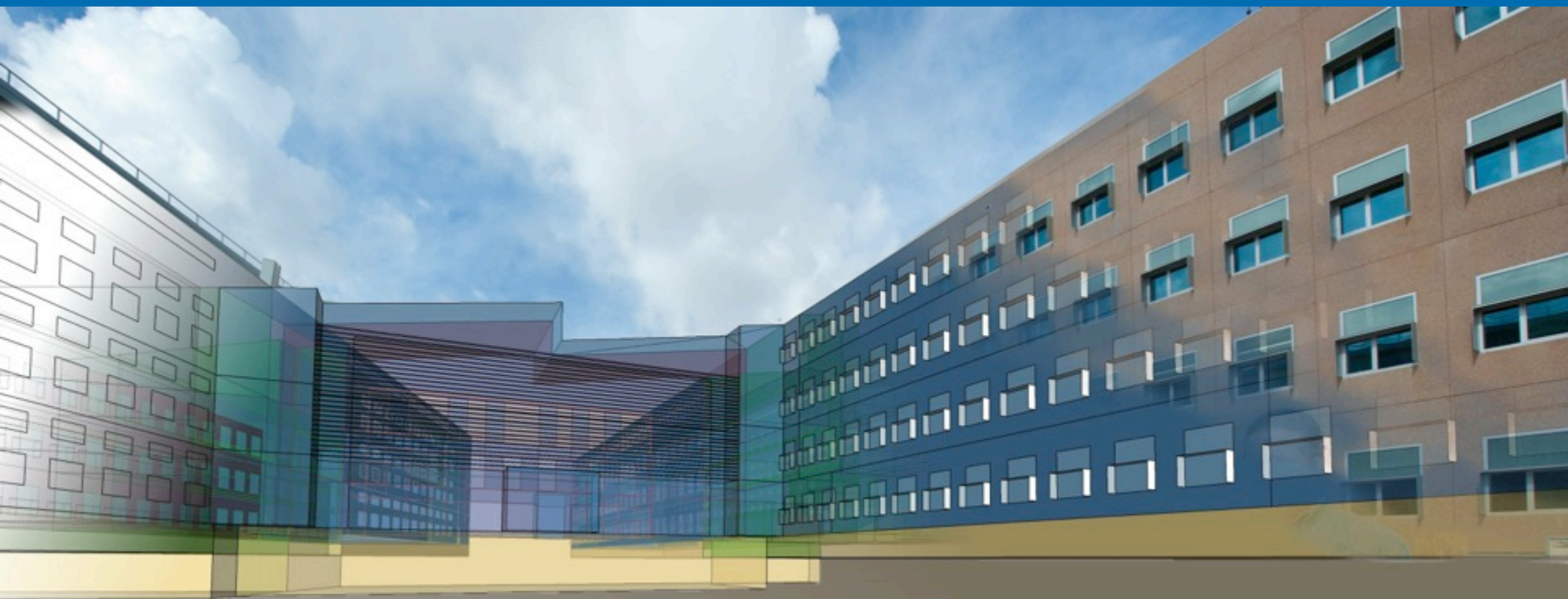


# OpenStudio-Radiance Update



**Rob Guglielmetti**  
**NREL Commercial Buildings Group**

**14th Annual International Radiance Workshop**  
**August 17-19, 2015**

# Agenda

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- **OpenStudio and DOE's BEM Ecosystem**
- **OpenStudio Measures**
- **Daylighting and BEM rant**
- **OpenStudio/Radiance Features Update**
- **NREL/GitHub mirror of Radiance Source Repository**

# Inspirational Quotations

**“To nature, who gives us marvelous complexity,  
all the while making it look easy.”**

- Greg Ward, “Rendering with Radiance”



**“Without lamps, there’d be no light.”**

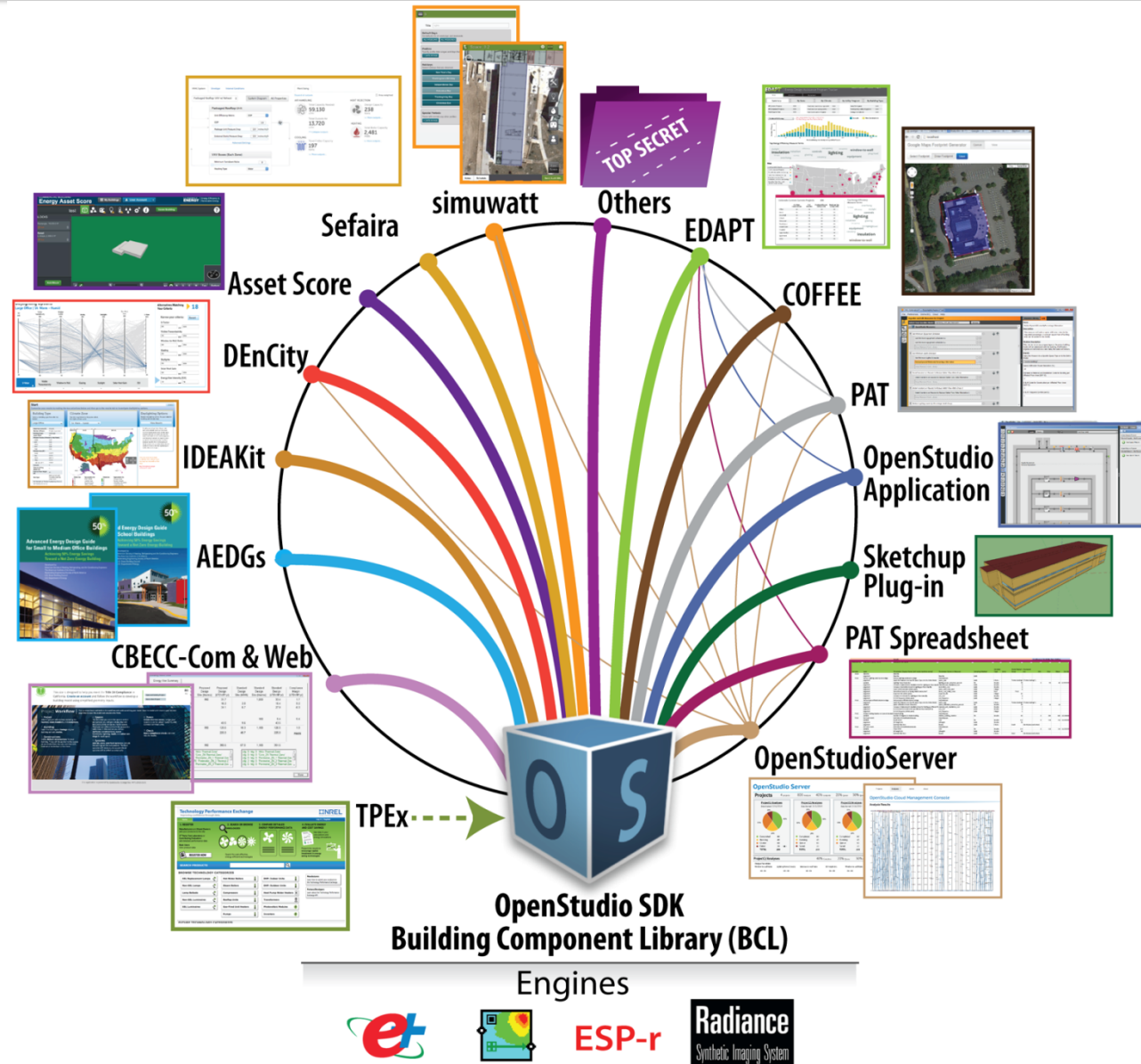
- John Bender, “The Breakfast Club”

(obviously, not a lighting designer)

# OpenStudio's Energy Modeling Ecosystem

OpenStudio is an open source platform that bridges the gap between capable but complex engines and the easy-to-use applications that drive energy savings.

The Technology Performance Exchange (TPEx) and Building Component Library (BCL) provide the raw data that powers the ecosystem.

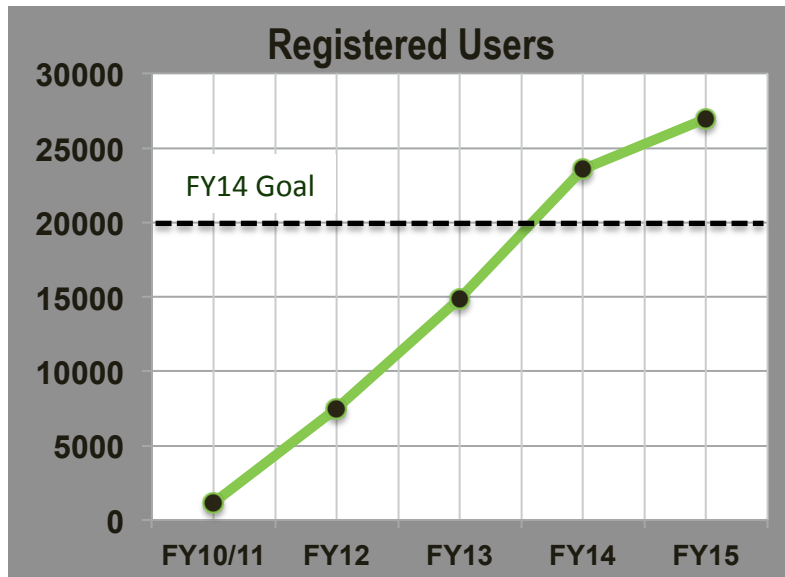




# Who Uses OpenStudio?

## The market for OpenStudio is diverse and includes:

- Developers wishing to quickly and cost-effectively bring new software to market;
- A&E practitioners who use applications for new construction and retrofit projects;
- Utilities trying to reduce costs of incenting EE, improve realization rates, and assess technology potentials;
- Researchers designing and assessing new technologies; and
- Students who are the next generation of building designers.



# OpenStudio Partners (Partial List)



CONSORTIUM for  
BUILDING ENERGY  
INNOVATION



concept3D  
Location. Web. 3D.



BuildRIGHT Illinois  
Energy Efficiency Education



Natural Resources  
Canada



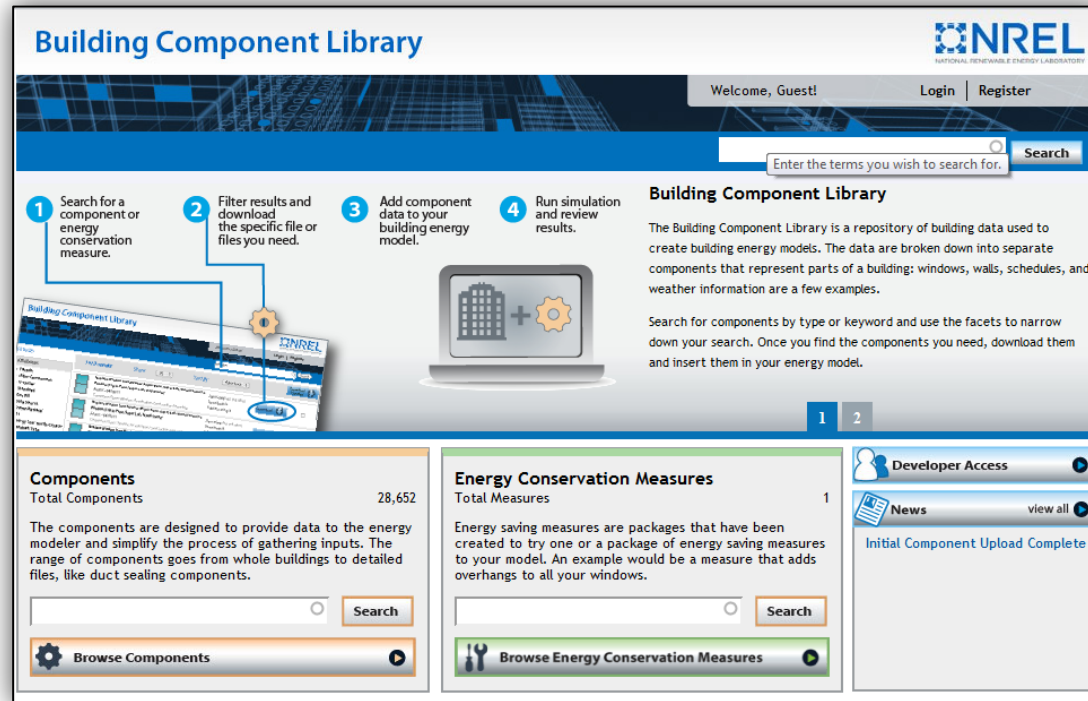
Argonne  
NATIONAL LABORATORY



GENABILITY



# Foundations: The Building Component Library (BCL)



- An Internet-connected source of building energy modeling data:
  - Enables drag-and-drop modeling for **quick** technology evaluations
  - Provides **consistent**, detailed inputs to drive decision-making
  - **Searchable** readily available within applications
  - The BCL is key to OpenStudio's **extensibility**

# The BCL: A Source for Reusable Input Data...

The screenshot shows the Building Component Library (BCL) website. At the top, there's a header with the NREL logo and navigation links like 'Welcome, Guest!', 'Login', and 'Register'. Below the header is a search bar with the placeholder text 'Enter the terms you wish to search for.' and a 'Search' button. A four-step guide is displayed: 1. Search for a component or energy conservation measure. 2. Filter results and download the specific file or files you need. 3. Add component data to your building energy model. 4. Run simulation and review results. The main content area is divided into two sections: 'Components' and 'Energy Conservation Measures'. The 'Components' section shows 'Total Components: 28,652' and a description: 'The components are designed to provide data to the energy modeler and simplify the process of gathering inputs. The range of components goes from whole buildings to detailed files, like duct sealing components.' It includes a search bar and a 'Browse Components' button. The 'Energy Conservation Measures' section shows 'Total Measures: 1' and a description: 'Energy saving measures are packages that have been created to try one or a package of energy saving measures to your model. An example would be a measure that adds overhangs to all your windows.' It also includes a search bar and a 'Browse Energy Conservation Measures' button. On the right side, there's a 'Developer Access' section with a 'News' link and a 'view all' link. A status message 'Initial Component Upload Complete' is visible.

