

EnergyPlus SPARK*DOE-2* EnergyPlus *VisualSPARK* DOE-2 *GenOpt* EnergyPlus
SPARK EnergyPlus*DOE-2* GenOpt *EnergyPlus*DOE-2 *VisualSPARK*

BUILDING ENERGY SIMULATION ★ USER NEWS

SPARK EnergyPlus*DOE-2* GenOpt *EnergyPlus*DOE-2 *VisualSPARK*
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*If you are interested in High-
Performance Buildings (like
laboratories, clean-rooms and
data centers) for High-Tech
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[http://hightech.lbl.gov/htnews/
/newsletter.html](http://hightech.lbl.gov/htnews/newsletter.html)*

*Two new DOE-2 Consultants on
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China and Tom Lunneberg of
Carlsbad, California*

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Release of EnergyPlus 1.3.0

The tenth major version of EnergyPlus (1.3.0) was released on April 25, 2006 and is now available in versions for both the Windows and Linux operating systems. Download this newest release at no cost from the EnergyPlus web site: www.energyplus.gov.

New Features

- UFAD (Under Floor Air Distribution) room air model for exterior zones is now available.
- Completely reworked airflow modeling -- the new AirflowNetwork model replaces both COMIS and ADS and has the combined capabilities. Calculation of infiltration, ventilation, mixing and cross mixing moved to system time step for future feature development of hybrid (mixed mode) ventilation control. Differences in results are usually minor.
- Outside air temperature is now varied as a function of zone or surface height above ground. Wind profile options can be set separately for the weather station and the building site. Includes new zone and surface report variables for height dependent properties. There will be differences in results, particularly in files with Ventilation or Infiltration.
- Simple earth tube model for preconditioning (heating/cooling) outside air.
- Tempering valve (3-way valve emulation) for effective and safe use of stored thermal energy.
- Variable and constant speed headered pumps.
- Detailed ice storage.
- New Compact HVAC models for fan powered VAV, fan coil, night cycle controls, outside air heat recovery, supply air temperature reset, chilled/hot water temperature reset, VAV supply fan part-load options, VAV fan blow through or draw through option, and zone supply and return plenums.
- Energy end-use subcategories are now user-definable.
- New report variable for Zone Operative Temperature (Operative Temperature Control planned for V 1.4 in October).

And many other enhancements and significant speed improvements throughout.

Ask an EnergyPlus Expert

PUMP EFFICIENCY

I defined a PUMP:CONSTANT SPEED with a pipe loop. The pump pressure is 10,000 and the motor efficiency is 0.9. Everything sizes OK and I get the result:

```
Pump power 34.4 W, shaft power 30.9 W, flow 0.2413 kg/s.
```

The fraction shaft/pump power agrees with the motor efficiency, but I cannot see where the pump efficiency is defined. Using the relationship $\text{Power} = \text{Pressure} \times \text{Volume} / \text{Efficiency}$, it seems a pump efficiency of around 0.78 is used.

Answer

From the SizePump subroutine:

```
! note: we assume pump impeller efficiency is 78% for autosizing  
TotalEffic = 0.78 * PumpEquip(PumpNum)%MotorEffic
```

Ask an EnergyPlus Expert

THE SLAB PROGRAM

Could someone describe in detail how to use the slab program? I've read the Auxiliary Program Guide, but I still don't understand all the instructions and I can't make the program run. Thanks.

Answer

1. Open a DOS command prompt window

```
(Start --Programs --Accessories --Command Prompt)
```

2. Change to the directory where EnergyPlus is installed (modify the commands below if you did not install EnergyPlus in the default install path):

```
C:  
CD \EnergyPlusV1-2-3-031\
```

3. Change to the ground preprocessor directory:

```
CD PreProcess\GrndTempCalc
```

4. Run the slab example file:

```
runslab SlabExample USA_IL_Chicago-OHare_TMY2
```

We will include these and more instructions in the Auxiliary Program Guide for the next release.

WEATHER: SKY COVER DEFINED

What is the difference between "opaque sky cover" and "total sky cover" ?

Answer

Total sky cover is the amount of sky covered by clouds in 10ths.

Opaque sky cover is the amount of sky covered by opaque clouds in 10ths.

True, they are similar, but you can have sky cover that is not opaque and they can be different.

The following definitions come from the TMY2/IWEC descriptions. The v.1.3.0 release of EnergyPlus includes them under the field definitions:

Field:Total Sky Cover

This is the value for total sky cover (tenths of coverage; i.e., 1 is 1/10 covered. 10 is total coverage. Total sky cover is defined as the amount of sky dome in tenths covered by clouds or obscuring phenomena at the hour indicated at the time indicated. This is not used unless the field for Horizontal Infrared Radiation Intensity is missing and then it is used along with Opaque Sky Cover to calculate Horizontal Infrared Radiation Intensity. Minimum value is 0; maximum value is 10; missing value is 99.

Field:Opaque Sky Cover

This is the value for opaque sky cover (tenths of coverage; i.e., 1 is 1/10 covered. 10 is total coverage. Opaque sky cover is defined as the amount of sky dome in tenths covered by clouds or obscuring phenomena that prevent observing the sky or higher cloud layers at the time indicated. This is not used unless the field for Horizontal Infrared Radiation Intensity is missing and then it is used along with Total Sky Cover to calculate Horizontal Infrared Radiation Intensity. Minimum value is 0; maximum value is 10; missing value is 99.

Ask an EnergyPlus Expert

PARAMETRIC RUNS

How do I create an .imf input file with `##include COUNTER.INC` for running a file repeated times?

