Greening Your Buildings by Implementing Performance Simulations in Early Design

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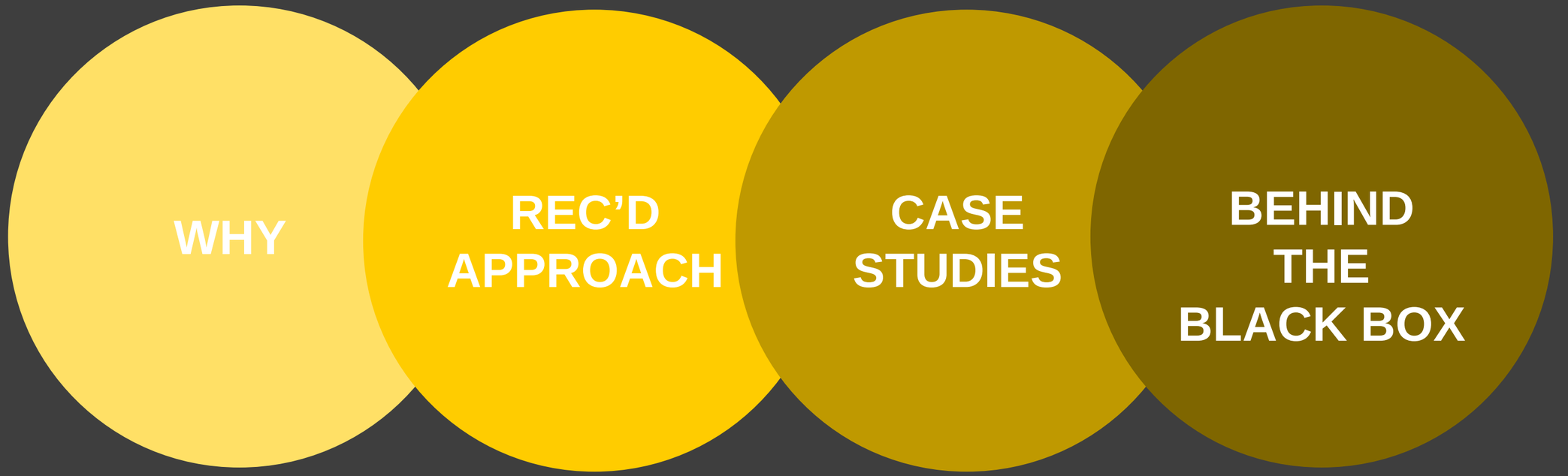
Class summary

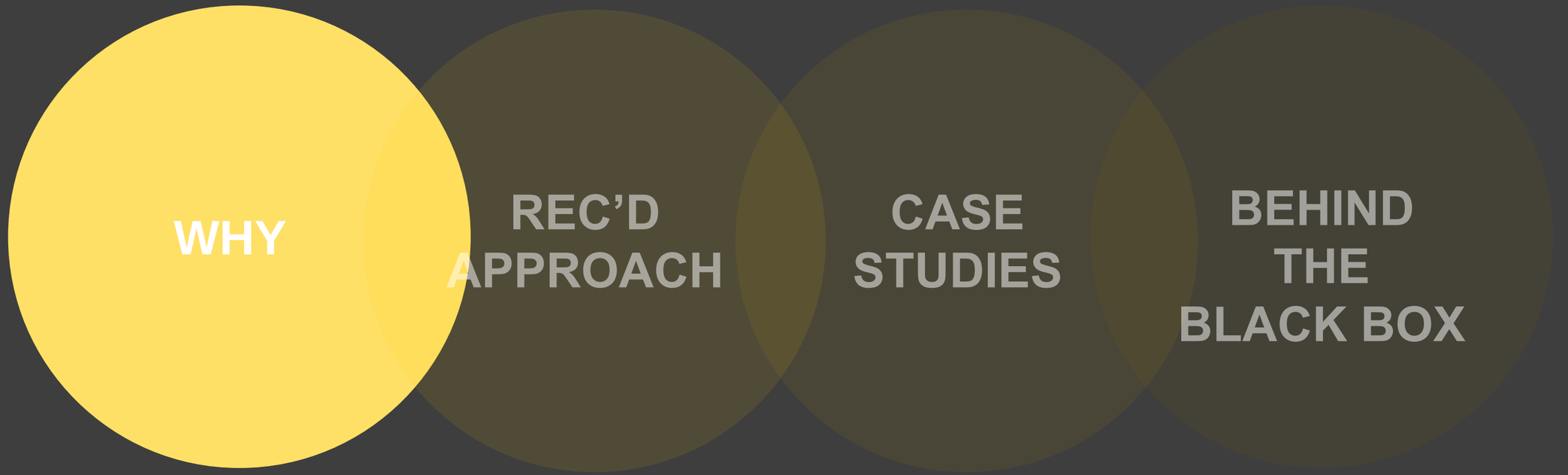
Early design analysis and assessment will be the most significant factors in the future to design high-performance building. New high-performance building design workflows are making analysis tools more accessible and easier to use earlier in the design process than ever before.

Analysis tools can go a long way toward informing design decisions, saving time, and improving the usefulness and validity of your design.

Key learning objectives

- At the end of this class, you will be able to:
  - Discover different building performance analysis workflows and their applications
  - Learn how to apply building performance analysis workflows to design projects
  - Learn how to use early analysis data to impact design decisions to reduce building-energy use
  - Learn best practice tips for using conceptual analysis tools to yield actionable results


WHY
REC'D APPROACH
CASE STUDIES
BEHIND THE BLACK BOX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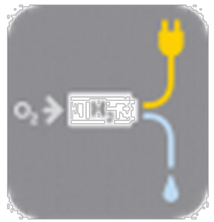
STRATEGIES TO IMPROVE ENERGY EFFICIENCY

BETTER BUILDING TECHNOLOGIES

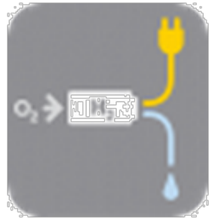


STRATEGIES TO IMPROVE ENERGY EFFICIENCY

BETTER BUILDING TECHNOLOGIES



BETTER DESIGN PROCESS

Initial Design Charrette → Pre/Concept Design → Schematic Design → Design Development → Construction Documents

Pressroom

Industry Experts Agree Energy Modeling is Key to Reaching Carbon Neutrality in Buildings

AIA data shows current scarcity of design projects meet carbon reduction targets

Contact: Scott Frank
202-626-7467
sfrank@aia.org

For immediate release:

Washington, D.C. – November 18, 2015 – There has been an increase in the number of design projects, gross square footage and net-zero energy projects that have been reported as part of the American Institute of Architects 2030 Commitment. Those positive steps on the path to reaching carbon neutral buildings by the year 2030 are countered, however, by a small percentage of projects that met the 60 percent carbon reduction target for 2014.

LEED V4 Rating Systems

Perform a preliminary “simple box” energy modeling analysis…

What are the benefits?

