IES VE with CBECC-Com and Whole-Building Energy Modeling

Liam Buckley
ASHRAE Member, M.Eng., C.Eng. MIEI, BEMP
Liam.Buckley@iesve.com

Agenda

IES VE with CBECC-Com and Whole-Building Energy Modeling

1. Introduction to IES and our Technology
2. IES VE with CBECC-Com
3. How do I model …….. for Compliance and Design
4. Case Studies
5. Q & A

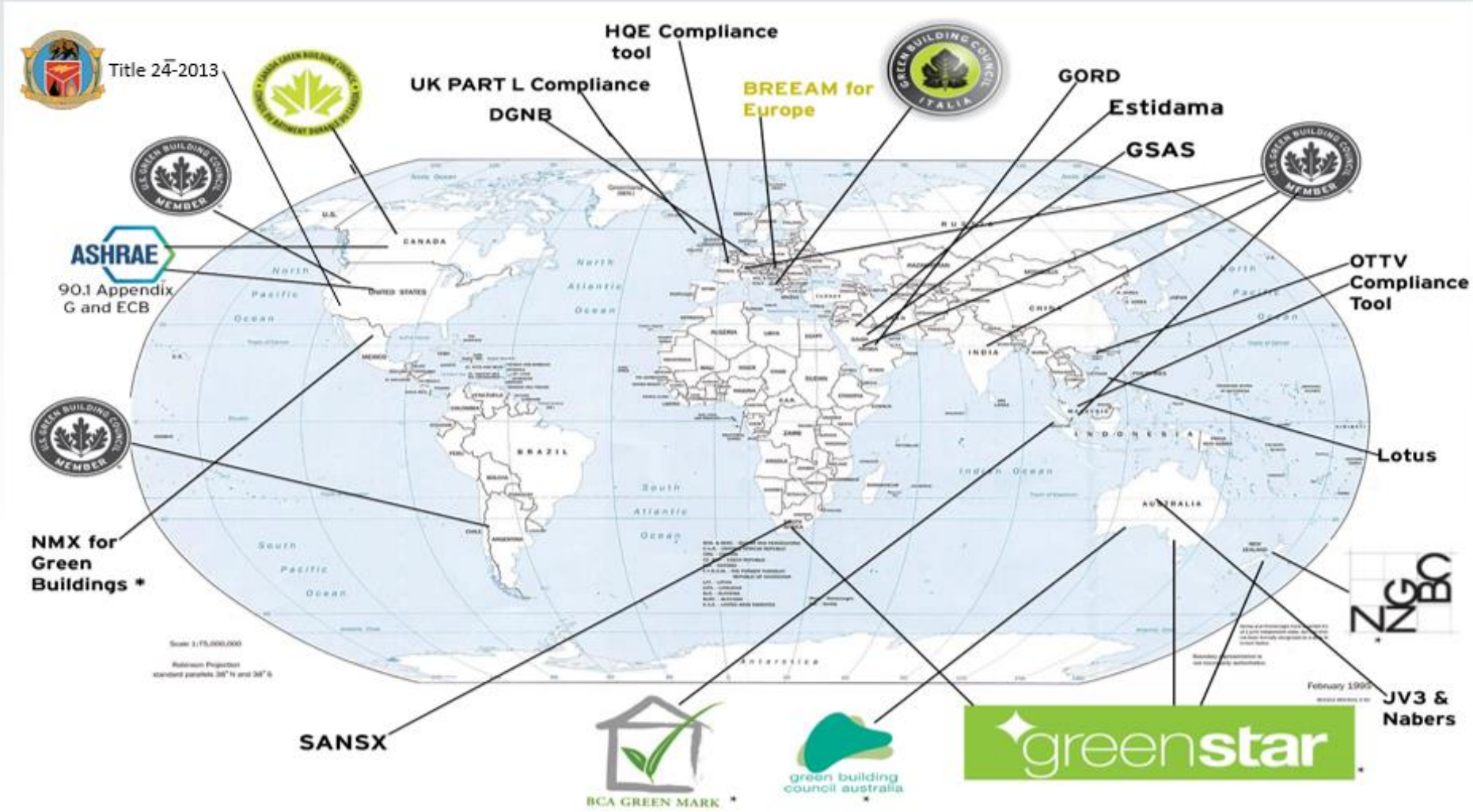
IES Ltd. – What we do

IES VE with CBECC-Com and Whole-Building Energy Modeling

1. Software
   - Compliance
   - Building Performance Analysis
2. Training
   - Compliance (Utilities: 1 Day)
   - Building Performance Analysis (2-3 Days)
3. (Sub)Consulting
   - Building Performance Analysis
   - Compliance
4. Research & Development
   - Masterplanning, existing buildings
   - www.iesve.com

IES Ltd. – What we do

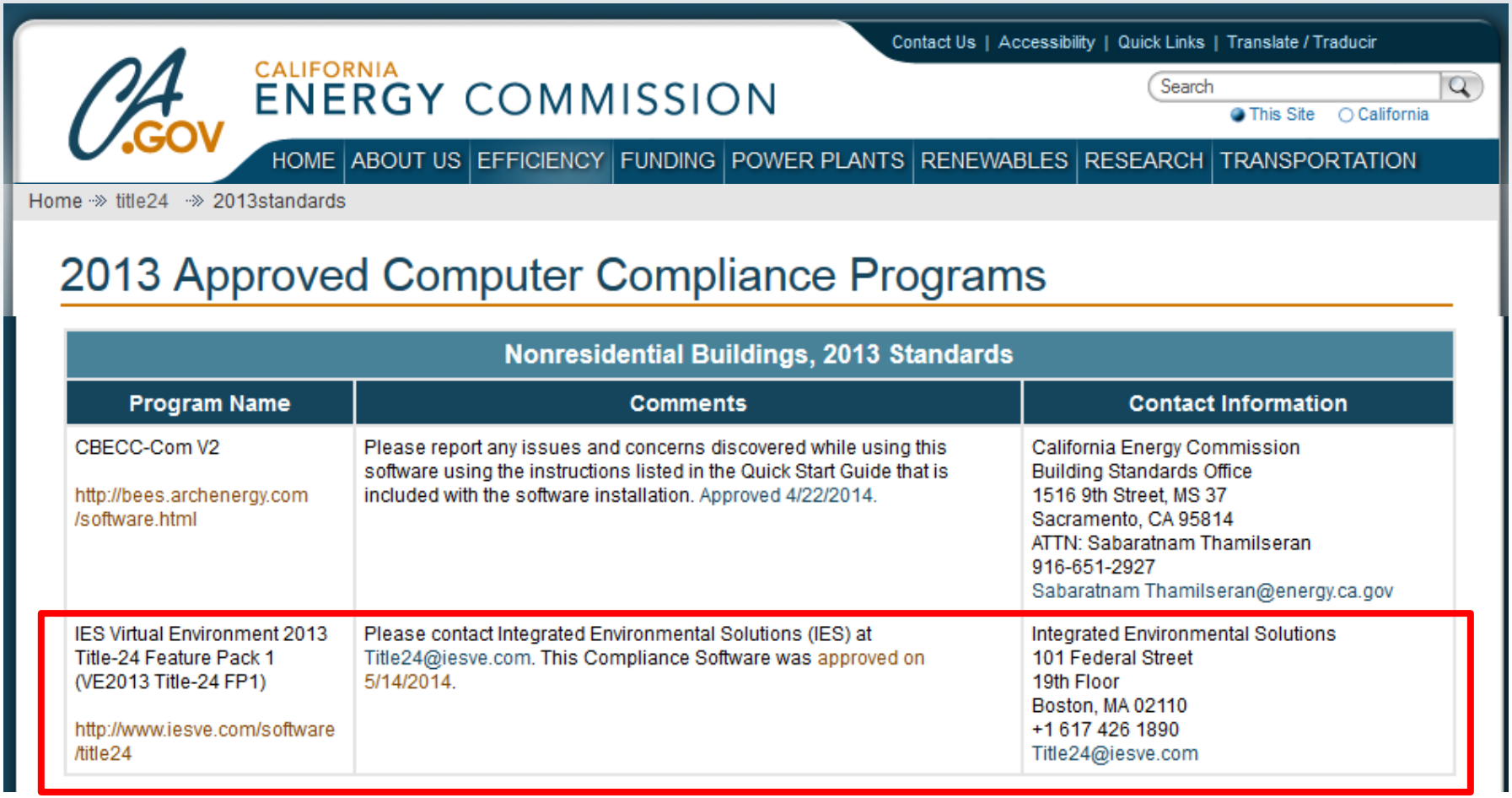
IES VE with CBECC-Com and Whole-Building Energy Modeling



* these systems are currently in discussion and awating approval

CEC - 2013 Approved Software

IES VE with CBECC-Com and Whole-Building Energy Modeling



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CA.GOV CALIFORNIA ENERGY COMMISSION

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Home » title24 » 2013standards

2013 Approved Computer Compliance Programs

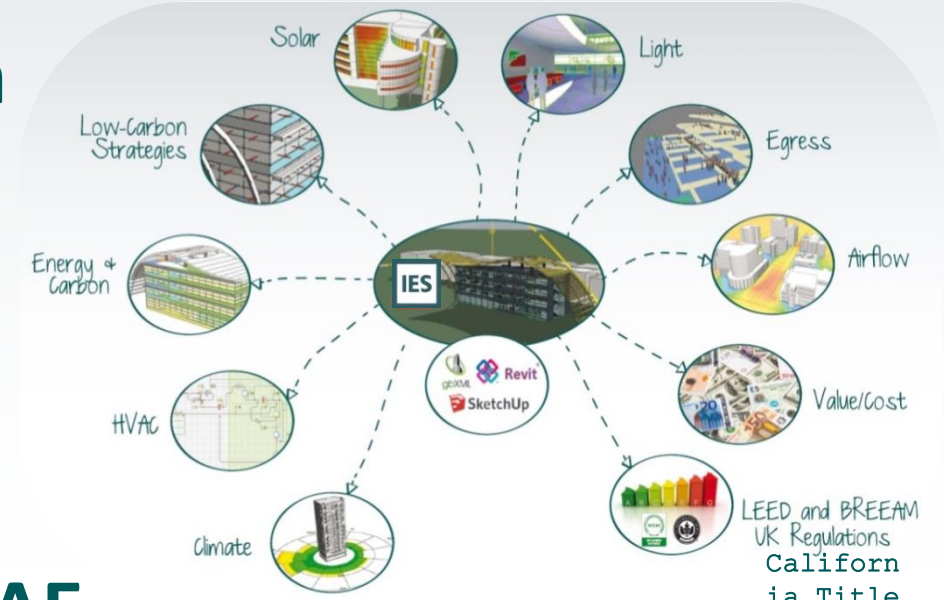
Nonresidential Buildings, 2013 Standards		
Program Name	**Comments**	**Contact Information**
CBECC-Com V2 http://bees.archenergy.com/software.html	Please report any issues and concerns discovered while using this software using the instructions listed in the Quick Start Guide that is included with the software installation. Approved 4/22/2014.	California Energy Commission Building Standards Office 1516 9th Street, MS 37 Sacramento, CA 95814 ATTN: Sabaratnam Thamilseran 916-651-2927 Sabaratnam Thamilseran@energy.ca.gov
IES Virtual Environment 2013 Title-24 Feature Pack 1 (VE2013 Title-24 FP1) http://www.iesve.com/software/title24	Please contact Integrated Environmental Solutions (IES) at Title24@iesve.com. This Compliance Software was approved on 5/14/2014.	Integrated Environmental Solutions 101 Federal Street 19th Floor Boston, MA 02110 +1 617 426 1890 Title24@iesve.com

Reference: CEC at: www.energy.ca.gov/title24/2013standards/2013_computer_prog_list.html

Why use the IESVE software?

IES VE with CBECC-Com and Whole-Building Energy Modeling

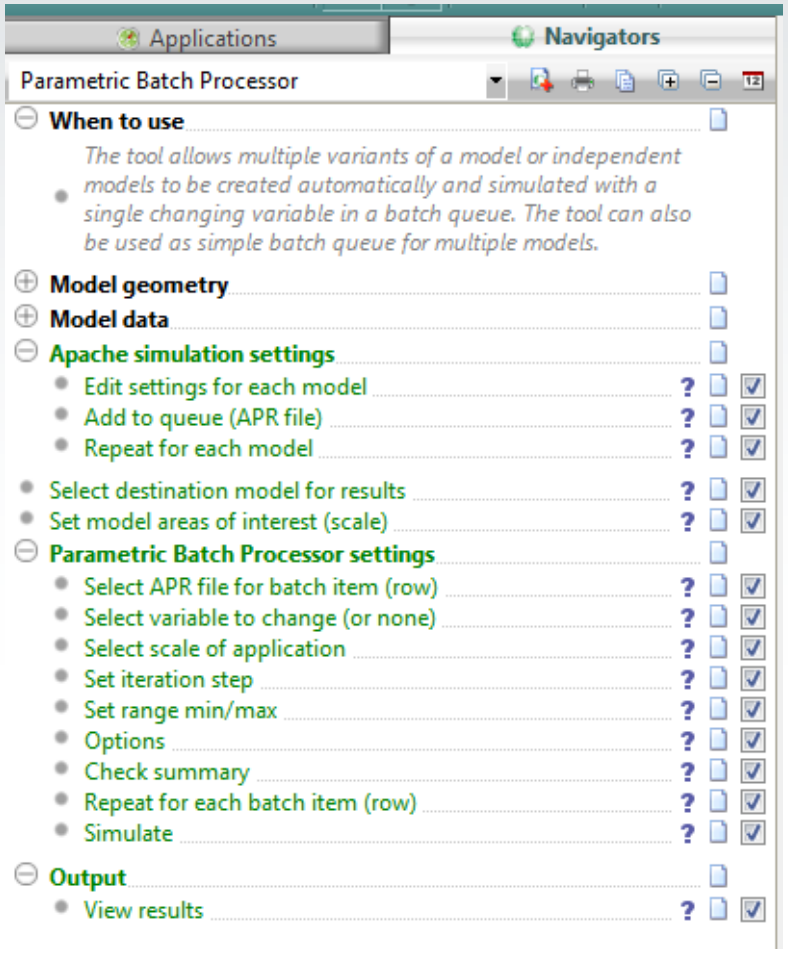
1. Title 24 Compliance
2. Design & Optimization
3. HVAC Sizing
4. (Day)lighting Design
5. LEED Energy Modeling
6. AIA 2030, NZEB, ASHRAE
7. Occupancy Comfort (Thermal & Visual)
8. Save time/effort supporting multiple models

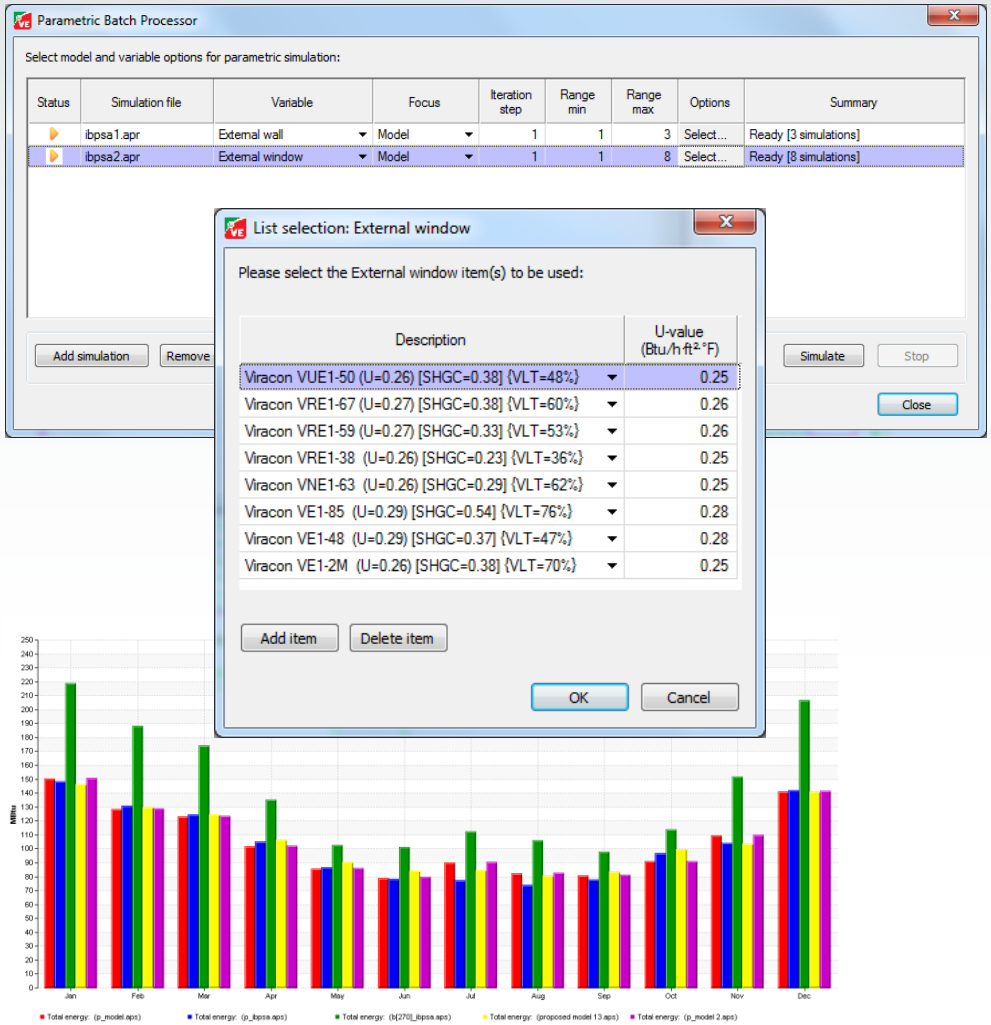


m&s

(1) IES VE Navigators – E.g. Parametric Analysis

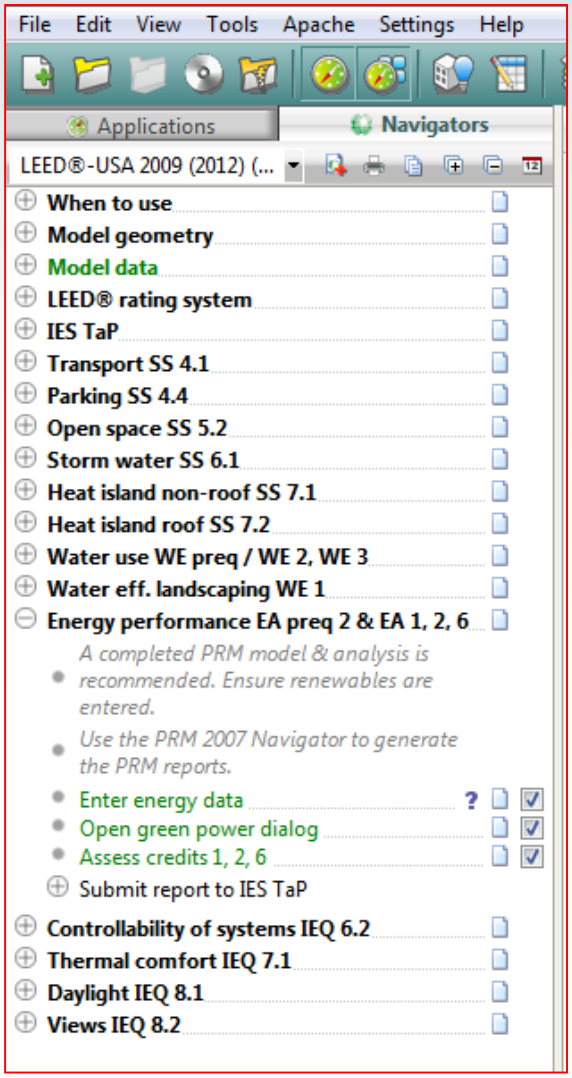
IES VE with CBECC-Com and Whole-Building Energy Modeling





