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HOW TO MEET YOUR 2030 CHALLENGE GOALS WITH REVIT AND INSIGHT

AARON KETNER

DEKKER PERICH SABATINI



Today's Presentation

Who, What, Where, Why
What is the 2030 Challenge and AIA+2030?
How it all begins
Spreading awareness
Team communication
Building Performance Analysis (BPA)
Total environmental impact
Case study

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ARCHITECTURE



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LANDSCAPE ARCHITECTURE



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INTERIOR DESIGN

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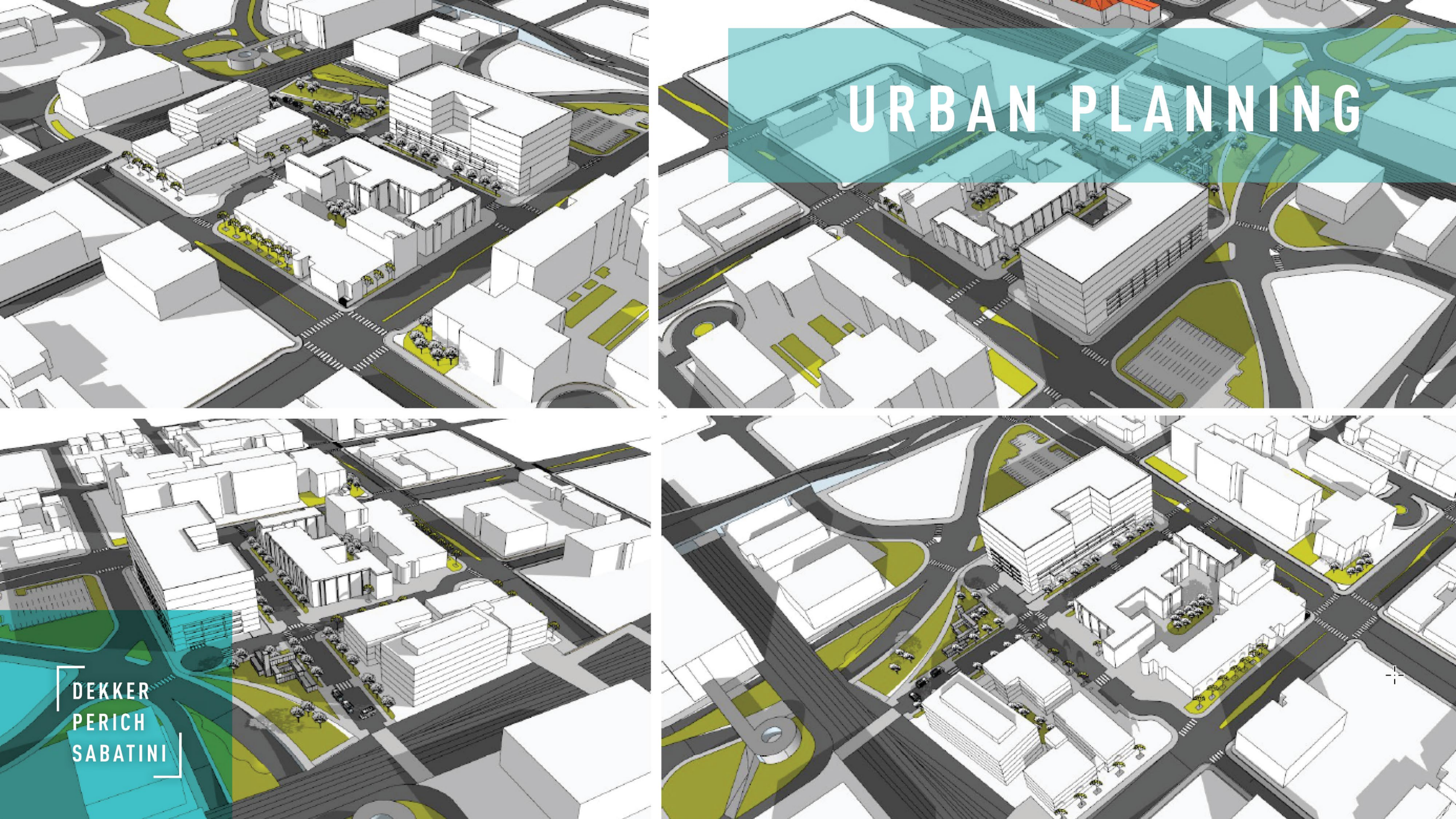

URBAN PLANNING

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STRUCTURAL ENGINEERING



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BUILDING PERFORMANCE ANALYSIS



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Over the next twenty years, an area equal to a staggering 3.5 times the entire built environment of the U.S. will be redesigned, reshaped, and rebuilt globally.



x 3.5

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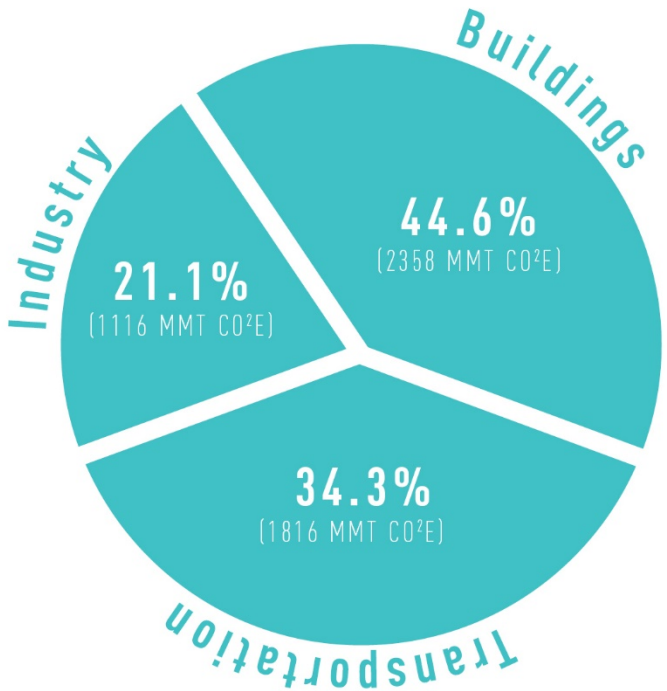
U.S. Energy Consumption by Sector



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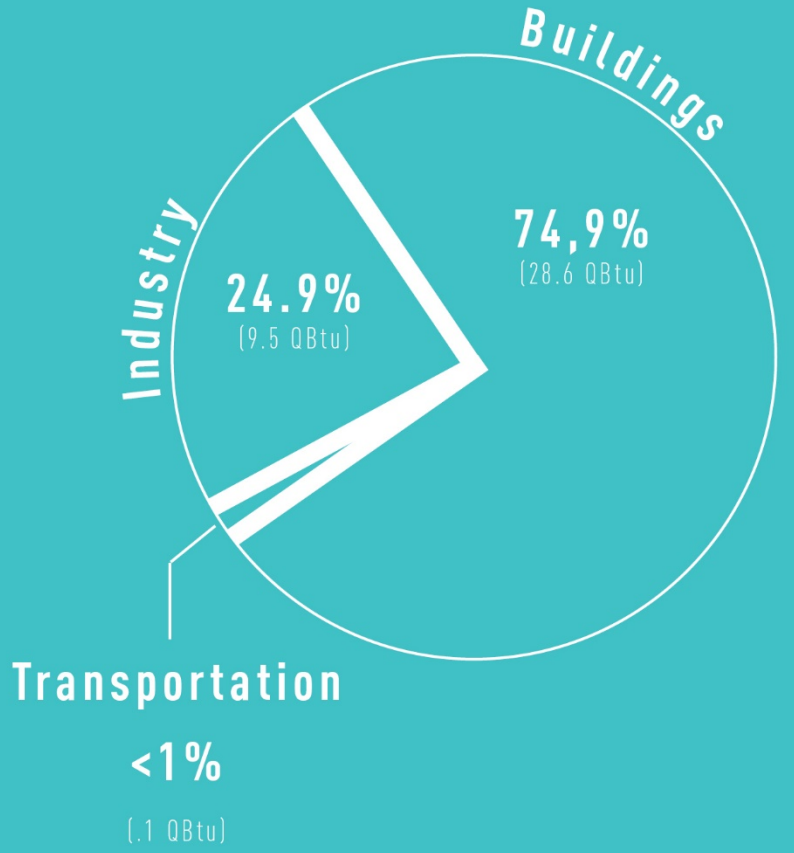
Source: 2013 2030, Inc./ Architecture 2030. All rights reserved.
Data Source: U.S. Energy Information Administration

U.S. Electricity Consumption by Sector



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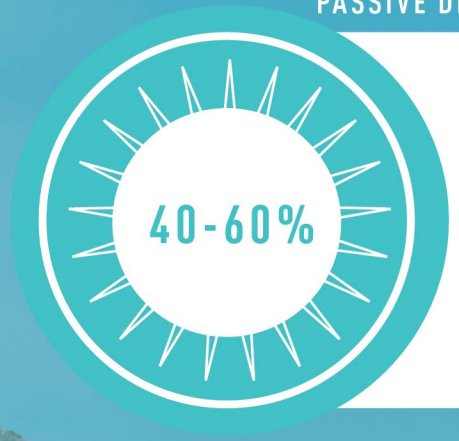
Data Source: U.S. Energy Information Administration

THE 2030 CHALLENGE



PATH TO ZERO

PASSIVE DESIGN STRATEGIES



- Building Orientation
- Shading
- Daylighting
- Passive Heating & Cooling
- Materials
- Passive Systems

FOSSIL FUEL FREE ENERGY



- On Site Renewables
- Off Site Renewables

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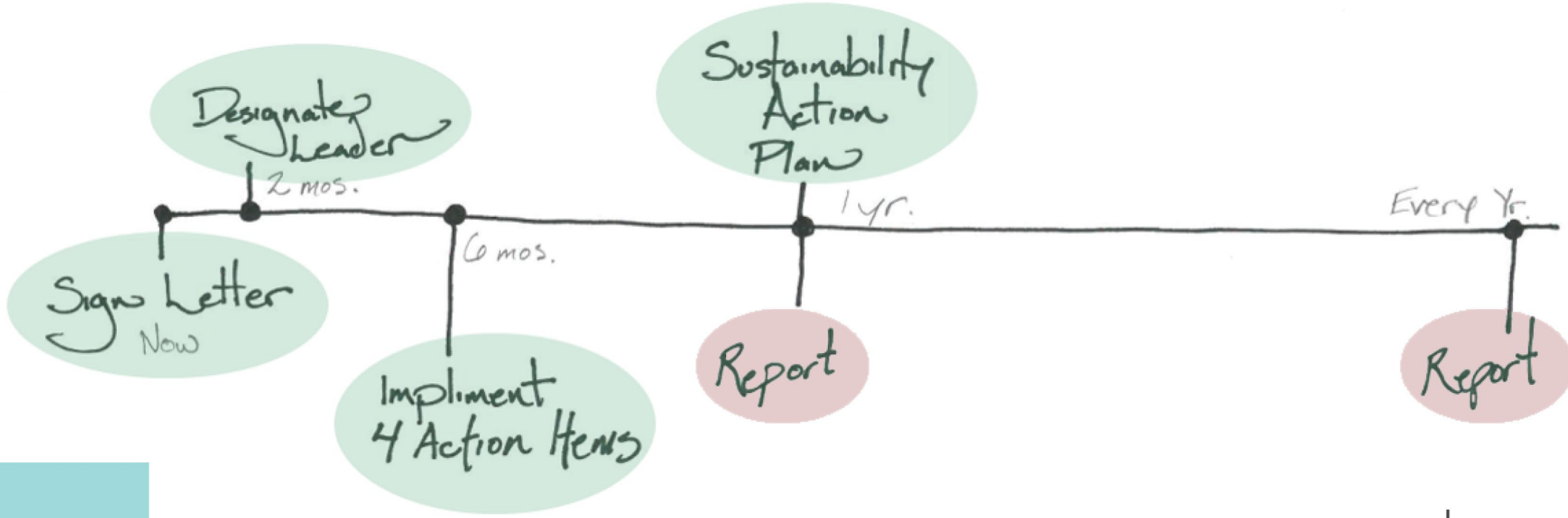
*Using no fossil fuel GHG-emitting energy to operate.


GLOBAL INITIATIVE
architecture 2030
AIA+2030 & Architecture 2030
AIA 2030™
NATIONAL COMMITMENT

How it all begins...



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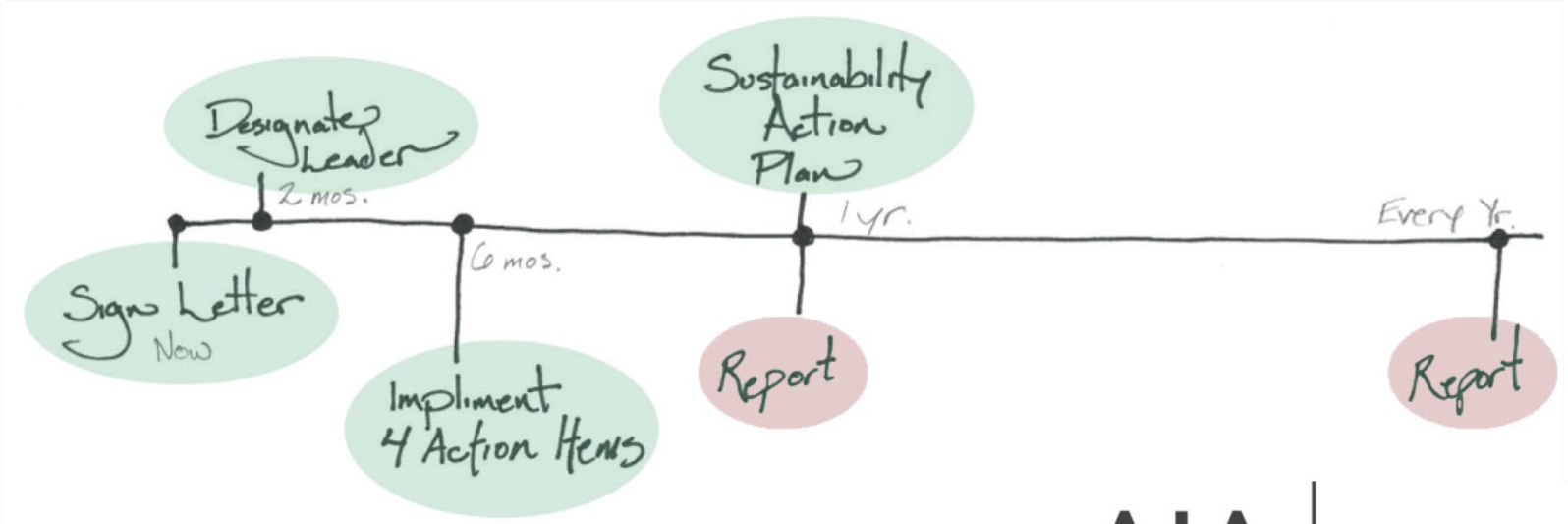
AIA 2030™

Aimee Smith, LEED AP



Intern Architect
Sustainability Specialist



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AIA 2030™



INTERNAL

Sustainability Plan
&
Action Items

EXTERNAL

Energy Modeling
&
Reporting

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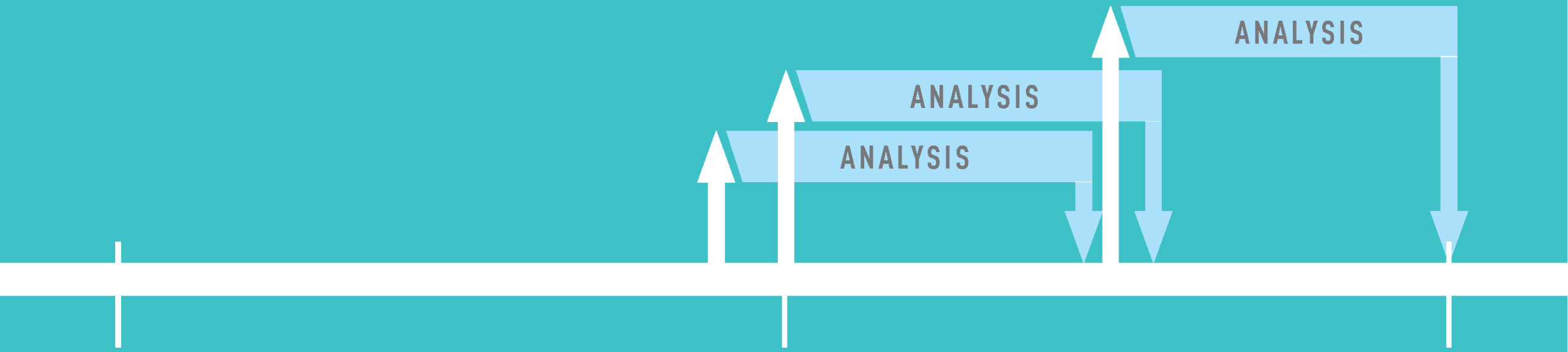
+3.2 MILLION SF REPORTED TO AIA+2030

ANALYSIS AS DOCUMENTATION TOOL



SCHEMATIC DESIGN

DESIGN DEVELOPMENT

CONSTRUCTION DOCUMENTS

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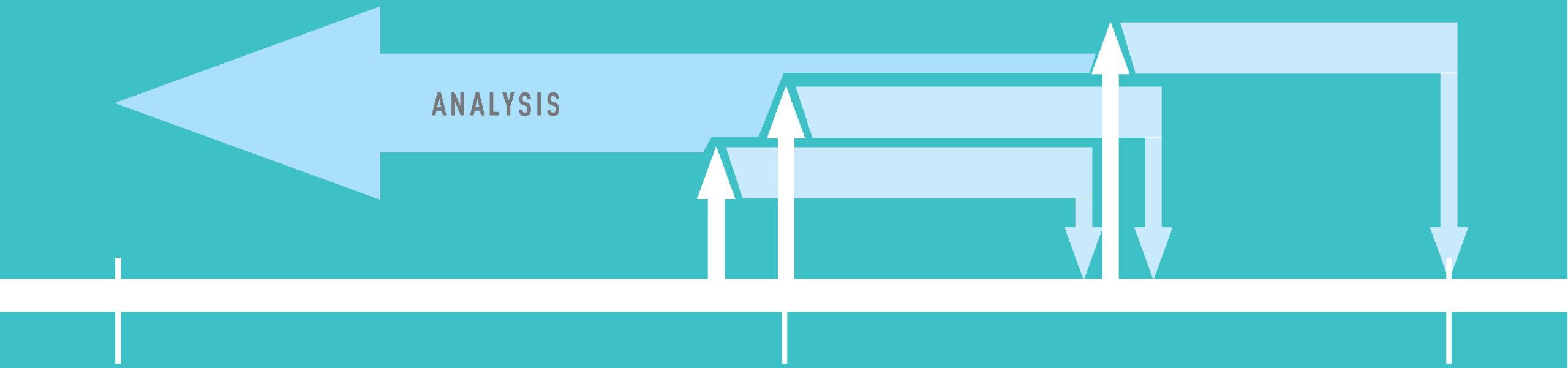
ANALYSIS AS DESIGN TOOL



SCHEMATIC DESIGN

DESIGN DEVELOPMENT

CONSTRUCTION DOCUMENTS

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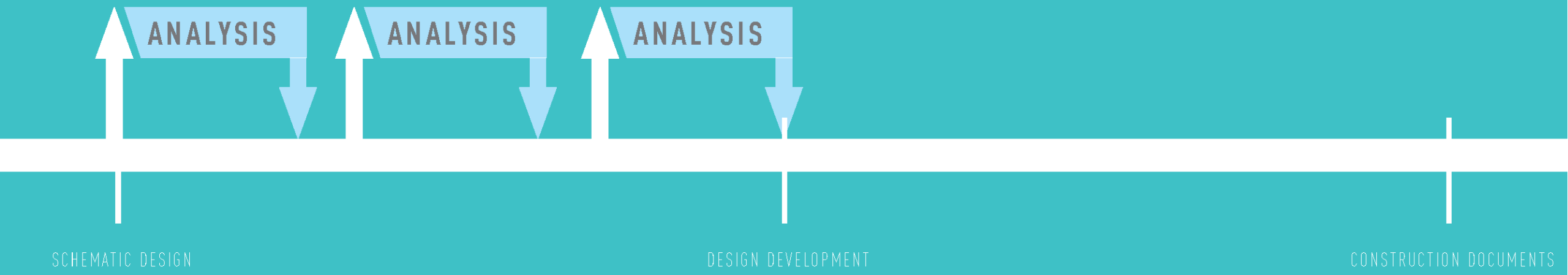
ANALYSIS AS ITERATIVE DESIGN PROCESS



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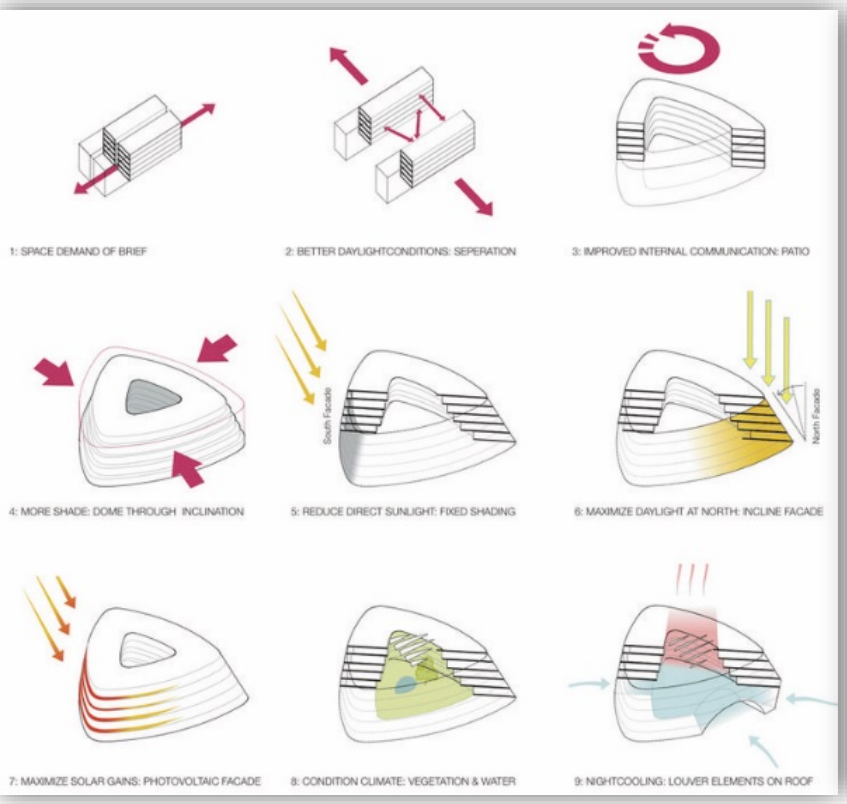
THE 2030 CHALLENGE





Design Strategies

The largest energy reductions can be achieved through design



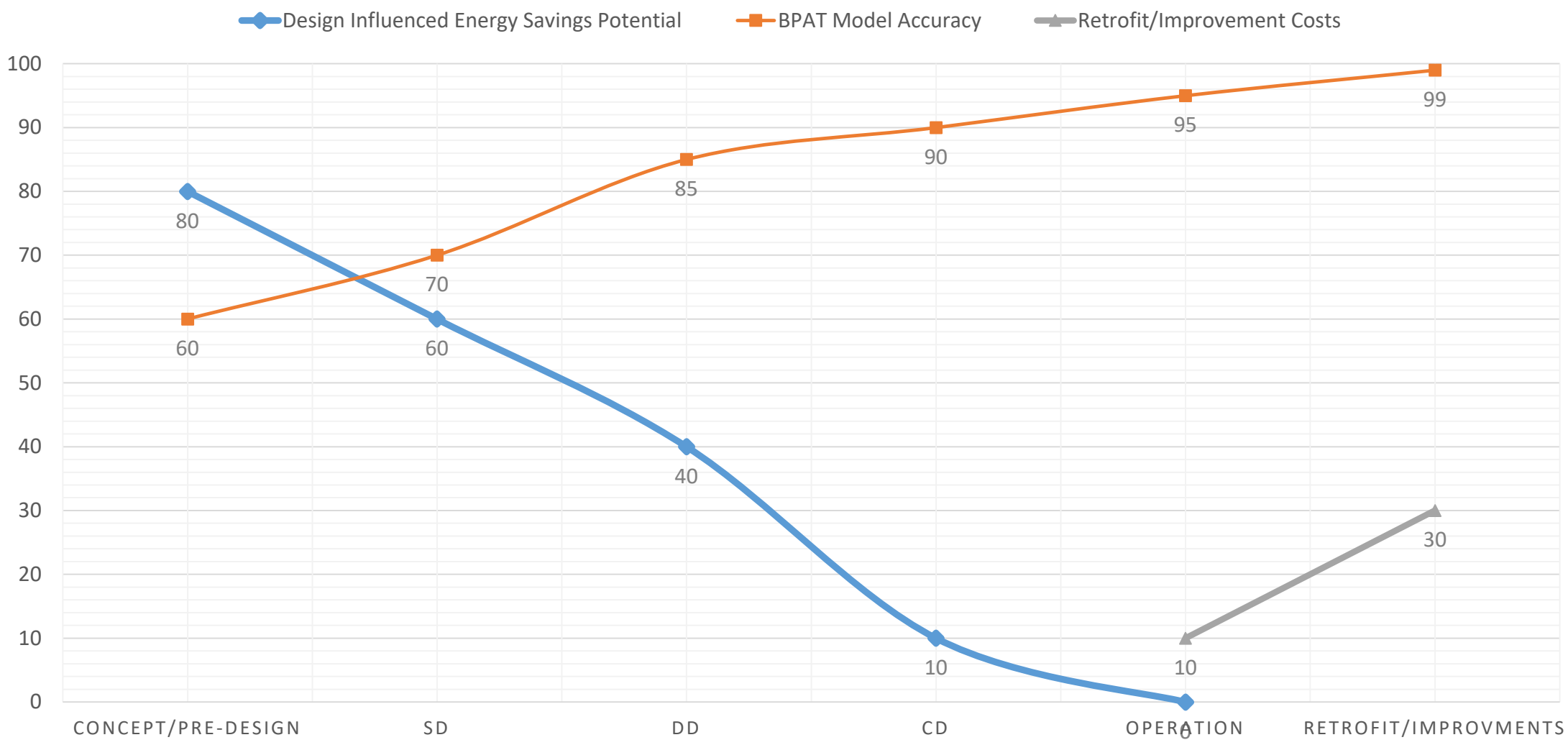
Technologies & Systems

Includes all on-site renewable energy systems



Off-Site Renewable Energy

20% Maximum



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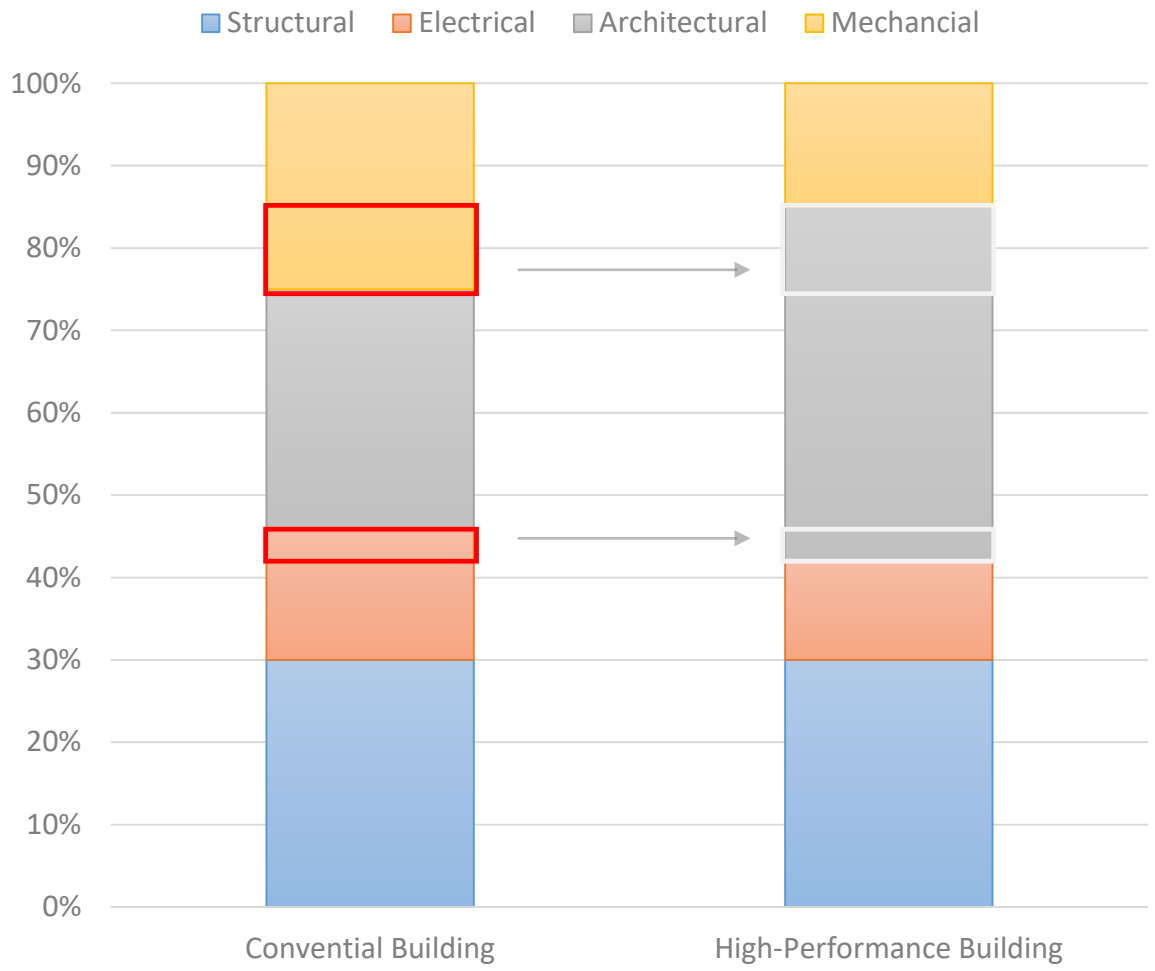
What/When to Model

Integrated BPAT Design Shifts Project Investment



Approaching the design process by incorporating building performance simulation into an integrated design process tends to **redistribute** costs rather than increase them.

Architects: greater attention to high quality projects

Engineers: ability to take on more work

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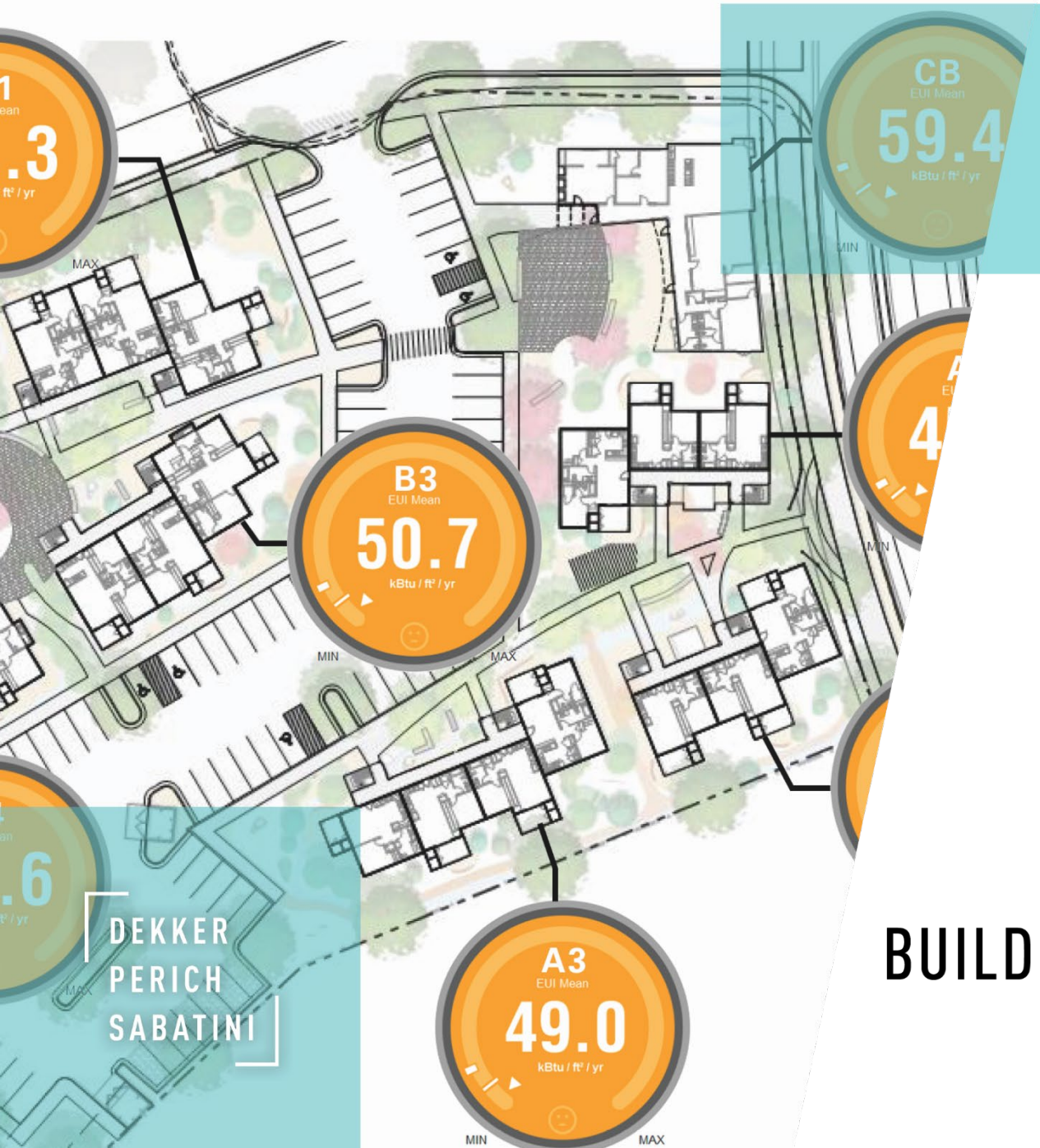


Building Performance Analysis

Tools and Capabilities

BENCHMARKING EUI

SOLAR INSOLATION

DAYLIGHT ILLUMINANCE

SOLAR IRRADIANCE

RENEWABLE PV ENERGY

INTERIOR LIGHTING - LEED V4

BUILDING ENVELOPE HEAT TRANSFER

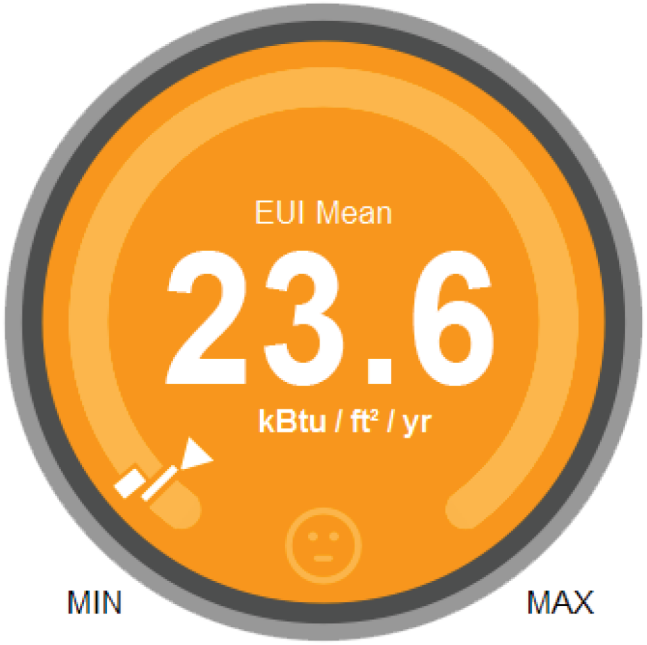
FLOW DESIGN - WIND TUNNEL

BENCHMARKING EUI

What is EUI?