Answer

Mike Witte created a new example file; it's in the Examples folder in the yahoo group files area. Go to:

http://groups.yahoo.com/group/EnergyPlus_Support/files/Examples/Parametric-5ZoneWarmest.zip

Description: Example input (imf) file and group (epg) file for a series of parametric runs using the group simulation feature in EP-Launch. Can also be accomplished using batch files in a similar fashion.

Background:

When using `##include`, be sure you have the included file (COUNTER.INC) in the correct folder (where you run EnergyPlus) or give the full path for the included file, i.e., `##include C:\xxx\xxx\COUNTER.INC`. Otherwise, EnergyPlus won't be able to find the included file. Also, note that `##include` does not work with spaces in the path. If you are not aware of the `epmdet` output file, this shows the full details of the `ep-macro` processing. Any macro errors will be in this file. We assume you are using the EP-Launch group feature to do this. Make sure that your master input file has an .imf extension. If it does not, then the `##` macro commands will not be processed.

GROUND TEMPERATURES

Can you please tell me how (and where) to get the value of ground temperatures for a location?

Answer

The EPW weather files contain the average monthly ground temperatures for 5 ft (1.33 m) below grade calculated using a simple equation developed by Tom Kusuda at the US National Bureau of Standards (now NIST) back in the early 1970's. The constant deep ground temperature, in the absence of geothermal anomalies, is the same as the average annual air temperature plus 1 C. It is true that the statistics file (.stat), distributed with the weather data, lists such ground temperatures, but these are open field ground temperatures. They are useful as inputs to ground heat exchangers or ponds, but not under the floor of a conditioned building. EnergyPlus has a 3-D heat transfer preprocessor that will calculate monthly average ground temperatures for slabs and basements (most accurate approach). Please read the Input Output/Reference (ground temperatures) and Auxiliary Programs (ground heat transfer) documents for more details and a discussion of reasonable default values to use.

DOUBLE FAÇADE

I need to model double façades. In the example files, I found `doublefaçade.idf` for a one-story building. However, I need to model an eight-story building and don't know how to model the air passing through the floor and ceiling in the double façade zone. Also, how do I specify steel grating in the double façade?

Answer

If the double-façade space is open from bottom to top, then it could be modeled as one thermal zone (one outside surface) that is eight stories high. The inside wall would be eight surfaces that are stacked on top of each other (assuming that this interacts with eight different interior zones). If you have to divide the double-façade space into multiple thermal zones, then you would use either MIXING or CROSS MIXING for simple specified airflows between the zones. Or a full airflow network could also be described using the COMIS (Air Flow Network in EnergyPlus 1.3.0 and subsequent versions) model instead of the simple mixing and cross mixing.

If the steel grating is meant to simply shade some of the solar gains, then it could be modeled as an interior or exterior shade or blind.

Ask an EnergyPlus Expert

ROOF MODEL

Can a roof spanning over several zones be modeled as one big, rectangular heat transfer surface?

Answer

It needs to be divided into surfaces covering each zone, so break it up by zones.

Question

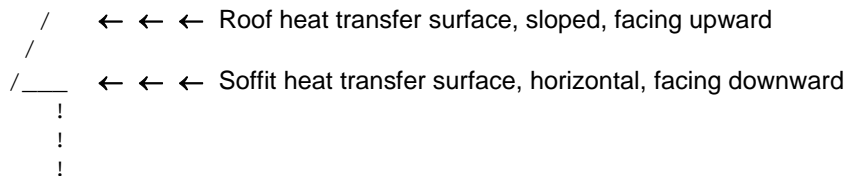
The roof has sizable overhangs on all sides. According to the EnergyPlus documentation, roof extensions/overhangs do not need to be modeled as separate shading surfaces. If I understand correctly, EnergyPlus determines the portion that extends beyond the walls (using entered wall and roof vertices) to calculate shading effects. Since the roof will be divided into sections covering several zones, will an overhang associated with a particular roof section be limited to shading only the wall(s) of the zone to which it belongs? Or, depending on the Sun's position, can it also shade the walls of other zones?

Answer

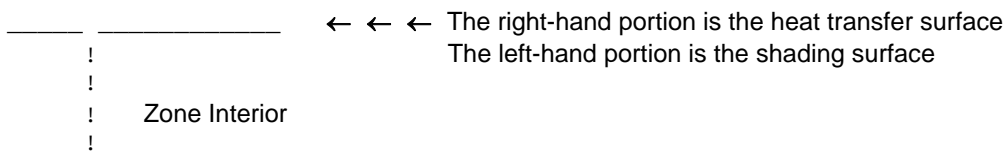
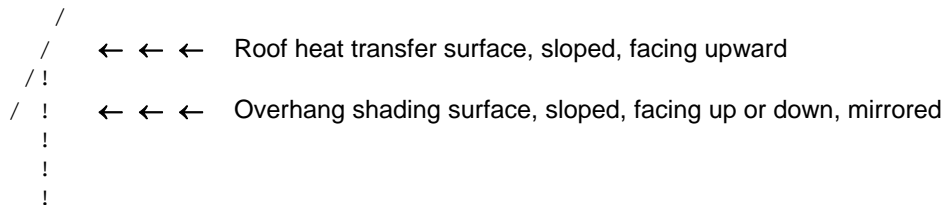
No! Surfaces cast shadows only in the direction that they face. A roof faces upward and does not cast shadows downward. If you use FullExterior as the shadowing option (in the BUILDING object), then shadows cross zone boundaries, that is automatic.

For roofs that extend beyond the walls, there are two issues to consider: (1) how much of the roof area transfers heat into the building? and (2) how to model shading impacts.

