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

FEMP Federal Energy Management Program

FEMP's Energy Efficiency Resources for Data Centers

10/5/2016

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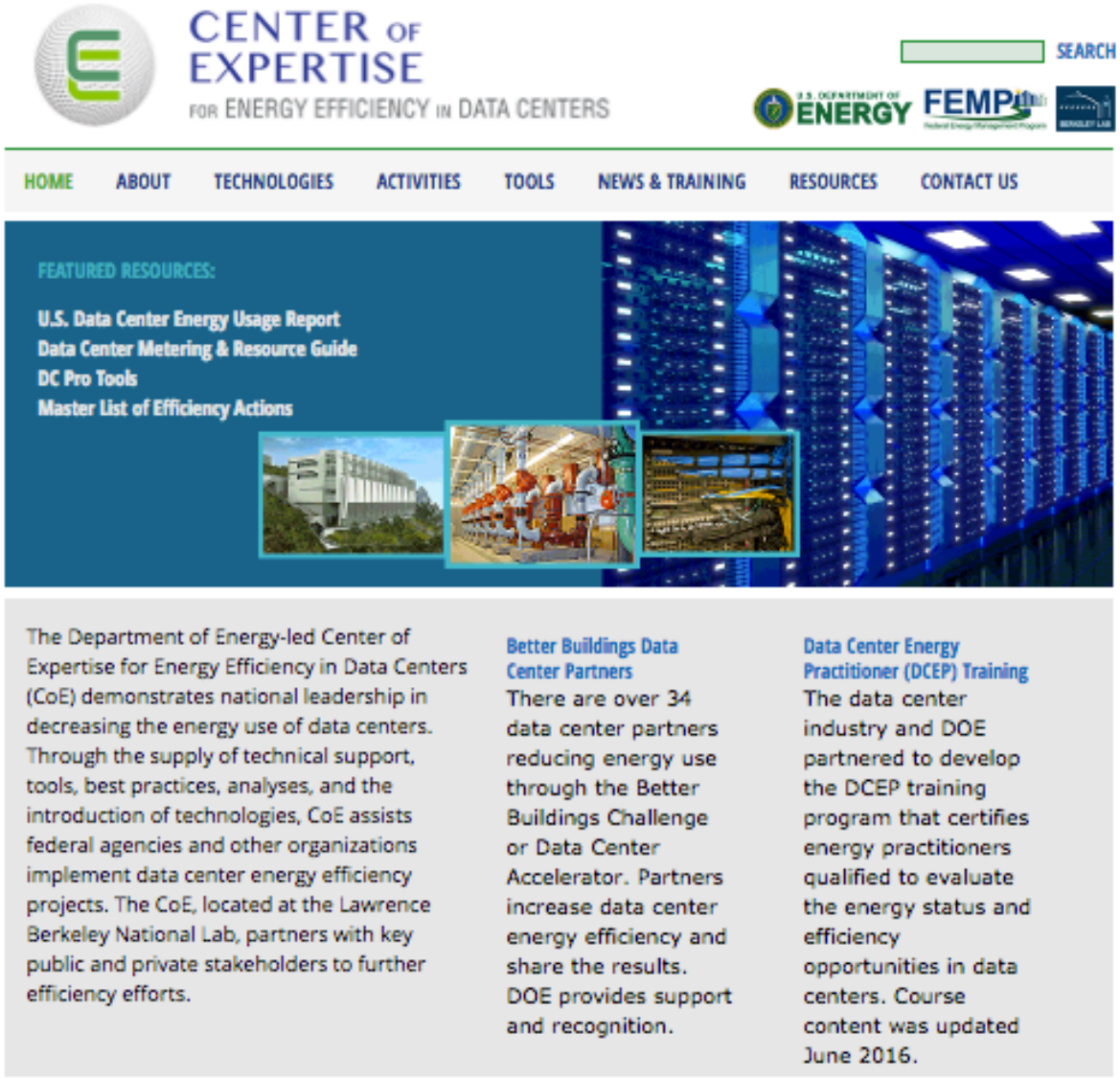
Agenda

- Center of Expertise for Energy Efficiency in Data Centers
- Other Resources
  - Energy- and Water-Efficient Products
  - Federal Electronics Stewardship Working Group (FESWG)
  - Project Financing
  - Institutional Change

Center of Expertise for Energy Efficiency in Data Centers



Navigation

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Featured Resources

Featured Activities

datacenters.lbl.gov

Technologies

Technologies

Cooling Air / Air Management

Technologies, example

Cooling Air / Air Management

In most cases, air distribution in data centers involves mixing of cooled air with air that has been heated by the IT equipment making it difficult to supply the cool air to where it is needed and resulting in inefficient heat transfer to the cooling system.

Poor air management leads to more air being circulated than required, which leads to air mixing and short circuiting. It also results in recirculated hot air, which is the cause of most host spots.

HIGH-LEVEL BEST PRACTICES

- Install the Racks in Rows
- Implement Hot and Cold Aisles
- Preserve Any Hot-Aisle/Cold-Aisle Arrangements
- Rearrange Perforated Floor Tiles, Locating Them Only in Cold Aisles and Matching the Tile Flow Rate with the IT Equipment Airflow Rate
- Cover Openings Within and Between Racks
- Evaluate the Air Path (Under the raised floor or in the ceiling space) and Rearrange the Cables, Wires, and Pipes to Address Possible Congestion in the Cooling Air Path
- Seal the Remainder of the Cable Penetrations
- Separate Cold Air and Hot Air
- Shut Off Extra CRAC/CRAH/AHU
- Reset Each CRAC/CRAH/AHU Chilled Water Valve Setpoint with the Highest Air Intake Temperature at the Racks in that Zone
- Convert the Data Center CRAC/CRAH/AHU Air Temperature Control to the Rack Inlet Air Temperature Control
- Use Modeling Tools such as CFD or Thermal Imaging Install Variable Frequency Drives (VFDs) on CRAC/CRAH/AHU Fans with Advanced Control

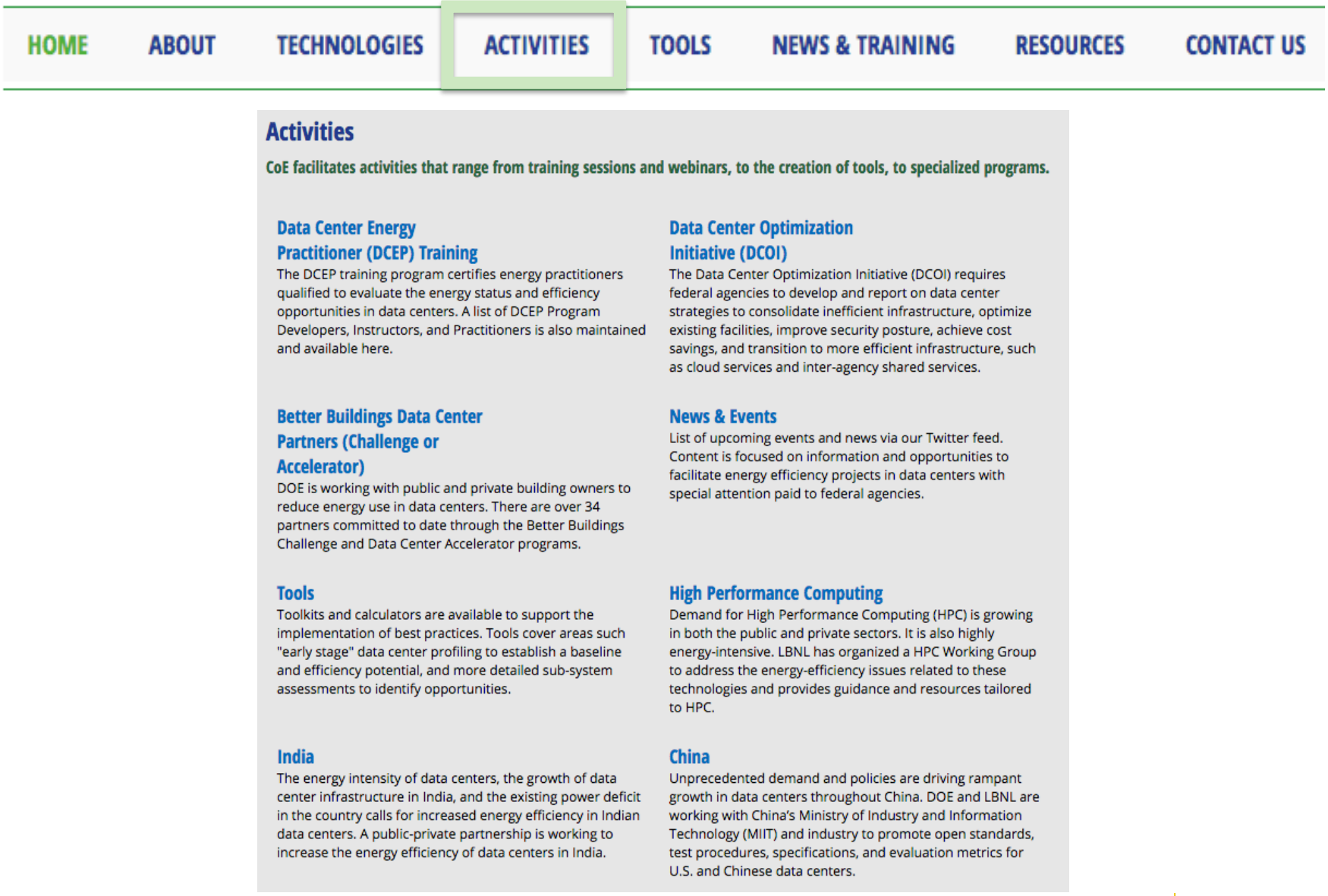
FEATURED RESOURCES

- Data Center Master List of Efficiency Actions provides more information on the high-level best practices outlined above as well as a more detailed list of best practices related to cooling air and air management.
- The excel-based Data Center Air Management Tool provides air management recommendations (actions) and the potential for reducing the supply airflow rate and increasing the supply air temperature without affecting the thermal equipment environment. The Tool also estimates % energy reduction, kWh reduction, and associated $ savings for fans and chillers. It is based on user input. An accompanying Data Collection Guide is also available.