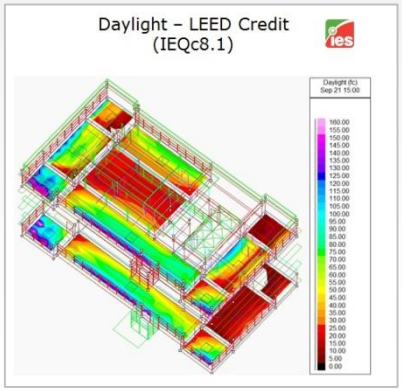
(1) IES VE Navigators – E.g. LEED® Navigator

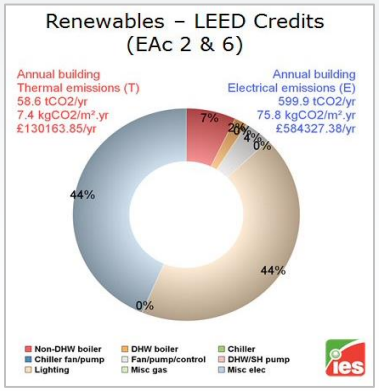
IES VE with CBECC-Com and Whole-Building Energy Modeling

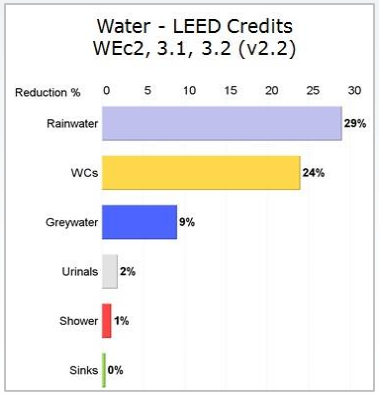


18 Credits (46-58 Points)

Daylighting & Views; Thermal Comfort; Controllability of Systems; Water Use & Water Efficiency; Transport; Parking; Heat Island Roof; Storm Water; Open Space; Increased Ventilation; Optimize Energy Performance and Green Power.







Result:

Analysis #1...

LEED® EQ 8.1 option 2 **1 credit**

Credit 1 (75%) Pass

Spaces 81% pass

Result[3]:

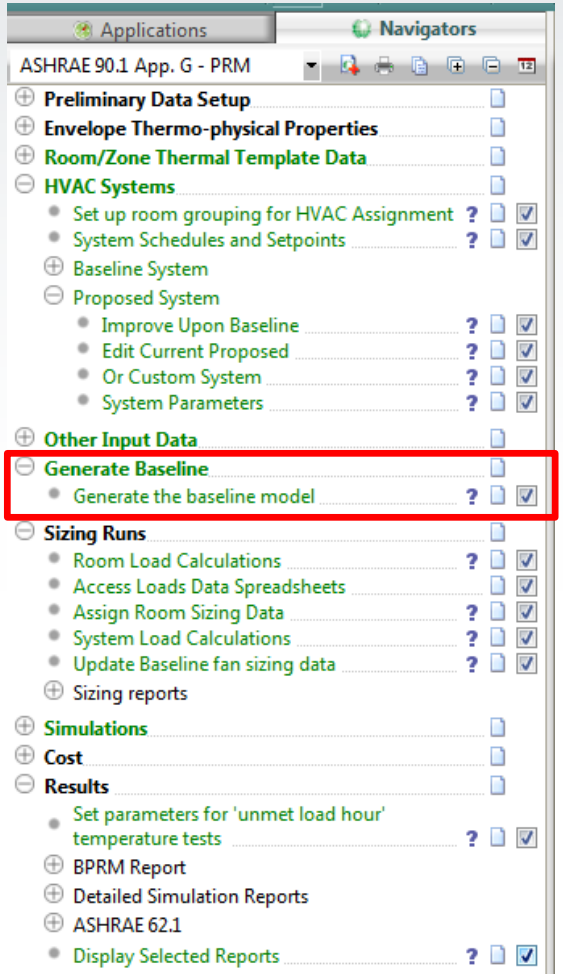
LEED® EA 2 **8 credits**

Cost reduction 98%

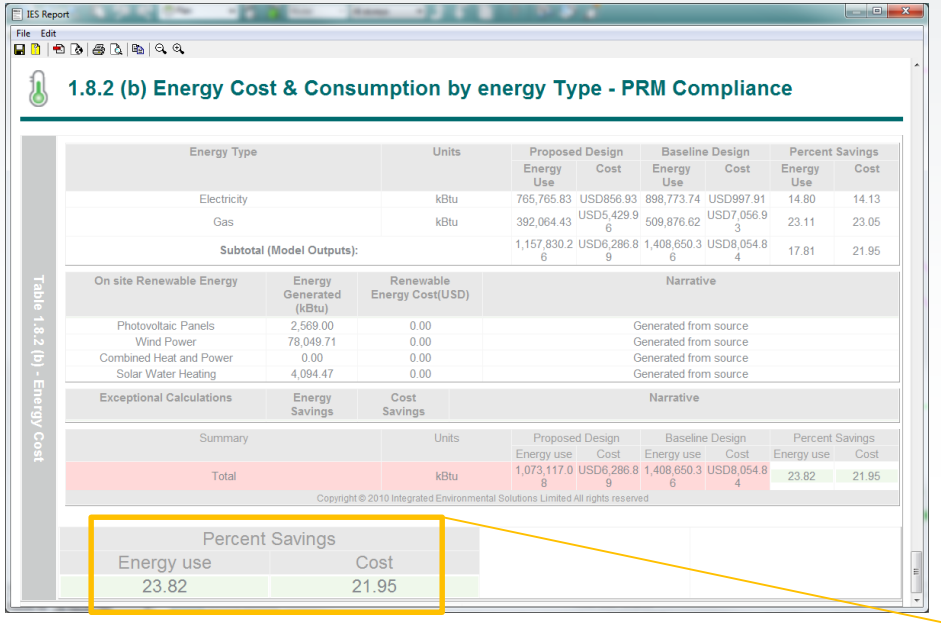
(1) IES VE Navigators – E.g. ASHRAE 90.1 Navigator

IES VE with CBECC-Com and Whole-Building Energy Modeling

LEED Energy Modeling; Navigator Workflow



ASHRAE 90.1 Navigator Output Reports:

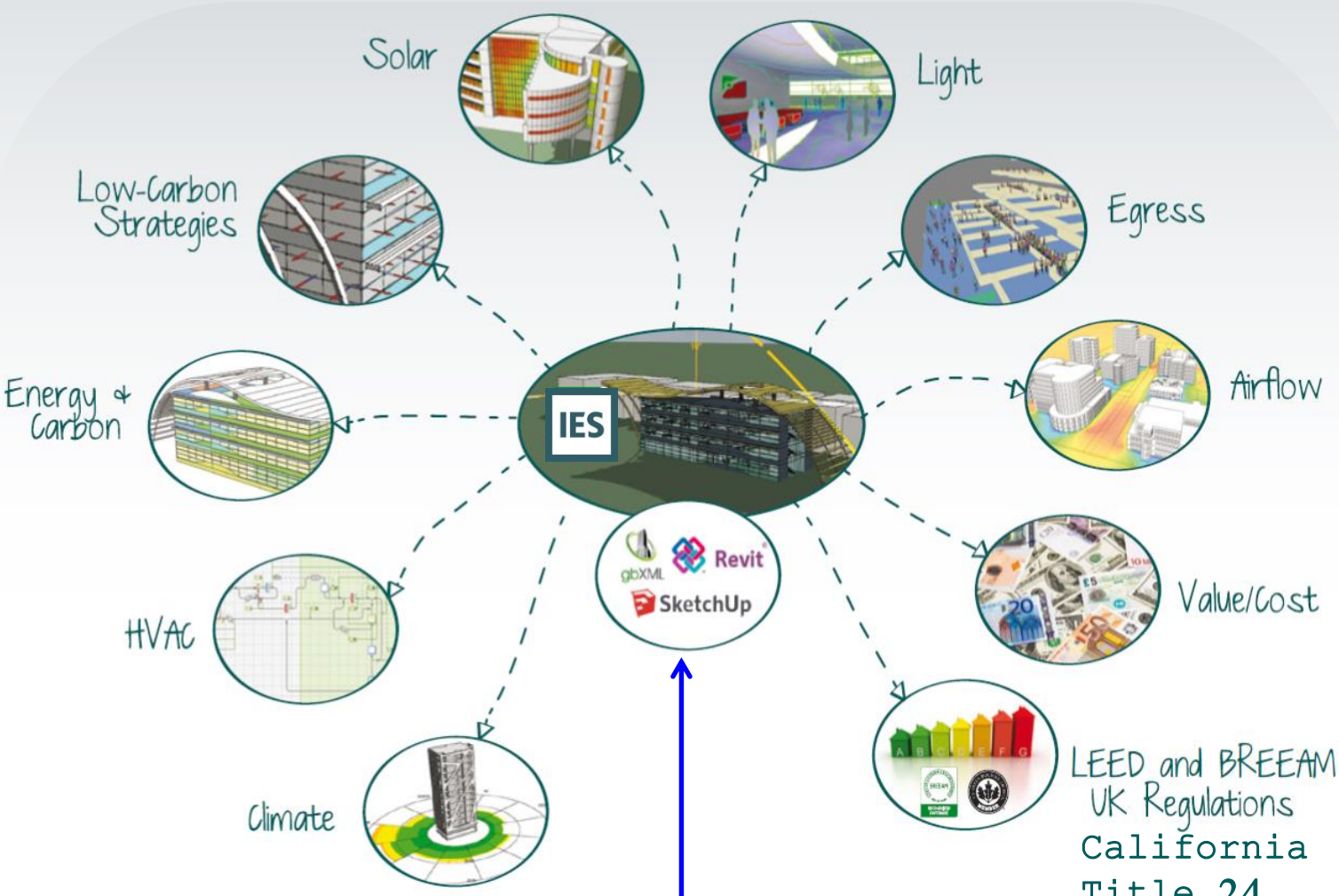


Percent Savings

Energy use	Cost
23.82	21.95

(2) IES VE Applications – One Central Model

IES VE with CBECC-Com and Whole-Building Energy Modeling

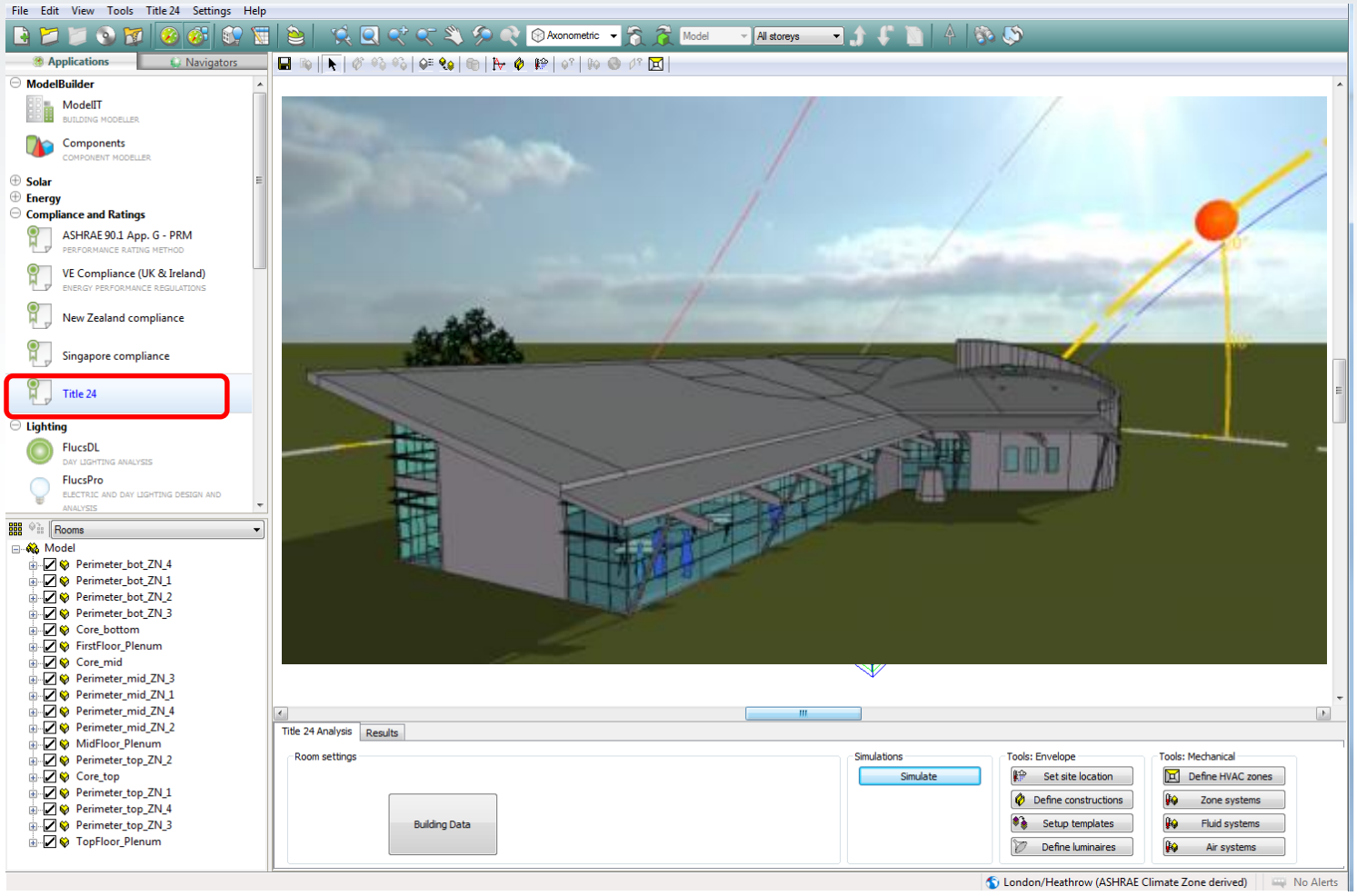


YouTube: BIM Integration with the VE

(2) IES VE Applications: E.g. California Title 24

IES VE with CBECC-Com and Whole-Building Energy Modeling

IESVE Title 24 Application:



(2) IES VE Applications: E.g. California Title 24, Outputs

IES VE with CBECC-Com and Whole-Building Energy Modeling

Title 24 Analysis | Results

(kTDV/ft2-yr)

	Space heating	Space cooling	Fans	Heat rejection	Pumps	DHW	Lighting	Total
Proposed	48.8	254.9	44.6	0	4.1	15.9	25.3	393.6
Standard	48	215.1	214.7	0	0	6.8	61.9	546.5
Margin	-0.8	-39.8	170.1	0	-4.1	-9.1	36.6	152.9

PASS

Outputs
- Summary
- Unmet load hours
- Certificate

Energy Use Summary

End Use	Standard Design Site (MWh)	Standard Design Site (therms)	Standard Design (kTDV/ft2)	Proposed Design Site (MWh)	Proposed Design Site (therms)	Proposed Design (kTDV/ft2)	Compliance Margin (kTDV/ft2)
Space Heating		548.00	48.00	0.00	590.00	48.80	-0.80
Space Cooling	10.90		215.10	18.60		254.90	-39.80
Indoor Fans	19.50		214.70	3.70		44.60	170.10
Heat Rejection							
Pumps & Misc.				0.40		4.10	-4.10
Domestic HW		88.00	6.80		205.00	15.90	-9.10
Lighting	5.80		61.90	2.50		25.30	36.60
Compliance Total	36.20	636.00	546.50	25.20	795.00	393.60	152.90
Receptacle	7.60		87.00	7.60		87.00	
Process							
Process Ltg							
TOTAL	43.80	636.00	633.50	32.80	795.00	480.60	