15%

ENERGY USAGE

OPERATION COST

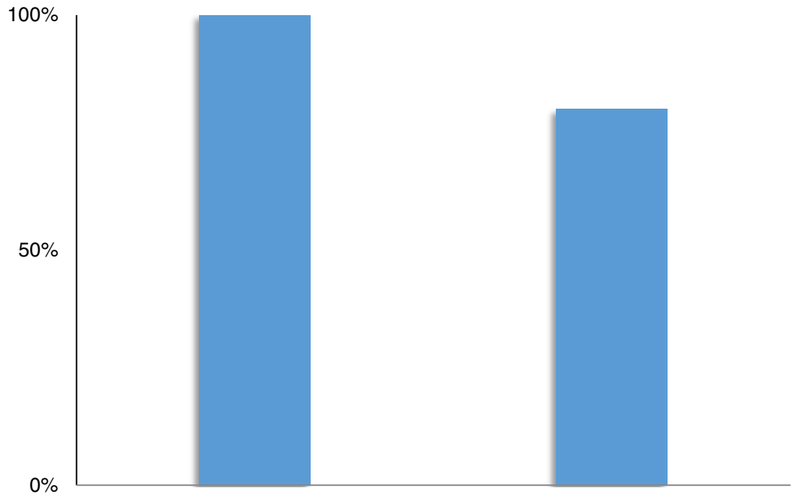
15%

ENERGY USAGE

OPERATION COST

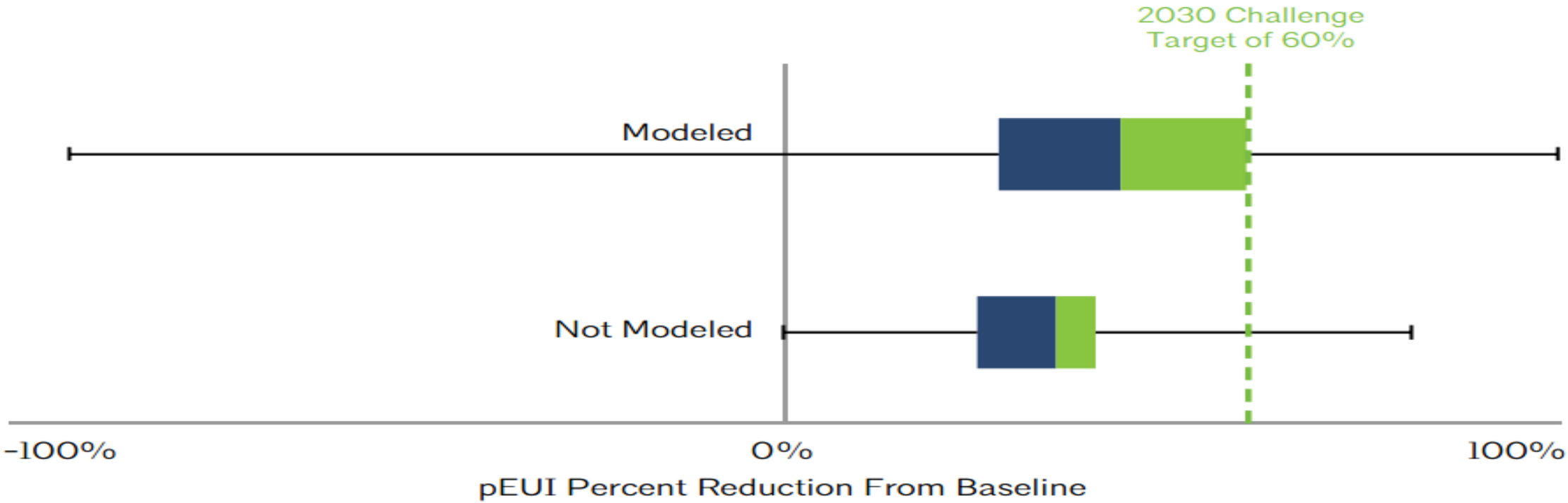
20%

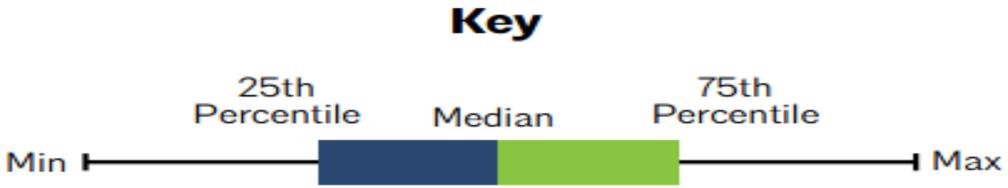
PEAK LOAD



INITIAL COST

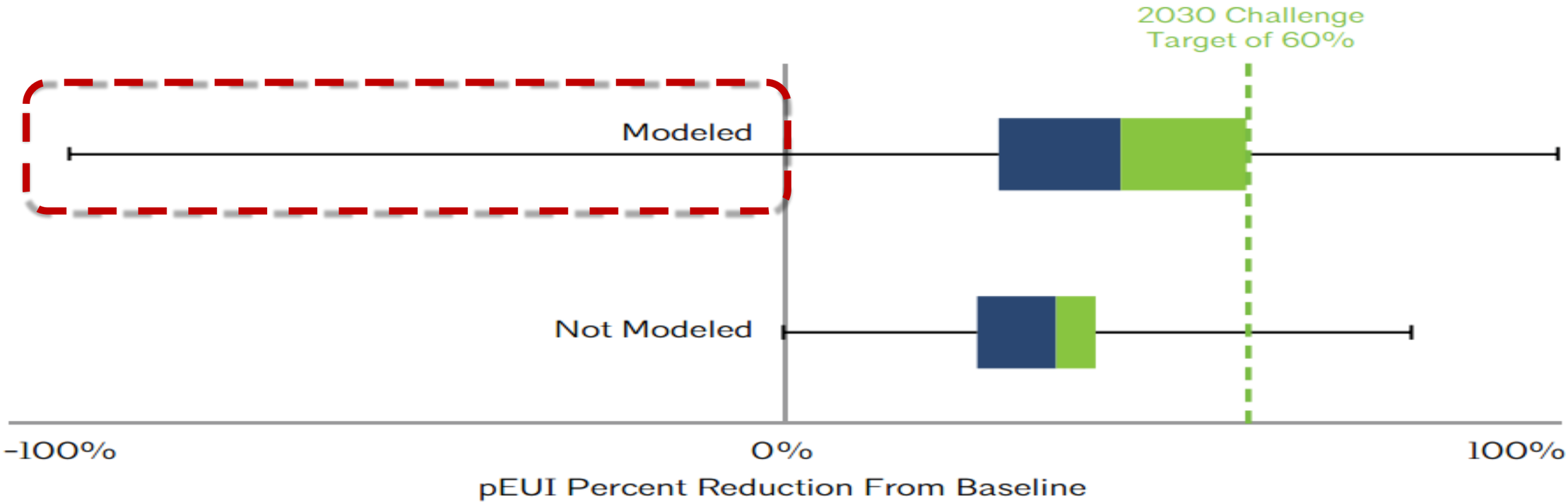
pEUI Reduction Modeled and Nonmodeled

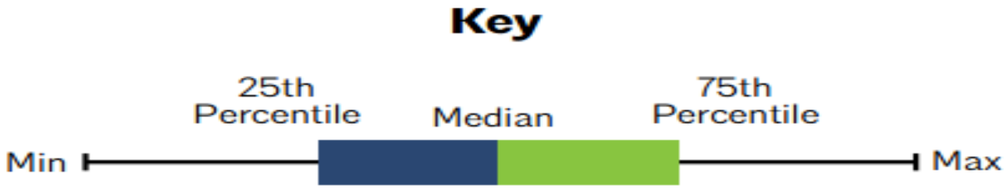




Source: AIA 2030 Commitment – 2014 Progress Report

pEUI Reduction Modeled and Nonmodeled





Source: AIA 2030 Commitment – 2014 Progress Report

Accuracy in Energy Modeling

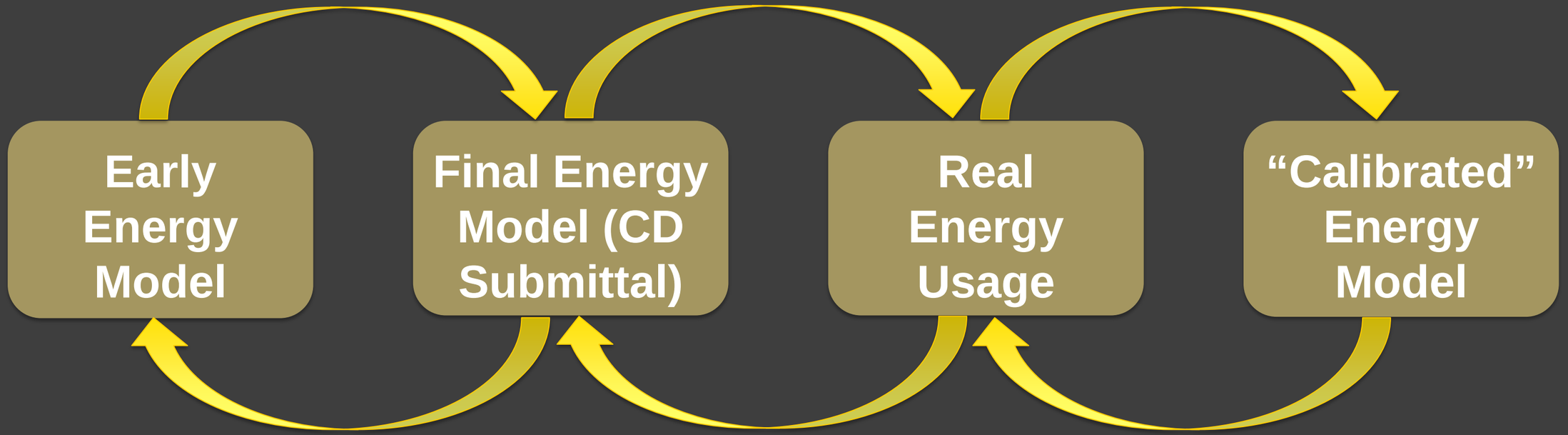
Early Energy Model

Final Energy Model (CD Submittal)

Real Energy Usage

“Calibrated” Energy Model

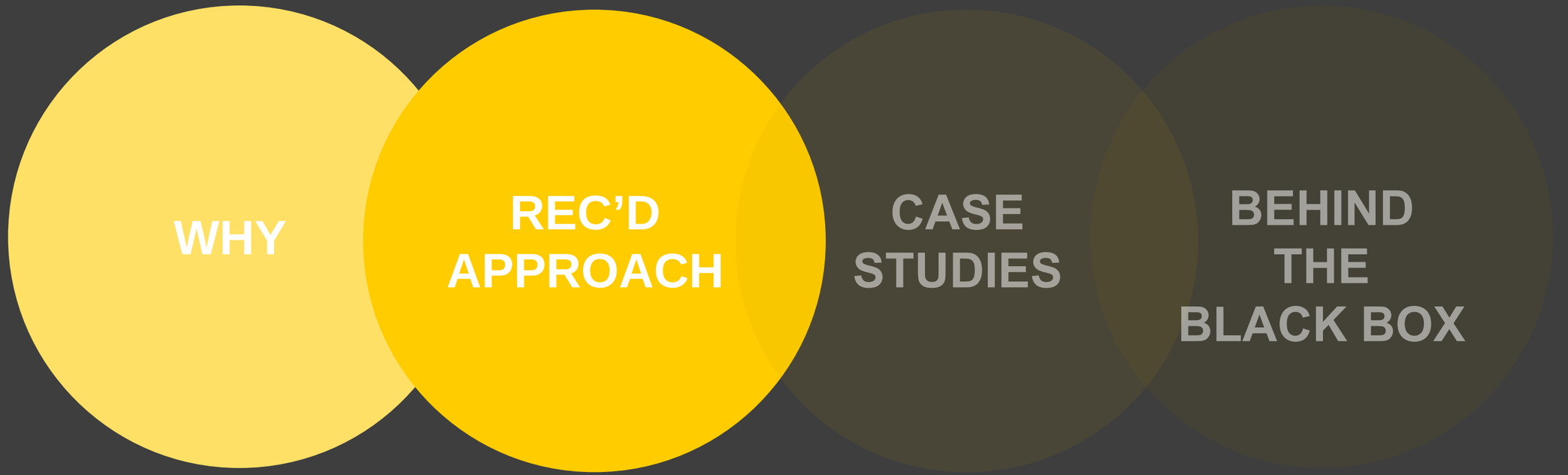
Accuracy in Energy Modeling (20-20-10 Rule)



