate zone manually by checking this box: ☐
(Required for data centers located outside the United States)

* State/Region: Alabama

* County: Autauga

Climate Zone: 3A Determined by entries above.

* What is a typical (average) air temperature leaving the cooling coils (supply)? 60F (16C) ?

* What is a typical (average) air temperature entering the cooling coils (return)? --Select One-- ?

* Do you have active, working humidification controls? ☐ Yes ☐ No ?

* Do you have active, working dehumidification controls? ☐ Yes ☐ No ?

* Does the CRAC/CRAH/AHU have a free cooling coil (water side economizer)? ☐ Yes ☐ No ?

* Is there air-side free cooling? ☐ Yes ☐ No ?

* Cooling System Type? Air-Cooled DX ?

* Is there an Uninterruptible Power Supply (UPS)? ☒ Yes ☐ No If a UPS exists but is not used, answer No.

* UPS Technology Type: --Select One--

* UPS Module Size (kVA): --Select One--

* UPS Voltage: --Select One--

* What is the average load factor per active UPS module? --Select One-- ?

Calculate PUE Print Estimate

Calculate PUE

Print Estimate

Live Demo: PUE Estimator – Results

PDF

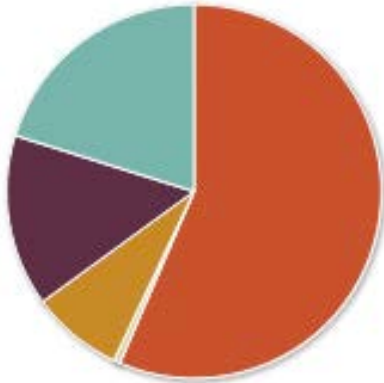
Excel

[Back](#) [Save to PDF](#) [Export Breakout to Excel](#)

Power Usage Effectiveness (PUE)

1.8

Energy Use Distribution



Report generated through the PUE Estimator
(datacenters.lbl.gov/dcpro): 2/5/2016

PUE: 1.5

Energy Use Distribution	%
IT Equipment	66.2
Lights	0.7
Power Chain	1.3
Fans	9.7
Cooling	22.2

PUE Estimator Inputs

State/Region:	Alabama
County:	Autauga
Climate Zone:	3A
What is a typical (average) air temperature leaving the cooling coils (supply)?	60F (16C)
What is a typical (average) air temperature entering the cooling coils (return)?	75F (24C)
Do you have active, working humidification controls?	Yes
Do you have active, working dehumidification controls?	No

Live Demo: DC Pro Tools - Access

Data Center Profiler (DC Pro) Tools

[\[Log In \]](#)

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PUE ESTIMATOR

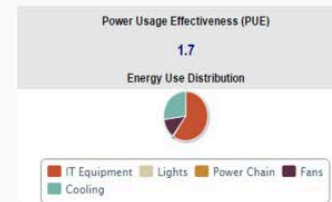
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To access the archived DC Pro V3, click [here](#). Please note that data entered into V3 has already been migrated into the current version of DC Pro.



GET STARTED



[Log in or Register to begin using DC Pro](#)



[Access the PUE Estimator \(no login required\)](#)

Log in or Register for DC Pro

Access the PUE Estimator

Resources

DC Pro Tools Homepage: datacenters.lbl.gov/dcpro

Live Demo: DC Pro – Log in/Register

Data Center Profiler (DC Pro) Tools

Log In - DC Pro

Please enter your username and password. Please [Register](#) if you don't have an account.

Please [click here](#) if you have forgotten your password.

If you are using Internet Explorer, you may need to allow both "lbl.gov" and "54.86.8.76" in your Privacy settings.
(Internet Options > Privacy > Sites)


Account Information

Username:

Password:

Register

Log in



Live Demo: DC Pro – Data Center Records

Data Center Profiler (DC Pro) Tools

Data Center Explorer <<<Collapse

[Acme Data Center](#)

Welcome to DC Pro Idemates1! [Change Password] [Log Out]

DCPRO

How to use the tools on this page?

← To begin an assessment, navigate to the Data Center Explorer on the left side of the page and select a data center.