OK | Cancel

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD NRCC-PRF-01-E

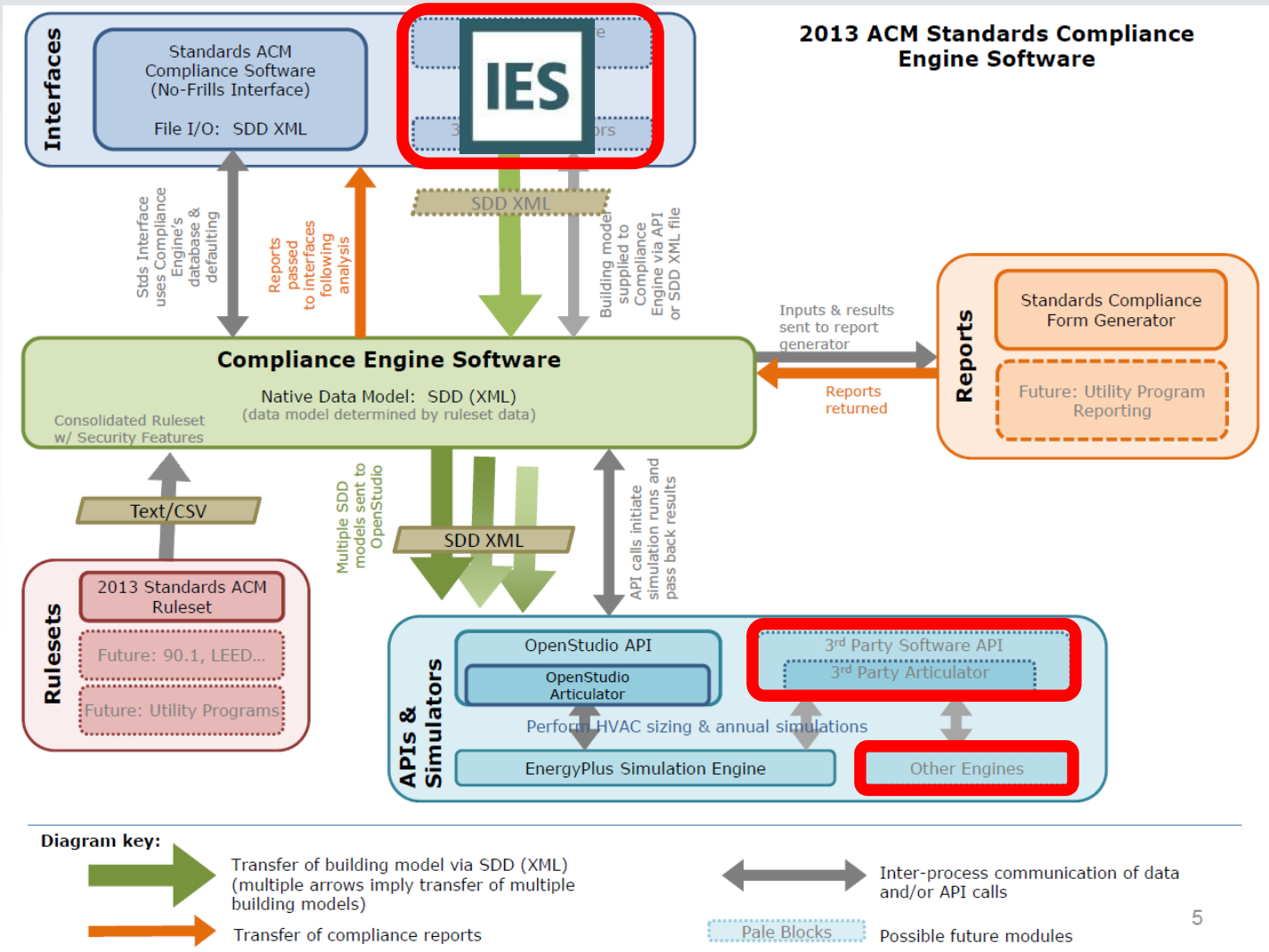
Project Name: SMUD T24 Training **Calculation Date/Time:** Page 2 of 7

Compliance Scope: New Complete Building including Envelope, Lighting and HVAC **Input File Name:**

B. COMPLIANCE RESULTS				
01	BUILDING COMPLIES			
02	Special Features are Required -TBD			
03	HERS Verification is Required - TBD			
ANNUAL TDV ENERGY USE SUMMARY (kBtu/ft2/yr)				
	04	05	06	07
Energy Component	Standard Design	Proposed Design	Compliance Margin	Percent Better than Standard*
Space Heating	48.0	48.8	-0.8	-1.7%
Space Cooling	215.1	254.9	-39.8	-18.5%
Indoor Fans	214.7	44.6	170.1	79.2%
Heat Rejection	–	–	–	–
Pumps & Misc.	–	4.1	-4.1	NaN
Domestic Hot Water	6.8	15.9	-9.1	-133.8%
Lighting	61.9	25.3	36.6	59.1%
COMPLIANCE TOTAL	546.5	393.6	152.9	28.0%
Receptacle	87.0	87.0		0.0%
Process	–	–		–
Process Lighting	–	–		–
TOTAL	633.5	480.6		24.1%

How IESVE integrates with CBECC-Com

IES VE with CBECC-Com and Whole-Building Energy Modeling



Reference: CBECC at www.bees.archenergy.com/software.html

IES-VE Landscape with Title 24 and CBECC-Com

IES VE with CBECC-Com and Whole-Building Energy Modeling

T24 Compliance

CBECC-Com
- Climate
- Zone Assignments
- Constructions
- Internal Gains
- HVAC Systems

↓

- Ruleset Process (SSDXML)

↓

- Results / Reports

Building Design & Performance Analysis

IES VE Model Geometry

↓

IES VE Suite of Analysis

↓

Climate, envelope, etc.

↓

SOLAR	**DAYLIGHT**	**AIRFLOW**	**HVAC**
• Solar shading & simulation	• Daylight harvesting simulation	• Natural ventilation simulation	• Chilled beams, • UFAD / DV,

↓

Hourly, Annual Energy & CO2 Simulation

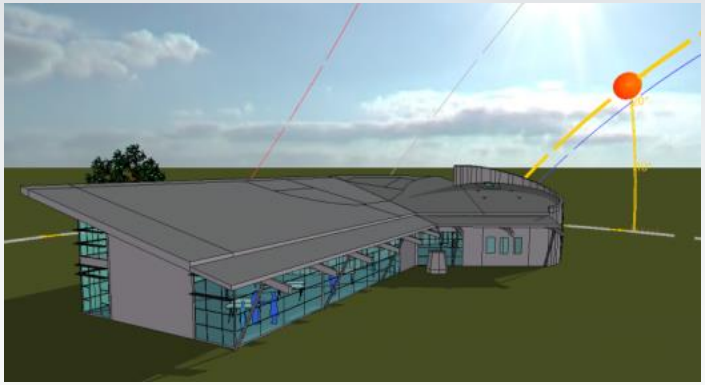
↓

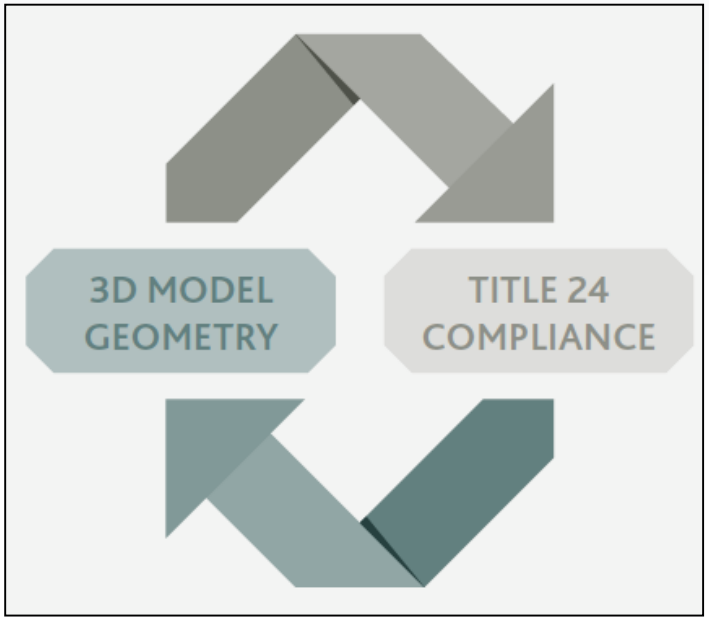
Results, Reports and Re-simulate
- Consider other HVAC, renewable energies, etc.

Why use IES-VE for Title 24 Compliance?

IES VE with CBECC-Com and Whole-Building Energy Modeling

1. **Free 3D Model Application**
2. **T24 Application is $250**
3. **Two Applications are Fully Interoperable, i.e. no data loss with geometry revisions.**
4. **Spreadsheet Interoperability (Crtl+V)**
5. **Technical Support Provided**





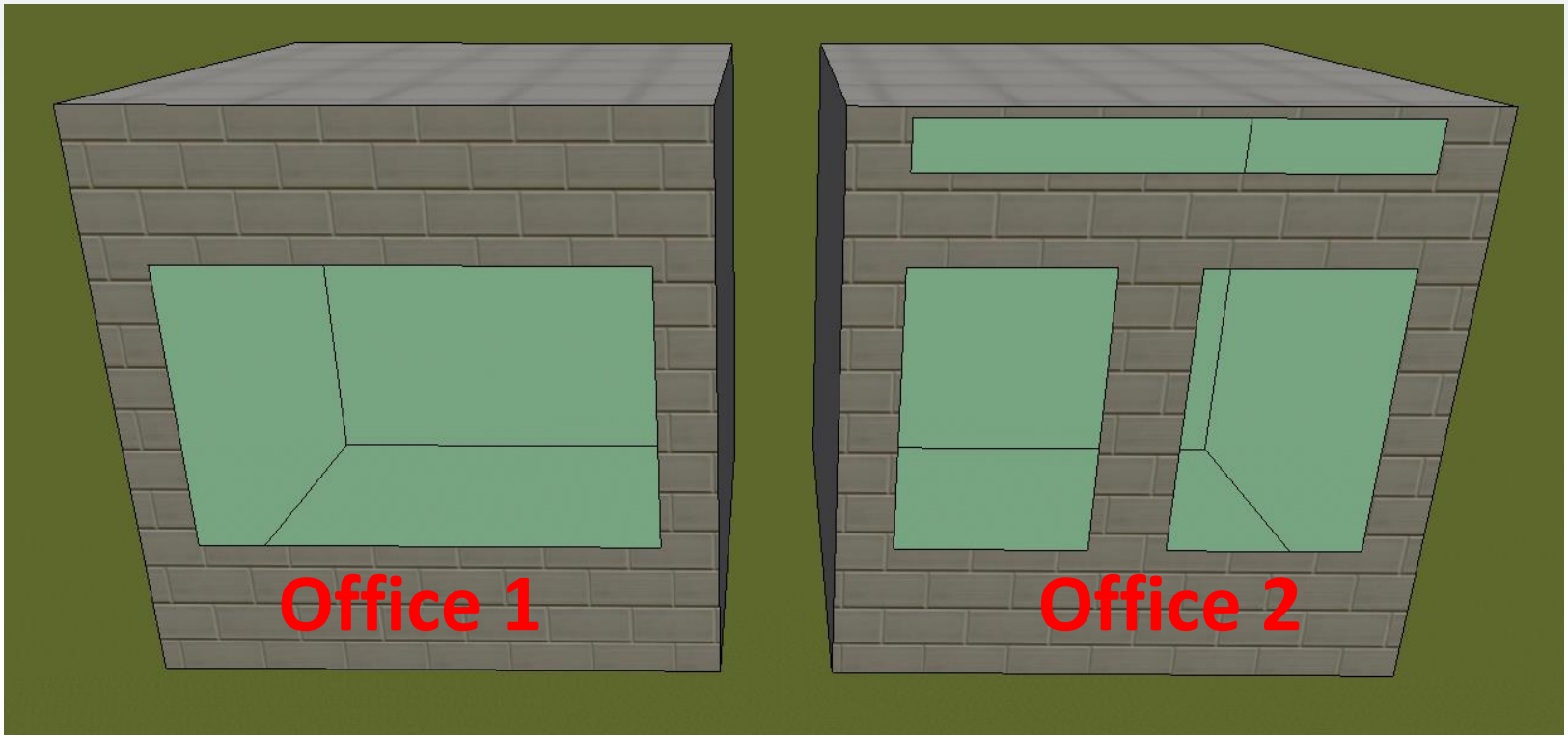
How to Model…

Model Geometry

IES VE with CBECC-Com and Whole-Building Energy Modeling

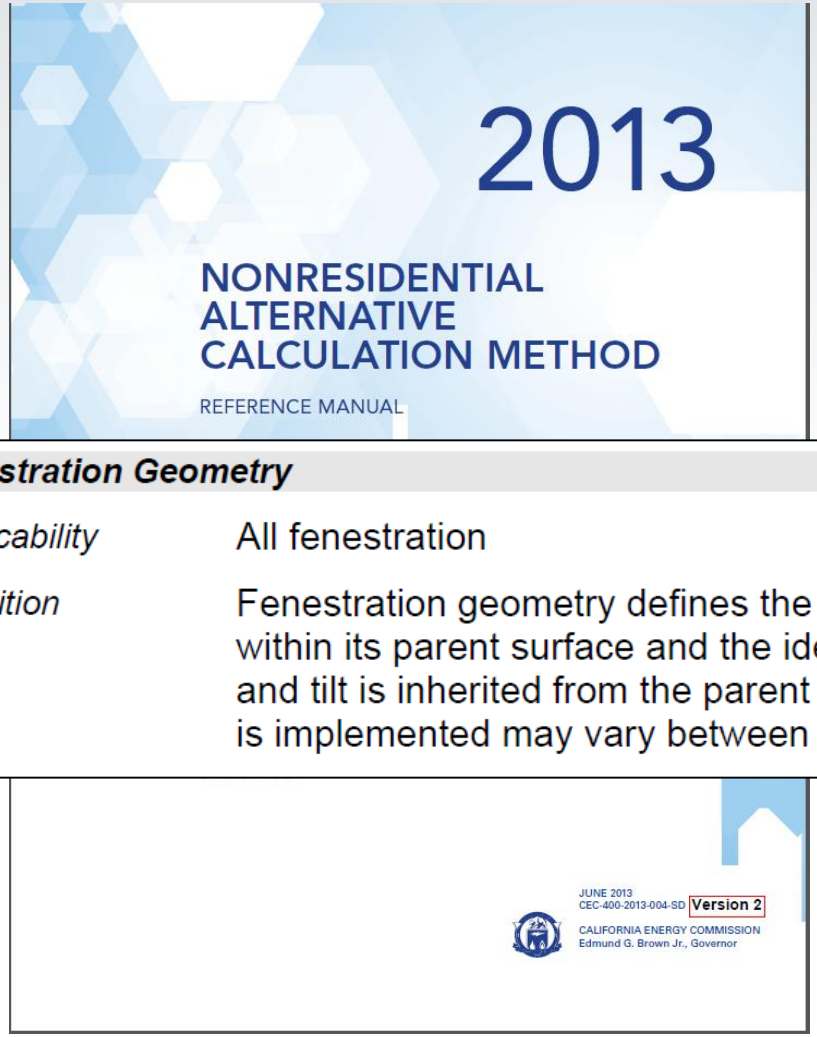
Q: Which office space has the higher heating load?

Both: San Diego – Office Gains – VE1-2M – 40% Glazing



Model Geometry

IES VE with CBECC-Com and Whole-Building Energy Modeling



Fenestration Geometry

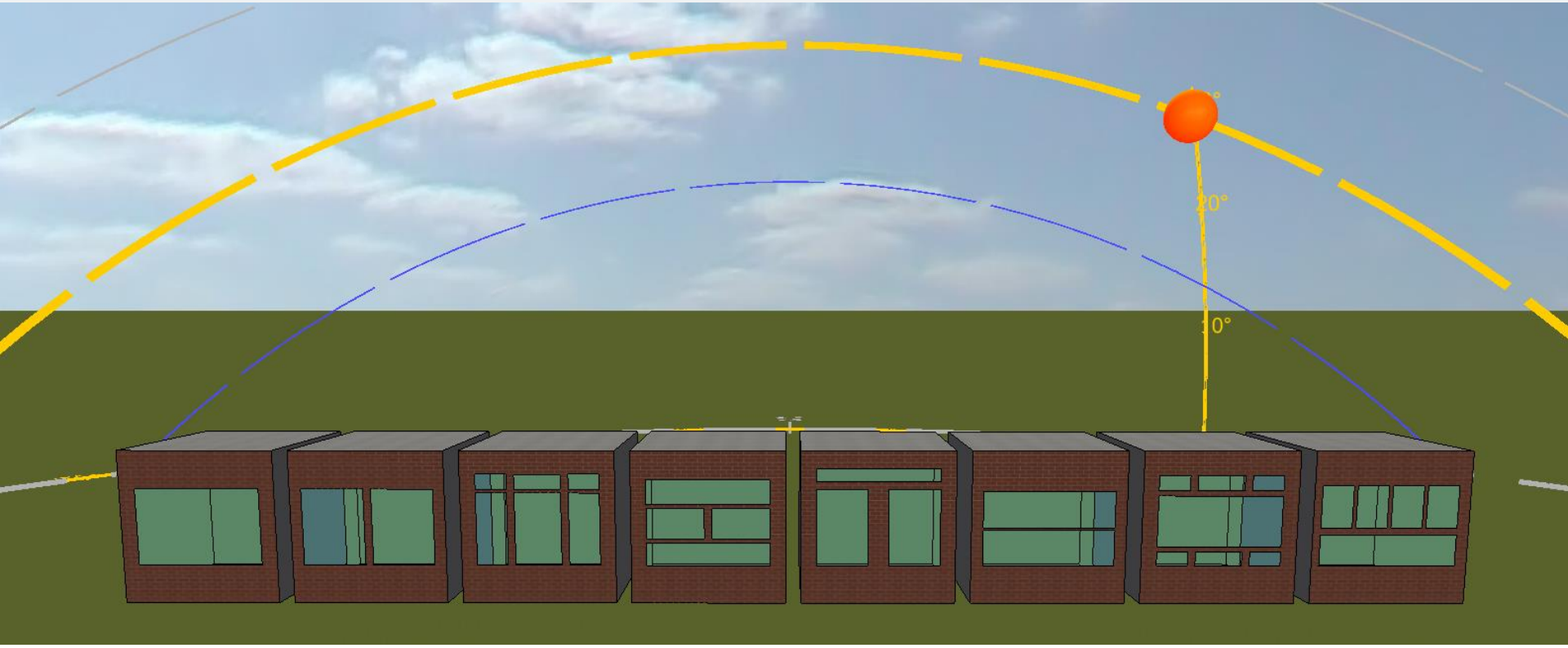
Applicability	All fenestration
Definition	Fenestration geometry defines the position and dimensions of the fenestration surface within its parent surface and the identification of the parent surface. The orientation and tilt is inherited from the parent surface. The details of how the coordinate system is implemented may vary between Compliance Software programs.

Model Geometry

IES VE with CBECC-Com and Whole-Building Energy Modeling

Q: What about now… (highest heating load)?