The screenshot shows the details for the 'ASHRAE 90.1 Constructions Exterior Wall Steel-Framed NR' component. On the left, there's a 3D cross-section diagram of the wall assembly. Below it, there's a 'Click to view more images' link, a 'Fidelity level' bar, a 'User Rating' section, and 'Downloads: 7'. The 'Component Types' section lists 'Construction', 'Assembly', 'Wall', and 'Exterior Wall'. The 'Attributes' table shows the following data:

Attributes	
Standard	ASHRAE 90.1 Constructions
Construction	Exterior Wall
Construction type	Steel-Framed
Effective r-value	0.4421 ft <sup>2</sup> F h/Btu
Insulation minimum r-value	R ft <sup>2</sup> F h/Btu
Film coefficients	false
OpenStudio Type	OS:Construction

The 'Source' section is empty. The 'Files' table shows the following data:

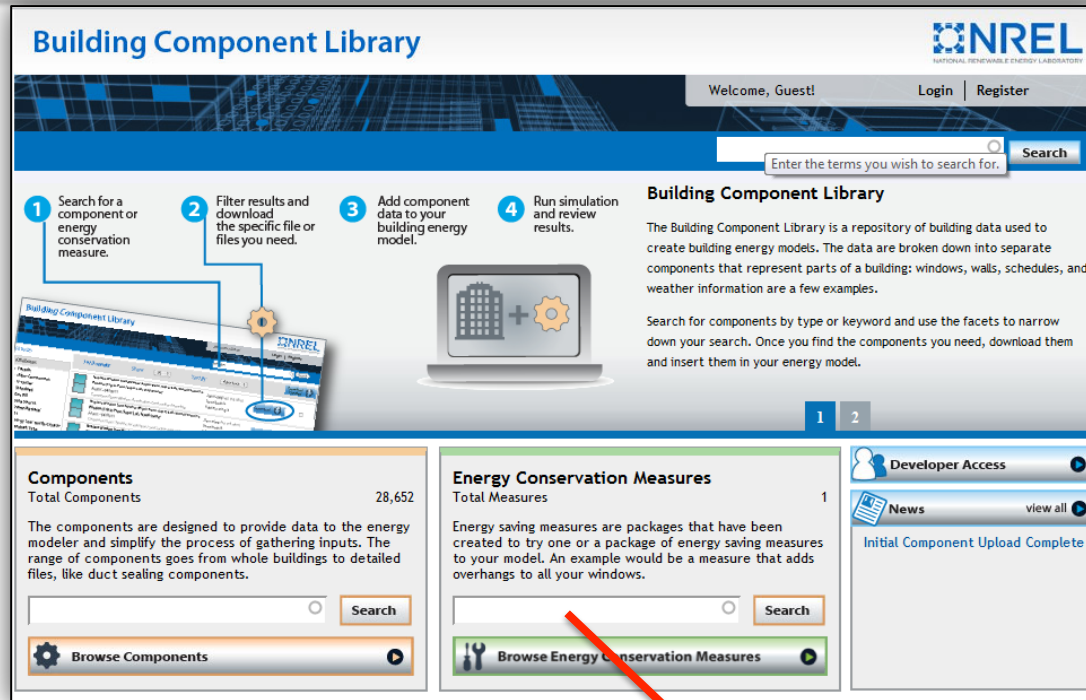
Files	
ASHRAE 90.1 Constructions_Exterior Wall_Steel-Framed_NR_v7.0.0.036.idf	EnergyPlus 7.0.0.036
ASHRAE 90.1 Constructions_Exterior Wall_Steel-Framed_NR_v0.7.0.osm	OpenStudio 0.7.0
ASHRAE 90.1 Constructions_Exterior Wall_Steel-Framed_NR_v0.7.0.osc	OpenStudio 0.7.0

## Components:

- Assembled to form complete energy models
- Include constructions, lights, schedules, weather data, PV components, and more

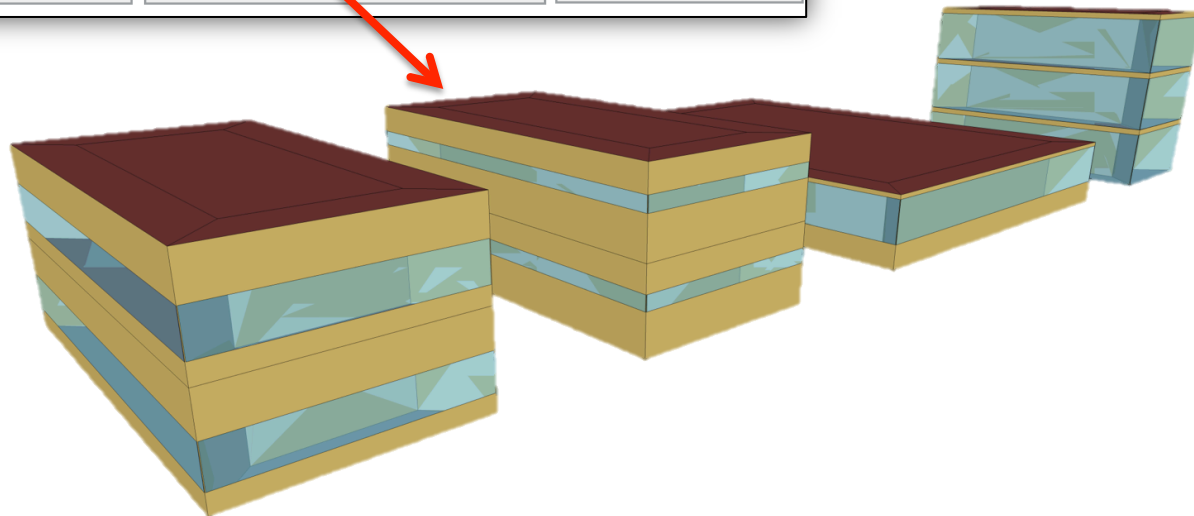


# ...and a “Measures” Repository



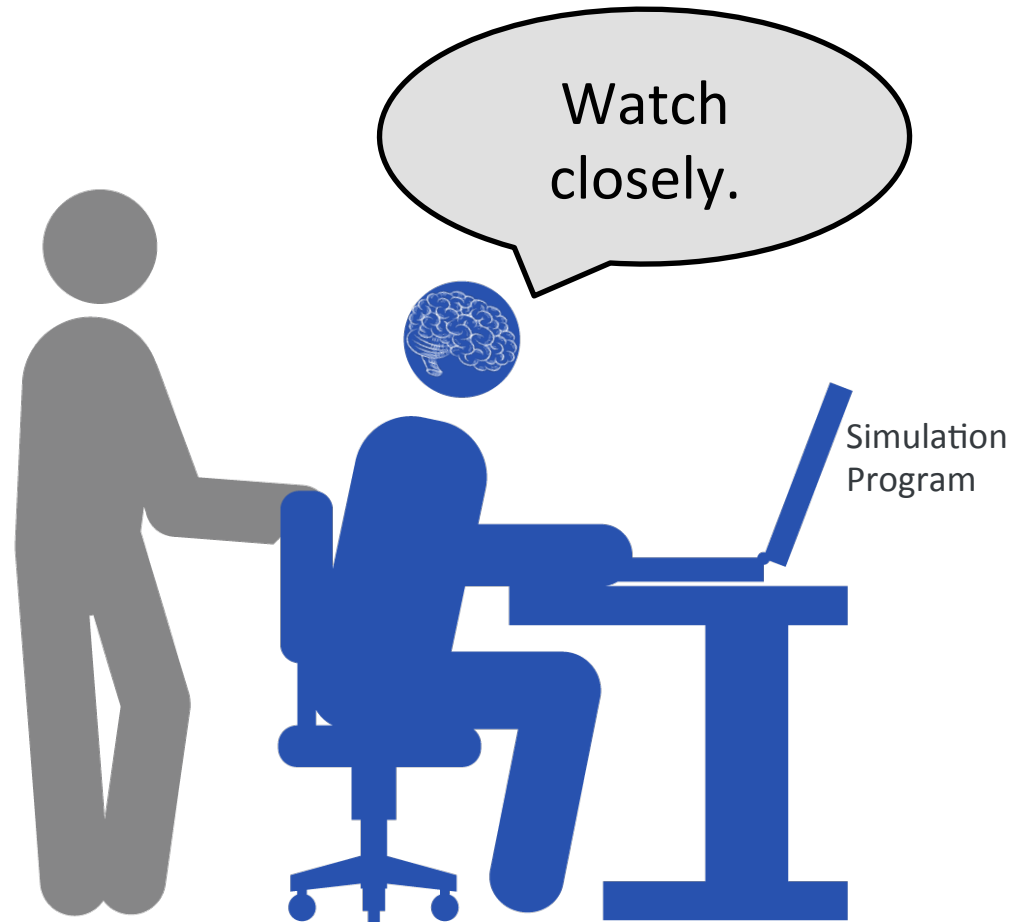
## Measures:

- Contain logic needed to transform an energy model easily and consistently
- Can be applied singly or as part of a parametric analysis



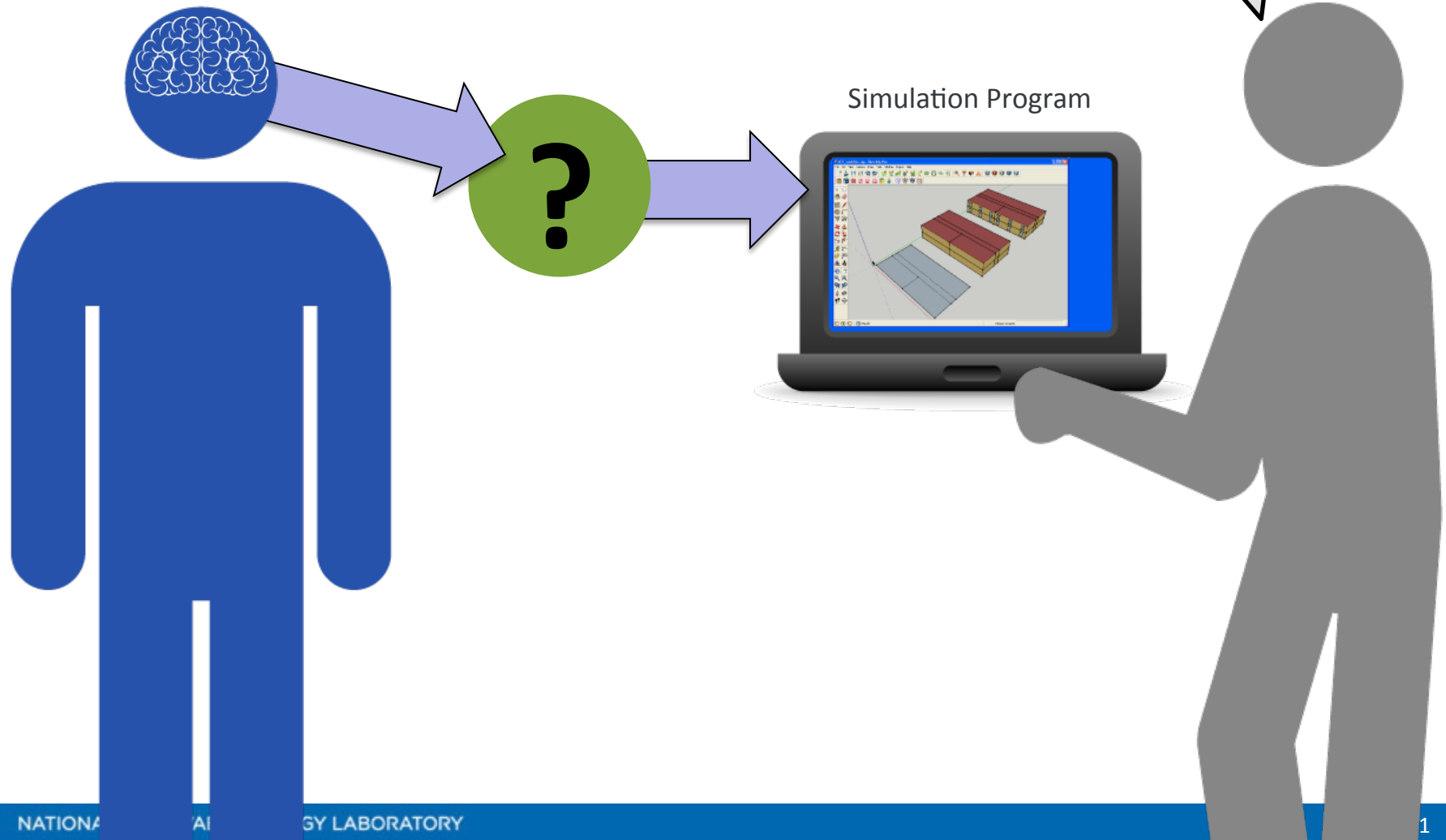
# Modeling Today

**Knowledge is passed one-to-one:  
Inconsistent, not scalable, not transparent**



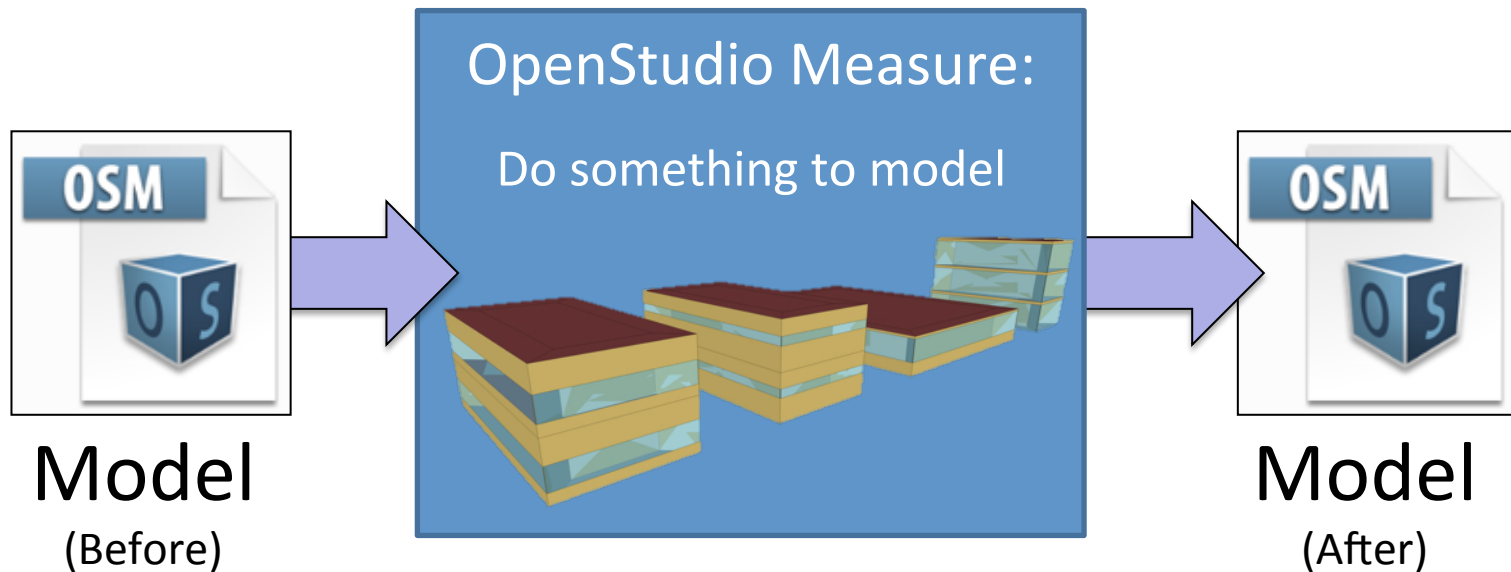
# What We've Needed

**A better way to share modeling techniques.**



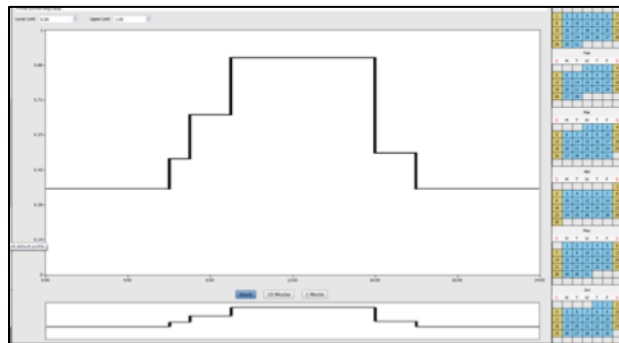
# It Exists! – OpenStudio Measures

OpenStudio Measures are (generally) short scripts that transform building models **quickly** and **easily**

