

# DC Pro Assessment Tools

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# Assessment tools

- LBNL is developing tools to assist in performing energy assessments in data centers. This activity is sponsored by the Department of Energy under the Save Energy Now program - the tools are available for public use.
- The Green Grid organization is collaborating and providing content for the IT portions of the tools.
- An assessment process is described along with a suggested report format.
- The assessment tools are collectively called DC Pro.



## DOE tool suite: DC Pro

- **Profiling Tool**: profiling and tracking
  - Establish PUE baseline and efficiency potential (few hours effort)
  - Document actions taken
  - Track progress in PUE over time
- **Assessment tools**: more in-depth site assessments
  - Suite of tools to address major sub-systems
  - Provides savings for efficiency actions
  - ~2 week effort (including site visit)



# DC Pro tools

## *High Level Profiling Tool*

- Overall energy performance (baseline) of data center
- Performance of systems (infrastructure & IT) compared to benchmarks
- Prioritized list of energy efficiency actions and their savings, in terms of energy cost (\$), source energy (Btu), and carbon emissions (Mtons)
- Points to more detailed system tools



**IT Module**

- Servers
- Storage & networking
- Software



**Cooling**

- Air handlers/ conditioners
- Chillers, pumps, fans
- Free cooling



**Air Management**

- hot cold separation
- environmental conditions



**Electrical Systems**

- UPS
- Transformers
- Lighting
- Standby gen.



**On-Site Gen**

- Renewables
- use of waste heat

# Online profiling tool

## INPUTS

- Description
- Utility bill data
- System information
  - IT
  - Cooling
  - Power
  - On-site gen

The screenshot shows the DC Pro website header with the U.S. Department of Energy logo and the text "Energy Efficiency and Renewable Energy". Below this is a green banner for the "Industrial Technologies Program" and a red banner for "DC Pro". A navigation bar contains links for "New", "Open", "Save", "FAQ", "Tutorial", and "Feedback". The main content area is titled "Data Center Energy Profiler" and features a login form with fields for "Username" and "Password", and buttons for "Get Started Now!", "Returning User", "Login", "Forgotten password", and "Register". A text block below the form describes the tool's purpose: "The Data Center Energy Profiler, or DC Pro, is an online software tool provided by the U.S. Department of Energy to help industries worldwide identify how energy is being purchased and consumed by their data center(s) and also identify potential energy and cost savings. DC Pro is designed so that the user can complete a data center profile in about an hour. The DC Pro online tutorial will explain what data center information you need to complete a DC Pro case. When you complete a DC Pro case you are provided with a customized, printable report that shows the details of energy purchases for your data center, how energy is consumed by your data center, potential cost and energy savings, comparison of your data center energy utilization versus other data centers, and a list of next steps that you can follow to get you started saving energy." A "DC Pro Resources" sidebar lists "Online tutorial" and "Checklist that you". At the bottom, it states "The current version of DC Pro is 1.1.1.1, released 12/12/2006." and provides navigation links: "Industrial Technologies Program Home | EERE Home | U.S. Department of Energy Home | Webmaster | Web Site Policies | Security & Privacy | USA.gov".

## OUTPUTS

- Overall efficiency (PUE)
- End-use breakout
- Potential areas for energy efficiency improvement
- Overall energy use reduction potential



# Overview of DC Pro Profiling Tool

On-Line Profiling Tool: Profiling and tracking

- Establish PUE baseline and efficiency potential (few hours effort)
- Document actions taken
- Track progress in PUE over time



## Profiling Tool: Walk-Through (Step-by-Step)

[www.eere.energy.gov/datacenters](http://www.eere.energy.gov/datacenters)

The following slides step through the screens of the tool.

# Logging In

The screenshot shows a Mozilla Firefox browser window with the address bar displaying "ITP BestPractices: DC Pro - Home Page". The browser's menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Yahoo!", "Tools", and "Help". The page content features the U.S. Department of Energy logo and the text "Energy Efficiency and Renewable Energy". A green banner reads "Industrial Technologies Program". Below this is a blue banner for "Data Center Energy Profiler" with a "Save ENERGY Now" graphic. A navigation bar contains links for "Home", "New Case", "FAQ", "Support", "Checklist", "Feedback Survey", and "Tutorial".