If your data center is not listed on the left side of this page, [add it here](#).

Once your data center is selected, add a new DC Profile or modify an existing profile.

After you complete a DC Profile, you can view assessment results, recommended tasks, and export to Excel or PDF (Actions column).


If you have an Exported DC Profile XML File from DC Pro V3, [Click Here](#) to Import it.

You can delete a DC Profile using the Delete button (Actions column).

Data Center Explorer

Create new data center

Live Demo: DC Pro – New Data Center

 **Add a Data Center**

- required field

General Info

Name

Street

City

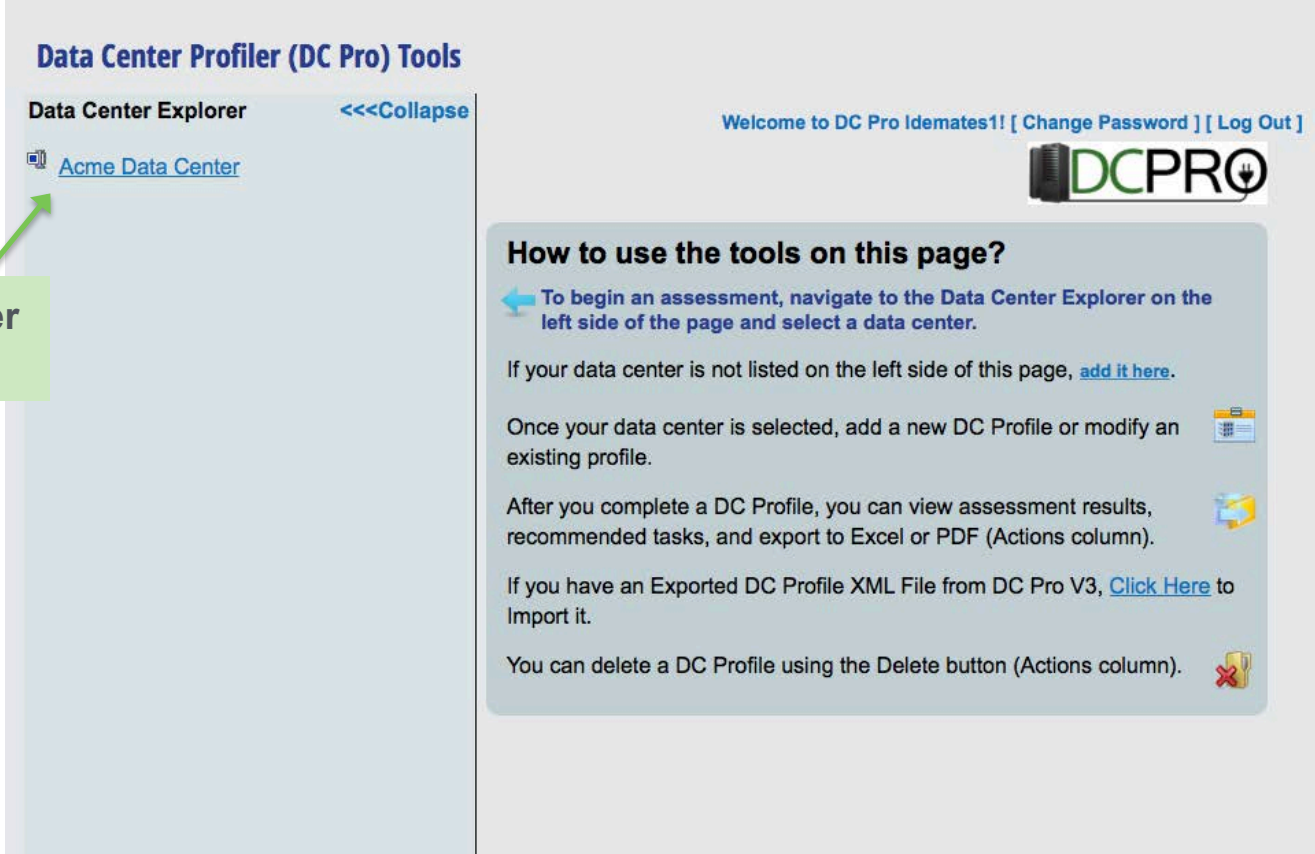
State

Zipcode

Description

Organization


Live Demo: DC Pro – Data Center Records




The screenshot shows the 'Data Center Profiler (DC Pro) Tools' interface. On the left, under 'Data Center Explorer', there is a link for 'Acme Data Center'. A green callout box labeled 'Data Center Explorer' with an arrow points to this link. The main content area on the right includes a welcome message, a 'DCPRO' logo, and a 'How to use the tools on this page?' section with instructions on how to begin an assessment, add new data centers, and manage profiles.

Data Center Profiler (DC Pro) Tools

Data Center Explorer <<<Collapse

 [Acme Data Center](#)


Welcome to DC Pro Idemates1! [[Change Password](#)] [[Log Out](#)]




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You can delete a DC Profile using the Delete button (Actions column). 

Live Demo: DC Pro – New DC Profile

Data Center Explorer

<<<Collapse







Acme Data Center

Welcome to DC Pro Idemates1! [Change Password] [Log Out]

Acme Data Center

DCPRO


DC Profiles

Profile Name	PUE	Last Updated	Actions
Acme Data Center	1.6	2/10/2016	  
Acme Data Center	0	2/11/2016	  


Add DC Profile


NEW

How to use the tools on this page?


 To begin an assessment, navigate to the Data Center Explorer on the left side of the page and select a data center.

If your data center is not listed on the left side of this page, [add it here](#).