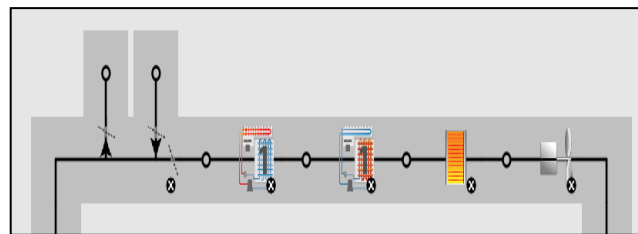




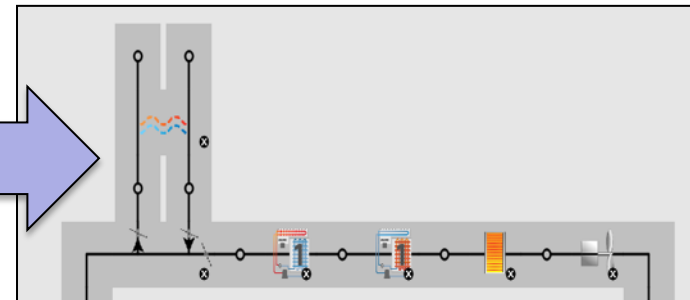
# Sample Measures



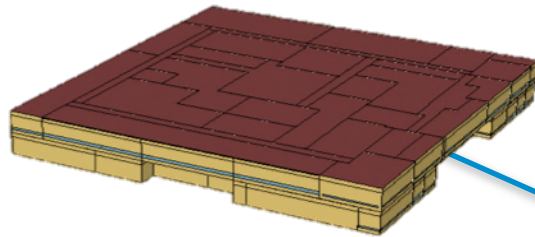
Night Setback Measure



Add Heat Recovery Measure



# Measures Workflow Example



Baseline Model

OpenStudio Parametric Analysis Tool (PAT)

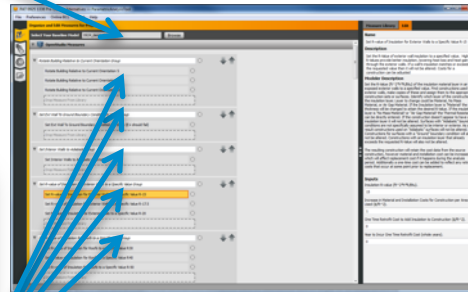


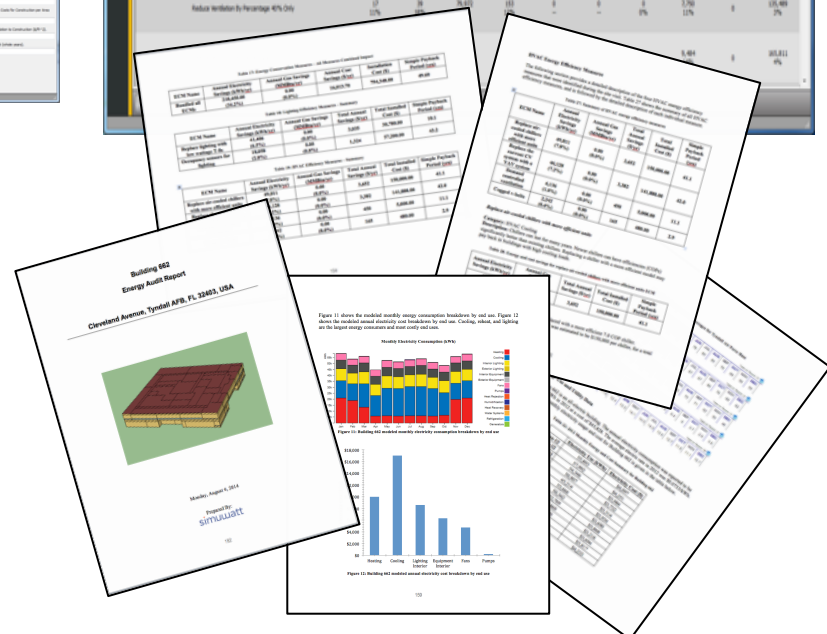
Table 11: Building 882 modeled monthly energy consumption (kWh) by end use

Design Alternative Name	Energy Use Intensity (kBtu/ft <sup>2</sup> ·yr)	Peak Electric Demand (kW)	Electricity Consumption (kBtu)	Natural Gas Consumption (kBtu)	District Cooling Savings (kBtu)	District Heating Savings (kBtu)	First Year Capital Cost (\$)	Annual Utility Cost (\$)	Total LCC (\$)
Baseline	281	225	807,289	1,389	0	0	1,307,590	69,879	4,362,421
Enable Demand Controlled Ventilation Alternative Only	28	22	71,639	227	0	0	0	8,340	18,122
Enable Economizer Control (Cool Dry-Bulb Only)	9	22	64,721	0	0	0	0	3,723	14,088
Control Differential Strategies Only	9	22	64,740	0	0	0	0	3,719	14,088
Control (Cool Dry-Bulb and Dry-Bulb Only)	9	22	64,721	0	0	0	0	3,723	14,088
Reduce Window-to-Floor Percentage 30% Only	12	28	62,247	117	0	0	0	5,911	20,126
Reduce Window-to-Floor Percentage 40% Only	12	28	56,822	112	0	0	0	2,780	17,489



Online Database of Measures

Life cycle analysis identifies cost-effective measures that are automatically documented

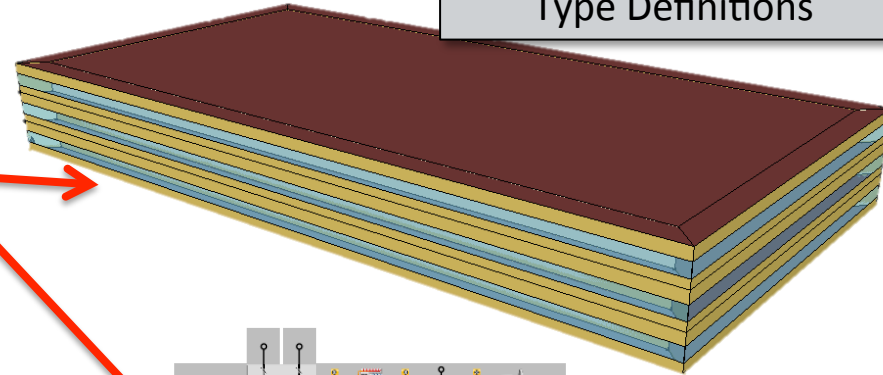


# OpenStudio Enables Automated Model Generation...

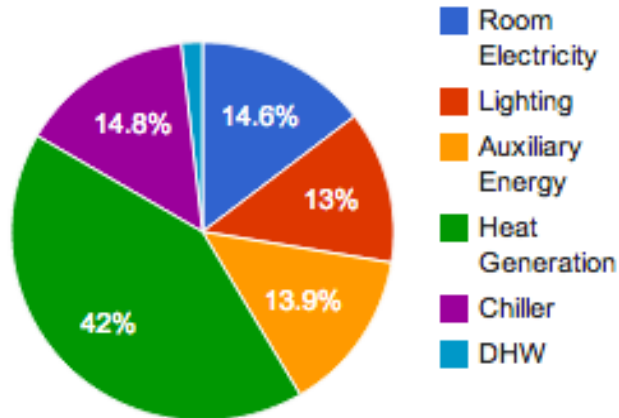
```
VirtualPULSE_run.rb
1 require 'openstudio'
2 require 'VirtualPULSEModel'
3
4 #create a new model
5 model = VirtualPULSEModel.new
6
7 #add geometry (in this case a simple multi-story core/perimeter building)
8 model.add_geometry({"length" => 100,
9                    "width" => 100,
10                   "height" => 10})
11 #add windows at a given window-to-wall ratio
12 model.add_windows({"wtr" => 0.4})
13 #add HVAC - Packaged VAV w/ Reheat - DX Cooling, Hot Water heat and reheat
14 model.add_hvac({"fan_eff" => 0.5,
15               "hvac_eff" => 0.5,
16               "hvac_type" => "Packaged VAV w/ Reheat - DX Cooling, Hot Water heat and reheat"})
17 #add thermostats
18 model.add_thermostats({"heating_setpoint" => 24,
19                      "cooling_setpoint" => 75,
20                      "fan_setpoint" => 75})
21 #assign constructions from a local library to the model (windows/etc. in the model)
22 model.add_constructions({"construction_library_path" => "#{Dir.pwd}/VirtualPULSE_default_constructions.osm"})
23
24 #add space type from a remote library (NREL reference building vintage) to the model
25 model.add_space_type({"NREL_reference_building_vintage" => "ASHRAE_90.1-2004",
26                     "space_type" => "Office"})
27 #add design days to the model
28 model.add_design_days({})
29
30 #save the OpenStudio model (.osm)
31 model.save_openstudio_model({"osm_save_directory" => Dir.pwd})
32 #translate the OpenStudio model (.osm) to an EnergyPlus model (.idf)
33 model.translate_to_energyplus_and_save_idf({"idf_save_directory" => Dir.pwd})
34 #run the EnergyPlus model (.idf)
35 VirtualPULSEModel::run_energyplus_simulation({"idf_directory" => Dir.pwd})
36
```

13 Lines of Ruby Code + Comments

Geometry and Space Type Definitions

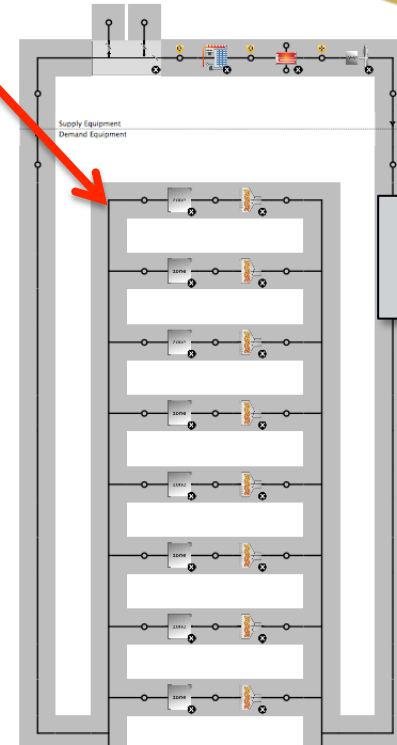


Equipment Consumption [kBTUx10<sup>6</sup>]