In the case of a gable roof with an attic, the full roof area transfers heat into the attic zone, and there need to be additional heat transfer surfaces (facing downward) to model the soffit heat transfer.



In the case where the roof extension does not transfer heat, the extra roof area must be a shading surface. Shading surfaces are mirrored automatically, so they ***do*** cast shadows in all directions. In this case, extending the roof heat transfer surface area would also overestimate the heat transfer through the roof.



Ask an EnergyPlus Expert

PARAMETRIC RUNS

I am trying to run a very simple macro. I want to generate three files with three different values for the "complex field 4" of a SCHEDULE:COMPACT object, but my counter won't work.

I set a group simulation and used the "user defined location" to set the number of repeat simulations to three. EnergyPlus runs three times but keeps assigning the same value to my variable. I think there's something wrong with my syntax but I don't know how to fix this. I'm using version 1.3.

Answer

For additional guidance, download the example file (Parametric-5ZoneWarmest.zip) in the Files\Example folder on the EnergyPlus support site.

EXHAUST FROM UNCONDITIONED SPACES

I am trying to simulate a "semi open" system where air is extracted from a bathroom that has no direct connection with the primary air loop. My first instinct was to use the "Zone Exhaust Fan" object between the subject zone and an outside node, while making up the extracted volume of air using the "Mixing" object between the unconditioned bathroom and an adjacent zone. How do I define a Node representing the bathroom space (inlet to the exhaust fan)? Is there such thing as an "open-loop" air system in EnergyPlus?

Answer

The simplest approach would be to combine the bathroom space into the same thermal zone as the adjacent space.

If you need to model the bathroom as a separate thermal zone, then what you suggest is the best approach. For the bathroom zone, use a CONTROLLED ZONE EQUIP CONFIGURATION object to define a zone node and an exhaust node and list the exhaust fan as the only piece of equipment in the ZONE EQUIPMENT LIST.

Note that EnergyPlus has no way to do an air balance on this, so the simple zone with exhaust fan will see no impact from the exhaust fan operation other than electric power consumption.

The MIXING object will impact the bathroom zone by providing air from the adjacent zone. But MIXING has no impact on its source zone; you must allow for this by adding INFILTRATION to the source zone or by supplying outside air in the air loop that serves the source zone.

If you are modeling heat recovery, or anything else where the return air flow rate is important, then you will also need an exhaust fan in the adjacent zone (with zero power consumption) to reduce the return air flow from that zone.

QuickLink To EnergyPlus Documentation

<http://www.eere.energy.gov/buildings/energyplus/documentation.html>

EnergyPlus Version 1.3.0

Download a free copy of the program

<http://www.energyplus.gov/>

Support Tools

Support software is listed on our website (http://SimulationResearch.lbl.gov/EP/ep_tools.html) and in Section 2 of this newsletter.

Weather Data from 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 Meteorom files for EnergyPlus](#).

Ask an EnergyPlus Expert

Questions from EnergyPlus users are answered promptly via email by program developers. To submit questions, join the EnergyPlus User Group at http://groups.yahoo.com/group/EnergyPlus_Support/.

A selection of questions/answers are compiled (yearly) into a downloadable PDF document: Q and A for [2002](#), Q and A for [2003](#), Q and A for [2004](#), Q and A for [2005](#)

Are you an EnergyPlus Consultant ?

If you are engaged in EnergyPlus consulting, and would like to be listed in the *Building Energy Simulation User News* and on our website (<http://SimulationResearch.lbl.gov>), please send details to klellington@lbl.gov.

Join the EnergyPlus User Group

The developers of EnergyPlus have formed a support group to foster discussion and maintain an archive of information for program Users. We invite questions about program usage and suggestions for improvement to the code. Go to http://groups.yahoo.com/group/EnergyPlus_Support/

Testing and Validation <http://www.eere.energy.gov/buildings/energyplus/testing.html>.

EnergyPlus is being developed by University of Illinois and Lawrence Berkeley National Laboratory, with the assistance of 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).

The Forecast Looks Favorable for ...

(Free!) Weather Data on Demand

Access archived weather data from around the world through this U.S. DOE web interface:

www.eere.energy.gov/buildings/energyplus/cfm/weatherdata/weather_request.cfm

Hourly weather data is continuously collected and stored into a local database, available through this web interface. Most stations have information for dry bulb temperature, wet bulb temperature, wind speed/direction, atmospheric pressure, visibility, cloud conditions, and precipitation type.



Spotlight on SPARK – Part 5 of 5

Frequently Asked Questions about the Simulation Problem Analysis and Research Kernel Software

Download VisualSPARK 2.01 (Free!) from http://gundog.lbl.gov/VS/vs201_eula.html

This is a list of frequently asked questions (FAQ) for VisualSPARK users. If you need help for something that is not covered by the [SPARK Reference Manual](#), the [SPARK Atomic Class API](#), the [SPARK Problem Driver API](#), or this FAQ, please email [us](#).

This FAQ is intended to supplement, not replace, the SPARK documentation. Before emailing us a question, you should first check to see if the topic is covered in the various manuals.

[SPARK Command-line Operation](#)

[How to start a console window?](#)

[How to switch between target compilers?](#)

[How to run SPARK in DEBUG mode?](#)

[How to run sparksym?](#)

[How to perform a static build of a SPARK simulator?](#)

[How to link the SPARK solver against external libraries?](#)

[How to package all class binaries into a single library?](#)

[How to generate a beautified textual representation of the solution sequence?](#)

[How to generate a graphical view of the solution sequence?](#)

[SPARK Command-line Operation](#)

As an alternative to using the VisualSPARK GUI, SPARK can also be executed at the command-line. This mode of operation is more powerful since it lets the user perform tasks that cannot be done using VisualSPARK. The command-line operation requires that the user be familiar with shell execution and build process using makefiles.