Energy Use Intensity

kBTU / square foot / year



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architecture 2030

CBECS EUI Baseline Examples

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Banking/Financial Services	Bank Branch *		252.8	87.0	CBECS - Bank/Financial
	Financial Office*		148.1	67.3	CBECS - Office & Bank/Financial
Education	Adult Education		141.4	59.6	CBECS - Education
	College/University		262.6	130.7	CBECS - College/University
	K-12 School*		141.4	58.2	CBECS - Elementary/Middle & High School
	Pre-school/Daycare		145.7	70.9	CBECS - Preschool
	Vocational School		141.4	59.6	CBECS - Education
	Other - Education				

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Commercial Buildings Energy Consumption Survey

Baselines, D/P/S Average, Targets, 2030 Goals, NZEB

- *What are those?*
- **Baselines** – control data to compare active design against. This can be National CBECS baseline for 2030 challenge, or ASHRAE 90.1 standards for LEED or Federal Government projects.
- **D/P/S "Average"** – average performance data from projects reported to the D/P/S AIA+2030 portfolio.
- **Targets** – established performance targets for a specific project. Typically set during schematic design.
- **2030 Goals** – global targets set by Architecture 2030 and tracked by AIA+2030. Current 2030 Goal is 80% reduction in carbon based energy from the National CBECS baseline.
- **NZEB** – "Net-Zero Energy Building" is a building that achieves net-zero carbon emissions (100% Reduction) This is often achieved by offsetting grid energy (typically carbon based) with on-site renewable energy generation (until the grid energy becomes renewably sourced)

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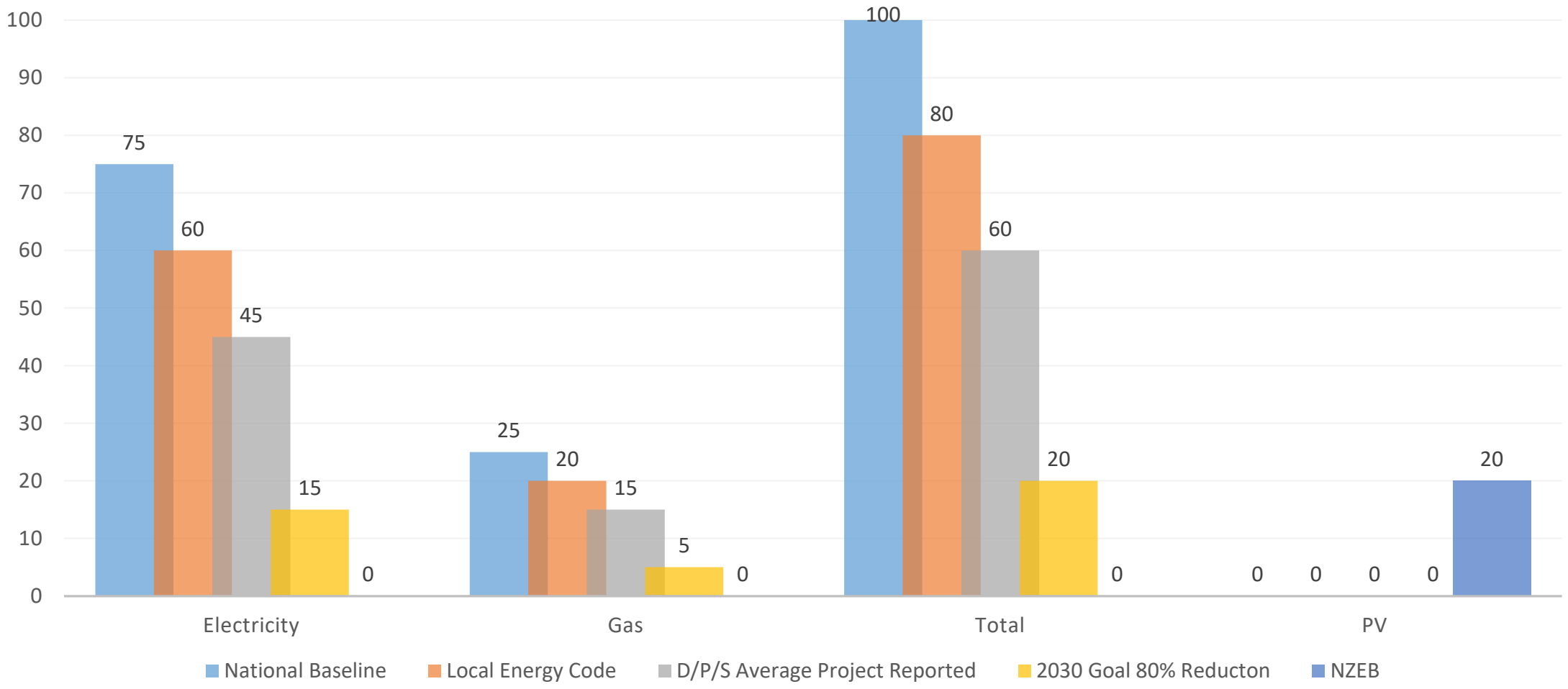

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Building Energy Breakdown Comparison

SOLAR INSOLATION R

BENCHMARKING EUI I F R
SOLAR INSOLATION R

DAYLIGHT ILLUMINANCE R

BENCHMARKING EUI IFR
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R

SOLAR IRRADIANCE R

BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R

RENEWABLE PV ENERGY



BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R
RENEWABLE PV ENERGY R aurora

INTERIOR LIGHTING - LEED V4 R

BENCHMARKING EUI

SOLAR INSOLATION

DAYLIGHT ILLUMINANCE

SOLAR IRRADIANCE

RENEWABLE PV ENERGY

INTERIOR LIGHTING - LEED V4

BUILDING ENVELOPE HEAT TRANSFER



BENCHMARKING EUI

SOLAR INSOLATION

DAYLIGHT ILLUMINANCE

SOLAR IRRADIANCE

RENEWABLE PV ENERGY

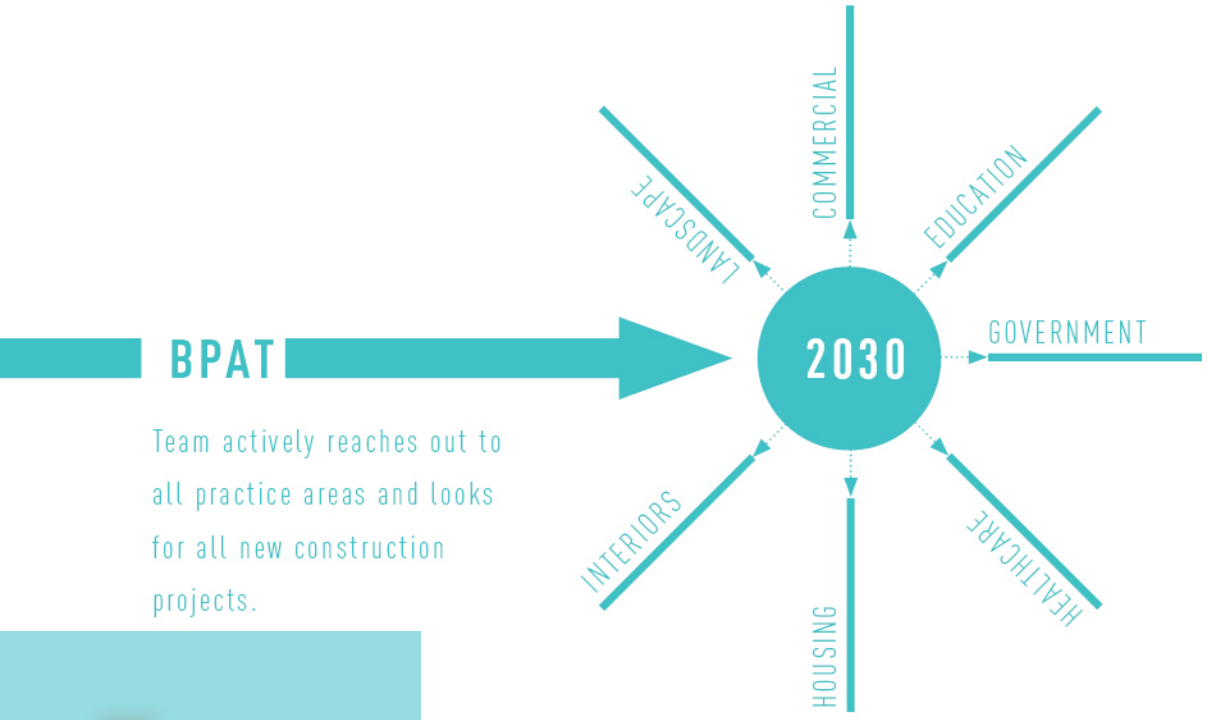
INTERIOR LIGHTING - LEED V4

BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL



BPAT PROCESS



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2030 REPORTING AS BASIC SERVICE



Spreading Awareness

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BPAT™

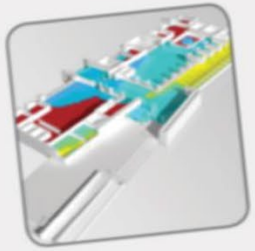
Building Performance Analysis Team

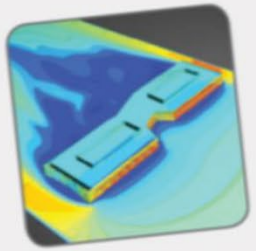
AIA 2030 Commitment

Capabilities Overview

BPAT@dpsdesign.org







August 21, 2017

Forms & Team Communication

FORMS | Analysis Request

Please complete the following form and indicate any additional building performance analyses that you may be interested in for the project.

Upon the completion of this form, please send to BPAT@dpsdesign.org - the Building Performance Analysis Team will schedule a meeting to go over basic project information soon after.

Project name:

Non-Disclosure Agreement? Project Codename:

D/P/S project number – Project ID:

Point of contact for project:

Check list – able to select multiple

BENCHMARKING: BASIC ANALYSIS FOR AIA 2030 REPORTING - REQUIRED

SOLAR INSOLATION ANALYSIS: SHADING DESIGN ITERATIONS

RENDERED ILLUMINANCE ANALYSIS: PLAN VIEW + 3D PERSPECTIVE VIEW

PV ENERGY ANALYSIS: IS THE 2030 CHALLANGE WITHIN REACH?

SOLAR PV ANALYSIS: DESIGN, PERFORMANCE, FINANCE

INTERIOR LIGHTING ANALYSIS: USED FOR LEED v4 EQc7

BUILDING ENVELOPE HEAT TRANSFER ANALYSIS: COLLABORATION WITH FAÇADE & ENCLOSURE DESIGN GROUP

FLOW DESIGN ANALYSIS: WIND TUNNEL

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Forms & Team Communication

FORMS | Building Information

Project name:

D/P/S project number – Project ID:

Please provide as much information as possible: any known R or U-values, glazing parameters, key features about type, structure, etc.

Building Type:

Exterior Walls:

Interior Walls:

Roof Types:

Ceiling Types:

Slab Types:

Floor Types:

Exterior Glazing:

Skylight Types - if any:

Exterior/Interior Window Shading:

Interior Lighting Types:

HVAC Systems - if known:

Building Orientation: If oriented to project north, is true north indicated/set in the model?

Upon the completion of this form, please send to BPAT@dpsdesign.org - the Building Performance Analysis Team.

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Forms & Team Communication

FORMS | Project Information

Project name:

D/P/S project number – Project ID:

Points of contact: Architecture Landscape
Structural MEP

Project File Format: Revit SketchUp AutoCAD Other:

Project Building Use Type - list all if multi-use:

Project GSF per use type listed above:

Project City, State, Zip, Country:

Year of Occupancy:

AIA 2030 Reporting Year: 2017

Current Project Phase:

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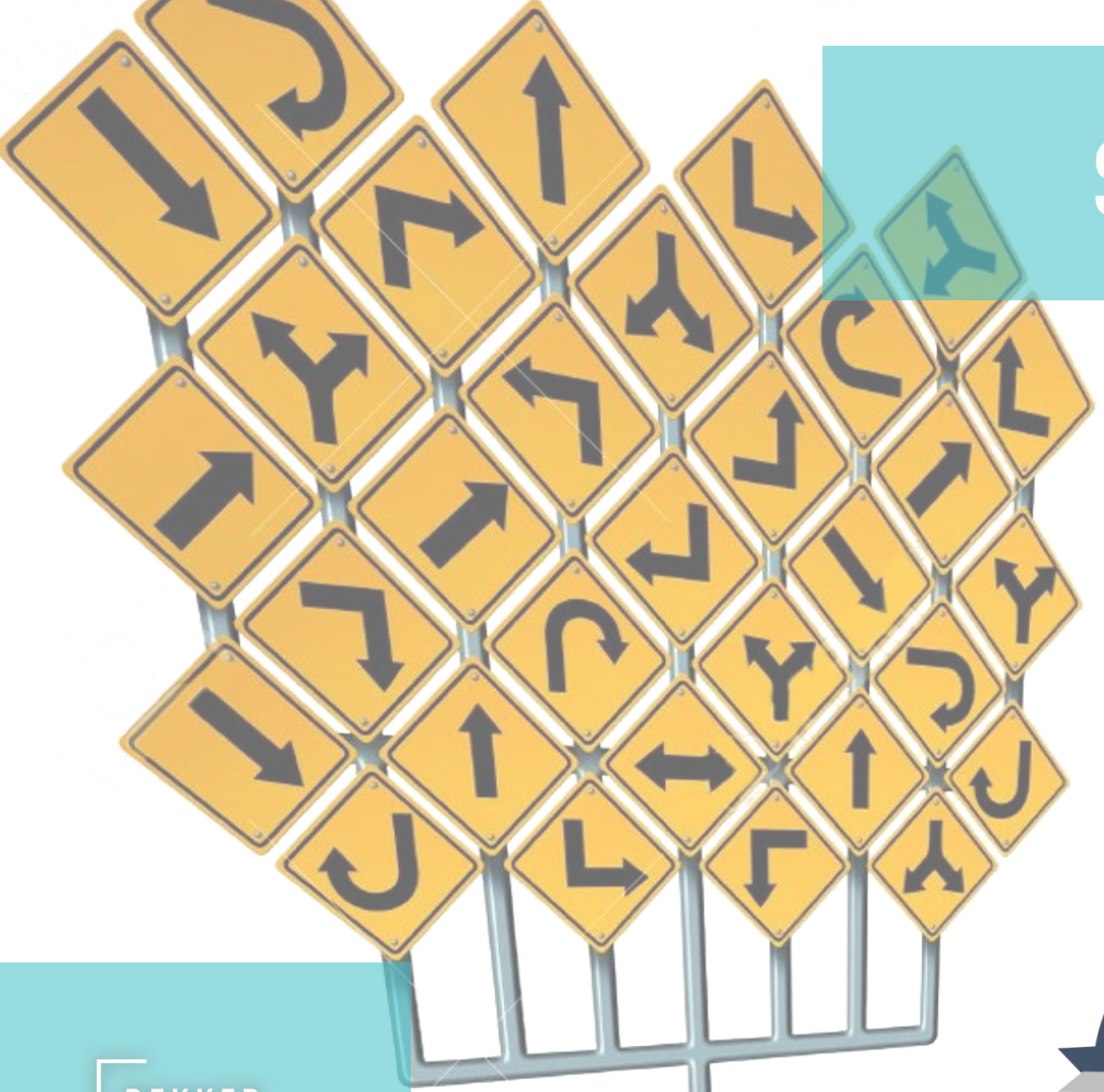
Starting on the right path...



BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R
RENEWABLE PV ENERGY R aurora
INTERIOR LIGHTING - LEED V4 R
BUILDING ENVELOPE HEAT TRANSFER
FLOW DESIGN - WIND TUNNEL F



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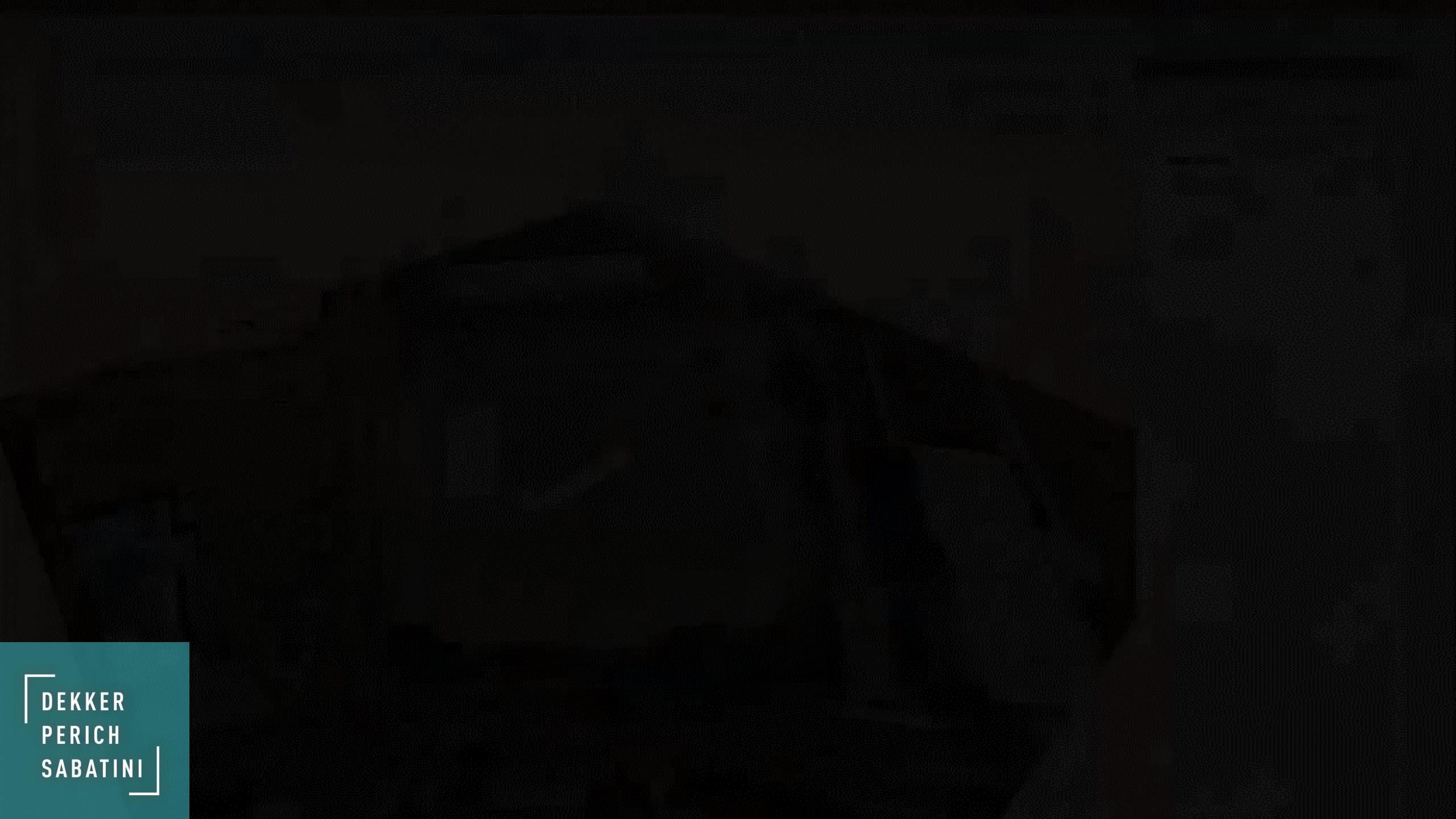
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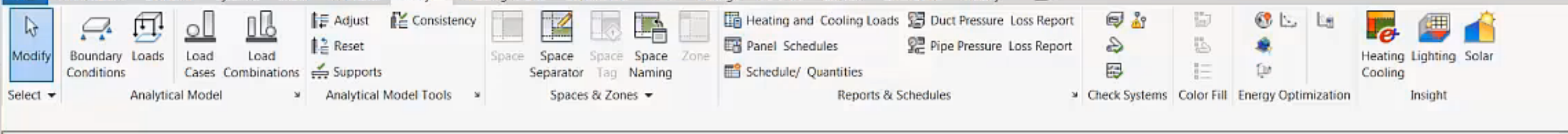



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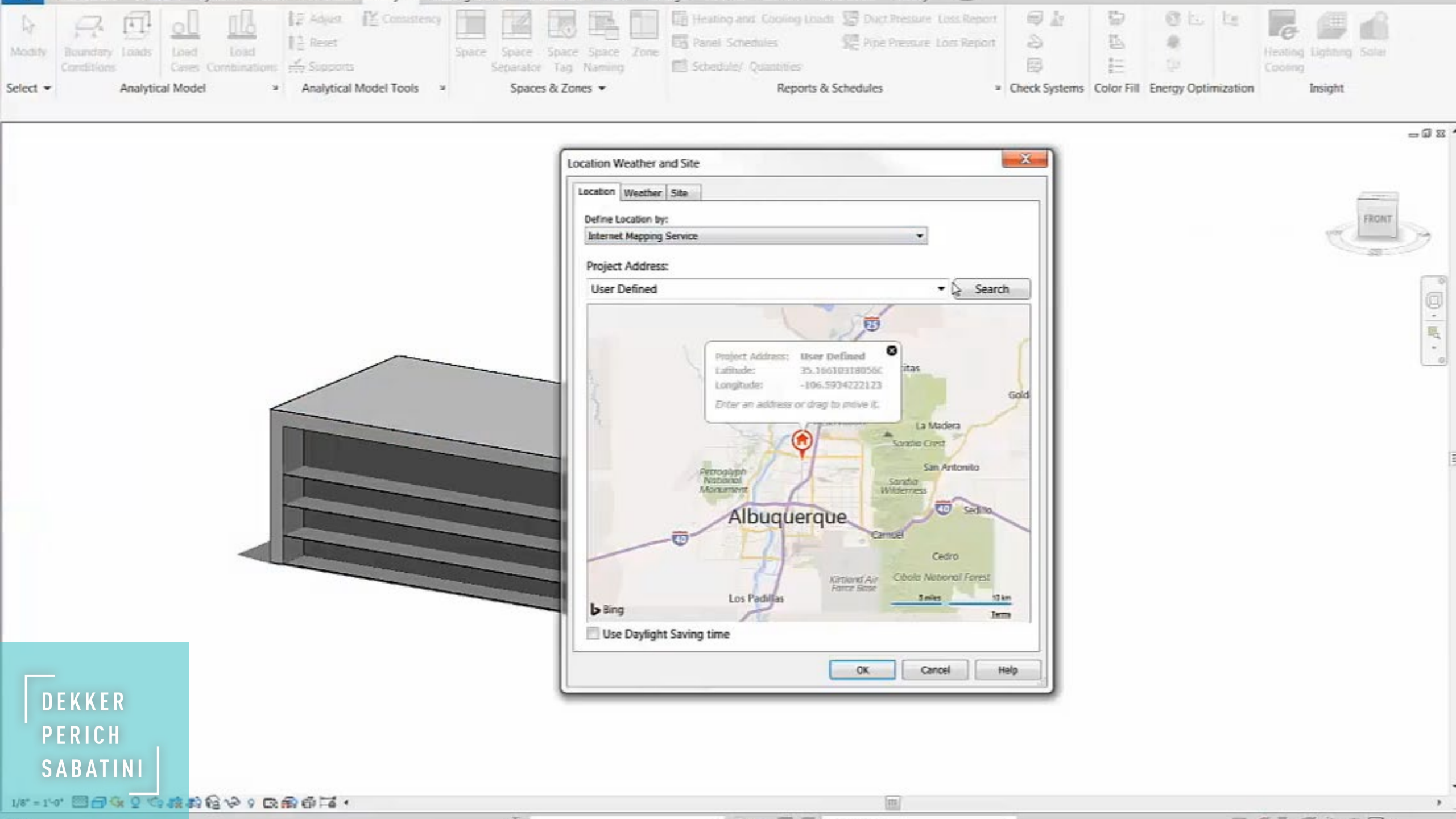
Modify
Boundary Conditions
Loads
Load Cases
Load Combinations
Adjust
Reset
Supports
Consistency
Space
Space Separator
Space Tag
Space Naming
Zone
Heating and Cooling Loads
Panel Schedules
Schedules/ Quantities
Duct Pressure Loss Report
Pipe Pressure Loss Report
Heating Cooling
Lighting
Solar
Select
Analytical Model
Analytical Model Tools
Spaces & Zones
Reports & Schedules
Check Systems
Color Fill
Energy Optimization
Insight
Location Weather and Site
Location
Weather
Site
Define Location by:
Internet Mapping Service
Project Address:
User Defined
Search
Project Address: User Defined
Latitude: 35.166103180560
Longitude: -106.5934222123
Enter an address or drag to move it.
Albuquerque
La Madera
Sandia Crest
San Antonito
Sandia Wilderness
Petroglyph National Monument
Carnuel
Cedro
Cibola National Forest
Kirtland Air Force Base
Los Padillas
Bing
Use Daylight Saving time
OK
Cancel
Help
FRONT
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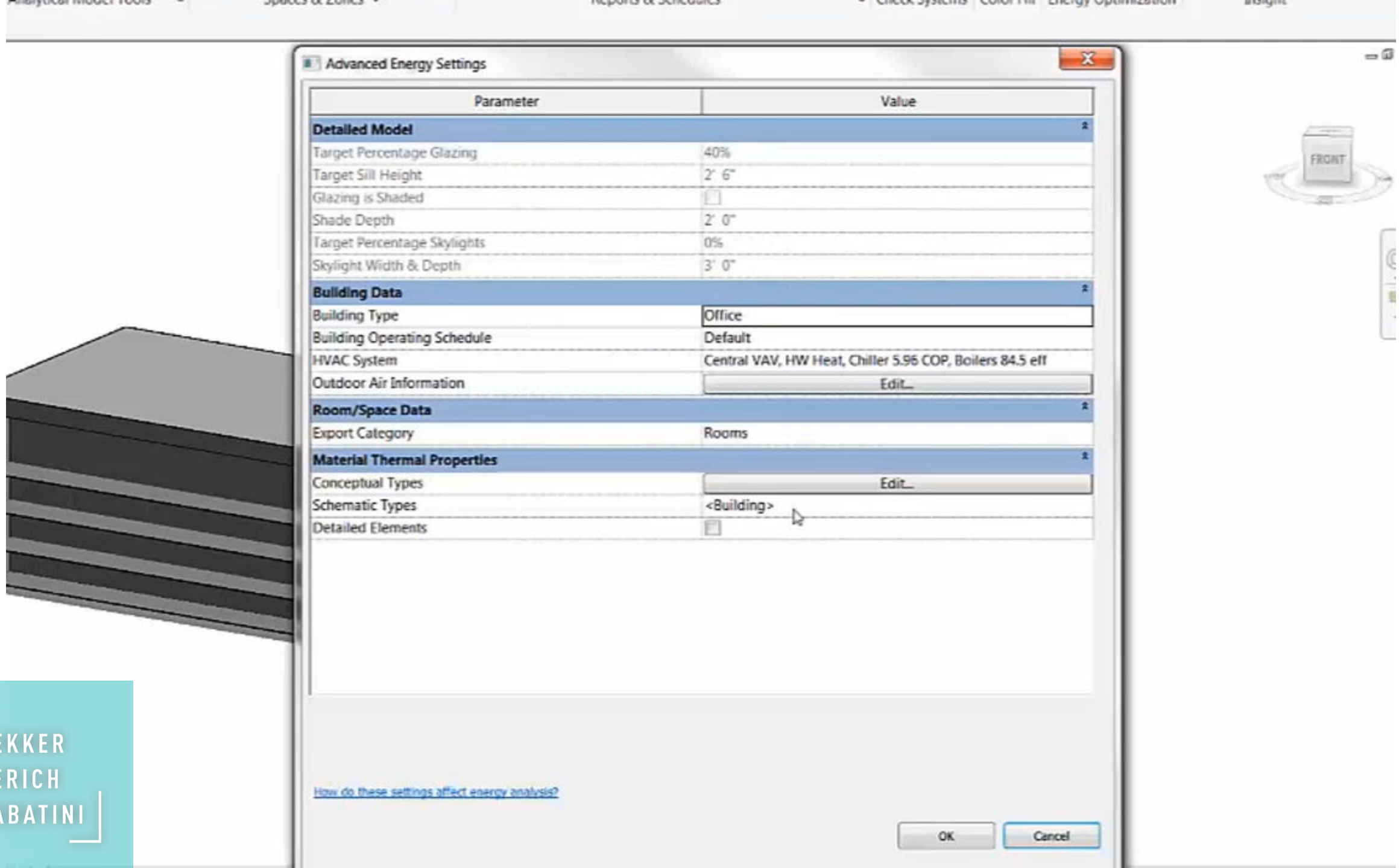

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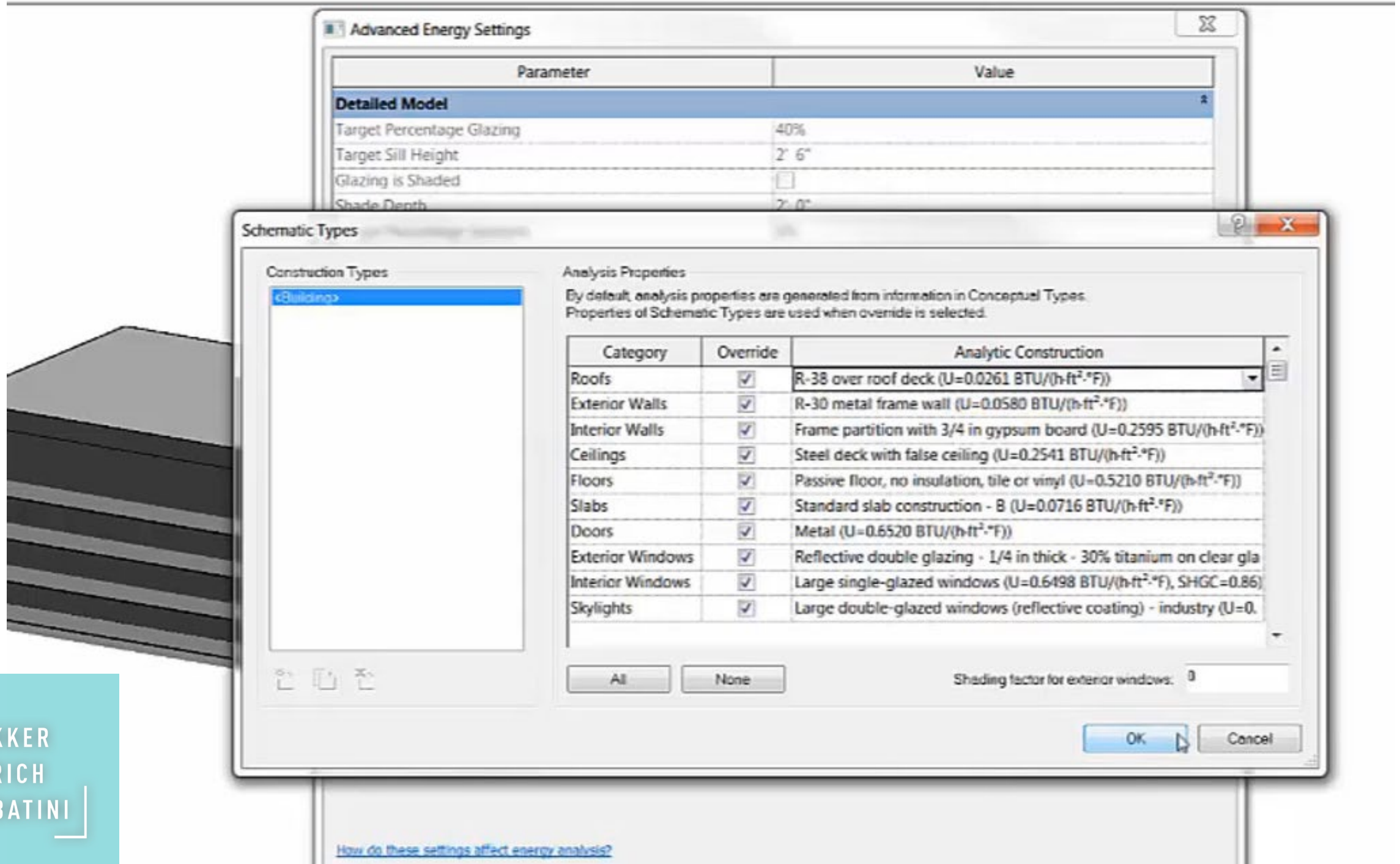