Links:

Data Center Master List of Efficiency Actions
Data Center Air Management Tool
Datacenter Air Management Tool Data Collection Guide
All Air Cooling / Air Management Resources

Activities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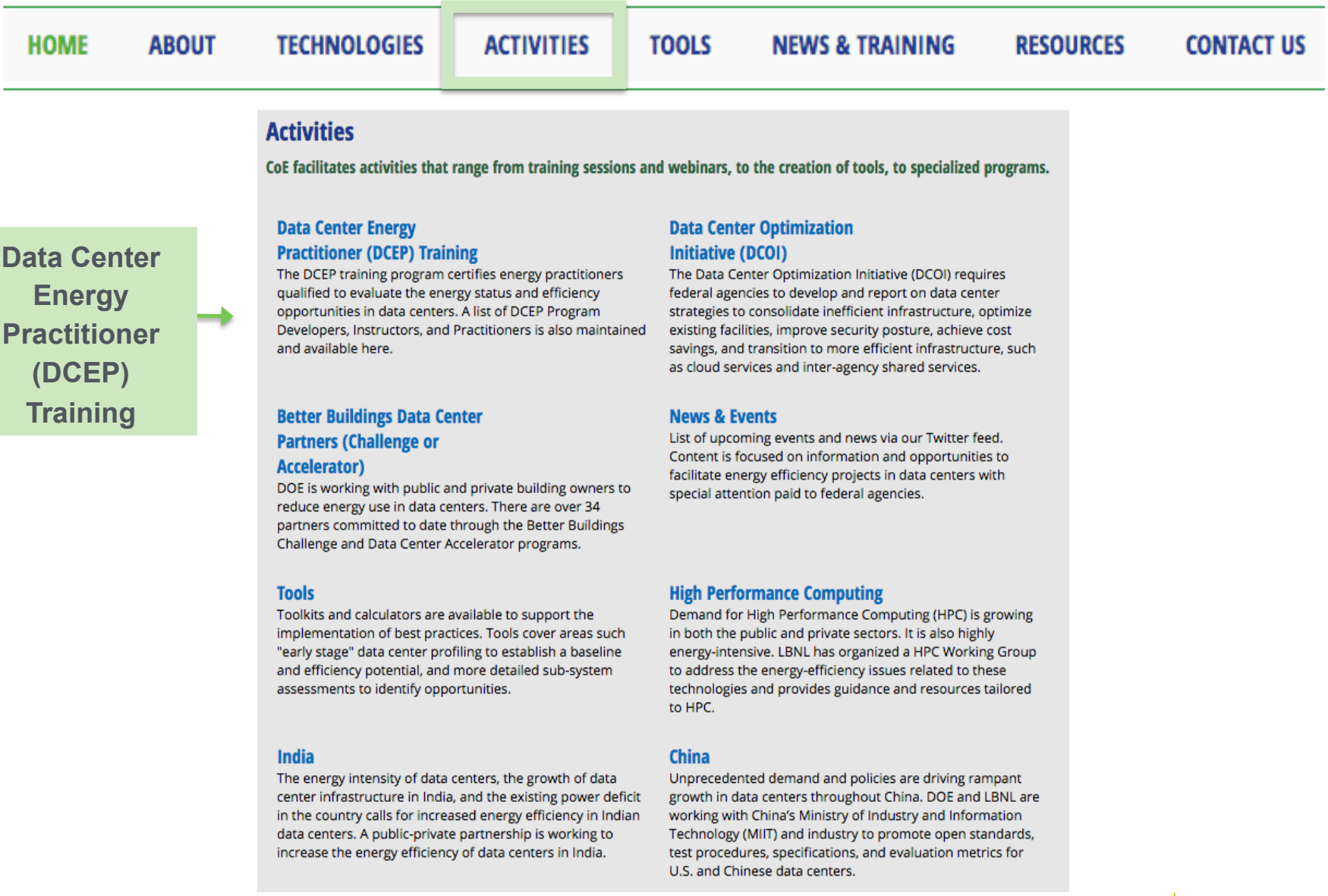
Activities
CoE facilitates activities that range from training sessions and webinars, to the creation of tools, to specialized programs.
Data Center Energy Practitioner (DCEP) Training
The DCEP training program certifies energy practitioners qualified to evaluate the energy status and efficiency opportunities in data centers. A list of DCEP Program Developers, Instructors, and Practitioners is also maintained and available here.
Data Center Optimization Initiative (DCOI)
The Data Center Optimization Initiative (DCOI) requires federal agencies to develop and report on data center strategies to consolidate inefficient infrastructure, optimize existing facilities, improve security posture, achieve cost savings, and transition to more efficient infrastructure, such as cloud services and inter-agency shared services.
Better Buildings Data Center Partners (Challenge or Accelerator)
DOE is working with public and private building owners to reduce energy use in data centers. There are over 34 partners committed to date through the Better Buildings Challenge and Data Center Accelerator programs.
News & Events
List of upcoming events and news via our Twitter feed. Content is focused on information and opportunities to facilitate energy efficiency projects in data centers with special attention paid to federal agencies.
Tools
Toolkits and calculators are available to support the implementation of best practices. Tools cover areas such "early stage" data center profiling to establish a baseline and efficiency potential, and more detailed sub-system assessments to identify opportunities.
High Performance Computing
Demand for High Performance Computing (HPC) is growing in both the public and private sectors. It is also highly energy-intensive. LBNL has organized a HPC Working Group to address the energy-efficiency issues related to these technologies and provides guidance and resources tailored to HPC.
India
The energy intensity of data centers, the growth of data center infrastructure in India, and the existing power deficit in the country calls for increased energy efficiency in Indian data centers. A public-private partnership is working to increase the energy efficiency of data centers in India.
China
Unprecedented demand and policies are driving rampant growth in data centers throughout China. DOE and LBNL are working with China's Ministry of Industry and Information Technology (MIIT) and industry to promote open standards, test procedures, specifications, and evaluation metrics for U.S. and Chinese data centers.

Activities



Data Center Energy Practitioner (DCEP) Training

Activities, example

Data Center Energy Practitioner (DCEP) Training

Program Description

Data centers are energy-intensive and opportunities exist to reduce energy use, but significant knowledge, training, and skills are required to perform accurate data center energy assessments. In order to accelerate energy savings, the data center industry and DOE partnered to develop the Data Center Energy Practitioner (DCEP) Program. The DCEP training program certifies energy practitioners qualified to evaluate the energy status and efficiency opportunities in data centers.

The entire DCEP course curriculum was updated in 2016 in collaboration with the industry to reinforce proven best practices as well as introduce new tools and techniques in key areas such as IT equipment, air management, cooling systems, and electrical systems.

DCEPs will:

- Be qualified to identify and evaluate energy efficiency opportunities in data centers;
- Demonstrate proficiency in the use of the Data Center Profiler (DC Pro) and select Assessment Tools
- Address energy opportunities in electrical systems, air management, HVAC, and IT equipment;
- Meet academic/work experience requirements (pre-qualifications);
- Receive training on conducting data center assessments;
- Be required to pass one or two exams.

DCEP - Federal Requirements

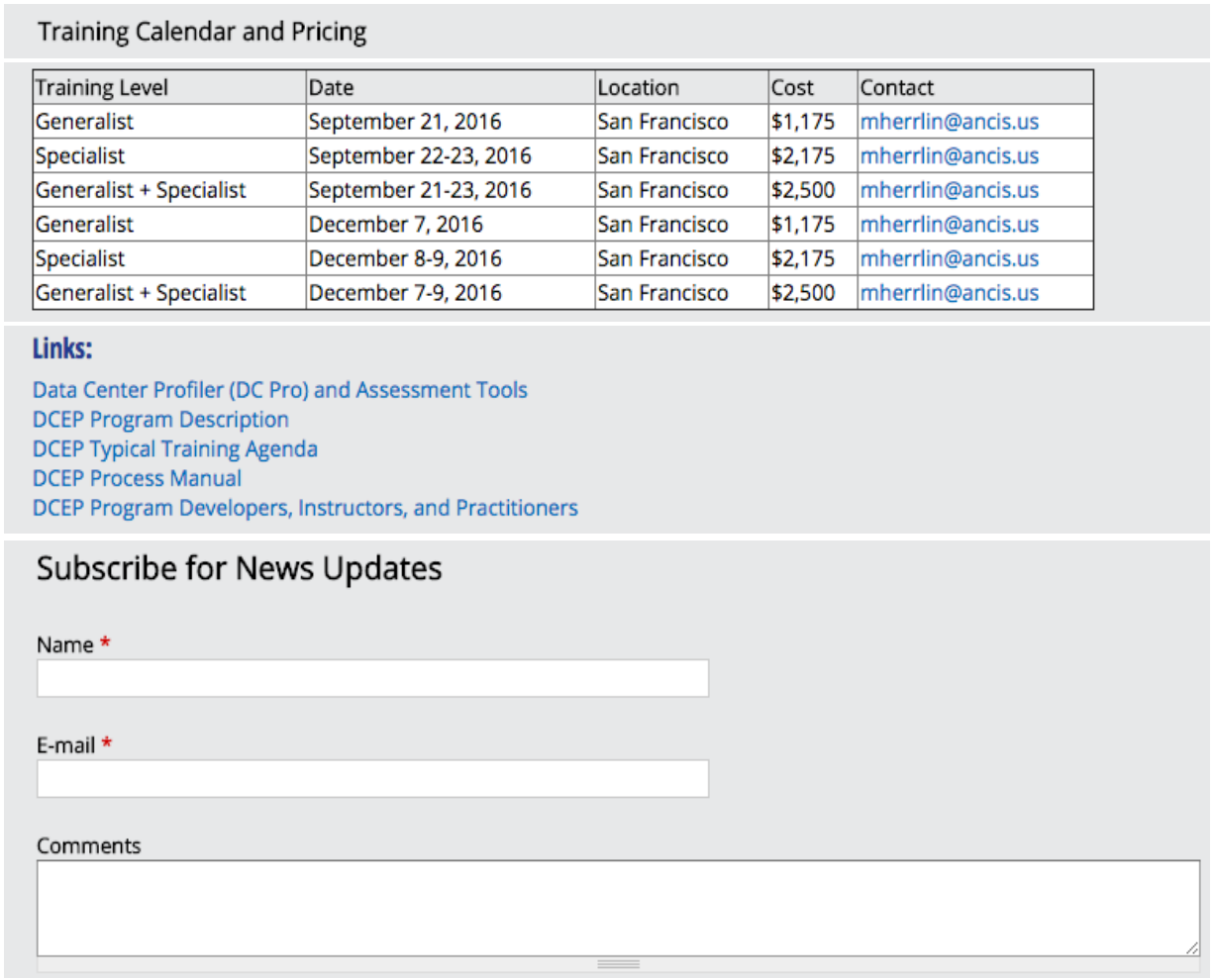
The Data Center Optimization Initiative (DCOI) established in OMB Memorandum M-16-19 supersedes the Federal Data Center Consolidation Initiative (FDCCI) and fulfills the data center requirements of the Federal Information Technology Acquisition Reform Act (FITARA).