- **ALL 8: San Diego – Office Gains – VE1-2M – 40% Glazing**

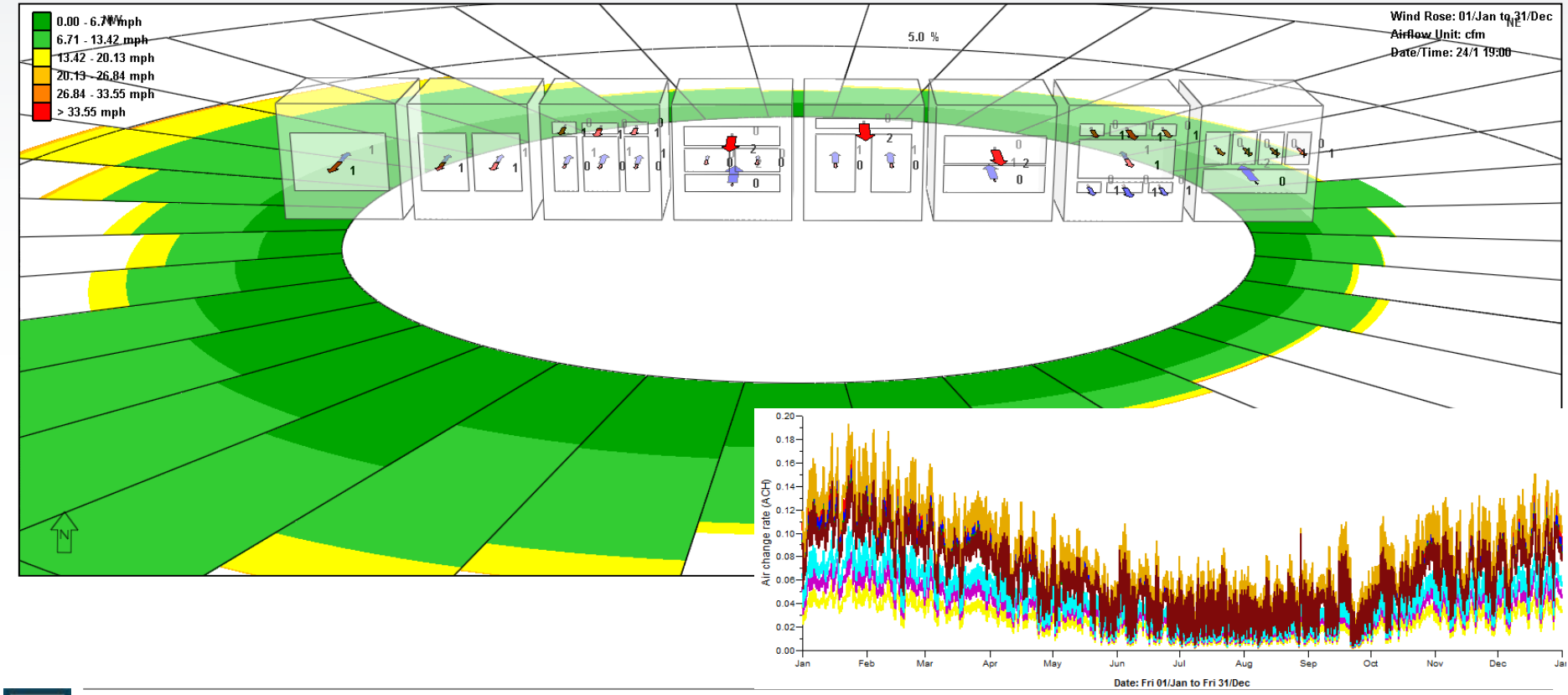


Model Geometry & Infiltration

IES VE with CBECC-Com and Whole-Building Energy Modeling

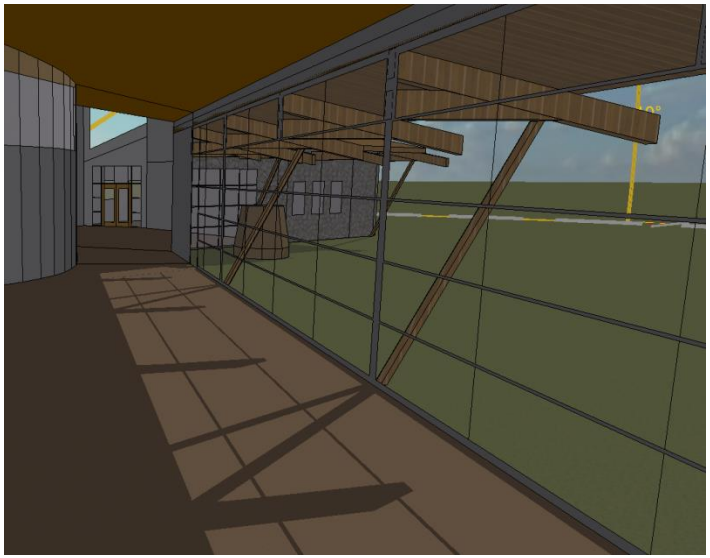
Q: What about now… (highest heating load)?

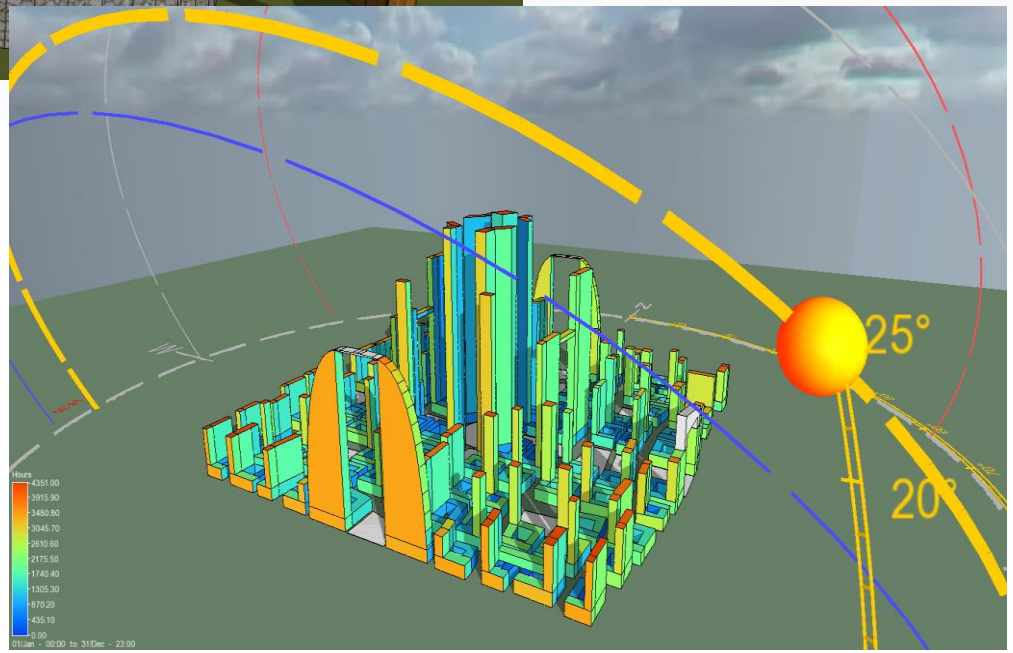
- **ALL 8: San Diego – Office Gains – VE1-2M – 40% Glazing**



Model Geometry & Solar Gains

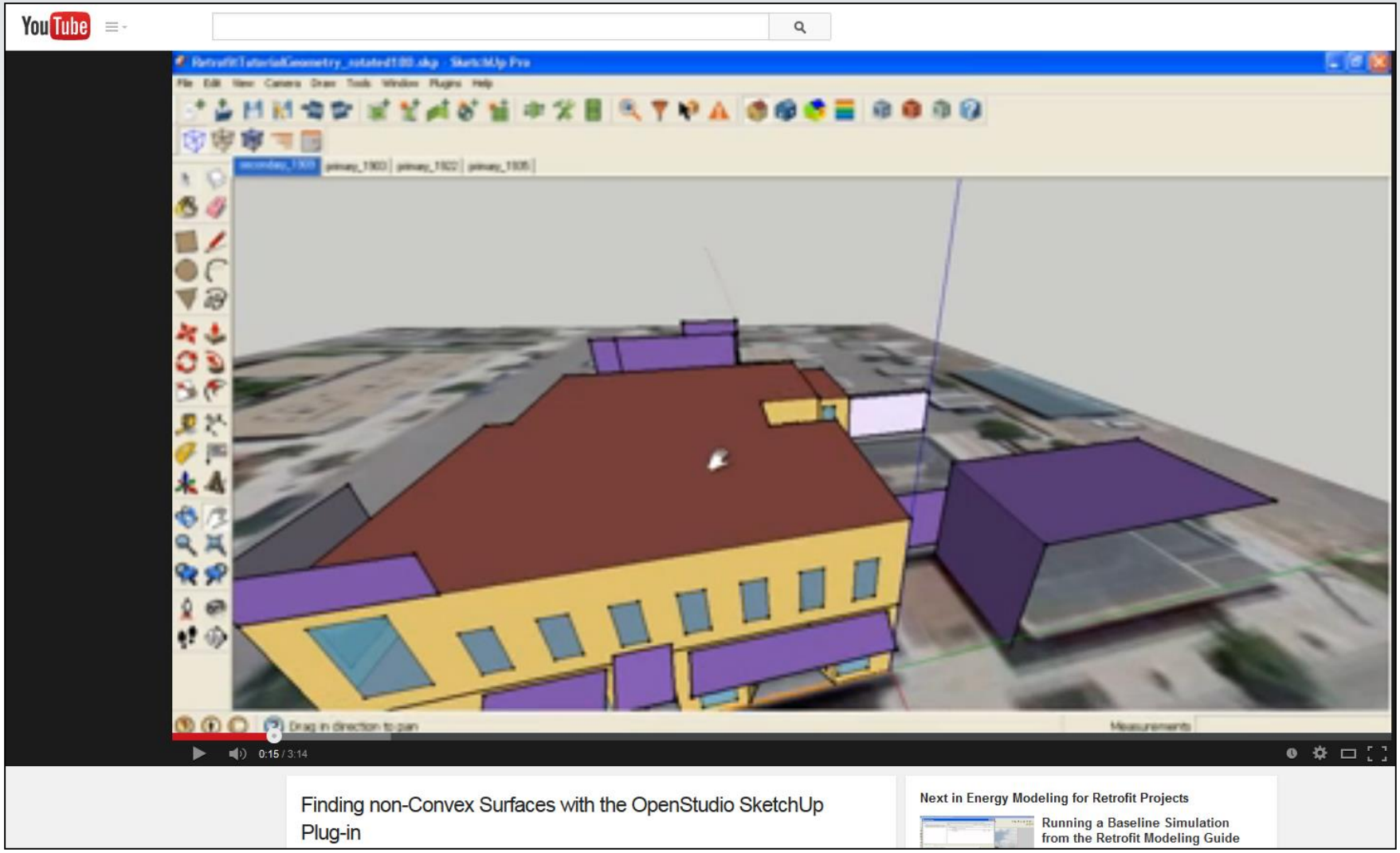
IES VE with CBECC-Com and Whole-Building Energy Modeling





Caution!! CBECC-Com uses OpenStudio

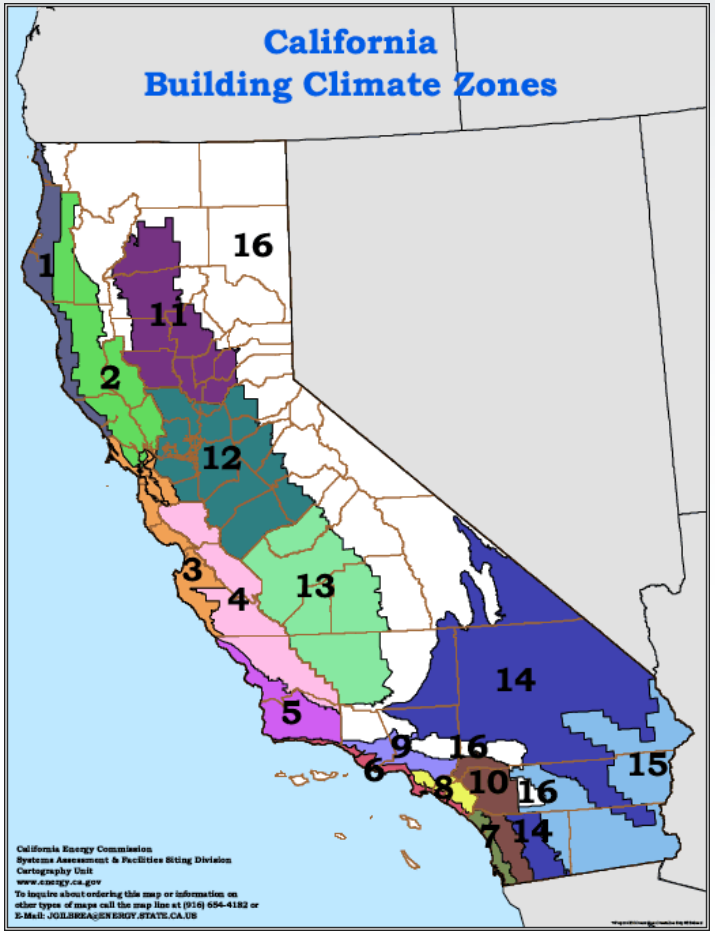
IES VE with CBECC-Com and Whole-Building Energy Modeling



Climatic Analysis & Weather Files

IES VE with CBECC-Com and Whole-Building Energy Modeling

Title 24 Site Location:



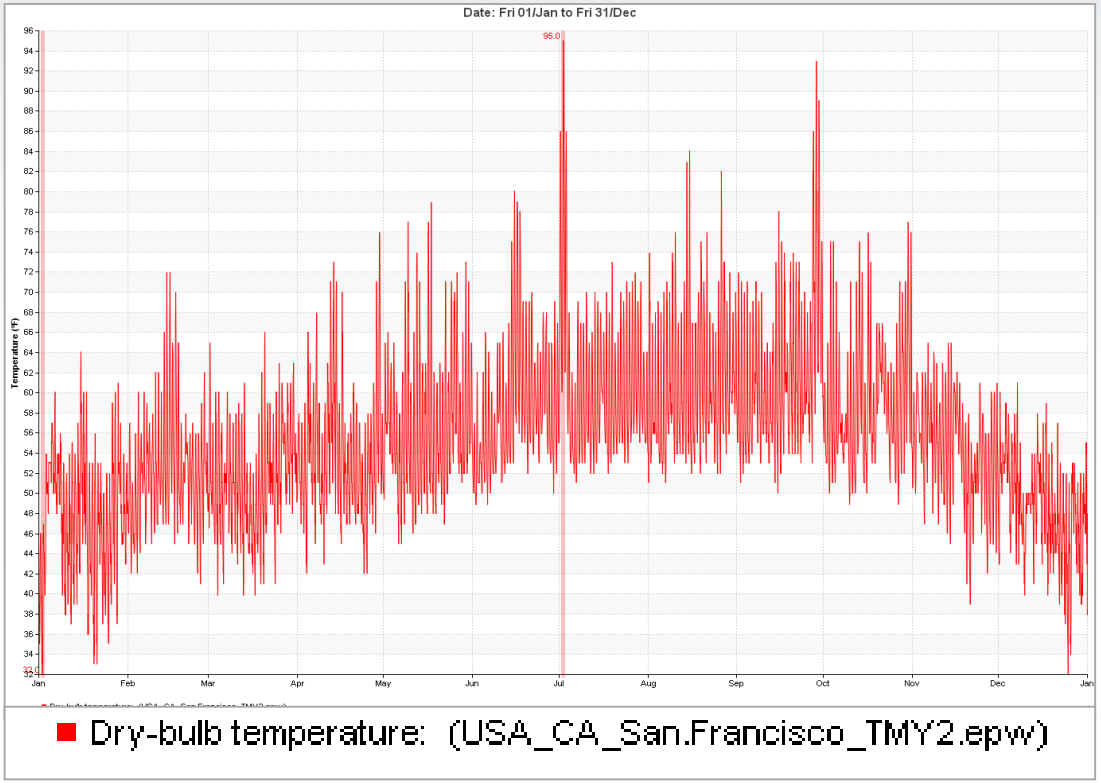
- New 2013 weather data set consists of 86 location specific weather files and 16 generic climate zone files.
- The 86 location specific weather files are intended for use in all code compliance simulations.
- The 16 climate zone weather files are the files for a single selected “reference location” for each climate zone.
- TDV factors are defined for each fuel type (electricity, natural gas, and propane) per climate zone.

