11th Annual International Radiance Workshop 2012

eLAD eLearning platform for Lighting and Daylighting

Maria Konstantoglou

Lawrence Berkeley National Laboratory

University of Thessaly, Volos, Greece

mkonstantoglou@lbl.gov
https://elad.lbl.gov

grant-supported project through LBNL
by the US Department of Energy (DOE)

Main team members:

LBNL:

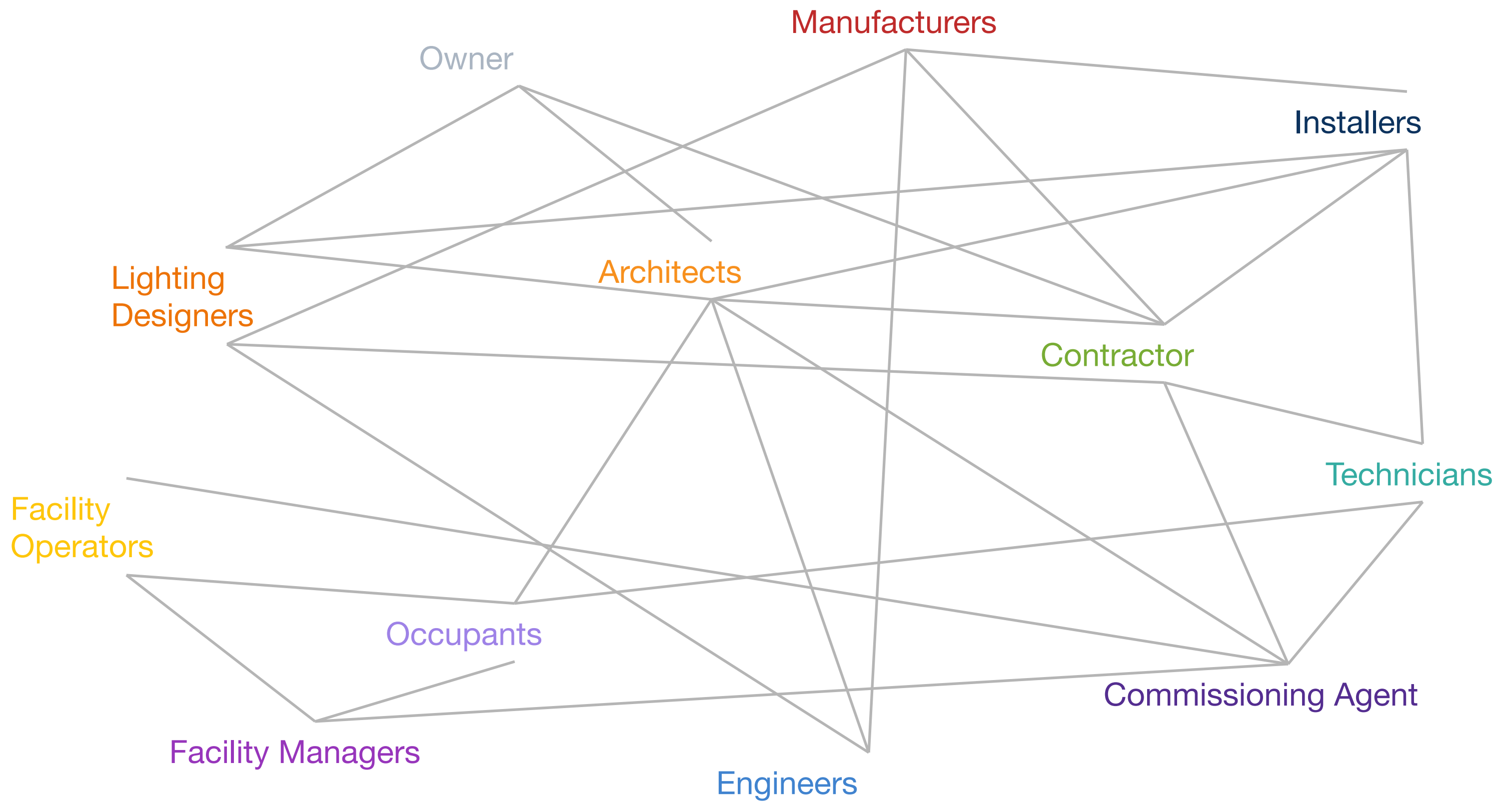
Randolph Fritz (Radiance Scripting)
Maria Konstantoglou (Radiance Scripting)
Kirsten Heming (Project Coordinator)

SuPerB, Institute for the Sustainable Performance of Buildings:

Joseph Deringer (Project Leader)

eLAD enables users to learn about lighting and daylighting for commercial buildings

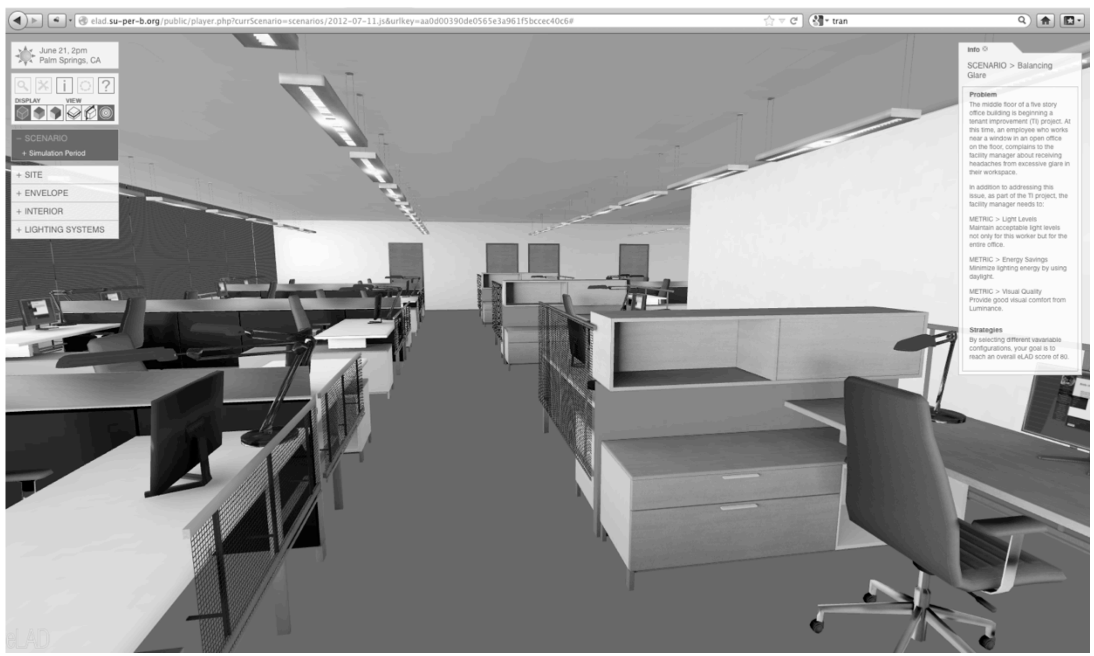
eLAD is intended to be used in academic and applied professional settings



INTRODUCTION: **what is eLAD**

eLAD provides an interactive 3D environment enabling users to explore and learn about optimizing and integrating lighting systems

- # Open-source.
- # Available at no cost to users via web-based, public-domain delivery platforms.
- # Customizable, allows for scalability and flexibility to be used as a training guide, to a supplementary educational tool.