The Memorandum states: Implementing Instructions [for Executive Order 13693] also advise that **"all existing and new data centers shall have at least one certified Data Center Energy Practitioner (DCEP) assigned to manage its performance."**

whitehouse.gov/sites/default/files/omb/memoranda/2016/m_16_19_1.pdf

whitehouse.gov/sites/default/files/docs/eo_13693_implementing_instructions_june_10_2015.pdf

DCEP – Resources



Training Calendar and Pricing

Training Level	Date	Location	Cost	Contact
Generalist	September 21, 2016	San Francisco	$1,175	mherrlin@ancis.us
Specialist	September 22-23, 2016	San Francisco	$2,175	mherrlin@ancis.us
Generalist + Specialist	September 21-23, 2016	San Francisco	$2,500	mherrlin@ancis.us
Generalist	December 7, 2016	San Francisco	$1,175	mherrlin@ancis.us
Specialist	December 8-9, 2016	San Francisco	$2,175	mherrlin@ancis.us
Generalist + Specialist	December 7-9, 2016	San Francisco	$2,500	mherrlin@ancis.us

Links:

Data Center Profiler (DC Pro) and Assessment Tools
DCEP Program Description
DCEP Typical Training Agenda
DCEP Process Manual
DCEP Program Developers, Instructors, and Practitioners

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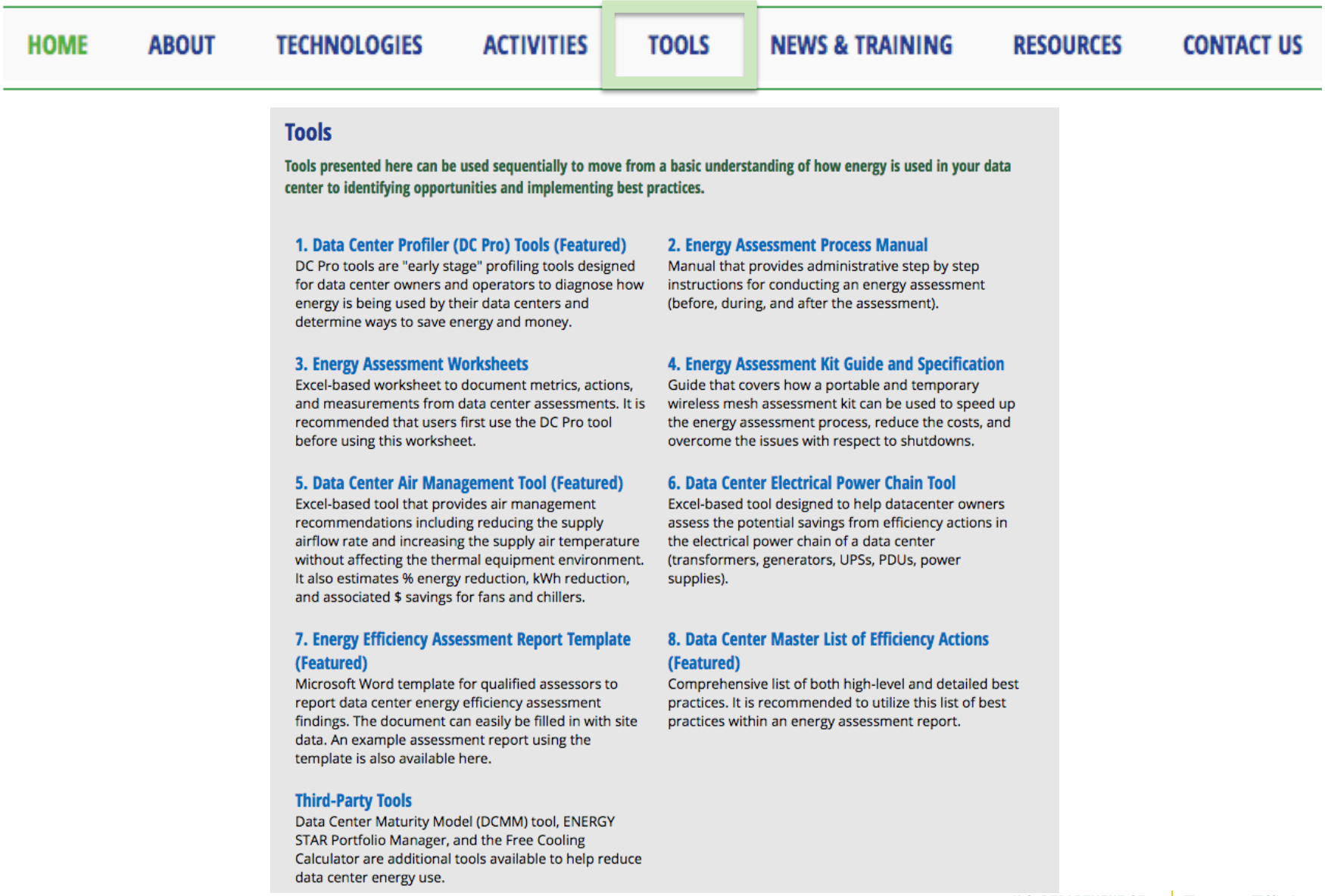
Tools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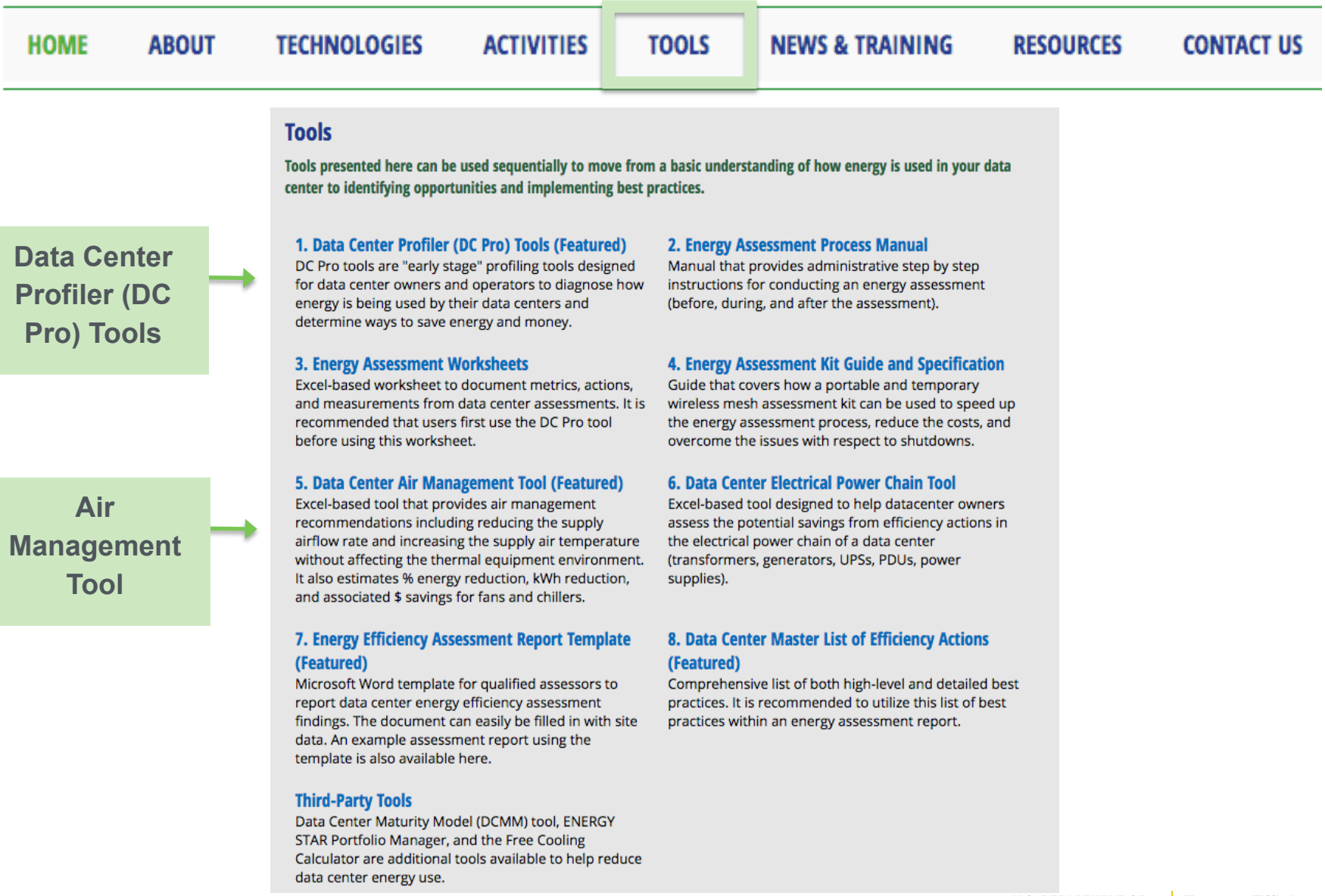
Tools
Tools presented here can be used sequentially to move from a basic understanding of how energy is used in your data center to identifying opportunities and implementing best practices.
1. Data Center Profiler (DC Pro) Tools (Featured)
DC Pro tools are "early stage" profiling tools designed for data center owners and operators to diagnose how energy is being used by their data centers and determine ways to save energy and money.
2. Energy Assessment Process Manual
Manual that provides administrative step by step instructions for conducting an energy assessment (before, during, and after the assessment).
3. Energy Assessment Worksheets
Excel-based worksheet to document metrics, actions, and measurements from data center assessments. It is recommended that users first use the DC Pro tool before using this worksheet.
4. Energy Assessment Kit Guide and Specification
Guide that covers how a portable and temporary wireless mesh assessment kit can be used to speed up the energy assessment process, reduce the costs, and overcome the issues with respect to shutdowns.
5. Data Center Air Management Tool (Featured)
Excel-based tool that provides air management recommendations including reducing the supply airflow rate and increasing the supply air temperature without affecting the thermal equipment environment. It also estimates % energy reduction, kWh reduction, and associated $ savings for fans and chillers.
6. Data Center Electrical Power Chain Tool
Excel-based tool designed to help datacenter owners assess the potential savings from efficiency actions in the electrical power chain of a data center (transformers, generators, UPSs, PDUs, power supplies).
7. Energy Efficiency Assessment Report Template (Featured)
Microsoft Word template for qualified assessors to report data center energy efficiency assessment findings. The document can easily be filled in with site data. An example assessment report using the template is also available here.
8. Data Center Master List of Efficiency Actions (Featured)
Comprehensive list of both high-level and detailed best practices. It is recommended to utilize this list of best practices within an energy assessment report.
Third-Party Tools
Data Center Maturity Model (DCMM) tool, ENERGY STAR Portfolio Manager, and the Free Cooling Calculator are additional tools available to help reduce data center energy use.

