Building Energy Simulation

USER NEWS

Highlights

Recent Reports

Regular Features

EnergyPlus Training

Register Now for these EnergyPlus training workshops.

March 18-19, 2008, Illinois Institute of Technology (IIT), Chicago, IL, USA
http://www.iit.edu/~archdoc/energyseminar3.html

May 20-23, 2008, Quebec City, QC, Canada, Organized by IBPSA-Canada as part of the eSim 2008 conference.
http://www.esim.ca/2008/workshops.htm#energyplus

New Features of EnergyPlus 2.1

NATURAL AND MECHANICAL VENTILATION

- A new system availability manager was added to allow system-level control of hybrid ventilation systems.

HVAC

- Added water-cooled condenser capability to refrigeration compressor racks for useful heat recovery.
- Chilled and hot-water coils can now be used in the outside air system to preheat or precool outside air.
- New desiccant dehumidifier with additional capabilities and flexibility compared to the existing solid desiccant dehumidifier model.
- Water side economizer (including simulation of integrated and non-integrated water side economizers).
- Packaged terminal air conditioner (PTAC) added to model a fan, DX cooling coil, and a gas, electric, hydronic or steam heating coil serving a single zone.
- Multispeed heat pump with up to four discrete speeds for both cooling and heating.
- Heat losses (and gains) from plant piping.
- New and updated Compact HVAC objects:
  - Compact HVAC chilled water coils now use the COIL:WATER:COOLING model by default, COIL:Water:DetailedFlatCooling can be selected as an option.
  - Compact HVAC unitary system now supports the draw-thru fan placement option, and allows a schedule for the supply fan operating mode (continuous or cycling).
  - New Compact HVAC options for dehumidification and humidification controls for unitary and VAV system types.
  - New primary-secondary loop options for Compact HVAC chilled water loops.
  - Compact HVAC expanded to support specification of outside air as a combination of flow/person, flow/area and flow/zone.
  - Compact HVAC baseboard heat option added for unitary and VAV zones.
  - New Compact HVAC objects for unitary heat pump, unitary VAV, packaged terminal air conditioner, and packaged terminal heat pump.

INPUT

- Example input files created for all new features (More than 225 example input files now available).

OUTPUT

- New tabular reports for surface shadowing, shading, lighting, HVAC sizing, system and component sizing, and outside air.
- New Report:SurfaceColorScheme allow users to select their own colors for building elements in the DXF output.

Release of EnergyPlus 2.1

DATASETS

- Color schemes for DXF. (original and default)

DESIGN DAY

- User now can choose between ASHRAE Clear Sky and Zhang-Huang solar radiation models for use in design day calculations.

Geometry/Windows/Walls/Shading

- Surface Surround Subsurface error detection more robust (less false errors)
- Autocalculate now allowed for shading surfaces (number of vertices)

ZONE MODEL

- Zone sizing calculations now include heat gains from domestic/service hot water uses and water heaters.

UTILITIES

- WeatherConverter now produces KML output (for Google Earth) of latitude, longitude, elevation, and a few climate statistics for locations in a list processing run.
- Add comma delimited form of CLM (ESP-r Ascii files) conversion to WeatherConverter.
- WinEPDraw produces in new default colors.

DOCUMENTATION AND GUIDES

- The Getting Started Manual has been completely rewritten to provide more hands-on example exercises and other information for getting up to speed on EnergyPlus.
- The Input/Output Reference and Engineering Reference Manuals have been updated and extended for all new features and updates. Total documentation now exceeds 3500 pages.

The BLDG-SIM Mailing List has a New Home

The popular BLDG-SIM mailing list has moved from Gard Analytics to OneBuilding.org. If you subscribe to BLDG-SIM (or any of the other lists formerly maintained by GARD) you will be automatically switched over to OneBuilding.org. An archive of all BLDG-SIM posts is located at the following URLs.