Participants:

Lawrence Berkeley National Laboratory

Stanford Research Institute

SuPerB, Institute for the Sustainable Performance of Buildings

International panel of lighting experts

Hayden McKay, Horton Lees Brogden Lighting Design
Matthew Tanteri, Parsons School of Constructed Environments
Prasad Vaidya, The Weidt Group
Kevin Van Den Wymelenberg, University of Idaho
Christopher Meek, University of Washington
Aris Tsangrassoulis, University of Thessaly
Heather Burpee, University of Washington
Richard Mistrick, Penn State
Susan Ubbelhode, University of Berkeley
Michael Donn, Victoria University of Wellington
Christoph Reinhart, Harvard University

eLearning Software Platform

System Logic:

Using existing LBNL simulation Engines:

Radiance,

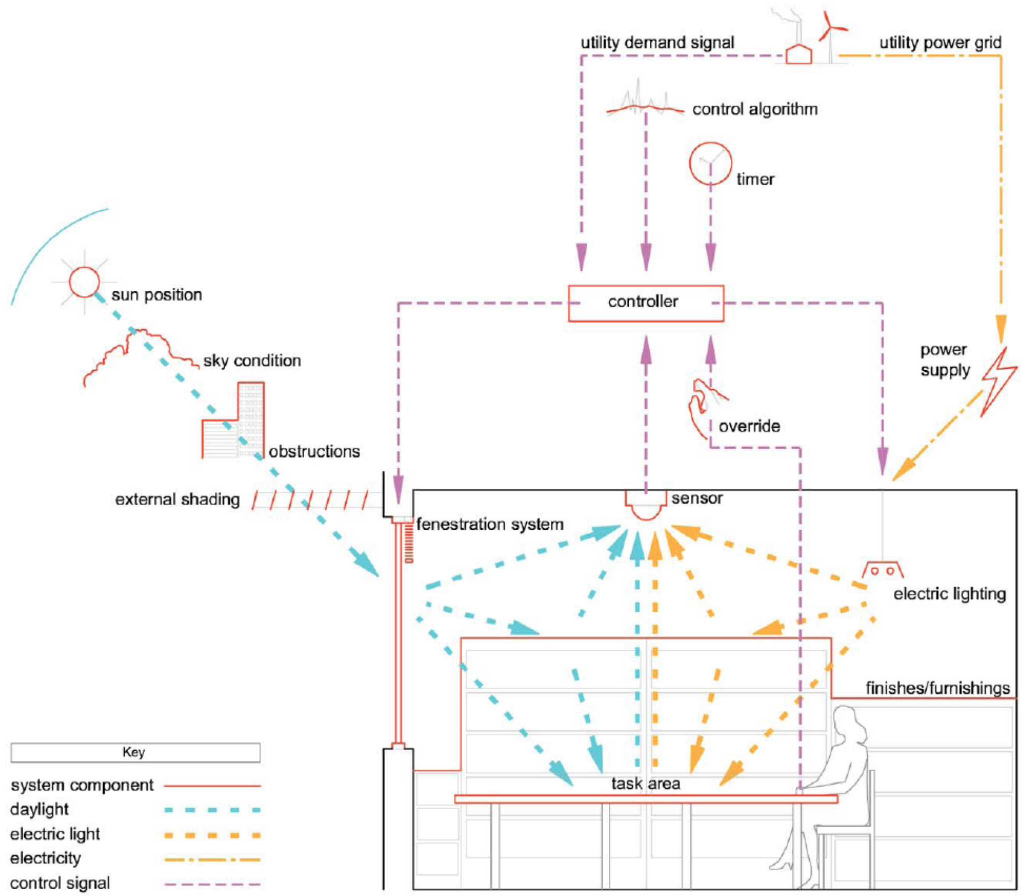
For simulation-driven lighting

and daylighting Scenarios