Tools



Data Center Profiler (DC Pro) Tools

Air Management Tool

Tools, example 1

Data Center Profiler (DC Pro) Tools

[Log In]

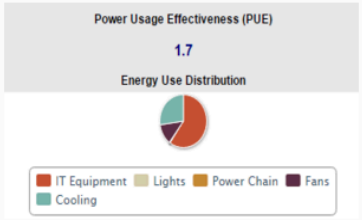
The Data Center Profiler (DC Pro) and the PUE Estimator are "early stage" scoping tools designed for data center owners and operators to diagnose how energy use is distributed in their data center and determine ways to save energy and money. Both DC Pro and the PUE Estimator estimate Power Usage Effectiveness (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

GET STARTED

Log in or Register to begin using DC Pro

Access the PUE Estimator (no login required)

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.

datacenters.lbl.gov/dcpro

Tools, example 2

Datacenter Air Management Tool (v.1.18)

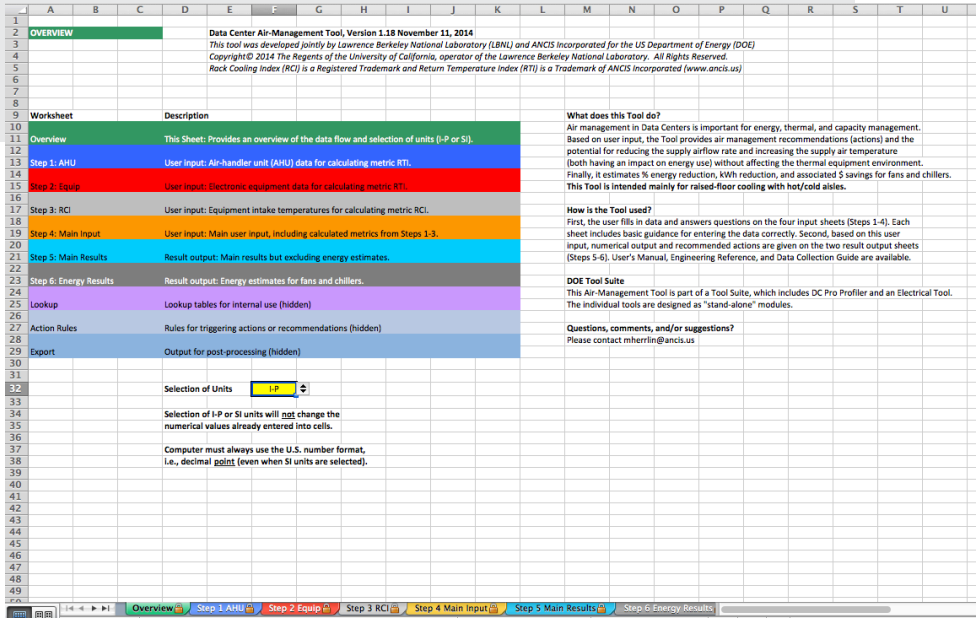
11/11/2014

Technologies:

Cooling Air / Air Management

File:

Air Management Tool v1.18 (11-11-14) Distribution.xls



OVERVIEW

Data Center Air-Management Tool, Version 1.18 November 11, 2014

This tool was developed jointly by Lawrence Berkeley National Laboratory (LBNL) and ANCIS Incorporated for the US Department of Energy (DOE)

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Rack Cooling Index (RCI) is a Registered Trademark and Return Temperature Index (RTI) is a Trademark of ANCIS Incorporated (www.ancis.us)

Worksheet	Description
Overview	This Sheet: Provides an overview of the data flow and selection of units (I-P or SI).
Step 1: AHU	User input: Air-handler unit (AHU) data for calculating metric RTI.
Step 2: Equip	User input: Electronic equipment data for calculating metric RTI.
Step 3: RCI	User input: Equipment intake temperatures for calculating metric RCI.
Step 4: Main Input	User input: Main user input, including calculated metrics from Steps 1-3.
Step 5: Main Results	Result output: Main results but excluding energy estimates.
Step 6: Energy Results	Result output: Energy estimates for fans and chillers.
Lookup	Lookup tables for internal use (hidden)
Action Rules	Rules for triggering actions or recommendations (hidden)
Export	Output for post-processing (hidden)

Selection of Units: I-P

Selection of I-P or SI units will not change the numerical values already entered into cells.

Computer must always use the U.S. number format, i.e., decimal point (even when SI units are selected).

What does this Tool do?

Air management in Data Centers is important for energy, thermal, and capacity management. Based on user input, the Tool provides air management recommendations (actions) and the potential for reducing the supply airflow rate and increasing the supply air temperature (both having an impact on energy use) without affecting the thermal equipment environment. Finally, it estimates % energy reduction, kWh reduction, and associated $ savings for fans and chillers. **This Tool is intended mainly for raised-floor cooling with hot/cold aisles.**

How is the Tool used?

First, the user fills in data and answers questions on the four input sheets (Steps 1-4). Each sheet includes basic guidance for entering the data correctly. Second, based on this user input, numerical output and recommended actions are given on the two result output sheets (Steps 5-6). User's Manual, Engineering Reference, and Data Collection Guide are available.

DOE Tool Suite

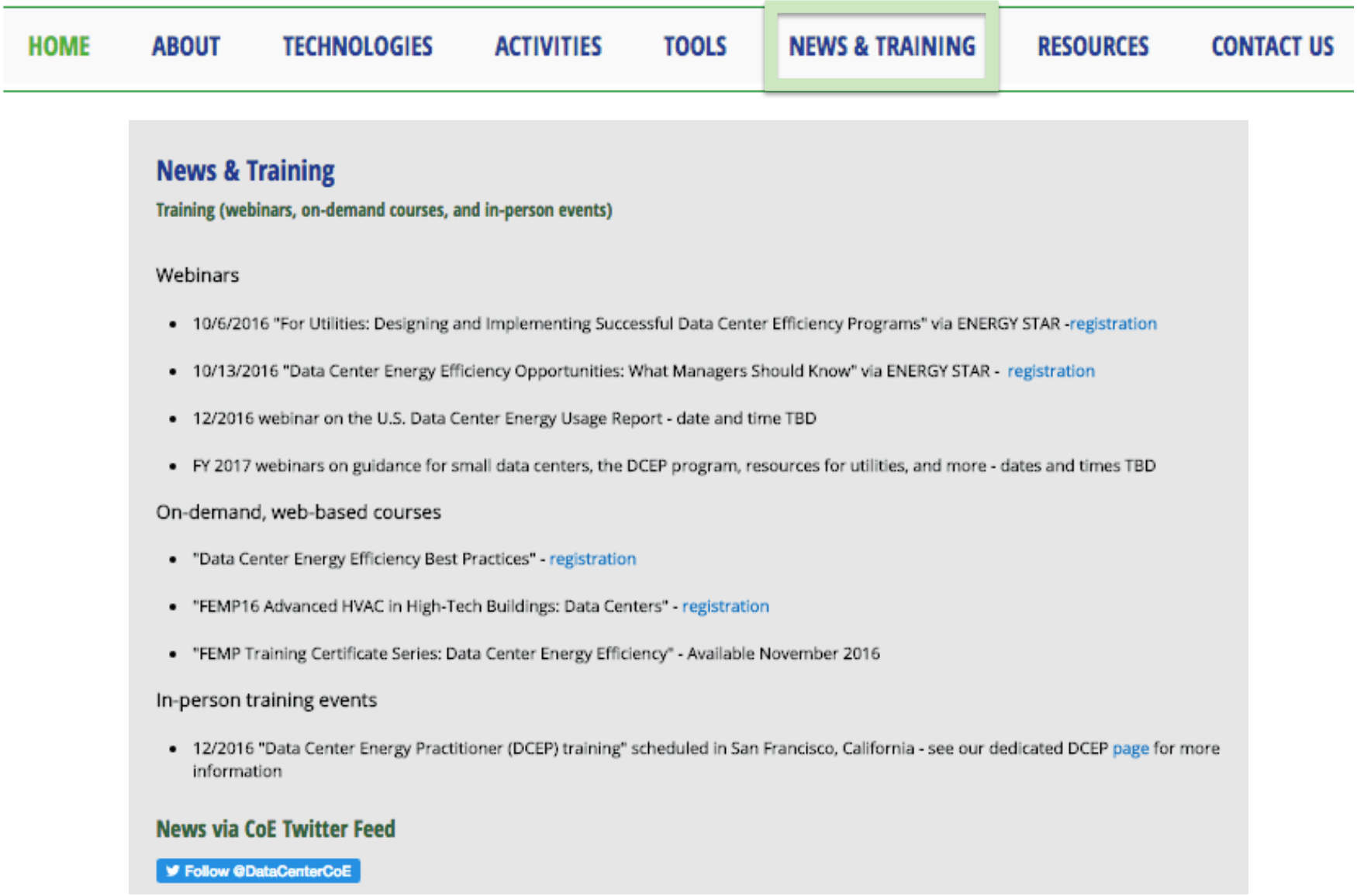
This Air-Management Tool is part of a Tool Suite, which includes DC Pro Profiler and an Electrical Tool. The individual tools are designed as "stand-alone" modules.