Climatic Analysis & Weather Files

IES VE with CBECC-Com and Whole-Building Energy Modeling

Weather Data (8,760)

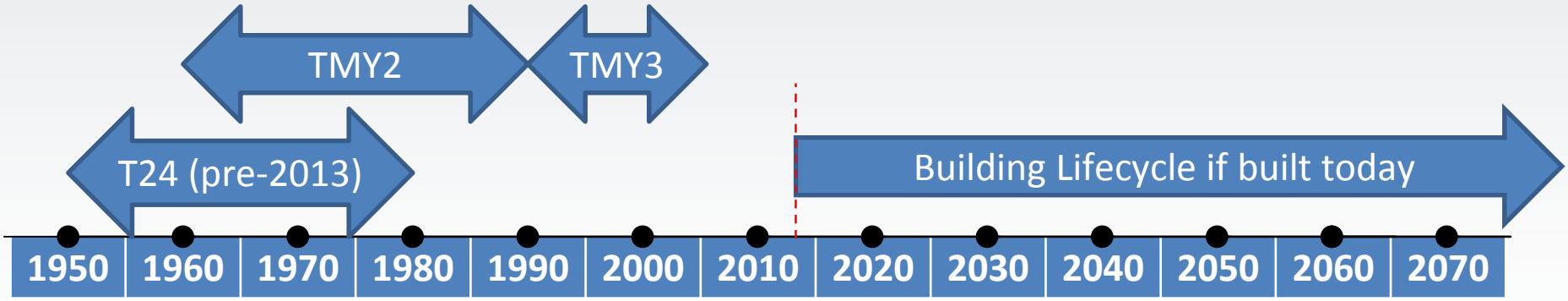
- **Dry-bulb temperature**
- **Wet-bulb temperature**
- **External Dew-Point Temperature**
- **Wind Speed**
- **Wind Direction**
- **Direct Radiation**
- **Diffuse Radiation**
- **Global Radiation**
- **Solar Altitude**
- **Cloud Cover**
- **Atmospheric Pressure**
- **External Relative Humidity**
- **External Moisture Content**

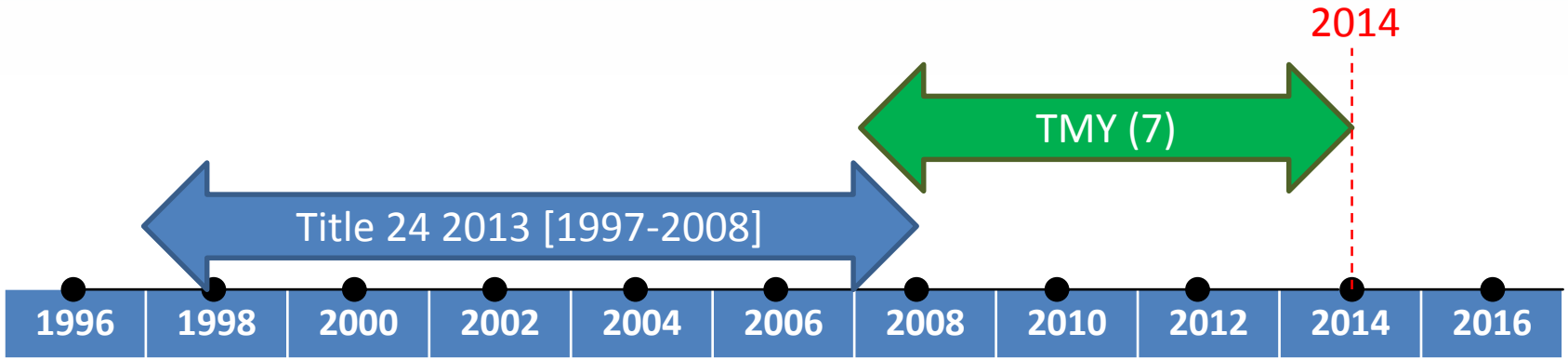


Climatic Analysis & Weather Files

IES VE with CBECC-Com and Whole-Building Energy Modeling

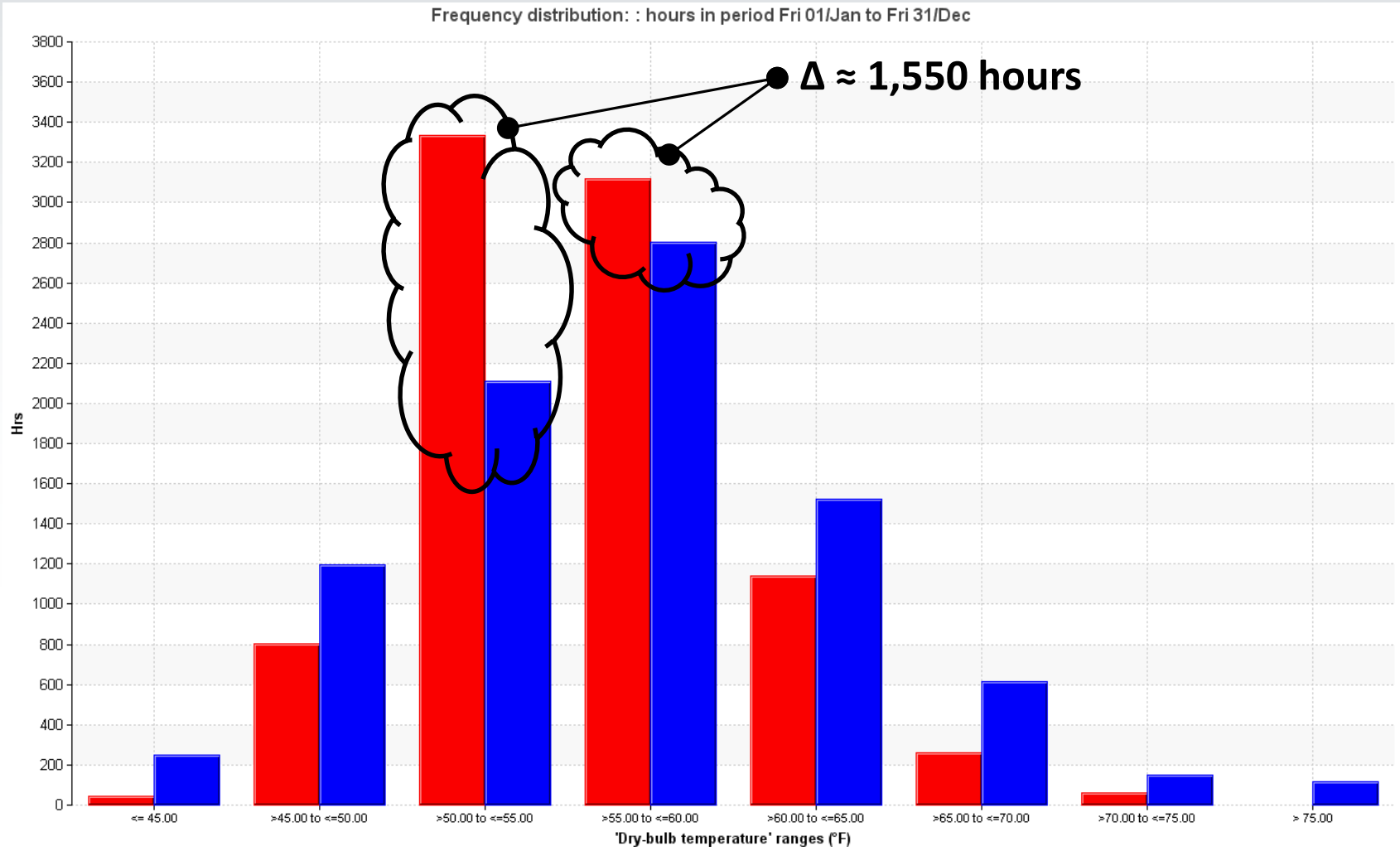
Q: What Weather Data do you use? TMY 2, TMY 3, AMY





Climatic Analysis for San Francisco

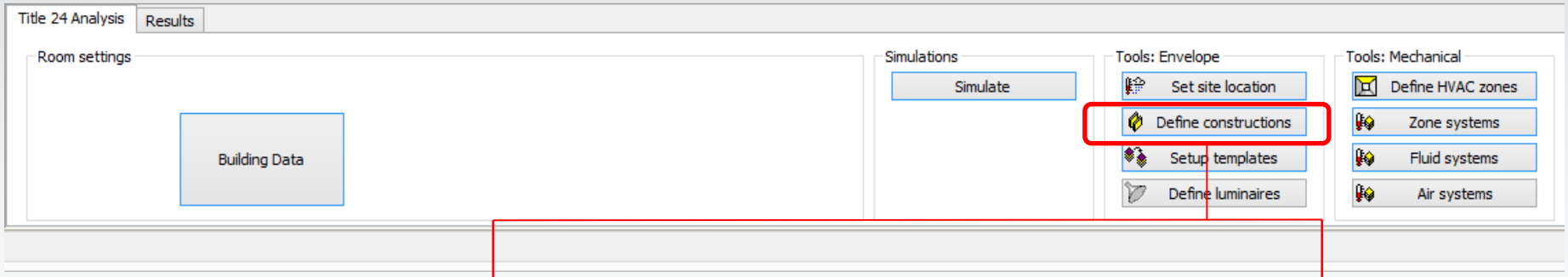
IES VE with CBECC-Com and Whole-Building Energy Modeling



TMY 7 versus Title 24 climate files (dry bulb °F)

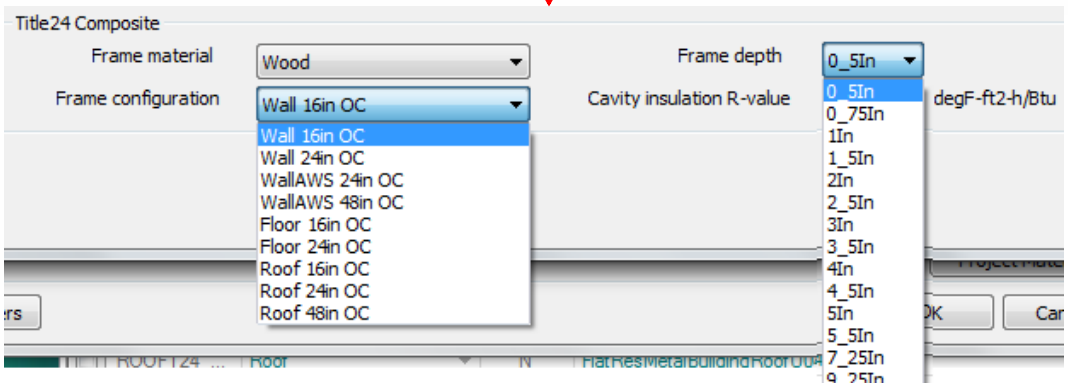
IES-VE Title 24 Envelope

IES VE with CBECC-Com and Whole-Building Energy Modeling



Construction layers

Material (outside to inside)	Thickness in	Conductivity Btu·in/h·ft²·°F	Density lb/ft³	Specific Heat Capacity Btu/lb·°F	Resistance ft²·h·°F/Btu	Vapour Resistivity (perm·in)^-1	Category
[T24_0356] Metal Standing Seam - 1/16 in.	0.06"	4.001	488.220	0.1200	-	-	Asphalts &
[T24_0194] Expanded Polystyrene - EPS - 3 1/2 in.	3.50"	0.240	1.000	0.2700	-	-	Boards, Sheets



IES-VE Envelope

IES VE with CBECC-Com and Whole-Building Energy Modeling

Glazing:

Description: Viracon VE1-2M (U=0.26) [SHGC=0.38] {VLT=70%} ID: GDPK61 External Internal

Performance

Net U-value (including frame) 0.2610 Btu/h·ft²·°F U-value (glass only) 0.2600 Btu/h·ft²·°F ASHRAE

Net R-value 3.8466 ft²·h·°F/Btu g-value (EN 410) 0.3850 Visible light normal transmittance 0.7

\+ Surfaces

\- Frame

Percentage 1.00 Absorptance 0.7 Outside surface area ratio 1.0000 Type Metal

U-value 0.3647 Btu/h·ft²·°F Resistance 1.892 ft²·h·°F/Btu Inside surface area ratio 1.0000

LCA frame materials Edit

\- Shading device

Local shade ? None External shade ? None Internal shade ? None

\+ Regulations

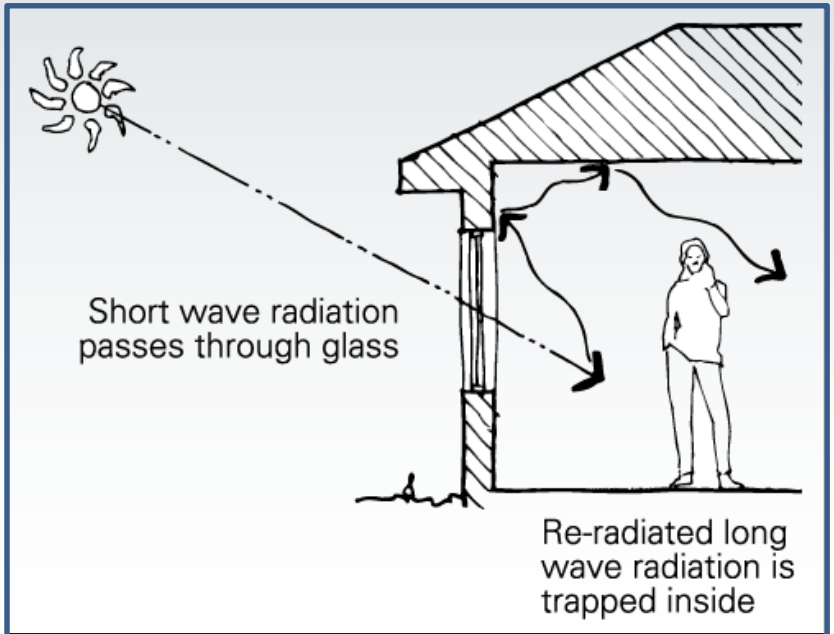
\+ Dwellings

Construction layers (outside to inside)

Material	Thickness in	Conductivity Btu·in/h·ft²·°F	Type	Gas	Convection coefficient Btu/h·ft²·°F	Resistance ft²·h·°F/Btu	Transm.	Outside Reflect.	Inside Reflect.	Refractive Index	Outside Emiss.	Inside Emiss.
[PK611] Outer layer	0.25"	0.222	Uncoated				0.330	0.310	0.640	1.526		
Cavity	0.51"					1.844						
[CF611] Inner layet	0.25"	6.101	Uncoated				0.780	0.070	0.070	1.526		

Product Type: Fixed window | Cert Method: NFRC Rated | Tint: Clear | Diffusing?

Assm Context: Manufactured | Divider: True Divided Lite | Greenhouse/Garden? | Glass block?



THETA = Angle of incidence
T(D) = Short wave solar transmission (directly transmitted fraction)
T(R) = Long wave + convection from inner pane (retransmitted fraction)

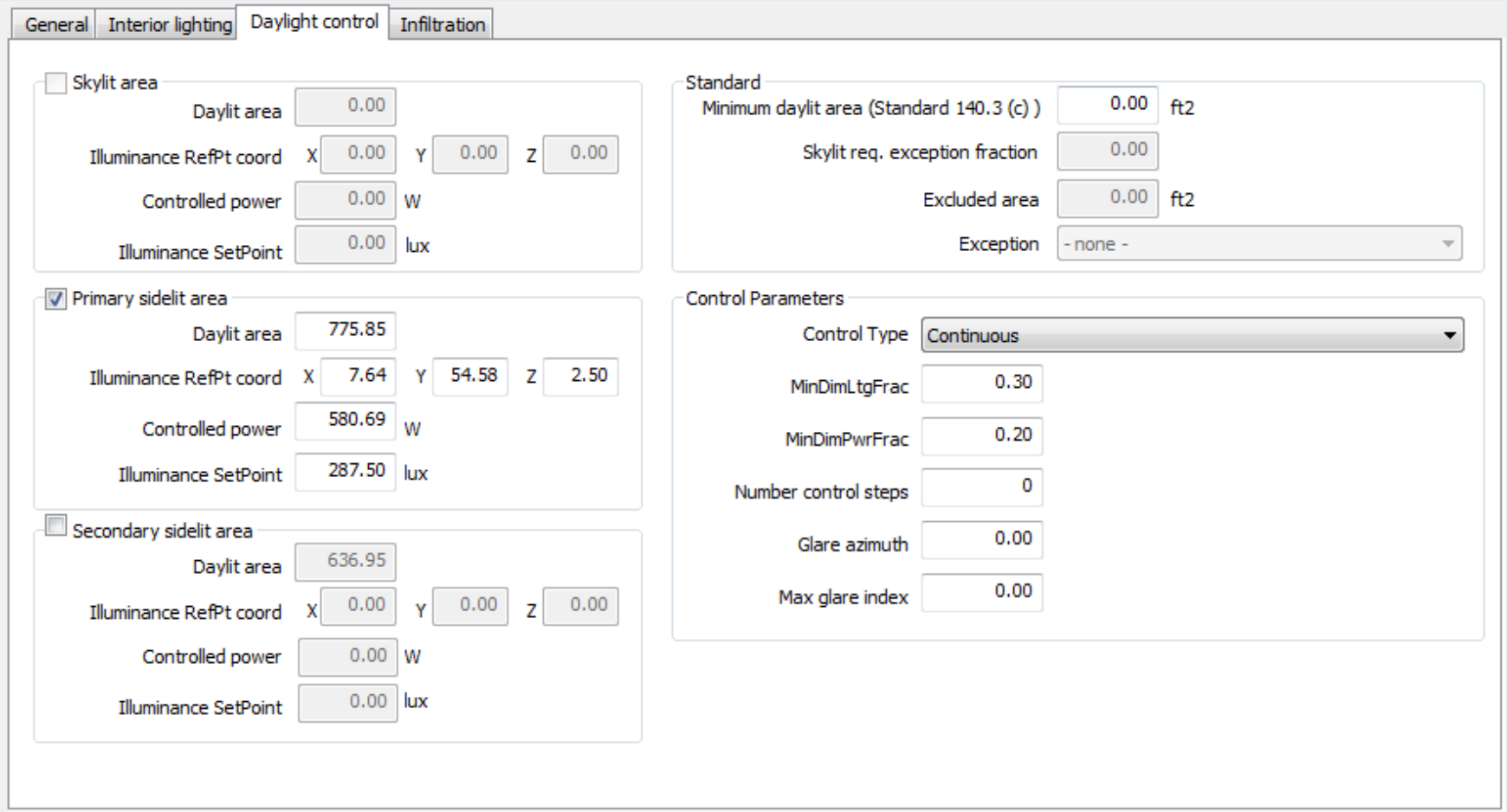
THETA	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
T(D)	0.269	0.268	0.263	0.255	0.243	0.225	0.198	0.150	0.069	0.000
T(R)	0.110	0.111	0.112	0.113	0.115	0.117	0.116	0.110	0.086	0.000

Short-wave shading coefficient	0.3097
Long-wave shading coefficient	0.1270
Total shading coefficient	0.4367
SHGC (center-pane)	0.3800

IES-VE Title 24 Daylighting

IES VE with CBECC-Com and Whole-Building Energy Modeling

Daylighting – automatic calculation:

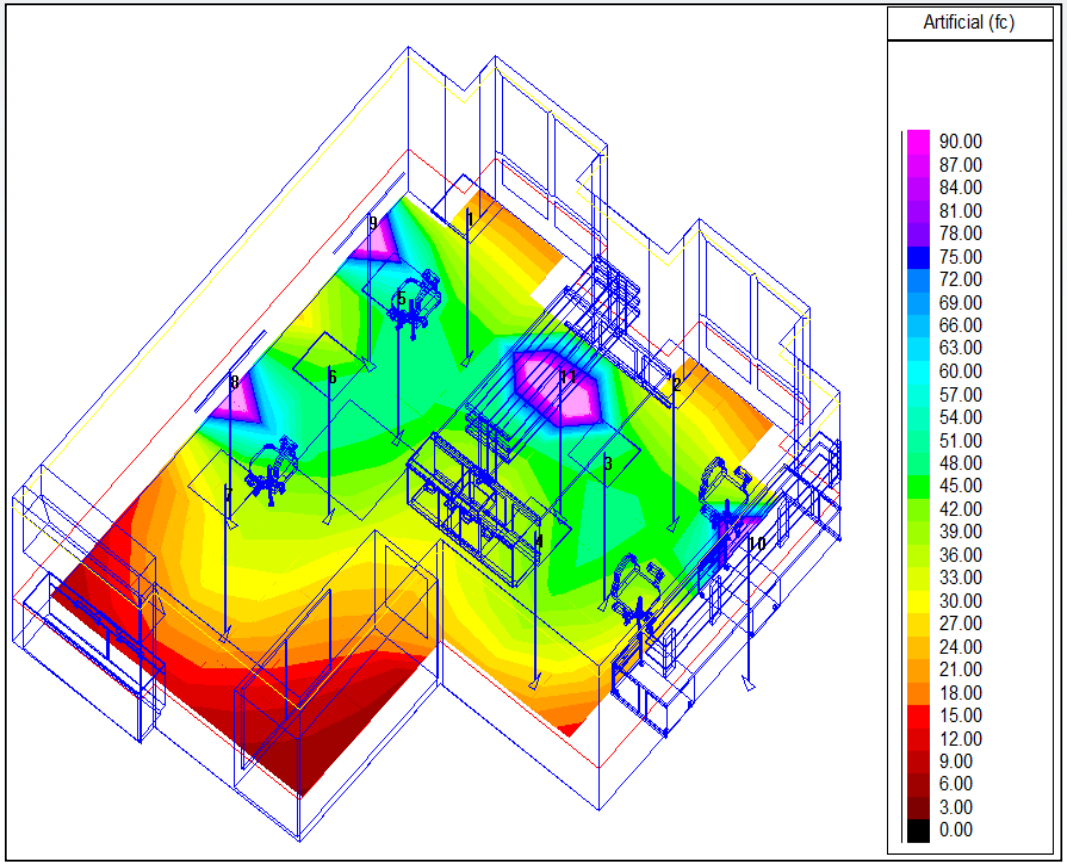


IES-VE Daylight & Energy Simulation

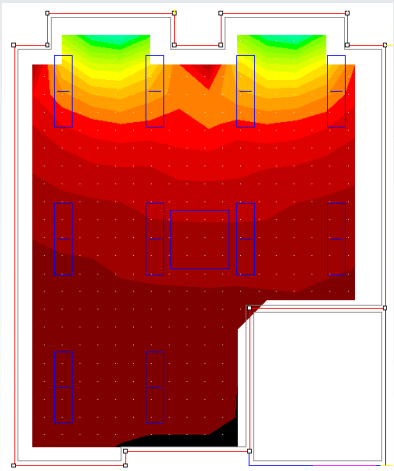
IES VE with CBECC-Com and Whole-Building Energy Modeling