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AUTODESK® INSIGHT

INSIGHTS LEARNING SUPPORT LUC WING

Insights / All Uncategorized

208.9 | 14.1

58.9

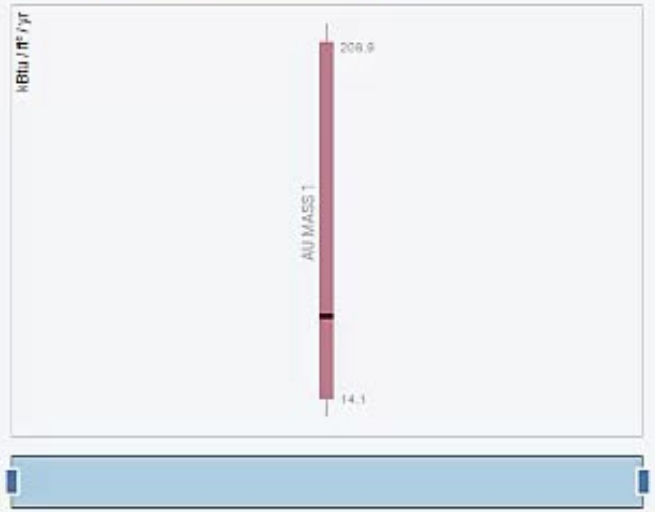
kBtu / ft² / yr



AU MASS 1

Model Comparison

Scenarios: Custom



2030 PALETTE

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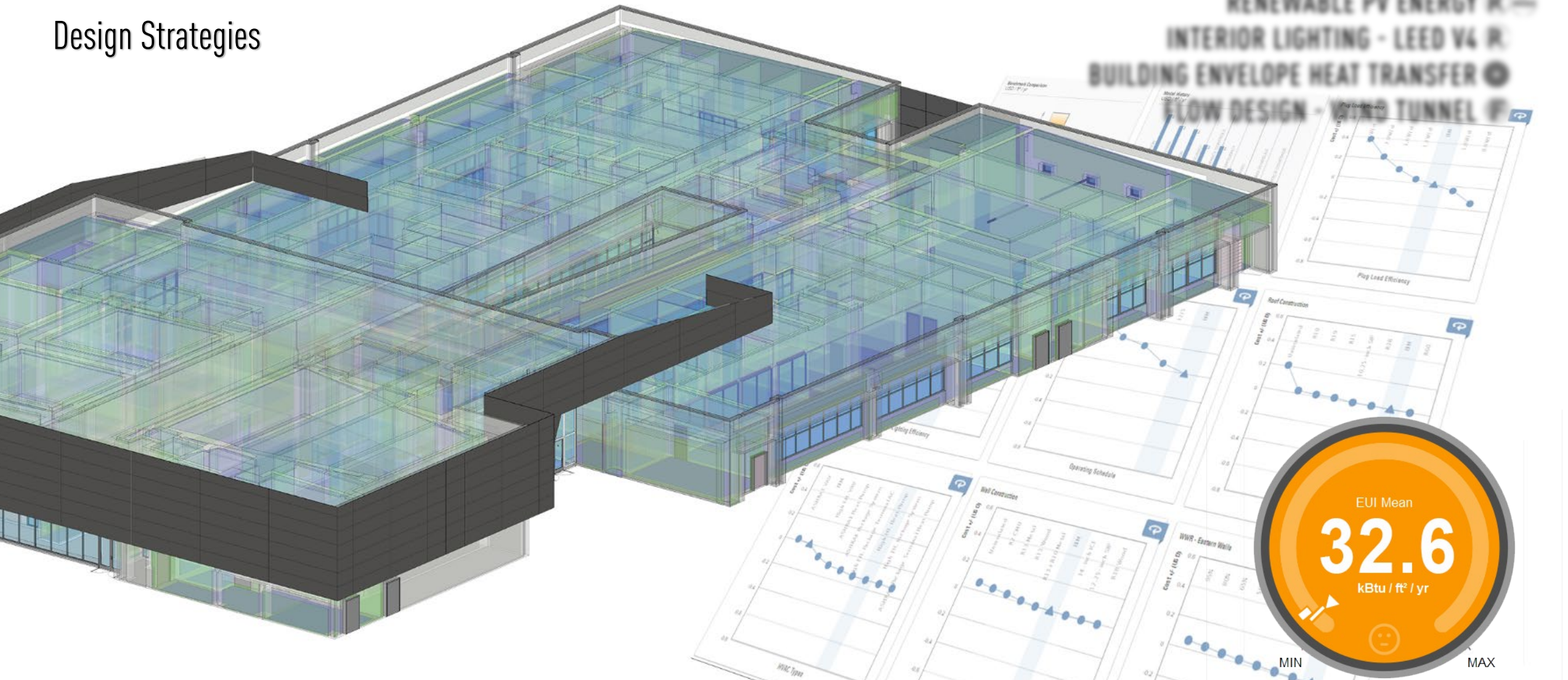
Design Strategies



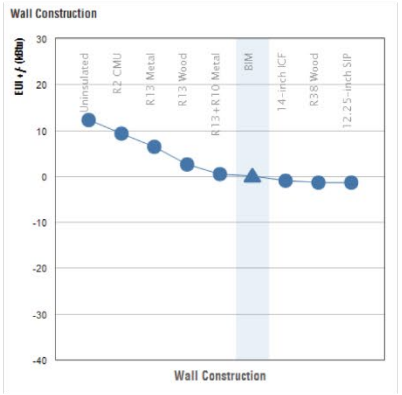
ANALYSIS DESCRIPTIONS

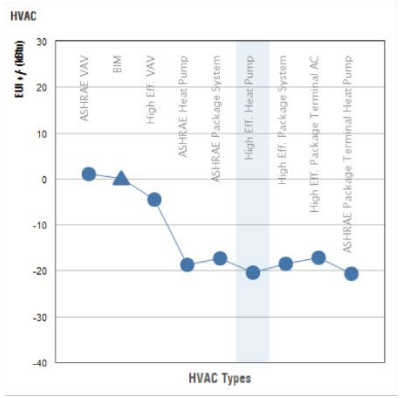
BENCHMARKING EUI ANALYSIS | Basic Analysis for AIA 2030 Reporting

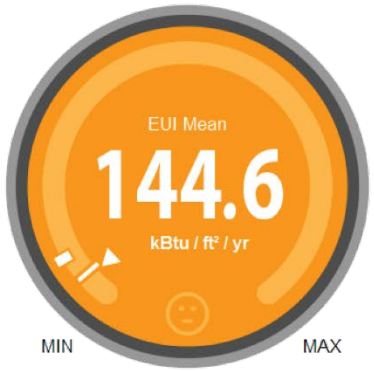
This analysis is our quick-start analysis of choice for establishing and tracking EUI throughout the project's development. The calculated EUI for the project is required for every new construction project at D/P/S and to be submitted to the AIA 2030 portfolio.

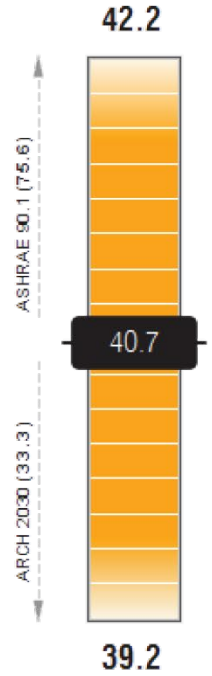
This analysis is a visual way to interact with key performance metrics, benchmarks, and ranges with a real-time cause and effect feeback to guide towards informed decisions.

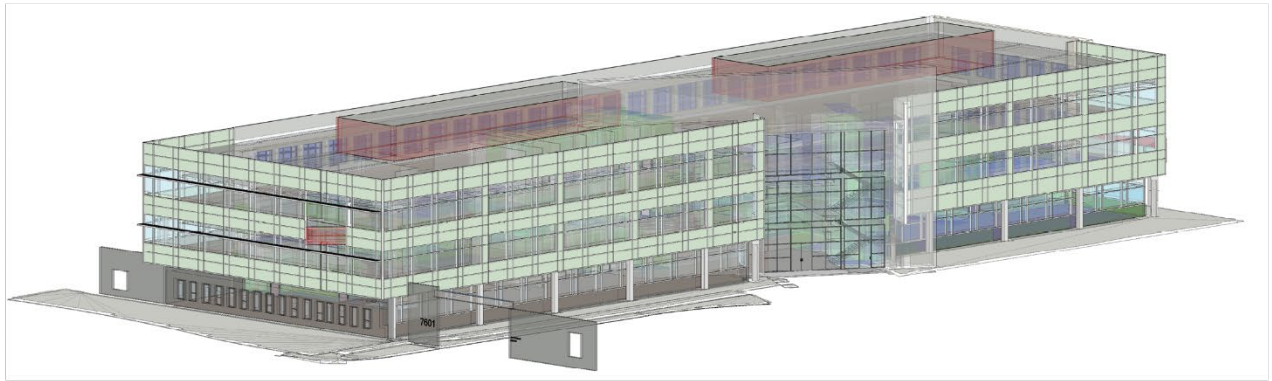
Energy Use Intensity (EUI) – a metric used to express the building's energy consumed per square foot per year. EUI is calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building. This simplified metric allows easy comparisons within the building type category since the energy consumed is broken down into a square foot per year.











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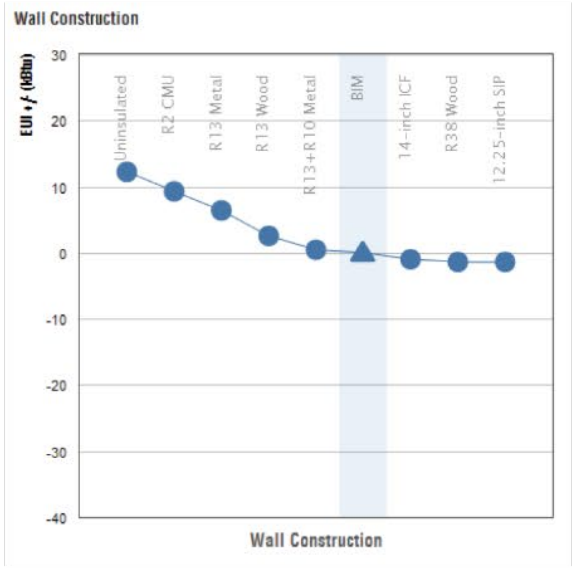

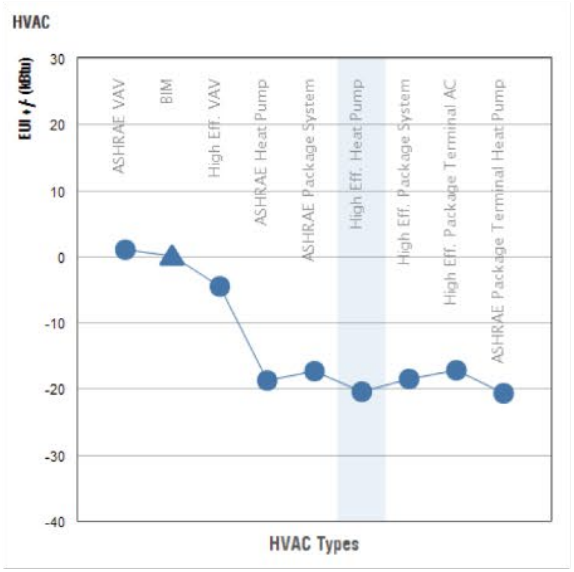

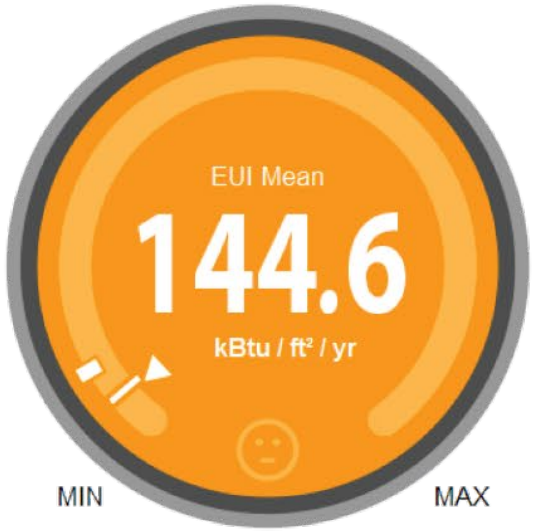

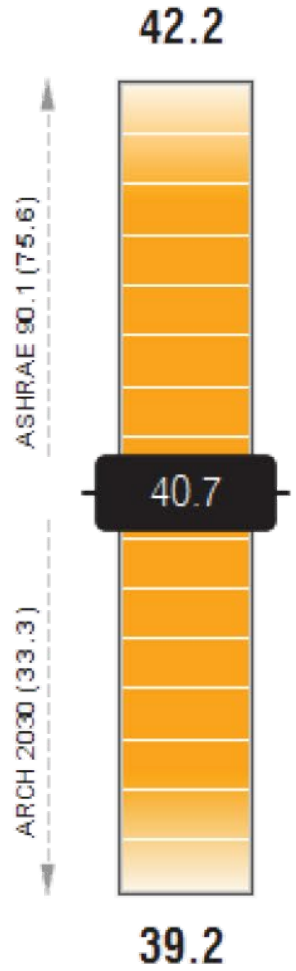

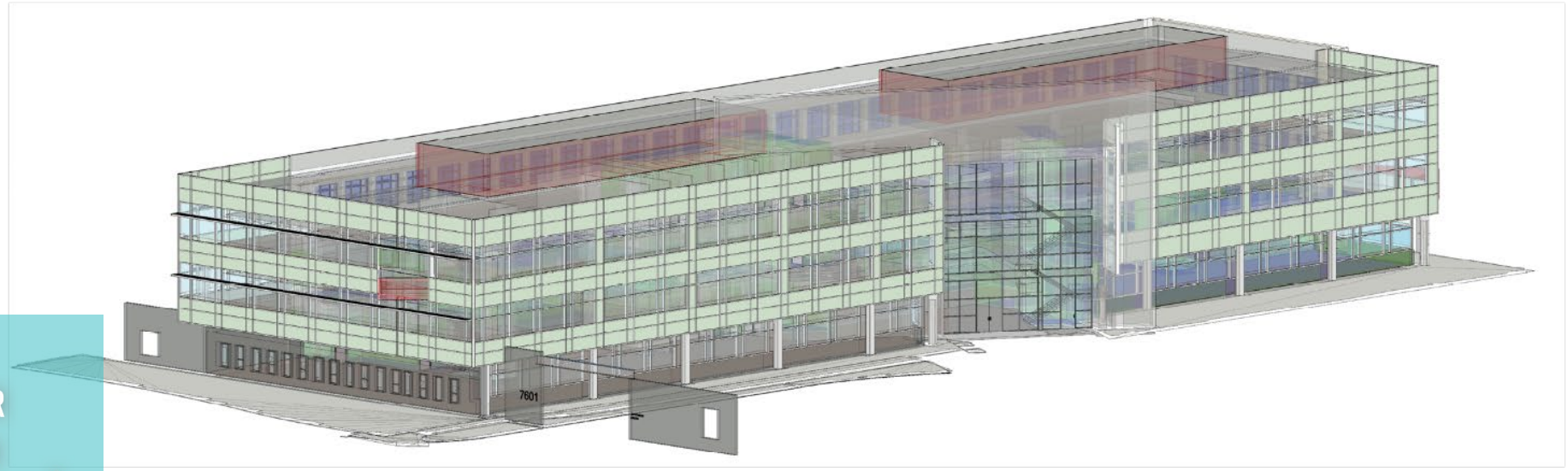

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Analysis: This analysis has found the campus to perform consistantly and achieves an average of about 43% reduction in energy consumption from the ASHRAE 90.1 baseline analysis. The addition of renewable energy generation has the potential to take the campus close to the 2030 Challenge goal of 70% reduction. Solar Carports provide shade for onsite parked vehicles and provide an opportunity to add significant square-footage of Photovoltaic panels (solar panels).

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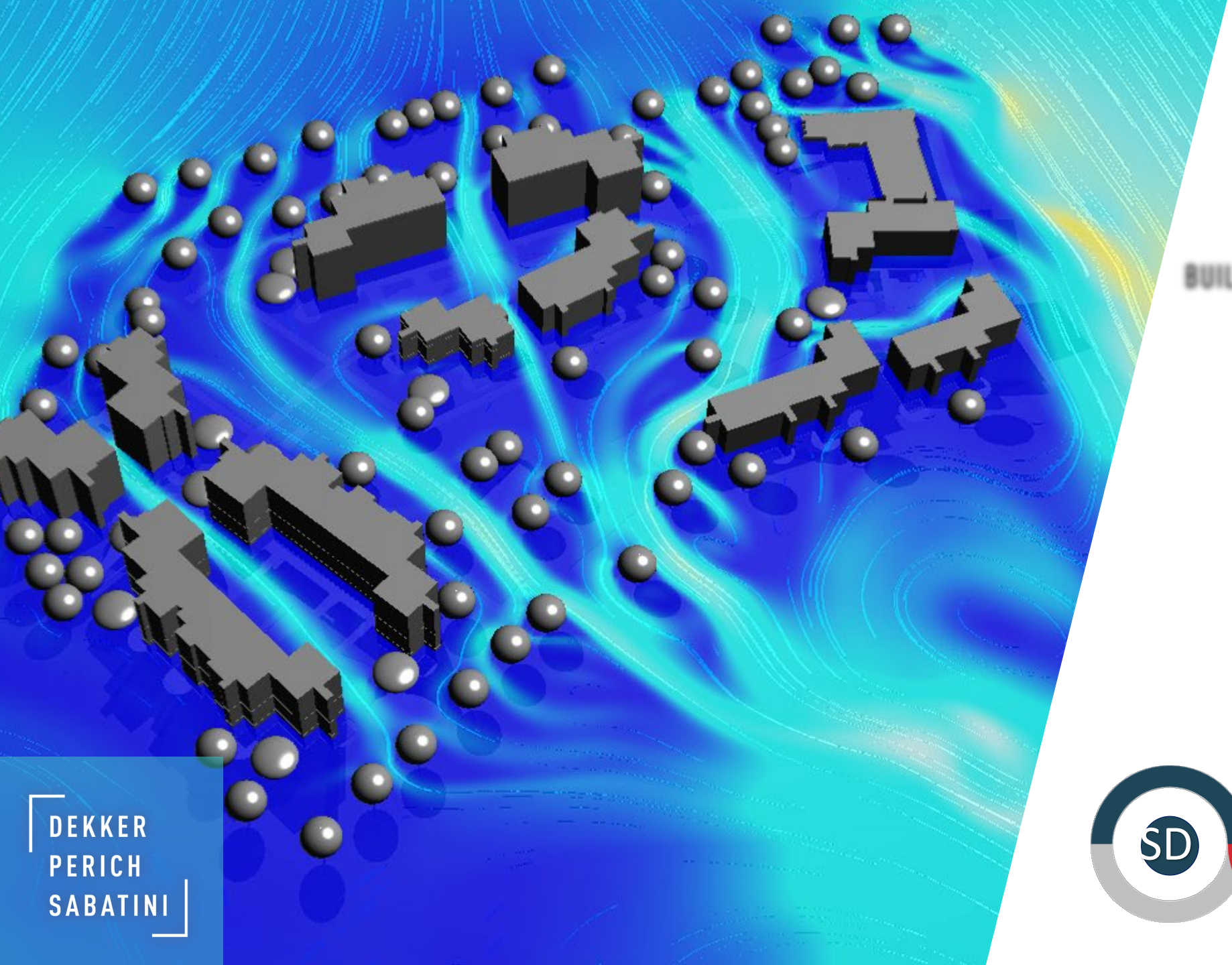

BENCHMARKING EUI I F R

SOLAR INSOLATION R

DAYLIGHT ILLUMINANCE R

SOLAR IRRADIANCE R

RENEWABLE PV ENERGY R

INTERIOR LIGHTING - LEED V4 R

BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL

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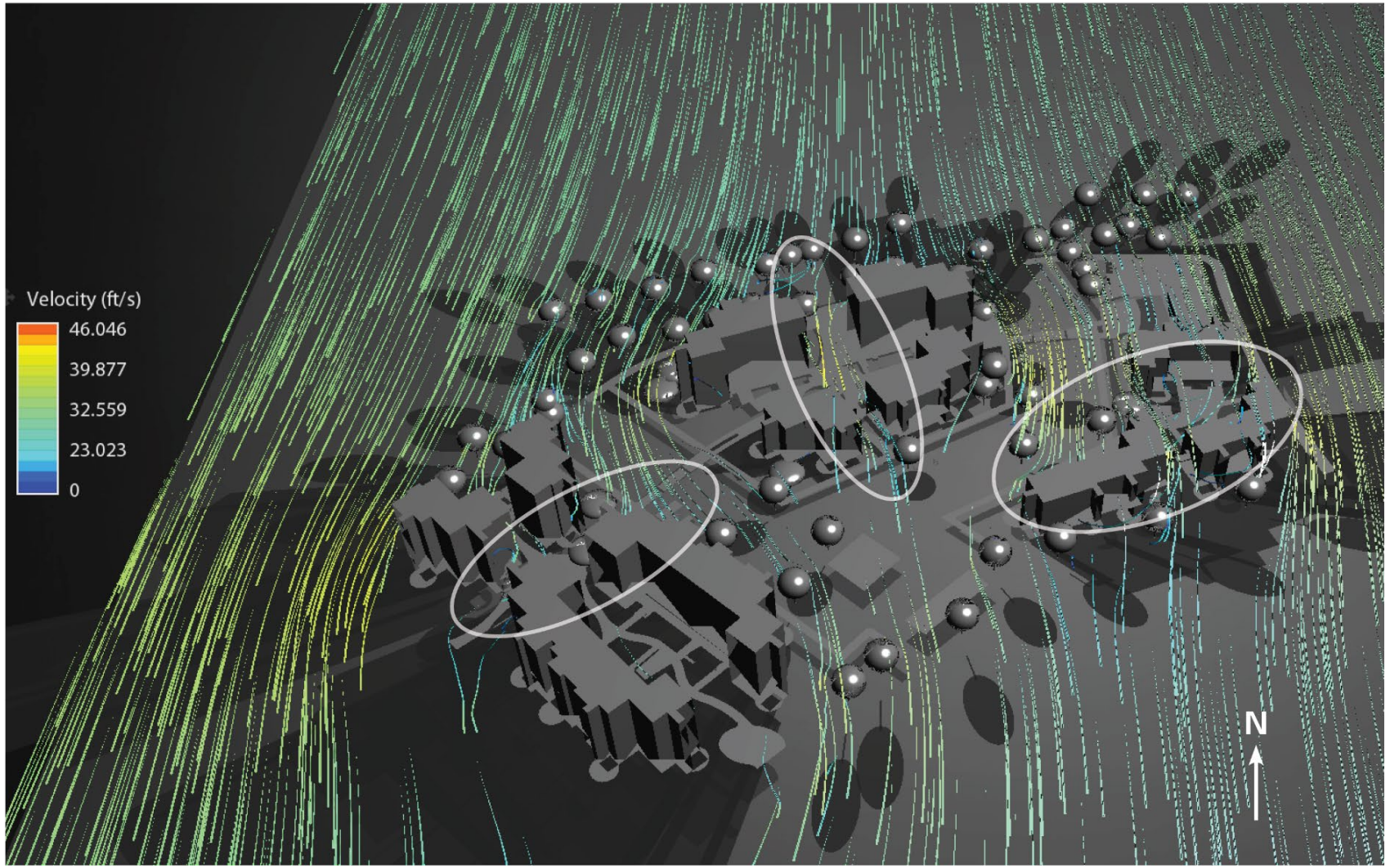
SITE FLOW DESIGN ANALYSIS | Winter Average Winds - North 13mph

Analysis: Current landscape and positioning of the buildings provide intermediate protection for the courtyards during the winter months. The trees push the wind gusts upwards; althought, three "canyoning" winds exist in this analysis causing concern for drifting snow in these areas. Additional trees may provide protection for these areas. Another concern is that these canyoning winds exist where there is minimal solar access, potentially preventing the thawing and melting of snow/ice - see the following solar irradiance analysis.



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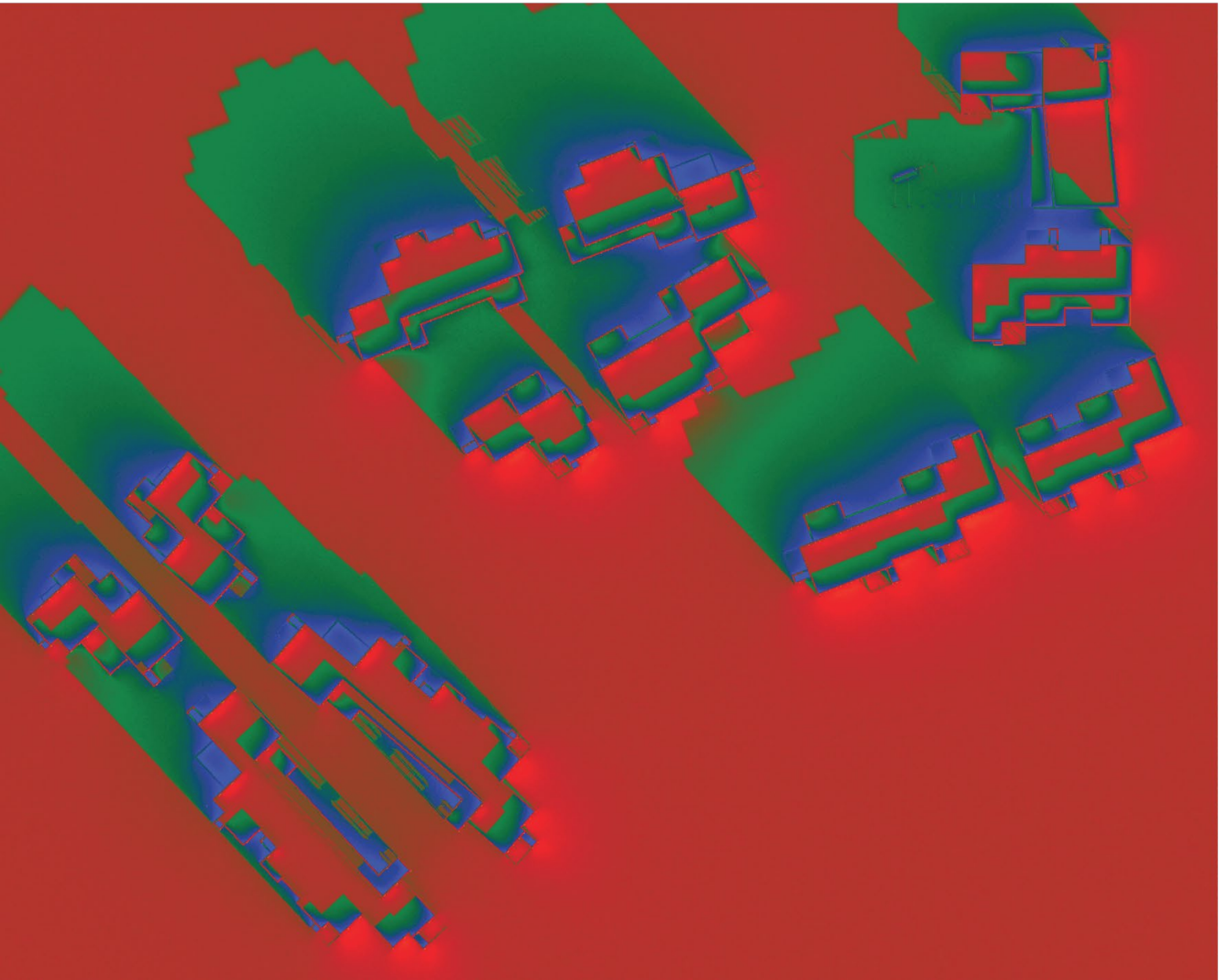
RENDERED SOLAR IRRADIANCE ANALYSIS | Winter Solstice - 9am, 12noon, 3pm



— High Exposure

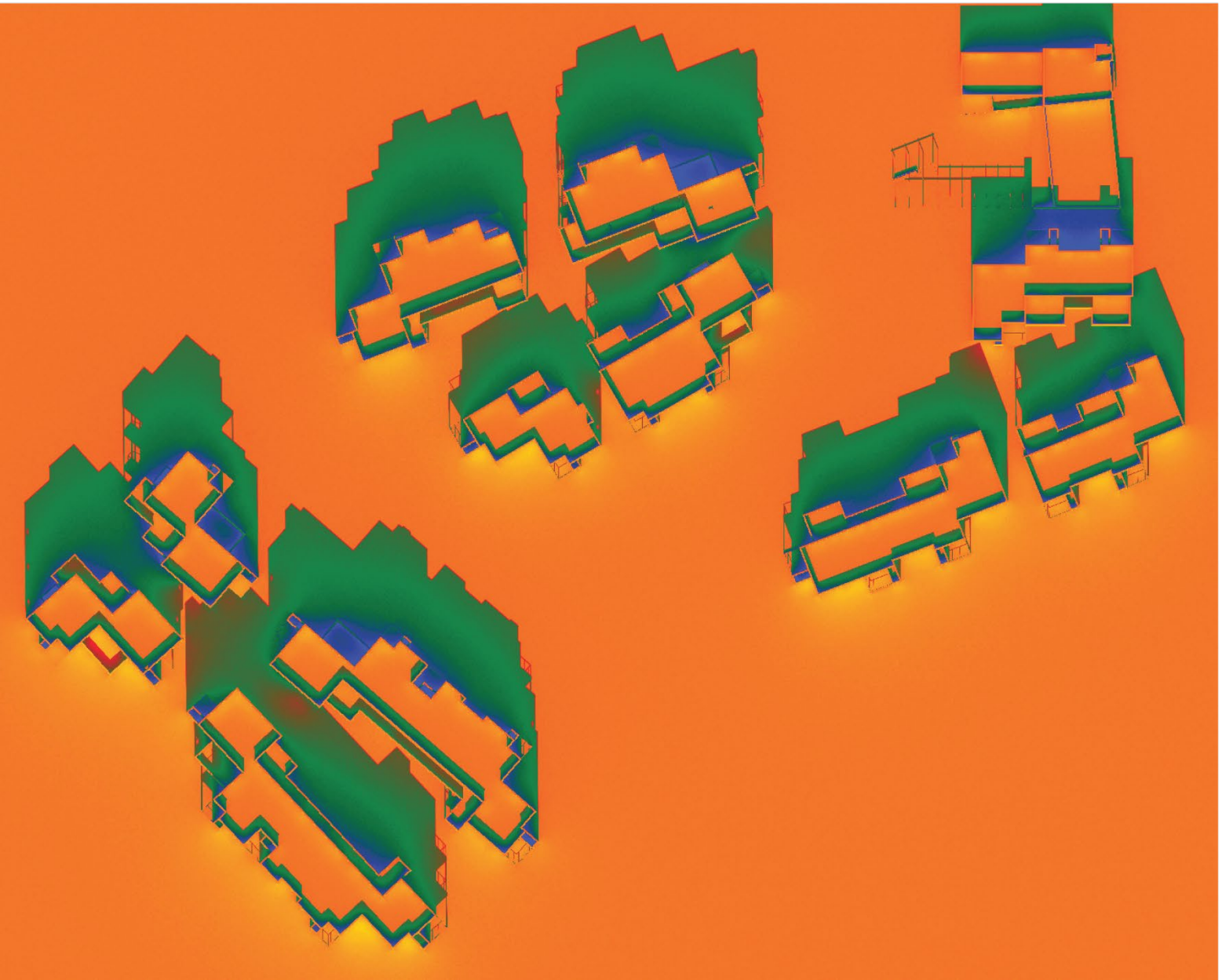
— Moderate Exposure

— Low Exposure

BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R
RENEWABLE PV ENERGY R
INTERIOR LIGHTING - LEED V4 R
BUILDING ENVELOPE HEAT TRANSFER
FLOW DESIGN - WIND TUNNEL F