Questions, comments, and/or suggestions?

Please contact mherrlin@ancis.us

Overview | Step 1 AHU | Step 2 Equip | Step 3 RCI | Step 4 Main Input | Step 5 Main Results | Step 6 Energy Results

News and Training



News and Training, example

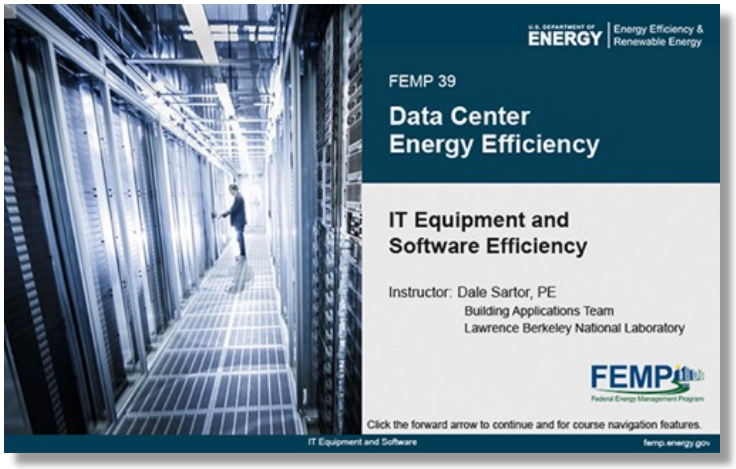
DATA CENTER ENERGY EFFICIENCY Series (November 2016)

- **Data Center Energy Efficiency Best Practices**
  - 0.2 CEUs
- **IT Equipment and Software Efficiency**
  - 0.1 CEUs
- **Environmental Conditions**
  - 0.1 CEUs
- **Air Management**
  - 0.2 CEUs
- **Cooling Systems**
  - 0.2 CEUs
- **Electrical Systems**
  - 0.1 CEUs

FEMP TRAINING

FEMP Certificate Series

IACET



eere.energy.gov/femp/training/

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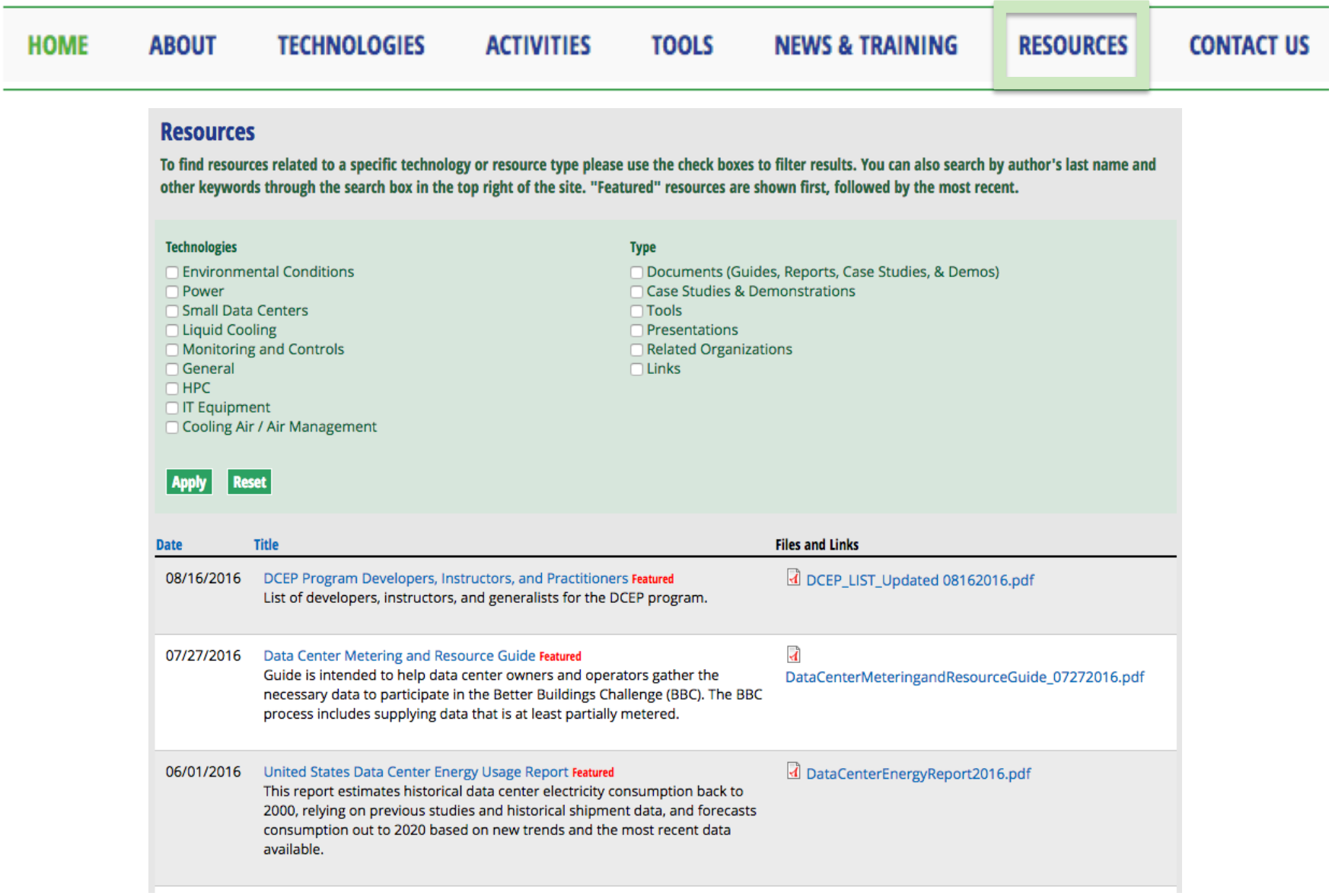
Resources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Liquid Cooling
Monitoring and Controls
General
HPC
IT Equipment
Cooling Air / Air Management
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Documents (Guides, Reports, Case Studies, & Demos)
Case Studies & Demonstrations
Tools
Presentations
Related Organizations
Links
Apply
Reset
Date
Title
Files and Links
08/16/2016
DCEP Program Developers, Instructors, and Practitioners Featured
List of developers, instructors, and generalists for the DCEP program.
DCEP_LIST_Updated 08162016.pdf
07/27/2016
Data Center Metering and Resource Guide Featured
Guide is intended to help data center owners and operators gather the necessary data to participate in the Better Buildings Challenge (BBC). The BBC process includes supplying data that is at least partially metered.
DataCenterMeteringandResourceGuide_07272016.pdf
06/01/2016
United States Data Center Energy Usage Report Featured
This report estimates historical data center electricity consumption back to 2000, relying on previous studies and historical shipment data, and forecasts consumption out to 2020 based on new trends and the most recent data available.
DataCenterEnergyReport2016.pdf

Resources, example 1

Data Center Metering and Resource Guide

07/27/2016

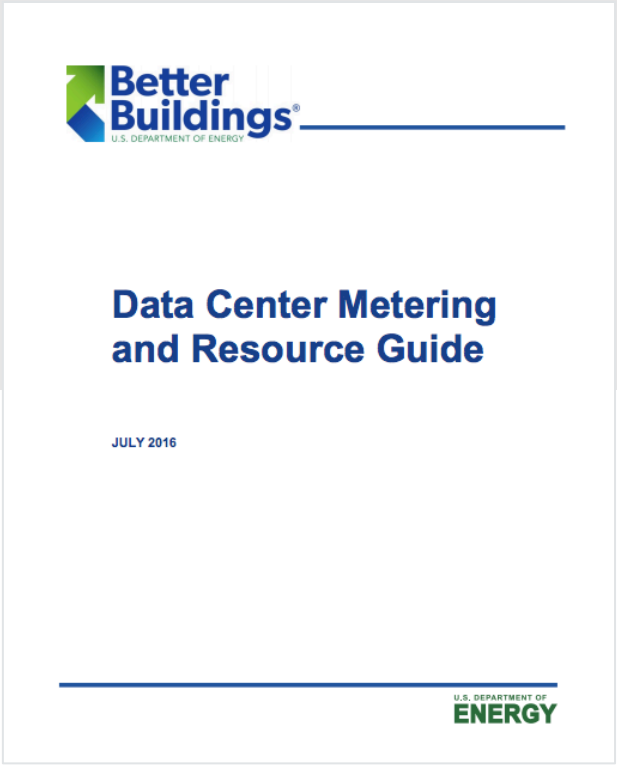
Guide intends to help data center owners and operators implement a metering system that allows their organizations to gather the necessary data for effective decision-making and energy-efficiency improvements. Focus is on the necessary data to calculate the power usage effectiveness (PUE) metric. Author(s): Mahdavi, R. and S. Greenberg

Technologies:

Power
Monitoring and Controls
General

File:

DataCenterMeteringandResourceGuide_07272016.pdf



Resources, example 2

Data Center Master List of Energy Efficiency Actions

02/11/2016

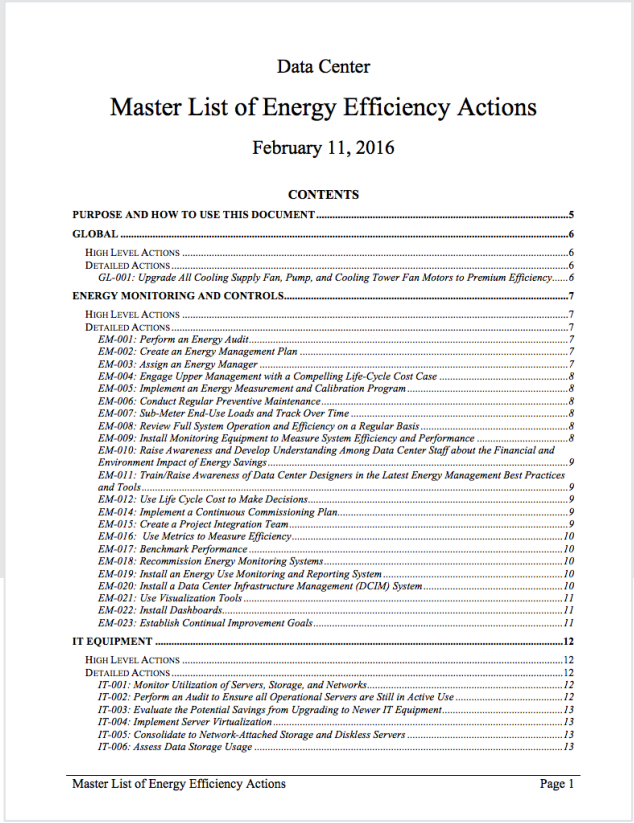
Comprehensive list of recommended efficiency actions for data centers. The Master list also feeds into our Data Center Profiler (DC Pro) tool to provide tailored recommendations for improvement.