(Day)lighting Simulation & Design

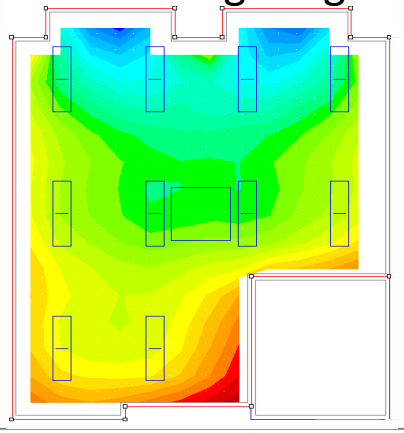
Luminaire simulations on a room by room basis



Daylighting Only



Combined Daylighting + Artificial Lighting

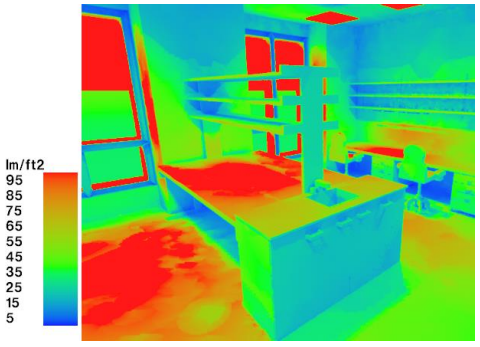


IES-VE Daylight & Energy Simulation

IES VE with CBECC-Com and Whole-Building Energy Modeling

Daylight Harvesting, Glare & Daylight Autonomy

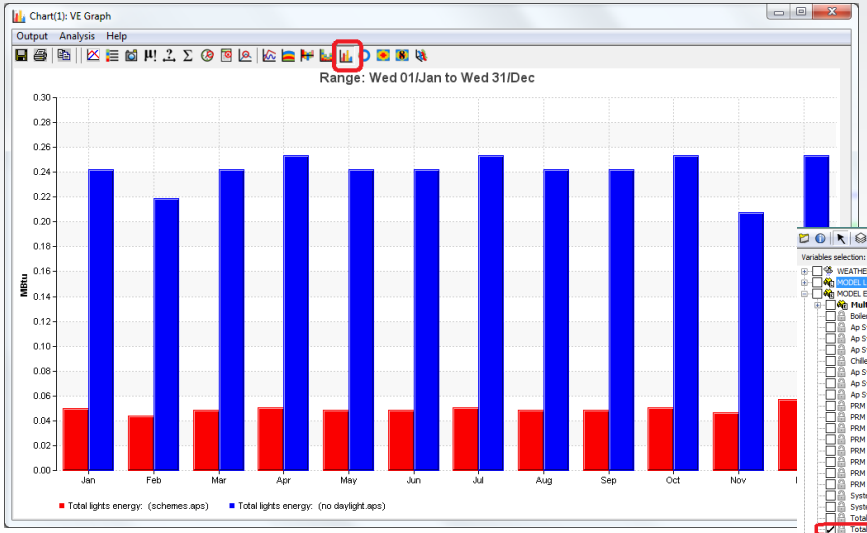
- Task Lighting
- Detailed Daylight Tracking
- Link to HVAC Loads Sizing and Energy Simulation



IES-VE Coupling Daylight & Energy Simulation

IES VE with CBECC-Com and Whole-Building Energy Modeling

Annual Monthly Lighting Energy
with & without daylight harvesting

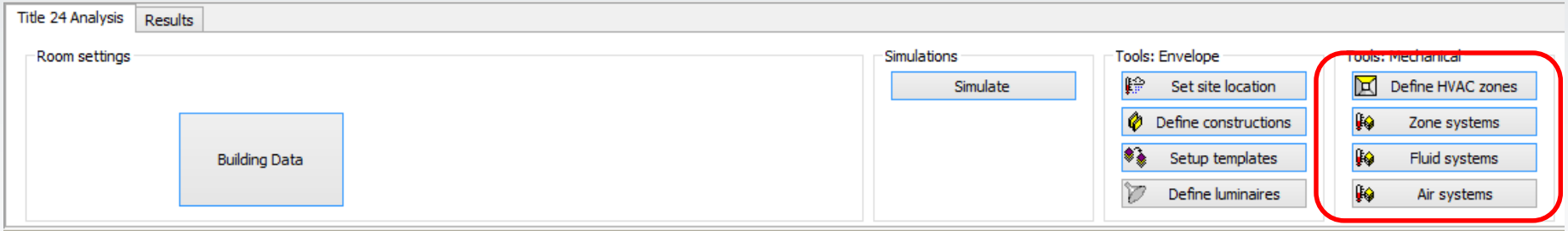


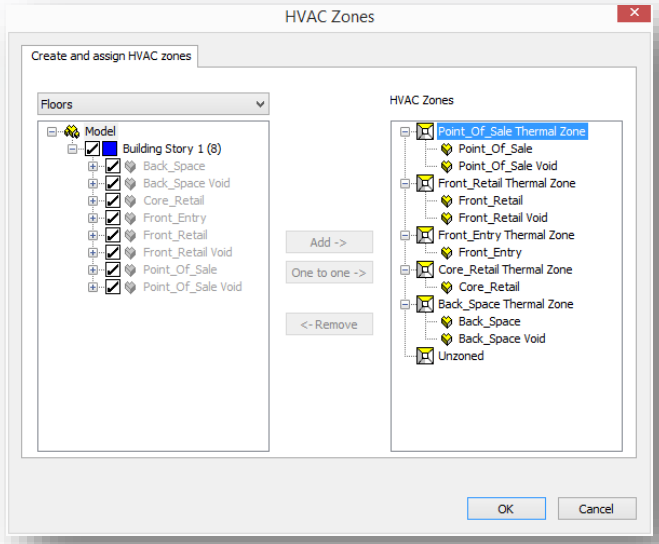
Daily Lighting Energy
with & without daylight harvesting

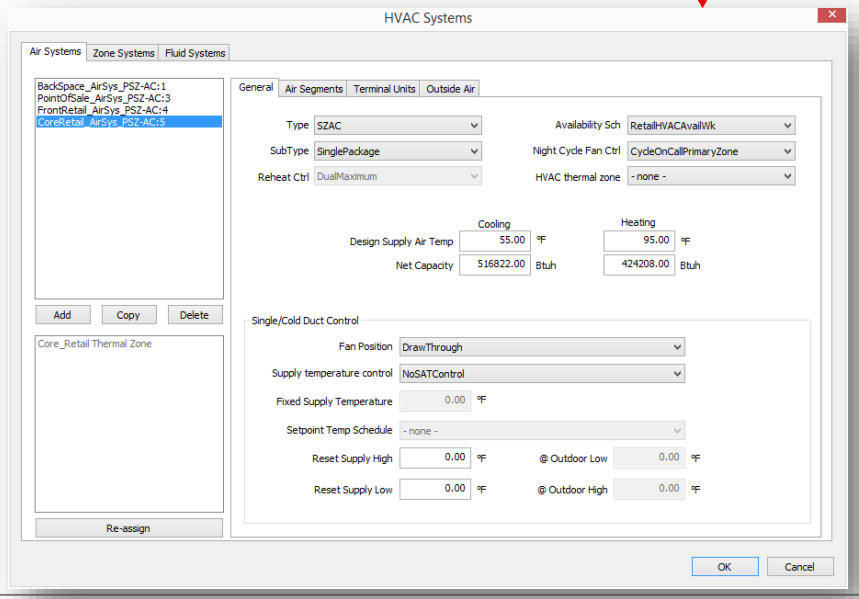
IES-VE Title 24 HVAC

IES VE with CBECC-Com and Whole-Building Energy Modeling

Zoning & HVAC:



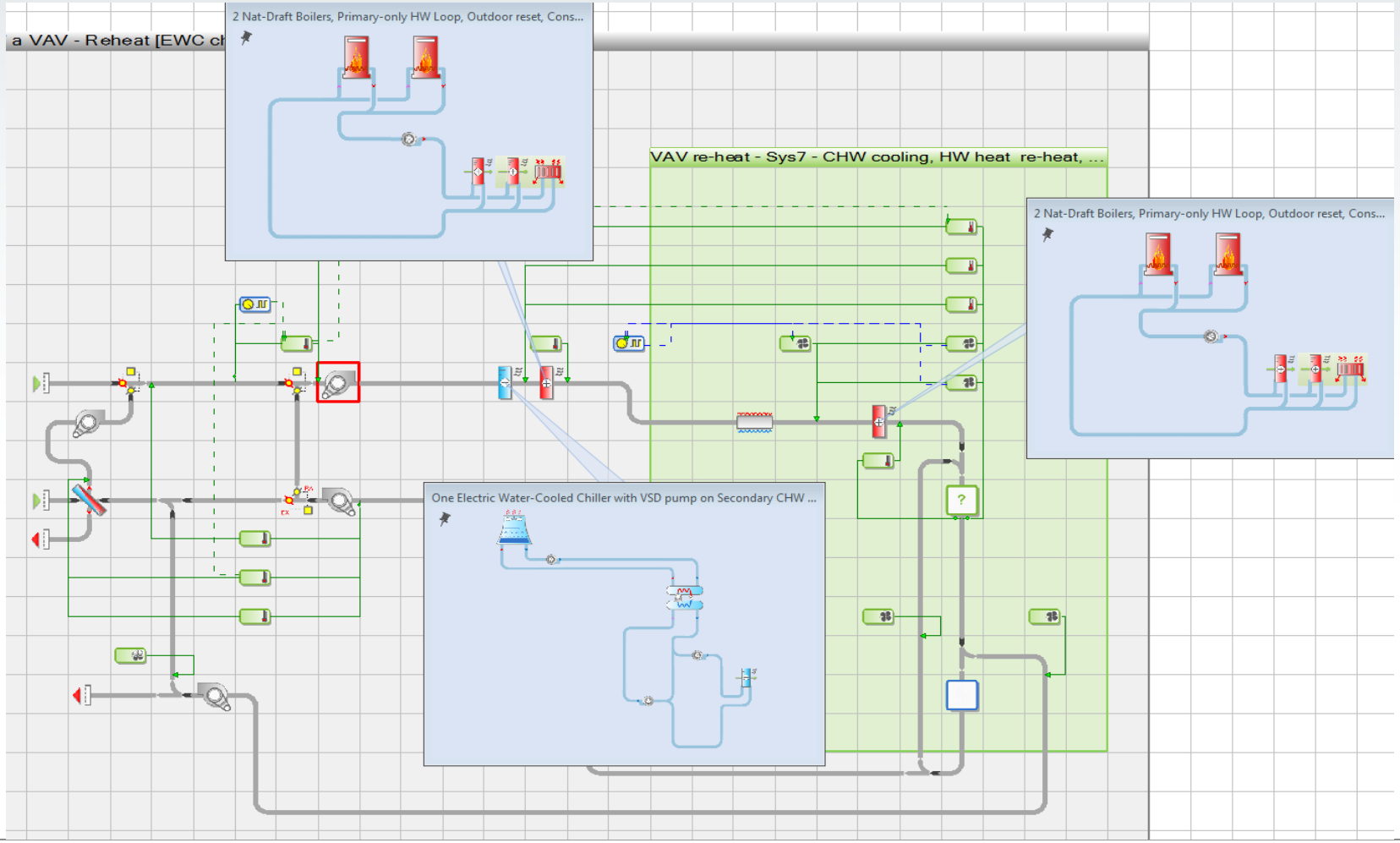




IES-VE HVAC Systems Sizing and Simulation

IES VE with CBECC-Com and Whole-Building Energy Modeling

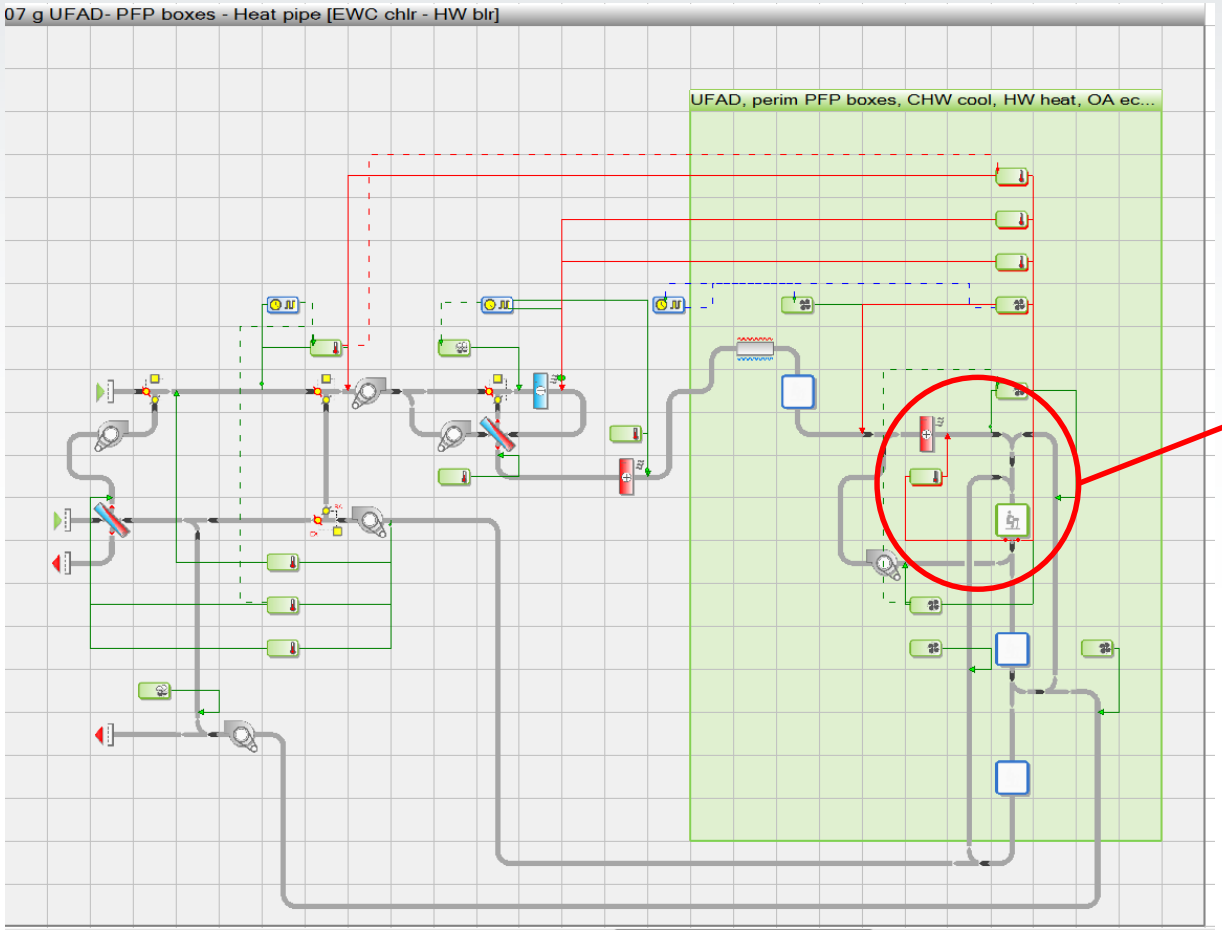
ASHRAE Baseline/Reference HVAC Systems

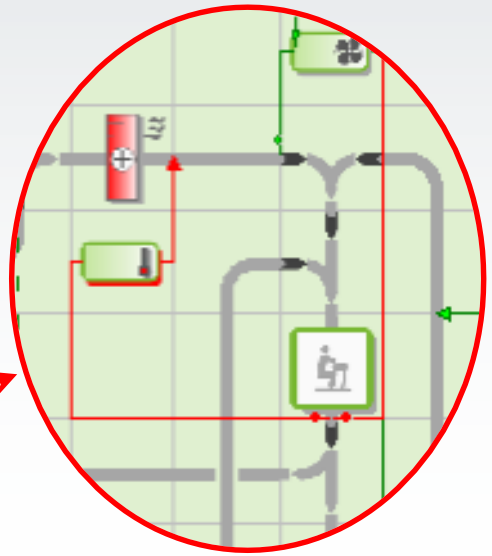


IES-VE HVAC Systems Simulation

IES VE with CBECC-Com and Whole-Building Energy Modeling

Underfloor Air Distribution (Displacement Vent.)