SD DD

RENDERED SOLAR IRRADIANCE ANALYSIS | Winter Solstice - 9am, 12noon, 3pm



— High Exposure

— Moderate Exposure

— Low Exposure

BENCHMARKING EUI I F R

SOLAR INSOLATION R

DAYLIGHT ILLUMINANCE R

SOLAR IRRADIANCE R

RENEWABLE PV ENERGY R

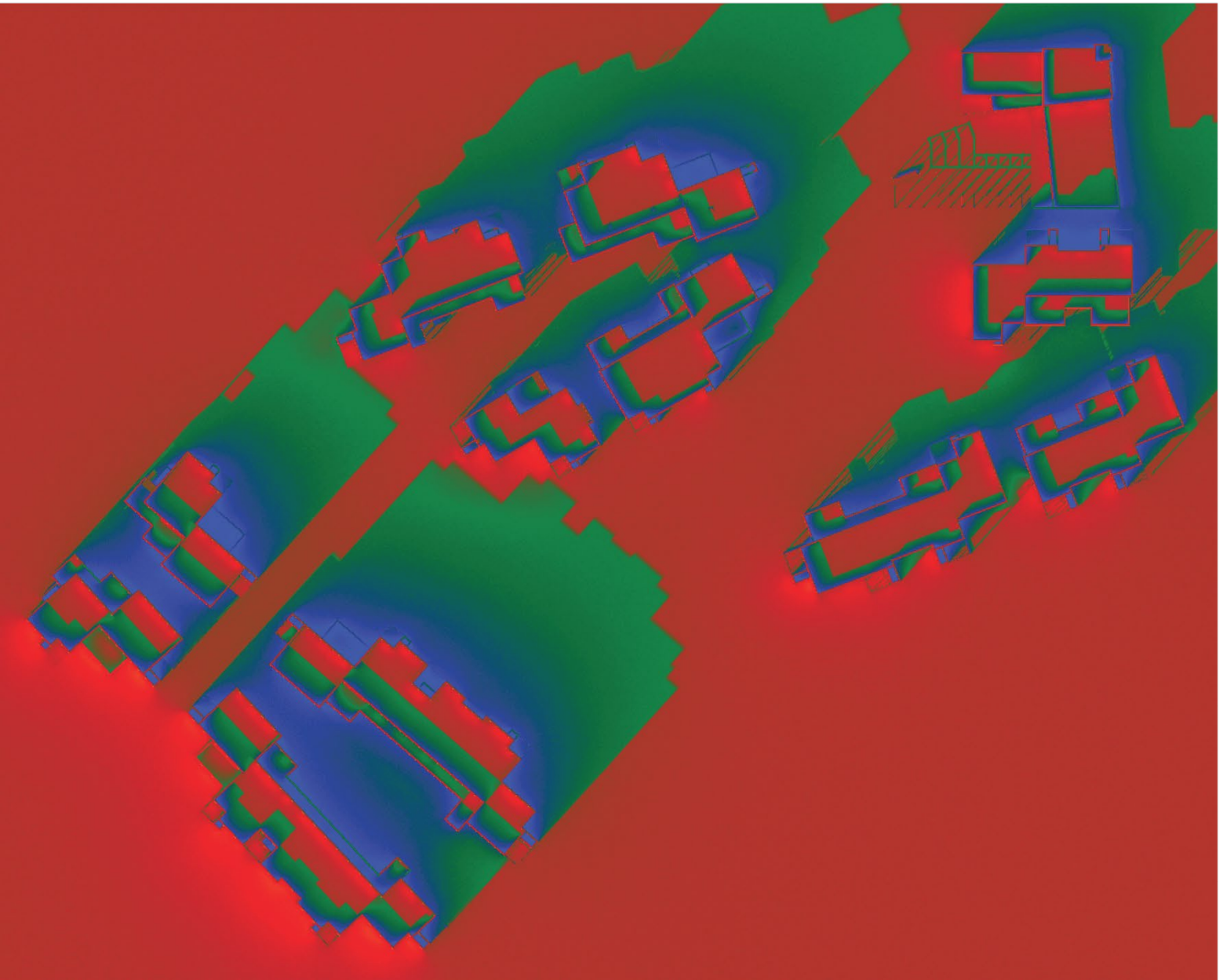
INTERIOR LIGHTING - LEED V4 R

BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL F

SD DD

RENDERED SOLAR IRRADIANCE ANALYSIS | Winter Solstice - 9am, 12noon, 3pm



— High Exposure

— Moderate Exposure

— Low Exposure

BENCHMARKING EUI I F R

SOLAR INSOLATION R

DAYLIGHT ILLUMINANCE R

SOLAR IRRADIANCE R

RENEWABLE PV ENERGY R

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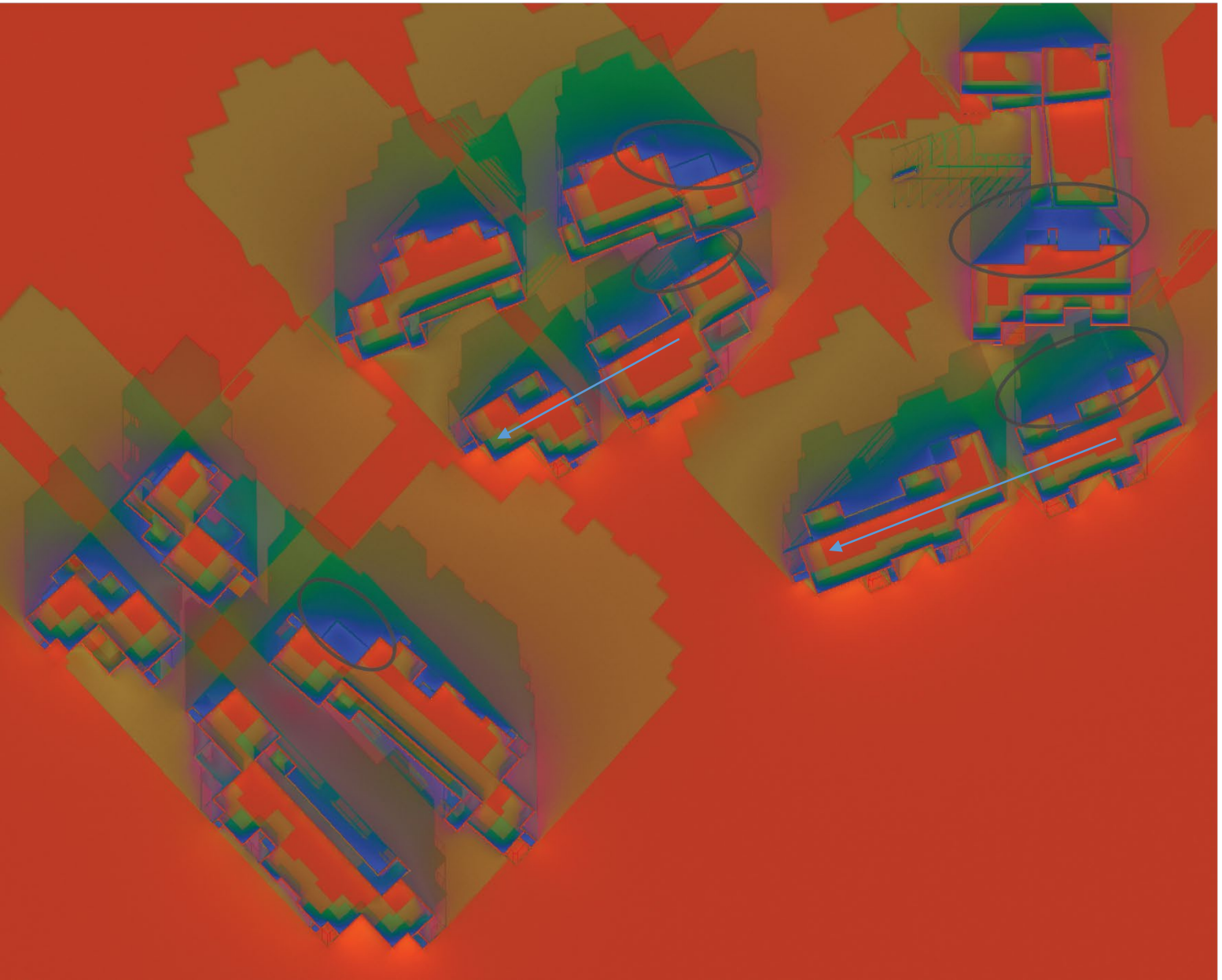
SD DD

RENDERED SOLAR IRRADIANCE ANALYSIS | Winter Solstice - 9am, 12noon, 3pm



— High Exposure

— Moderate Exposure

— Low Exposure

BENCHMARKING EUI I F R

SOLAR INSOLATION R

DAYLIGHT ILLUMINANCE R

SOLAR IRRADIANCE R

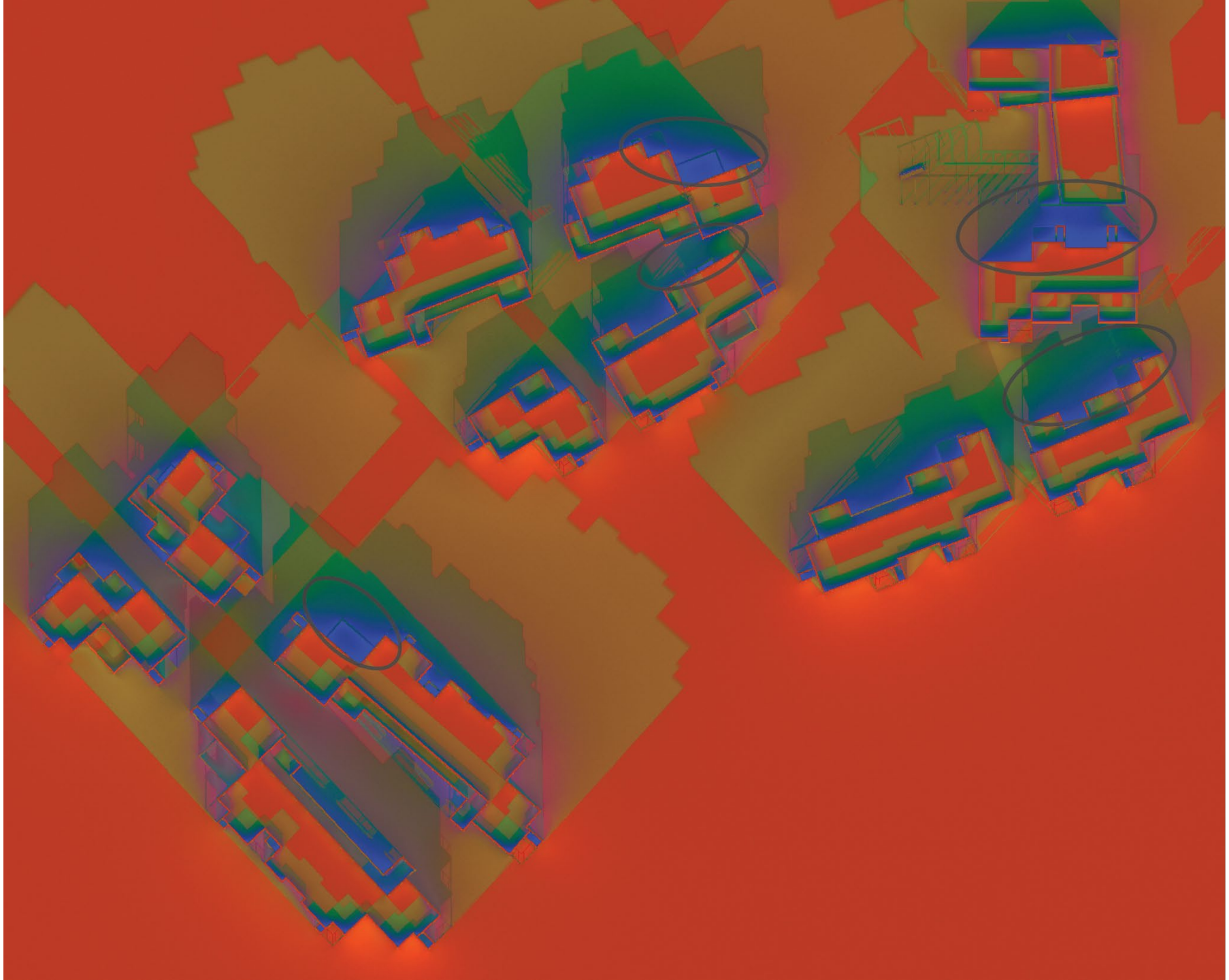
RENEWABLE PV ENERGY R

INTERIOR LIGHTING - LEED V4 R

BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL F

SD DD



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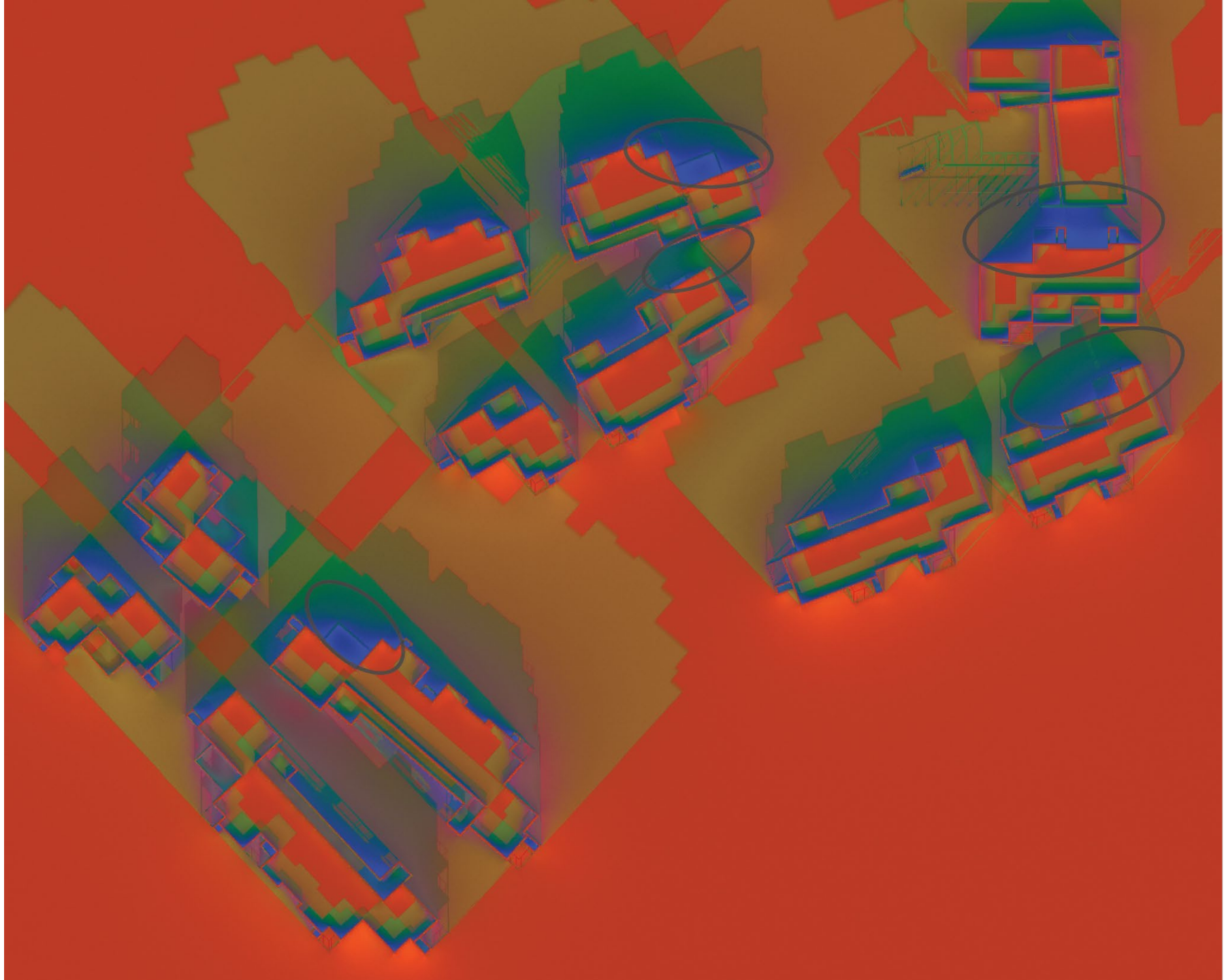

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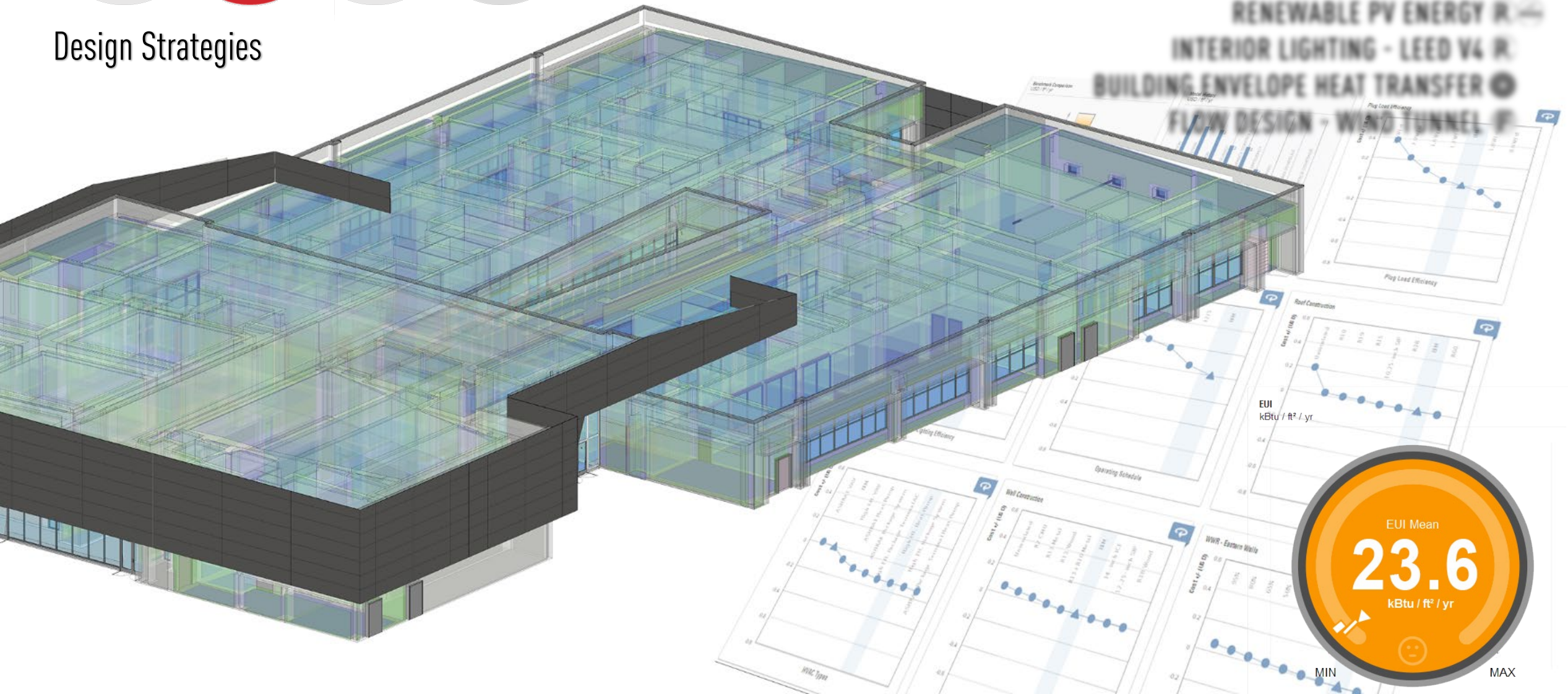
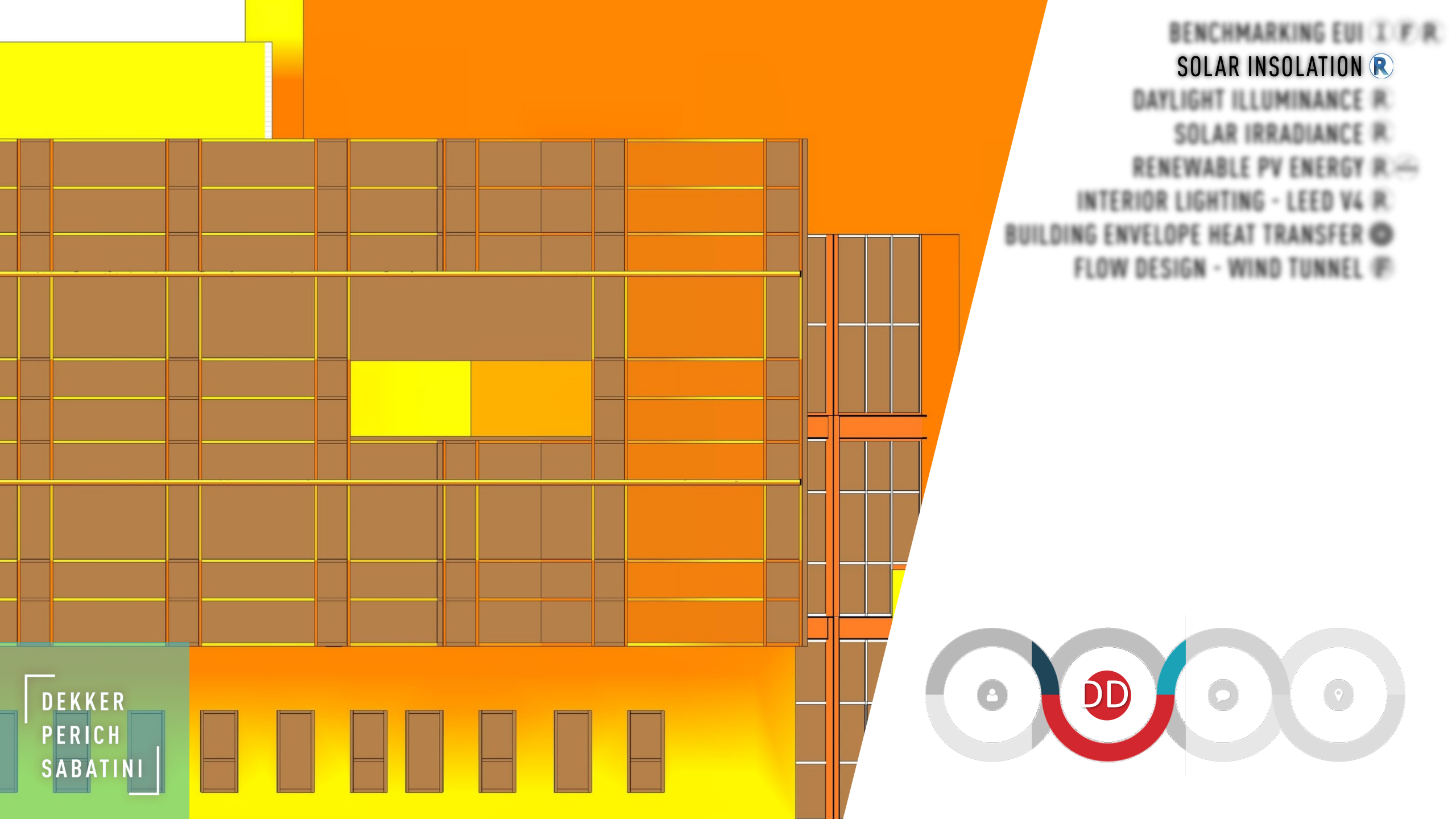
Design Strategies




BENCHMARKING EUI I F R
SOLAR INSOLATION R
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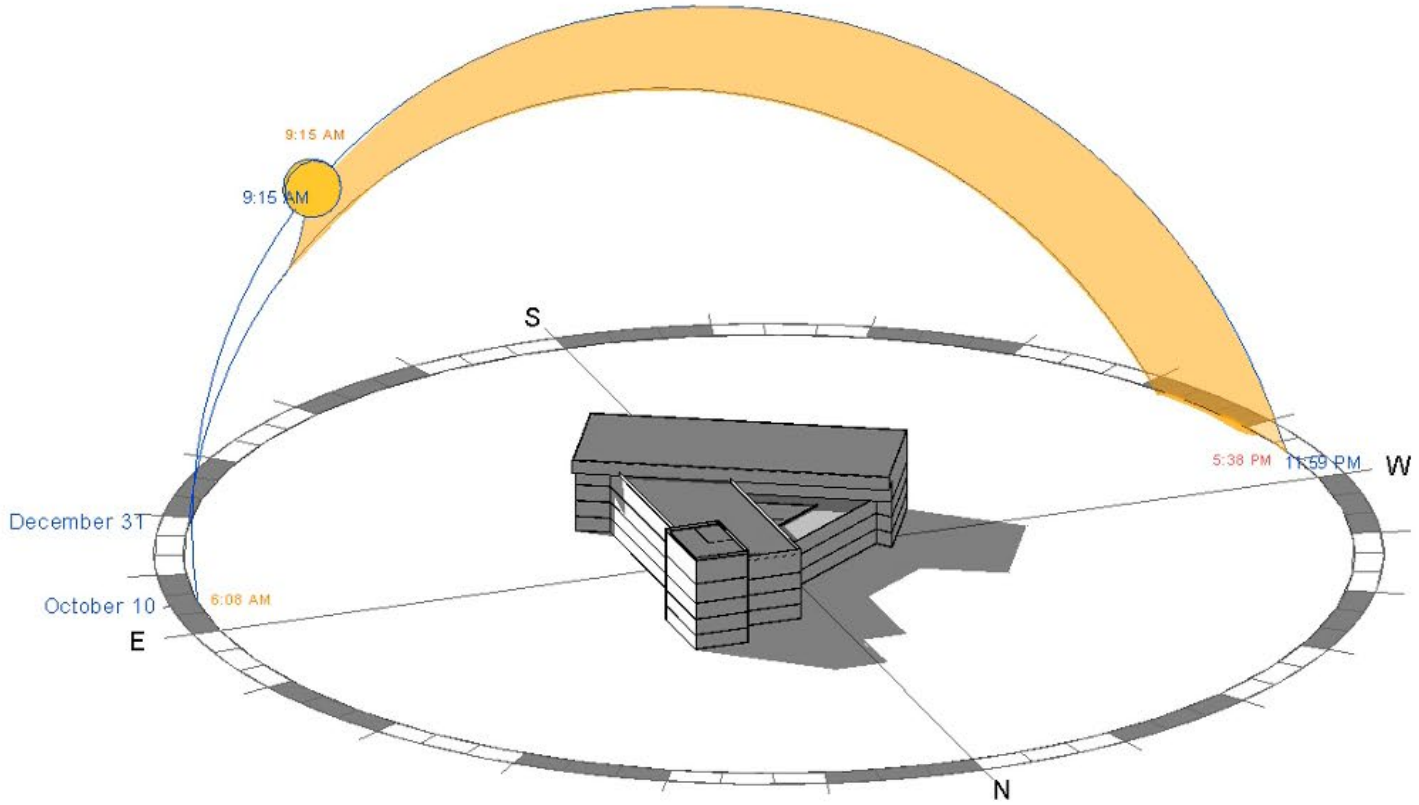
File | Architecture | Structure | Systems | Insert | Annotate | Analyze | Massing & Site | Collaborate | View | Manage | Add-Ins | Lumion | Extensions | Modify

Modify | Boundary Conditions | Loads | Load Cases | Load Combinations | Adjust | Reset | Supports | Consistency | Space | Space Separator | Space Tag | Space Naming | Zone | Heating and Cooling Loads | Panel Schedules | Schedule/ Quantities | Duct Pressure Loss Report | Pipe Pressure Loss Report | Check Systems | Color Fill | Energy Optimization | Heating Cooling | Lighting | Solar

Select | Analytical Model | Analytical Model Tools | Spaces & Zones | Reports & Schedules | Check Systems | Color Fill | Energy Optimization | Insight





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1/8" = 1'-0"

Click to select, TAB for alternates, CTRL adds, SHIFT unselects.

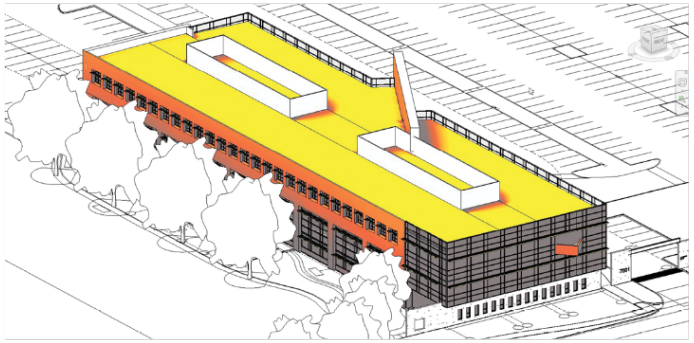
Main Model

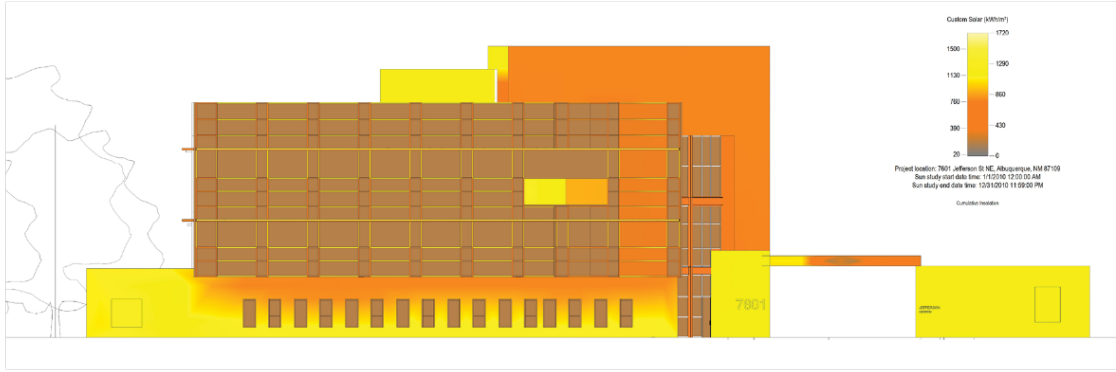
SOLAR INSOLATION ANALYSIS | Shading Design Iterations

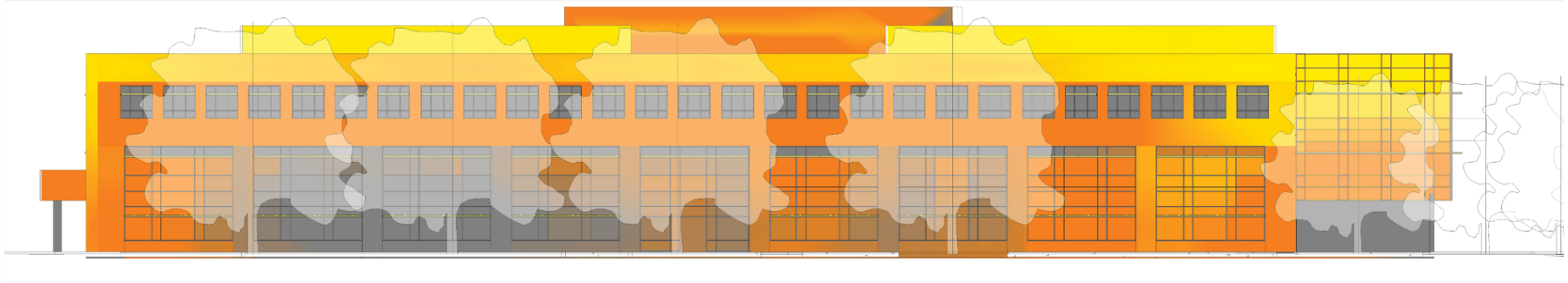
A graphic representation and analysis on the amount of solar radiation that falls on a surface **across a given time period.**

Exterior Use: Evalute the effectiveness of a shading design iteration. Use in conjunction with the **Rendered Illuminance Analysis (pg 9)** to evalute how the shading design performs at a **specific time of the year.**

Interior Use: Finds potential locations for large amounts of solar heat gain – too much or too little.