Technologies:

Cooling Air / Air Management
Monitoring and Controls
General
IT Equipment
Power
Environmental Conditions

File:

DCProMasterList02112016.pdf



Data Center

Master List of Energy Efficiency Actions

February 11, 2016

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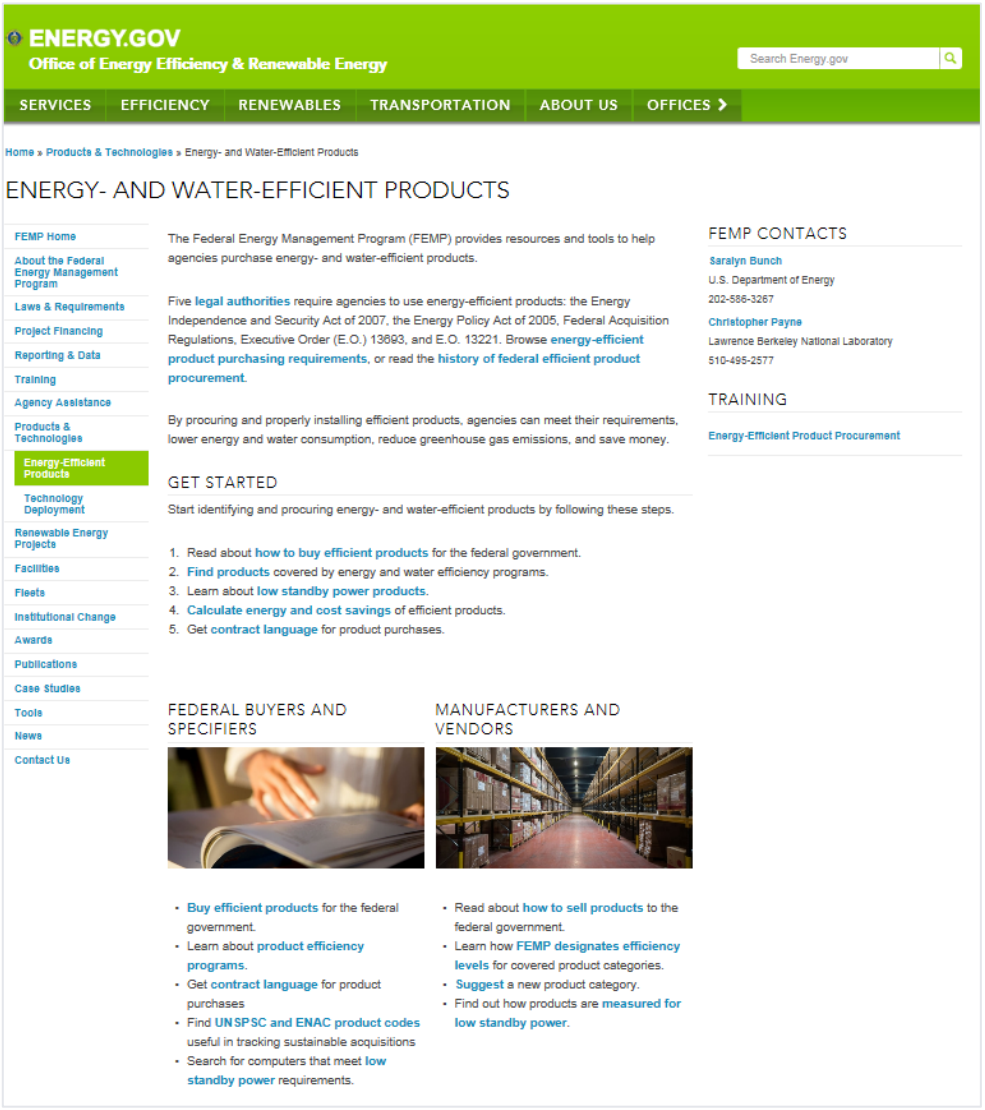
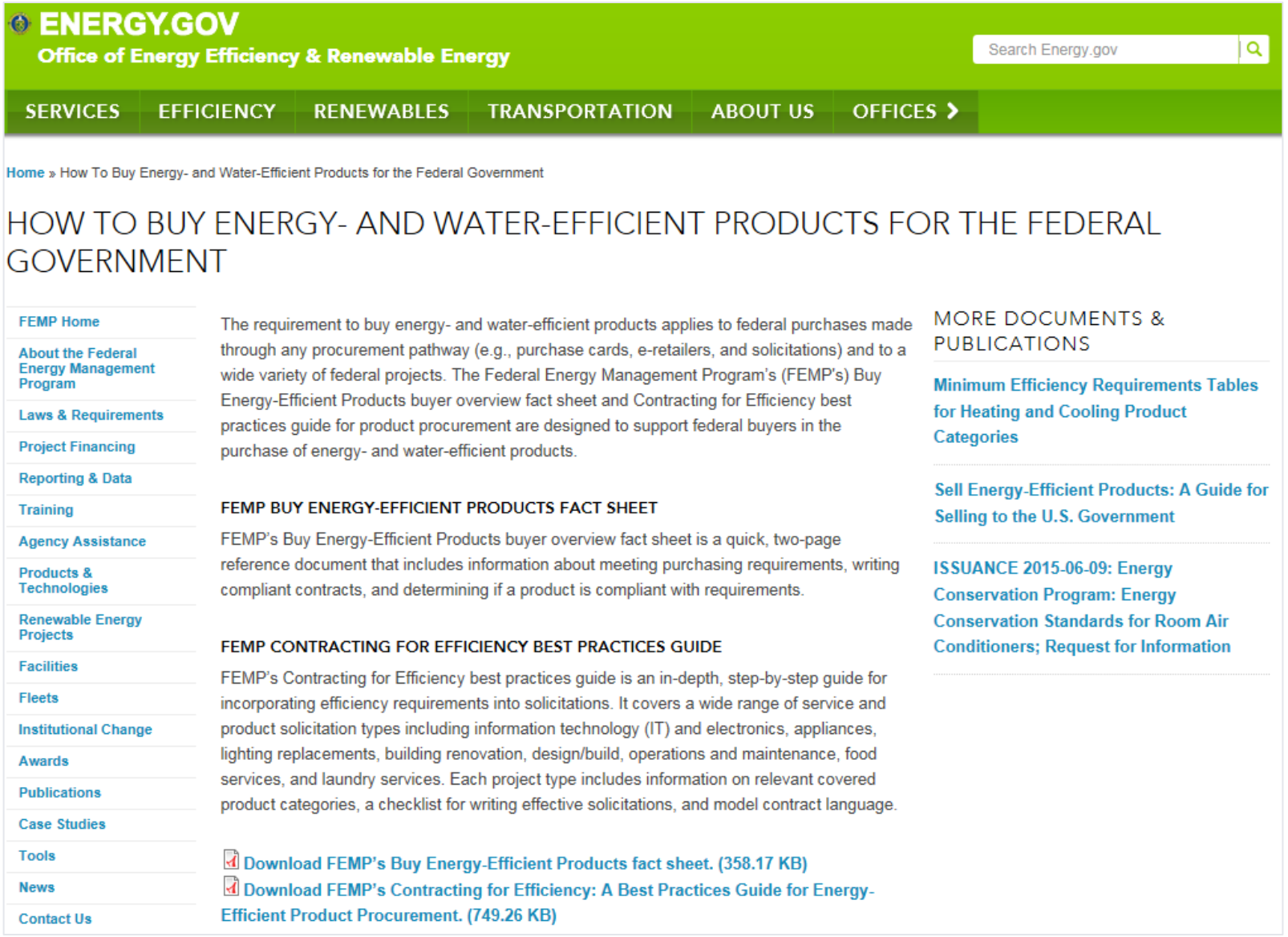
Energy- and Water-Efficient Products