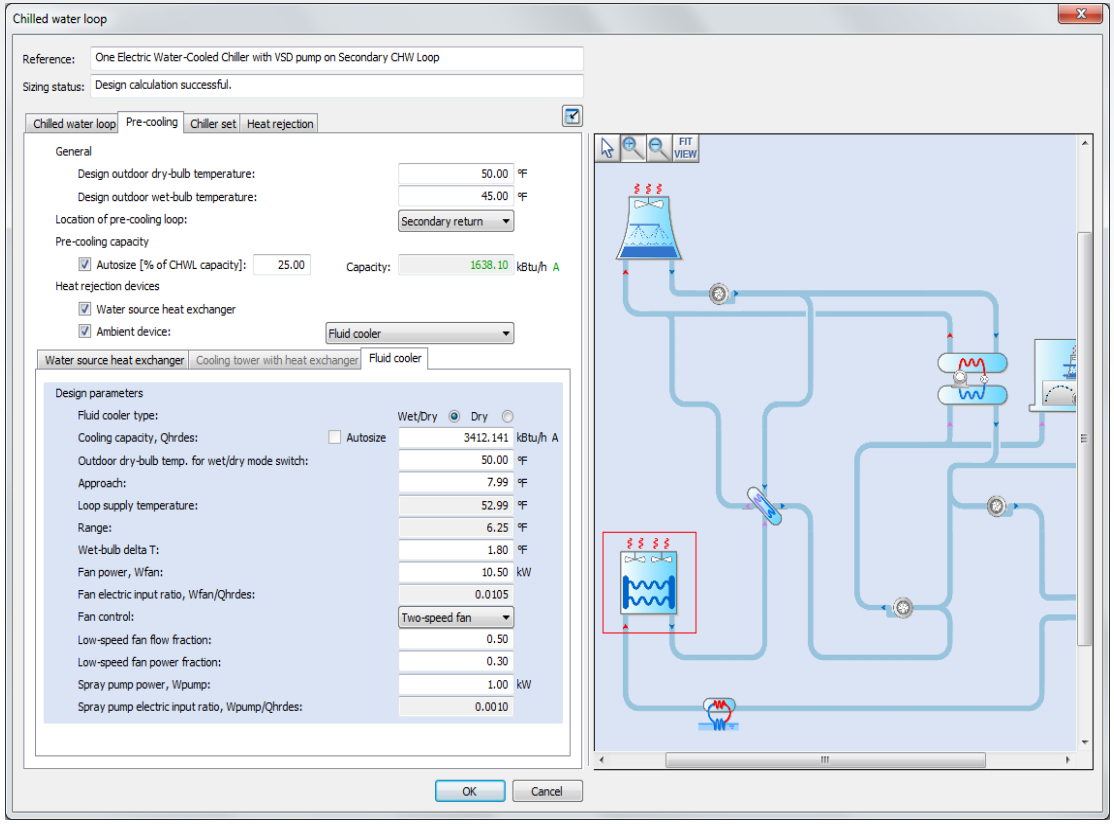


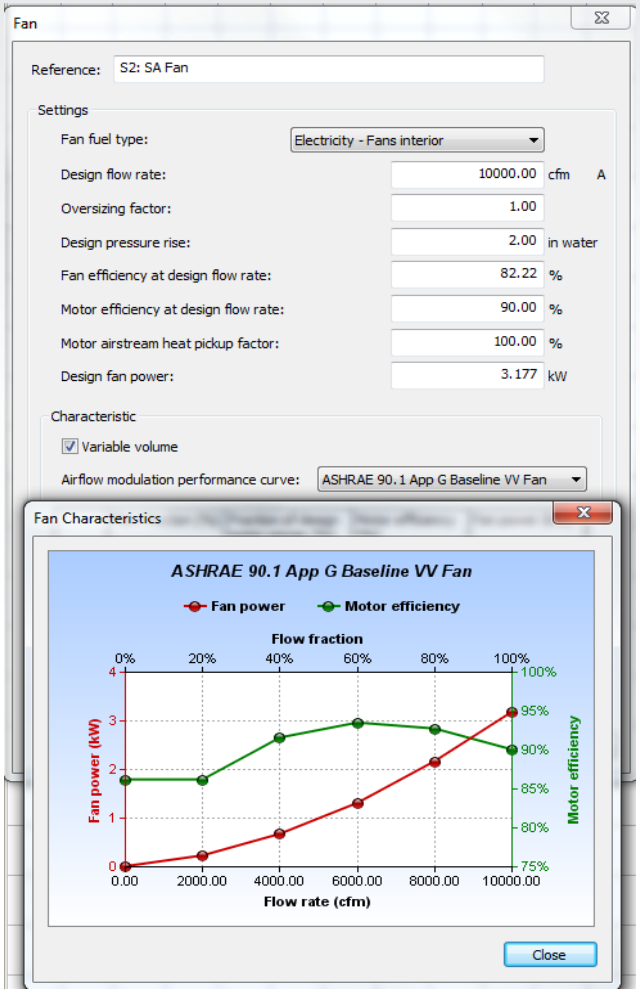
HVAC Control Sensor Location at Occupied room/zone LAC

IES-VE HVAC Systems Sizing and Simulation

IES VE with CBECC-Com and Whole-Building Energy Modeling

HVAC Optimization, performance curves



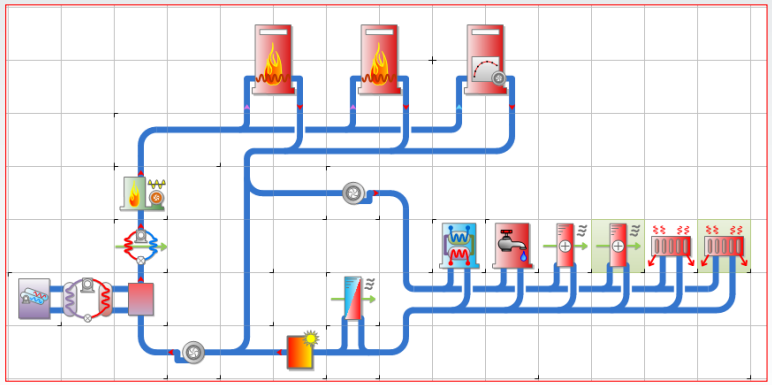


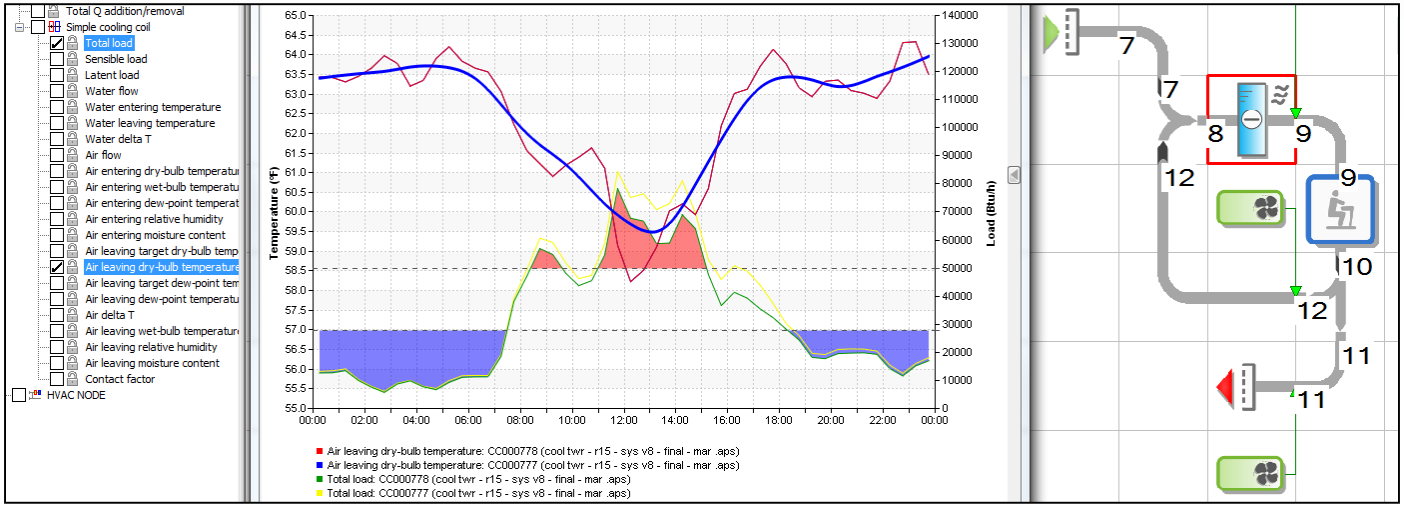
IES-VE HVAC Systems Sizing and Simulation

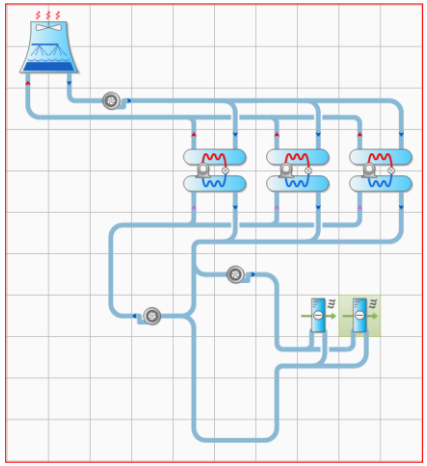
IES VE with CBECC-Com and Whole-Building Energy Modeling

HVAC Optimization: tracking plant performance

- Extensive pre-defined library
- System & Zone Level Sizing
- 62.1 Ventilation
- HVAC Sizing Reports
- Node-sizing airside network
- Expanded Waterside Capabilities
- Ability to cope with Innovative Systems







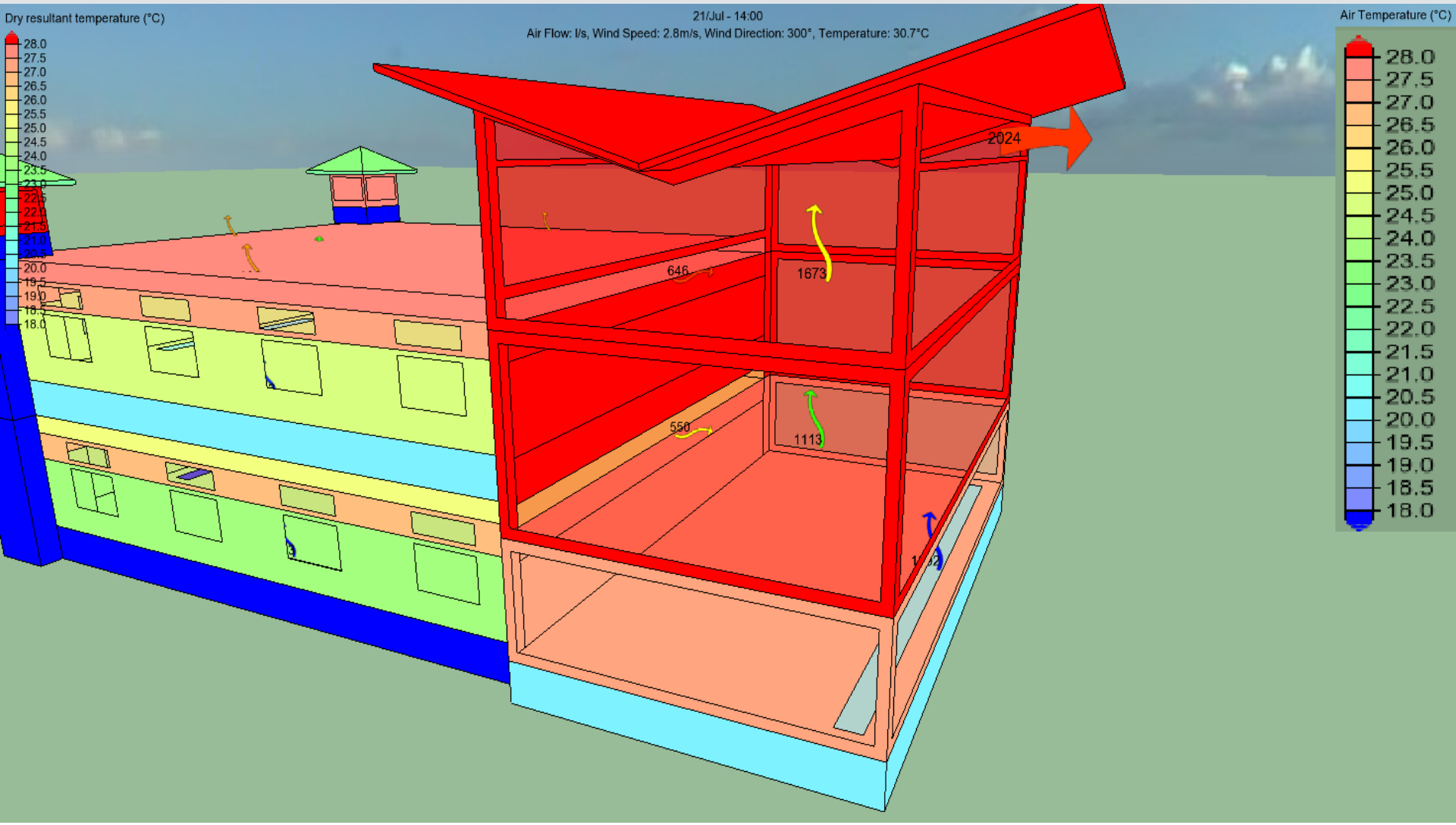
IES-VE (Natural Ventilation)

IES VE with CBECC-Com and Whole-Building Energy Modeling

Passive Building Design – Airflow

IES-VE (Thermal Comfort)

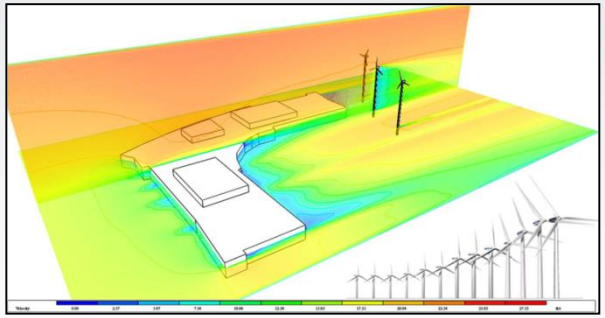
IES VE with CBECC-Com and Whole-Building Energy Modeling

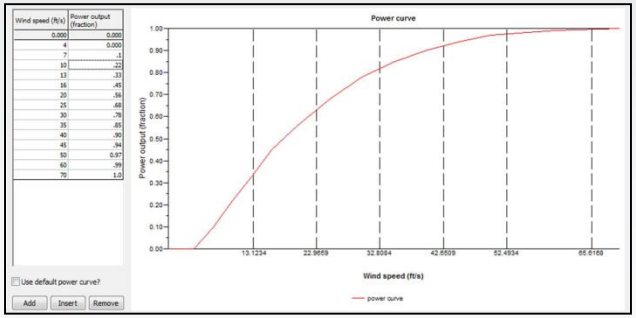


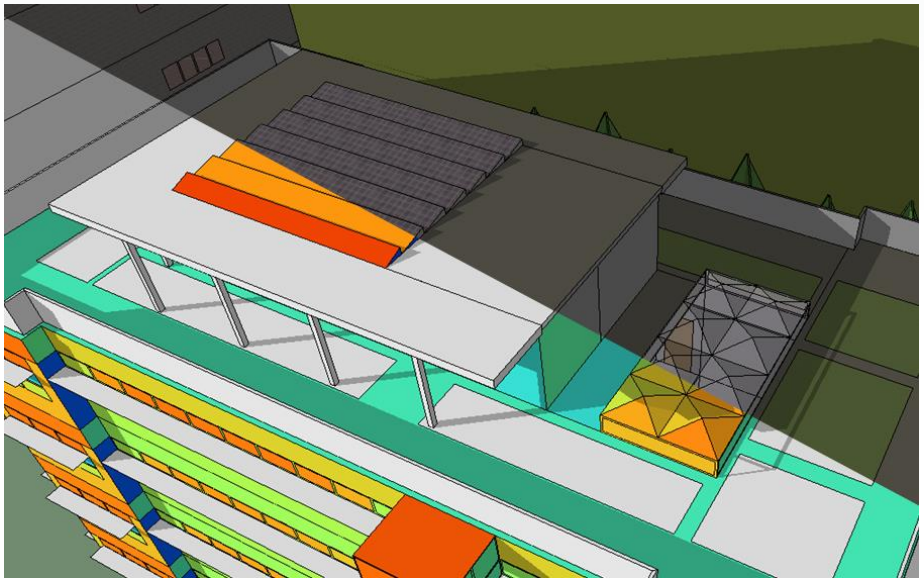
IES-VE Renewable Energy Simulation

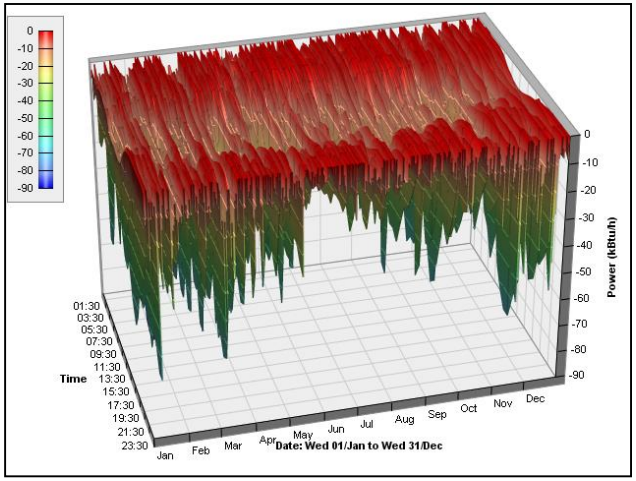
IES VE with CBECC-Com and Whole-Building Energy Modeling

Wind Turbines, Photovoltaic & Solar HW Panels









IES-VE Title 24

IES VE with CBECC-Com and Whole-Building Energy Modeling

Title 24 Reports:

- Simulation errors & warnings
- Unmet hours (by thermal zone)
- Energy consumption by end-use
- TDV energy comparison (Proposed v. Standard)
- Standard Design report (Certificate of Compliance)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD NRCC-PRF-01-E