The main heading is "Data Center Energy Profiler". Underneath, there is a "Get Started Now!" section with two options: "Returning User" and "First Time User". The "Returning User" section includes a login form with fields for "Username" (containing "bsmith@abc.com") and "Password" (represented by dots), a "Forgot password" link, and a "Login" button. The "First Time User" section has a "Click here to register" link.

A text block explains the tool: "The Data Center Energy Profiler, or DC Pro, is an online software tool provided by the U.S. Department of Energy to help industries worldwide identify how energy is being purchased and consumed by their data center(s) and also identify potential energy and cost savings. DC Pro is designed so that the user can complete a data center profile in about an hour. When you complete a DC Pro case you are provided with a customized, printable report that shows the details of energy purchases for your data center, how energy is consumed by your data center, potential cost and energy savings, comparison of your data center energy utilization versus other data centers, and a list of next steps that you can follow to get you started saving energy." Below this text, it states "This is Version 1.0 of DC Pro released 10/01/2008."

A "DC Pro Resources" box contains a link to the "Information Page": "Information Page - The DC Pro Information Page lists all of the information that you will need to collect to complete the DC Pro."

At the bottom, a footer contains several links: "Industrial Technologies Program Home", "EERE Home", "U.S. Department of Energy", "Webmaster", "Web Site Policies", "Security & Privacy", and "USA.gov".

# Step 1: Case Information

ITP BestPractices: DC Pro - Case Information - Mozilla Firefox

File Edit View History Bookmarks Yahoo! Tools Help

U.S. Department of Energy  
**Energy Efficiency and Renewable Energy** *Bringing you a prosperous future where energy is clean, abundant, reliable, and efficient*

Industrial Technologies Program

Data Center Energy Profiler

Home | [New Case](#) | [FAQ](#) | [Support](#) | [Checklist](#) | [Feedback Survey](#) | [Tutorial](#)

Current User: Bob Smith [Logout](#)

1 2 3 4 5 6

**Step 1 - Case Information**

Welcome to DC Pro, if you are a returning user and wish to modify an existing case please select the case below. If you wish to start a new case please select "Start New Case" below. If you wish to track energy use and retrofits, please select "Track Retrofits"

DC Pro will require information on IT operations as well as facilities infrastructure operations, and may require that information be obtained from multiple people within an organization. There are two options for gathering and inputting information from multiple people:

1. Collect and input: Ask each person to provide their information using the [checklist](#), and have one person enter it into DC Pro
2. Sequential direct input: Ask each person in turn to log in to DC Pro and enter information (DC Pro allows you to input data over multiple sessions).

If you need additional information on this step [click here](#).

Name:  Company:

Existing Cases:

- Data Center Example 1bb
- KT Test
- All Actions
- RE - NB Test- Do Not Modify

or

[Industrial Technologies Program Home](#) | [EERE Home](#) | [U.S. Department of Energy](#)  
[Webmaster](#) | [Web Site Policies](#) | [Security & Privacy](#) | [USA.gov](#)

Done

# Step 1: Case Information (continued)

ITP BestPractices: DC Pro - Case Information - Mozilla Firefox

File Edit View History Bookmarks Yahoo! Tools Help

DC Pro will require information on IT operations as well as facilities and data center operations, and may require data which may be obtained from multiple people within an organization. There are two options for gathering and inputting information from multiple people:

1. Collect and input: Ask each person to provide their information using the [checklist](#), and have one person enter it into DC Pro.
2. Sequential direct input: Ask each person in turn to log in to DC Pro and enter information (DC Pro allows you to input data over multiple sessions).

If you need additional information on this step [click here](#).

Name:  Company:

Existing Cases:  or

Enter a name for your case and enter the company name which houses the data center. Then enter the basic information about the datacenter facility.