Once your data center is selected, add a new DC Profile or modify an existing profile. 

After you complete a DC Profile, you can view assessment results, recommended tasks, and export to Excel or PDF (Actions column). 

If you have an Exported DC Profile XML File from DC Pro V3, [Click Here](#) to Import it.

You can delete a DC Profile using the Delete button (Actions column). 

New Profile

21

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

Live Demo: DC Pro – DC Profile

Information

Either click on one of the headers to go to those questions, or click on the 'Continue' button to be taken to the next set of questions.

By clicking on the 'Previous' or 'Next' Section buttons, you will have the option to save your profile and you will be able to exit the application without losing your data.

Items with a Light background contribute to the PUE calculation. Please make sure to answer all of them to get a more accurate calculation.

Clicking on a ? will give you more information about the selected row.

A * signifies a required field. This is required in order for the report to save, and only exists in the first section.

[Continue](#)

- 1. Data Center General Information
- 2.1 Energy Use Systems - Energy Management
- 2.2 Energy Use Systems - IT Equipment
- 2.3 Energy Use Systems - Environmental Conditions
- 2.4 Energy Use Systems - Air Management
- 2.5 Energy Use Systems - Cooling
- 2.6 Energy Use Systems - IT Equipment Power Chain
- 2.7 Energy Use Systems - Lighting
- 3. Results
- 4. Recommended Tasks

[Print Profile](#)

Power Usage Effectiveness (PUE)

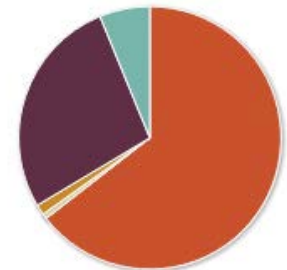
Insufficient Data to Calculate

Energy Use Distribution

Power Usage Effectiveness (PUE)

1.6

Energy Use Distribution



Input
Sections
(1-2)

Results

Recommended
Tasks

Print Profile

Live Demo: DC Pro - Results

3. Results

Current PUE: 1.6

Potential PUE: 1.2

Energy Use Distribution	Current Energy Use	Potential Energy Use ?
	%	%
IT Equipment	64.5	86.2
Lights	0.6	0.1
Power Chain	1.3	1.7
Fans	27.4	8.6
Cooling	6.2	3.4

[Previous Section](#)

[Next Section](#)