To have access to the SPARK build command-line operation, you need to copy the lib/makefile.prf file into the current project directory and rename it Makefile. When using the runspark shell program, this happens automatically if there is no Makefile file in the current project directory yet.

[How to start a console window?](#)

To run SPARK at the command-line you must first open a console window.

Linux/UNIX environments

On Linux and UNIX platforms, you can just use the normal shell window.

Windows environments

On Windows platform, this is done by selecting "SPARK_console" in the "VisualSPARK" menu. Another way of starting the console window is to click on the "_shortcut_SPARK_console" shortcut file located in the directory where VisualSPARK was installed. Note that the user has access to all common UNIX-like shell commands from the Windows console window.

[How to switch between target compilers?](#)

SPARK by default relies on the g++ compiler to build the binaries for the atomic classes in your problem. However, it is possible to switch the target compiler if one wishes to use Microsoft VC++ for example. This is done at the command-line by executing the shell script called config.sh located in the install directory of the VisualSPARK installation.

To configure SPARK to use the g++ compiler, type:

```
% sh config.sh compiler=g++ <enter>
```

To configure SPARK to use the Microsoft VC++ compiler, type:

```
% sh config.sh compiler=vc VCVARS='E:\Program Files\Microsoft Visual Studio\VC98\Bin' <enter>
```

whereby VCVARS contains the path to the VCVARS32.bat file which defines the environment variables required to run MS VC++ at the command-line.

After executing the configure shell script, you have to exit the console window and reopen it to make sure that the environment variables are correctly set. It is recommended that you copy the VCVARS32.bat file to the VisualSPARK installation directory before reopening the console window. From the on the new compiler will be used whenever an atomic class needs to be built. After having switched to a new compiler it is always best to execute make clean in the project directory to force previously existing class binarie to be re-built.

[How to run SPARK in DEBUG mode?](#)

SPARK by default runs using the release solver library. If you run into numerical problems during the simulation you should consider to run SPARK using the DEBUG solver library. The DEBUG library will generate extensive debug information to the file called debug.log . This file can grow very large if your simulation is dynamic and the simulation horizon is distant. Make sure that you only use the DEBUG library when you are debugging a SPARK problem, not in production phase.

To run SPARK in debug mode, you have to set the environment variable SPARK_DEBUG to yes.

```
% set SPARK_DEBUG=yes <enter>
```

To revert back to the release mode, set the environment variable SPARK_DEBUG back to its default value no.

```
% set SPARK_DEBUG=no <enter>
```

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Make sure that you execute `make clean` in the project directory after you have changed the environment variable `SPARK_DEBUG`. This will ensure that the `DEBUG` solver library is used for your next simulation run.

[How to run sparksym?](#)

When writing a new atomic class the inverses for the specified equation have to be implemented as C++ functions. Fortunately, these tasks can be automated using symbolic processing (also called computer algebra) tools.

SPARK provides a program called `sparksym` that fills this need. With it you can generate all symbolic inverses of an algebraic equation, generate C++ functions implementing these single-valued inverses, or create the complete SPARK atomic class. Actually, `sparksym` is an interface to third-party symbolic programs. Currently, it can use either:

- Mathomatic
- Maple
- Mathematica
- MACSYMA

A subset of the Mathomatic program is integrated in `sparksym`, so that option is always available. If Maple, Mathematica or MACSYMA are detected on your machine when SPARK is installed, or if you install them later and take steps to link them to SPARK, you can select one as an alternative symbolic engine for `sparksym`. Maple, Mathematica and MACSYMA are more powerful than Mathomatic, allowing more complex equations to be handled.

The Mathomatic program integrated in `sparksym` can only process expressions containing the algebraic operators `+`, `-`, `*`, `/`, `=` and well-formed expressions using parenthesis. Mathematical functions such as `sin`, `cos`, `ln`, `exp`, ... will not be detected, and therefore no inverse form will be generated.

Note that the `sparksym` executable provided with SPARK does not give you the full capability of Mathomatic. You can download the DOS shareware program from <http://www.lightlink.com/computer/math/>. Among other features, it is capable of symbolic elimination of variables and equations in sets of equations; sometimes this feature can be used to help develop efficient SPARK classes.

In order to make a symbolic engine available to `sparksym`, you need to declare the absolute paths along with the executable program name where each tool can be located. This can be done using the following environment variables where the paths have to be replaced with the actual paths to each symbolic tool on your computer.

```
SPARK_MAPLE="c:\program files\maple\...\maple.exe"  
SPARK_MATHEMATICA="c:\program files\mathematica\...\mathematica.exe"  
SPARK_MACSYMA="c:\program files\macsyma\...\macsyma.exe"
```

As an alternative to using environment variables, you can also specify the respective paths to each symbolic tool in a file called `sparksym.prf`, which must reside in the same directory where the program `sparksym` resides (e.g., the `bin/` subdirectory of your VisualSPARK installation).