+/- 20% Compared to the Baseline Compliance

+/- 20% Compared to the Baseline Compliance

+/- 10% Compared to the Baseline Compliance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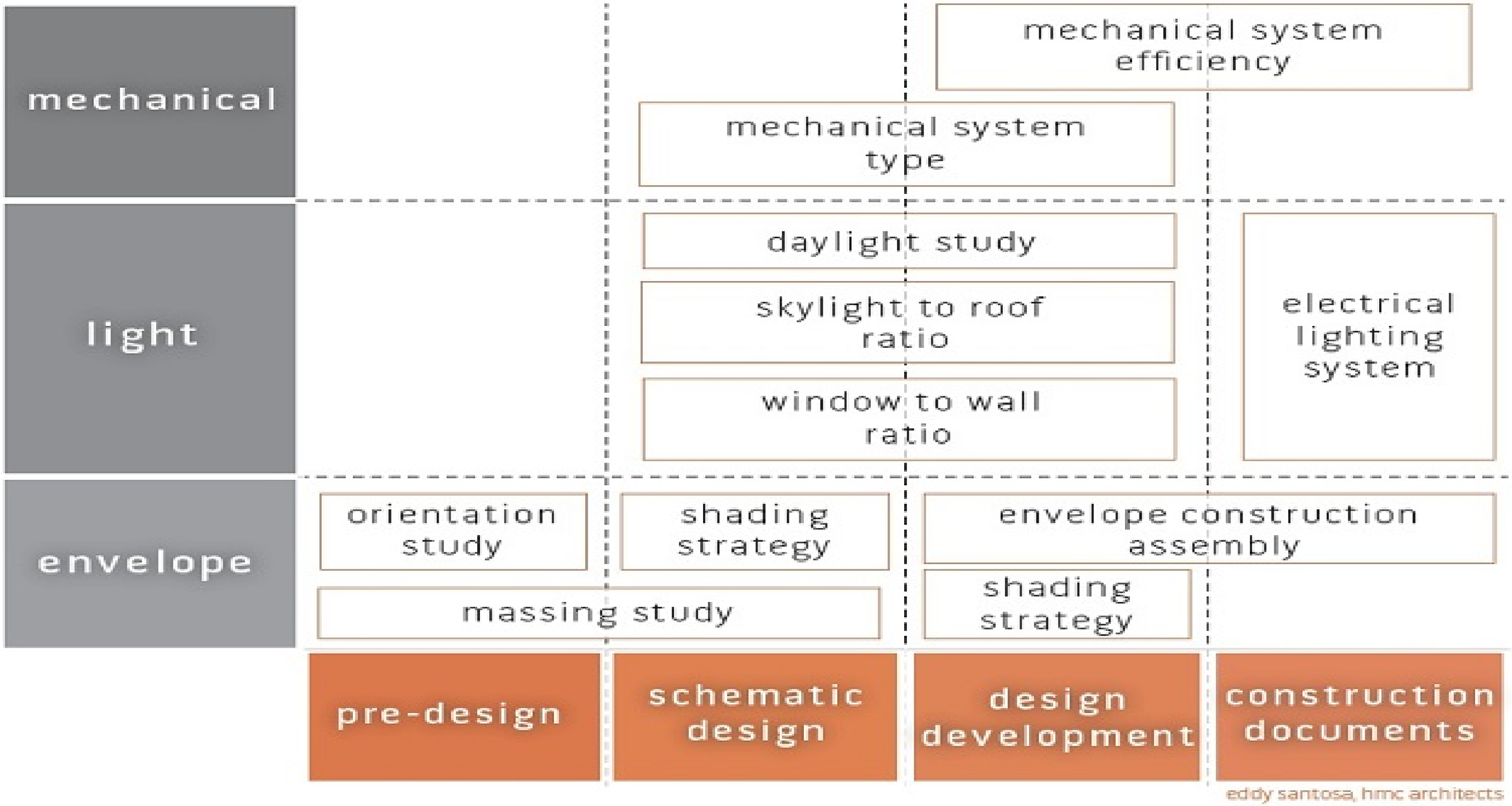
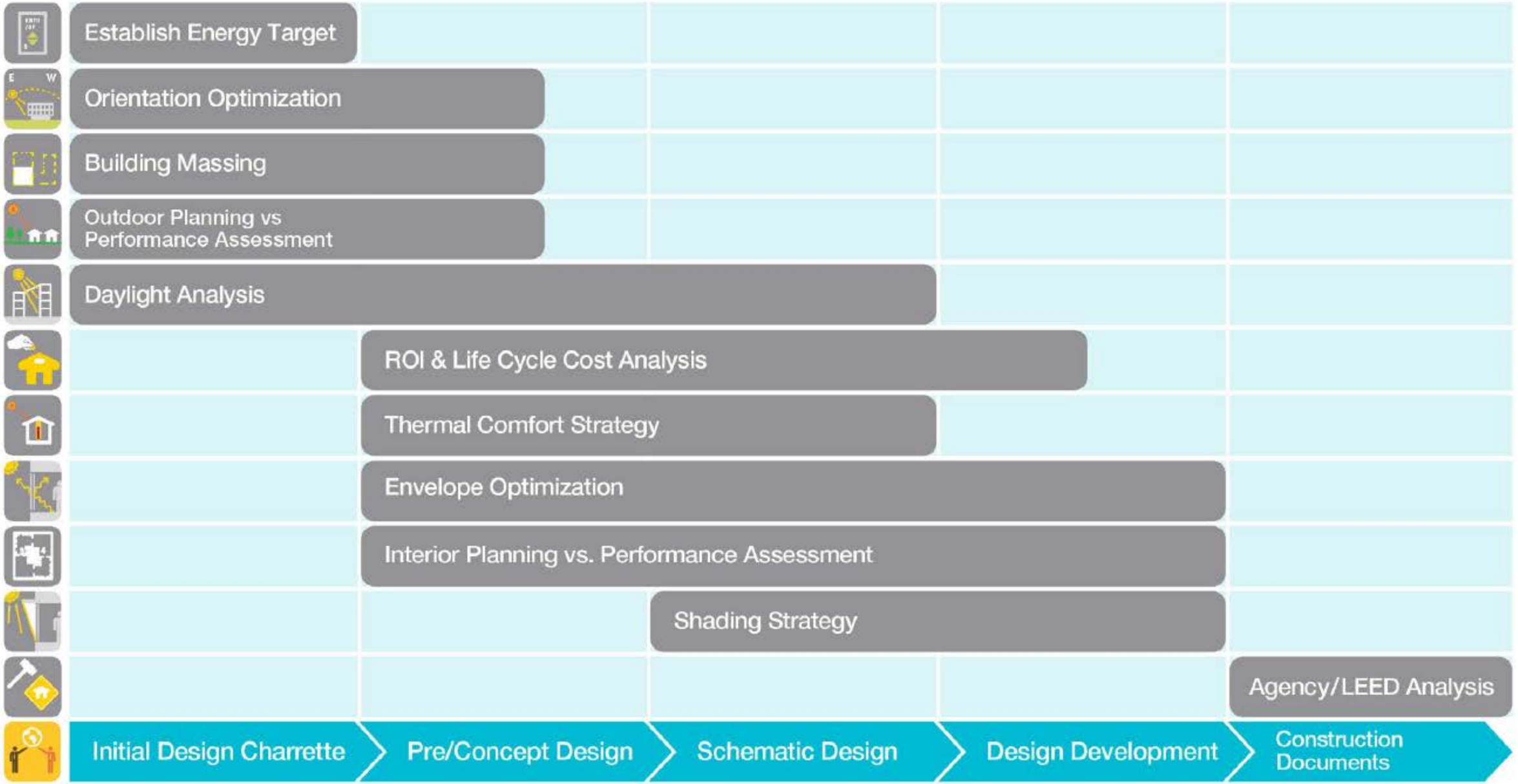
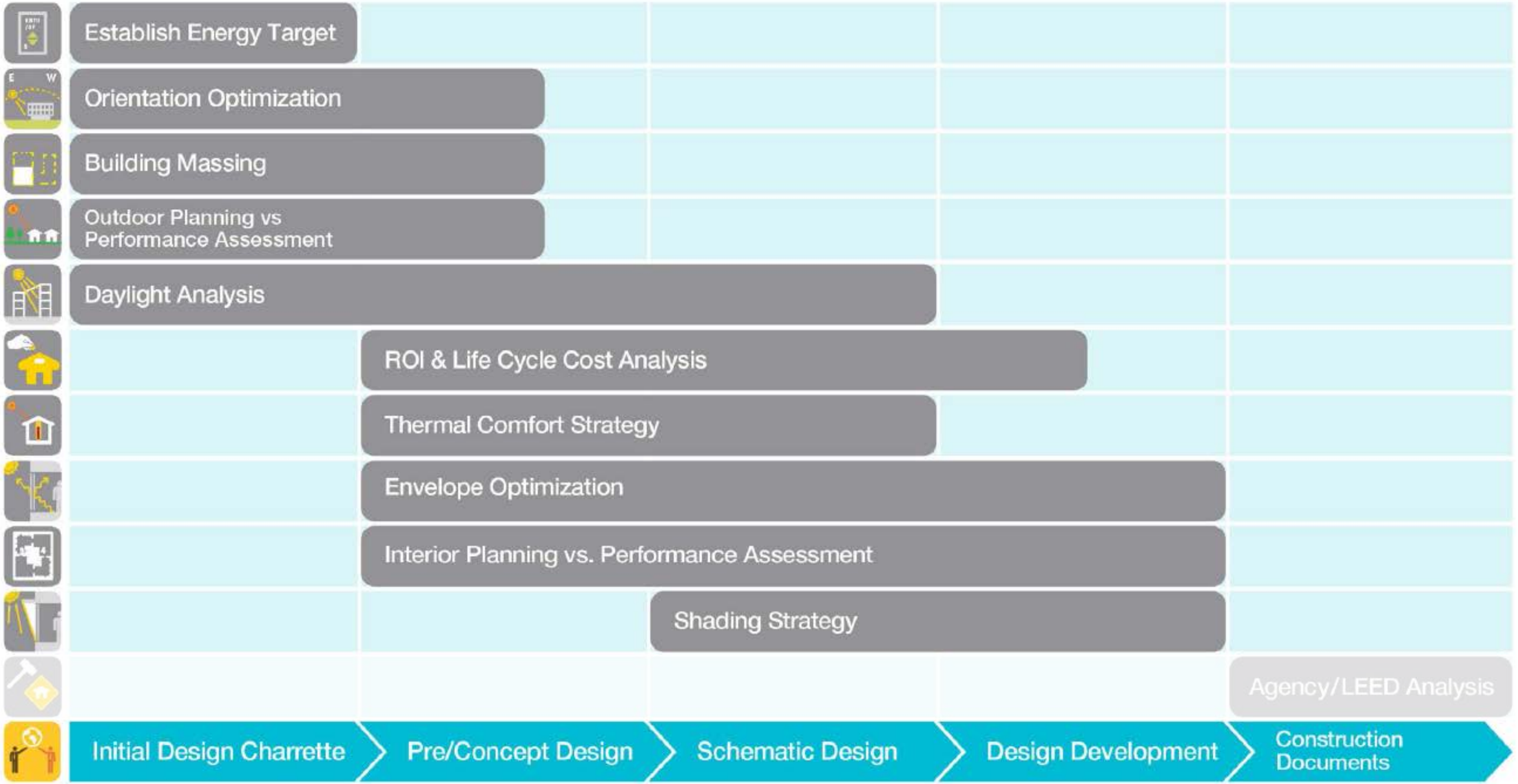
Typical Approach in Performance