Archived by thread: http://www.gard.com/ml/bldg-sim-archive/threads.html

Archived by date   http://www.gard.com/ml/bldg-sim-archive/maillist.html

General information about the mailing list is at:
            http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org.

See also http://lists.onebuilding.org/pipermail/bldg-sim-onebuilding.org/

EnergyPlus Available for Apple's Intel-based Macintosh Platform

The newest version of EnergyPlus (2.1), released 10/31/07, is available for Apple's Intel-based Macintosh platform (in addition to Windows and Linux versions). Download at no cost from the EnergyPlus web site: http://www.energyplus.gov.

Our thanks to Greg Stark of Building Synergies, LLC for his help in porting EnergyPlus to the Apple Macintosh platform.

Status of EnergyPlus Plug-In for SketchUp

DOE plans to release an EnergyPlus plug-in for Google's SketchUp at the end of 2007. This free EnergyPlus plug-in will integrate building simulation functionality into the SketchUp drawing environment. The plug-in stores EnergyPlus input data on SketchUp surfaces as they are drawn by the user. An EnergyPlus toolbar provides a way to create zones and surfaces with only a few mouse clicks. Construction assignments are 'painted' onto surfaces using a palette of EnergyPlus wall, roof, and window constructions. Users will be able to execute an annual simulation from within SketchUp. Watch the EnergyPlus web site http://www.energyplus.gov and email for more information.

EnergyPlus_Support Group at YahooGroups

Are you a commercial or academic user of EnergyPlus? Join over 1200 EnergyPlus users in an email group on YahooGroups. It's a place to ask your questions and share information with other users. The YahooGroup provides a searchable archive of all 7 years of discussion. You can also upload files to share with other users. This group supplements but does not replace the primary program support.
EnergyPlus-Support@gard.com.

The main web page for the group is: http://groups.yahoo.com/group/EnergyPlus_Support

To subscribe, send an email message to:
EnergyPlus_Support-subscribe@yahoogroups.com

NEW ENERGYPLUS CONSULTANT
-- INDIA AND THE MIDDLE EAST --

SMH Adil
Building Energy Analyst - Mechanical Engineer
Global Evolutionary Energy Design GEED
D-15, Abul Fazal Enclave
Jamia Nagar, Okhla
New Delhi-110025
INDIA

Mob: +91 9873588571

Ph: +91 11 26957717

adil@geedindia.org

http://www.geedindia.org/index.html

Ask an EnergyPlus Expert . . .

AIR FLOW BETWEEN ZONES

I would like to use Airflownetwork to model a commercial building with these characteristics:

1. A central zone surrounded by several adjacent zones.

2. The adjacent zones communicate with the central zone through doors.

3. A central system (as yet undefined) provides treated, fresh outside air to the central zone.
The air flow rate accounts for the fresh air delivered to the central and adjacent zones.

4. It is planned that adjacent zones will have negative pressure so that a compensating air flow rate will then be drawn from the central zone through a door; an extraction fan will exhaust an air flow rate equal to the fresh air needed in the zone. Adjacent zones will also have a zone forced air unit to provide the necessary local heating or cooling.

Answer
Airflownetwork has limitations that prevent it from being used for this application. However, you can model your building as follows:

1. In the central zone, add a ZONE EXHAUST FAN with a flow rate equal to the amount of air that passes to the adjacent zones. This will balance the airflows for the central zone (return = supply - exhaust). Why put the exhaust (extractioni fan) in the central zone? Because the air loop simulation needs to know that some quantity of air is leaving the central zone through a path that is not the return duct. It does not matter if the air leaves through an exhaust fan, a door to an adjacent zone, or whatever.

2. Use MIXING objects to move air from the central zone to the adjacent zones. You may wonder why there is no exhaust fan in the adjacent zones. When MIXING adds air to a zone, it assumes that an equal amount of air has left the zone, and it does not matter where the air went. So, the "extraction" of air from the adjacent zones is already modeled. The extracting fan power can be accounted for in the central zone exhaust fan.