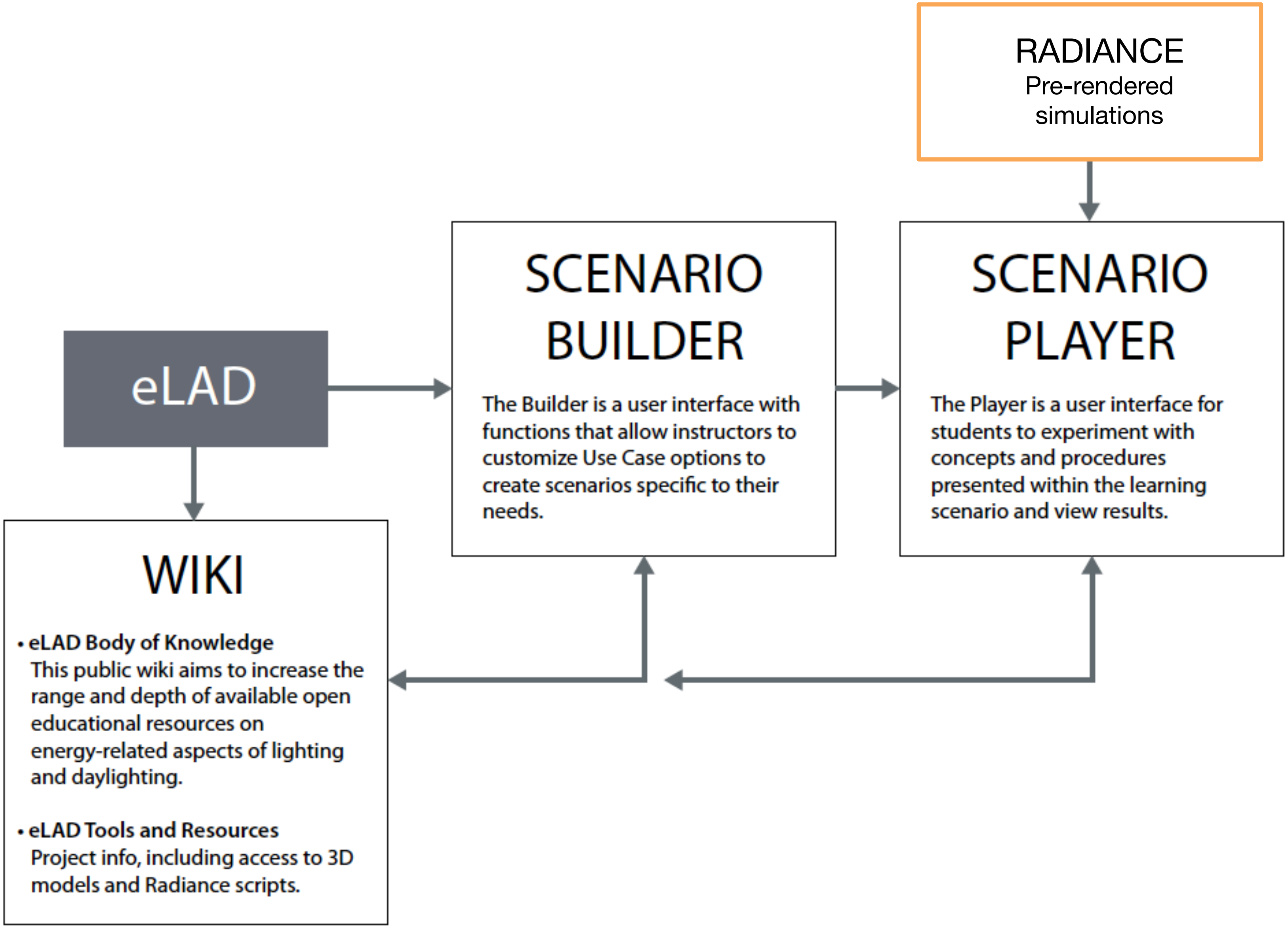
eLAD is an early adopter of WebGL

WebGL provides support for 3D animated graphics in web sites

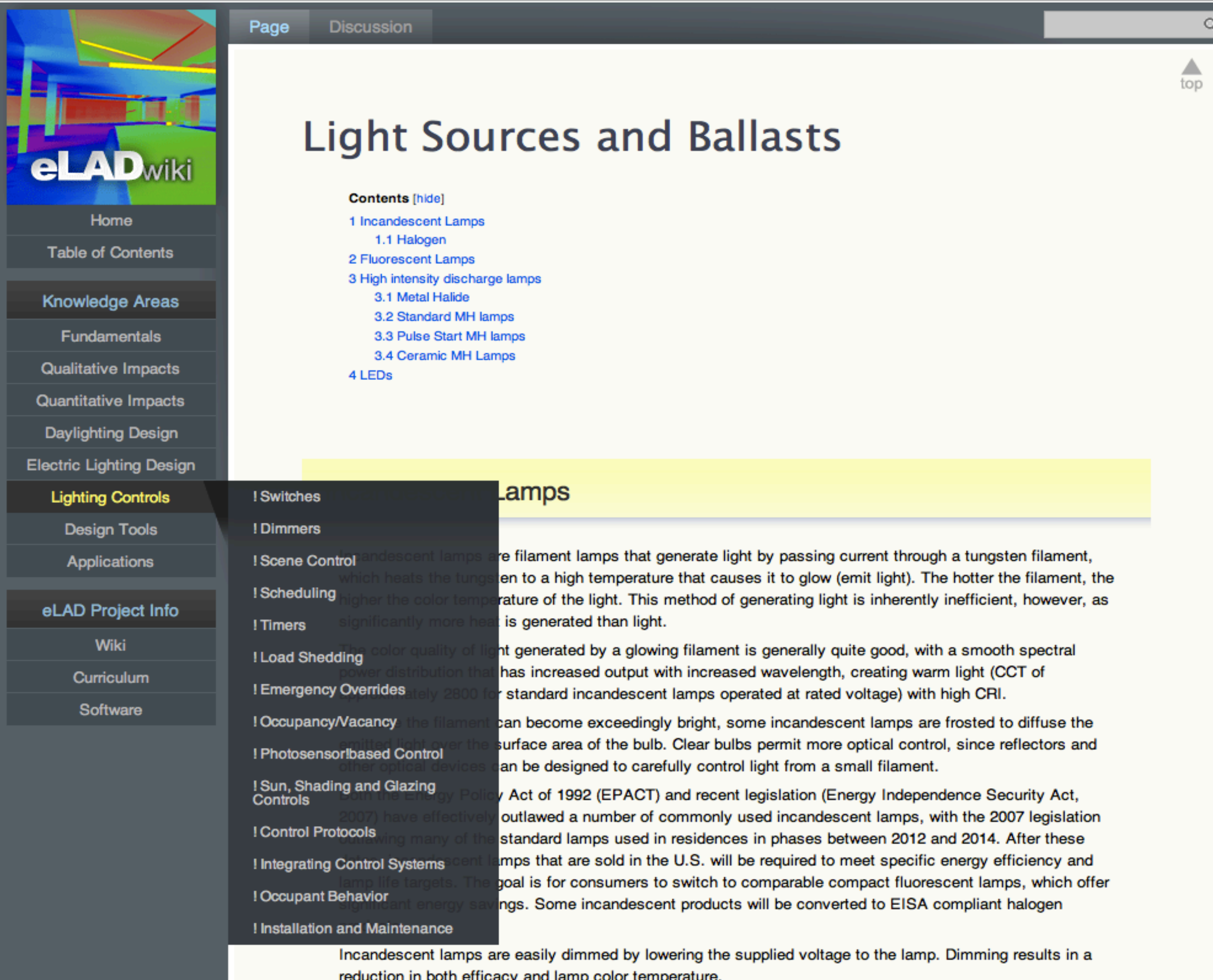
eLAD is built partly in Kuda, an authoring environment for WebGL



STRUCTURE


RADIANCE
Pre-rendered simulations
eLAD
SCENARIO BUILDER
The Builder is a user interface with functions that allow instructors to customize Use Case options to create scenarios specific to their needs.
SCENARIO PLAYER
The Player is a user interface for students to experiment with concepts and procedures presented within the learning scenario and view results.
WIKI
• eLAD Body of Knowledge
This public wiki aims to increase the range and depth of available open educational resources on energy-related aspects of lighting and daylighting.
• eLAD Tools and Resources
Project info, including access to 3D models and Radiance scripts.