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```
(
  Paths (
    MACSYMA ( "c:\program files\macsyma\..." ()
    Mathematica ( "c:\program files\mathematica\..." ()
    Maple ( "c:\program files\maple\..." ()
  )
)
```

If both the environment variables and the sparksym.prf file are specified, then the paths indicated in the environment variables will be used to locate the symbolic tool in question. If neither is specified, sparksym will use the default symbolic tool, i.e., Mathematic.

Command-line usage of sparksym is with the command:

```
% sparksym -engine -option [name] "equation" [target] [outFile] <enter>
```

where:

engine

O for Mathematic (default)
P for Maple
E for Mathematica
S for MACSYMA

option

i to generate a single inverse
a to generate all inverses
f to generate a function
c to generate an atomic class

name is the name of the function or of the atomic class (used only with option f or c).

equation is a symbolic equation of the form <expression>=<expression> (enclose in double quotes if spaces occur).

target is the variable to be solved for (used only for options i and f).

outFile is the optional file name where the result should be output.

For example, to generate the inverse equation for T using the ideal gas law, with output to the screen:

```
sparksym -O -i "p*v = n*R*T" T <enter>
```

This will produce:

```
Inverse: T = p*v/n/R
```

Or to create the SPARK idealGasLaw atomic class, with results written to idealGasLaw.cc:

```
sparksym -O -c idealGasLaw "p*v=n*R*T" idealGasLaw.cc <enter>
```

The class generated is directly usable, but perhaps not as complete as you may wish. For example, the ports are all assigned a description which is the same as the port name, units are [-] (i.e., unspecified), and the INIT, MIN, and MAX values are set at 1, -100000,

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and 100000 respectively. You can edit the output file to give more appropriate values for these items if you wish.

Finally, variables for which sparksym could not find an explicit inverse use an inverse in residual form defined as the default residual for the atomic class. Consult the SPARK Reference Manual for more information about the DEFAULT_RESIDUAL mechanism. You may wish to edit the residual functions to improve numerical stability.

[How to perform a static build of a SPARK simulator?](#)

By default, the SPARK build process will perform a dynamic build whereby the problem to be solved is loaded at runtime from its description in the XML file and by explicitly linking against the dynamic libraries for the atomic classes. This approach requires that the XML file and the dynamic libraries for the atomic classes be present and accessible at runtime.

However, sometimes it is preferable to generate a stand-alone, self-contained simulator executable for the problem you want to solve. This is achieved by performing a static build instead of the default dynamic build.

To perform a static build, you have to set the environment variable SPARK_STATIC_BUILD to yes.

```
% set SPARK_STATIC_BUILD=yes <enter>
```

To revert back to the dynamic build mode, set the environment variable SPARK_STATIC_BUILD back to its default value no.

```
% set SPARK_STATIC_BUILD=no <enter>
```

Make sure that you execute `make clean` in the project directory after you have changed the environment variable SPARK_STATIC_BUILD. This will ensure that the class library are correctly rebuilt and linked against the SPARK solver.

As an alternative to setting the environment variable, you can specify its new value as one of the arguments at the command-line when executing the makefile.

```
% make SPARK_STATIC_BUILD=yes solver <enter>
```

For more details on the SPARK build process, consult the [SPARK Problem Driver API](#) .

[How to link the SPARK solver against external libraries?](#)

When compiling atomic classes that rely on external libraries, it is necessary to be able to customize the SPARK build process to account for these user-specific settings. The SPARK master makefile `lib/makefile.prf` defines arguments to address such needs:

- SPARK_COMPILE_OPTIONS to specify options for the compiler.
- SPARK_LINK_STATIC_OPTIONS to specify options for the linker such as a list of external static libraries to link against.
- SPARK_LINK_DYNAMIC_OPTIONS to specify options for the linker such as a list of stubs for the external dynamic libraries to link against.

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The following command

```
% make solver SPARK_COMPILE_OPTIONS=-Ic:\abc\inc  
SPARK_LINK_DYNAMIC_OPTIONS="c:\abc\lib\abc.lib" <enter>
```

will build the SPARK solver for the current project using the additional include directory c:\abc\inc and linking against the stub file c:\abc\lib\abc.lib. Note that it is the responsibility of the user to make sure that the dynamic library abc.dll attached to the stub file abc.lib is reachable by the SPARK solver at startup. This can be accomplished by specifying the path to the DLL file in the system PATH or by copying the dynamic library into the <spark>/bin directory.

The following command (on one line)

```
% make solver SPARK_COMPILE_OPTIONS=-Ic:\abc\inc  
SPARK_LINK_STATIC_OPTIONS="c:\abc\lib\abc.lib" <enter>
```

will build the SPARK solver for the current project using the additional include directories c:\abc\inc and linking against the static library file c:\abc\lib\abc.lib.

[How to package all class binaries into a single library?](#)

To package all compiled atomic classes used in the current project into a single static library, execute the `proj_lib` target in the makefile. It will generate a single static library named `lib<PbName>.{a,lib}`, whereby `<PbName>` stands for the name of the current project and the actual extension varies depending on the platform and compiler.

```
% make proj_lib <enter>
```

To package all compiled atomic classes used in the current project into a single dynamic library, execute the `proj_libdyn` target in the makefile. It will generate a single dynamic library named `lib<PbName>.{so|dll}`, whereby `<PbName>` stands for the name of the current project and the actual extension varies depending on the platform and compiler.