Note that the air loop simulation is not aware of the MIXING objects in terms of balancing airflow. It is the user's responsibility to make sure that the flow rates are balanced.

NATURAL VENTILATION -- HOLE BETWEEN ZONES

I am modeling the natural ventilation through a lower and upper zone; a large hole exists between the two zones. I specified two Surface:HeatTransfer components, one for the ceiling of the lower zone and the other for the floor of the upper zone.

1. I used a window to represent the hole and again specified two Surface:HeatTransfer:Sub.
Can I get away with specifying just one window in one of the Surface:HeatTransfer components?

2. Based on the Input/Output Reference (excerpt below from p. 621), it says that I cannot include this surface in the air flow simulation. Can I still model this horizontal hole between the zones and, if Yes, how do I do it. [excerpt: *An interior heat transfer surface (Surface:HeatTransfer) whose surface name is used as the input for the Outside Face Environment Object field represents a floor without ground contact and is not allowed as an AirflowNetwork:Multizone:Surface.*]

Answer
First, I assume you are aware that large horizontal openings cannot be modeled well. See guidance under "AirflowNetwork:Multizone:Component Detailed Opening" in the Input/Output Reference.

1. For any interzone surface or subsurface, you have the option of describing only one instance and setting the OutsideFaceEnvironment Object = UnenteredOtherZoneSurface. EnergyPlus then automatically generates the mirrored instance of this surface in the adjacent zone.

2. If I'm reading the excerpt correctly, that text is referring to adiabatic surfaces (where the surface refers to itself as the other side object). This needs clarification; it is not a new restriction.

Ask an EnergyPlus Expert . . .

FANCOIL:4PIPE

I am simulating a building using fancoil for air-conditioning and my IDF is just like the example file "FancoilAutosize." I want to know how the Fancoil:4pipe modulates the outside air flow rate. How is the maximun outside air rate autosized? Is it just determined by ZONESIZING? Is the outside air flow always set to the autosized maximun outside air flow rate? I want to use outside air for free cooling when the outdoor temperature is lower than the zone air set point. Should I create a CONTROLLER:OUTSIDE AIR for the fancoil outside air mixer, whether or not the FANCOIL;4PIPE modulates the outside air flow in a complex way, just like CONTROLLER:OUTSIDE AIR?

Answer
The outside air flow rate in the fancoil model is fixed. Whenever the fancoil unit is schedule to be on, the fan runs continuously and the outside air flow rate is constant. There are no other control options available for the fancoil unit. When the outdoor air temperature is cool outside, then the cooling coil in the fancoil unit will automatically consume less chilled water since the outside air is providing some cooling. But there is no way to increase the outside air flow as with an economizer. If the outside air flow rate is autosized, the flow is according to the ZONE SIZING inputs.

REPORTS – LOADS NOT MET

I modeled a large building in conformance with ASHRAE 90.1 Appendix G. After completing the model, how can I get the unmet load hours from EnergyPlus? Should I add some variable report? And, if so, which variable should I choose?

Answer
The following report variables are applicable:

Time Heating Setpoint Not Met Any Zone[hr]
Time Cooling Setpoint Not Met Any Zone[hr]
Time Heating Setpoint Not Met While Occupied Any Zone[hr]
Time Cooling Setpoint Not Met While Occupied Any Zone[hr]

These can be reported using REPORT VARIABLE, or REPORT:TABLE:MONTHLY.

A predefined report object may be found in Datasets\StandardReports.idf

Report:Table:Monthly,
Setpoints Not Met With Temperatures, !- Name

And there was a new option added to version 2.1

REPORT:TABLE:PREDEFINED, System Summary;

which will report these variables for the entire run period.