Simulated End Uses

Detailed HVAC and Zoning



# ...and Cloud-Based Analysis

User  
Interfaces



Scripted  
Analysis



spreadsheet  
interfaces

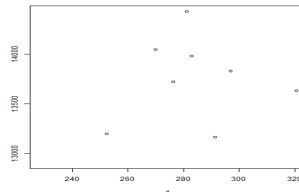
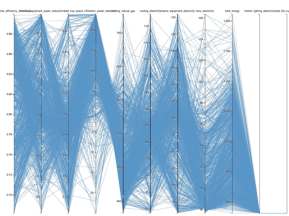
Area	System	Area Type	Area Value	Area Unit	Area Description	Area Status	Area Comment
100	Area 1	Area 1	100	100	Area 1	100	Area 1
101	Area 2	Area 2	101	101	Area 2	101	Area 2
102	Area 3	Area 3	102	102	Area 3	102	Area 3
103	Area 4	Area 4	103	103	Area 4	103	Area 4
104	Area 5	Area 5	104	104	Area 5	104	Area 5
105	Area 6	Area 6	105	105	Area 6	105	Area 6
106	Area 7	Area 7	106	106	Area 7	106	Area 7
107	Area 8	Area 8	107	107	Area 8	107	Area 8
108	Area 9	Area 9	108	108	Area 9	108	Area 9
109	Area 10	Area 10	109	109	Area 10	109	Area 10
110	Area 11	Area 11	110	110	Area 11	110	Area 11
111	Area 12	Area 12	111	111	Area 12	111	Area 12
112	Area 13	Area 13	112	112	Area 13	112	Area 13
113	Area 14	Area 14	113	113	Area 14	113	Area 14
114	Area 15	Area 15	114	114	Area 15	114	Area 15
115	Area 16	Area 16	115	115	Area 16	115	Area 16
116	Area 17	Area 17	116	116	Area 17	116	Area 17
117	Area 18	Area 18	117	117	Area 18	117	Area 18
118	Area 19	Area 19	118	118	Area 19	118	Area 19
119	Area 20	Area 20	119	119	Area 20	119	Area 20
120	Area 21	Area 21	120	120	Area 21	120	Area 21
121	Area 22	Area 22	121	121	Area 22	121	Area 22
122	Area 23	Area 23	122	122	Area 23	122	Area 23
123	Area 24	Area 24	123	123	Area 24	123	Area 24
124	Area 25	Area 25	124	124	Area 25	124	Area 25
125	Area 26	Area 26	125	125	Area 26	125	Area 26
126	Area 27	Area 27	126	126	Area 27	126	Area 27
127	Area 28	Area 28	127	127	Area 28	127	Area 28
128	Area 29	Area 29	128	128	Area 29	128	Area 29
129	Area 30	Area 30	129	129	Area 30	129	Area 30
130	Area 31	Area 31	130	130	Area 31	130	Area 31
131	Area 32	Area 32	131	131	Area 32	131	Area 32
132	Area 33	Area 33	132	132	Area 33	132	Area 33
133	Area 34	Area 34	133	133	Area 34	133	Area 34
134	Area 35	Area 35	134	134	Area 35	134	Area 35
135	Area 36	Area 36	135	135	Area 36	135	Area 36
136	Area 37	Area 37	136	136	Area 37	136	Area 37
137	Area 38	Area 38	137	137	Area 38	137	Area 38
138	Area 39	Area 39	138	138	Area 39	138	Area 39
139	Area 40	Area 40	139	139	Area 40	139	Area 40
140	Area 41	Area 41	140	140	Area 41	140	Area 41
141	Area 42	Area 42	141	141	Area 42	141	Area 42
142	Area 43	Area 43	142	142	Area 43	142	Area 43
143	Area 44	Area 44	143	143	Area 44	143	Area 44
144	Area 45	Area 45	144	144	Area 45	144	Area 45
145	Area 46	Area 46	145	145	Area 46	145	Area 46
146	Area 47	Area 47	146	146	Area 47	146	Area 47
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150	Area 51	Area 51	150	150	Area 51	150	Area 51
151	Area 52	Area 52	151	151	Area 52	151	Area 52
152	Area 53	Area 53	152	152	Area 53	152	Area 53
153	Area 54	Area 54	153	153	Area 54	153	Area 54
154	Area 55	Area 55	154	154	Area 55	154	Area 55
155	Area 56	Area 56	155	155	Area 56	155	Area 56
156	Area 57	Area 57	156	156	Area 57	156	Area 57
157	Area 58	Area 58	157	157	Area 58	157	Area 58
158	Area 59	Area 59	158	158	Area 59	158	Area 59
159	Area 60	Area 60	159	159	Area 60	159	Area 60
160	Area 61	Area 61	160	160	Area 61	160	Area 61
161	Area 62	Area 62	161	161	Area 62	161	Area 62
162	Area 63	Area 63	162	162	Area 63	162	Area 63
163	Area 64	Area 64	163	163	Area 64	163	Area 64
164	Area 65	Area 65	164	164	Area 65	164	Area 65
165	Area 66	Area 66	165	165	Area 66	165	Area 66
166	Area 67	Area 67	166	166	Area 67	166	Area 67
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169	Area 70	Area 70	169	169	Area 70	169	Area 70
170	Area 71	Area 71	170	170	Area 71	170	Area 71
171	Area 72	Area 72	171	171	Area 72	171	Area 72
172	Area 73	Area 73	172	172	Area 73	172	Area 73
173	Area 74	Area 74	173	173	Area 74	173	Area 74
174	Area 75	Area 75	174	174	Area 75	174	Area 75
175	Area 76	Area 76	175	175	Area 76	175	Area 76
176	Area 77	Area 77	176	176	Area 77	176	Area 77
177	Area 78	Area 78	177	177	Area 78	177	Area 78
178	Area 79	Area 79	178	178	Area 79	178	Area 79
179	Area 80	Area 80	179	179	Area 80	179	Area 80
180	Area 81	Area 81	180	180	Area 81	180	Area 81
181	Area 82	Area 82	181	181	Area 82	181	Area 82
182	Area 83	Area 83	182	182	Area 83	182	Area 83
183	Area 84	Area 84	183	183	Area 84	183	Area 84
184	Area 85	Area 85	184	184	Area 85	184	Area 85
185	Area 86	Area 86	185	185	Area 86	185	Area 86
186	Area 87	Area 87	186	186	Area 87	186	Area 87
187	Area 88	Area 88	187	187	Area 88	187	Area 88
188	Area 89	Area 89	188	188	Area 89	188	Area 89
189	Area 90	Area 90	189	189	Area 90	189	Area 90
190	Area 91	Area 91	190	190	Area 91	190	Area 91
191	Area 92	Area 92	191	191	Area 92	191	Area 92
192	Area 93	Area 93	192	192	Area 93	192	Area 93
193	Area 94	Area 94	193	193	Area 94	193	Area 94
194	Area 95	Area 95	194	194	Area 95	194	Area 95
195	Area 96	Area 96	195	195	Area 96	195	Area 96
196	Area 97	Area 97	196	196	Area 97	196	Area 97
197	Area 98	Area 98	197	197	Area 98	197	Area 98
198	Area 99	Area 99	198	198	Area 99	198	Area 99
199	Area 100	Area 100	199	199	Area 100	199	Area 100

Server



OpenStudio Cloud Management Console

Analysis Results



Cloud, Cluster, or Localhost



...



Workers



# Yes, but...

- What's that third one there?
- Well, that's Radiance.
- Where's that fit in?
- Oh, yeah...



# Radiance Measure

## Daylight simulation with Radiance is now available as an OpenStudio measure!

```
# see the URL below for information on how to write OpenStudio measures:
# http://nrel.github.io/OpenStudio-user-documentation/measures/measure_writing_guide/

# design document for this measure is at https://docs.google.com/document/d/16_TLRuhc4VFs2o0gRAp81hR0bet7-s6fUEWo3H07LpE/edit#

require 'fileutils'
require 'csv'
require 'tempfile'
require 'date'

# start the measure
class RadianceMeasure < OpenStudio::Ruleset::ModelUserScript

  # human readable name
  def name
    return "Radiance Daylighting Measure"
  end

  # human readable description
  def description
    return "This measure uses Radiance instead of EnergyPlus for daylighting calculations with OpenStudio."
  end

  # human readable description of modeling approach
  def modeler_description
    return "The OpenStudio model is converted to Radiance format. All spaces containing daylighting objects (illuminance map, daylighting
  end

  # define the arguments that the user will input
  def arguments(model)
    args = OpenStudio::Ruleset::OSArgumentVector.new

    chs = OpenStudio::StringVector.new
    chs << 'Yes'
    chs << 'No'
    apply_schedules = OpenStudio::Ruleset::OSArgument::makeChoiceArgument('apply_schedules', chs, true)
    apply_schedules.setDisplayName('Apply schedules')
    apply_schedules.setDefaultValue('Yes')
    apply_schedules.setDescription('Replace lighting and shading control schedules with schedules computed by Radiance')
    args << apply_schedules
  end
end
```

# Radiance Measure

---

By moving the Radiance simulation workflows to the OS Measure Framework, users can use Radiance for/with:

- GUI-based parameter space creation (PAT)
- Large-scale analysis (OpenStudio-Server)
- Simulations on local systems or on the cloud (AWS, other)

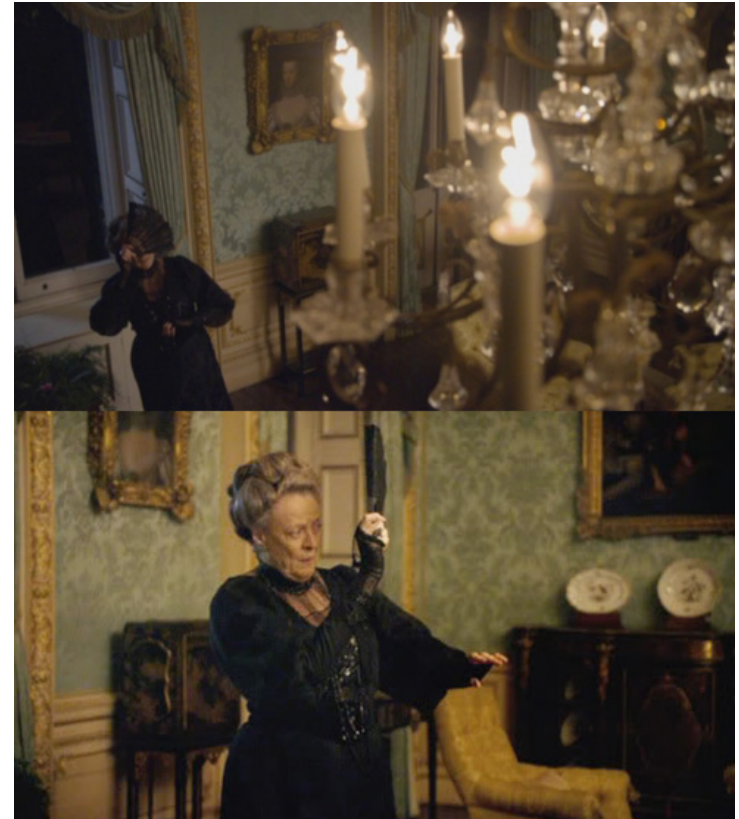
# So what?

Evaluating daylight in a space *constrained by an energy model's notion of architecture*, is a fool's errand!

Climate based daylight modeling and spatial daylight distribution form the foundation of all modern “dynamic daylight metrics”, which are here to stay.

And real buildings have *people* in them!

***Modern metrics require better tools, both for application and refinement***



***“Oh, dear, such a glare!”***

- Violet, Dowager Countess of Grantham, offering her opinion of small-size, intense light sources



# Why Radiance?

**Real buildings are partitioned by space use, not by HVAC zone!**

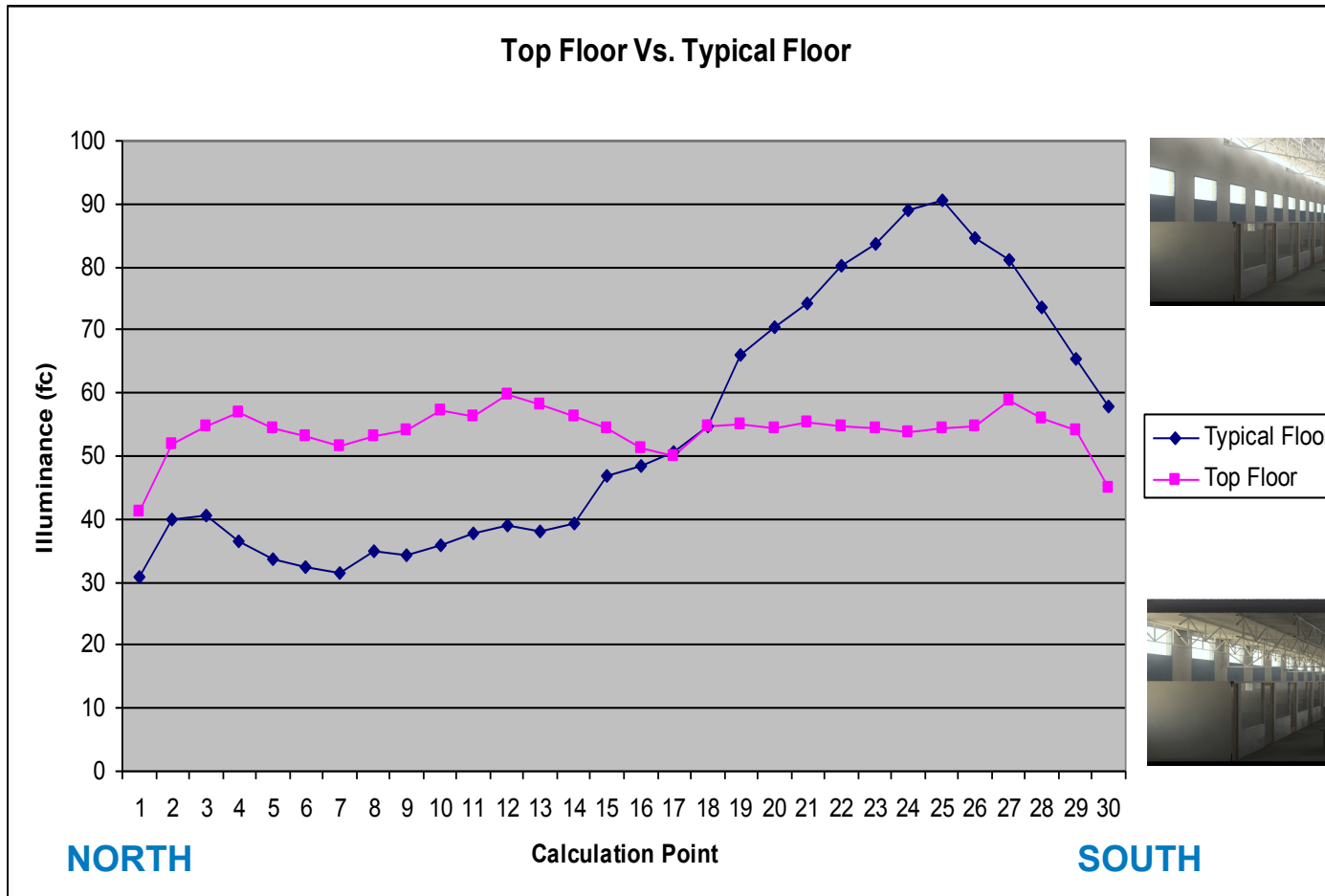
EnergyPlus' sense of interior architectural space has no relationship to the actual interior architecture!