Products & Technologies

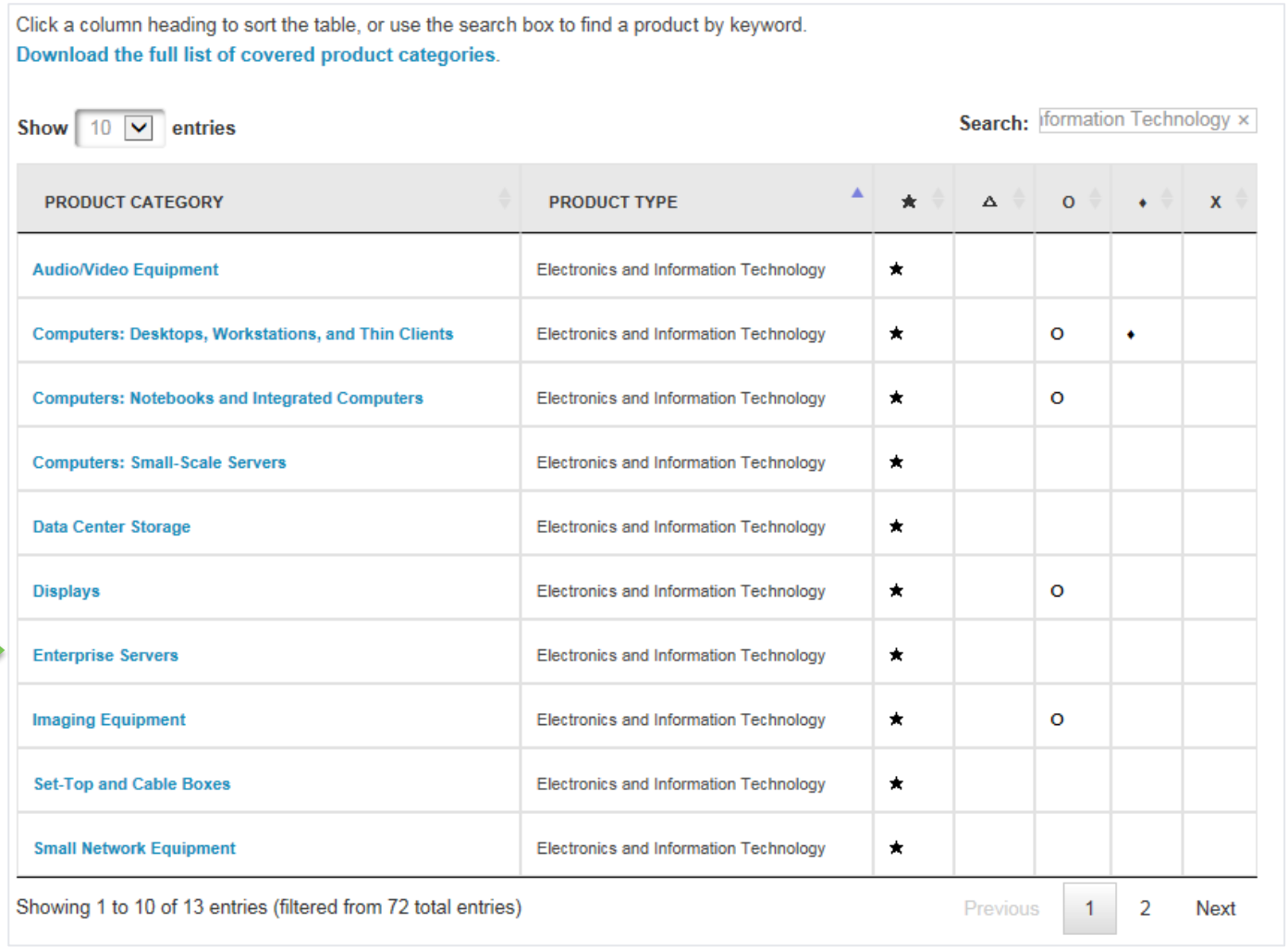


energy.gov/eere/femp/energy-and-water-efficient-products

How to Buy Efficient Products



Finding Efficient Products



Click a column heading to sort the table, or use the search box to find a product by keyword.
Download the full list of covered product categories.

Show 10 entries Search: formation Technology ×

PRODUCT CATEGORY	PRODUCT TYPE	★	△	O	♦	X
Audio/Video Equipment	Electronics and Information Technology	★				
Computers: Desktops, Workstations, and Thin Clients	Electronics and Information Technology	★		O	♦	
Computers: Notebooks and Integrated Computers	Electronics and Information Technology	★		O		
Computers: Small-Scale Servers	Electronics and Information Technology	★				
Data Center Storage	Electronics and Information Technology	★				
Displays	Electronics and Information Technology	★		O		
Enterprise Servers	Electronics and Information Technology	★				
Imaging Equipment	Electronics and Information Technology	★		O		
Set-Top and Cable Boxes	Electronics and Information Technology	★				
Small Network Equipment	Electronics and Information Technology	★				

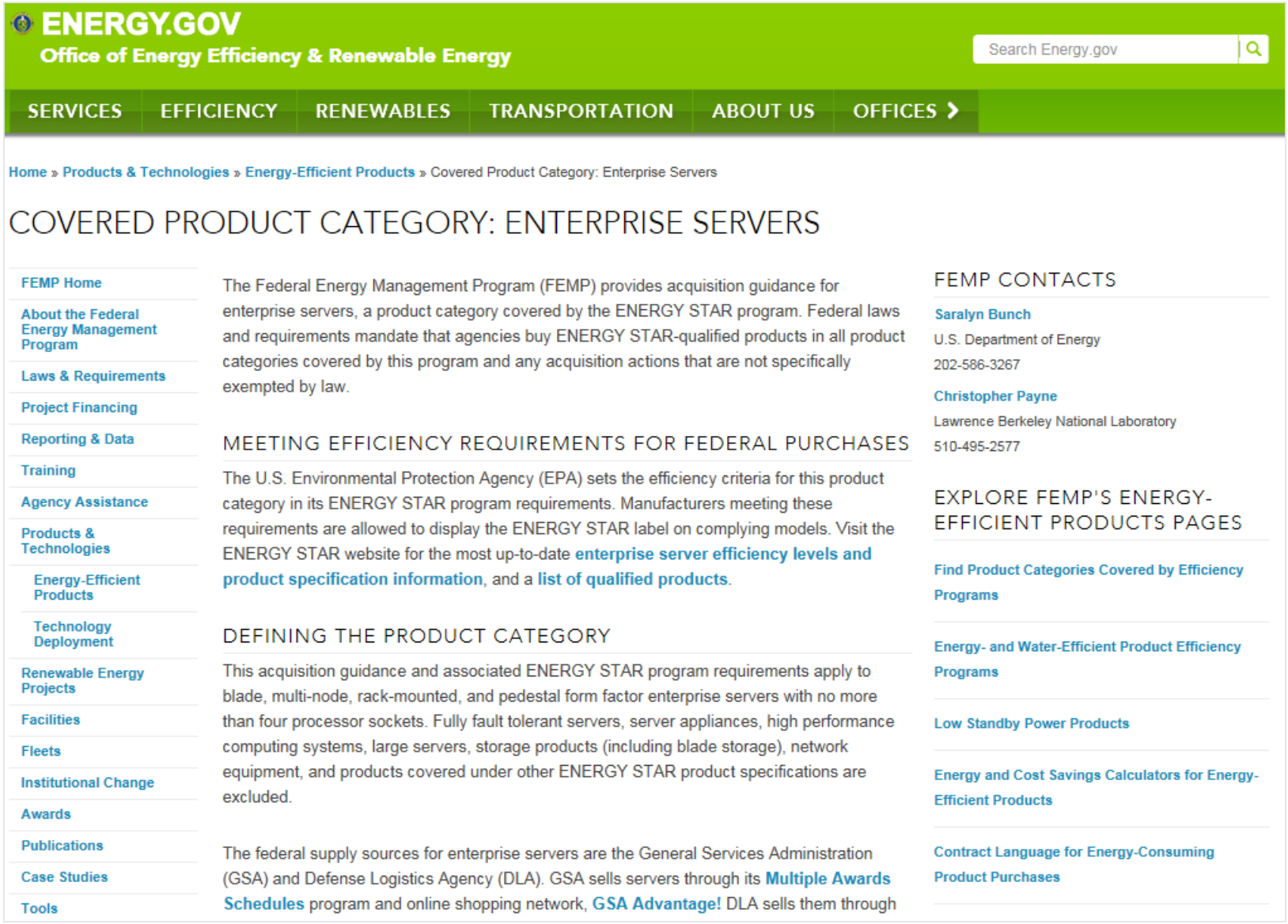
Showing 1 to 10 of 13 entries (filtered from 72 total entries) Previous 1 2 Next

LEGEND

★	ENERGY STAR
△	FEMP Designated
O	EPEAT
♦	Low Standby Power
X	WaterSense

energy.gov/eere/femp/find-product-categories-covered-efficiency-programs

Acquisition Guides



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The Federal Energy Management Program (FEMP) provides acquisition guidance for enterprise servers, a product category covered by the ENERGY STAR program. Federal laws and requirements mandate that agencies buy ENERGY STAR-qualified products in all product categories covered by this program and any acquisition actions that are not specifically exempted by law.

MEETING EFFICIENCY REQUIREMENTS FOR FEDERAL PURCHASES

The U.S. Environmental Protection Agency (EPA) sets the efficiency criteria for this product category in its ENERGY STAR program requirements. Manufacturers meeting these requirements are allowed to display the ENERGY STAR label on complying models. Visit the ENERGY STAR website for the most up-to-date **enterprise server efficiency levels and product specification information**, and a **list of qualified products**.

DEFINING THE PRODUCT CATEGORY

This acquisition guidance and associated ENERGY STAR program requirements apply to blade, multi-node, rack-mounted, and pedestal form factor enterprise servers with no more than four processor sockets. Fully fault tolerant servers, server appliances, high performance computing systems, large servers, storage products (including blade storage), network equipment, and products covered under other ENERGY STAR product specifications are excluded.