CONTENT: **wiki:** https://elad.lbl.gov

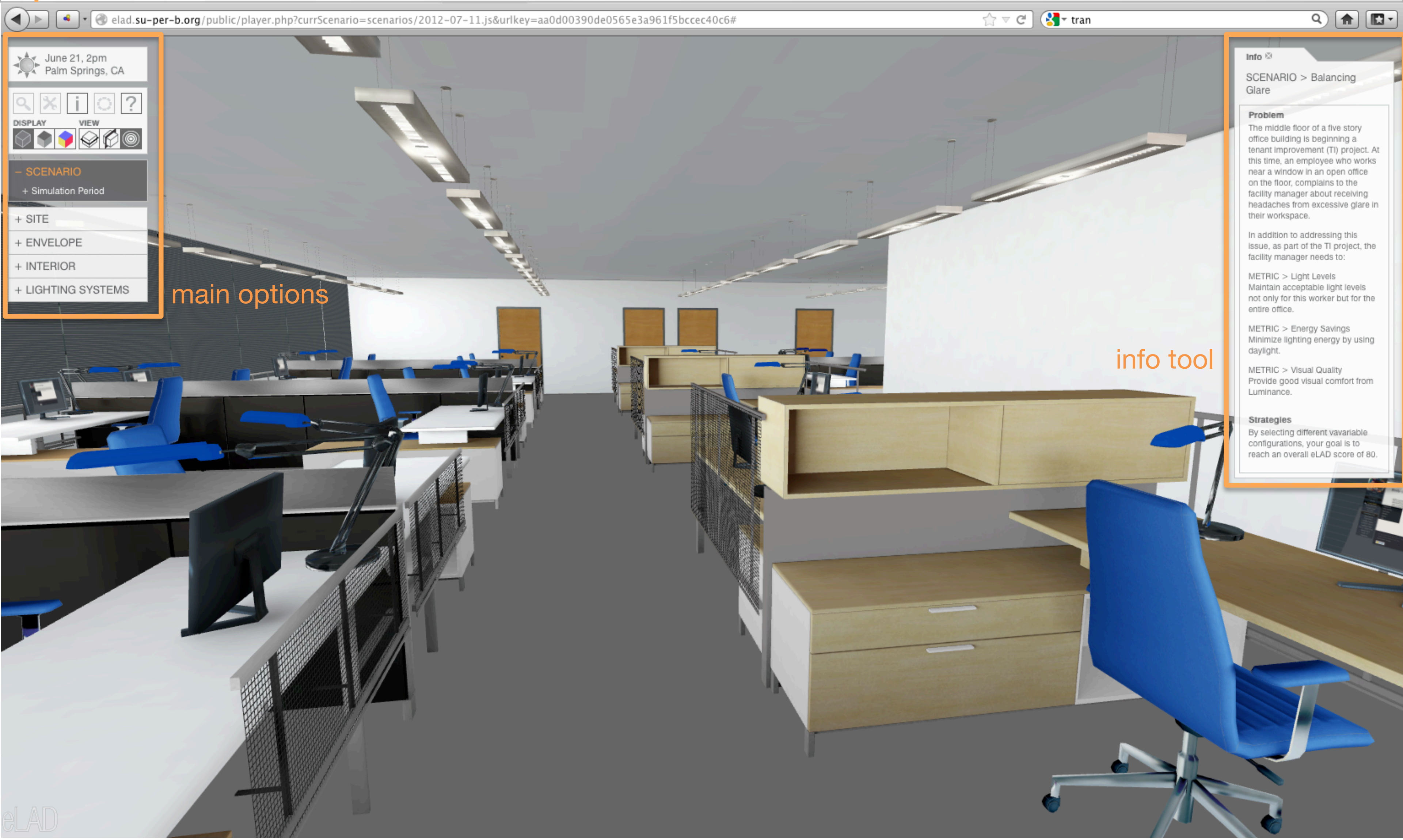


Phase 1 of the project completed in the end of July 2012

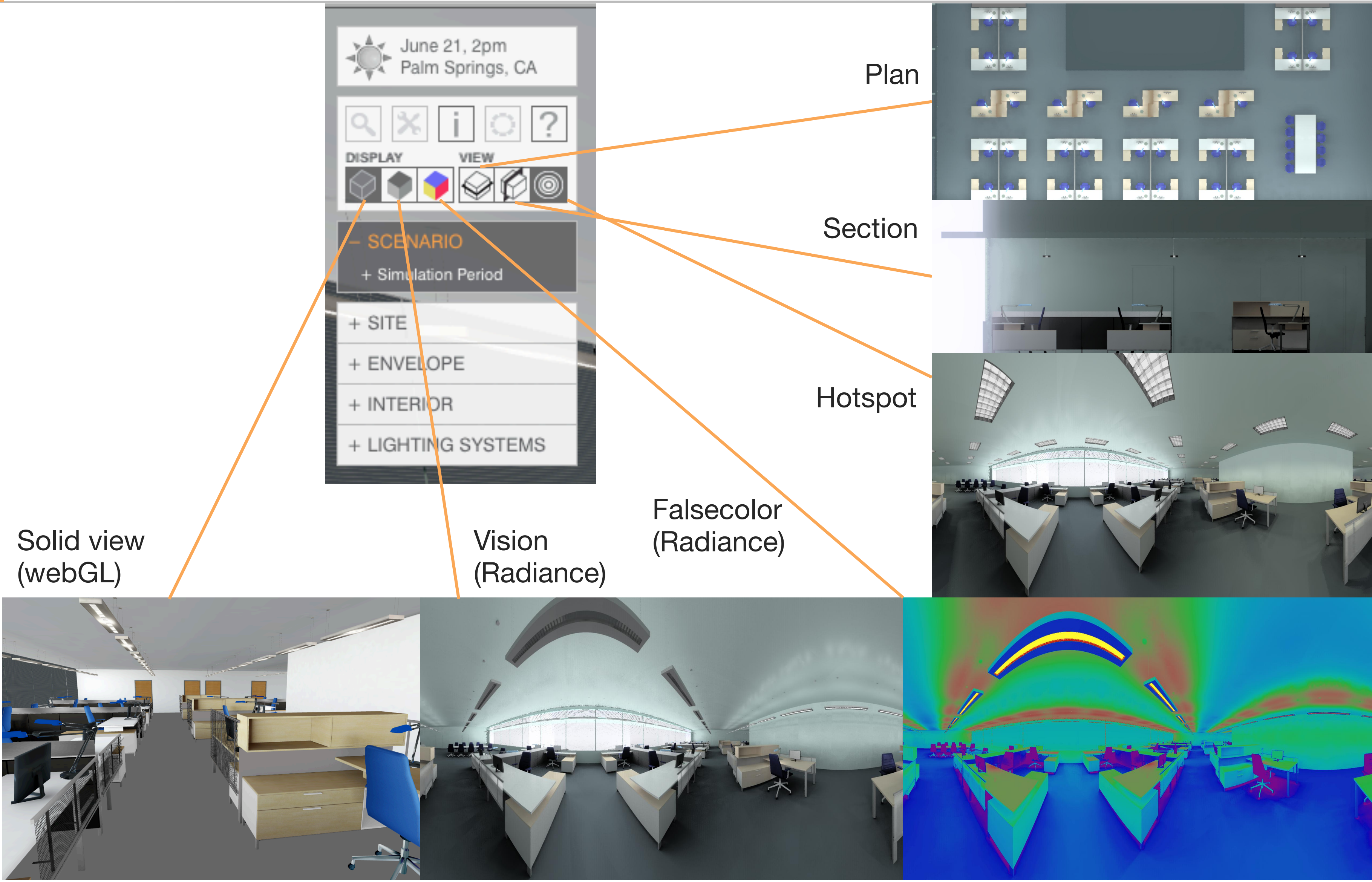
Demo available in the wiki:

http://elad.lbl.gov/index.php/Demo_eLAD

SCENARIO PLAYER: **Graphic User Interface**



SCENARIO PLAYER: **Graphic User Interface**



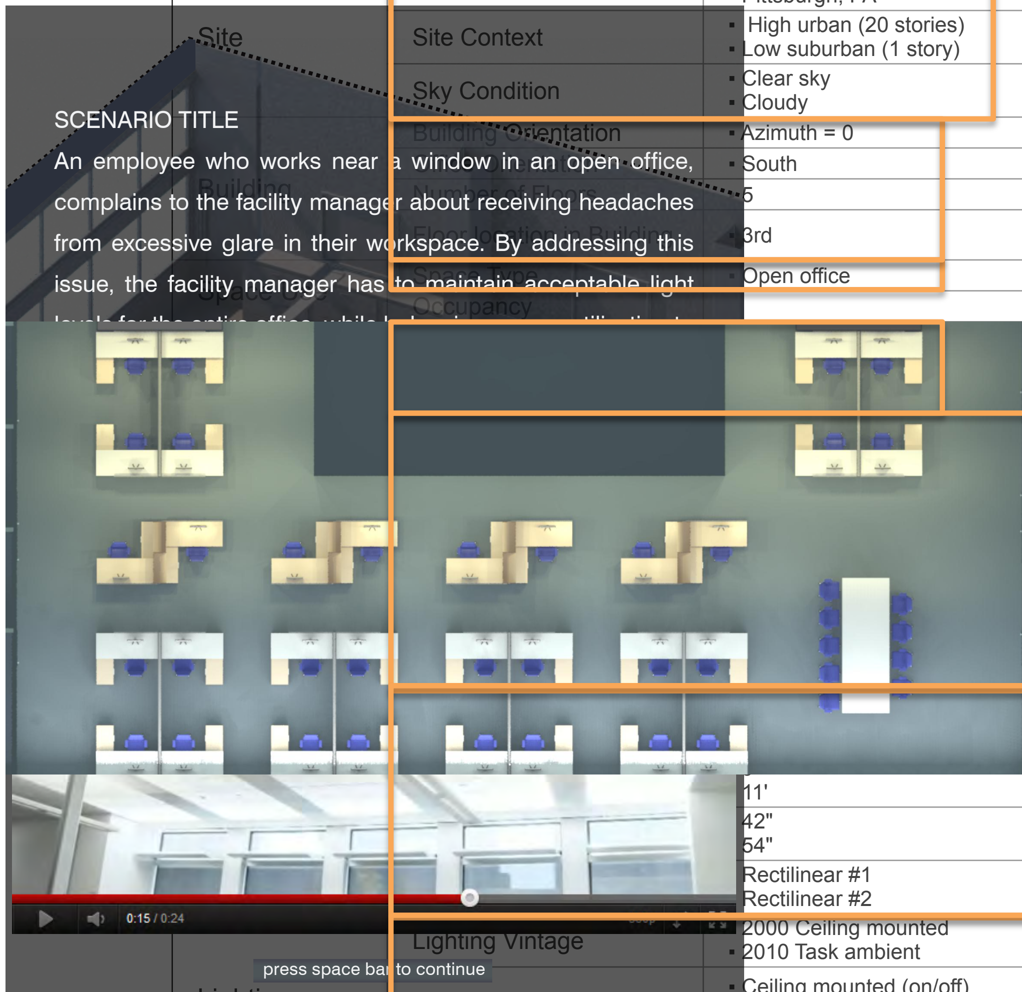
SIMULATION variables

Combinations of variables lead to simulation cases

Building System	Variable	Phase 1 Variable Options - current
Scenario	Scenario Description	
	Simulation Period	▪ June 21, 2pm ▪ Dec 21, 10am
Site	Location	▪ Palm Springs, CA ▪ Pittsburgh, PA
	Site Context	▪ High urban (20 stories) ▪ Low suburban (1 story)
	Sky Condition	▪ Clear sky ▪ Cloudy
Building	Building Orientation	▪ Azimuth = 0
	Office Orientation	▪ South
	Number of Floors	▪ 5
	Floor location in Building	▪ 3rd
Space Use	Space Type	▪ Open office
	Occupancy	
Envelope	Skin Type	▪ Single skin
	Wall Type	▪ Curtain wall
	Glass Type	▪ Single pane
	Glass Transmittance	▪ 0.4 ▪ 0.6
	Internal Shading	▪ View window - blinds (closed) ▪ View window - blinds (horizontal) ▪ View window - none (up)
	External Shading	▪ Fixed overhang/shelf ▪ None
	Shading Controls	
	Window-Wall Ratio	▪ 0.4 ▪ 0.6
Interior	Surface Reflectance	▪ High (wall 0.8, ceiling 0.9, floor 0.3, work surface 0.6, partition 0.7) ▪ Low (wall 0.4, ceiling 0.7, floor 0.1, work surface 0.4, partition 0.5)
	Ceiling Height	▪ 9' ▪ 11'
	Partition Height	▪ 42" ▪ 54"
	Furniture Layout	▪ Rectilinear #1 ▪ Rectilinear #2
Lighting	Lighting Vintage	▪ 2000 Ceiling mounted ▪ 2010 Task ambient
	Controls	▪ Ceiling mounted (on/off) ▪ Ceiling mounted (daylight dimming) ▪ Task (on/off) ; ambient (on/off) ▪ Task (on/off) ; ambient (daylight dimming)

SIMULATION variables

Building System	Variable	Phase 1 Variable Options - current
Scenario	Scenario Description	
	Simulation Period	▪ June 21, 2pm ▪ Dec 21, 10am
Site	Location	▪ Palm Springs, CA ▪ Pittsburgh, PA
	Site Context	▪ High urban (20 stories) ▪ Low suburban (1 story)
	Sky Condition	▪ Clear sky ▪ Cloudy
Building	Building Orientation	▪ Azimuth = 0
	[illegible]	▪ South
	Number of Floors	▪ 5
	Floor location in Building	▪ 3rd
Space Use	Space Type	▪ Open office
	Occupancy	[illegible]
[illegible]	[illegible]	[illegible] al)
[illegible]	[illegible]	[illegible] 0.3, work surface 0.6, partition 0.7) [illegible] 0.1, work surface 0.4, partition 0.5)
	[illegible]	11'
	[illegible]	42" 54"
	[illegible]	Rectilinear #1 Rectilinear #2
Lighting	Lighting Vintage	▪ 2000 Ceiling mounted ▪ 2010 Task ambient
	Controls	▪ Ceiling mounted (on/off) ▪ Ceiling mounted (daylight dimming) ▪ Task (on/off) ; ambient (on/off) ▪ Task (on/off) ; ambient (daylight dimming)



SIMULATION variables

Naming

v - view,
m – mode,
d - date,
g - geometry,
n – neighborhood,
s- sky conditions,
t – transmittance,
i - internal shading,
e – external shading,
w – window/wall ratio,
r – reflectance,
p - partition height,
f - furniture layout,
z - ceiling height,
l – lighting vintage,
c - controls

Building System	Variable	Phase 1 Variable Options - current
Scenario	Scenario Description	
	Simulation Period	▪ June 21, 2pm ▪ Dec 21, 10am
Site	Location	▪ Palm Springs, CA ▪ Pittsburgh, PA
	Site Context	▪ High urban (20 stories) ▪ Low suburban (1 story)
	Sky Condition	▪ Clear sky ▪ Cloudy
Building	Building Orientation	▪ Azimuth = 0
	Office Orientation	▪ South
	Number of Floors	▪ 5
	Floor location in Building	▪ 3rd
Space Use	Space Type	▪ Open office
	Occupancy	
Envelope	Skin Type	▪ Single skin
	Wall Type	▪ Curtain wall
	Glass Type	▪ Single pane
	Glass Transmittance	▪ 0.4 ▪ 0.6
	Internal Shading	▪ View window - blinds (closed) ▪ View window - blinds (horizontal) ▪ View window - none (up)
	External Shading	▪ Fixed overhang/shelf ▪ None
	Shading Controls	
	Window-Wall Ratio	▪ 0.4 ▪ 0.6
Interior	Surface Reflectance	▪ High (wall 0.8, ceiling 0.9, floor 0.3, work surface 0.6, partition 0.7) ▪ Low (wall 0.4, ceiling 0.7, floor 0.1, work surface 0.4, partition 0.5)
	Ceiling Height	▪ 9' ▪ 11'
	Partition Height	▪ 42" ▪ 54"
	Furniture Layout	▪ Rectilinear #1 ▪ Rectilinear #2
Lighting	Lighting Vintage	▪ 2000 Ceiling mounted ▪ 2010 Task ambient
	Controls	▪ Ceiling mounted (on/off) ▪ Ceiling mounted (daylight dimming) ▪ Task (on/off) ; ambient (on/off) ▪ Task (on/off) ; ambient (daylight dimming)