```
% make proj_libdyn <enter>
```

[How to generate a beautified textual representation of the solution sequence?](#)

As an alternative to the basic textual representation of the solution sequence contained in the EQS file, it is possible to generate a beautified textual representation in HTML format. In the project directory, execute

```
% make html <enter>
```

to generate the HTML view of the solution sequence described in the [2sum.xml](#) file.

For example, the HTML view of the solution sequence for the 2sum problem would look like [this](#). You can compare it to the basic textual representation of the solution sequence generated in the [2sum.eqs](#) file.

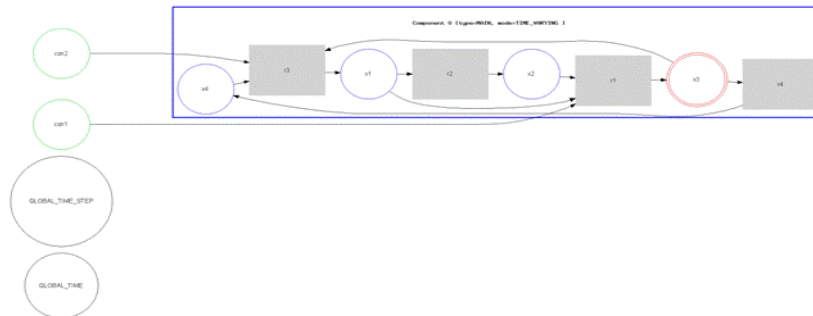
[How to generate a graphical view of the solution sequence?](#)

Since SPARK 2.1, it is possible to generate a graphical view of the solution sequence produced by the graph-theoretic pre-processing performed in the sparksetup program. The graphical representation is generated from the XML description of the problem topology using the [GraphViz](#) graph drawing software. The available file formats for the generated graph are:

- svg (Scalable Vector Graphics)
- ps
- gif
- jpeg
- png

The SVG output can be easily viewed using a SVG viewer like [Adobe SVG Viewer](#) on various platforms (Win, Linux, Max and Solaris).

The graphical view is a directed graph for the solution sequence whereby the equation nodes are represented as square boxes and the variable nodes as circles. The incoming arrows into an equation indicate the arguments needed by the selected inverse equation, whereas the outgoing arrows indicate the calculated variables. Each equation node is labelled with the name of the atomic class instance. Finally, the SPARK components are shown with a dotted blue line around all the equations they consist of.



To distinguish between each variable type the following color codes are used:

- Known variables are shown in green circles.
- Global variables such as the global time and the global time step are shown in black circles.
- Unknown non-break variables are shown in blue circles.
- Unknown break variables are shown in red double circles.

It is possible to customize the graph output by specifying the following parameters at the command-line:

- ARG_InputsAsSource = YES|NO
If YES, then all input variables are located as source to the graph. The default value is YES.
If NO, then all input variables are freely located on the graph to minimize crossovers.

Please visit our website at <http://SimulationResearch.lbl.gov>

- ARG_VarFontSize
Specifies the font size in pts to use for the variable labels. The default value is 10 pts.
- ARG_EqFontSize
Specifies the font size in pts to use for the equation labels. The default value is 12 pts.
- ARG_EqBoxWidth
Specifies the width in inches of the variable boxes. The default value is 1 inch.

For example, the following command executed in the project directory:

```
% make svg ARG_InputsAsSource=NO ARG_EqBoxWidth=2 <enter>
```

will generate the SVG graphical output for the solution sequence of the current project, whereby the input variables will be freely located on the graph and the equation boxes will be 2 inches wide.

Note that as an alternative to specifying the previous arguments at the command-line, it is also possible to set new environment variables named after the arguments.

<p>New EnergyPlus Consultant</p> <p>Hyeun Jun Moon, Ph.D. LEED Assistant Professor Dept. of Architectural Engineering Dankook University San 8, Hannam, Yongsan Seoul, Korea Tel: 82-2-793-2509 Cel: 82-10-7109-4449 hyeunjun@gmail.com hmoon@dankook.ac.kr</p>	<p>New DOE-2 Consultant</p> <p>Tom Lunneberg, Principal Innovative Energy Solutions 6965 El Camino Real, #105-492 Carlsbad, CA 92009 Tel/Cel: (760) 805-3230 tlunneberg@innovative-nrg... www.innovative-nrg.com</p>	<p>New DOE-2 Consultant</p> <p>GAO, Qinglong , Green Building Design Yanta Road 13 Xi'an Shaanxi China 710055 Tel: +0086-029-82204806</p>
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Meetings - Conferences - Symposia

2006		
August 2-4	SimBuild 2006 – IBPSA USA	http://www.ibpsa.us/
August 13-18	ACEEE Summer Study on Energy Efficiency in Buildings	http://www.aceee.org
August 13-18	International Heat Transfer Conference	http://www.ihtc-13.com
August 27-31	International Building Physics/Science Conference (IBPC3)	http://www.bcee.concordia.ca/ibpc3/
September 13-14	World Energy Engineering Congress	http://www.energycongress.com
September 13-15	Energie 2006	gcelery@etai.fr
September 19-22	Rethinking Sustainable Construction 2006	http://www.treoo.ufl.edu/rsc06/
October 17-19	Labs21 Annual Conference	http://www.labs21century.gov/conf/
November 15-17	Greenbuild 2006 (usgbc)	greenbuild@conferon.com
November 20-21	ClimaMed 2006	http://www.climamed2006.org
December 11-13	System Simulation in Buildings (SSB 2006)	http://www.ulg.ac.be/labothap/ann-ssb.htm



DOE-2



DOE-2.1E (version 121) 1,000-Zone version for Windows from ESTSC; other vendors of DOE-2 based programs are listed on our website: <http://SimulationResearch.lbl.gov/>.

Cost is as follows:

- \$ 300 U.S. Government/Non-Profits/Education
- \$ 575 U.S. Public, Mexico, Canada
- \$1129 to \$1268 Other Foreign

[DOE-2 Documentation on a CD from ESTSC - Cost US\\$100](#)

What is included on the CD?

DOE-2 Reference Manual (Part 1) and (Part 2) DOE-2 BDL Summary (2.1E)
DOE-2 Engineers Manual (2.1A) DOE-2 Supplement to the Reference Manual (2.1E)

Order Software and ESTSC Documentation

Ed Kidd or Kim Buckner
NCI Information Systems, Inc.
Energy Science and Technology Software Center (ESTSC)
P.O. Box 1020
Oak Ridge, TN 37831

Phone: 865/576-1037
Fax: 865/576-6436
Email: estsc@adonis.osti.gov

Purchase DOE-2 Documentation

DOE-2 Sample Run Book (2.1E) -- The Sample Run book is the only DOE-2 manual not available electronically. It must be purchased separately from NTIS; ordering information may be found at <http://SimulationResearch.lbl.gov> > DOE-2 > Documentation

Free DOE-2 Documentation (<http://simulationresearch.lbl.gov/>> DOE-2 > Documentation)

[DOE-2 Basics Manual \(2.1E\)](#)

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 2005](#) [for 2004](#) [for 2003](#) [for 2002](#)

A compilation of all the "how to" and "DOE-2 Puzzler" articles from the newsletter.

[Changes and Bug Fixes to DOE-2.1E \(txt file\)](#)

Description of all changes and bug fixes in a text document.

[Feel the \(virtual\) earth move under your feet . . .](#) Does your family complain that you never take them anywhere? Silence their whines (and do it for free!) by taking the whole gang on a virtual tour of California's Hayward Earthquake Fault. Go here for a (cheap) thrill: http://quake.wr.usgs.gov/research/geology/hf_map/GE_helicopter.htm.
And don't miss this great map from the U. S. Geological Survey (bottom of the helicopter page) at <http://nmviewoc.cr.usgs.gov/viewer.htm>

Free Building Energy Software from Lawrence Berkeley National Laboratory	
BDA 3.1 (<i>Building Design Advisor</i>) gaia.lbl.gov/BDA (building decision-making from design through completion)	
COMIS www-epb.lbl.gov/comis (multi-zone air flow and contaminant transport model)	
EnergyPlus 1.3.0 www.energyplus.gov/ (next-generation whole-building energy analysis program, based on BLAST and DOE-2)	
GenOpt[®] 2.0 SimulationResearch.lbl.gov (generic optimization program)	
Optics 5.2 windows.lbl.gov/materials/optics5/ (for analyzing optical properties of glazing systems)	
RADIANCE 3.5 radsite.lbl.gov/radiance/ (analysis and visualization of lighting in design)	
Desktop Radiance 2.0β radsite.lbl.gov/deskrad/ (integrates the Radiance Synthetic Imaging System with AutoCAD Release 14)	
Radiance Control Panel www.squ1.com/site.html (automates some Radiance tasks once the model has been created)	
THERM 5.2 windows.lbl.gov/software/therm/therm.html (models two-dimensional heat-transfer effects in building components where thermal bridges are of concern)	
VisualSPARK 2.0 SimulationResearch.lbl.gov (<i>Simulation Problem Analysis and Research Kernel</i>) (connect component models to simulate innovative building envelope and HVAC systems)	
WINDOW 5.2 windows.lbl.gov/software/window/window.html (thermal analysis of window products)	
Free Software / Request by Fax from 510.486.4089	
RESFEN 3.1 windows.lbl.gov/software/resfen/resfen.html (choose energy-efficient, cost-effective windows for a given residential application)	
Web Based	
Home Energy Saver hes.lbl.gov (quickly computes home energy use)	

2006 EnergyPlus Training from <http://www.gard.com/training.htm>

August 01 Cambridge, Massachusetts (at MIT)
Immediately before the IBPSA-USA SimBuild Conference at MIT
Early registration deadline is June 28, 2006; Registration closes after July 24

Building Energy Software Tools Directory

This directory provides information on over 300 building software tools for evaluating energy efficiency, renewable energy, and sustainability in buildings. The energy tools listed in this directory include databases, spreadsheets, component and systems analyses, and whole-building energy performance simulation programs. Know of a tool (yours?) that isn't in the directory? Send email to Dru Crawley at Drury.Crawley@ee.doe.gov.

Visit http://www.eere.energy.gov/buildings/tools_directory/about.cfm

Recent Reports

Click on the link to download these (pdf) reports.
If you run into problems, contact kl Wellington@lbl.gov.

[Download paper \(PDF\)](#)

*The 9th International IBPSA Conference, Building Simulation 2005
Held August 15-18, 2005 in Montreal, Canada*

Contrasting The Capabilities Of Building Energy Performance Simulation Programs

[Drury B. Crawley](#)¹, Jon W. Hand², Michaël Kummert³, and Brent T. Griffith⁴

¹U S Department of Energy, Washington, DC, USA

²Energy Systems Research Unit, University of Strathclyde, Glasgow, Scotland, UK

³University of Wisconsin-Madison, Solar Energy Laboratory, Madison, Wisconsin, USA

⁴National Renewable Energy Laboratory, Golden, Colorado, USA

ABSTRACT