Live Demo: DC Pro – Tasks

4. Recommended Tasks

Reload Tasks

Task	Description
Configure equipment in straight lineups (rows) for hot/cold aisles and cable management	Since straight equipment lineups are generally a prerequisite to alternating hot and cold aisles, it should have a very high priority. Straight lineups also allow structured cable management.
Use adequate ratio system flow to rack flow (target 1.0 or RTI=100%)	Ideally, the total flow rate of air delivered by the cooling equipment fans is equal to the total flow rate of the IT equipment fans, and no air bypasses the racks or recirculates in the racks. When balancing the data center air flow, aim for this ideal.
Balance the air-distribution system (diffusers/tiles)	Over-head ducted systems can be adequately balanced using conventional methods whereas raised-floor systems are balanced by using "enough" perforated tiles. The latter often becomes more an art rather than science, especially since the pressure difference across the floor is small.
Implement an air-balancing program	Generally, the supply flow should closely match the equipment flow. The Return Temperature Index (RTI) is a measure of by-pass air or recirculation air. Both are detrimental to the performance of the data center. The target is 100% whereas >100% implies recirculation air and <100% implies by-pass air.
	Basic cooling systems simply circulate air through the space to be cooled, mechanically

Live Demo: DC Pro - Export

Report generated through the DC Pro Tool (datacenters.lbl.gov/dcpro): 2/5/2016

Back

Save to PDF

Export Results to Excel

PDF

Current PUE: 1.5

Excel

Potential PUE: 1.1

Energy Use Distribution	Current Energy Use	Potential Energy Use
	%	%
IT Equipment	67	88.5
Lights	0.7	0.1
Power Chain	1.3	1.8
Fans	14.1	9.5
Cooling	16.9	0.1

Task	Description
Place supply devices in cold aisles only	If the IT racks are arranged in alternating hot and cold aisles, it is important to prevent warm air from diluting the cold air in the cold aisles. This reduces the ability of the cold air to do useful cooling. Likewise, it is important to prevent cold air from diluting the warm air in the hot aisles. Again, this takes away the ability of the diluting cold air to do useful cooling. Additionally, cooling equipment capacity depends on the temperature of the warm air it receives. In most cases, the warmer the return air, the greater the cooling capacity. Diluting the warm return air impairs cooling capacity. There should be no reason to place supply air tiles or diffusers in the hot aisles.
Use appropriate overhead diffusers	The generally high pressure drops across the end devices (diffusers) and low pressure losses in the distribution system (ductwork) promote high air stability. Stability means that the system can be balanced successfully and that external disturbances have limited impact on that balance. In addition, the diffusers should have characteristics promoting penetration of the supply air into the cold aisles.

Resources

- DC Pro Tools homepage: datacenters.lbl.gov/dcpro
 - User's Manuals and detailed Calculation Reference Manual
 - Lists of Questions
 - Master List of Energy Efficiency Actions
- Center of Expertise website: datacenters.lbl.gov
 - Information on best practice technologies and strategies (Technologies)
 - Tools covering areas such as air management and writing an energy assessment report (Tools)
 - Database of resources including reports, guides, case studies (Resources)
 - Need assistance? (Contact Us)
- Data Center Energy Practitioner (DCEP) training (includes DC Pro): datacenters.lbl.gov/dcep

Data Centers: Part of the Better Buildings Family

Better Buildings Challenge

DOE-leadership initiative to make commercial, industrial buildings, data centers & multifamily housing 20%+ more efficient in 10 years

Data center partners commit to increasing the energy efficiency of their entire data center and building portfolio by at least 20% within 10 years and share their implementation model, annual progress, at least one showcase project and results.

Better Buildings Data Center Accelerator

Partners commit to improve the energy efficiency of one or more data centers by at least 25% within 5 years, track and share progress, and showcase a project. The Accelerator is a shorter-term effort covering 2014-2019.



Why Sign Up?

- Leverage DOE resources
- Network with peers
- Gain recognition
- 20% to 40% reductions in energy cost with short paybacks

Join the Challenge by e-mailing datacenterpartners@ee.doe.gov

Data Center Partner Roster – 34 partners



Attention Participants

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

Access the FEMP workshop *evaluation form* and *certificate of completion* using this link:

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

Questions?

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