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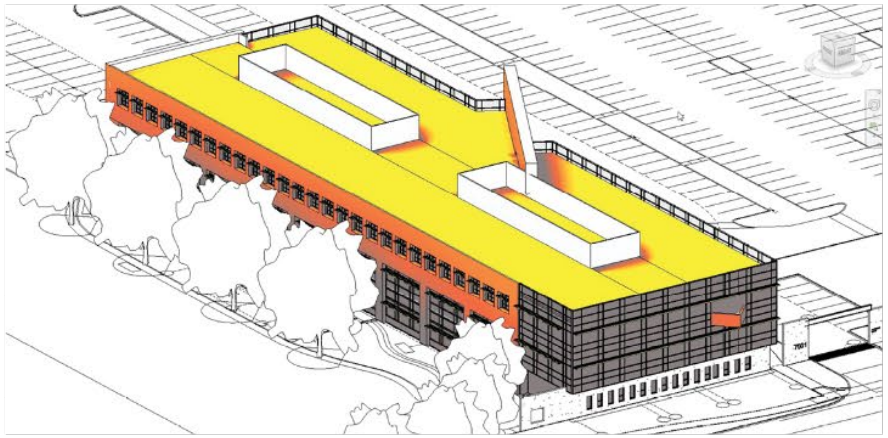

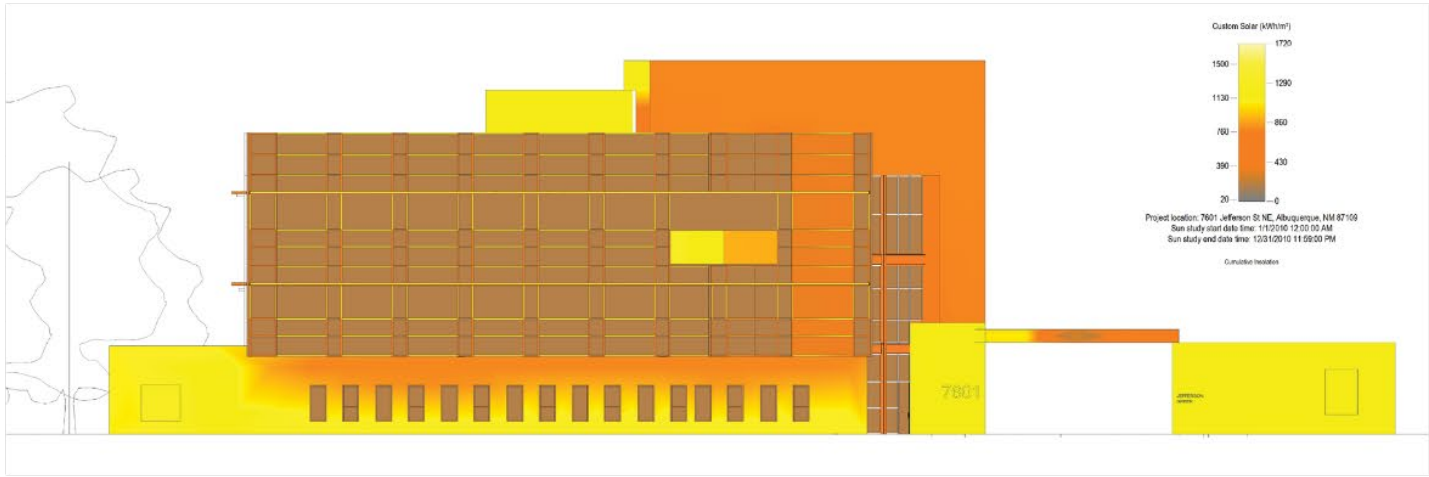

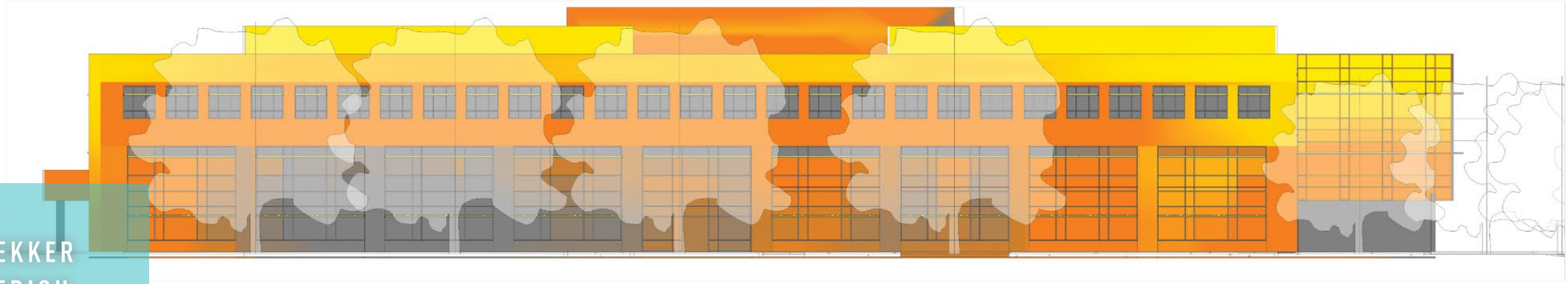

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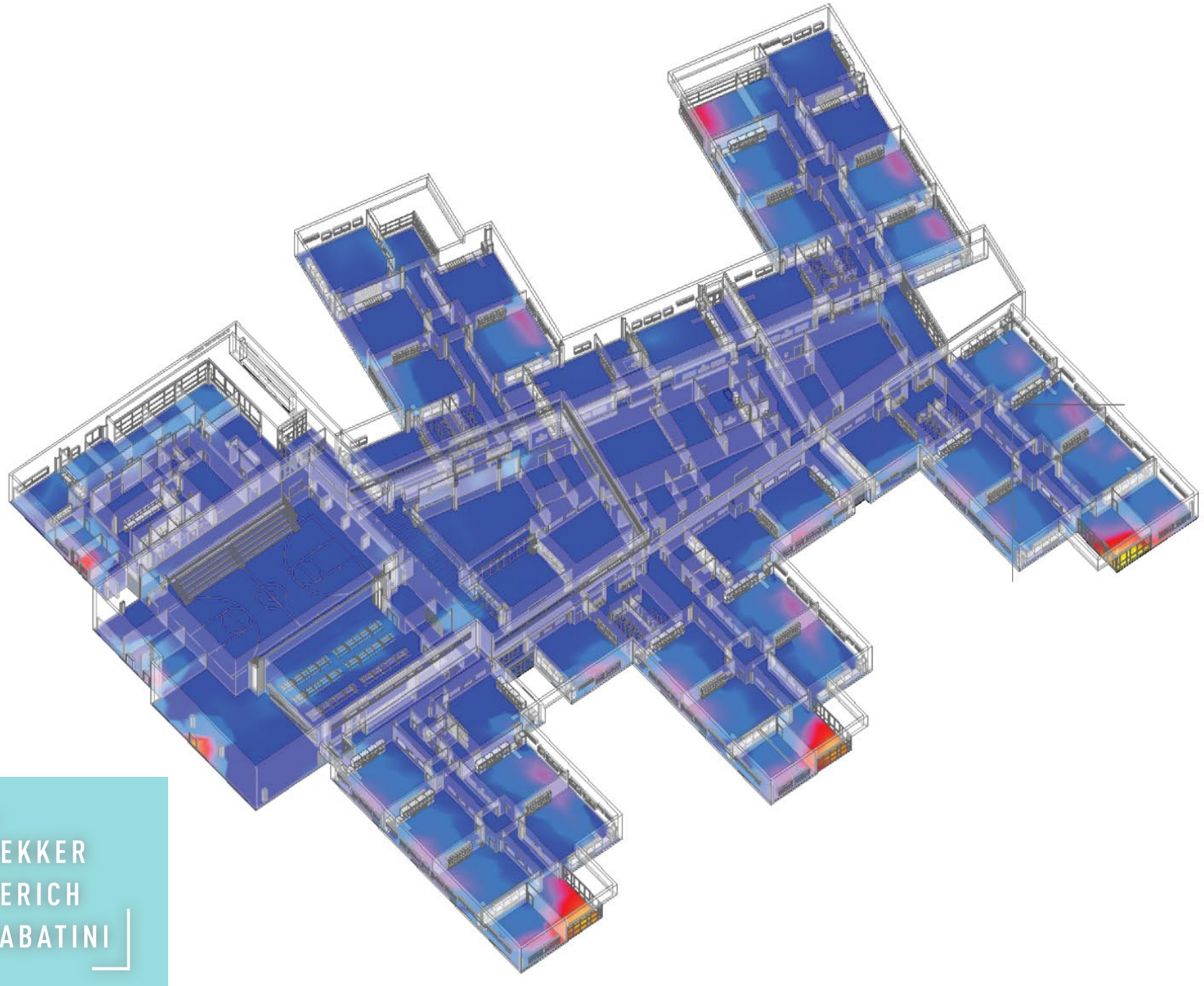

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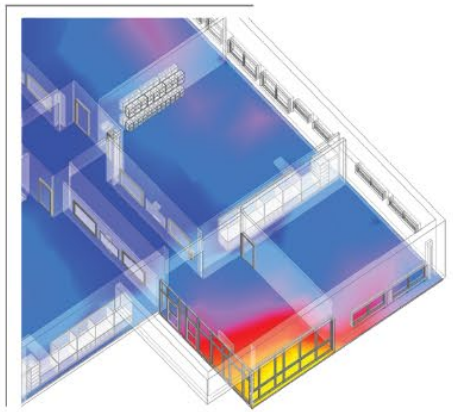

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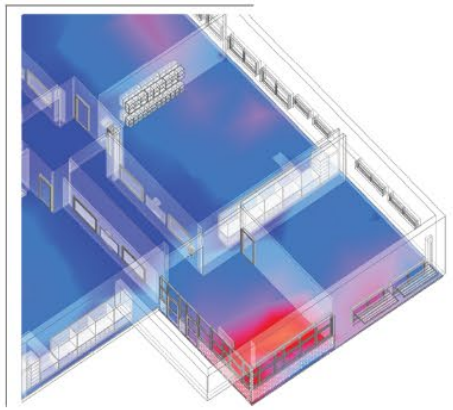

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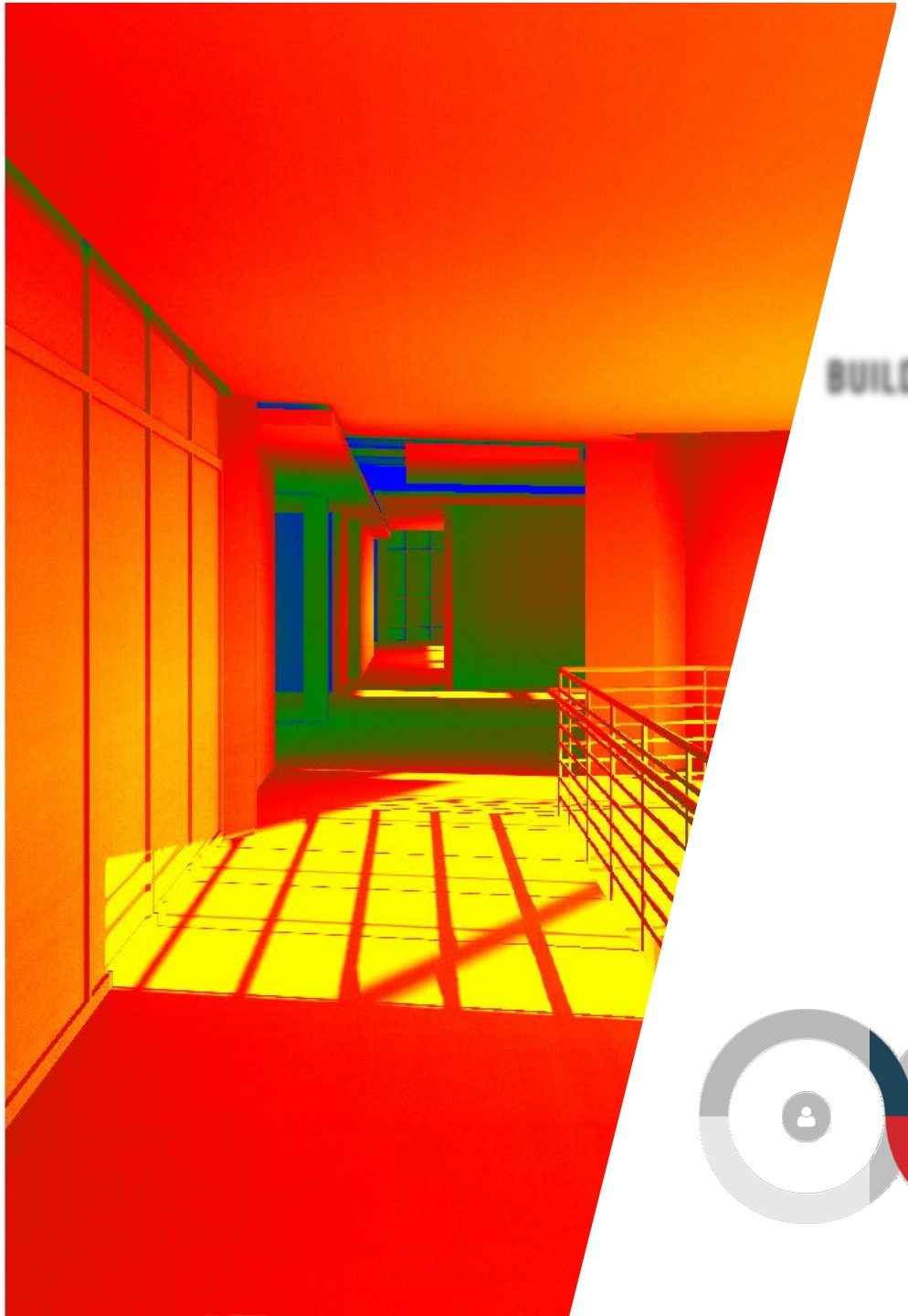

BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R
RENEWABLE PV ENERGY R
INTERIOR LIGHTING - LEED V4 R
BUILDING ENVELOPE HEAT TRANSFER
FLOW DESIGN - WIND TUNNEL F

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March 21 @ 9am/12noon/3pm



June 21 @ 9am/12noon/3pm



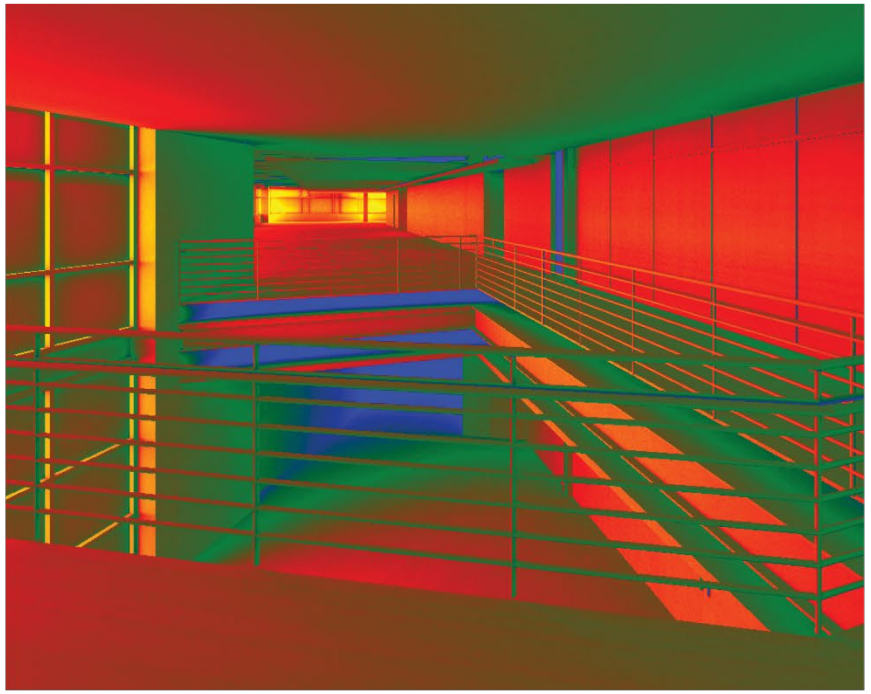
December 21 @ 9am/12noon/3pm

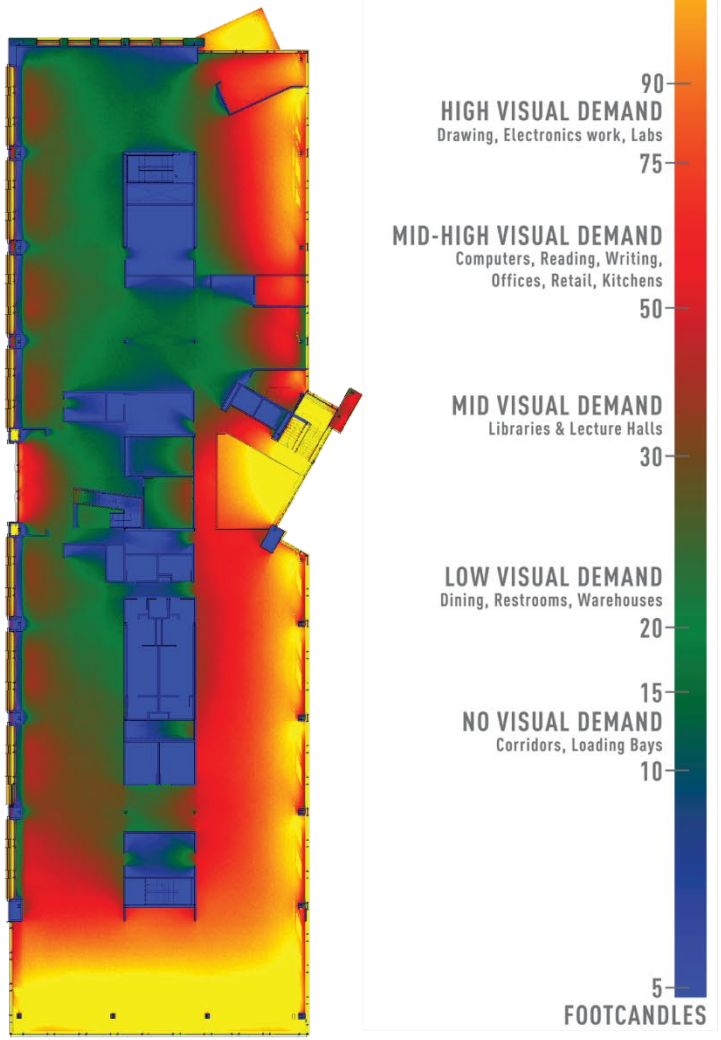
RENDERED ILLUMINANCE ANALYSIS | Plan View + 3D Perspective View

An illuminance rendering shows you whether your lighting design meets the requirements of the space, and it also helps you understand how much of this light you'll be able to get from daylighting. 3D perspective renders allow the designer to study daylight illuminance in greater detail. These renderings are an excellent way to convey this information with a client when making informed design and shading decisions.

The analysis is useful for determining whether or not there is enough daylight to perform different activities (like reading, office work, or drafting). Illuminance is measured in lux or footcandles (1 footcandle = 10.7 lux).

A building needs approximately 50 to 1000 lux, or 5 to 90 foot-candles for activities inside a building depending on the activity.





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BENCHMARKING EUI I F R

SOLAR INSOLATION R

DAYLIGHT ILLUMINANCE R

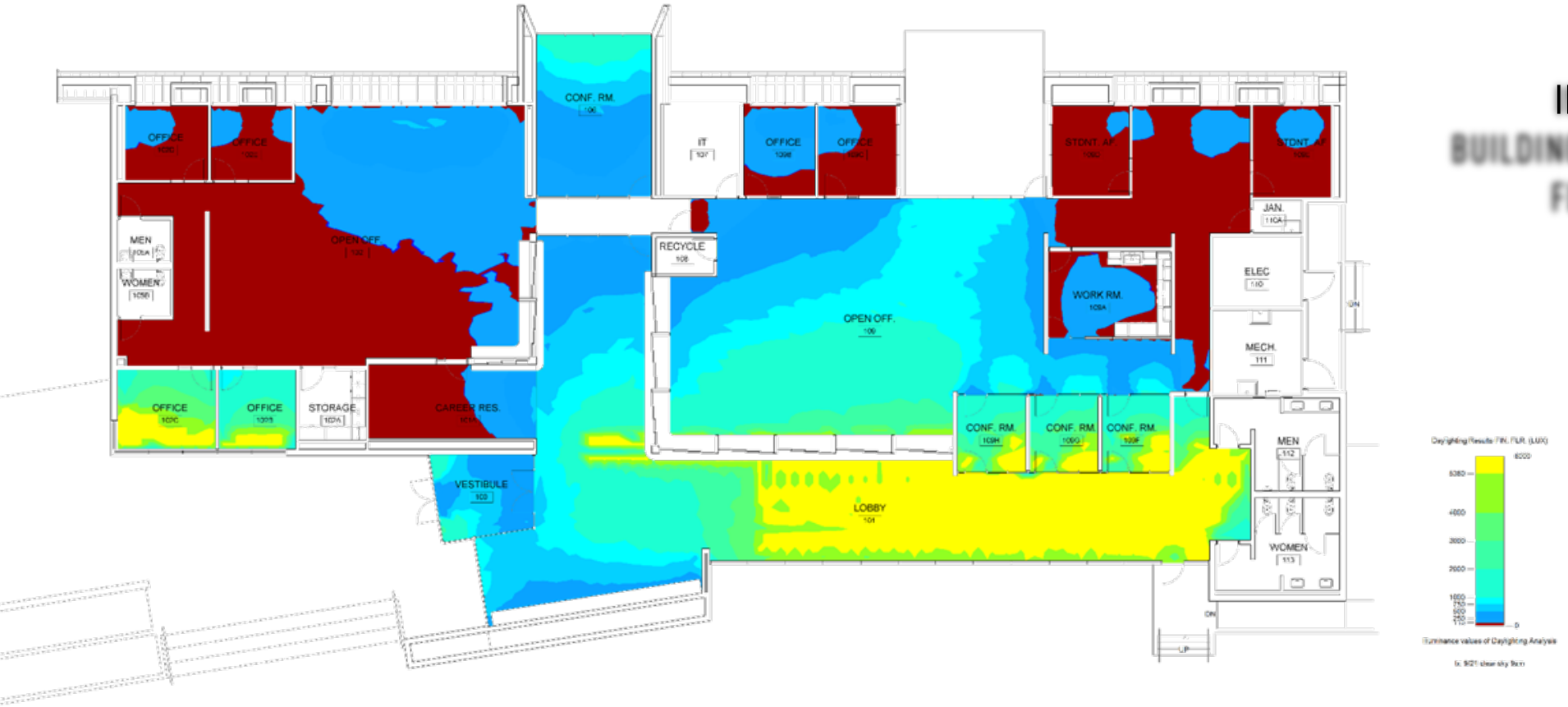
SOLAR IRRADIANCE R

RENEWABLE PV ENERGY R

INTERIOR LIGHTING - LEED V4 R

BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL F



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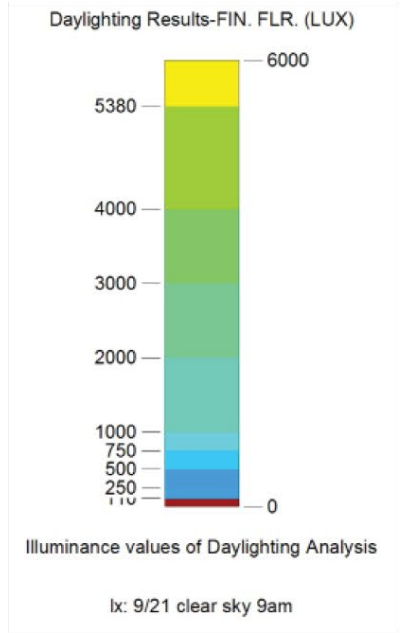
INTERIOR LIGHTING ANALYSIS | Used for LEED v4 EQc7

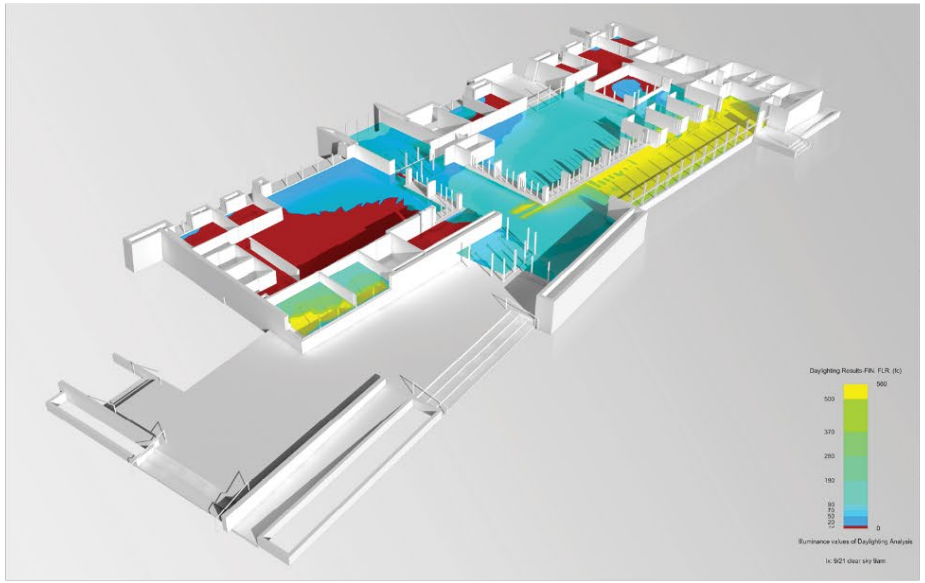
LEED v4 EQc7 opt1 (sDA + ASE): Simulation - Spatial Daylight Autonomy (2–3 points, 1-2 points Healthcare)
Demonstrate through annual computer simulations that spatial daylight autonomy 300/50% (sDA 300/50%) of at least 55%, 75%, or 90% is achieved. Use regularly occupied floor area. Healthcare projects should use the perimeter area determined under EQ Credit Quality Views.
Demonstrate through annual computer simulations that annual sunlight exposure 1000,250 (ASE 1000,250) of no more than 10% is achieved. Use the regularly occupied floor area that is daylit per the sDA 300/50% simulations.

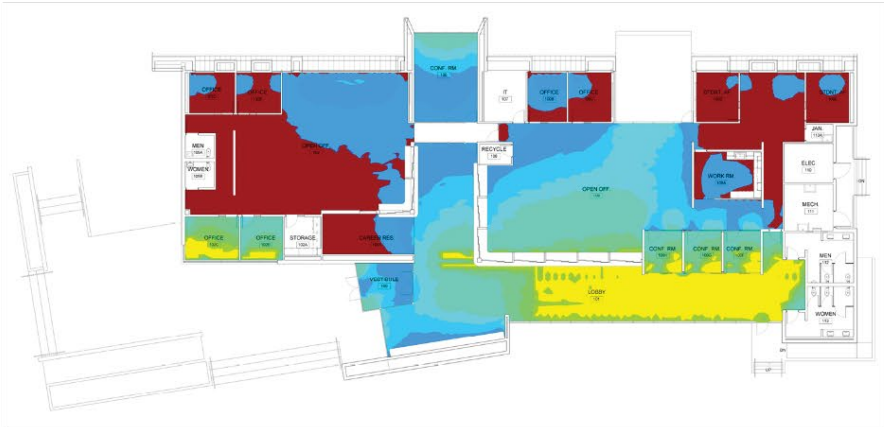
LEED v4 EQc7 opt2: Simulation - Illuminance Calculations (1–2 points)
Demonstrate through computer modeling that illuminance levels will be between 300 lux and 3,000 lux for 9 a.m. and 3 p.m., both on a clear-sky day at the equinox. Use regularly occupied floor area. Healthcare projects should use the perimeter area determined under EQ Credit Quality Views.

Definitions:
ASE - Annual Sunlight Exposure helps identify whether a space is subject to overlighting. Find where to add shading, or decrease exposure to daylight, to prevent "overlit" areas of a space.

sDA - Spatial Daylight Autonomy is used to evaluate whether a space receives enough usable daylight throughout the year based on space use type. Find where to add daylight to "underlit" areas of a space.







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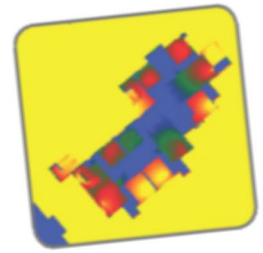
shade

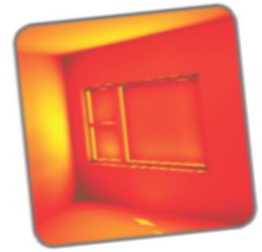
Building Performance Analysis Team

15-0145 Las Soleras

Interior Shading/Daylighting Analysis

BPAT@dpsdesign.org







September 26, 2017

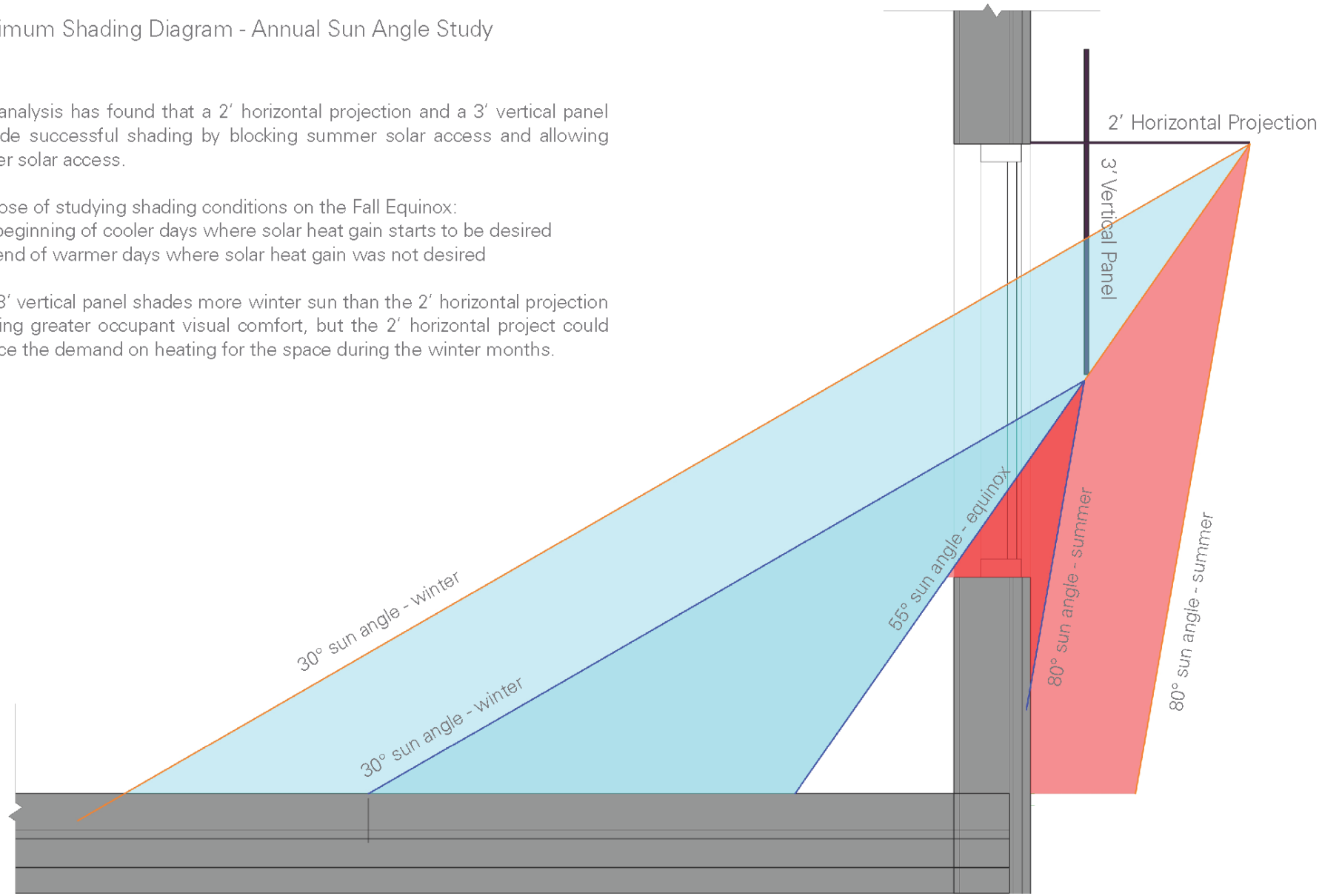
Optimum Shading Diagram - Annual Sun Angle Study

The analysis has found that a 2′ horizontal projection and a 3′ vertical panel provide successful shading by blocking summer solar access and allowing winter solar access.

Purpose of studying shading conditions on the Fall Equinox:

- beginning of cooler days where solar heat gain starts to be desired
- end of warmer days where solar heat gain was not desired

The 3′ vertical panel shades more winter sun than the 2′ horizontal projection causing greater occupant visual comfort, but the 2′ horizontal project could reduce the demand on heating for the space during the winter months.