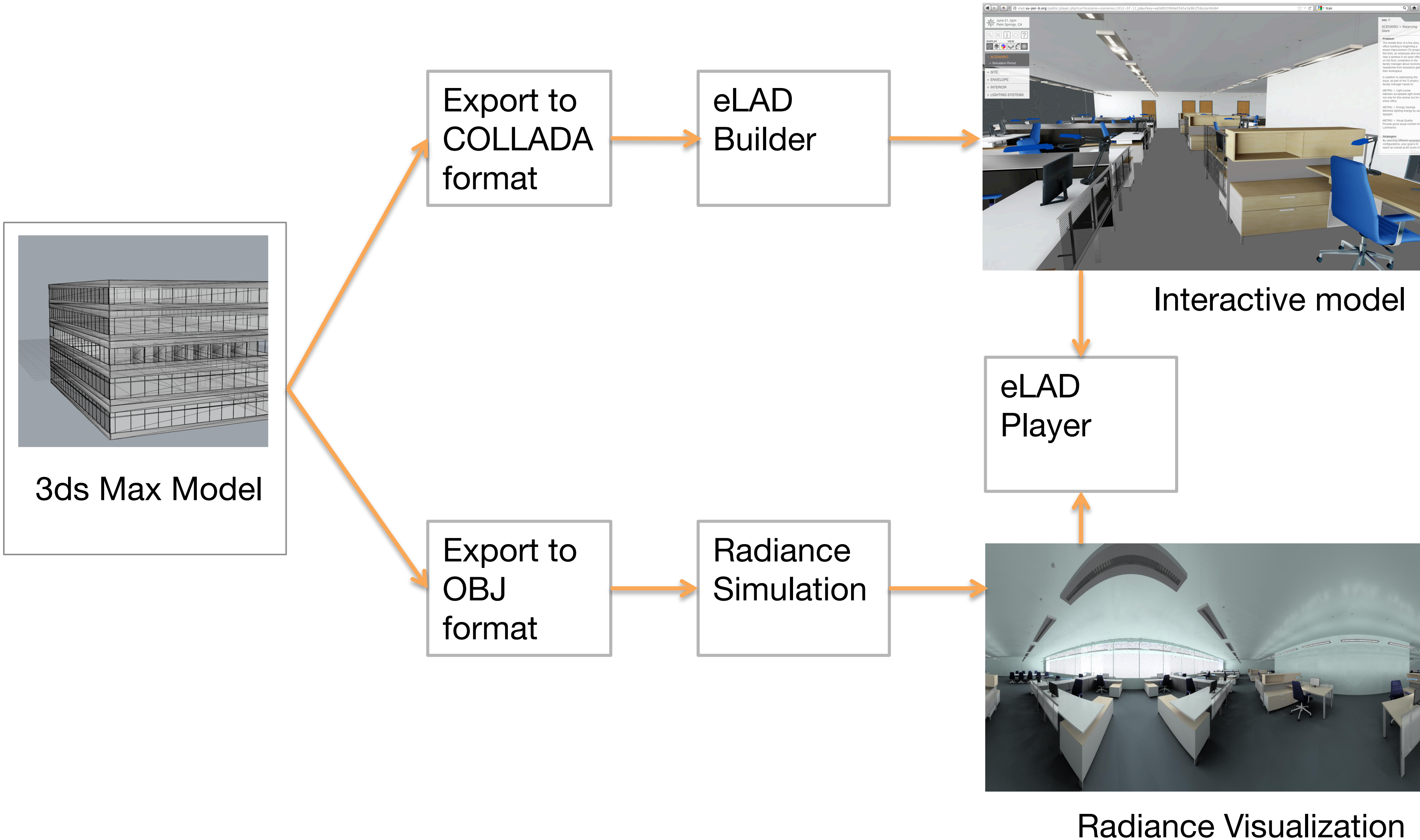
SIMULATION variables: **Naming**

v3-m1-d1-g1-n1-s1-t1-i2-e1-w1-r1-p1-f1-z2-l2-c2

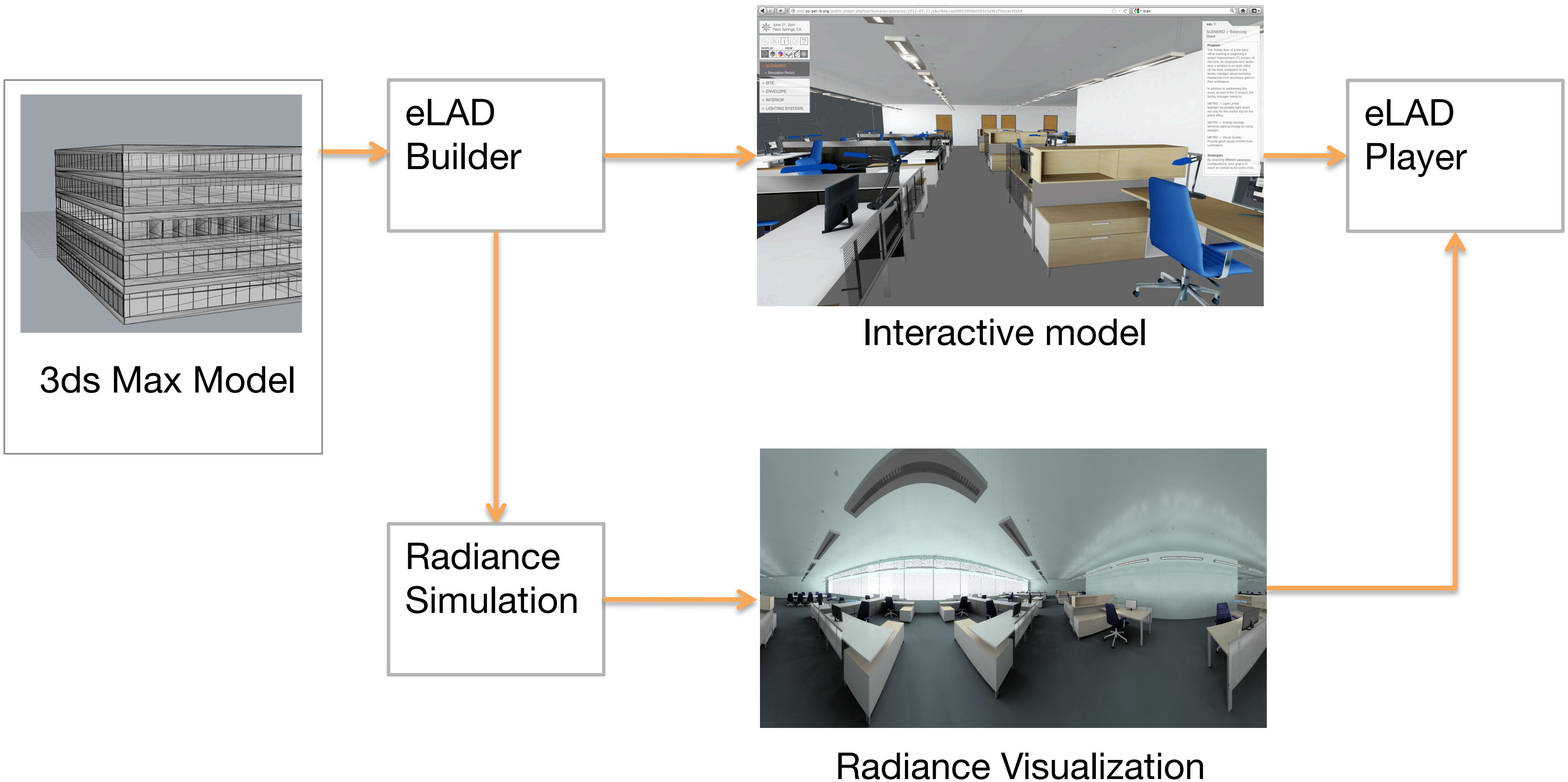
Radiance is used to calculate and visualize the results of student decisions

Integration into a workflow with 3ds Max and WebGL
simulation of daylighting controls

WORKFLOW: Phase 1



Workflow—Phase 2



Scripts for Radiance renderings are written in:

C Shell,
Python,
AWK.

Scripts may run directly:

in any unix-like environment,
or as batch jobs in the Portable Batch System.