Project Name: 030006-OffMed-Baseline **Calculation Date/Time:** Page 1 of 7

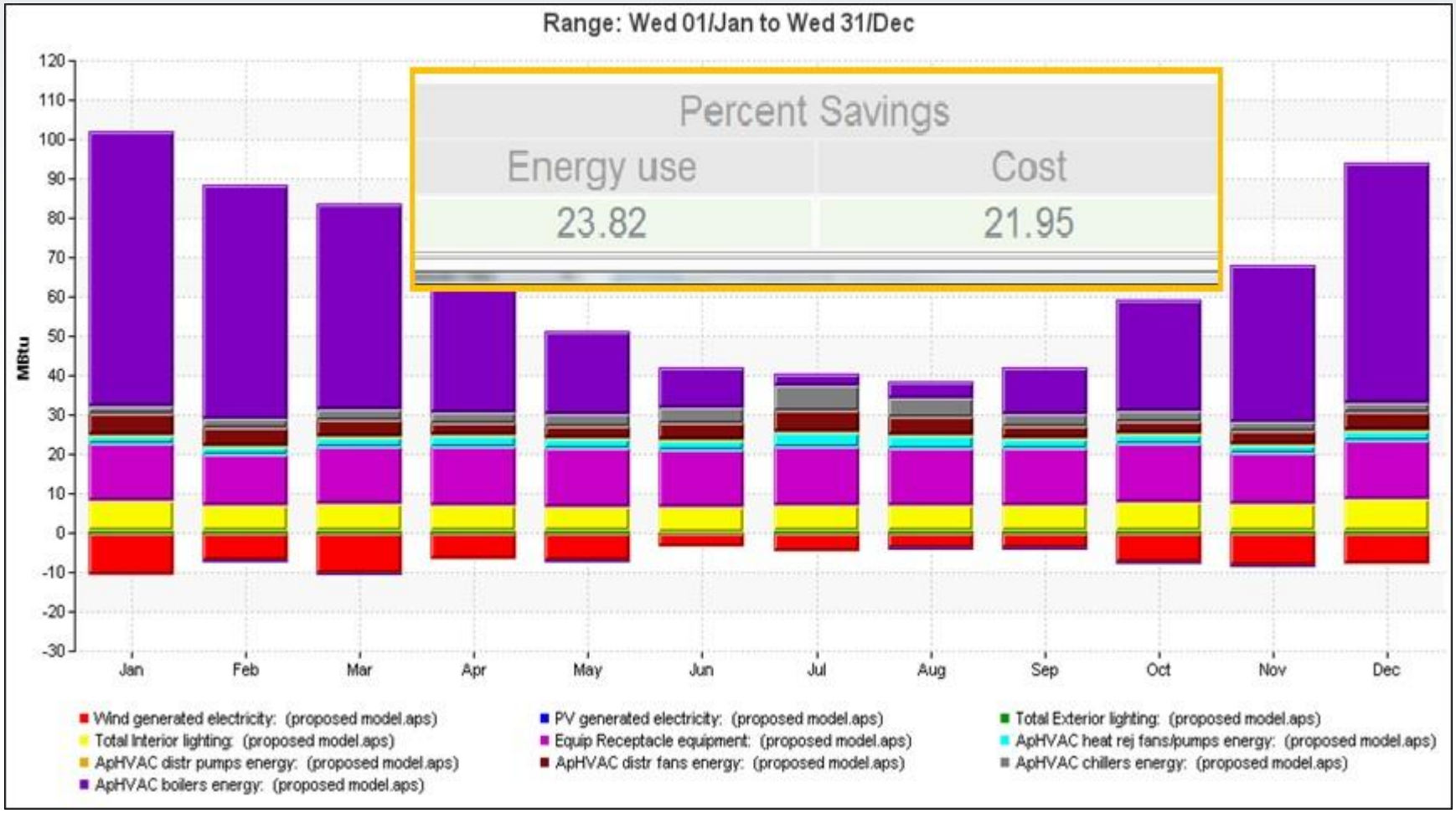
Compliance Scope : New Complete Building including Envelope, Lighting and HVAC **Input File Name:**

A. GENERAL INFORMATION					
01	Project Address	-specify-	21	Compliance Software	Virtual Environment 2014 version 6.4.0.12
02	City	-specify-	22	Compliance Manager Version	BEMCmpMgr 2013-2 (601)
03	Zip code	90505	23	Rule Set Filename	Constructed At Runtime
04	Climate Zone	ClimateZone6	24	Building Type	Nonresidential
05	Building Front Orientation	0	25	Construction Type	
06	Number of Above Grade Stories	3	26	North Wall Area (ft2)	6,386
07	Number of Below Grade Stories	0	27	East Wall Area (FT2)	4,257
08	Number of Dwelling Units	0	28	South Wall Area (ft2)	6,386
09	Total Conditioned Floor Area (ft2)	53,628	29	West Wall Area (ft2)	4,257

IES-VE Custom Energy Outputs

IES VE with CBECC-Com and Whole-Building Energy Modeling

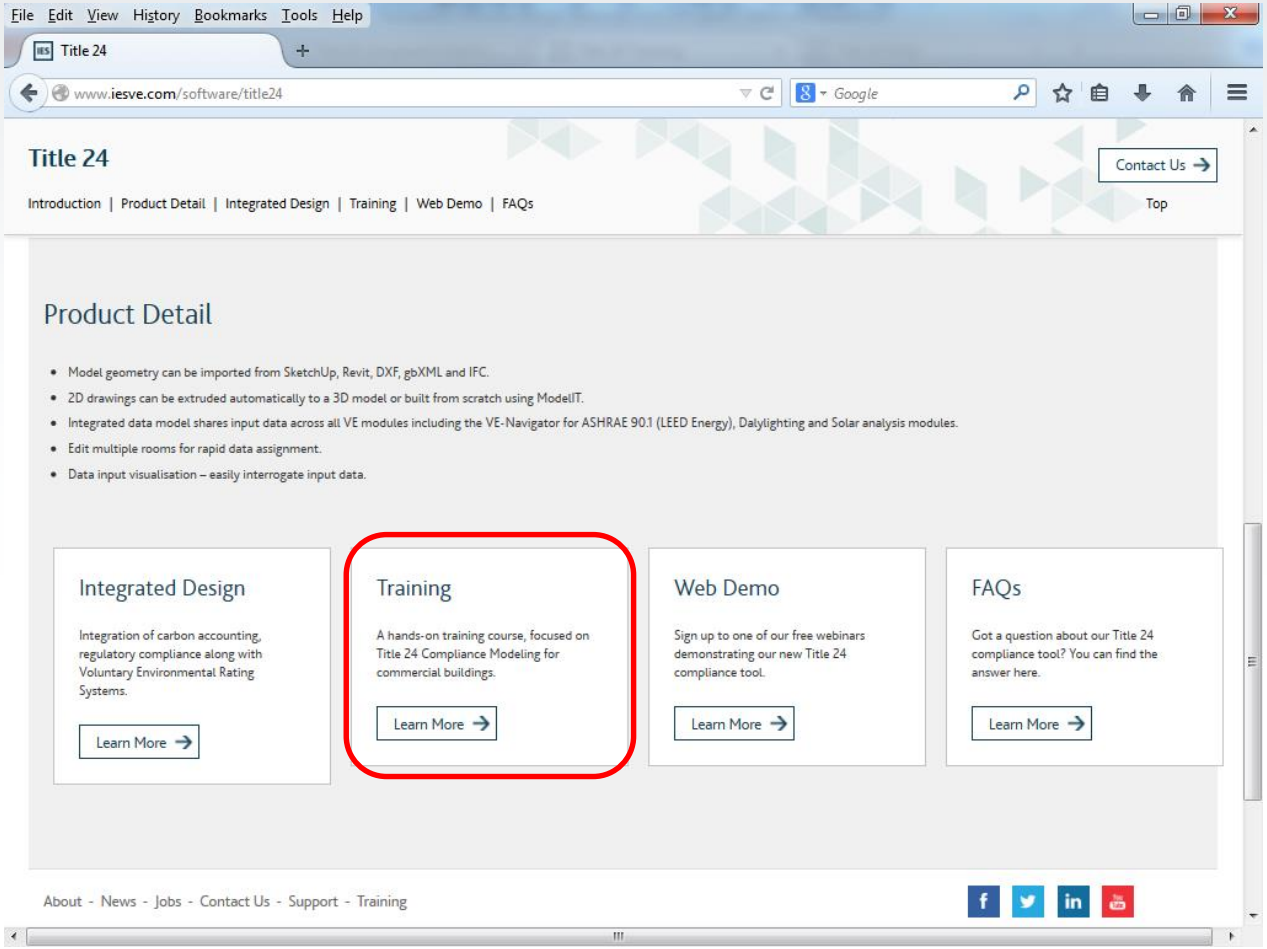
Building Energy Results Visualizations



IES-VE Title 24 Compliance Training

IES VE with CBECC-Com and Whole-Building Energy Modeling

www.iesve.com/software/title24



San Francisco (PG&E)
November 10th

LA/Edison (SCE)
November 6th

San Diego (SDGE)
November 18th

Sacramento (SMUD)
TBC

Web-training

IES-VE Title 24 Compliance Training

IES VE with CBECC-Com and Whole-Building Energy Modeling

Title 24 Training Agenda (9am-5pm)

- Introduction & distribution of training materials
- Overview of IES-VE software tools and Title 24 compliance workflow
- Model Management & Model Geometry:
  - Interoperability and Geometry Imports
  - 'build from scratch' workflow with tips & tricks
- Lunch (12:15-1:00pm)
- Building Data, Climate and Building Constructions Modeling
- Organization of Building Templates, room data, gains and profiles/schedules
- HVAC Zoning, air systems and fluids systems modeling
- Performing simulations, generating summary output reports and documentation

Example (AE) Training Agenda:

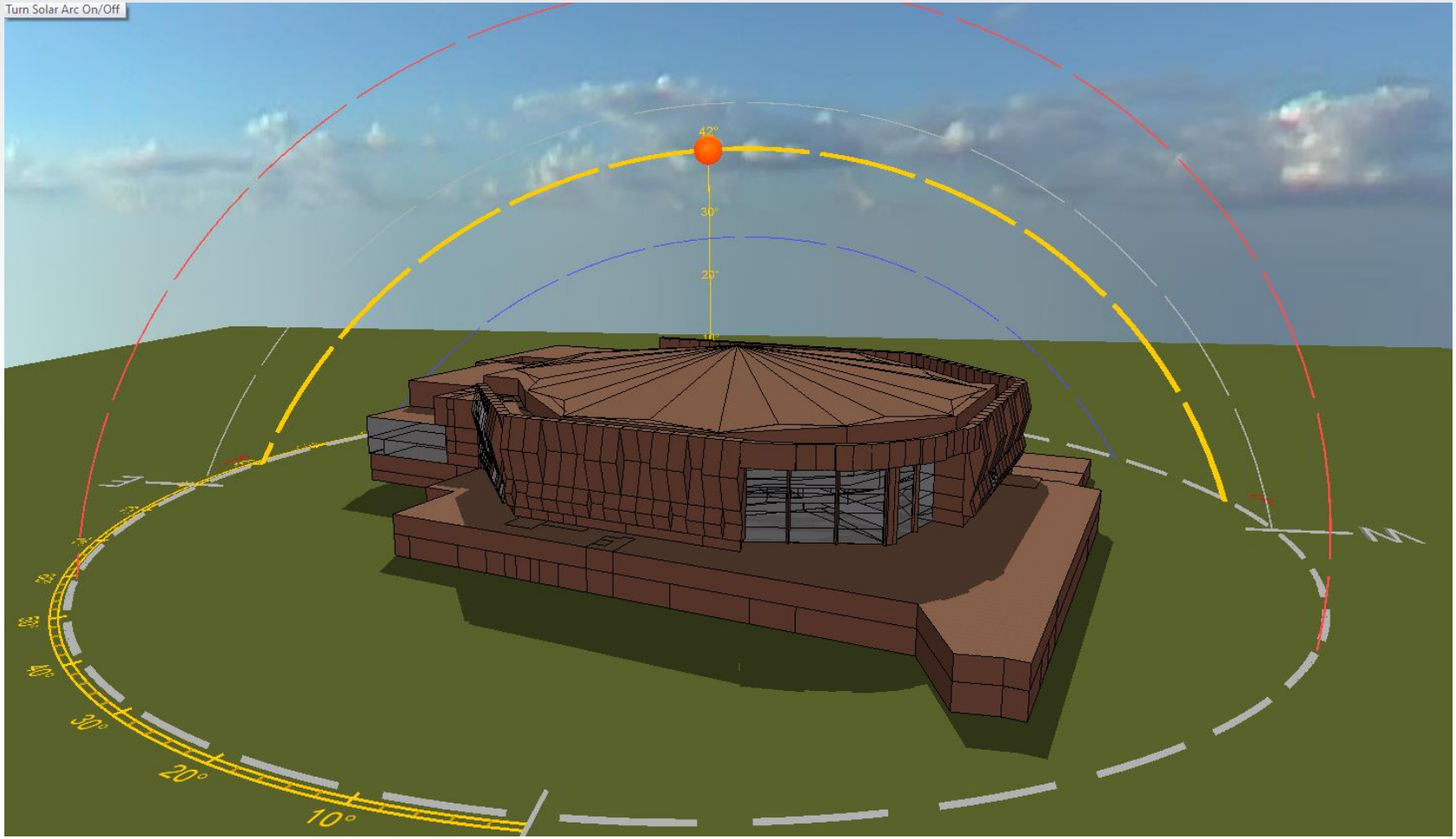
IES VE with CBECC-Com and Whole-Building Energy Modeling

Day 1 – Geometry & Daylight	Day 2 – Energy Simulation	Day 3 – Airflow & HVAC
Introduction SketchUp/Revit to IESVE work-flow **Model Massing in IES-VE** Climate Analytics	Water Efficiency, **Solar Shading Simulation** Energy Simulation (simple) **Internal Gains** Profiles/Schedules Envelope & Materials Studies	Intro to HVAC HVAC Loads **HVAC Systems Sizing** **Whole Building Energy Simulation** PRM Outputs & Reports **ASHRAE 62.1 & 90.1**
Lunch (60 minutes)		
Daylight Analysis Lighting Design Daylight for LEED Glare Analysis **3-D Daylight Simulation**	**Energy Simulation** Occupancy Thermal Comfort Renewable Energy Analysis **Natural Ventilation (bulk airflow)** **CFD Simulation (microscopic airflow)**	**Title 24 Compliance**
Discussion (15 minutes)		

Case Study: Kings Basketball Arena

IES VE with CBECC-Com and Whole-Building Energy Modeling

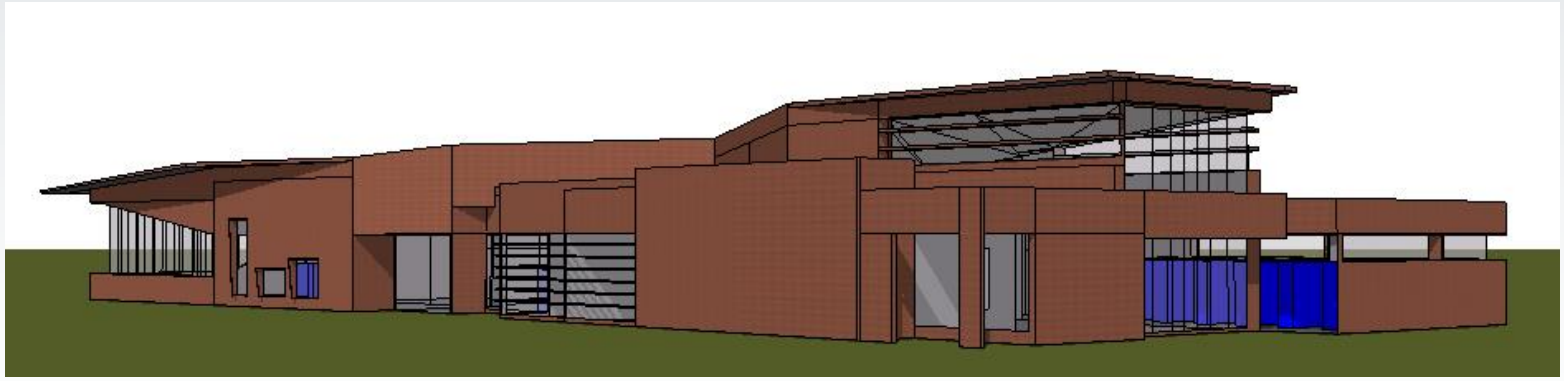
Case Study: SMUD & AECOM

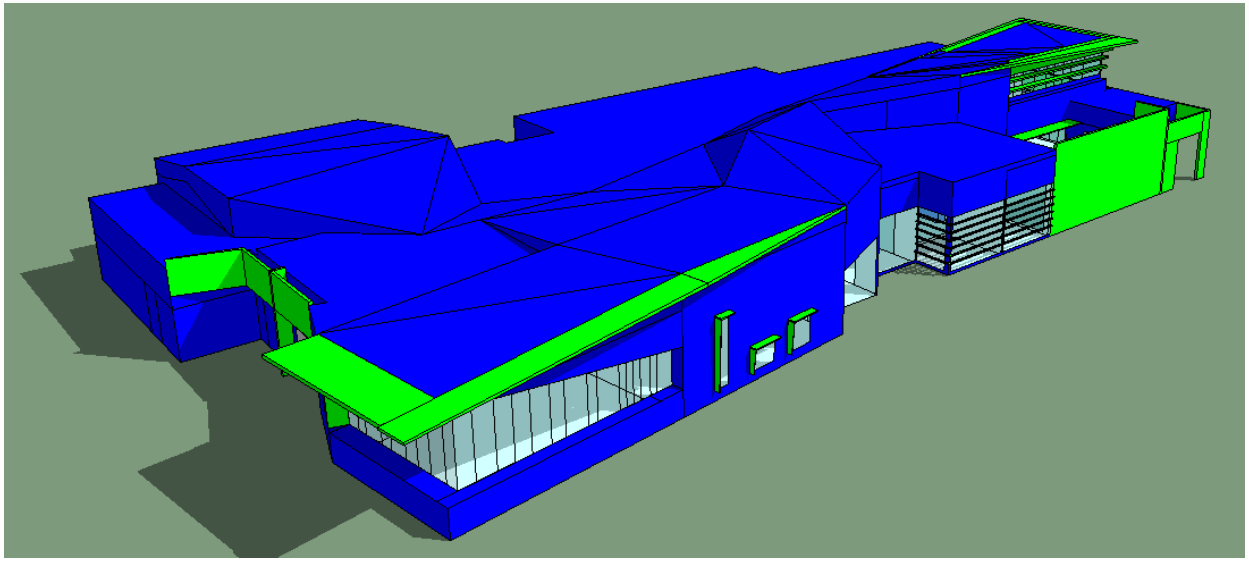


Case Study: South Wittier Library, Los Angeles

IES VE with CBECC-Com and Whole-Building Energy Modeling

LEED Platinum Case Study: Green Dinosaur





INTEGRATED ENVIRONMENTAL SOLUTIONS

Questions / Comments

Liam
Liam.Buckley@iesve.com

Martha

Todd
Todd.Lukesh@iesve.com

www.iesve.com