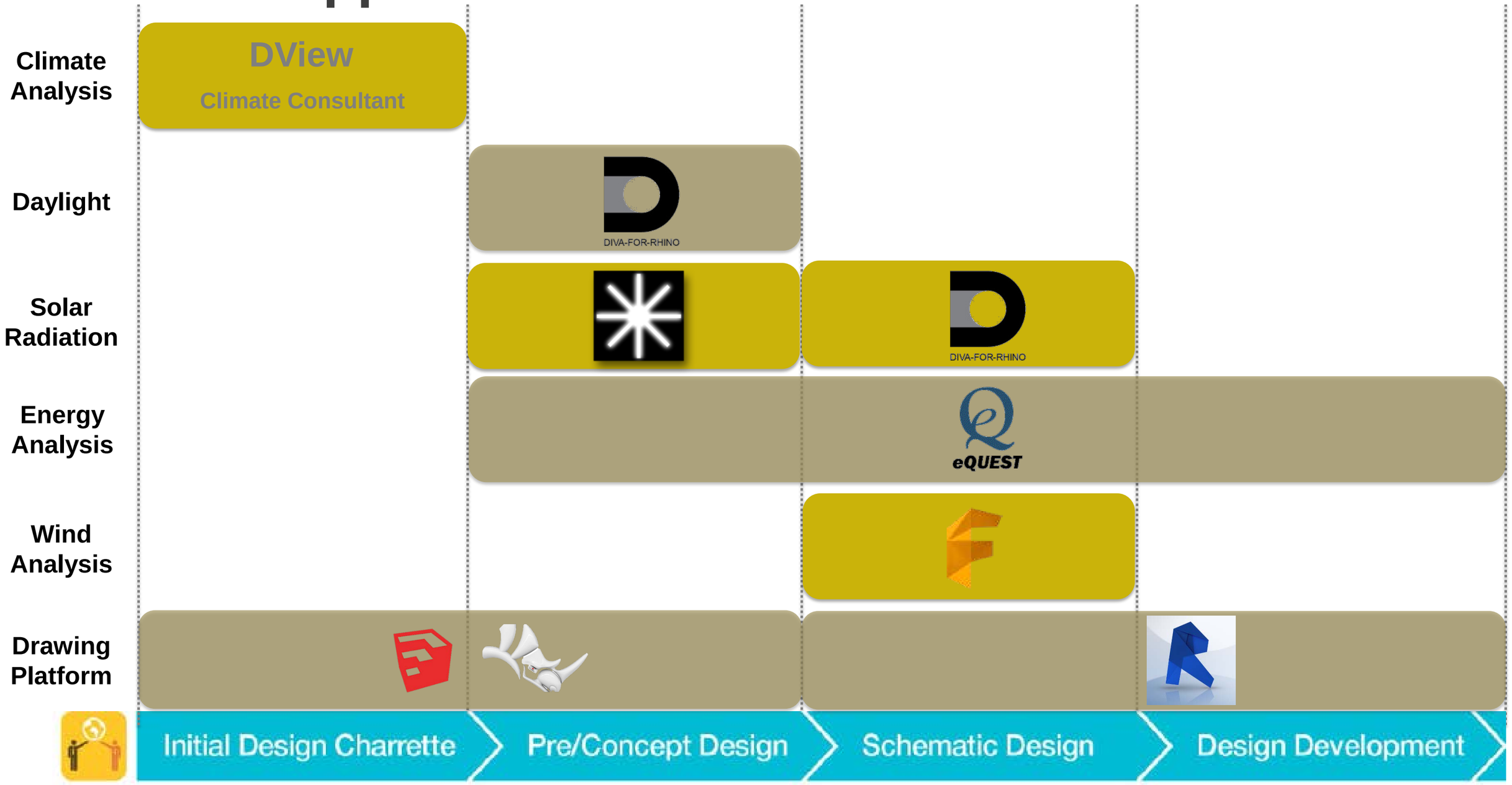
Our Typical Approach



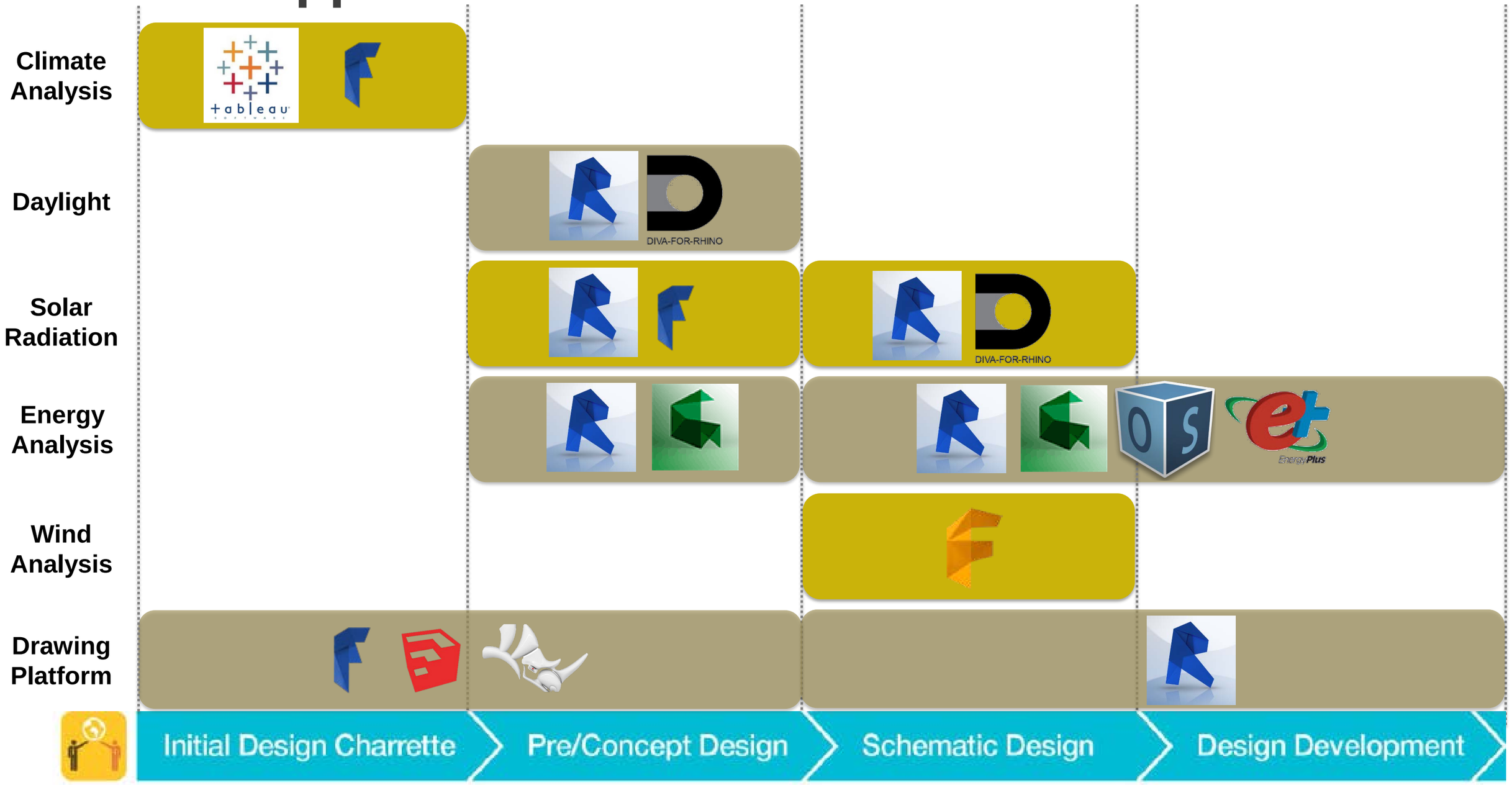
Our Typical Approach – Early Design



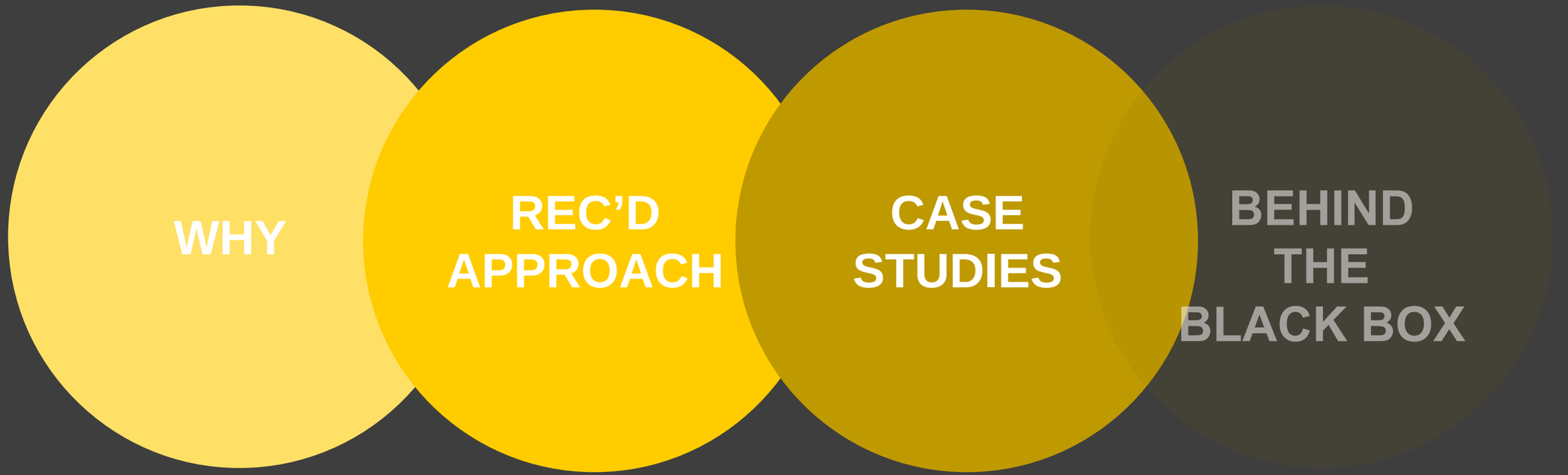
Current Approach



Future Approach



Tools can help to make the building greener, but the collaboration within the team is the key to the success.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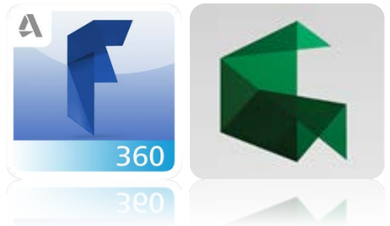
CASE STUDY 1

OFFICE BUILDING – SAN DIEGO

ASHRAE LOWDOWN SHOWDOWN COMPETITION

AUTODESK TEAM
(Eddy Santosa, Dustin Altschul, Yung Nguyen, Stephanie Egger, Krishnan Gowri)

Climate & Site Studies



Conceptual Energy Analysis
Solar Analysis

Massing Studies

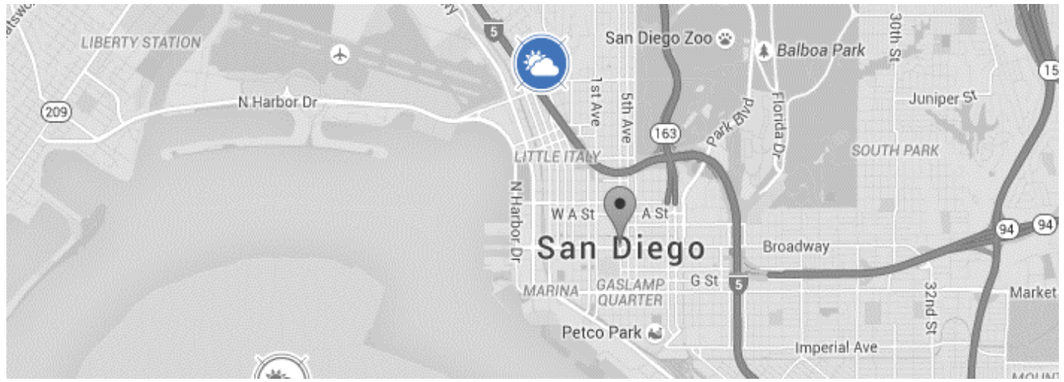
Space Planning
Envelope Material Impact
WWR
Wind Flow