Radiance and the OpenStudio model are not constrained by thermal zone boundaries



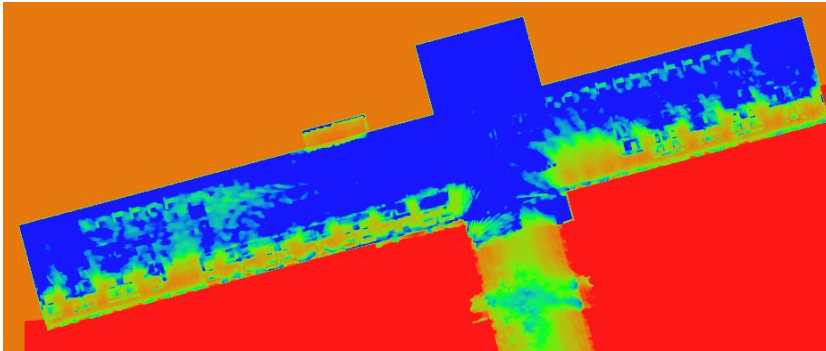
EnergyPlus Daylight Model

# Radiance allows Architecturally Honest Daylight Simulation in BEM

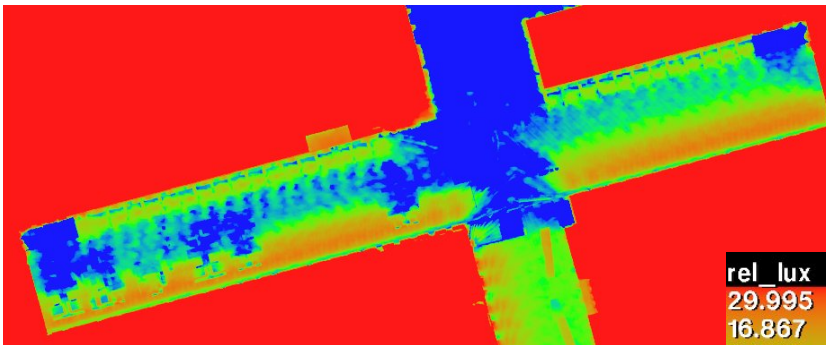


**Top vs. Typical Floor Illuminance Distribution**

# Architecturally Honest Simulation



First Floor



Second Floor

rel\_lux  
29.995  
16.867  
9.485  
5.334  
2.999  
1.686  
0.948  
0.533



# Why (not) Radiance?

The OpenStudio approach to Radiance is to provide better quality, climate-based, spatio-temporal daylighting data to inform:

- **General** daylight metrics (UDI! UDI! UDI!)
- Lighting energy savings potential and schedules for a **building energy model (BEM)**

LM-83 is a good start, but is already under scrutiny and revision proposal. Also requires lengthy calculations and detailed CFS data.

NREL has leveraged the OS Model and SDK for **integrated** daylight and building energy modeling, but more detailed daylight modeling, metrics reporting, and tighter linkage with EnergyPlus model objects is needed (and currently not funded) =(

</rant>

# OpenStudio/Radiance 3-Phase Workflow

---

## OpenStudio -> Radiance “Forward Translator”:

- **Converts model** from OpenStudio (.osm) to Radiance project:
  - Geometry
  - Materials
  - Analysis objects (illuminance grids, lighting control and glare analysis points)
  - Weather (.epw)
  - Schedules (lighting/equipment loads, occupancy, etc)
  - Views

# OpenStudio/Radiance 3-Phase Workflow

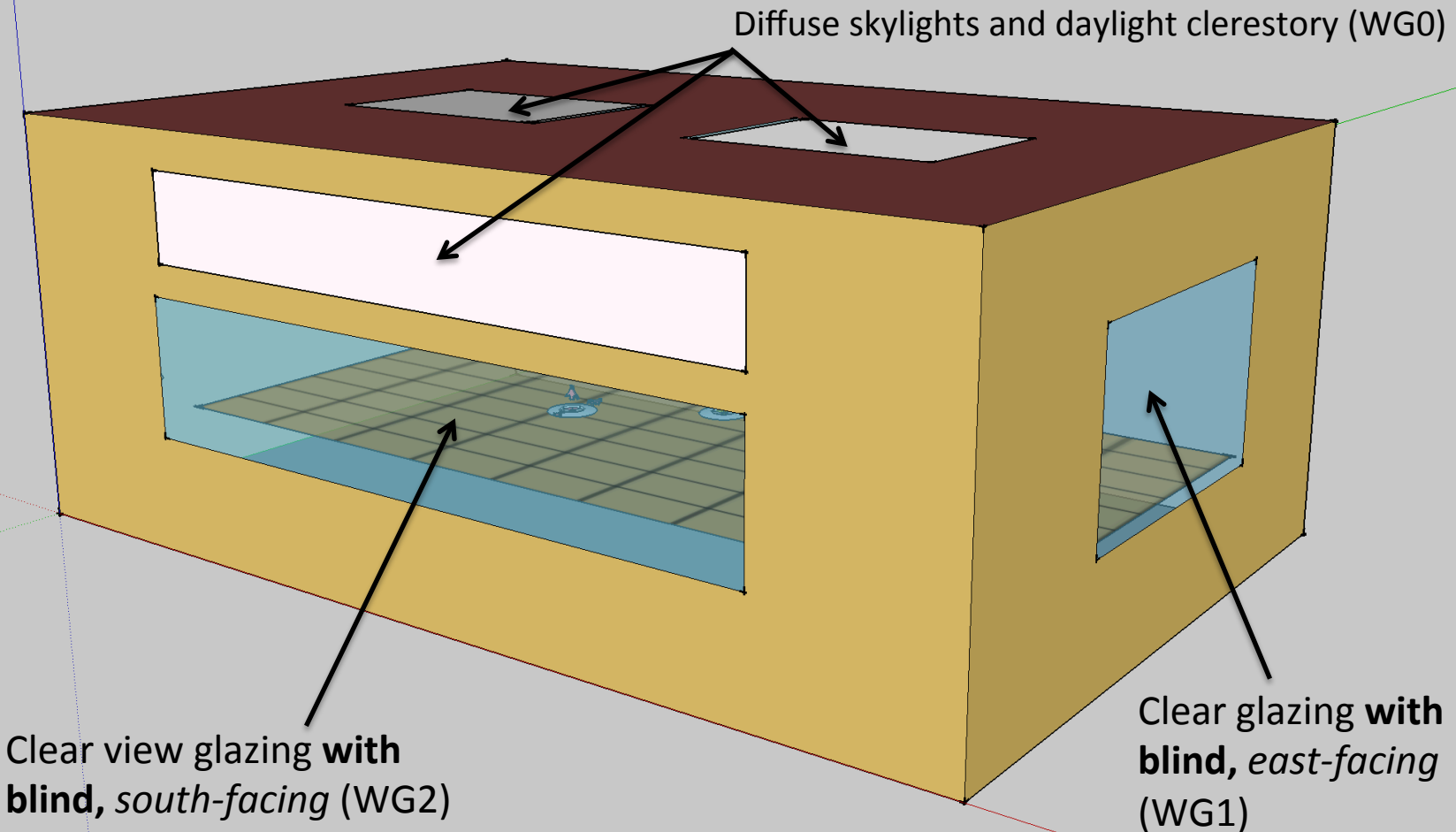
## OpenStudio -> Radiance “Forward Translator”:

- **Performs automatic window grouping:**
  - Uncontrolled windows are placed together, calculated as single phase
    - Single phase method
  - Controlled windows are logically grouped by:
    - Space
    - Orientation
    - VLT
    - CFS
      - OpenStudio v.1.9.0 will ship with BSDFs for:
        - Air! (allows to compute all view matrices simultaneously)
        - Blinds
        - Shadecloth
        - Daylight redirecting louvers



# Window Grouping Example

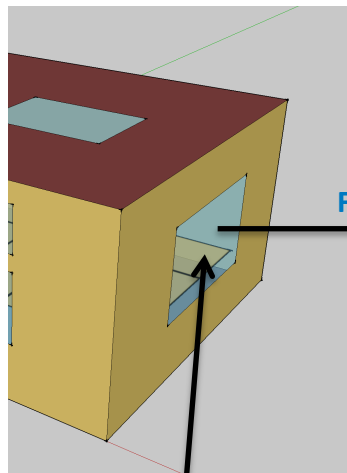
*Each window group receives an exterior solar gain sensor for shading control input (“auto shades”)*



# OpenStudio Rfluxmtx Integration

## OS::Radiance::ForwardTranslator

- Adds necessary headers for rfluxmtx
- ***Fully automates*** 3-phase matrix generation



ForwardTranslator

Clear glazing **with  
blind**, *east-facing*  
(WG1)

```
# OpenStudio Window Group: WG1
#@rfluxmtx h=kf u=Z o=output/dc/WG1.vmx
```

```
# SubSurface = East_Window
# Tvis = 0.25 (tn = 0.27)
WG1 polygon East_Window
```

```
0
0
12
8.561387500000031 4.110043965327130 2.504345203724800
8.561387500000031 4.110043965327130 0.973995203724805
8.561387500000031 1.633885650643690 0.973995203724805
8.561387500000031 1.633885650643690 2.504345203724800
```

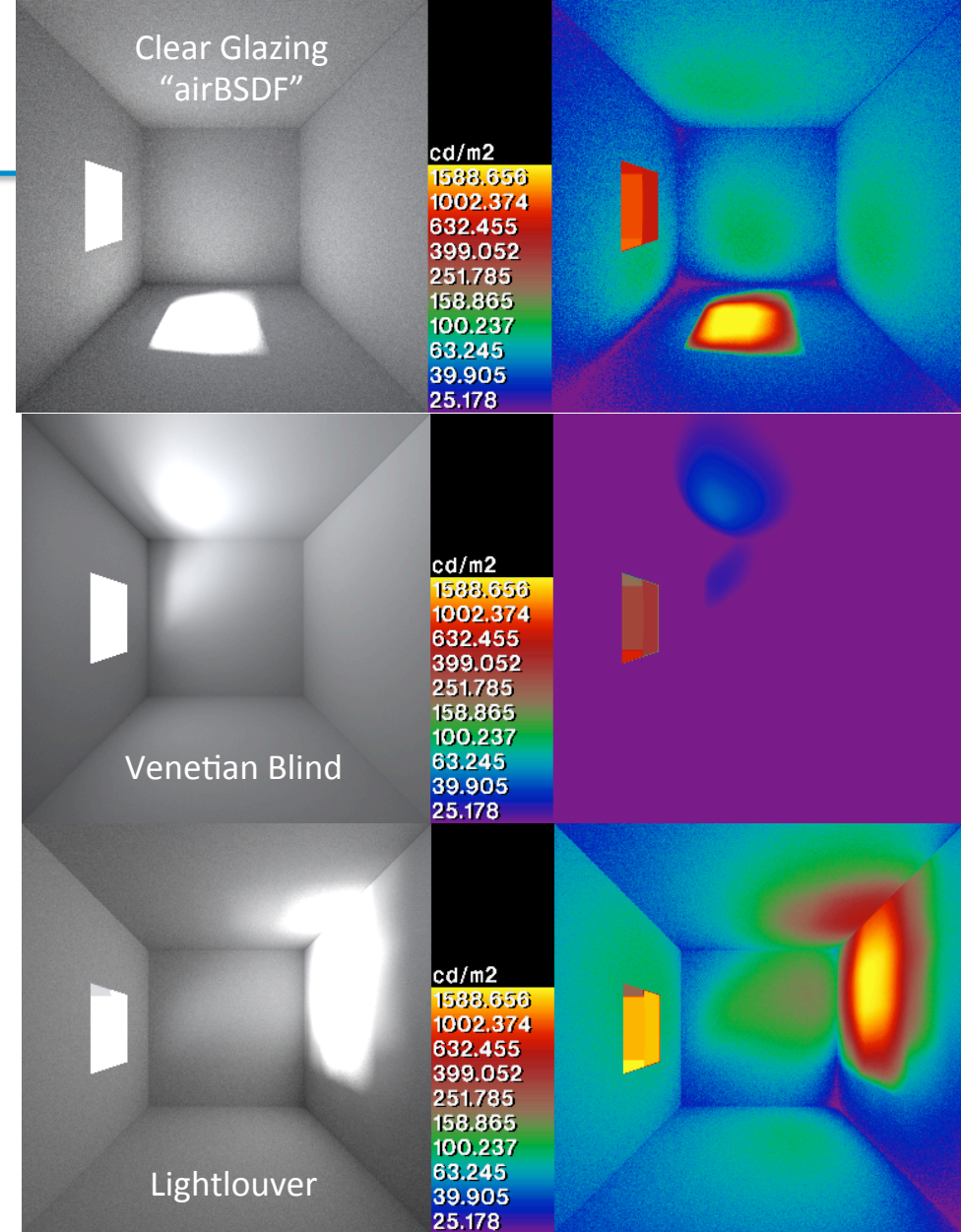
For (much) more on using rfluxmtx, see Andy McNeil's Presentation from the 2014 Radiance International Workshop:  
[http://www.radiance-online.org/community/workshops/2014-london/presentations/day1/McNeil\\_BSDFsandPhases.pdf](http://www.radiance-online.org/community/workshops/2014-london/presentations/day1/McNeil_BSDFsandPhases.pdf)

# CFS Support

OpenStudio 1.9.0 will include BSDFs for detailed simulation of complex fenestration systems (CFS):

- Venetian Blinds
- Shadecloth (e.g. Mechoshade)
- Daylight redirecting devices (e.g. Lightlouver)

*OpenStudio will allow you to use BSDFs as easily as any standard glazing material*