Journal of Building Performance Simulation

The *Journal of Building Performance Simulation* (co-edited by Ian Beausoleil-Morrison and Jan Hensen*)* is the new, official journal of the *International Building Performance Simulation Association* (*IBPSA*). The first issue will debut in March 2008. The *JBPS* is an international refereed journal, publishing only articles of the highest quality that are original, cutting-edge, well-researched and of significance to the international community. The journal also publishes original review papers and researched case studies of international significance.

Information about the journal is available at http://www.tandf.co.uk/journals/titles/19401493.asp

Ask an EnergyPlus Expert . . .

SIMULATION STARTING TEMPERATURE

In EnergyPlus is there a starting simulation temperature?

Answer
The loads convergence starts at 23C but then "warms up" until it reaches convergence through the heat balance and system iterations.

Question
Is it possible to change this temperature? And where can I find more information?

Answer
It is not a user-settable option. The warmup takes care of any drifts caused by using that as starting temperature. For more information, search on "warmup" in the documentation for numerous mentions.

To clarify, in the Building object:

Field: Loads convergence
This value represents the number at which the loads values must agree before "convergence" is reached. (Unit for this field is Watts.)

Field: Temperature Convergence
This value represents the number at which the zone temperatures must agree (from previous iteration) before "convergence" is reached. (Unit for this field is delta C).

Convergence of the simultaneous heat balance/HVAC solution is reached when either the loads or temperature criterion is satisfied. All tolerances have units so the temperature tolerance is in degrees C (or degrees K) and the loads tolerance is in Watts. Both tolerances work the same way, it is just that one looks at temperatures and one looks at heating and cooling loads. After the second warm-up day, the program compares the maximum temperature experienced in a space with the maximum temperature from the previous day. If those two temperatures are within the tolerance, then it has passed the first warm-up check. It does a similar comparison with lowest temperatures experienced within all the zones. If the current simulation day and the previous day values are within the tolerance, then it has passed the second warm-up check. Similar things are done with the loads tolerance and the maximum heating and cooling loads that are experienced within the spaces. Those are compared individually to the values for the previous day. If they are both in tolerance, then the simulation has passed the third and fourth warm-up check. The simulation stays in the warm-up period until ALL FOUR checks have been passed.

Please note that other "convergence tolerance" inputs are required for certain HVAC equipment (unit ventilator, unit heater, window AC, etc.). The purpose and units of these parameters are different from "load convergence tolerance" and "temperature convergence tolerance" in the BUILDING object.

Message from Dru Crawley -- Updated Meteonorm Weather Files

We've replaced all the Meteonorm Version 5 files that were on the EnergyPlus_Support YahooGroup with updated files from Meteonorm Version 6. The good news is that many more of the files have better and more complete data (less interpolation). However, the caveats about the synthetic weather remain.
Join the Yahoo group here: http://tech.groups.yahoo.com/group/EnergyPlus_Support/

"From the Lab to the Marketplace" A new website featuring the many Energy Efficient Technologies developed at Lawrence Berkeley Laboratory. Go to http://eetd.lbl.gov/l2m2/

EnergyPlus Version 2.1

Support Tools

Support software is listed on the main EnergyPlus website.

Weather Data

Main weather data site is at
http://www.eere.energy.gov/buildings/energyplus/cfm/weather_data.cfm
Weather data for more than 800 locations are now available in EnergyPlus weather format.
See the write-up on how to create Meteonorm Files

Ask an EnergyPlus Expert

Questions from program users are answered promptly via the EnergyPlus User Group at
Yahoo. To join, go to http://groups.yahoo.com/group/EnergyPlus_Support/
Selected questions and answers have been compiled into PDF documents:
for 2002, for 2003, for 2004, for 2005, for 2006, for 2007.

Are you an EnergyPlus consultant?

If you are an EnergyPlus consultant and would like to be listed in this newsletter and on our
website, please send details to klellington@lbl.gov

Testing and Validation

Go to http://www.eere.energy.gov/buildings/energyplus/testing.html   for info.