Schematic Design

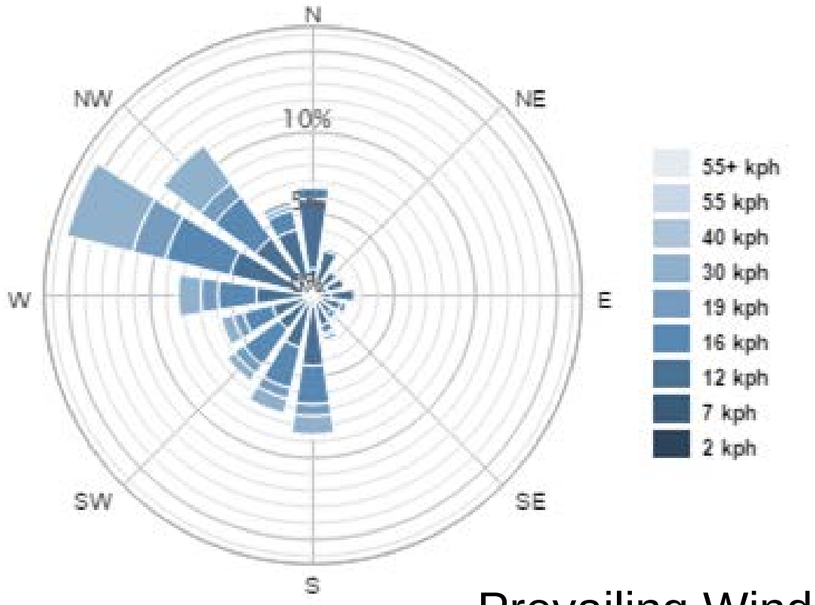
Whole Energy Model
HVAC
Renewable Potential