The federal supply sources for enterprise servers are the General Services Administration (GSA) and Defense Logistics Agency (DLA). GSA sells servers through its **Multiple Awards Schedules** program and online shopping network, **GSA Advantage!** DLA sells them through

FEMP CONTACTS

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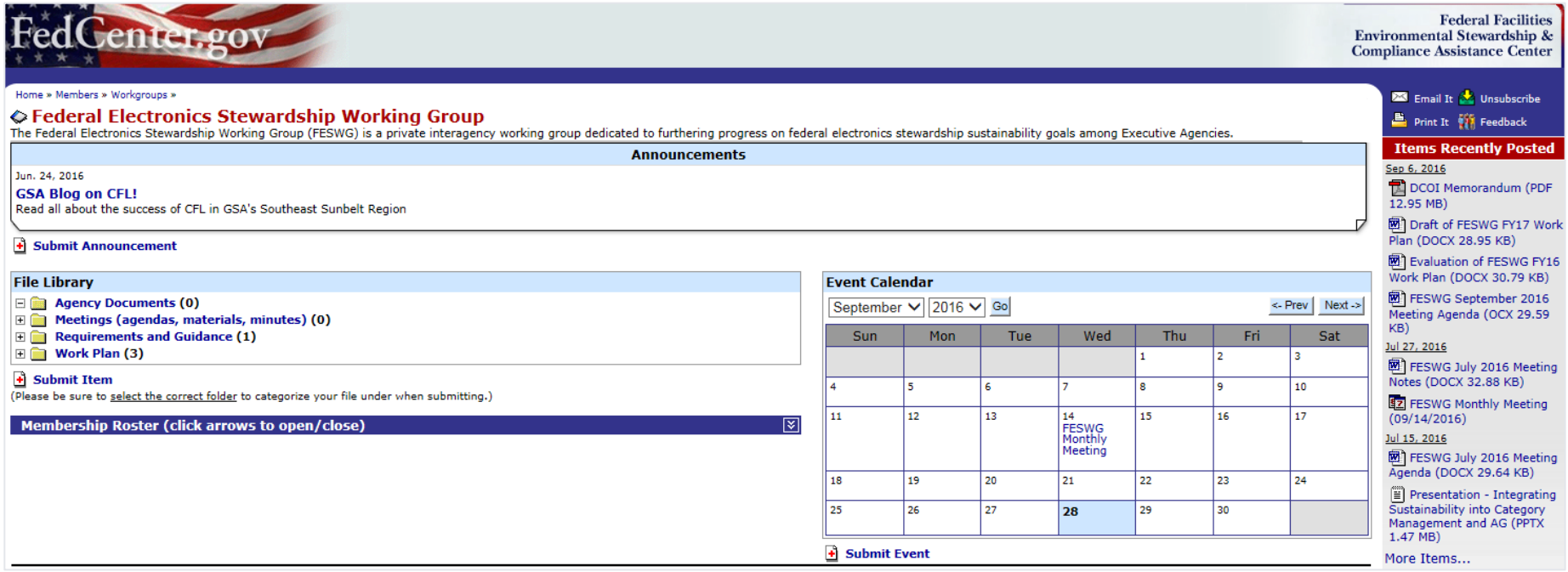
Christopher Payne
Lawrence Berkeley National Laboratory
510-495-2577

EXPLORE FEMP'S ENERGY-EFFICIENT PRODUCTS PAGES

- Find Product Categories Covered by Efficiency Programs
- Energy- and Water-Efficient Product Efficiency Programs
- Low Standby Power Products
- Energy and Cost Savings Calculators for Energy-Efficient Products
- Contract Language for Energy-Consuming Product Purchases

Federal Electronics Stewardship Working Group



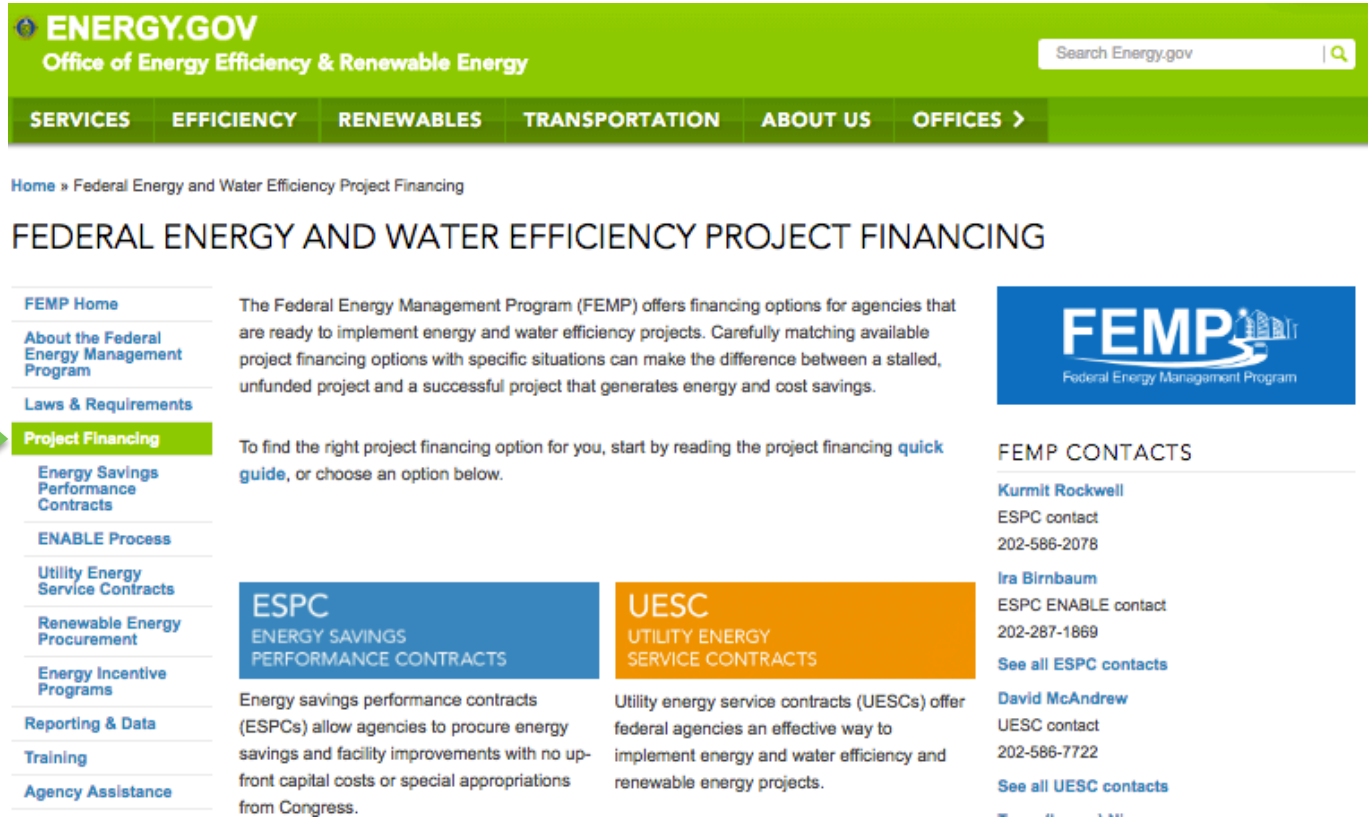
fedcenter.gov/members/workgroups/feswg/
(Requires FedCenter account and approved access)

Request to join the FESWG listserve by sending a blank message to join-feswg@fedcenter.gov

Project Financing

Energy savings performance contracts (ESPCs) and utility energy service contracts (UESCs) allow agencies to do energy projects with minimal up-front capital cost and no special appropriations from Congress.

Project Financing

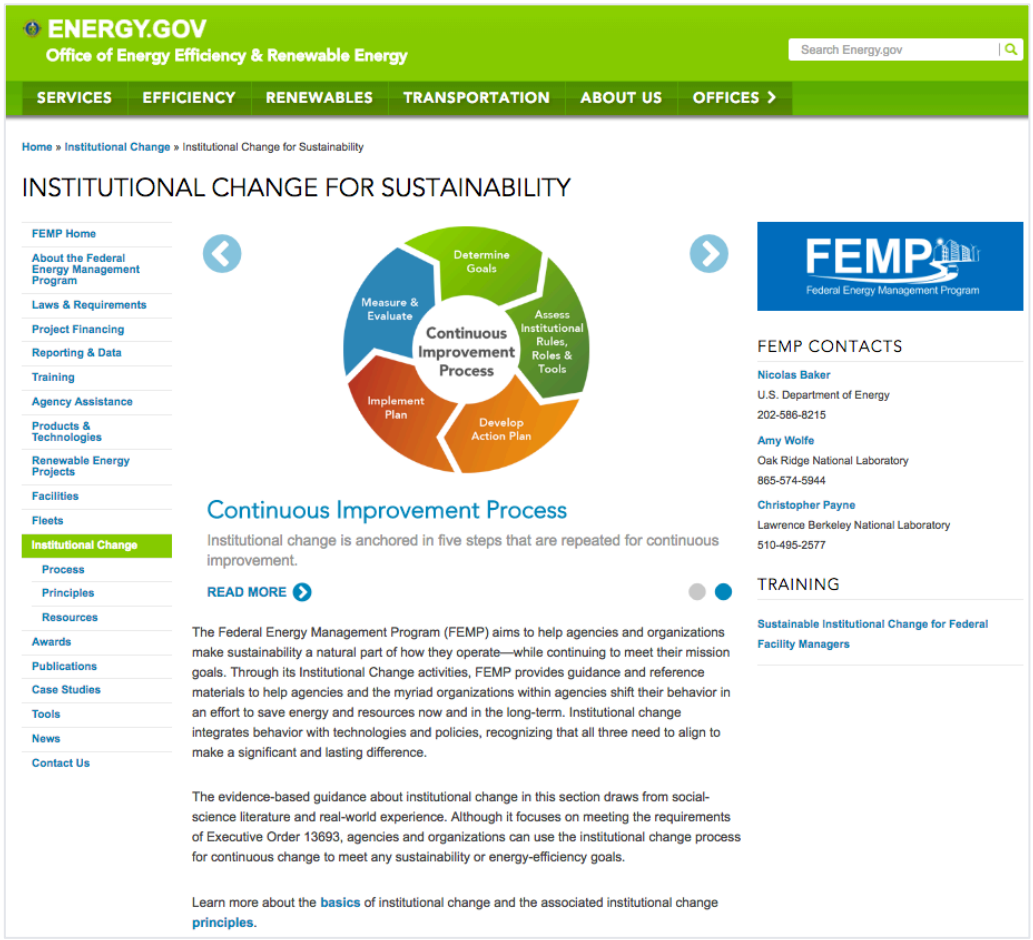


energy.gov/eere/femp/federal-energy-and-water-efficiency-project-financing

Institutional Change

Institutional change integrates behavior with technologies and policies, recognizing that all three need to align to make a significant and lasting difference.

Institutional Change



energy.gov/eere/femp/institutional-change-sustainability

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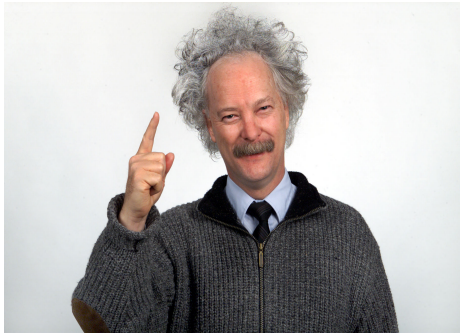

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