EnergyPlus is being developed by University of Illinois and Lawrence Berkeley National Laboratory, DHL Consulting, C. O. Pedersen Associates, Florida Solar Energy Center, GARD Analytics, the National Renewable Energy Laboratory, Oklahoma State University and others. Development of EnergyPlus is supported by the U. S. Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technologies Program (Program Manager, Dru Crawley).

WEATHER DATA AND CUSTOM WEATHER FILES

The EnergyPlus web site contains more than 1300 weather files from a large number of international sources. But we know that leaves a large part of the world with very few or no weather files. If you're looking for a weather file, first look at the EnergyPlus web site:
http://www.eere.energy.gov/buildings/energyplus/cfm/weather_data.cfm

Then, check the EnergyPlus YahooGroup to see whether a weather file has already been created and posted (you will need to join the EnergyPlus group)
http://tech.groups.yahoo.com/group/EnergyPlus_Support/

As a last resort, upon request, the EnergyPlus Team can create a few weather files for a country using the Meteonorm weather generator (http://www.meteotest.ch). Version 6 of Meteonorm, which was released mid-2007, includes EnergyPlus EPW format as an output option. Caution: Meteonorm uses interpolation, extrapolation and other statistics to derive the weather file. You use these weather files entirely at your risk; you need to review them carefully to ensure that they meet your needs. Send your request to the EnergyPlus_Support YahooGroup with the location you need -- one or two locations at most please! Usually we can create the files within a few days.

Also, if you know of weather data sets that we haven't included on the EnergyPlus web site, please send email to Drury.Crawley@ee.doe.gov

Recent Reports

USE OF SIMULATION TOOLS FOR MANAGING BUILDINGS ENERGY DEMAND

Alberto Hernandez Neto, Flávio Augusto Sanzovo Fiorelli
University of São Paulo, Escola Politécnica, Department of Mechanical Engineering.
Sao Paulo, Brazil

ABSTRACT
There are several ways to attempt to model a building and its heat gains from external sources as well as internal ones in order to evaluate a proper operation and also audit retrofits actions. These models apply various techniques varying from simple regression to more physically grounded models. A frequent hypothesis for all these models is that the input variables should be based on realistic data when they are available, otherwise the evaluation of energy consumption might be highly under or over estimated. In this paper, the use of EnergyPlus as an energy consumption auditing and predicting tool is tested using as a case study the Administration Building of the University of São Paulo. The building energy consumption profiles are collected as well as the campus meteorological data. A sensitivity analysis for the simulated building model on Energy Plus is done to evaluate the influence of several parameters such as the building profile occupation.
http://gundog.lbl.gov/dirpubs2/BS07/eplus_494.pdf

AIRFLOW NETWORK MODELING IN ENERGYPLUS

Lixing Gu
Florida Solar Energy Center
1679 Clearlake Road, Cocoa, FL 32922, USA

ABSTRACT
The airflow network model in EnergyPlus provides the ability to simulate multizone wind-driven airflows. The model is also able to simulate the impacts of forced air distribution systems, including supply and return air leaks. The air distribution system portion of the model is currently applicable for constant-air-volume systems. Future enhancements will include adding hybrid ventilation control and possible extension to include variableair-volume distribution systems. This paper describes the input objects, calculation procedures, model validation, and example results. The model inputs consist of five main objects: simulation control, multizone data, node data, component data, and linkage data. The model calculates pressure at each node and airflow through each component based on the pressure versus airflow relationship defined for each component. Using these airflow rates and HVAC equipment models, temperature and humidity ratio at each air node are then calculated. All cooling/heating loads resulting from the multizone airflow and air distribution system model are then summed and passed to EnergyPlus' zone air heat and moisture balance model which calculates zone air temperature and humidity ratio. The loads from multizone air flows are used to predict required system loads, while the loads due to the air distribution system are used to recalculate zone air temperatures and humidity ratios. EnergyPlus' airflow network model was validated against measured data from both the Oak Ridge National Laboratory (ORNL) and the Florida Solar Energy Center (FSEC). Whole building energy simulations were performed using EnergyPlus in addition to validating specific portions of its airflow network model. There was good agreement between the simulation results and the measured data.
http://gundog.lbl.gov/dirpubs2/BS07/eplus_398.pdf