Analysis Details

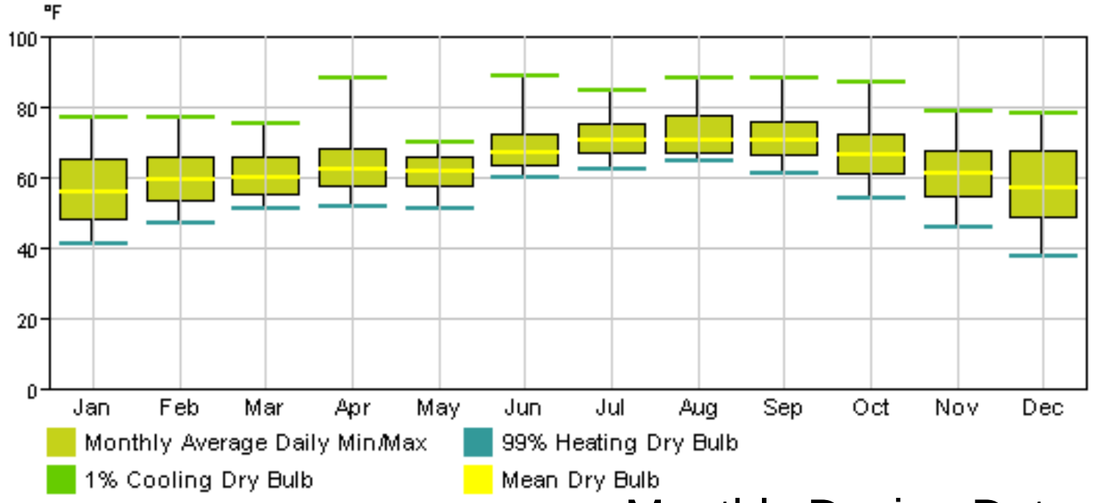
Climate & Site Studies



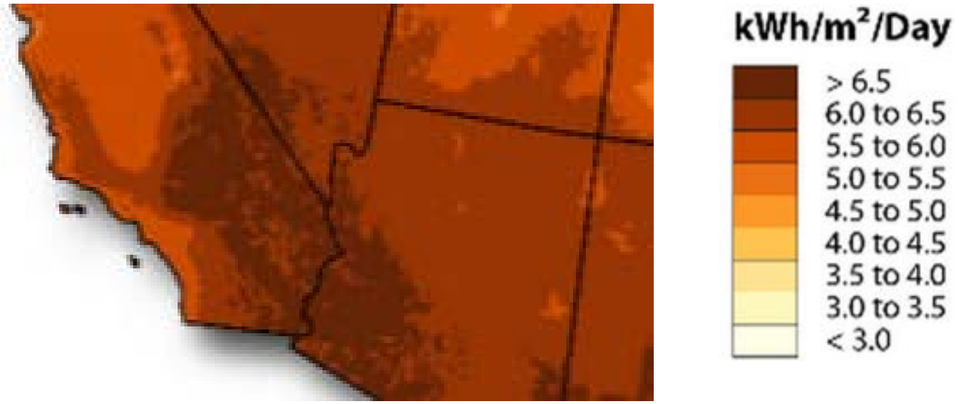
Downtown San Diego, IDEA District



Prevailing Wind

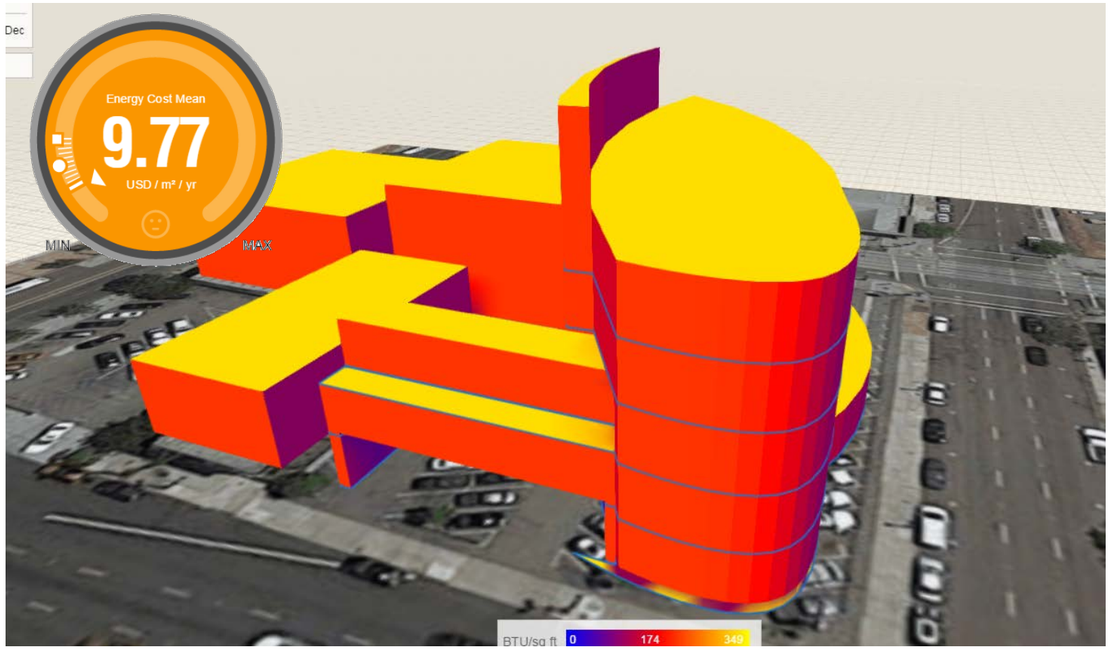


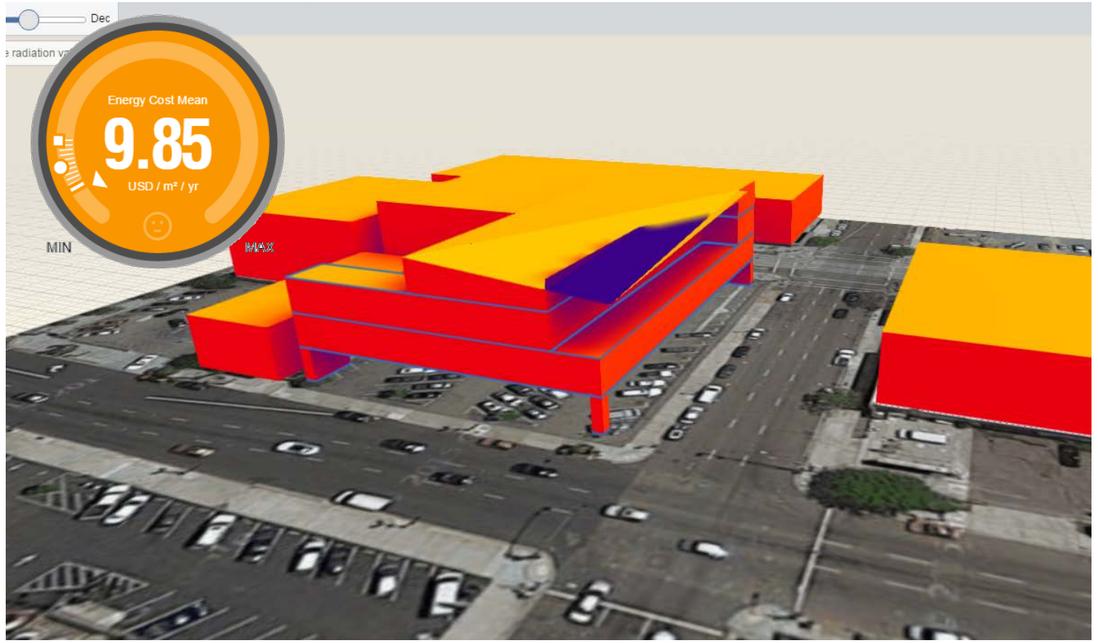
Monthly Design Data

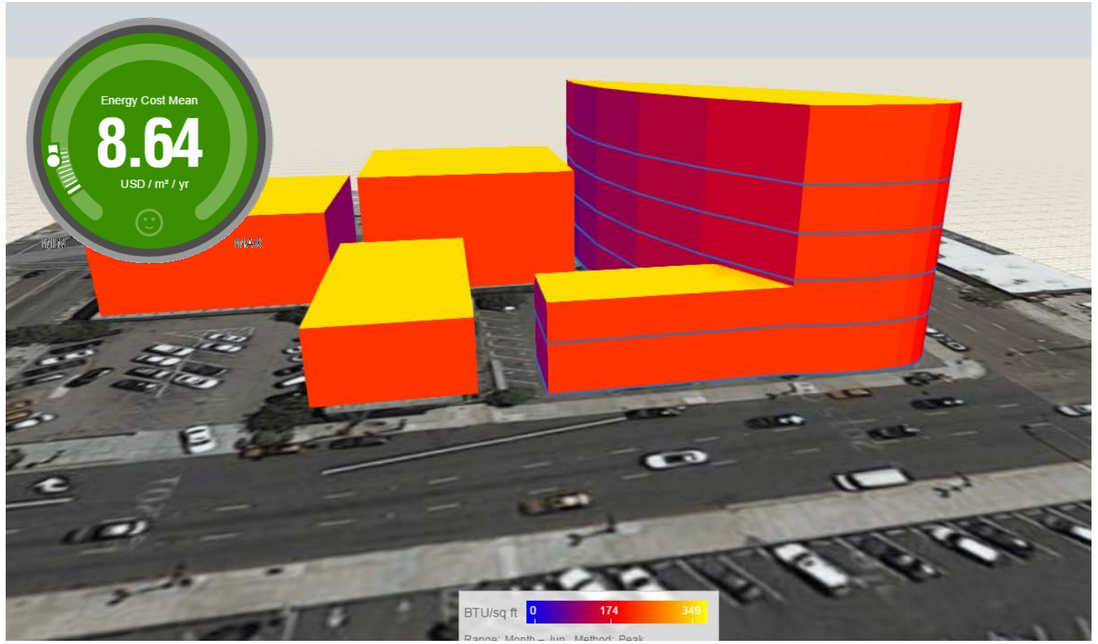


Solar Radiation

Massing Studies

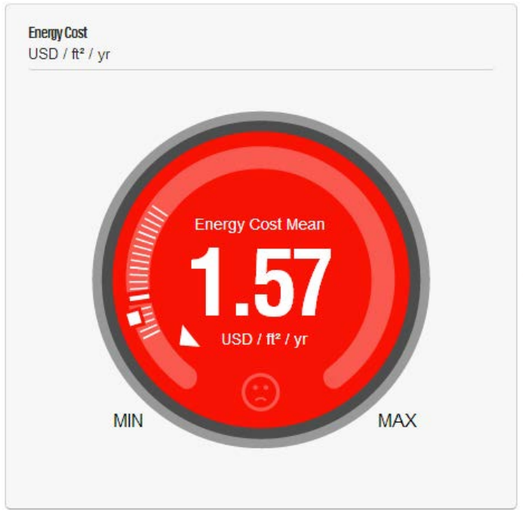


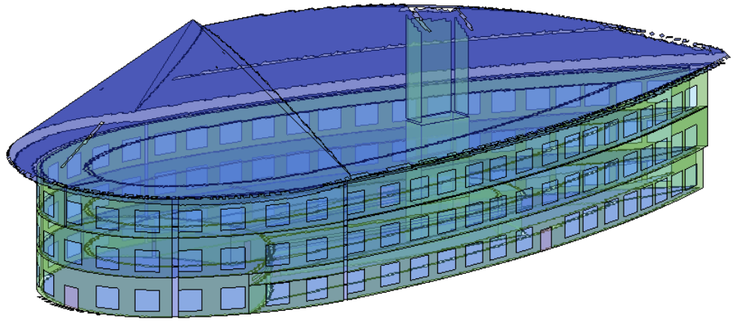


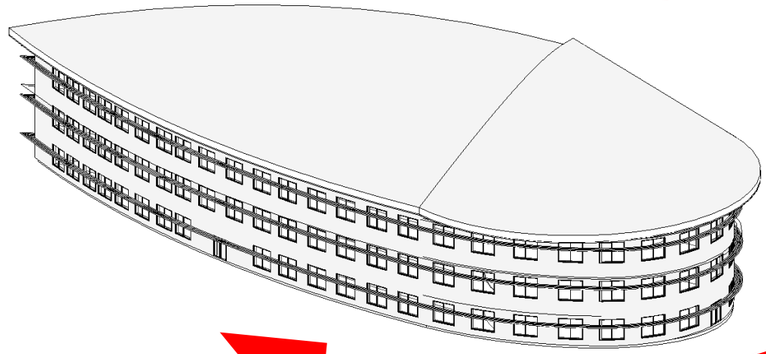


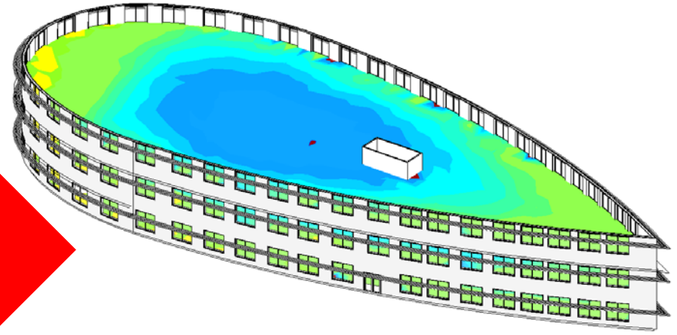
More than 6 schemes generated by team members …

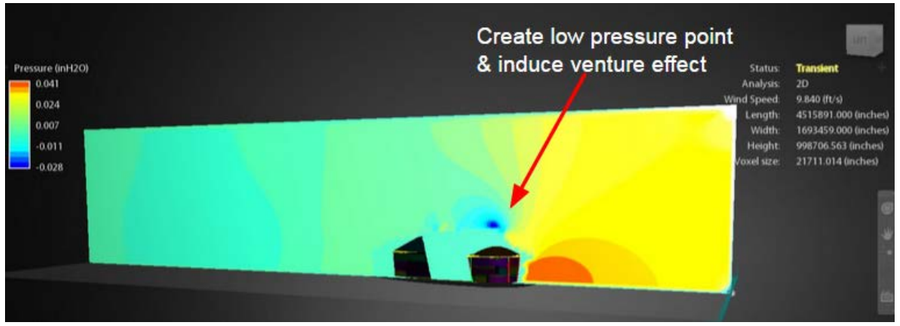