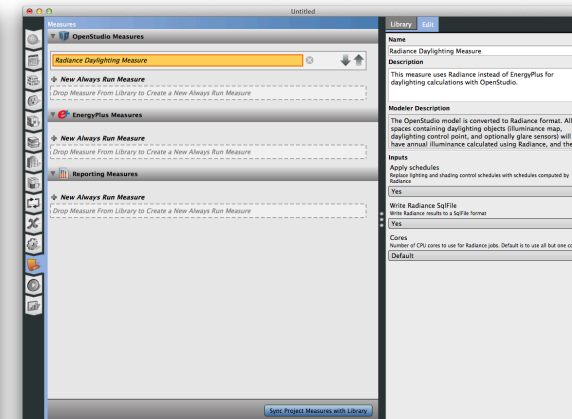
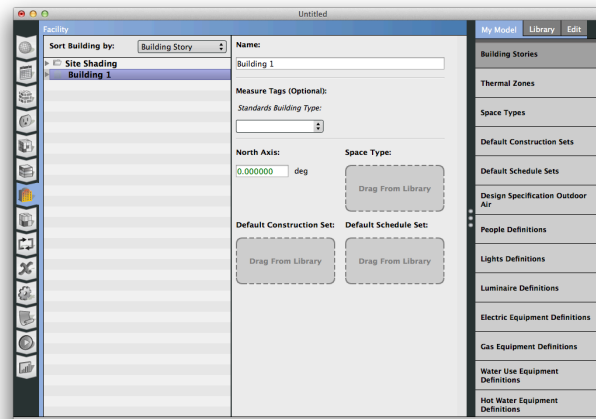
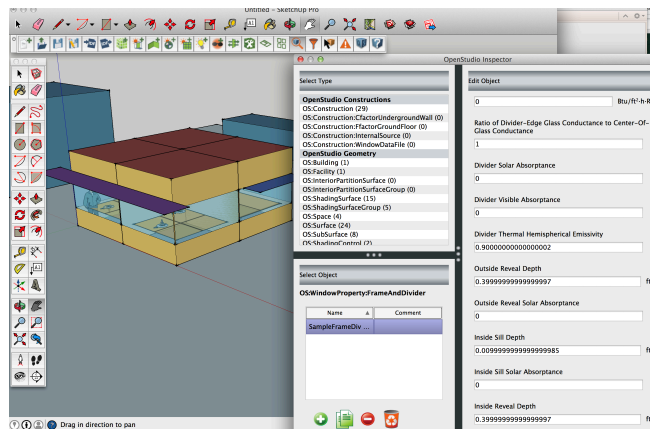
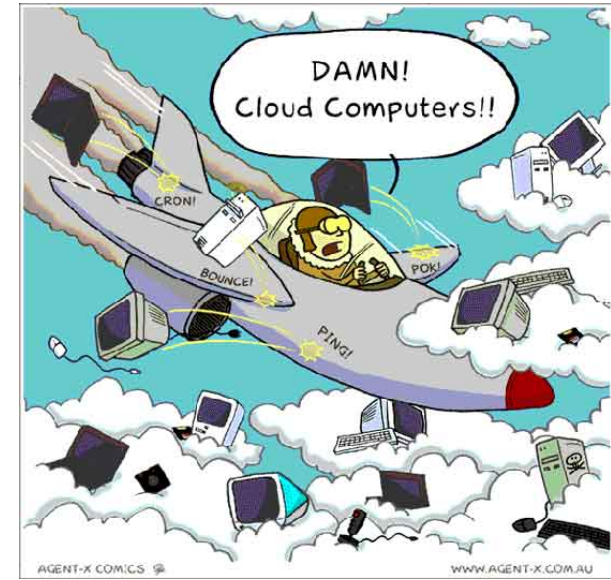


Additional info available at:  
<http://www.rumblestrip.org/2014/06/03/sanity-testing-bsdfs/>

← Probably NSFW, just sayin'.

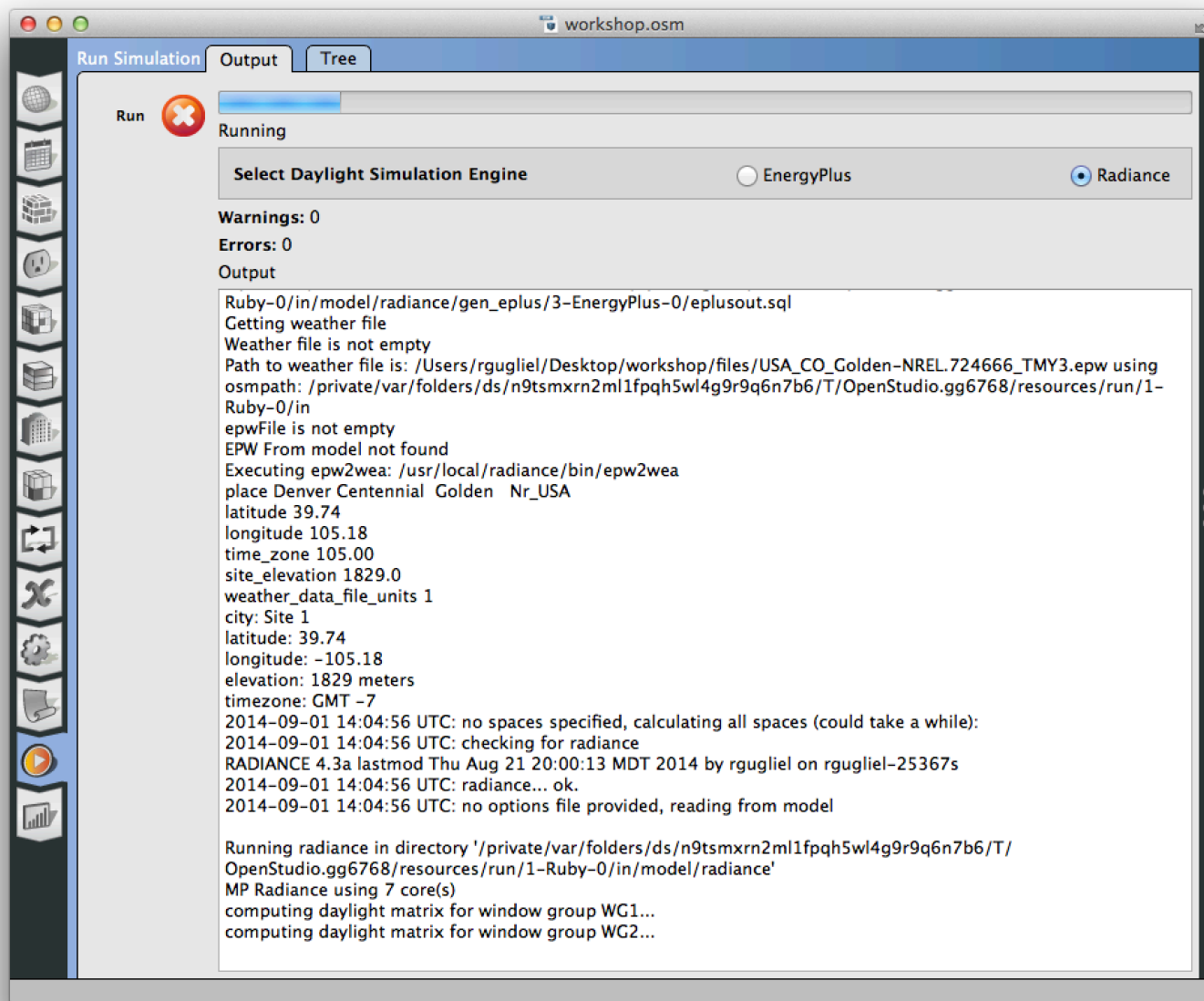
# New OpenStudio/Radiance Workflow

1. Create (or import) model in SketchUp
2. Finalize settings in OpenStudio Application (OSApp)
3. Run single model instance in OSApp, and/  
or:
4. Create parameter space in PAT and run  
zillions of models:
  - on local system,
  - or:
  - in the CLOUD!



# New OpenStudio/Radiance Workflow

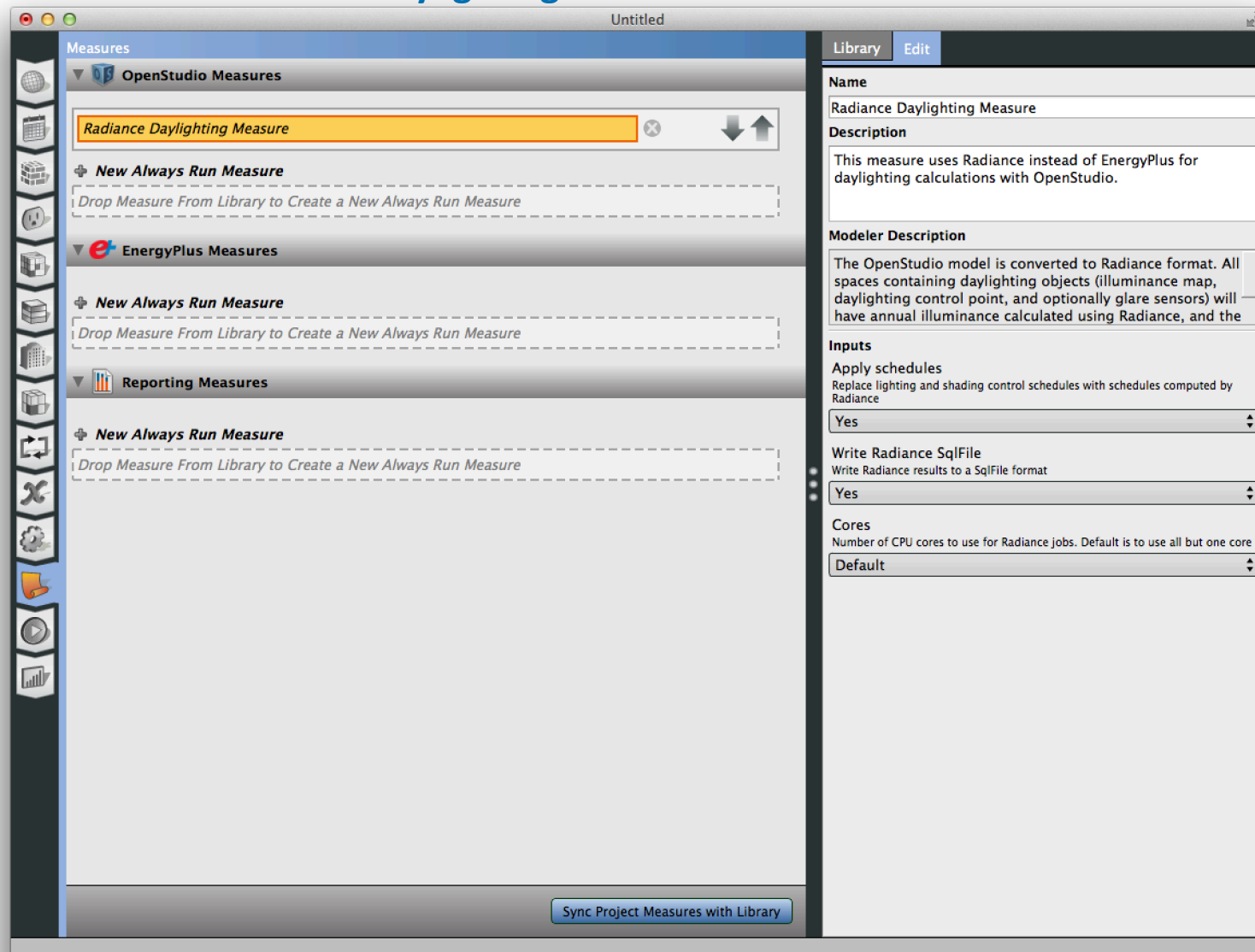
Simulation engine select radio buttons are gone...





# New OpenStudio/Radiance Workflow

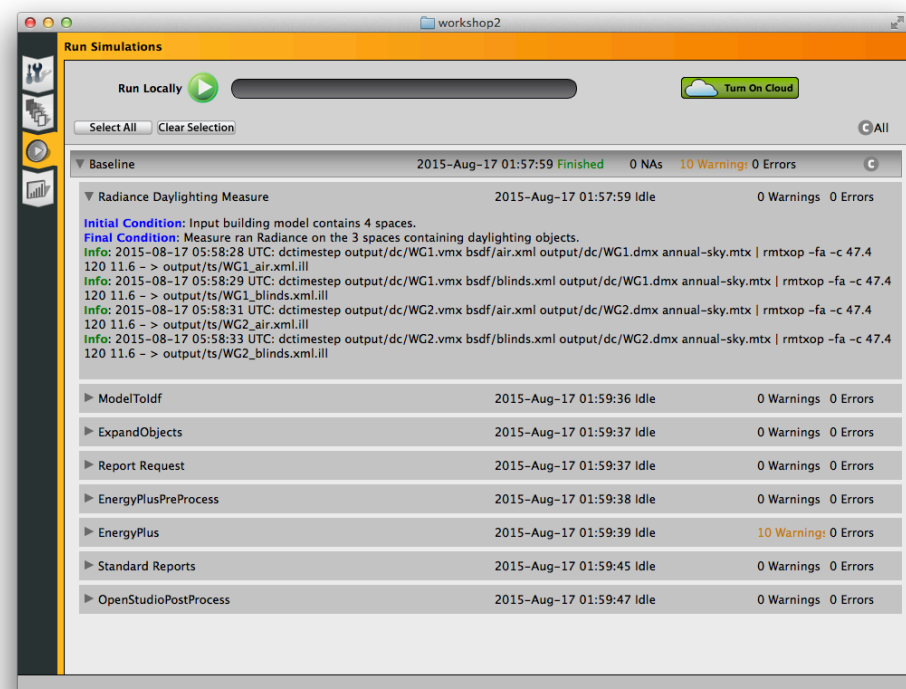
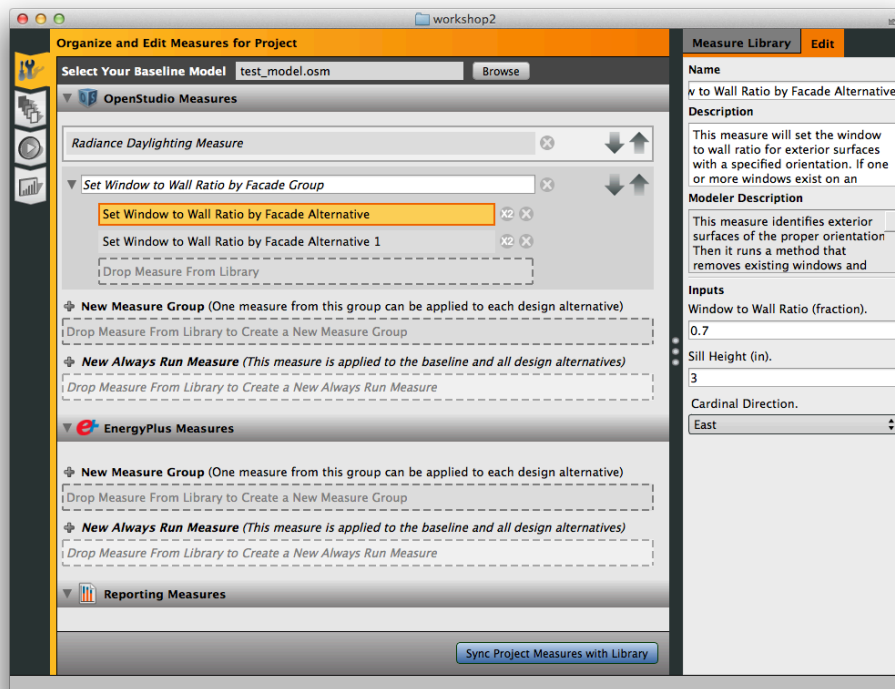
User now adds the Radiance Daylighting Measure to the “stack”