Blog On, Energy Simulation Enthusiasts, at http://bleer.lbl.gov

DEMAND RESPONSE

QUICK ASSESSMENT TOOL

Peng Xu, of Lawrence Berkeley National Laboratory, has developed a Demand Response Quick Assessment Tool. The tool, built on EnergyPlus simulation, is able to evaluate and compare different DR strategies, such as global temperature reset, chiller cycling, supply air temperature reset, etc.

The opportunities for demand reduction and cost savings with building demand responsive controls vary tremendously with building type and location. This assessment tool will predict the energy and demand savings, the economic savings, and the thermal comfort impact for various demand responsive strategies.

Users of the tool will be asked to enter the basic building information such as types, square footage, building envelope, orientation, utility schedule, etc. The assessment tool will then use the prototypical simulation models to calculate the energy and demand reduction potential under certain demand responsive strategies, such as precooling, zonal temperature set up, and chilled water loop and air loop set points adjustment.

Contact Peng Xu (PXu@lbl.gov)

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Ask an EnergyPlus Expert
2007 Questions and Answers

All the "Ask an EnergyPlus Expert" questions and answers from 2007 that appeared in the *Building Energy Simulation User News* have been combined into one .pdf file. Download from http://SimulationResearch.lbl.gov/dirpubs/un_articleEP07.pdf

If you'd like to review past years' "Expert" files, they are all on our Technical Reports page at http://SimulationResearch.lbl.gov/report.html.

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WikiPedia for Building Simulation

What do you get when you combine *Building Simulation* with a *WikiPedia*?? You get ***Simupedia*** -- a user-driven encyclopedia aimed at building simulation practitioners. The idea originated with IBPSA-Germany and it is hoped that Simupedia will become a world-wide effort. Add to it at http://www.ibpsa-germany.org/index.php/Simupedia/en

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New!! *Journal of Building Performance Simulation*

The International Building Performance Simulation Association (IBPSA) has reached an agreement with a publisher to launch a new academic journal for 2008: the *Journal of Building Performance Simulation*.
This exciting new publication is aimed at advancing and promoting the science of building performance simulation as a vibrant and important academic area. An official announcement of the journal and a call for papers will be made in 2008. For more information, contact Ian Beausoleil-Morrison at ibeausol@mae.carleton.ca

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Meetings - Conferences - Symposia

2008		
May 03-08	Solar 2008	http://www.ases.org/solar2008/
June 16-18	8th Nordic Symposium on Building Physics	http://www.nsb2008.org/
June 21-25	ASHRAE Annual Meeting in Salt Lake City, UT	http://www.ashrae.org
July 30 -Aug 01	SimBuild 2008 (Univ.Calif at Berkeley)	http://gaia.lbl.gov/ocs.index.php/simbuild/2008
August 17-22	Indoor Air 2008	http://www.indoorair2008.org

DOE-2.1E, Version 124

Are you a DOE-2 Consultant?

If you would like to be listed as a DOE-2 consultant on our website and in the *User News* please contact klellington@lbl.gov

DOE-2 Documentation OCR'd by the Energy Systems Lab, TAMU

PDF files at this link: http://esl.tamu.edu/pub/DOE%2D2%5FOCR%5FManuals/

More Free DOE-2 Documentation. Download from http://SimulationResearch.lbl.gov/

DOE-2 Basics Manual (2.1E) http://gundog.lbl.gov/dirpubs/BASIC/basiclist.html

Update Packages: Update Packages are not cumulative; each one contains different information. Download all four packages then print and insert the pages into your existing DOE-2 manuals.