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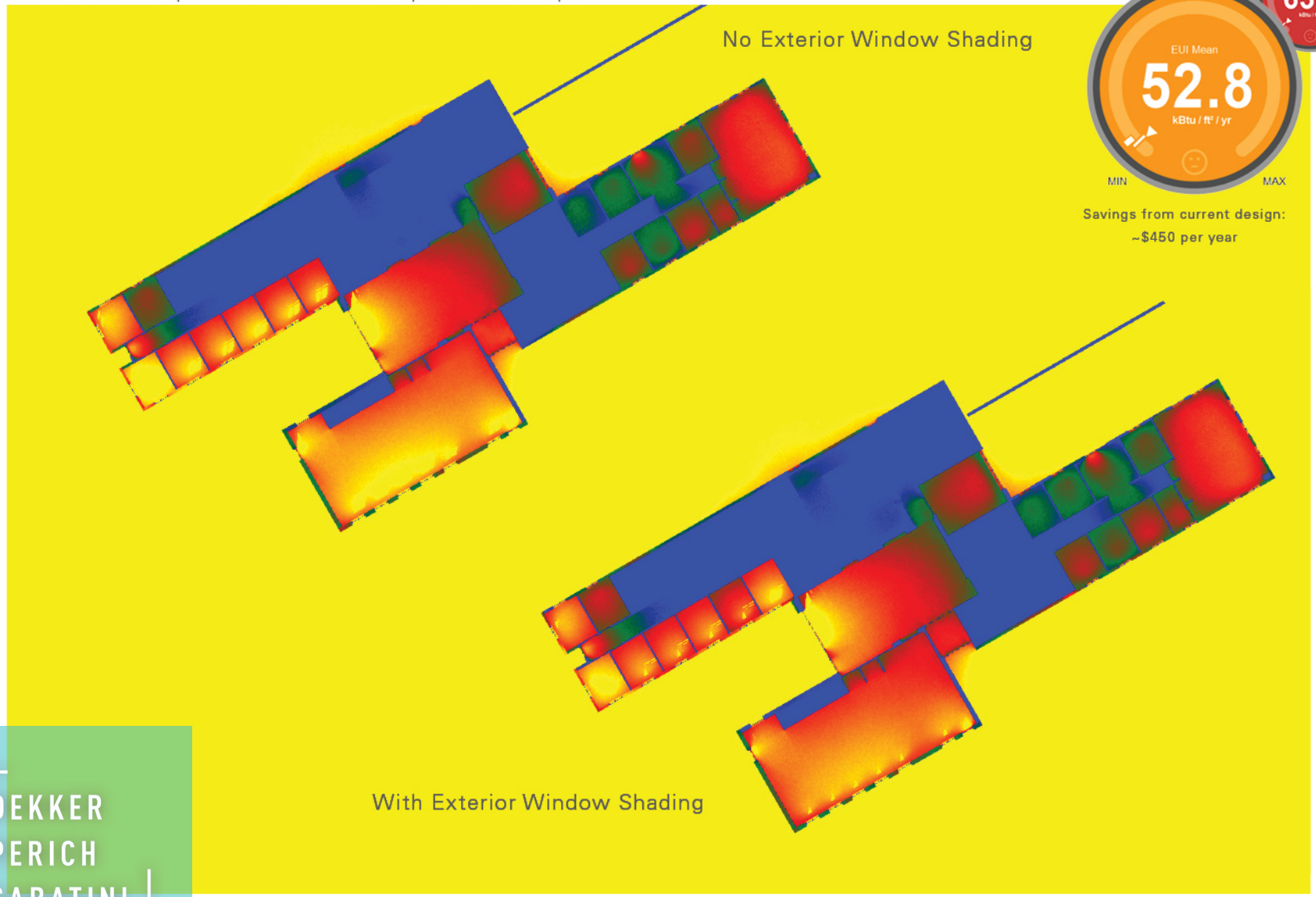
CURRENT DESIGN | Daylighting Study

Plan View - September 21st - Fall Equinox - 12:00pm



2030 / CBECS
Baseline EUI



-16%

Savings from current design:
~$450 per year

250
90
HIGH VISUAL DEMAND
Drawing, Electronics work, Labs
75
MID-HIGH VISUAL DEMAND
Computers, Reading, Writing, Offices, Retail, Kitchens
50
MID VISUAL DEMAND
Libraries & Lecture Halls
30
LOW VISUAL DEMAND
Dining, Restrooms, Warehouses
20
15
NO VISUAL DEMAND
Corridors, Loading Bays
10
5
FOOTCANDLES

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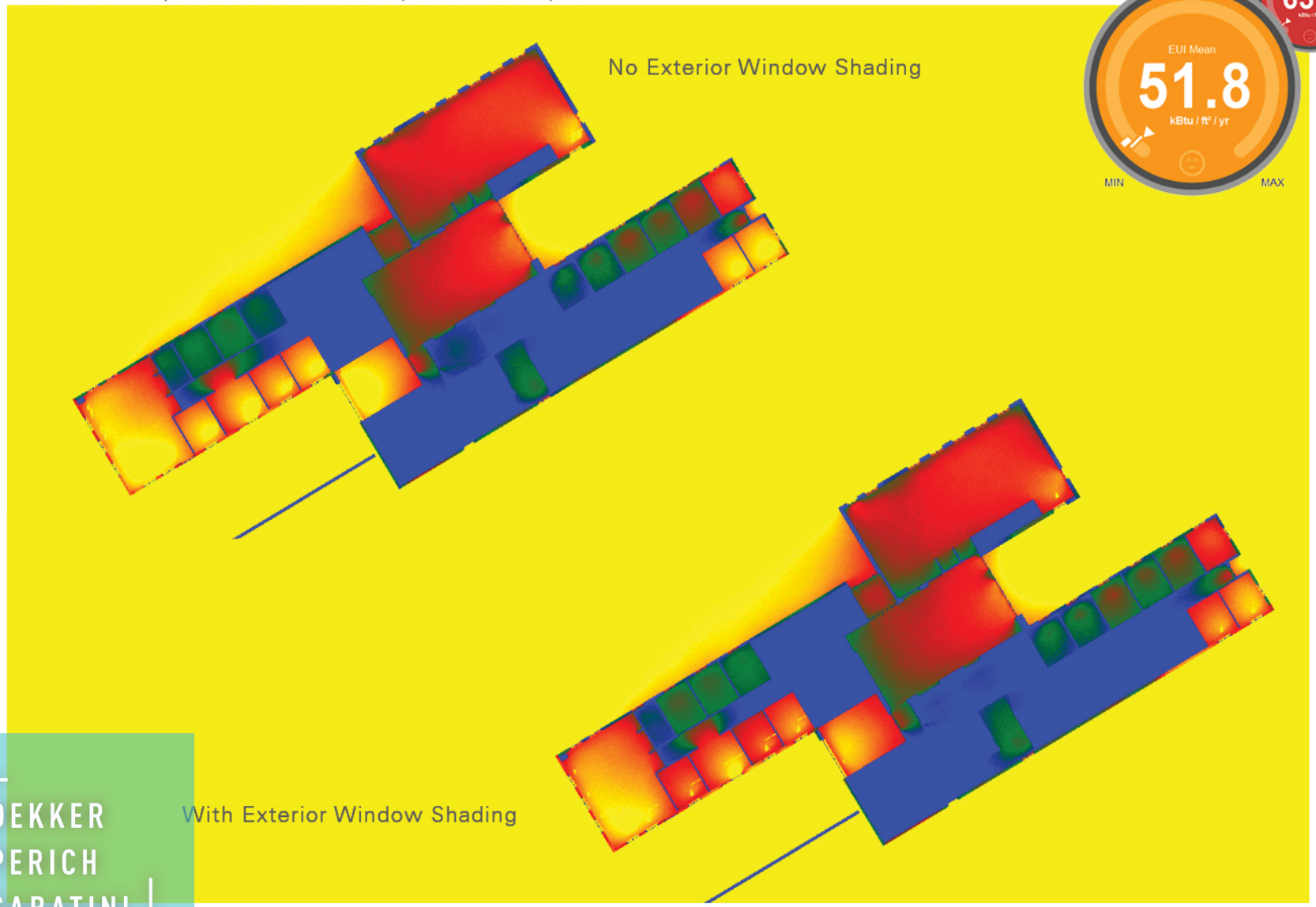
180 DEGREE ROTATION | Daylighting Study

Plan View - September 21st - Fall Equinox - 12:00pm



2030 / CBECS
Baseline EUI

-18%

250
90
HIGH VISUAL DEMAND
Drawing, Electronics work, Labs
75
MID-HIGH VISUAL DEMAND
Computers, Reading, Writing, Offices, Retail, Kitchens
50
MID VISUAL DEMAND
Libraries & Lecture Halls
30
LOW VISUAL DEMAND
Dining, Restrooms, Warehouses
20
15
NO VISUAL DEMAND
Corridors, Loading Bays
10
5
FOOTCANDLES

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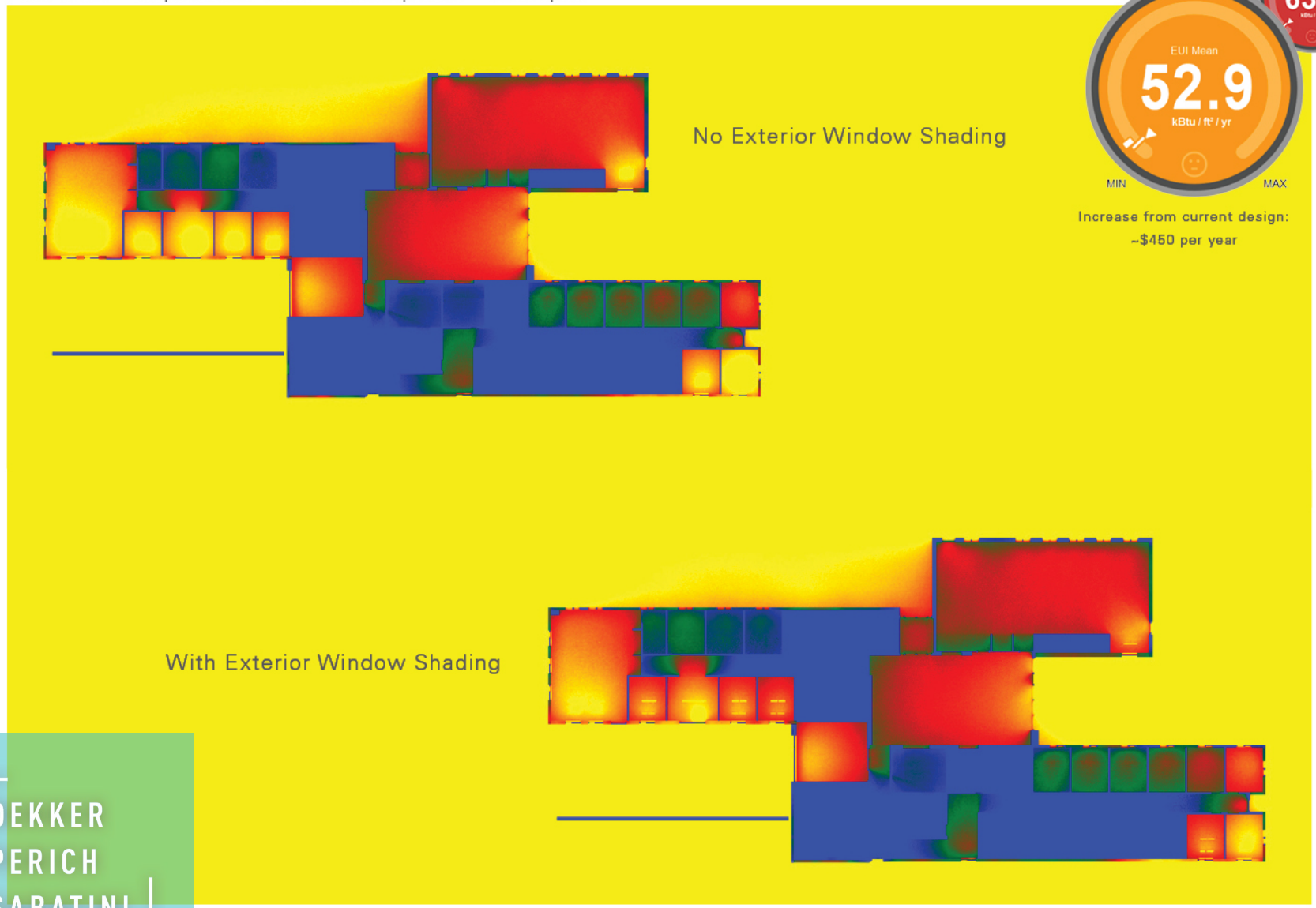
31 DEGREE ROTATION - EAST/WEST LONG AXIS | Daylighting Study

Plan View - September 21st - Fall Equinox - 12:00pm



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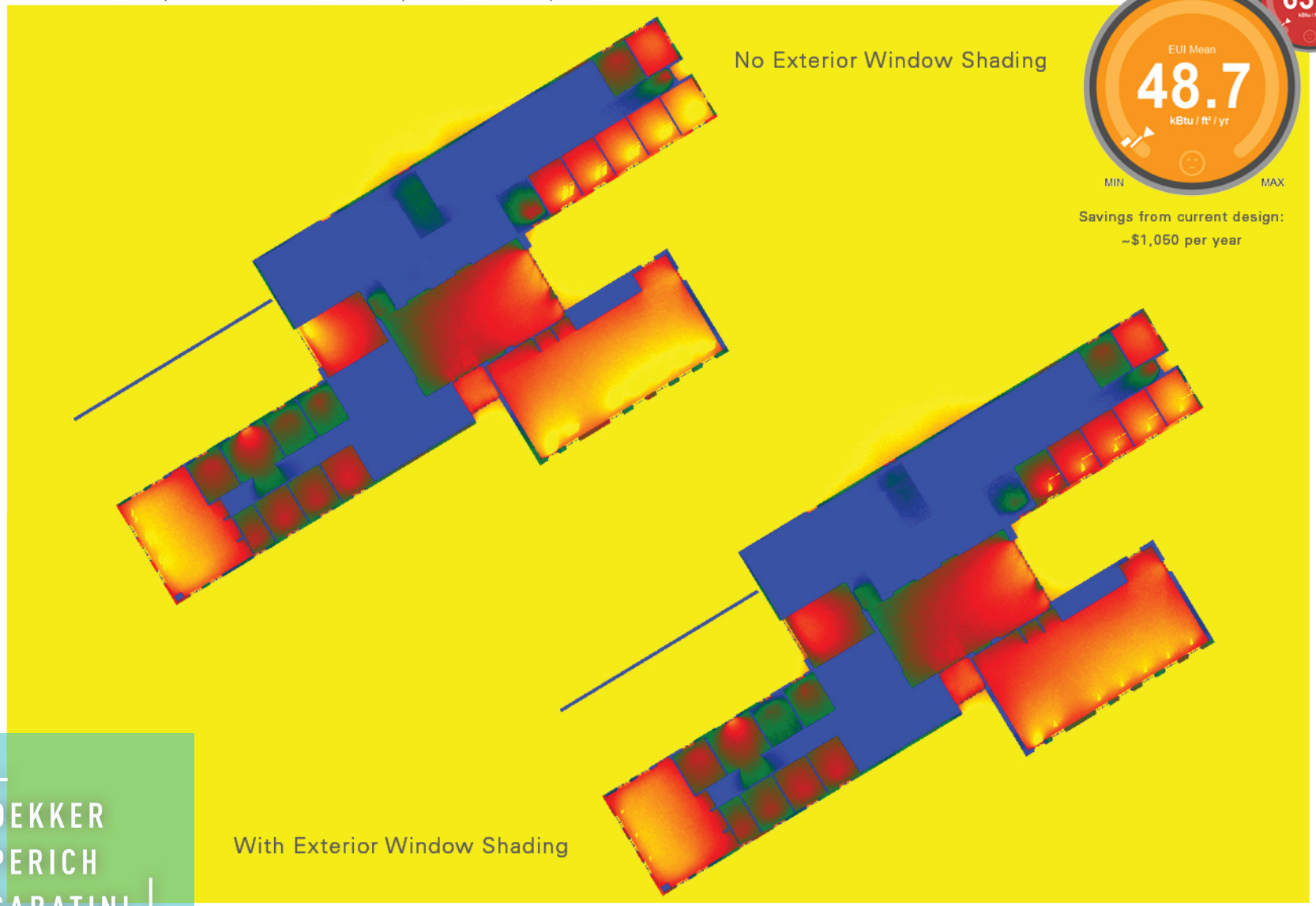
LONG-AXIS MIRRORED ORIENTATION | Daylighting Study

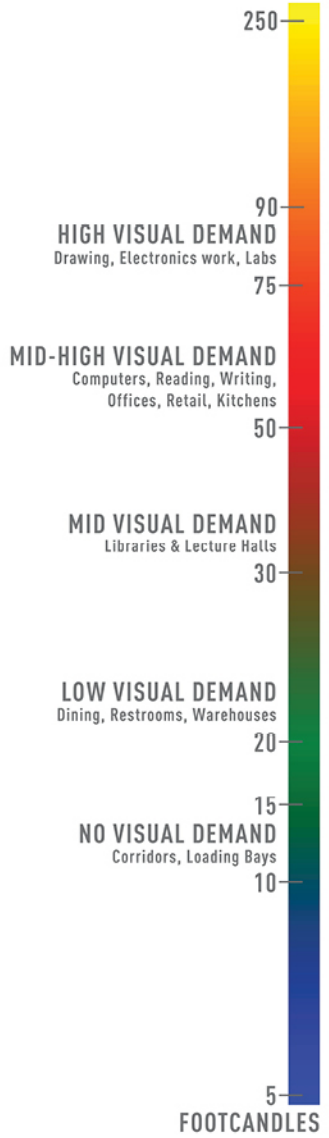
Plan View - September 21st - Fall Equinox - 12:00pm



-23 %

Savings from current design:
~$1,050 per year

2030 / CBECS
Baseline EUI



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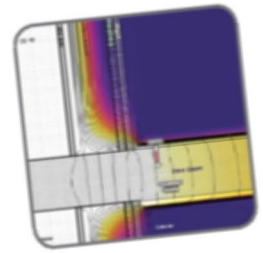
thermal

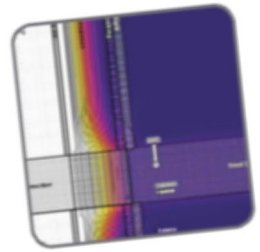
Building Performance Analysis Team

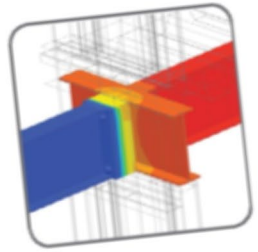
18-0005.001 - PHS FSED Paseo

Structural Thermal Bridging Analysis

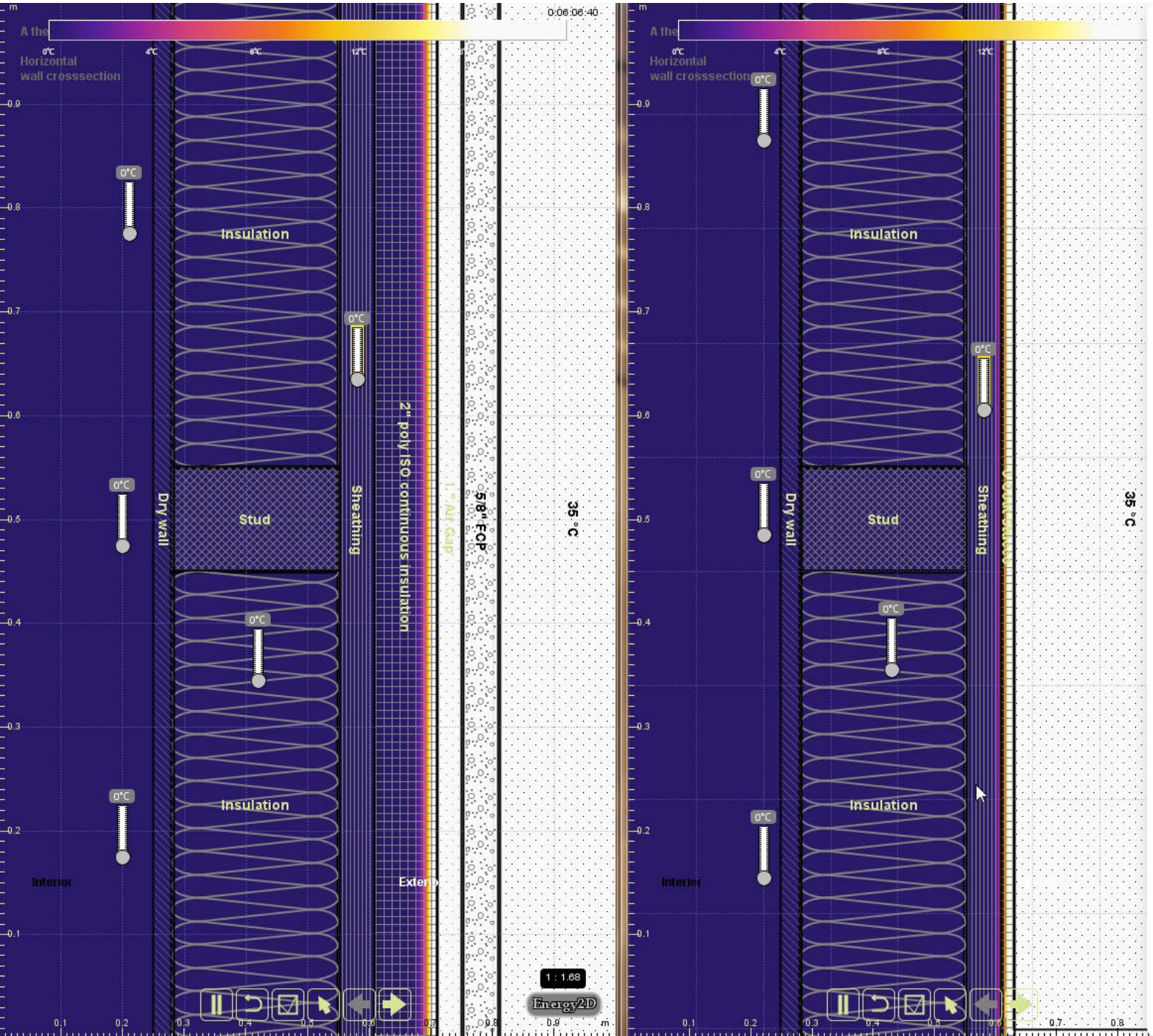
BPAT@dpsdesign.org







May 14, 2018



BENCHMARKING EUI

SOLAR INSOLATION

DAYLIGHT ILLUMINANCE

SOLAR IRRADIANCE

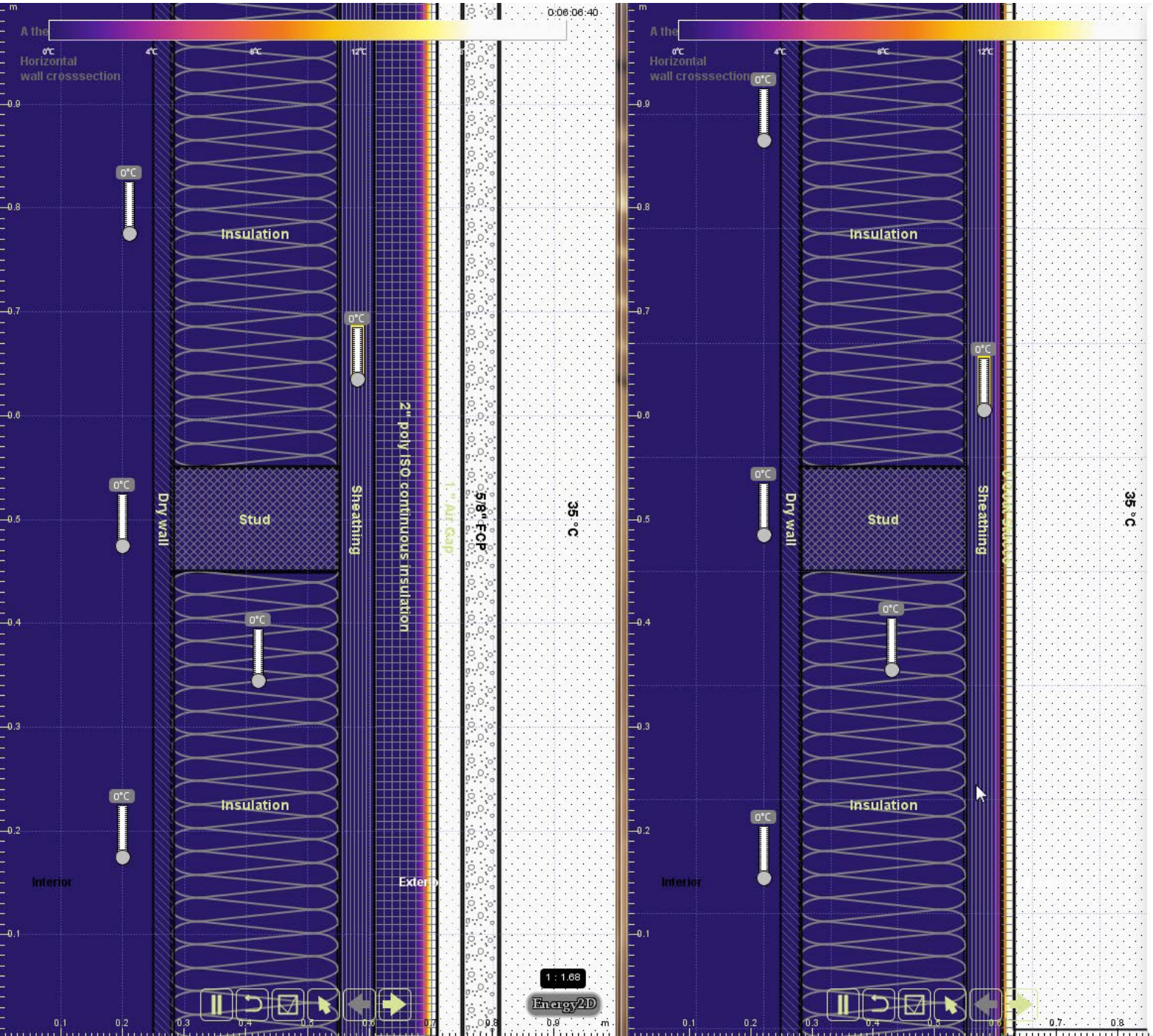
RENEWABLE PV ENERGY

INTERIOR LIGHTING - LEED V4

BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL

0 - 4 mins



BENCHMARKING EUI

SOLAR INSOLATION

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RENEWABLE PV ENERGY

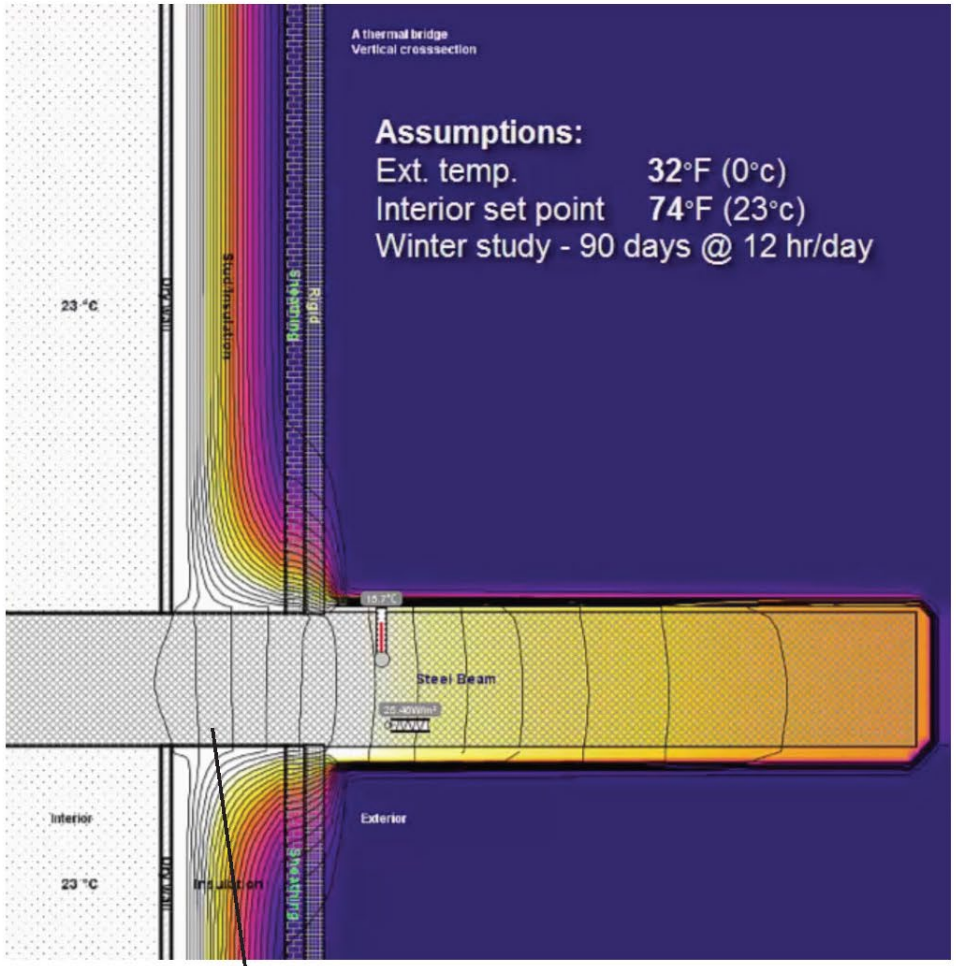
INTERIOR LIGHTING - LEED V4

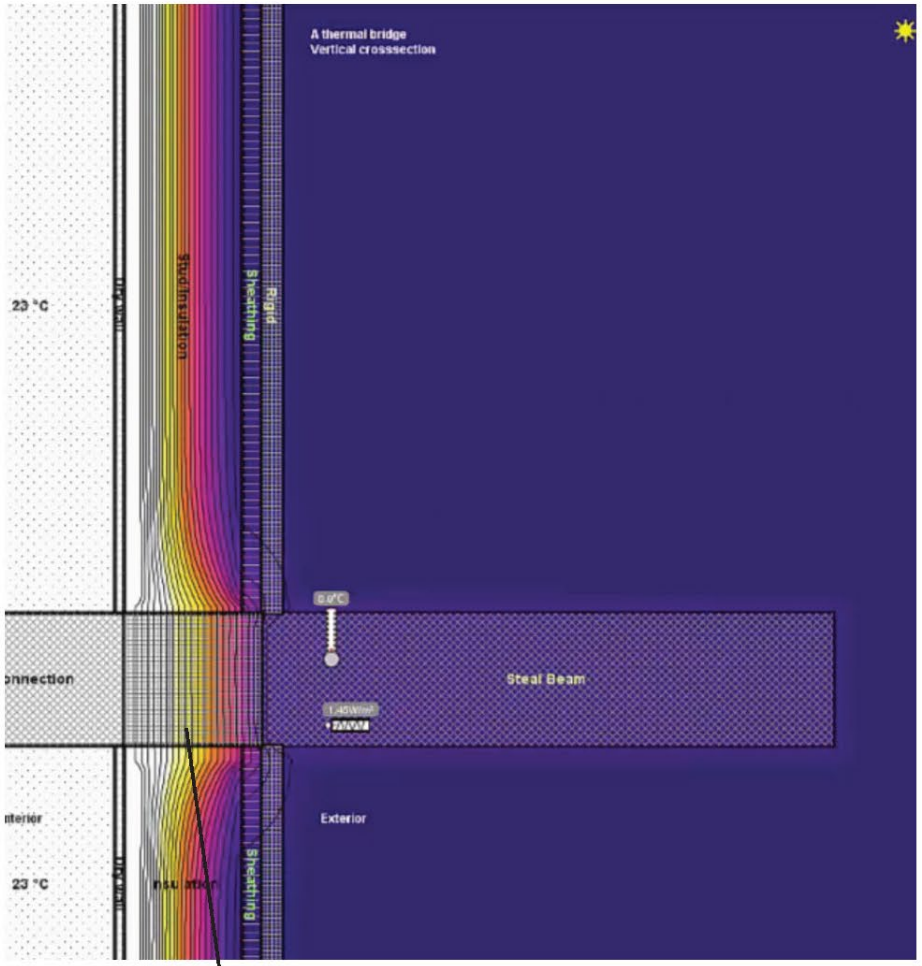
BUILDING ENVELOPE HEAT TRANSFER

FLOW DESIGN - WIND TUNNEL

0 - 4 mins

THERMAL BRIDGING ANALYSIS | Design Comparison - Product: Schock Isokorb





Thermal Bridge

- Structural steel beams easily transfer heat energy from within the building to the exterior of the building envelope.

Schock Isokorb Thermal Break

- Designed to resist the transfer of heat energy and keep HVAC system generated heat energy inside of the building envelope.

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Thermal Break Results:

Estimated Thermal Bridge Impact:

- Thermal break predicted building EUI of **102** kBTU/ft²/yr
- Thermal bridge causes an increase of **5.5 EUI** - bringing the building to **107.5** EUI

Cost Perspective:
To put this EUI increase into perspective, our high level cost analysis estimates structural thermal bridging to cause an increase in utility costs close to $2,700 per year.