Required fields are in **bold**

Case Name

Data Center Company

**Country**

**State/Region**

**County**

**Floor Area (sq feet) - Non Data Center Space**

**Floor Area (sq feet) - Data Center Space**

**Floor Area (sq feet) - Data Center Support Space**

**Type of Data Center**

**Data Center Tier (Uptime Institute definition)**

**Current Data Center Buildout Level**  %

Industrial Technologies Program Home | EERE Home | U.S. Department of Energy  
Webmaster | Web Site Policies | Security & Privacy | USA.gov

Done

Click on  
this icon  
for a  
ToolTip

# Step 2: Energy Use

The screenshot shows a web browser window titled "ITP BestPractices: DC Pro - Energy Use Systems - Berkeley Lab". The address bar shows the URL "http://dcpro.ppc.com/DCProEnergyUseSystems.aspx". The page header includes the U.S. Department of Energy logo and the text "Energy Efficiency and Renewable Energy". Below this is the "Industrial Technologies Program" banner and the "Data Center Energy Profiler" title. A navigation menu includes "Home", "New Case", "FAQ", "Help", "Current Case", "Checklist", and "Feedback Survey". The current case number is 456, and the user is identified as Bob Smith. A progress indicator shows six steps, with step 2, "Step 2 - Energy Use Systems", highlighted. A "Help" section on the right provides instructions: "All questions must be answered, if you are unsure of an answer give your best estimate." and "If you need to stop to find an answer, you can save your progress and come back later." The main content area contains a series of questions with radio button options for "Yes" and "No". The "Save & Continue" button is circled in red. At the bottom, there are links for "Industrial Technologies Program Home", "EERE Home", "U.S. Department of Energy", "Webmaster", "Web Site Policies", "Security & Privacy", and "USA.gov".

ITP BestPractices: DC Pro - Energy Use Systems - Berkeley Lab

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Data Center Energy Profiler

Home | New Case | FAQ | Help | Current Case | Checklist | Feedback Survey

Current Case: 456 Current User: Bob Smith Logout

1 2 3 4 5 6

Step 2 - Energy Use Systems

Please answer the following questions related to your data center. After completing the questions for one section click the next button to move to the next set of questions, after completing all of the Energy Use System questions, DC Pro will compute your data center End-Use Breakouts. If you need to modify an answer after moving to the next set, click the previous button to go back.

Energy Management	IT Equipment	Environmental Conditions	Air Management	Cooling Plant	IT Equipment Power Chain	Lighting	Default Breakouts
Has an energy audit or commissioning been conducted within the last 2 years? <input type="radio"/> Yes <input type="radio"/> No							
Is there a written energy management plan? <input type="radio"/> Yes <input checked="" type="radio"/> No							
Is there an energy manager directly responsible for the energy management plan? <input type="radio"/> Yes <input type="radio"/> No							
Has upper management accepted the energy management plan? <input type="radio"/> Yes <input type="radio"/> No							
Is there an energy measurement and calibration program in place? <input type="radio"/> Yes <input type="radio"/> No							
Is there a preventative maintenance program in place? <input type="radio"/> Yes <input type="radio"/> No							

Previous Save & Continue

Industrial Technologies Program Home | EERE Home | U.S. Department of Energy  
Webmaster | Web Site Policies | Security & Privacy | USA.gov

# Step 2: Energy Use (continued)

ITP BestPractices: DC Pro - Energy Use Systems - Berkeley Lab

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Industrial Technologies Program

## Data Center Energy Profiler

Home | New Case | FAQ | Help | Current Case | Checklist | Feedback Survey

Current Case: 456 Current User: Bob Smith Logout

1 2 3 4 5 6

**Step 2 - Energy Use Systems**

Please answer the following questions related to your data center. After completing the questions for one section click the next button to move to the next set of questions, after completing all of the Energy Use System questions, DC Pro will compute your data center End-Use Breakouts. If you need to modify an answer after moving to the next set, click the previous button to go back.