For the past 50 years, a wide variety of building energy simulation programs have been developed, enhanced and are in use throughout the building energy community. This paper is an overview of a report that provides up-to-date comparison of the features and capabilities of 20 major building energy simulation programs. The comparison is based on information provided by the program developers in the following categories: general modeling features; zone loads; building envelope, daylighting and solar; infiltration, ventilation and multizone airflow; renewable energy systems; electrical systems and equipment; HVAC systems; HVAC equipment; environmental emissions; economic evaluation; climate data availability, results reporting; validation; user interface, links to other programs; availability.

[Download paper \(PDF\)](#)

*The 9th International IBPSA Conference, Building Simulation 2005
Held August 15-18, 2005 in Montreal, Canada*

Modeling Ground Source Heat Pump Systems in a Building Energy Simulation Program (EnergyPlus)

Daniel E. Fisher¹ and Simon J. Rees²

¹Oklahoma State University, School of Mechanical and Aerospace Engineering,
Stillwater, Oklahoma, USA.

²De Montfort University, Institute of Energy and Sustainable Development, Leicester,
United Kingdom

ABSTRACT

Despite the low energy and lower maintenance benefits of ground-source heat pump systems, little work has been undertaken in detailed analysis and simulation of such systems. Long-term transient ground heat transfer significantly affects the performance of these systems. Annual and multi-year simulation consequently becomes an invaluable tool in the design of such systems – both in terms of calculating annual building loads and long-term ground thermal response. Models of vertical ground loop heat exchanges and water-to-water heat pumps have been implemented in the EnergyPlus program. The models are described, and techniques for modeling zone-system-plant interactions in the EnergyPlus environment presented. A case study is presented to show how the long-term (multi-year) effect of unbalanced loads on the ground loop, and the propagation of these effects through the system and zone models, can be calculated.

New Version!

xEsoView: Open Source File Viewer for EnergyPlus

Download from <http://xesoview.sourceforge.net/>

[xEsoView](#), an open source file viewer for EnergyPlus eso files, gives the user a very fast overview of the simulation results. The program lists all reported variable names, which can then be sorted and filtered. At the same time, it shows the graphical representation of the selected variable. The time axis can be changed using predefined ranges but xEsoView also supports zooming. With a selection box you can switch between the available environments, e.g. summer design day and run-period. A simple CTRL+C copies the variable data to the clipboard so you can easily paste the data into your favorite spreadsheet program for further analysis.

Features

- Switch between environments (summer design day, winter design day, run period)
- Sort variables (id, name, area, unit, timestep)
- Filter variables (name, area, unit, timestep)
- Show variable information (max, min, avg)
- Show file information
- Select time scale (total, month, week, day, hour)
- Grid, Zoom, Markers
- Copy graphic to clipboard
- Copy variable data to clipboard with (optional) time/date
- Reload eso file
- Export graphic as PDF

Version 0.2

Several minor bugs were fixed and a few improvements were added:

- A problem with partial empty data (report value scheduled) has been fixed.
- Added the ability to select the same variable again after switching environments.
- Ability to re-filter after switching environments.
- Weekdays can be shown in graphic fly-over mode.
- After sorting, selection is kept in the variable list.
- I.D.'s may now be sorted numerically.

xEsoView author: Christian Schiefer, Vienna, Austria -- christian.schiefer@mce-gt.at

August 2006 – Seminars from Southern California Gas Co <http://seminars.socalgas.com/int/default.asp/>

- | | |
|--------------|---|
| Tue 1 | EnergyPro Training: Indoor & Outdoor Lighting and Envelope and Windows (2 separate sessions) |
| Wed 2 | EnergyPro Training: Advanced and Mechanical (2 separate sessions) |
| Thu 3 | 2005 Non-Residential Title 24 Standards: Compliance & Beyond |

California Climate Zones on Google Earth™

Outlines of California's 16 Climate Zones have been overlaid on the aerial images of Google Earth. This is useful if you want to examine the boundary areas between two climate zones. The outlines are based on the GIS (Arcview) shapes.

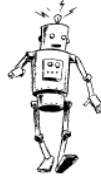
Google Earth is a free broadband, 3D application. To Download, go to <http://earth.google.com/>

Install and launch the application; then download and open Climate Zones CA-CZ.kmz (120kb).

The free version does not allow labeling on the map. Climate zones can be selectively viewed by using the check box along side each layer. We suggest that you uncheck all the climate zones and then select only the ones of interest at the time of viewing.

Free Membership in IBPSA-USA

The [IBPSA-USA](#) Board of Directors has voted unanimously to extend their policy of free membership. Those interested in renewing their membership or becoming new members may do so by expressing their desire to be IBPSA-USA members and providing updated contact information (Affiliation, Mailing address, Phone number, Email address)



Establishing membership may be done on-site at any IBPSA-USA meeting or by sending an email to the IBPSA-USA Secretary, Peter Ellis, at peter_ellis@nrel.gov, [P] 303.384.7443, [F] 303.384.7540

VisualDOE 4 and LEED Training for 2006

Architectural Energy Corporation is pleased to announce VisualDOE training seminars for 2006:

November 13-14 in Boulder, CO
July or August in NYC

Each seminar includes two days focused on DOE-2, the VisualDOE interface, new features of VisualDOE 4, general energy simulation skills, and LEED-NC 2.1 and 2.2 energy savings calculations for green buildings.

VisualDOE Training Team
Architectural Energy
142 Minna Street, 2nd Floor
San Francisco, CA 94105
Voice: (415) 957-1977
Fax: (415) 957-1381

vdoetraining@archenergy.com
www.visualdoe.com

Freebie!

*Quick, what's six feet long, over two feet wide and jam-packed with buildings factoids?
If you guessed that it's a poster entitled*

"Energy and Buildings in the 20th Century: Changing How We Live and Work in America"

you would be correct! Published by the U.S. Department of Energy as part of their "Greening America" campaign, the poster is a timeline of 20th century achievements in building.

There are photos of "milestone" buildings like the 1940 Solar House at M.I.T., Buckminster Fuller's 1927 Dymaxion House, the 1933 House of Tomorrow at the Chicago World's Fair, the Empire State Building, etc.

*In addition to the buildings, there are time lines for electricity and technology along with a mini history of how human shelters developed through the centuries; it warps you from the Mesa Verde Cave Dwellings to the present White House! The poster is available **free of charge** from your friendly federal government and would look terrific in an office or classroom. Please send your request to kl Wellington@lbl.gov.*