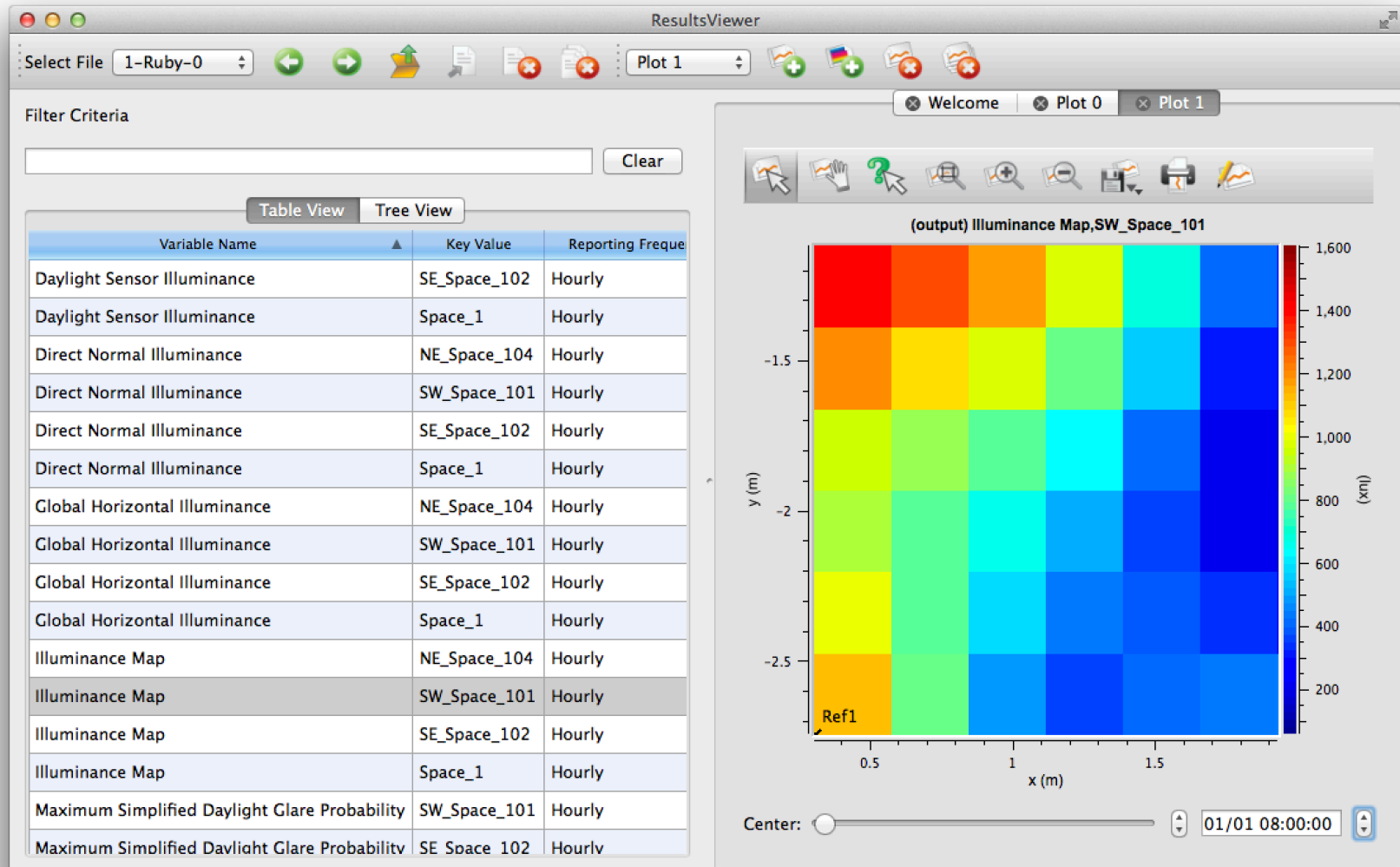
# New OpenStudio/Radiance Workflow

...and optionally loads in PAT for parametric analysis



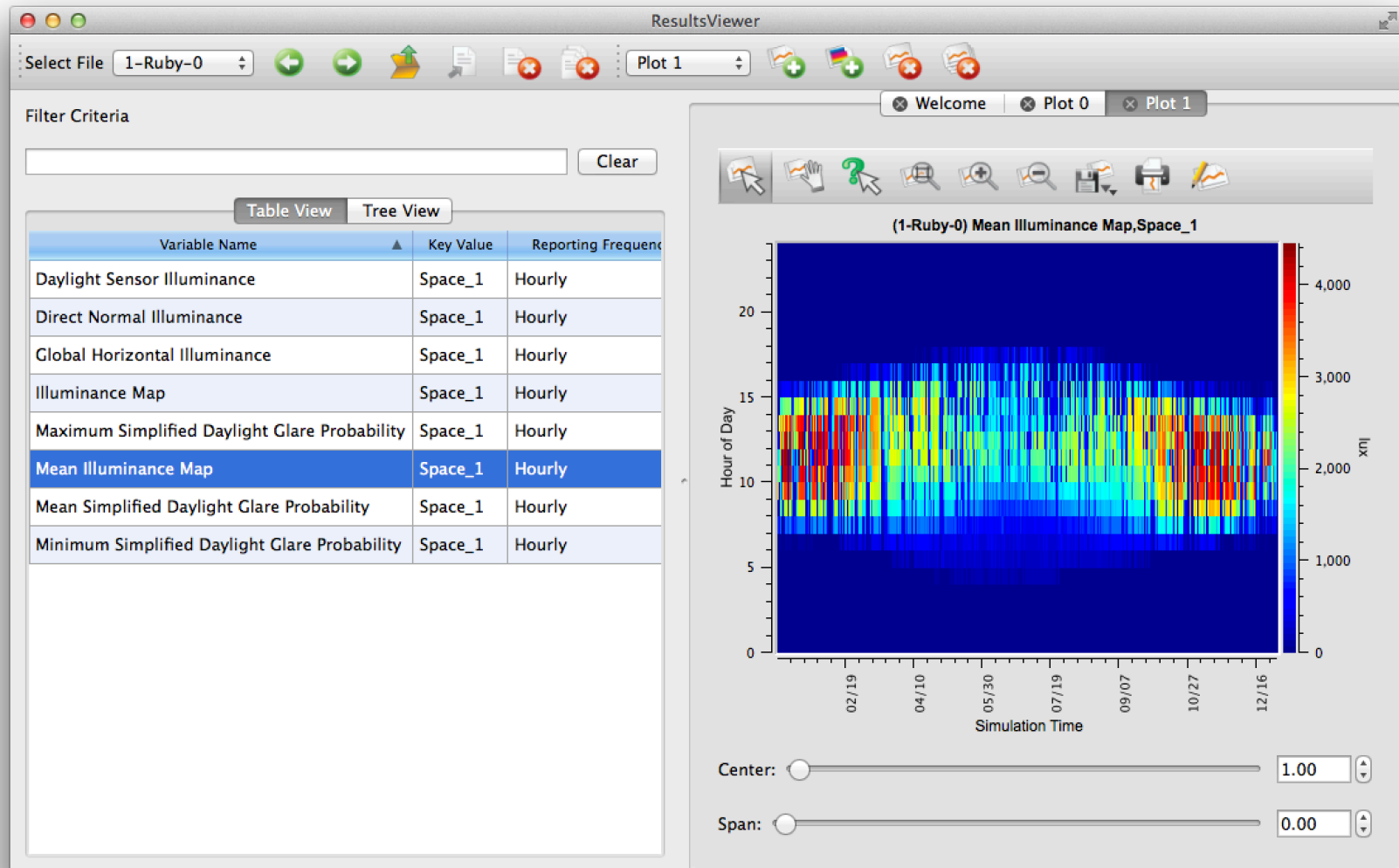
# New OpenStudio/Radiance Workflow

Individual space illuminance maps are saved in sql format...



# New OpenStudio/Radiance Workflow

Individual space illuminance maps are saved in sql format...



# New OpenStudio/Radiance Workflow

...and daylight metrics are stored in CSV format

```
# OpenStudio Daylight Metrics Report
# Average daylight autonomy for building daylight spaces: 0.65
# Space data format: [space_name] [metric(setpoint)] [input_hours_range] [metric_value] [hours_met] [input_hours]
NE_Space_104,DA(500),Daylit Hours,0.66,3102,4710
NE_Space_104,DA(500),Occupied Hours,0.47,2481,5270
NE_Space_104,DA(500),Daylit and Occupied Hours,0.66,2475,3735
NE_Space_104,conDA(500),Daylit Hours,0.68,3197,4710
NE_Space_104,conDA(500),0.49,Occupied Hours2565,5270
NE_Space_104,conDA(500),Daylit and Occupied Hours,0.68,2549,3735
NE_Space_104,UDI(100-3000),Daylit Hours,0.45,2134,4710
NE_Space_104,UDI(100-3000),Occupied Hours,0.32,1707,5270
NE_Space_104,UDI(100-3000),Daylit and Occupied Hours,0.45,2549,3735
SW_Space_101,DA(323),Daylit Hours,0.63,2959,4710
SW_Space_101,DA(323),Occupied Hours,0.46,2412,5270
SW_Space_101,DA(323),Daylit and Occupied Hours,0.65,2411,3735
SW_Space_101,conDA(323),Daylit Hours,0.72,3413,4710
SW_Space_101,conDA(323),0.52,Occupied Hours2761,5270
SW_Space_101,conDA(323),Daylit and Occupied Hours,0.74,2750,3735
SW_Space_101,UDI(100-3000),Daylit Hours,0.67,3172,4710
SW_Space_101,UDI(100-3000),Occupied Hours,0.48,2543,5270
SW_Space_101,UDI(100-3000),Daylit and Occupied Hours,0.68,2750,3735
SE_Space_102,DA(323),Daylit Hours,0.63,2953,4710
SE_Space_102,DA(323),Occupied Hours,0.45,2374,5270
SE_Space_102,DA(323),Daylit and Occupied Hours,0.63,2361,3735
SE_Space_102,conDA(323),Daylit Hours,0.71,3327,4710
SE_Space_102,conDA(323),0.51,Occupied Hours2675,5270
SE_Space_102,conDA(323),Daylit and Occupied Hours,0.71,2651,3735
SE_Space_102,UDI(100-3000),Daylit Hours,0.53,2499,4710
SE_Space_102,UDI(100-3000),Occupied Hours,0.38,2025,5270
SE_Space_102,UDI(100-3000),Daylit and Occupied Hours,0.54,2651,3735
```





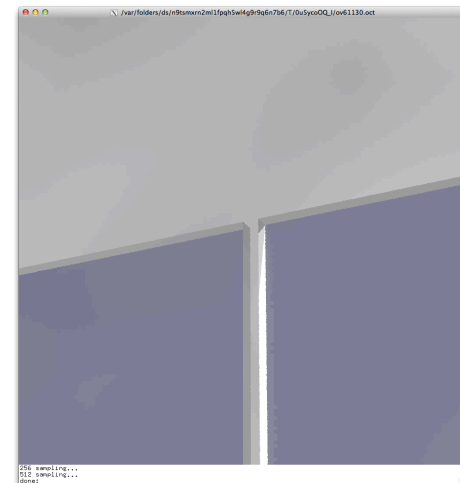
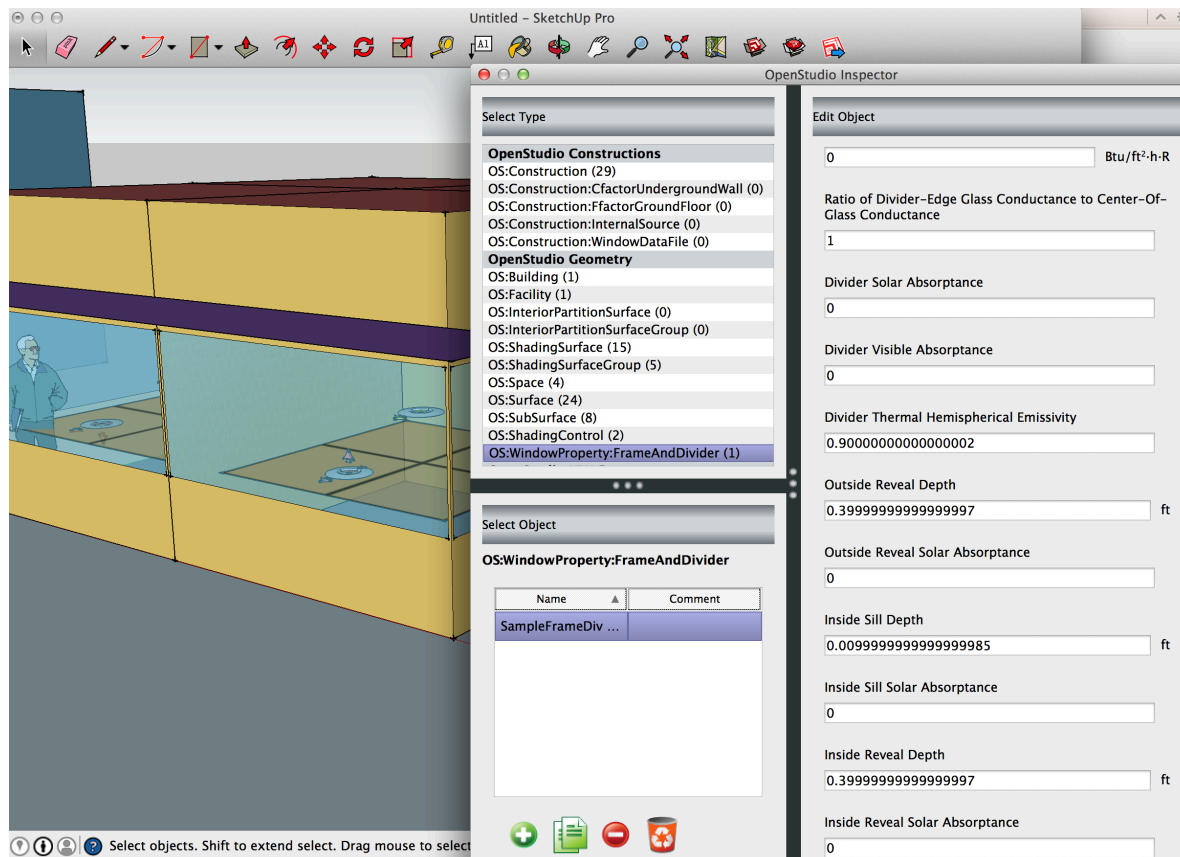
Why don't you  
show them? (demo)