Energy Management | IT Equipment | Environmental Conditions | Air Management | Cooling Plant | IT Equipment Power Chain | Lighting | Default Breakouts

This screen will compute estimated data center end use. You will have the opportunity to input the actual energy use in Step 4, in whole or in part. DC Pro will modify the default breakouts to accommodate the actual energy use.

**Estimated Data Center End Use**

Category	Percentage
IT Equipment	65%
Cooling	22%
Fans	5%
Electric Distribution Loss	2%
Data Center Lights	1%

Estimated Annual Data Center DCIE = 0.65

www.dotnetcharting.com  
Development Version: Not for production use.

**Help**

- All questions must be answered, if you are unsure of an answer give your best estimate.
- If you need to stop to find an answer, you can save your progress and come back later.

# Step 3: Production Information (optional)

The screenshot shows a web browser window titled "ITP BestPractices: DC Pro - Production Information - Berkeley Lab". The address bar shows "http://dcpro.ppc.com/DCProProduction.aspx". The page header includes the U.S. Department of Energy logo and the text "Energy Efficiency and Renewable Energy". Below the header is a green banner for the "Industrial Technologies Program" and a "Data Center Energy Profiler" section. A navigation menu includes "Home", "New Case", "FAQ", "Help", "Current Case", "Checklist", and "Feedback Survey". The current user is identified as "Bob Smith".

A progress indicator at the top shows six steps, with step 3 highlighted in green and labeled "Step 3 - Production Information (optional)".

**Help**

- The product name can be anything that you wish.
- If you want to enter production information, all fields are required. If you choose to skip this step, please leave all fields blank.

Use this screen to enter production information for your data center. This information will be used to calculate energy savings on a per unit of production basis.

The purpose of this screen is to gather some type of information that measures the activity at your data center. This information will be different for each data center. Below is a list of possible types of production information that different data centers might enter.

As you can see from the above examples you are free to enter any type of metric that measures production or activity at your data center. This information has no impact on the calculations of total energy savings by DC Pro. It is only used for your final report to show costs and savings per unit of production (or whatever metric you entered).

Product Name:

Average Quantity:

Units:

Period:

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[Webmaster](#) | [Web Site Policies](#) | [Security & Privacy](#) | [USA.gov](#)

# Step 4: Supplied Energy

ITP BestPractices: DC Pro - Supplied Energy - Berkeley Lab

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## Data Center Energy Profiler

Home | New Case | FAQ | Help | Current Case | Checklist | Feedback Survey

Current Case: 456 Current User: Bob Smith Logout

1 2 3 4 5 6  
**Step 4 - Supplied Energy (optional)**

Use the next four screens to enter data from utility bills and/or submeters recordings, entering this data is optional but doing so will help DC Pro more accurately profile your facility. If you do not, DC Pro will use the default energy end-use percentages from Step 2. Enter data only for those meters that support -- either partly or wholly -- the DC Load and/or the DC cooling system. You will be allowed to distribute any of the energy streams across the end-use breakout categories in the next step (Step 5) of the DC Pro process. If your facility does not use one or more of the energy stream simply leave that screen blank and click the Next button.

For each energy stream you will need to enter account information for each meter or sub-meter you have data on. For each account enter a Meter ID, select whether or not the meter is a sub-meter (and if so what meter it is a sub of), enter the average quantities and units purchased, and select the period for which this purchase reflects. Entering different period intervals for different energy streams is acceptable, as DC Pro will calculate the annual data, but do not enter more than 1 year of data.