Lawrence Berkeley National Labs Lawrencium cluster was used for the rendering process

Two main groups of simulation scripts:

A: scripts used to run simulations [e.g.: run.csh]

B: scripts that support the simulation group

some generate the files and directories used by the first group

[e.g.:Gen_numbered_runset gathers the files for a group of simulations]

C: Secondary group with scripts specific to the cluster

e.g.: a few scripts used to organize JPEG files or to rerun specific simulations

1/ gen_runset is used to create simulation case directories named after simulation case codes: e.g. “d1-g1-n1-s1-t1-i1-e1-w1-r1-p1-f1-z1-l1-c1”

2/ These codes are then linked with shorter case numbers such as “C00001”

3/ Run.csh is then used, either directly or as a batch job, to run the simulations for a single simulation case

It sets up a working directory and then defines the path to the directory depending on the case number

It generates the Radiance control script by calling the gen_rif_file

It sets up the selected views to render

4/ When images are generated, gather_jpegs gathers all the jpeg renderings into a single “jpegs” directory

Simulation of Lighting Controls

If the median illuminance on a row of desks is less than 600 lux

the overhead luminaires over that row are turned on

When desk lamps are present, the following rule is used:

when median illuminance in a row is:

- # over 600 lux, 25% of the desk lamps will be on
- # between 300 and 600 lux, 50% of the desk lamps will be on
- # under 300 lux, all the desk lamps will be on

meter_workplane_illuminance script -- measure the median illuminance on each row of desks

```
meter_workplane_illuminance casecode \
>median_ill_by_row
```

Script body:

```
# Create the octree
# Run rtrace
# Convert irradiances to illuminances
# Find the median illuminance of each row
```

Aliasing is used to control luminaires in the model

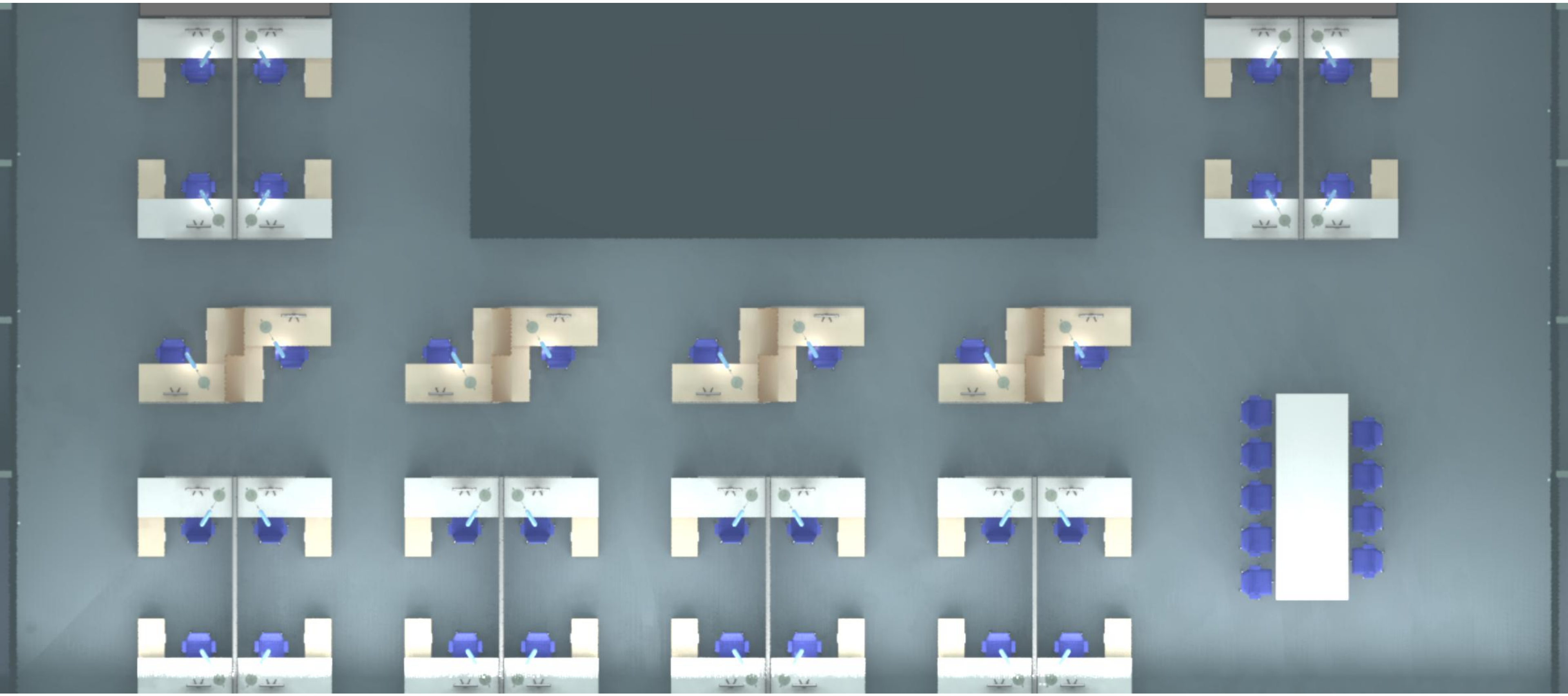
```
# Ceiling luminaire row 4
  inherit alias ceiling_illum_r4 luminaire_pendant3_CB087_light
  inherit alias ceiling_glow_r4 mat_luminaire_pendant_interior

# Desk luminaire row 4 level lo
  inherit alias desklamp_illum_r4_lo light_off
  inherit alias desklamp_glow_r4_lo glow_off

# Desk luminaire row 4 level med
  inherit alias desklamp_illum_r4_med desk_lamp_one_light
  inherit alias desklamp_glow_r4_med glow_off

# Desk luminaire row 4 level hi
  inherit alias desklamp_illum_r4_hi desk_lamp_one_light
  inherit alias desklamp_glow_r4_hi glow_off
```