Thermal Break Calculations:

Thermal Bridge: estimated loss of **25.4** W/m2 per penetration

Thermal Break: estimated loss of **1.4** W/m2 per penetration

Thermal Difference: estimated **24** W/m2 per penetration

Conversion:

- 24 W/m2 converts to 7.6 BTU/hour-sf²

Calculation of Thermal Bridge Losses:

- Cross Section Area x Loss x Simulation Hours x # of Penetrations
- 0.07 ft2 x 7.6 BTU/hour-sf2 x 1080 hours x 14 penetrations
- 8,044 BTUs lost during simulation hours

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High Performance Glass - Impact Comparison:

Estimated High Performance Glass Impact: Solarban 90 glass with current design

- Predicted building EUI of **102** kBTU/ft²/yr
- With the current window to wall ratios, typical double pane glazing causes an increase of **16 EUI** - bringing the building to **118** EUI

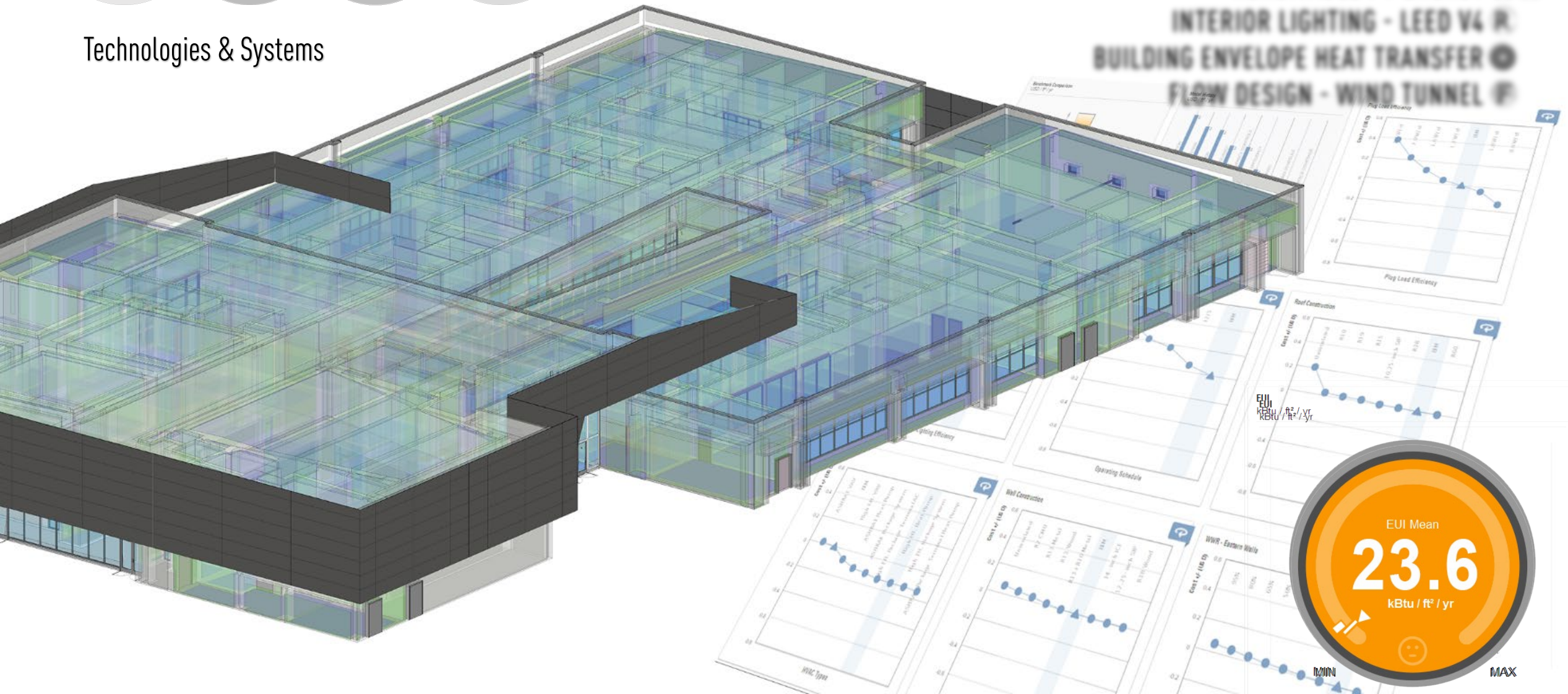
Cost Perspective:
To put this EUI increase into perspective, our high level cost analysis estimates the use of typical double pane glazing to cause an increase in utility costs close to $7,800 per year.

Comparison:
0.98 square feet of thermal bridging causes an increase of 5.5 EUI
1,756 square feet of lower performing glass causes an increase of 16 EUI

Ratios:
Thermal Break - 5.6 EUI per 1.0 square foot
High Performance Glass - 0.009 EUI per 1.0 square foot



Technologies & Systems



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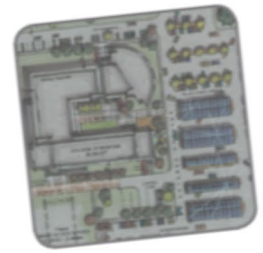
solar

Building Performance Analysis Team

17-0048 CHSU COM

Solar PV Analysis

BPAT@dpsdesign.org







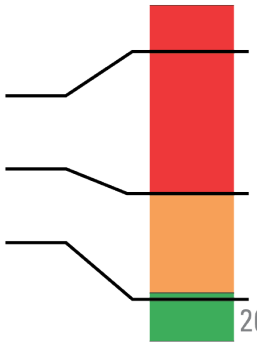
August 11, 2017

14% Roof Coverage - Proposed 2,257 ft²

ZeroTool Baseline EUI: 79.4

Current Revit Model EUI: 41.4

74% Baseline Reduction - EUI: 20.2



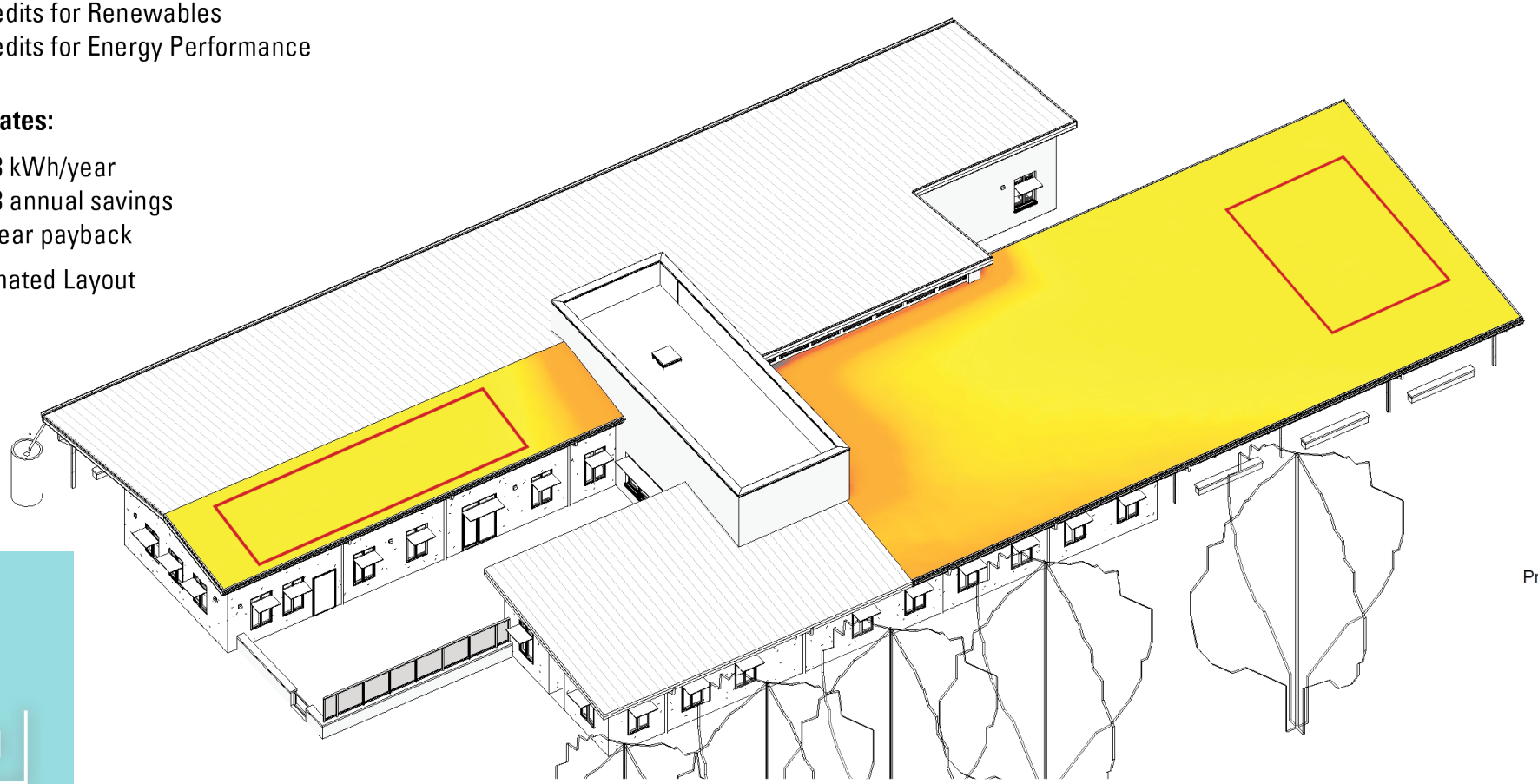
Additional LEED credits:

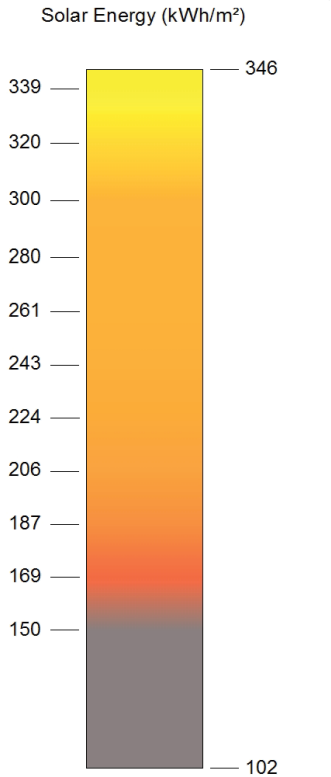
+2 credits for Renewables
+6 credits for Energy Performance

Estimates:

71,843 kWh/year
$7,903 annual savings
11.9 year payback

*Estimated Layout





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Sun study start date time: 1/1/2010 12:00:00
Sun study end date time: 12/31/2010 11:59:0C

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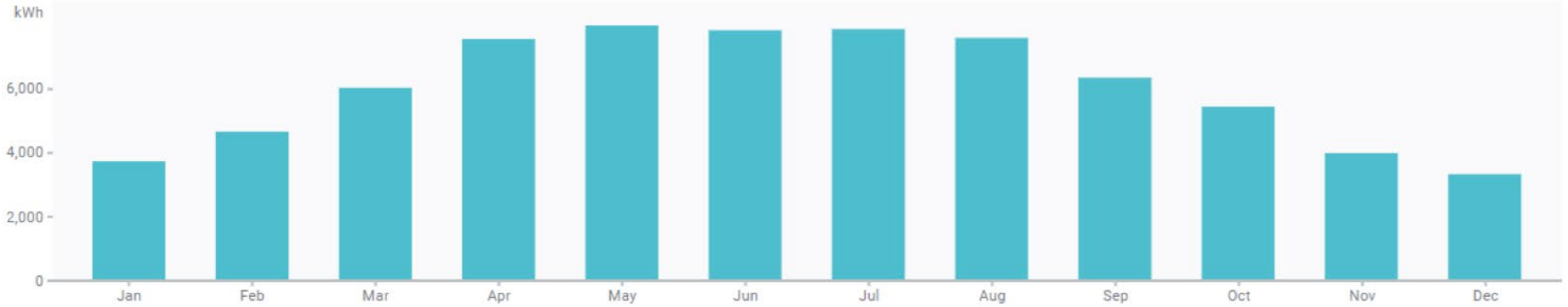
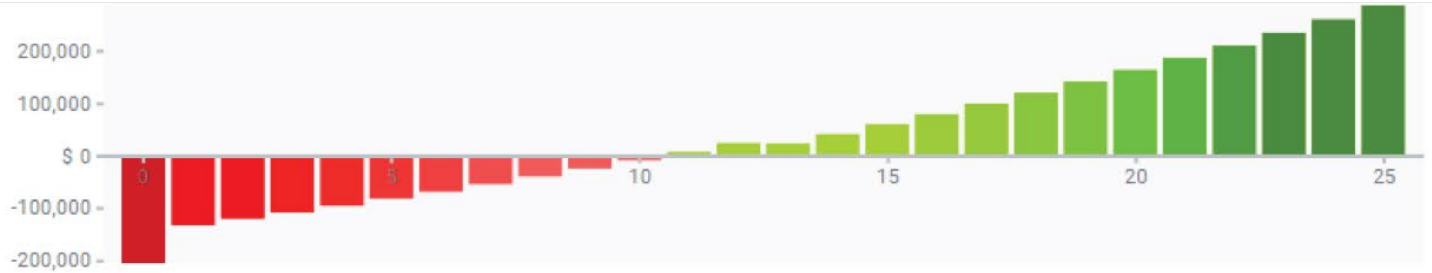
Production (kWh)	Offset (%)	Yield (kWh/kWp)	Performance Ratio
72,457	49	1,594	0.836



System Cost	204,539	$
Cost per Watt	4.5	$/W
NPV	287,736	$
Profitability Index	1.41	
IRR	8.86	%
LCOE	0.096	$/kWh
Payback Period	10.49	years

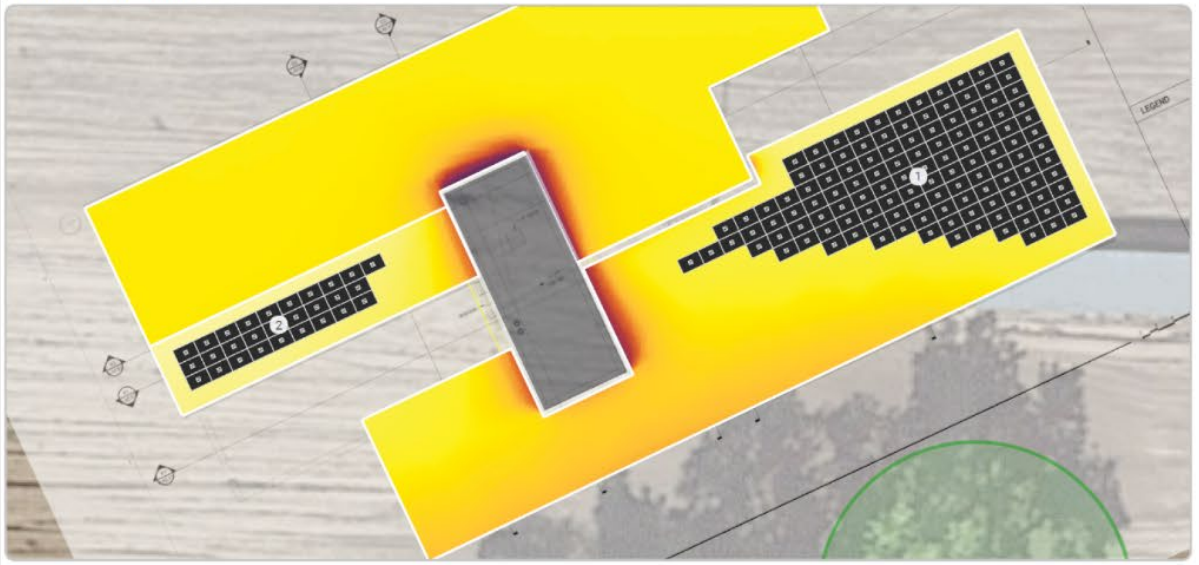


Planting 7,977 trees

Driving 740,678 fewer miles per year

Taking 65 cars off the road

Annual irradiance



kWh/m²/year

2,450 or more
2,100
1,750
1,400
1,050
700
350
0

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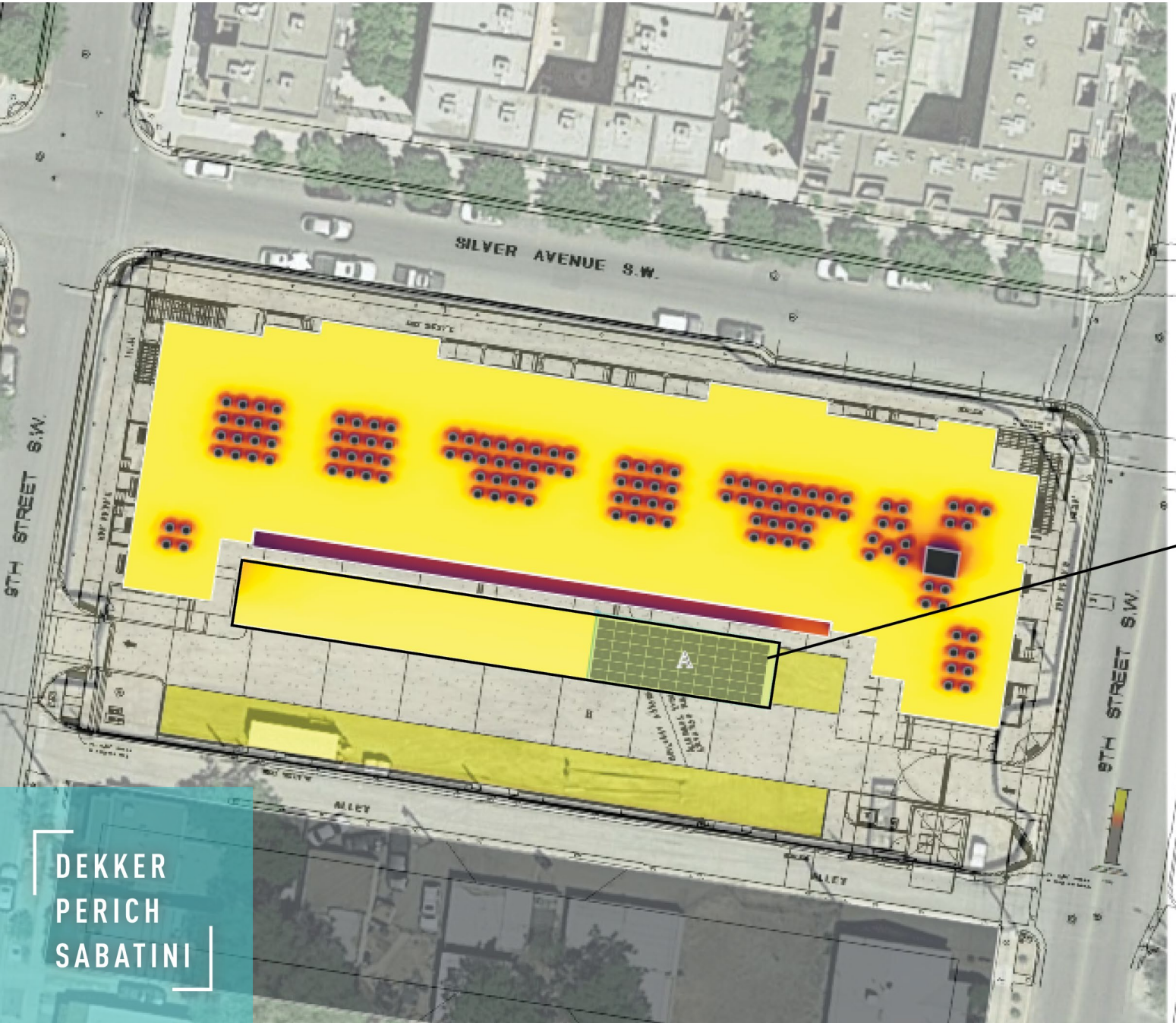
BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R
RENEWABLE PV ENERGY R aurora
INTERIOR LIGHTING - LEED V4 R
BUILDING ENVELOPE HEAT TRANSFER
FLOW DESIGN - WIND TUNNEL F



21.9 kW Design

- designed to meet the requested 20 kW PV system
- positioned for the addition of future PV Modules
- attains a minimum 90% solar access annually

DD CD

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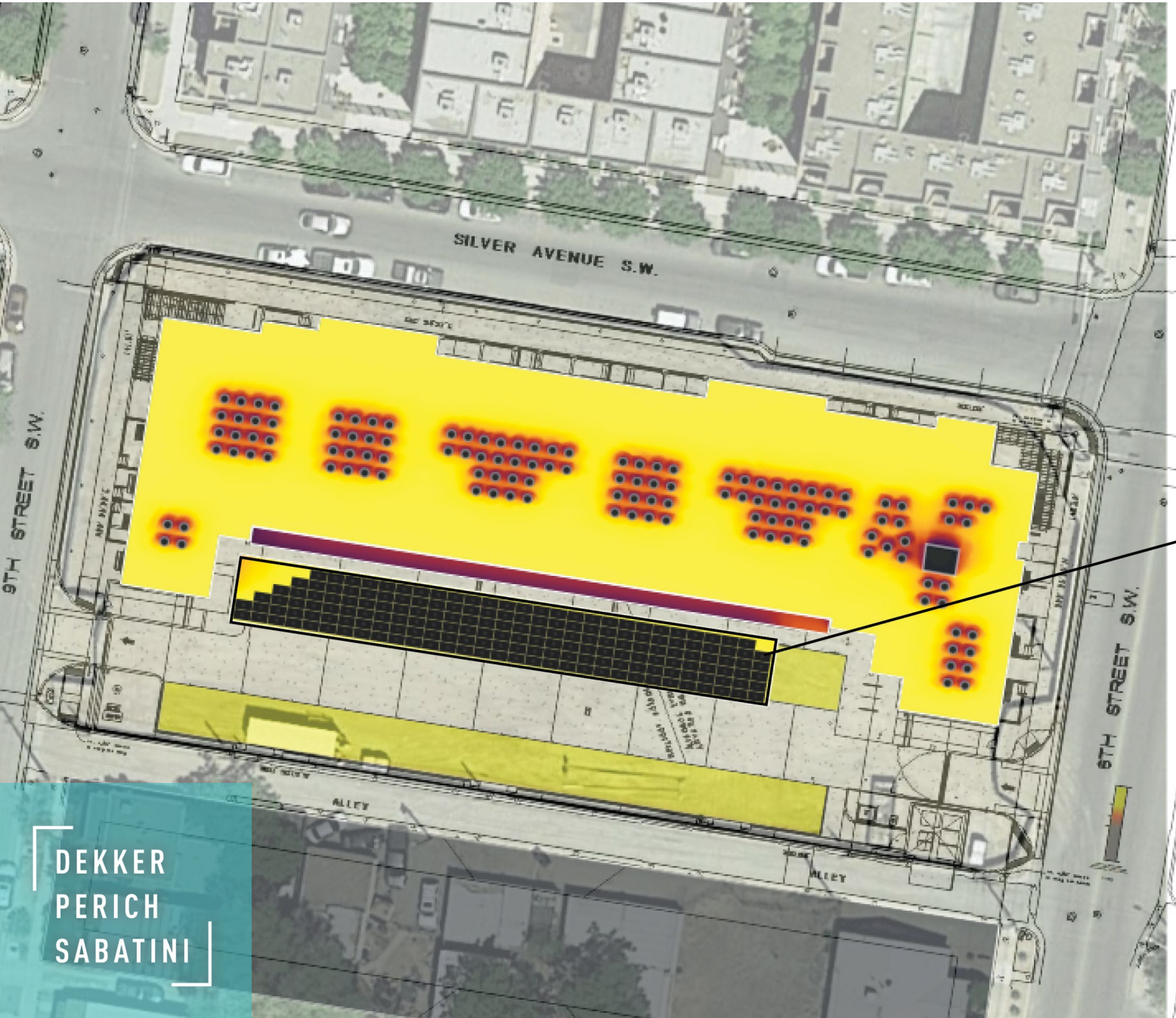
BENCHMARKING EUI I F R
SOLAR INSOLATION R
DAYLIGHT ILLUMINANCE R
SOLAR IRRADIANCE R
RENEWABLE PV ENERGY R aurora
INTERIOR LIGHTING - LEED V4 R
BUILDING ENVELOPE HEAT TRANSFER
FLOW DESIGN - WIND TUNNEL F



63.9 kW Design

- designed for the full capacity of carport
- attains a minimum 90% solar access annually

DD CD

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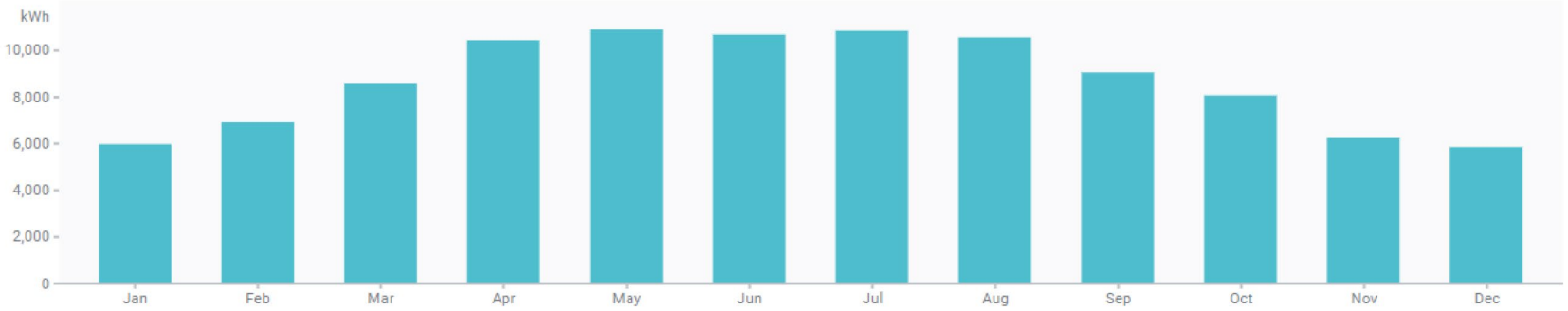
Production (kWh)	Offset (%)	Yield (kWh/kWp)	Performance Ratio
104,142	25	1,630	0.859



Irradiance

2,307 kWh/m2 — Irradiance at optimal tilt/orientation

-7.6% Tilt/Orientation

-6.4% Shade

-2.0% Soiling

0.0% Snow

1,896 kWh/m2 — **-3.0%** Incident angle modifier

DC

121,219 kWh — Energy after PV conversion

-3.9% Environmental conditions

-0.0% Module nameplate rating

-1.5% Light-induced degradation

-0.5% Connections

0.0% Mismatch

111,873 kWh — **-2.0%** DC wiring

AC

107,398 kWh — **-4.0%** DC/AC conversion

107,363 kWh — **-0.0%** Inverter clipping

Other

107,363 kWh — **0.0%** Age

-3.9% System availibility

104,142 kWh — **0.0%** Other

Over the lifetime of your system, you will save **2,047,053 lbs.** of coal

Removing **401** cars from the road per year

Driving **4,537,635** fewer miles per year

Planting **48,867** new trees per year

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21.9 KW PV SYSTEM

Over the lifetime of your system,
you will save **706,080 lbs.** of coal

Removing **138** cars from the road per year

Driving **1,565,144** fewer miles per year

Planting **16,855** new trees per year

55.5 KW PV SYSTEM

Over the lifetime of your system,
you will save **1,778,939 lbs.** of coal

Removing **349** cars from the road per year

Driving **3,943,315** fewer miles per year

Planting **42,466** new trees per year

83.2 KW PV SYSTEM

Over the lifetime of your system,
you will save **2,696,655 lbs.** of coal

Removing **529** cars from the road per year

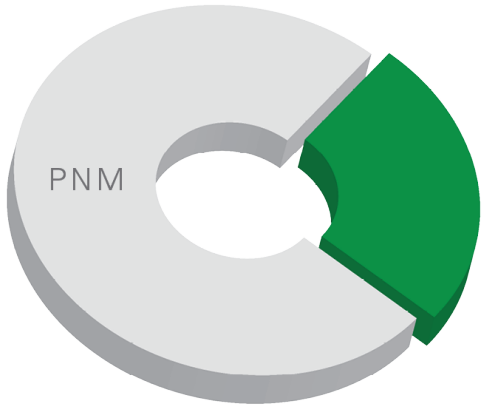
Driving **6,037,019** fewer miles per year

Planting **64,374** new trees per year

Bill savings that start right away:

	Year 1 Monthly Utility Bill Estimate	Year 1 Total Utility Cost Estimate
Without Solar	$4,484	$53,812
With Solar	**$3,081**	**$36,968**

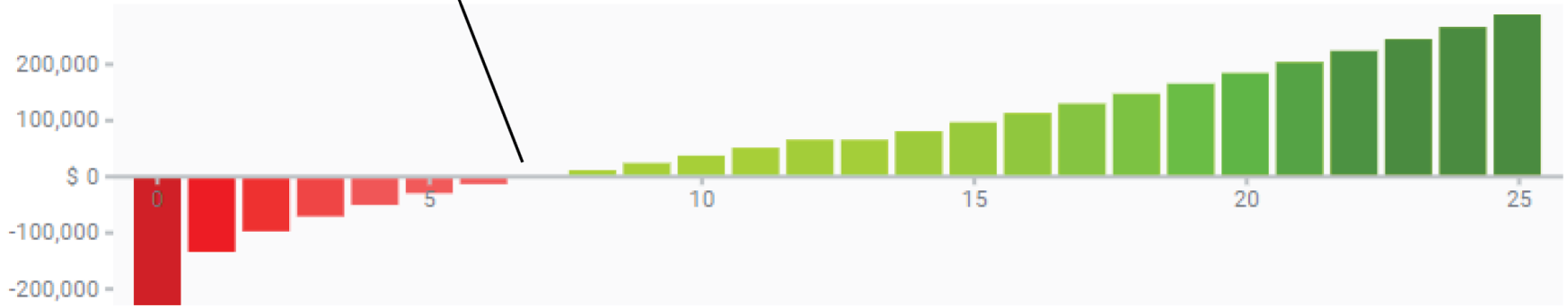
System Cost (Estimate)	$228,673
Cost per Watt	$3.58
Net Present Value	$288,798
Profitability Index	1.26
Internal Rate of Return	10.96%
Payback Period Estimate	**7.09 years**
Solar Module Warranty	**25 years**



Your System Generates

25.28%

of your energy from solar every year



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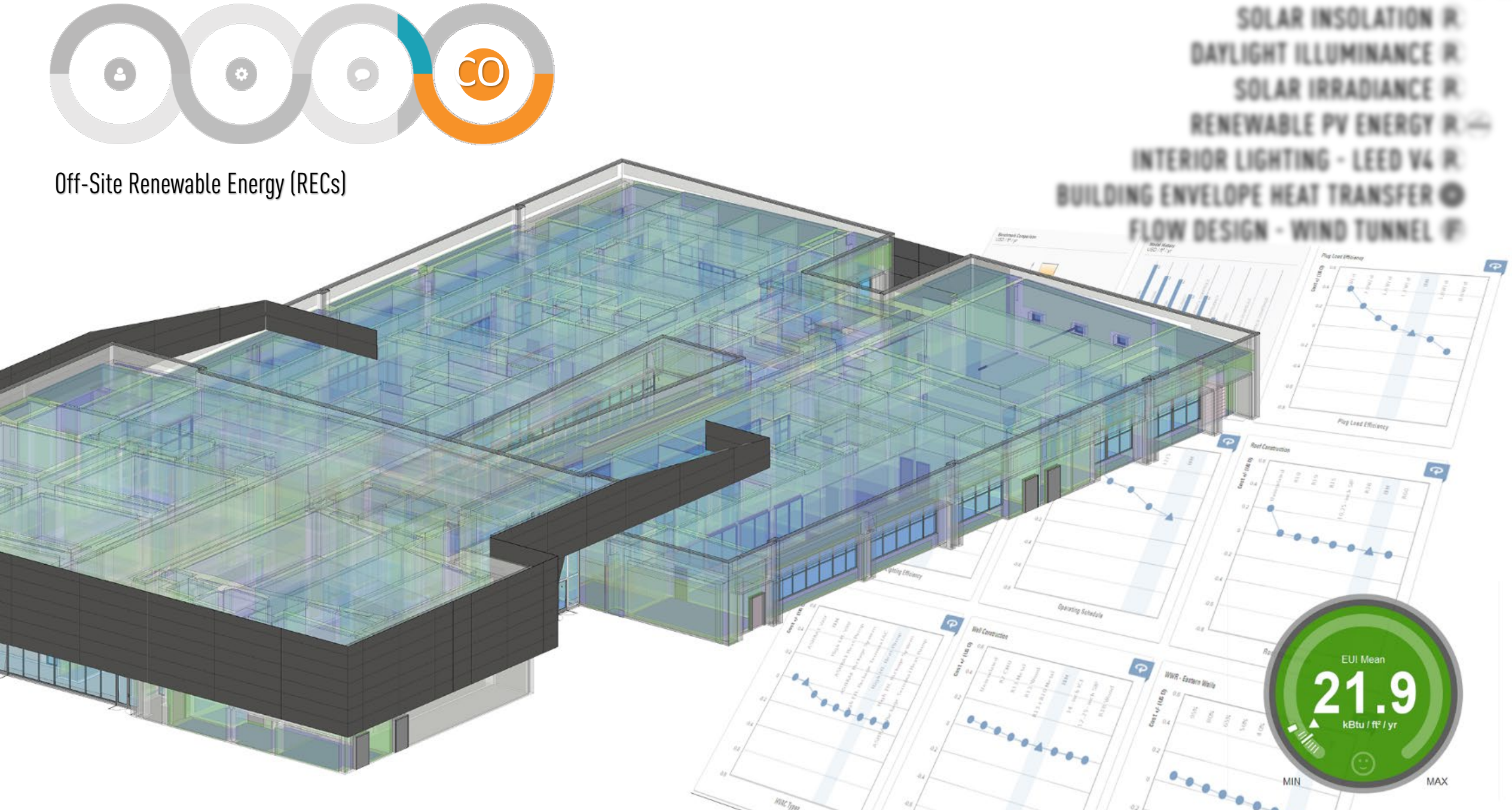

BENCHMARKING EUI
SOLAR INSOLATION
DAYLIGHT ILLUMINANCE
SOLAR IRRADIANCE
RENEWABLE PV ENERGY
INTERIOR LIGHTING - LEED V4
BUILDING ENVELOPE HEAT TRANSFER
FLOW DESIGN - WIND TUNNEL
Off-Site Renewable Energy (RECs)
EUI Mean
21.9
kBtu / ft² / yr
MIN
MAX

D/P/S BPAT Designed PV Systems Total Environmental Impact

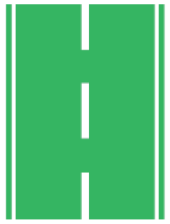
Over the lifetime of the designed systems,

68,800,000 lbs.

of coal will be saved



Removing **13,500** cars from the road



Driving **152,500,000** fewer miles per year



Planting **1,640,000** new trees

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As of 11/2018...