Electricity		Fuel		Steam		Chilled Water			
Meter ID	On Site	Sub-Meter Of	Use per Period	Units	Period	Bills per Period	Annual Use	Units	Annual Bills
<a href="#">Edit</a> <a href="#">Delete</a>	001	No	250,000	kWh	Monthly	\$1,110.00	3,000,000	kWh	\$13,320.00
<a href="#">Edit</a> <a href="#">Delete</a>	002	No	50,000	kWh	Monthly	\$250.00	600,000	kWh	\$3,000.00
<a href="#">Edit</a> <a href="#">Delete</a>	213	No	25,555	kWh	Monthly	\$12,345.00	306,660	kWh	\$148,140.00

[Save](#)

Previous Save & Continue Skip Step 4

Industrial Technologies Program Home | EERE Home | U.S. Department of Energy  
 Webmaster | Web Site Policies | Security & Privacy | USA.gov

**Help**

- You may enter as many meter accounts as you wish for each energy stream.
- If you do enter data for a particular stream, all fields are required.
- Remember to enter the average cost and quantity for the selected period.
- The cost that you enter should be the TOTAL cost of the energy stream for the selected period. This should include the cost of energy plus the total of all other charges including demand charges and any other recurring charges.
- Don't forget to enter energy that is generated on site at your plant. When entering on site generation just check the Generated On Site checkbox, but remember DO NOT ASSIGN ANY COST TO THIS.
- Click the information icons to display the tooltip popup. Tooltips help to better understand what the question is asking.

# Step 5: Energy Use Distribution (optional)

ITP BestPractices: DC Pro - Energy Use Distribution - Berkeley Lab

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Industrial Technologies Program

## Data Center Energy Profiler

Home | New Case | FAQ | Help | Current Case | Checklist | Feedback Survey

Current Case: 456 Current User: Bob Smith Logout

1 2 3 4 **5** 6

**Step 5 - Energy Use Distribution (optional)**

Use these screens to allocate the annual energy use for each meter identified in Step 4 across the Energy End-Use Breakout Categories.

If you do not know what the allocations are for a given meter, it is OK to skip this screen or enter estimates. All of the energy use for a given meter does not have to be allocated to the breakout categories. If the meter serves more than just the data center, it is OK to leave a portion of the energy in the Remainder column.

NOTE: DC Pro provides default percentages for you based on the information entered in Step 2. You may use these default percentages if you are unsure of the actual percentages that each energy use system uses. However, for more accurate results you should estimate your actual percentages and enter them in the boxes below.

Meter ID	Electricity		Fuel		Steam		Chilled Water		Summary						
	Total Annual Site Energy Use		Site Energy End-Use Breakout Categories												
	kWh/yr	%	IT Load	Lights	Electric Distribution Losses	Fans	Cooling & Humidity Controls	Site Energy Use Related to Data Center	Remainder (Non-Data Center Use)						
		kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%		
001	3,000,000	1700000	57%	90000	3%	350000	12%	600000	20%	90000	3%	2,830,000.0	94%	170,000	6%
002	600,000	400000	67%	60000	10%	90000	15%	18000	3%	12000	2%	580,000.0	97%	20,000	3%
213	306,660	153330	50%	91998	30%	0	0%	9199.8	3%	9199.8	3%	263,727.6	86%	42,932.4	14%
Totals		2,253,330	58%	241,998	6%	440,000	11%	627,199.8	16%	111,199.8	3%	3,673,727.6	94%	232,932.4	6%
Is this all the electricity associated with the breakout categories being used by the data center?		Yes		Yes		Yes		Yes		Yes					

Recalculate

Previous Save & Continue

**Help**

- Please enter a value for each meter or sub-meter. If the meter or sub-meter does not use any energy from a given category, enter zero.
- The total annual energy use for each meter are the values calculated in Step 4. If you notice a problem with a meter or need to modify one, go back to Step 4 by clicking the circle on the top of this page.
- The percentages in the "Energy Use Related to Data Center" and "Remainder" column for a given meter MUST equal 100%. DC Pro will not let you move onto the next page if they do not.
- You must select "Yes" or "No" in the final row before proceeding to the next energy type. Select "Yes" if there is no additional energy being used by the data center for a given breakout category. Select "No" if there is.