RADIANCE Renderings: **Plans**

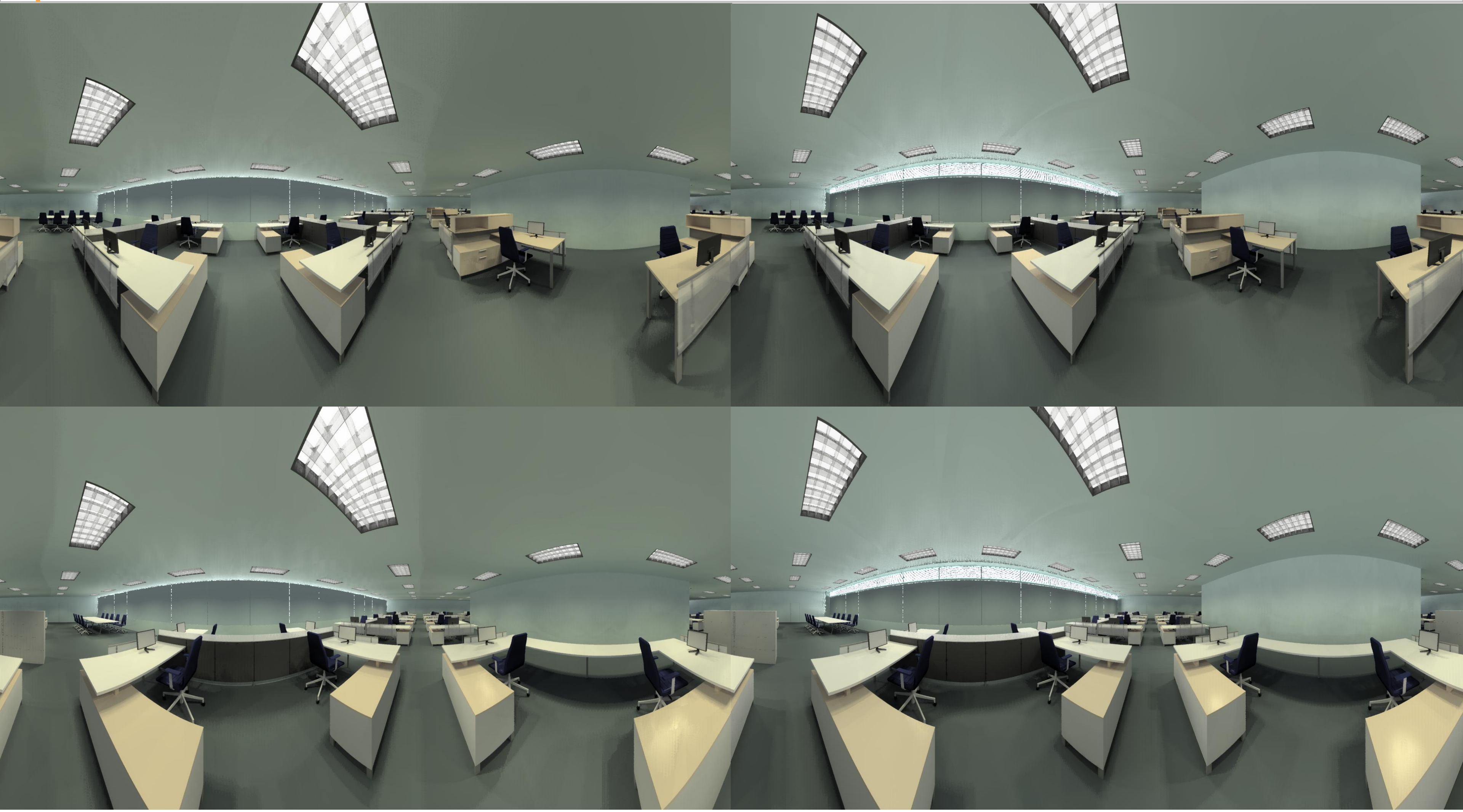


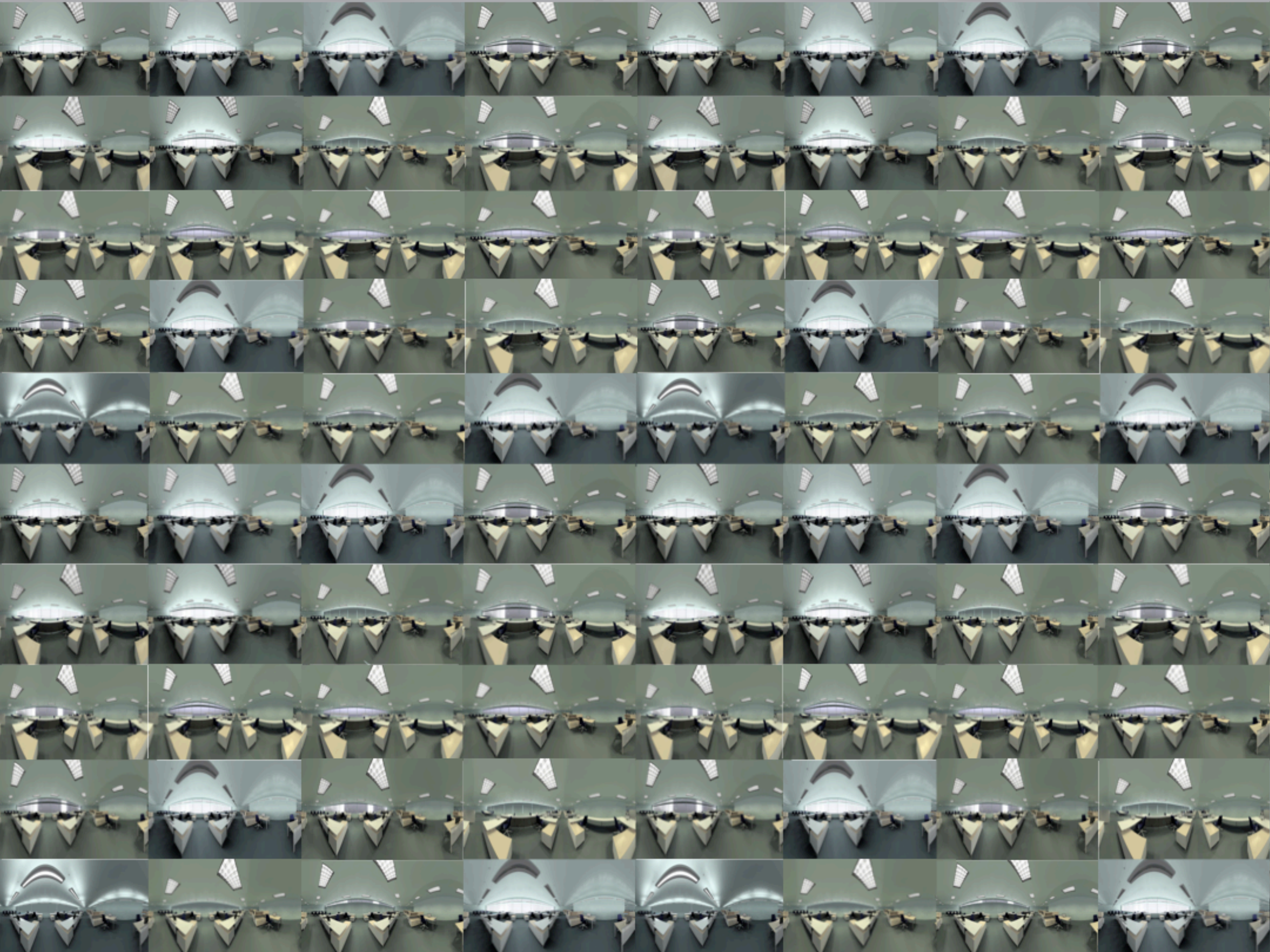
RADIANCE Renderings: **Sections**

RADIANCE Renderings: **Panoramic Views**

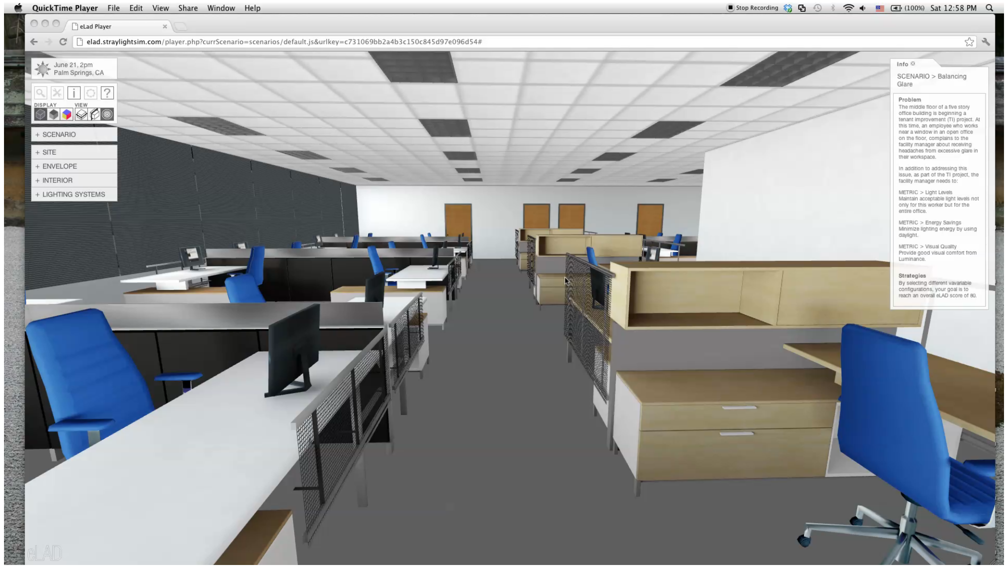
RADIANCE Renderings: **Panoramic Views**

RADIANCE Renderings: **Panoramic Views**





DEMO


QuickTime Player File Edit View Share Window Help
eLad Player
June 21, 2pm
Palm Springs, CA
SCENARIO
SITE
ENVELOPE
INTERIOR
LIGHTING SYSTEMS
SCENARIO > Balancing Glare
Problem
Strategies

eLAD development:

Adding more variables in Phase 2

Radiance:

Integrating Radiance into the Builder
Annual and Seasonal Simulations
Producing more renderings
Running renderings on a web server from JavaScript
Improving Daylighting Controls

eLAD eLearning platform for Lighting and Daylighting

Thank you.

mkonstantoglou@lbl.gov
https://elad.lbl.gov