# Wall Thickness

## OS::Window::FrameAndDivider

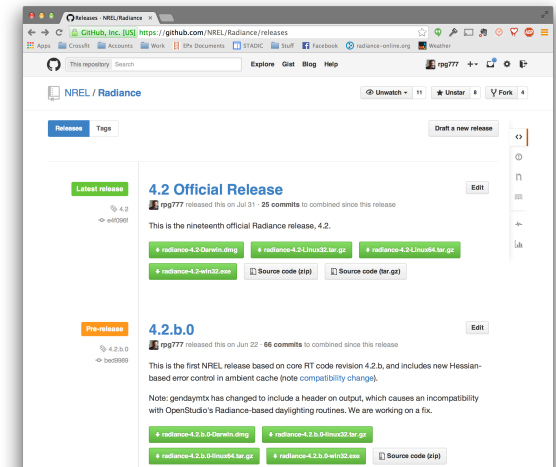
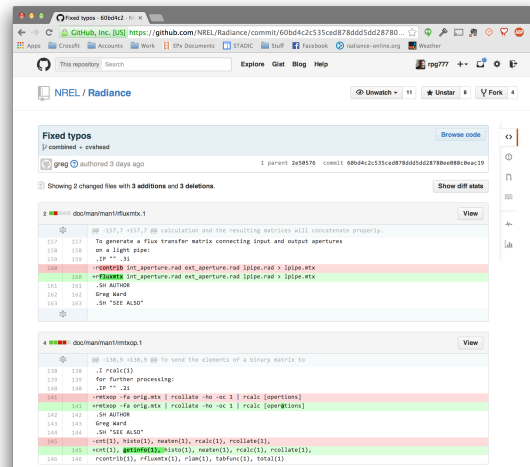
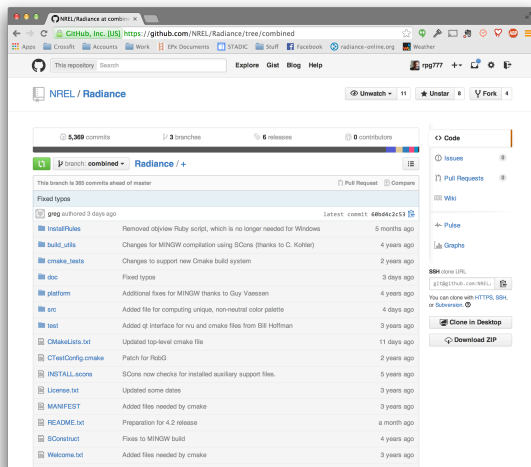
- Support for wall thickness, mullions and framing
- Translates to Radiance model (and EnergyPlus)





# Radiance on GitHub

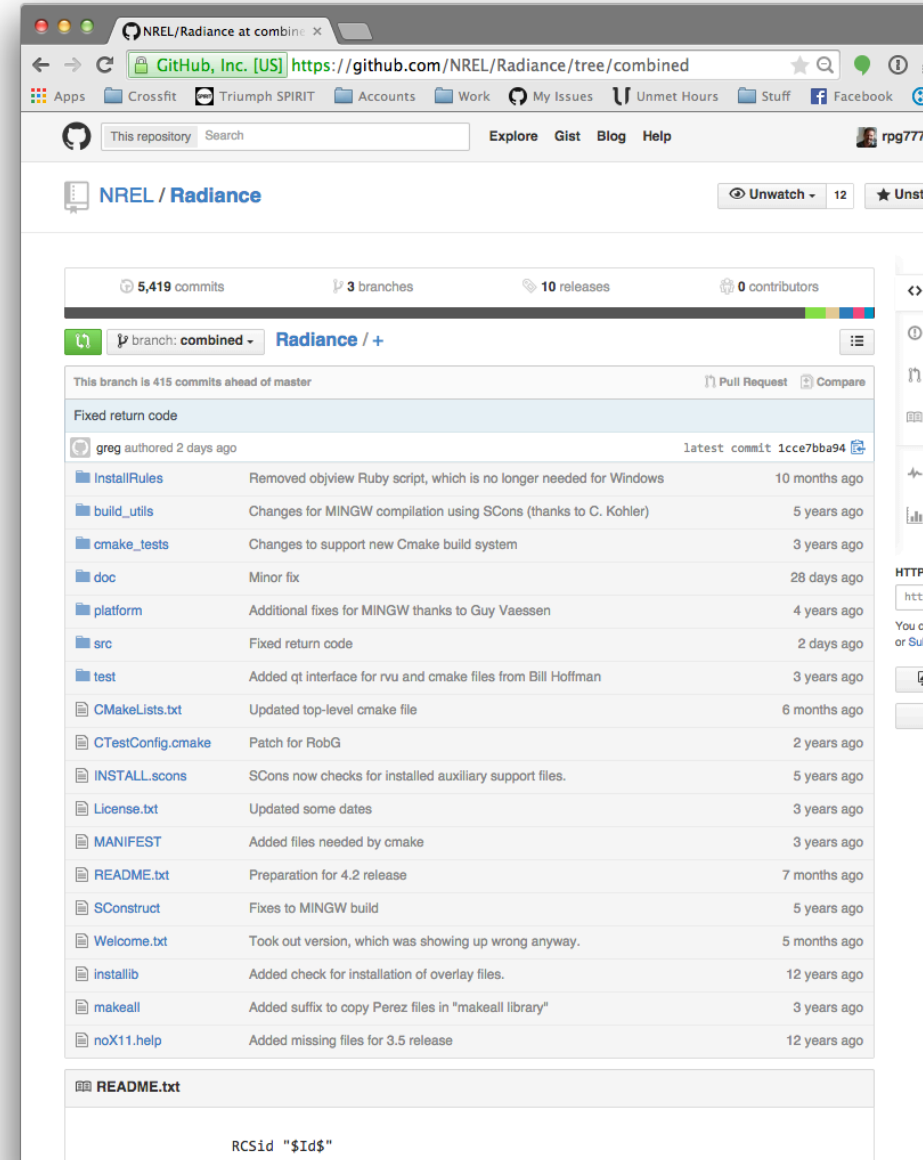
- Mirror of Radiance CVS source code repository
- Refreshed every 15 minutes
- Full revision history
- **Use “combined” branch for latest history!**
- NREL installers (Windows, Mac, Unix)
- Release snapshots
- <https://github.com/NREL/Radiance>
- Thanks/fist-bumps to Nick Long (NREL), Zack Galbreath (Kitware), and US Department of Energy for this resource!



# Radiance on GitHub

## GitHub mirror of Radiance source repository

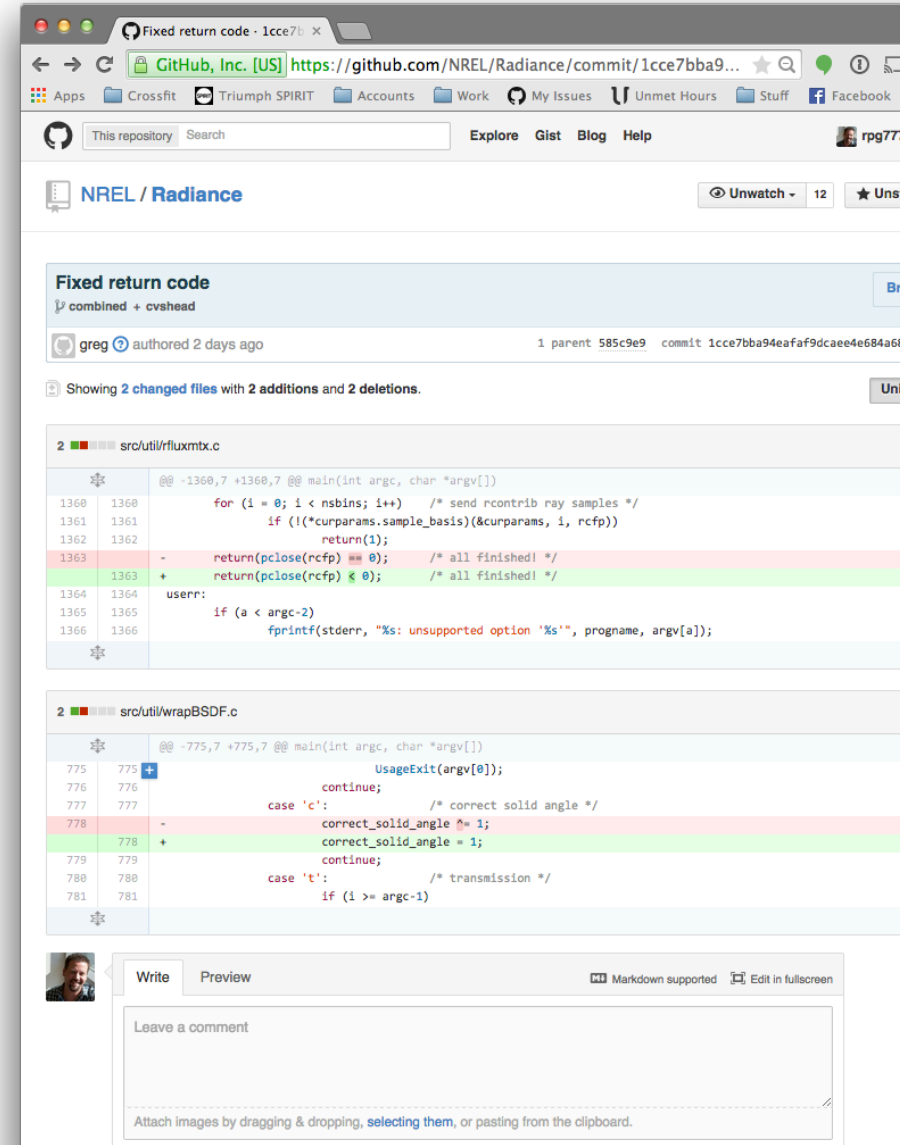
- Easy access to Radiance source code
- Release tags
- Revision history
- Installers (Packages)
- <https://github.com/NREL/Radiance>



# Radiance on GitHub

## GitHub mirror of Radiance source repository

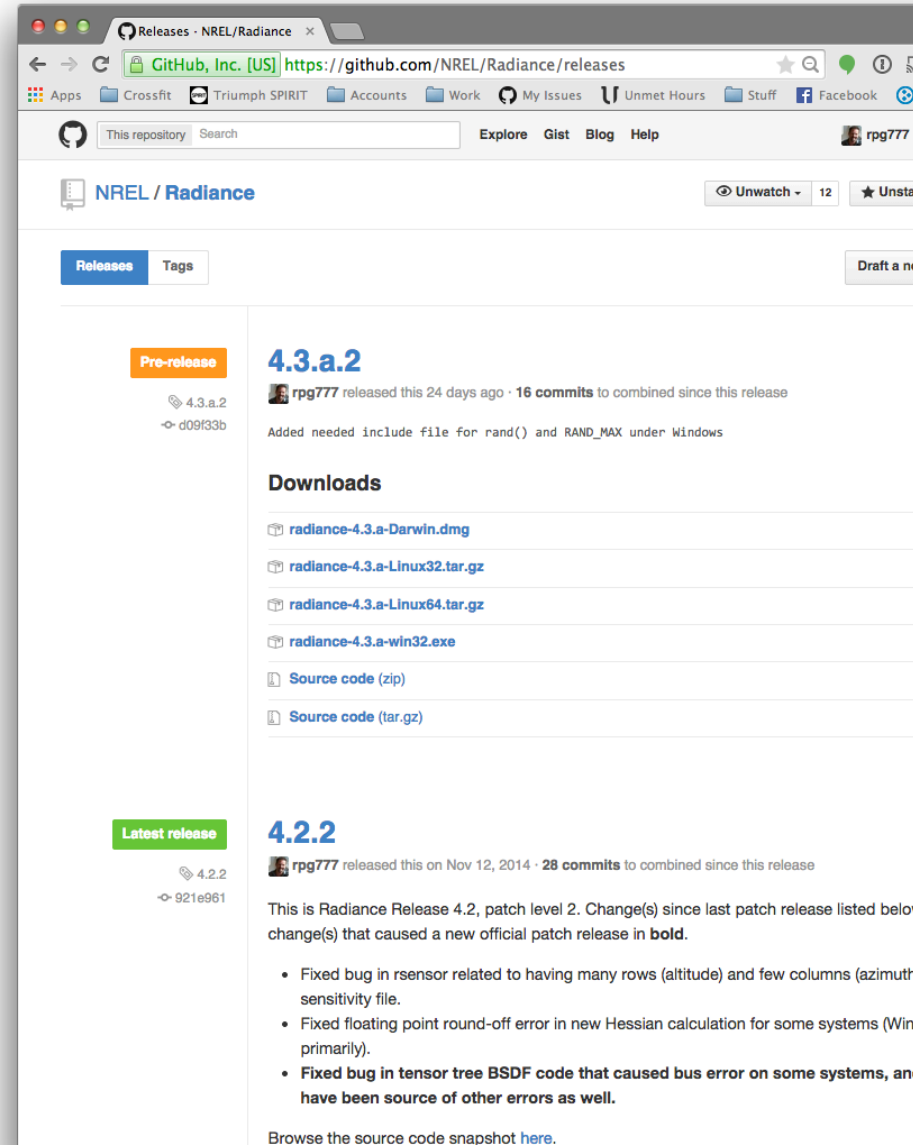
- Easy access to Radiance source code
- Release tags
- **Revision history**
- Installers (Packages)
- <https://github.com/NREL/Radiance>



# Radiance on GitHub

## GitHub mirror of Radiance source repository

- Easy access to Radiance source code
- Release tags
- Revision history
- **Installers (Packages)**
- <https://github.com/NREL/Radiance>



# OpenStudio/Radiance Roadmap

---

## For v1.9.0 (September 30, 2015)

- Radiance Measure
- Testing/validation
- Documentation

## FY2016 (Begins October 1, 2015)

- Continued support of Radiance source code mirror on GitHub
- Cross platform Radiance installers
- Auto grid generation (either internal tool or CBEIs dxGridmaker)
- Data visualization
  - Report “Measure”
  - JavaScript/Angular.js, etc...
  - ?





How's that  
demo going? (woof.)