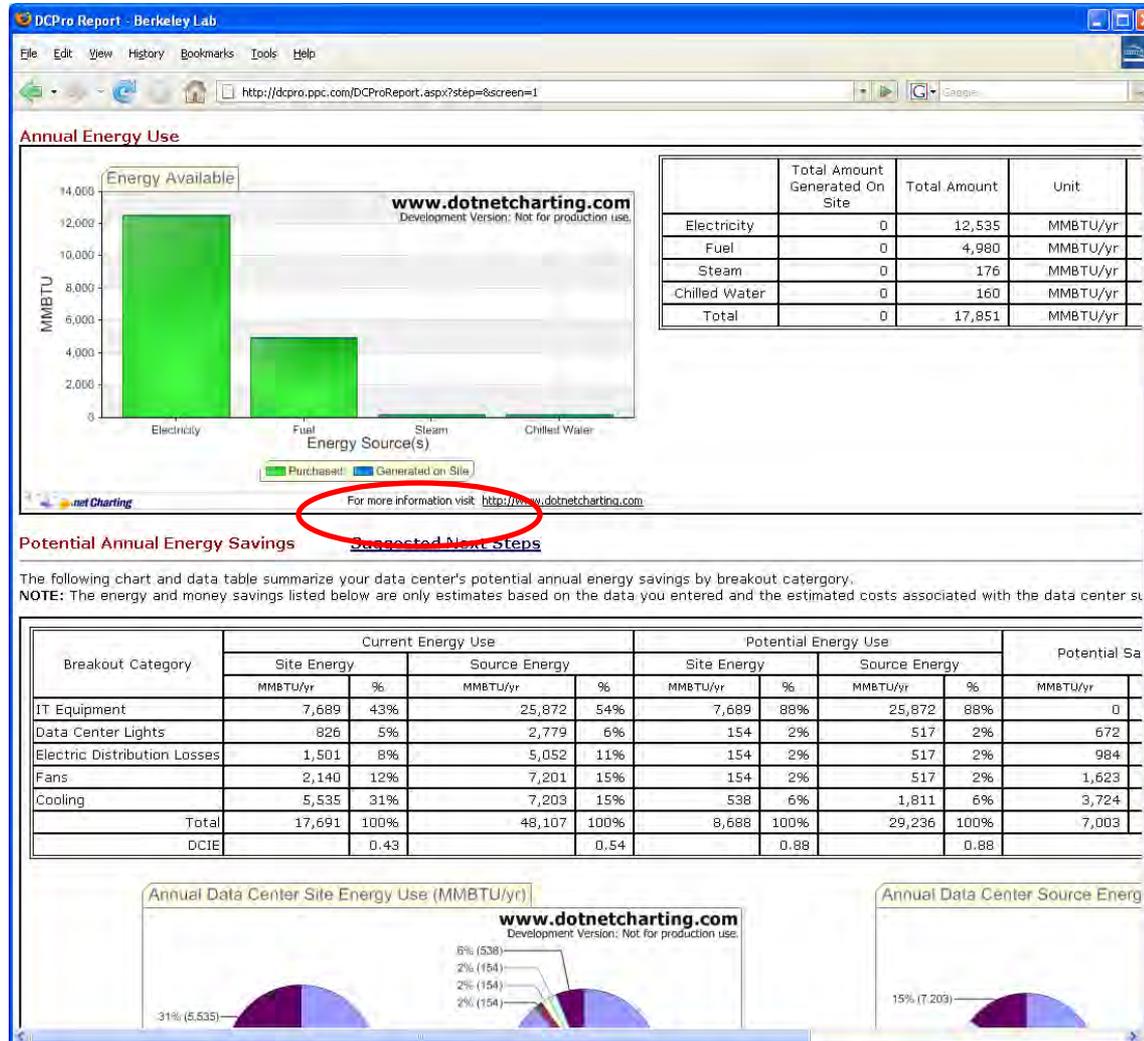


## Step 6: Results

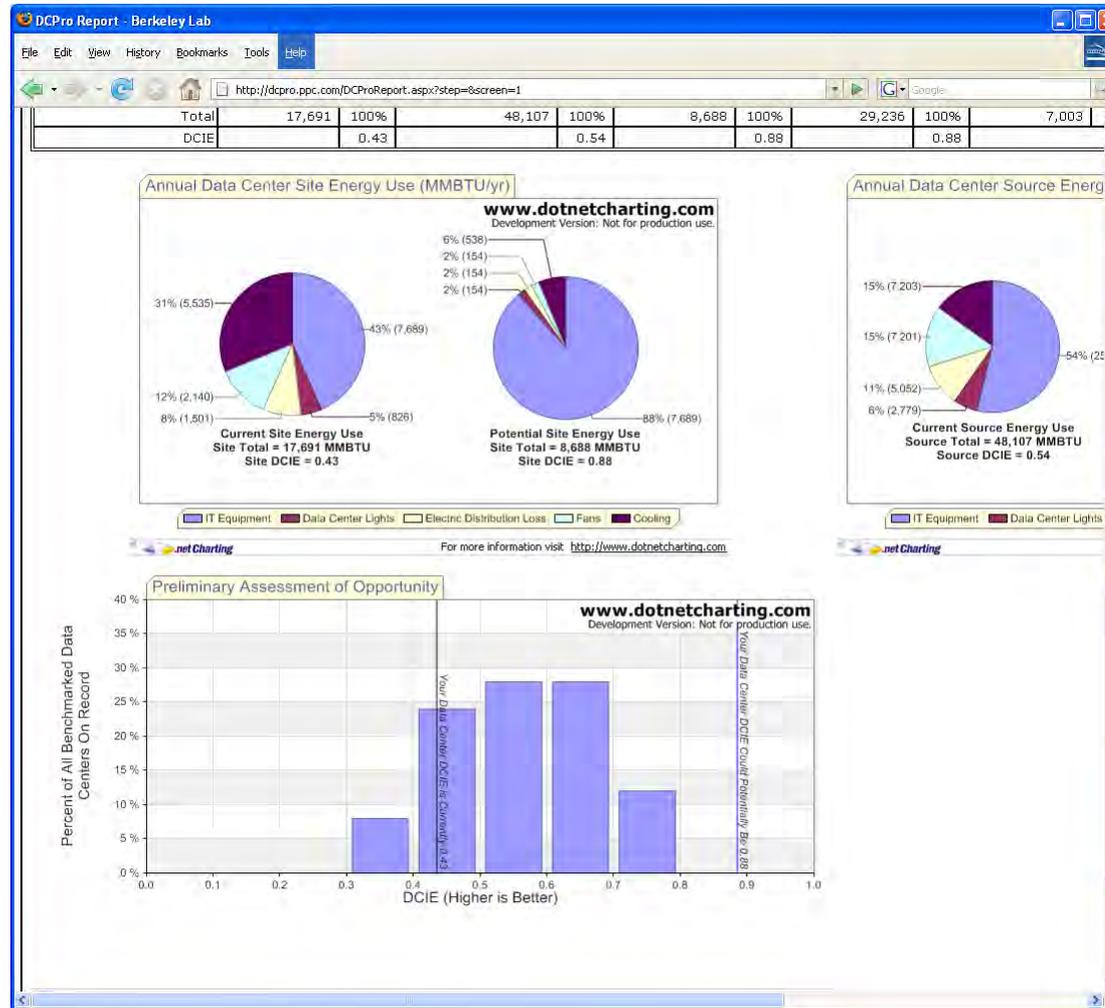
Summary Report providing the following information:

- Case Information
- Annual Energy Use
- Potential Annual Energy Savings & DCIE Benchmarking
- Potential Annual CO2 Savings
- Suggested Next Steps