Update Package #1: DOE-2.1E Basics, the Supplement and BDL Summary
Update Package #2: BDL Summary and Supplement
Update Package #3: Appendix A of the Supplement
Update Package #4: (1000-zone DOE-2.1E) BDL Summary

DOE-2 Modeling Tips (pdf files)   for 2006 2005 2004 2003 2002
A compilation of all the "how to" and "DOE-2 Puzzler" articles from the newsletter.

Changes and Bug Fixes to DOE-2.1E (txt file)
http://simulationresearch.lbl.gov/dirpubs/VERSIONS.txt
All changes and bug fixes in a plain-text document.

NEW DOE-2 CONSULTANT

Joseph Ling jling@aesc-inc.com
Alternative Energy Systems Consulting, Inc.   http://www.aesc-inc.com/
Suite 201
1 South Fair Oaks Avenue   Phone: (626) 260-4806
Pasadena, California 91105   Fax: (626) 792-9516

A new issue of the e-newsletter, Science at Berkeley Lab, is available at http://enews.lbl.gov

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Those energetic folks at the Building Simulation Laboratory at Texas A&M University have scanned all the DOE-2 manuals into pdf files. Jeff Haberl and Company have generously made the files available to DOE-2 users. Follow the link to the searchable pdf files [including the rare "Engineers Manual"].

http://esl.tamu.edu/pub/DOE%2D2%5FOCR%5FManuals/

American Council for an Energy-Efficient Economy (ACEEE)

March 31	2008 National Symposium on Market Transformation	(Washington, D.C.)
April 10	Energy Efficiency Finance Forum	(Arlington, VA)
August 17	2008 ACEEE Summer Study on Energy Efficiency in Buildings	

SAN DIEGO GAS AND ELECTRIC COMPANY

2008 ENERGY EFFICIENCY SEMINARS

Go to http://www.sdge.com then search for "Calendar"

March 11	Demand Response - A Practical Approach
June 10	2008 Nonresidential Title 24 Standards
August 20	2008 Nonresidential Title 24 Standards
October 23	2008 Nonresidential Title 24 Standards

SACRAMENTO MUNICIPAL UTILITIES DISTRICT (SMUD)

2008 WORKSHOPS

April 03	Energy Management Systems (EMS)
April 16	Emerging Cooling Technologies for the West
April 18	Lighting for Historical Places
April 29	Advanced Management Compressed Air Systems II
May 06	Principles of Lighting
June 24	Retrocommissioning and HVAC Fundamentals for the Field

Go to the main SMUD website at http://www.smud.org/index.html then click the tab for "Education and Safety" and then select "Workshops" underneath the heading.

PACIFIC GAS AND ELECTRIC COMPANY

2008 EDUCATIONAL PROGRAMS
For a complete listing of classes or to register go to www.pge.com/pec

BUILDING ENVELOPE

May 21	Solar Analysis Boot Camp

BUILDING PERFORMANCE

Mar 11	EnergyPro Nonresidential Software for Beginners

DAYLIGHTING

May 21	Solar Analysis Boot Camp

H V A C

Apr 15	HVAC Control Series: Principles of HVAC Control
Jun 03	Introduction to Geothermal Heat Pumps

LIGHTING

Jun 03	Lighting Fundamentals
Jun 04	Preparation for Nonresidential Lighting Technician Certification Exam

RENEWABLES

Apr 10	Understanding Financial Analysis Methods for Photovoltaic (PV) Systems
May 20	Photovoltaic (PV) Site Analysis and System Sizing

SOFTWARE

Mar 06	EnergyPro Nonresidential Software for Beginners

TITLE 24 (CALIFORNIA)

Mar 11	EnergyPro Nonresidential Software for Beginners
Mar 12	Advanced EnergyPro Calculations for Energy Star + Tax Credits

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