Schematic Design

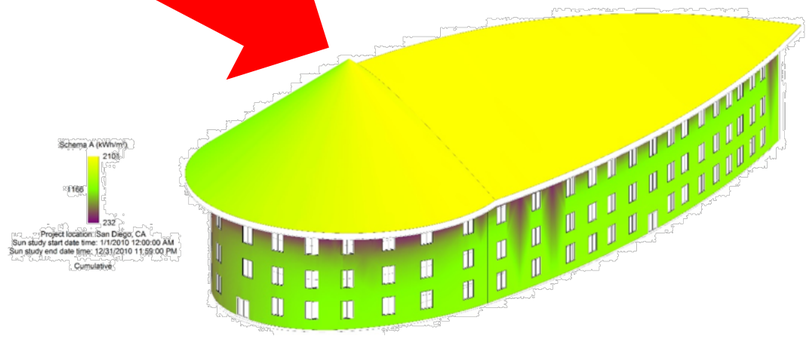




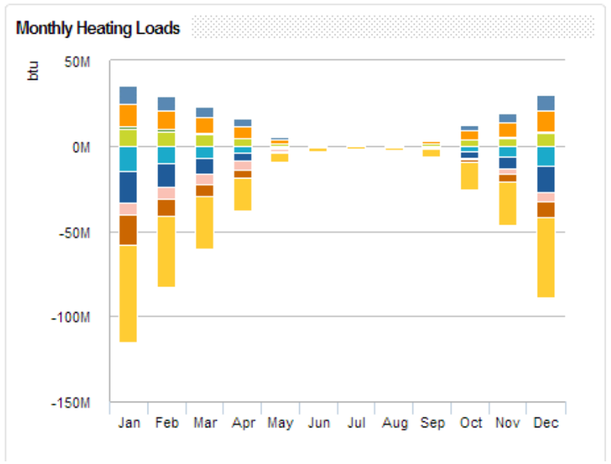


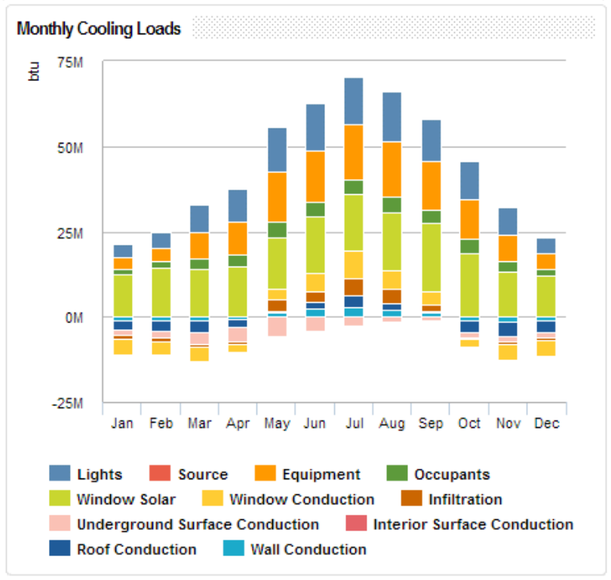


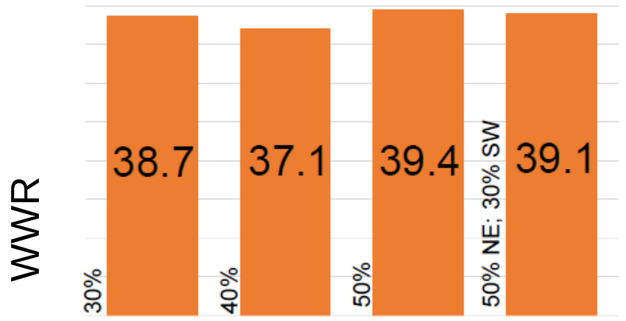




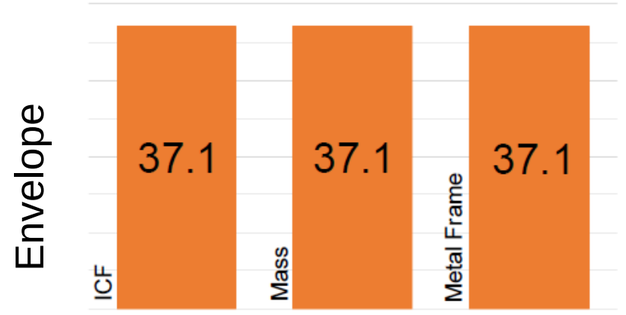
Analysis Details



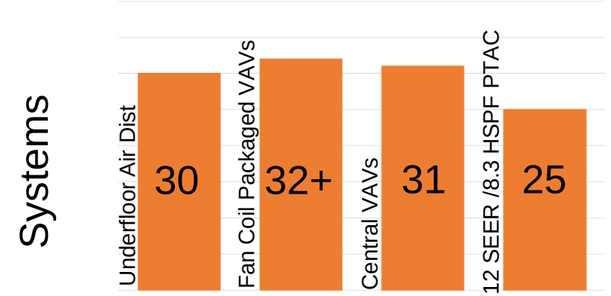




40% WWR



ICF



12 SEER /8.3 HSPF PTAC

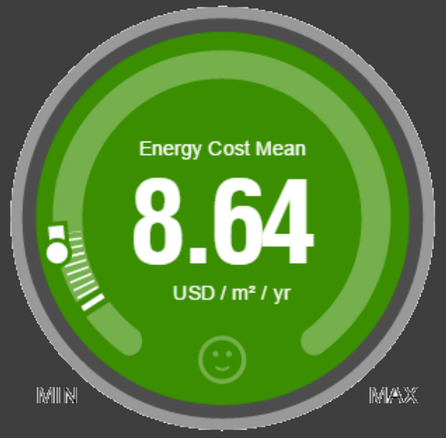
+LPD 30% reduction

ENERGY COST SUMMARY

BUILDING ONLY ENERGY COST
$43,577 -> ELECTRIC 315,978 kWh/yr and FUEL 571 Therms

RENEWABLE ENERGY OFFSET
PV SIZE 394 kW SYSTEM
$71,825

TOTAL ENERGY COST SAVING
$28,248 (NET POSITIVE)