# Step 6: Results



# Step 6: Results (continued)



County	Carroll County
State	Georgia

## Suggested Next Steps

Potential Annual Savings

Energy Management	IT Equipment	Environmental Conditions	Air Management	Cooling Plant	IT Equipment Power Chain	Lighting	Global Action
EC.A.1	Consider Air-Management measures	A low air temperature rise across the data center and/or IT equipment intake temperatures outside the recommended range suggest air management problems. A low return temperature is due to by-pass air and an elevated return temperature is due to recirculation air. Estimating the Return Temperature Index (RTI) and the Rack Cooling Index (RCI) will indicate if corrective, energy-saving actions are called for.					
EC.A.2	Consider increasing the supply temperature	A low supply temperature makes the chiller system less efficient and limits the utilization of economizers. Enclosed architectures allow the highest supply temperatures (near the upper end of the recommended intake temperature range) since mixing of hot and cold air is minimized. In contrast, the supply temperature in open architectures is often dictated by the hottest intake temperature.					
EC.A.4	Place temperature/humidity sensors so they mimic the IT equipment intake conditions	IT equipment manufacturers design their products to operate reliably within a given range of intake temperature and humidity. The temperature and humidity limits imposed on the cooling system that serves the data center are intended to match or exceed the IT equipment specifications. However, the temperature and humidity sensors are often integral to the cooling equipment and are not located at the IT equipment intakes. The condition of the air supplied by the cooling system is often significantly different by the time it reaches the IT equipment intakes. It is usually not practical to provide sensors at the intake of every piece of IT equipment, but a few representative locations can be selected. Adjusting the cooling system sensor location in order to provide the air condition that is needed at the IT equipment intake often results in more efficient operation.					
EC.A.5	Recalibrate temperature and humidity sensors	Temperature sensors generally have good accuracy when they are properly calibrated (+/- a fraction of a degree), but they tend to drift out of adjustment over time. In contrast, even the best humidity sensors are intrinsically not very precise (+/- 5% RH is typically the best accuracy that can be achieved at reasonable cost). Humidity sensors also drift out of calibration. To ensure good cooling system performance, all temperature and humidity sensors used by the control system should be treated as maintenance items and calibrated at least once a year. Twice a year is better to begin with. After a regular calibration program has been in effect for a while, you can gauge how rapidly your sensors drift and how frequent the calibrations should be. Calibrations can be performed in-house with the proper equipment, or by a third-party service.					
EC.A.6	Network the CRAC/CRAH controls	CRAC/CRAH units are typically self-contained, complete with an on-board control system and air temperature and humidity sensors. The sensors may not be calibrated to begin with, or they may drift out of adjustment over time. In a data center with many CRACs/CRAHs it is not unusual to find some units humidifying while others are simultaneously dehumidifying. There may also be significant differences in supply air temperatures. Both of these situations waste energy. Controlling all the CRACs/CRAHs from a common set of sensors avoids this.					
EC.A.8	Consider disabling or eliminating humidification controls or reducing the humidification setpoint	Tightly controlled humidity can be very costly in data centers since humidification and dehumidification are involved. A wider humidity range allows significant utilization of free cooling in most climate zones by utilizing effective air-side economizers. In addition, open-water systems are high-maintenance items.					
EC.A.9	Consider disabling or eliminating dehumidification controls or increasing the dehumidification setpoint	Most modern IT equipment is designed to operate reliably when the intake air humidity is between 20% and 80% RH. However, 55% RH is a typical upper humidity level in many existing data centers. Maintaining this relatively low upper limit comes at an energy cost. Raising the limit can save energy, particularly if the cooling system has an airside economizer. In some climates it is possible to maintain an acceptable upper limit without ever needed to actively dehumidify. In this case, consider disabling or removing the dehumidification controls entirely.					
EC.A.10	Change the type of humidifier	Most humidifiers are heat based; ie, they supply steam to the air stream by boiling water. Electricity or natural gas are common fuel sources. The heat of the steam becomes an added load on the cooling system. An evaporative humidifier uses much less energy. Instead of boiling water, it introduces a very fine mist of water droplets to the air stream. When set up properly the droplets quickly evaporate, leaving no moisture on nearby surfaces. This has an added cooling benefit, as the droplets absorb heat from the air as they evaporate.					



## Contact Information for the DC Pro Tool Suite

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510-486-5116

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DC Pro Support

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## Contact information:

### **Bill Tschudi, P.E.**

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# Questions? - Discussion



**Thank you for attending**