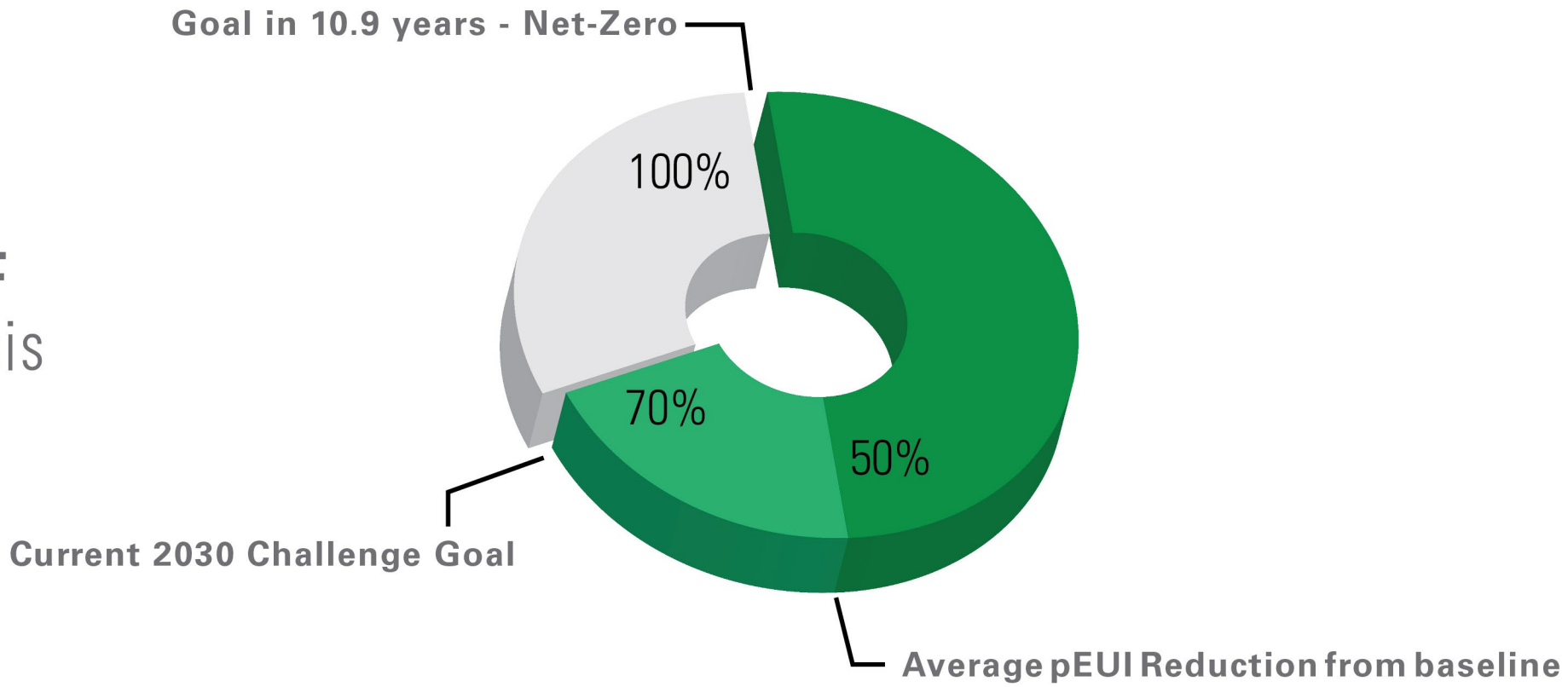
2 MW designed at a total of 97,000 sqft

architecture 2030

D/P/S Energy Reduction Progress

After 3 years...

3.2 million SF
of reported analysis



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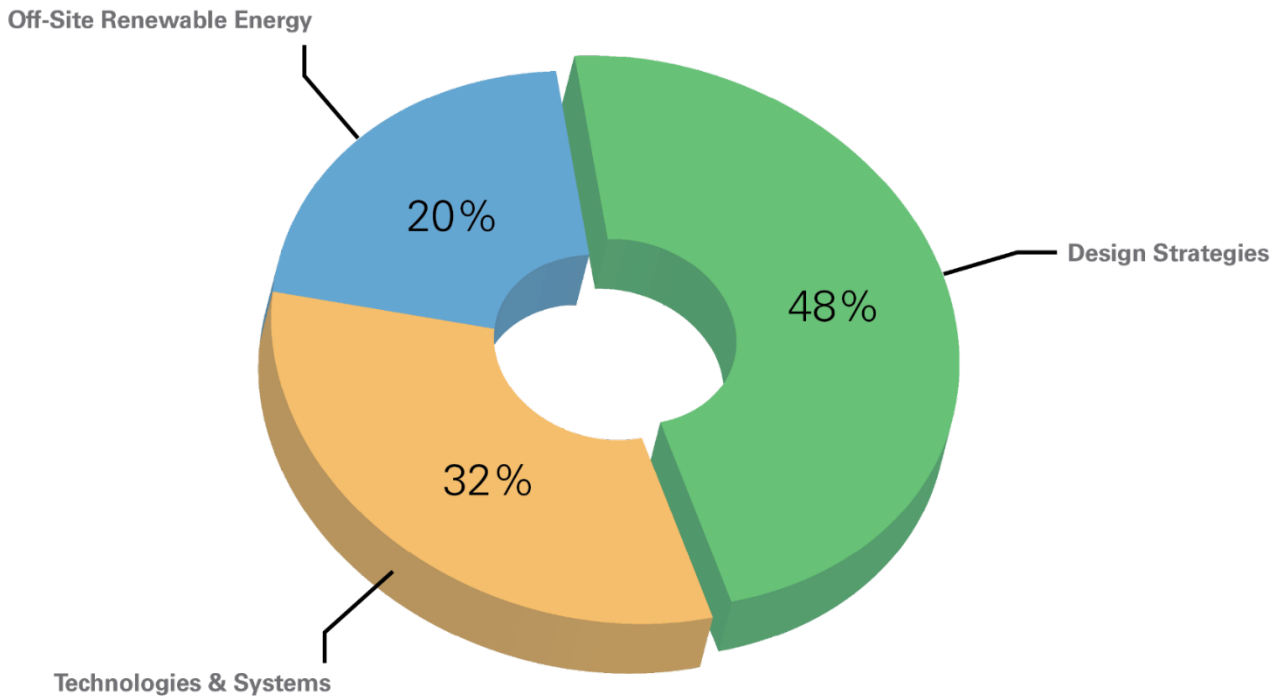
Average Strategy Breakdown



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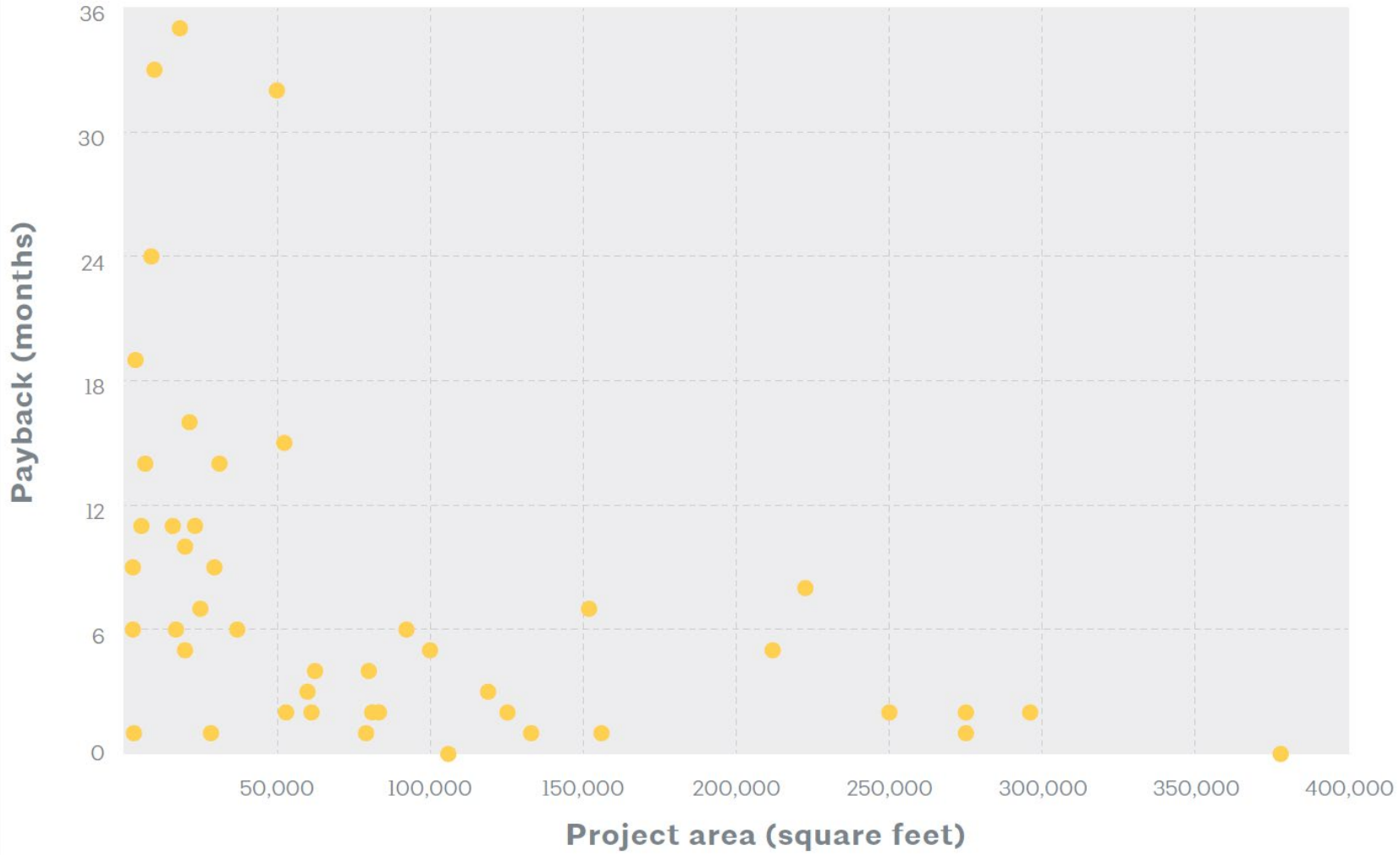
Savings is Money - Return on BPAT Time



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CASE STUDY | ARTESIA ADMINISTRATION AND TRAINING CENTER

EUI ANALYSIS
SOLAR ANALYSIS

DEKKER
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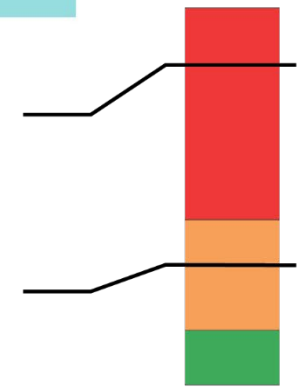
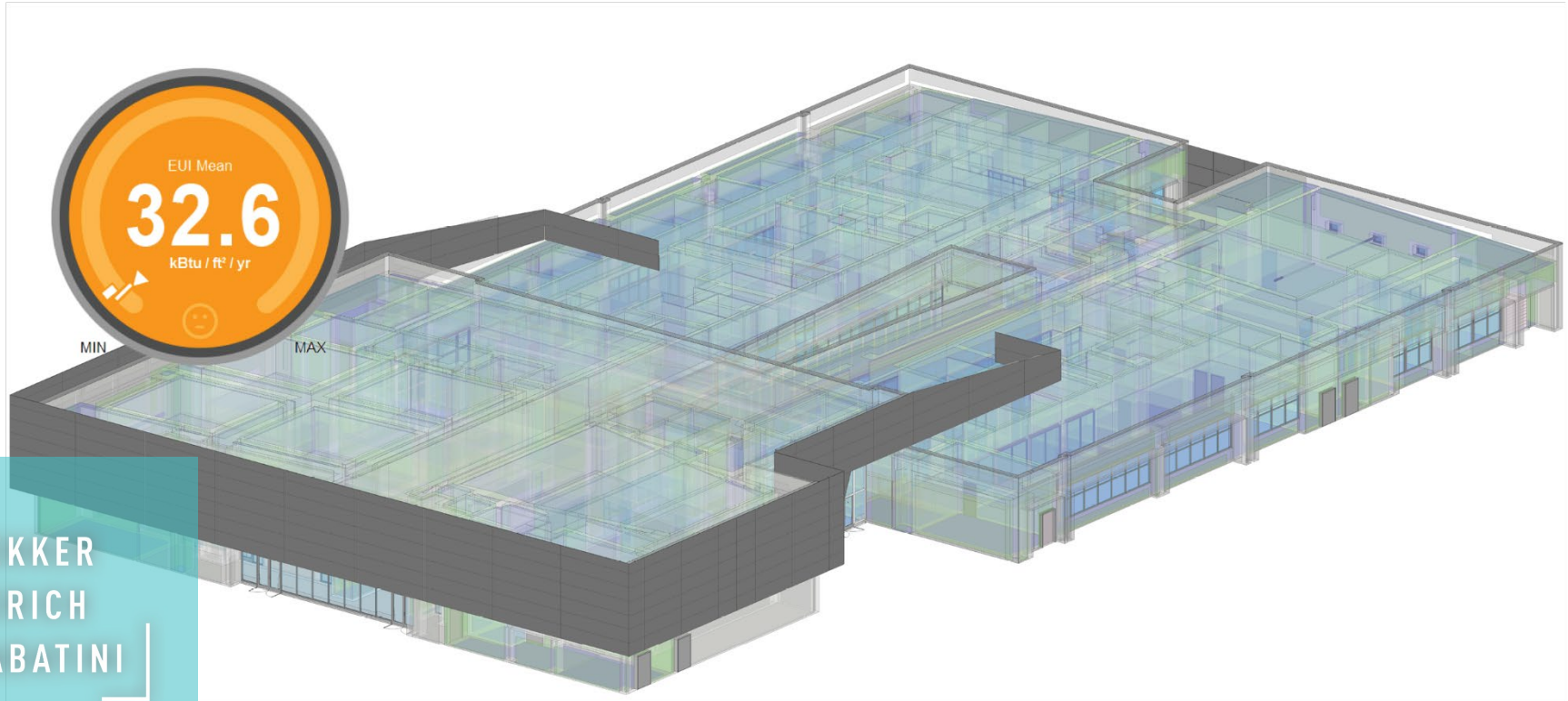
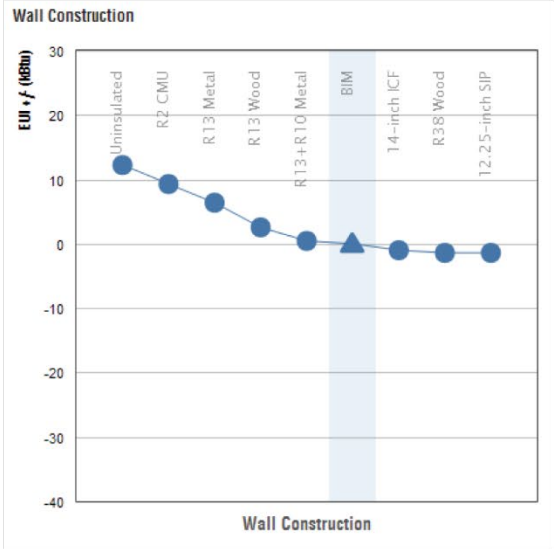
Design Strategies

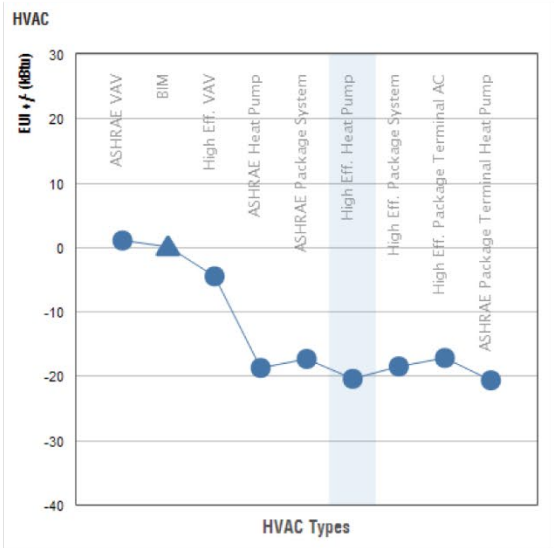
ZeroTool Baseline EUI: 76

57.1% Baseline Reduction - EUI: 32.6









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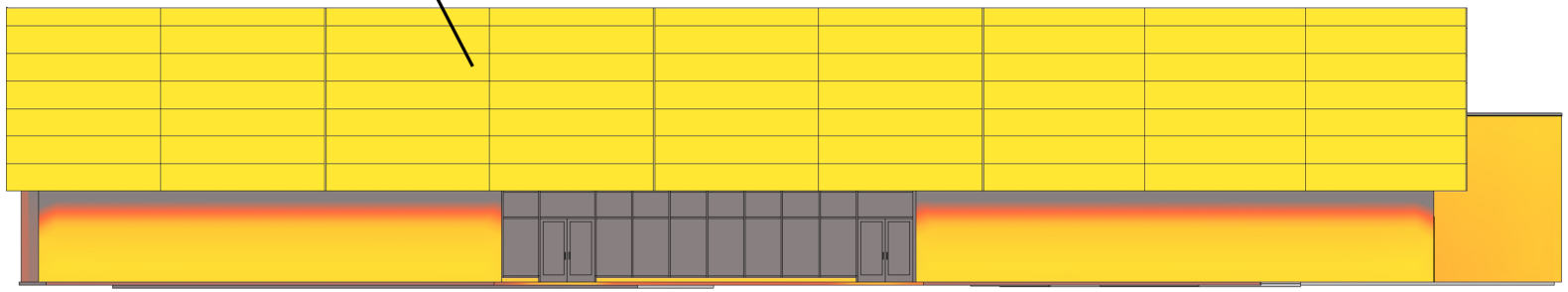
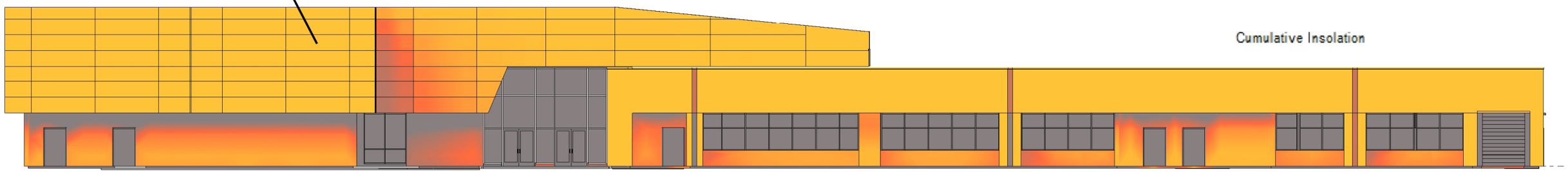
Building Shade



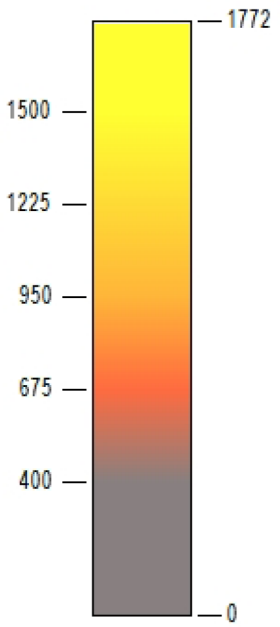
West Elevation

Building Shade



South Elevation

Solar Energy (kWh/m²)



Project location: 32.8440704345703,-104.397552490234
Sun study start date time: 1/1/2010 12:00:00 AM
Sun study end date time: 12/31/2010 11:59:00 PM

Cumulative Insolation



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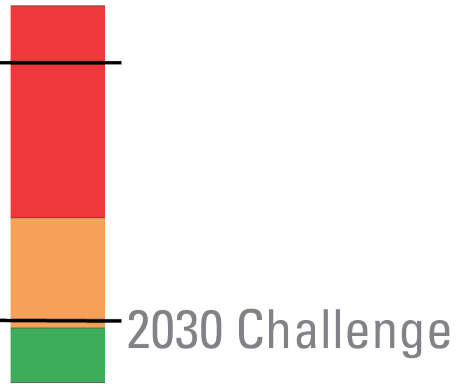
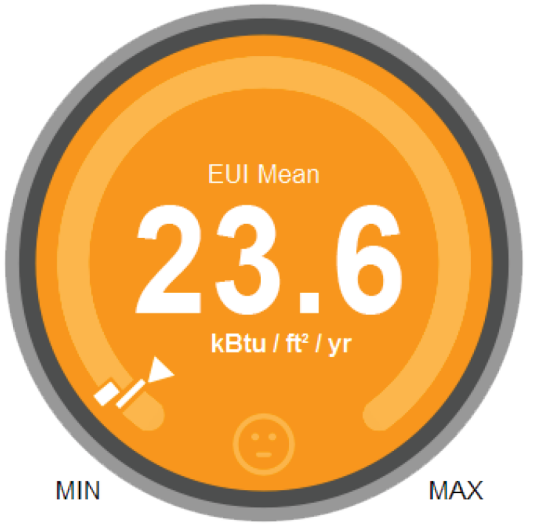
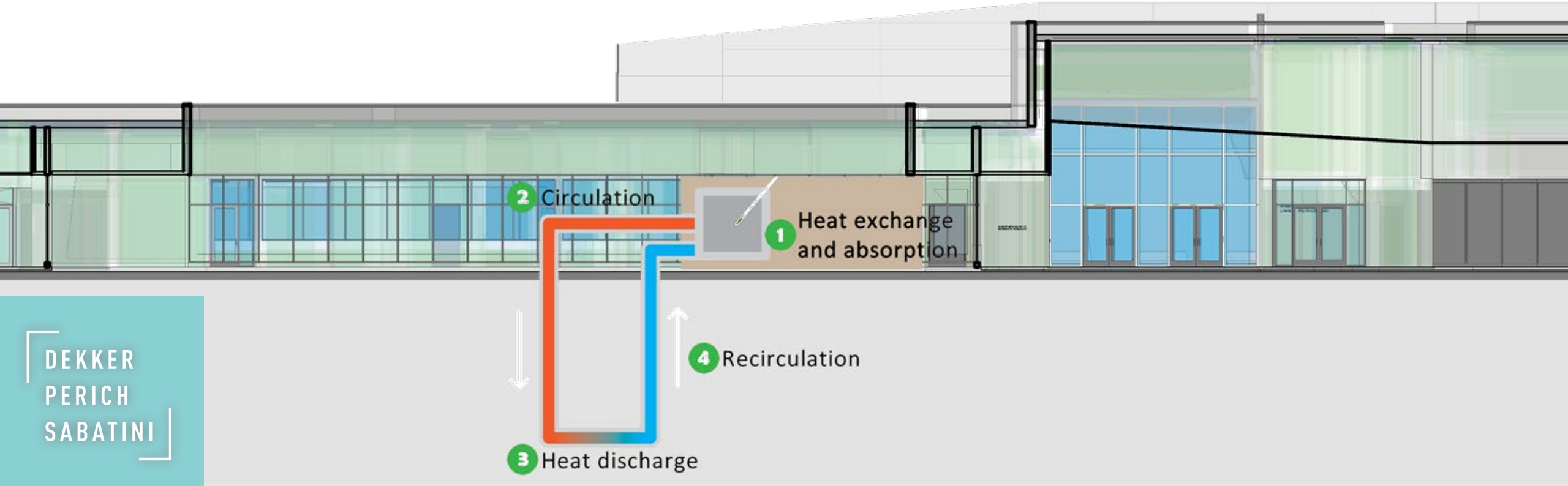
Technologies & Systems

ZeroTool Baseline EUI: 76

69.4% Baseline Reduction - EUI: 23.6







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Technologies & Systems

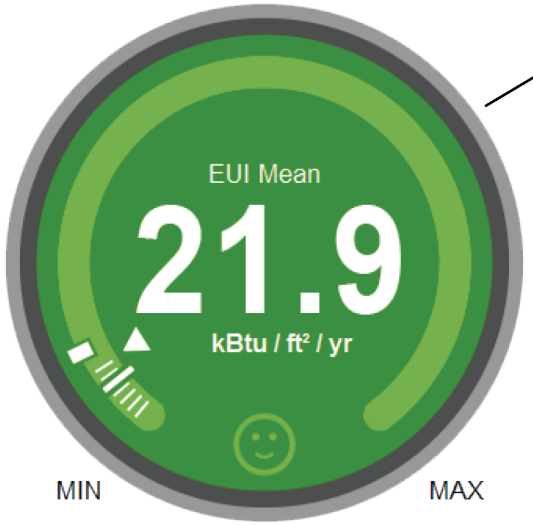
ZeroTool Baseline EUI: 76

71.2% Baseline Reduction - EUI: 21.9



2030 Challenge

Post-Solar Design



2030 Challenge - 11.7 kW Design

- covers two parking spaces
- designed to meet the required 9.5 kW PV system
- positioned for the addition of future PV Modules
- attains a minimum 95% solar access annually
- estimated payback period of 7 years

2 parking space carport:
70% reduction in fossil fuel energy
11.7 kW system

Environmental Impacts - 11.7 kW

Over the lifetime of your system,
you will save **387,560 lbs.** of coal

Removing **76** cars from the road per year

Driving **859,091** fewer miles per year

Planting **9,252** new trees per year

28 parking space carport:
Net-Zero & Carbon-Neutrality / 100% reduction
75.2 kW system.

POST OCCUPANCY VALIDATION | ARTESIA RESULTS

2018 BUILDING UTILITY BILLS

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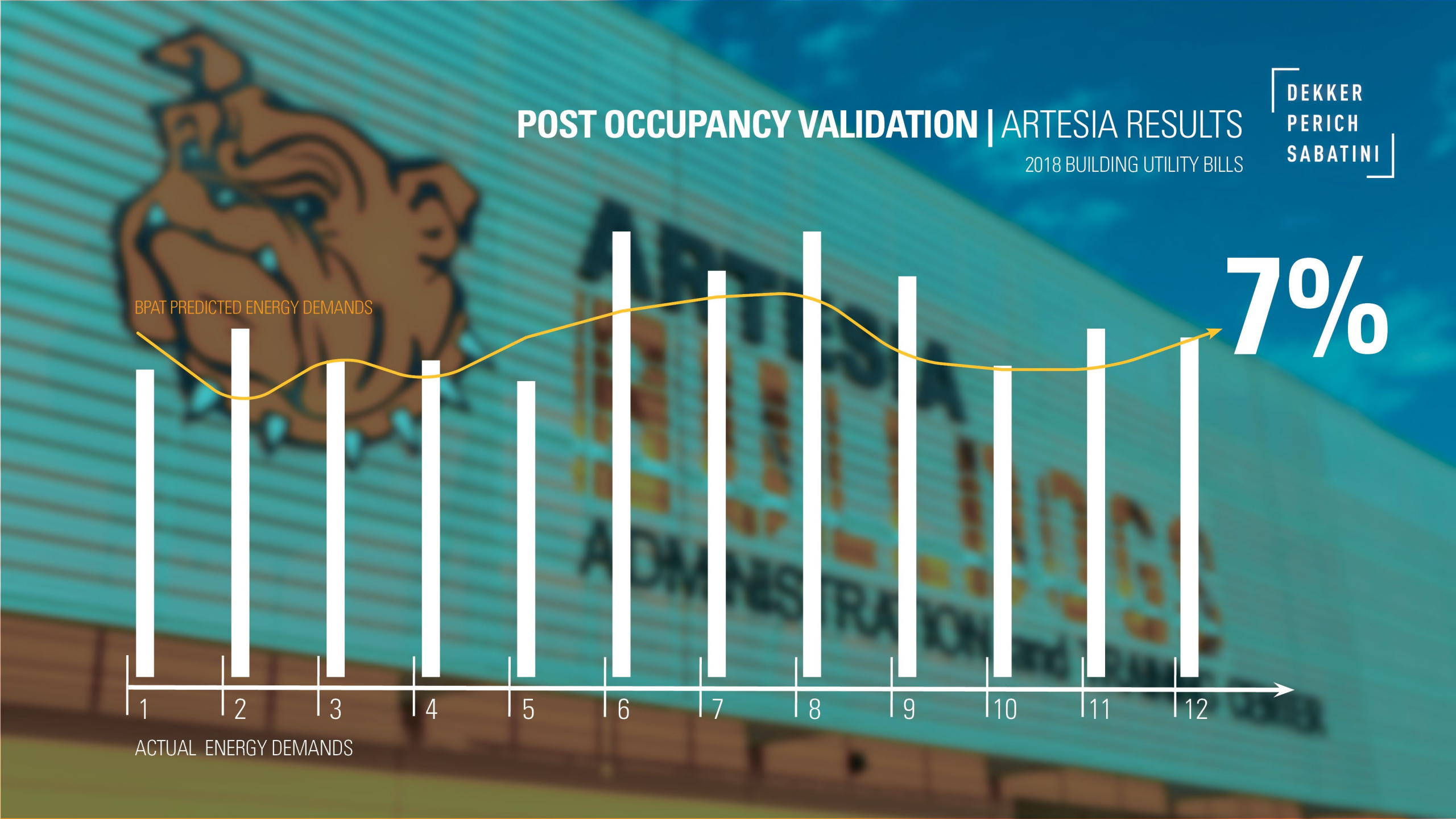
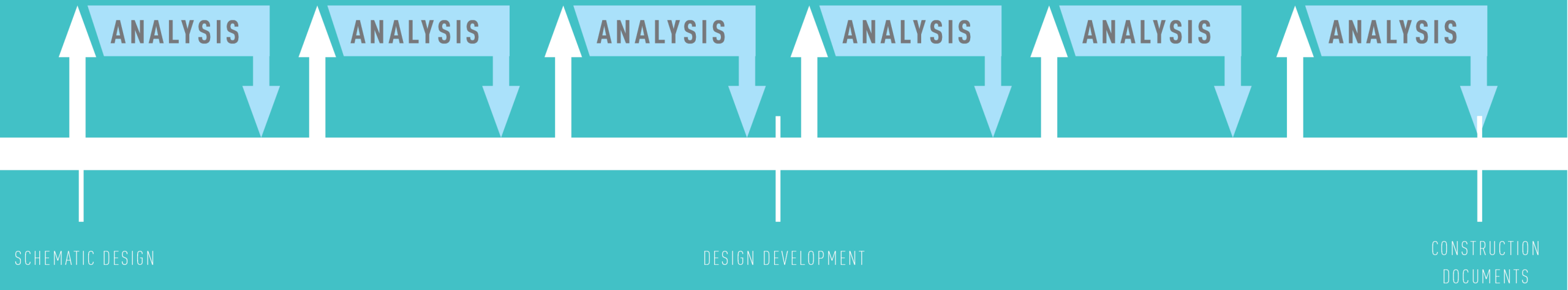


ANALYSIS AS ITERATIVE DESIGN PROCESS



SCHEMATIC DESIGN

DESIGN DEVELOPMENT

CONSTRUCTION DOCUMENTS

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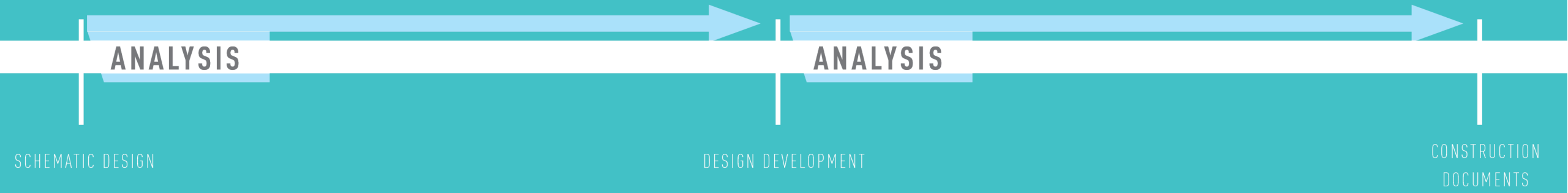
ANALYSIS AS DESIGN PROCESS



SCHEMATIC DESIGN

DESIGN DEVELOPMENT

CONSTRUCTION DOCUMENTS

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Key Take Aways

Differences between Architecture 2030 and AIA+2030

Aware of analysis capabilities and tools

Help spread building performance awareness

Develop standards for communication and conveying information

Develop deliverables for clients and design team

Join the Architecture 2030 global initiative

Begin your firm's commitment to the AIA 2030

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FOR MORE VISIT: *DPSDESIGN.ORG/BLOG*

THANK YOU
AARON KETNER

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