= 0.80 USD/ft²/yr

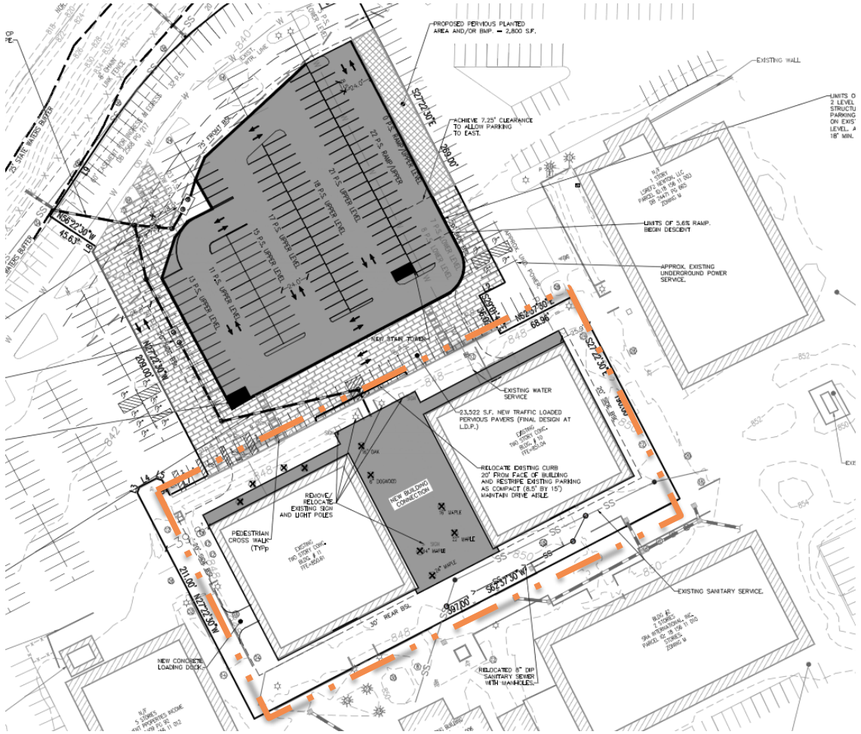
0.94 USD/ft²/yr

CASE STUDY 2

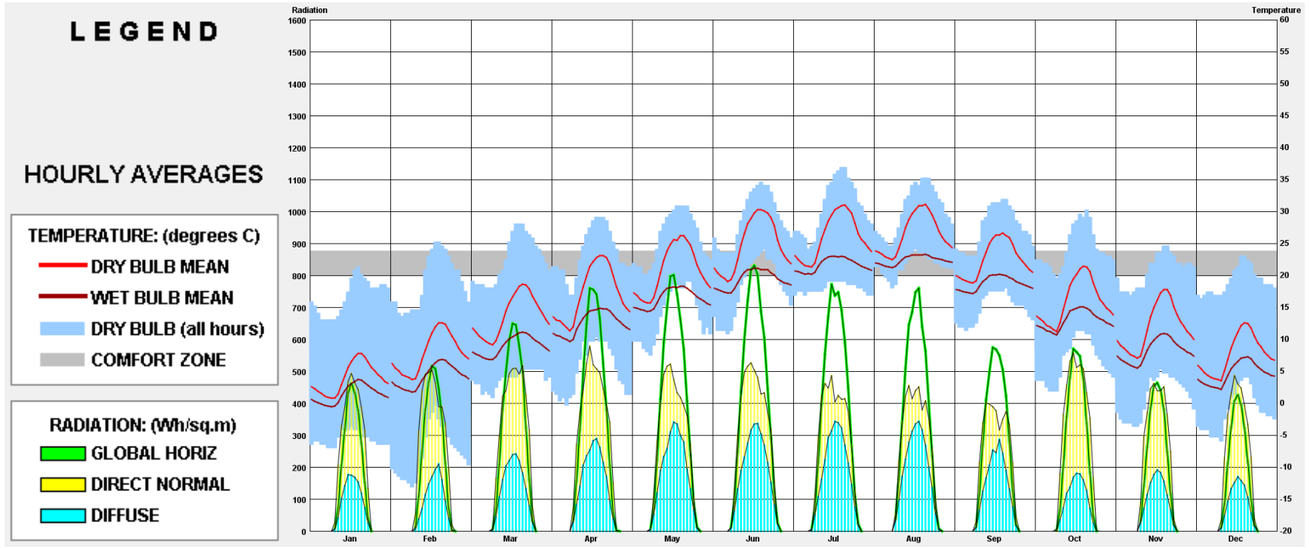
OFFICE BUILDING – ATLANTA

CALLISONRTKL

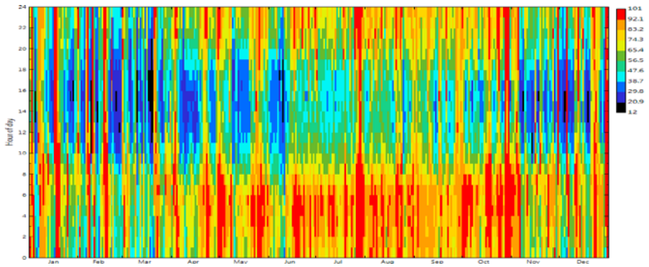
SITE AND CLIMATE CONDITION



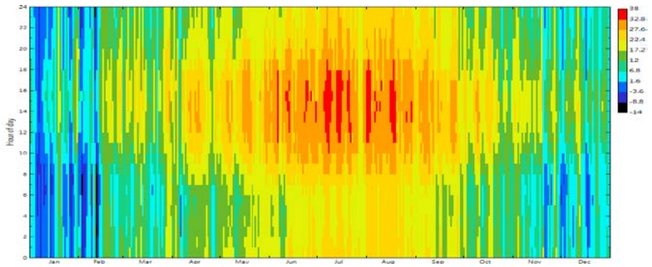
Existing site condition



Hourly Average Weather Data

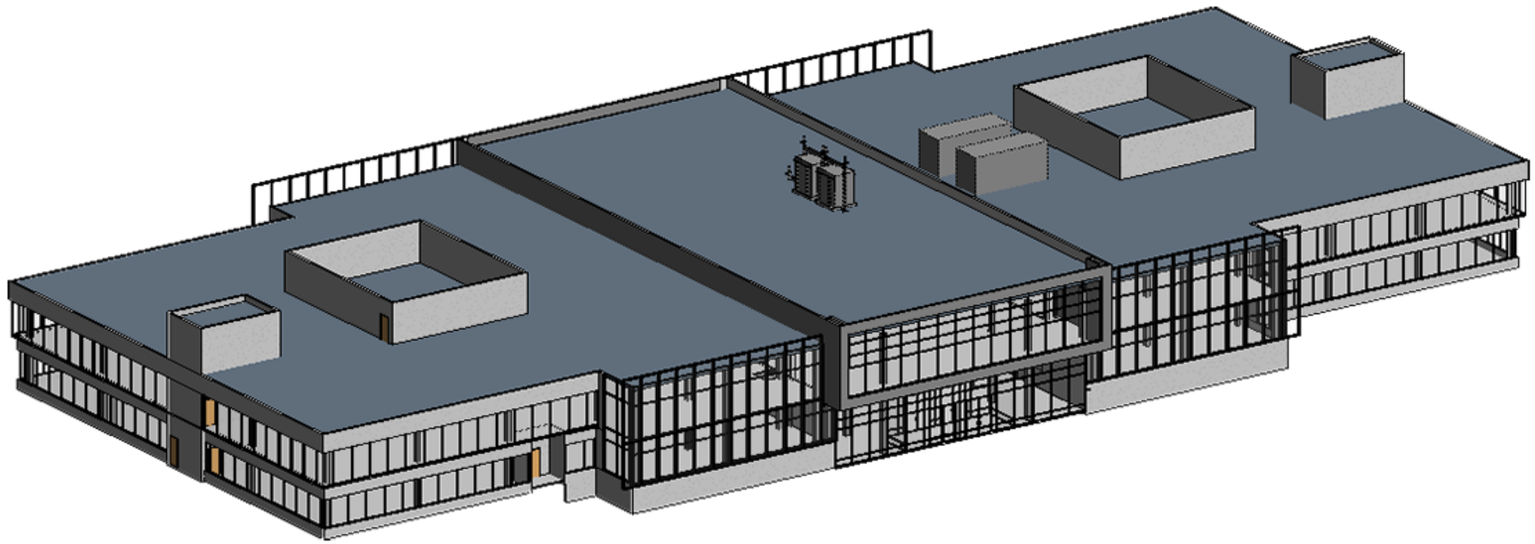


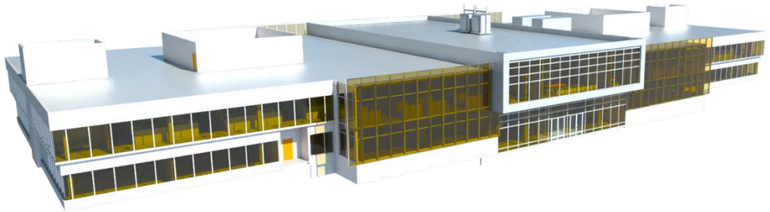
Relative Humidity Graph



Dry-Bulb Temperature Graph

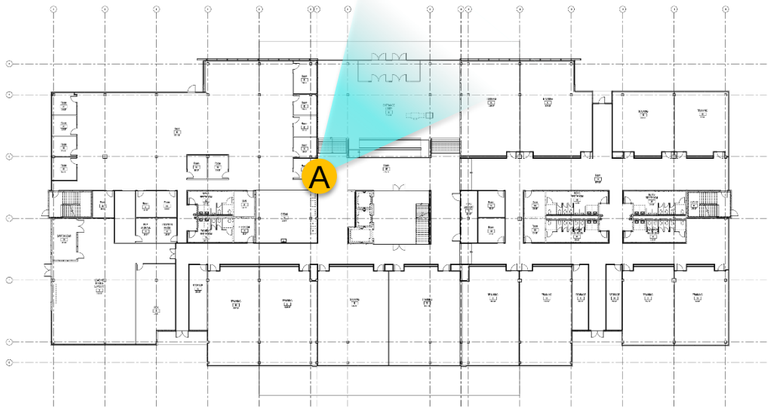
Baseline Design



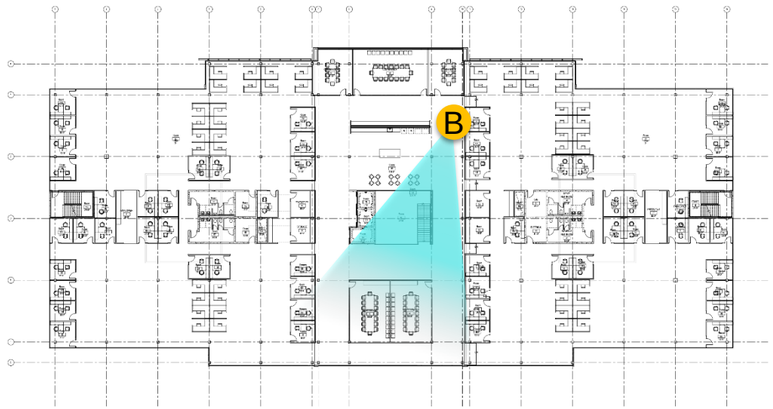


Perspective View A

Perspective View B

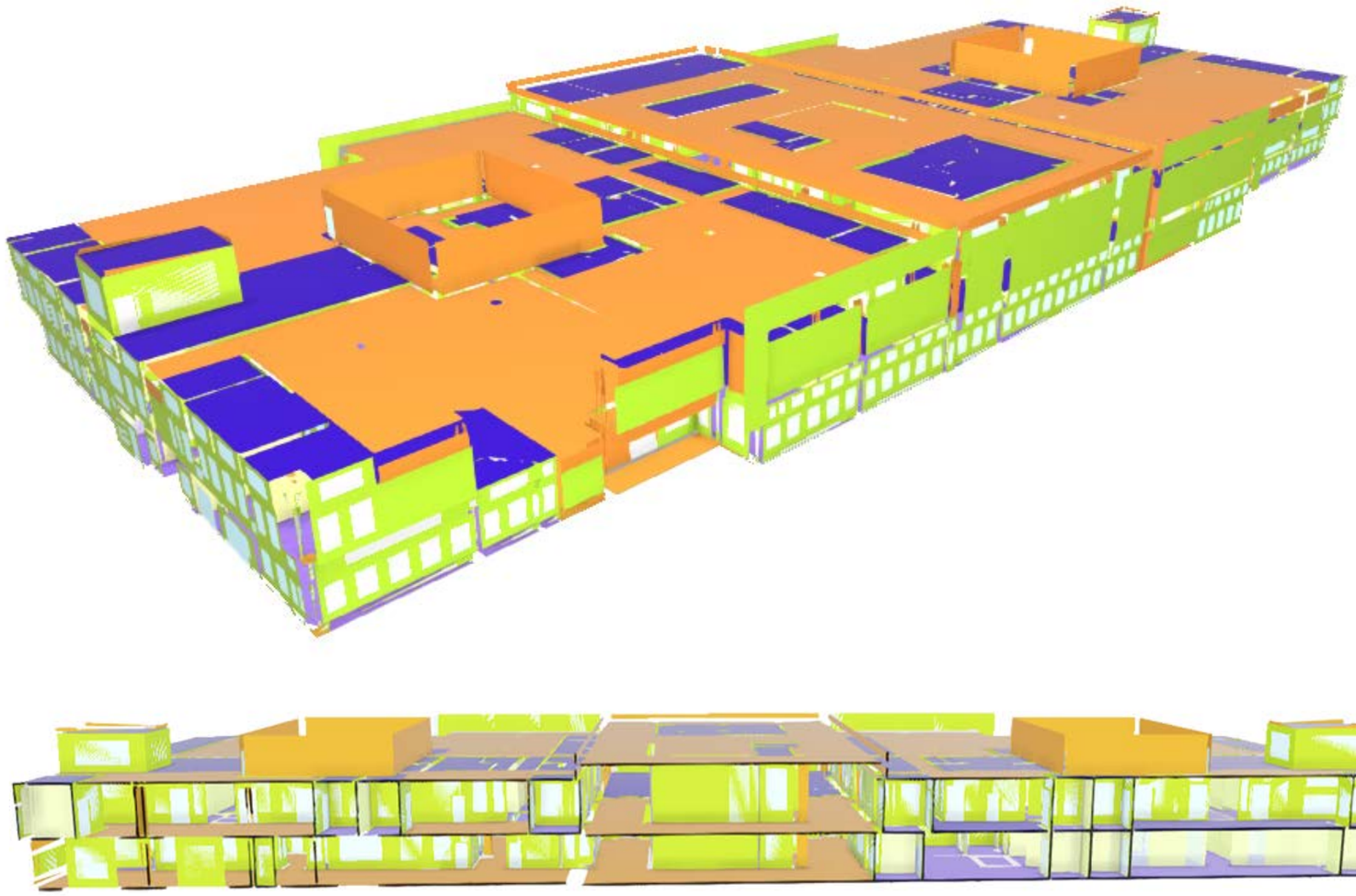


Level 1



Level 2

Insight 360 Analysis



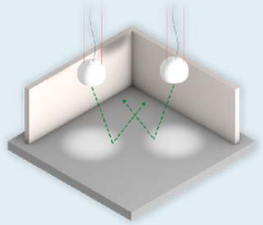
DESCRIPTION	STANDARDS	VALUE
Exterior Wall Construction: Steel-frame construction	ASHRAE 90.1 - 2007	R-13 + R-3.8 c.i. insulation - Overall U-value 0.084
Roof Construction: Insulation Entirely sbove deck	ASHRAE 90.1 - 2007	R-20 c.i. insulation - Overall U-value 0.048
Floor Construction: Mass	ASHRAE 90.1 - 2007	R-6.3 c.i. insulation - Overall U-value 0.107
Window to Gross Wall ratio (Uniformly distributed on all sides)	ASHRAE 90.1 - 2007	-
Fenestration Type - Vertical Glazing 0 - 40% of wall	ASHRAE 90.1 - 2007	-
Fenestration U-Value	ASHRAE 90.1 - 2007	U-value 0.60
Fenestration SHGC	ASHRAE 90.1 - 2007	0.25
Fenestration Assembly Max. VT/SHGC	ASHRAE 90.1 - 2007	-
Skylight U-value	ASHRAE 90.1 - 2007	-
Skylight SHGC	ASHRAE 90.1 - 2007	-

Parametric Adjustment

Lighting Efficiency

Represents the average internal heat gain and power consumption of electric lighting per unit floor area.

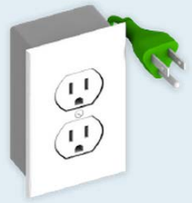
Current Setting:
0.7 W/sf



Plug Load Efficiency

The power used by equipment i.e. computers and small appliances; excludes lighting or heating and cooling equipment.

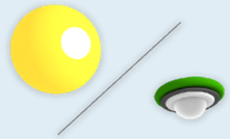
Current Setting:
1.0 W/sf



Daylighting & Occupancy Controls

Represents typical daylight dimming and occupancy sensor systems.

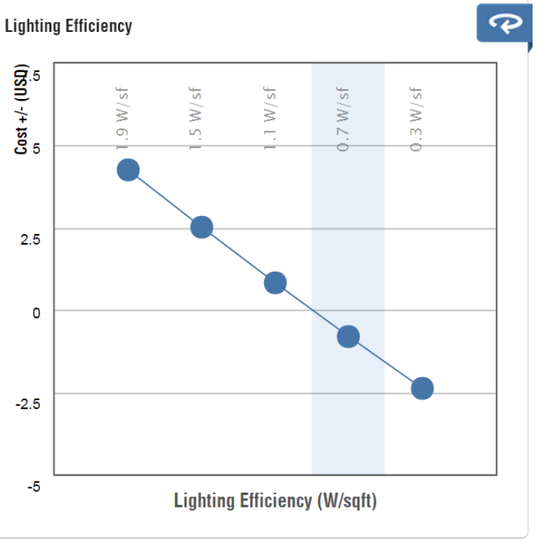
Current Setting:
Daylighting & Occupancy Controls

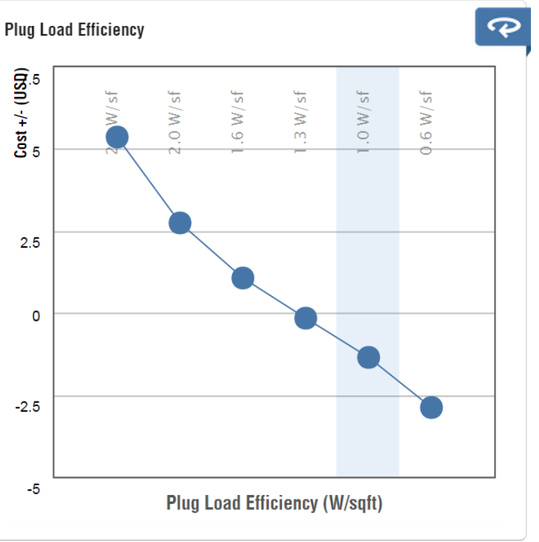


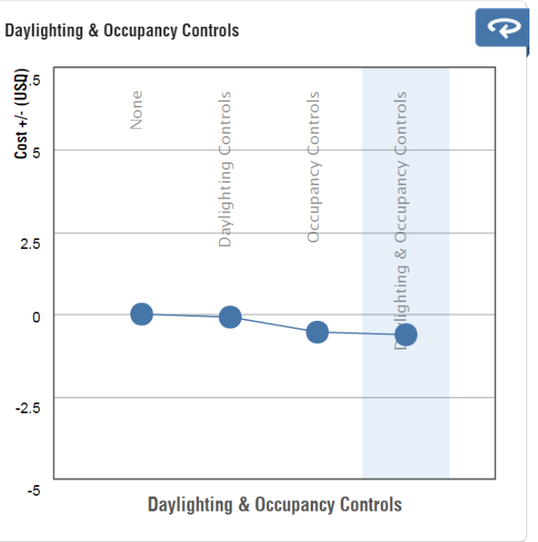
Infiltration

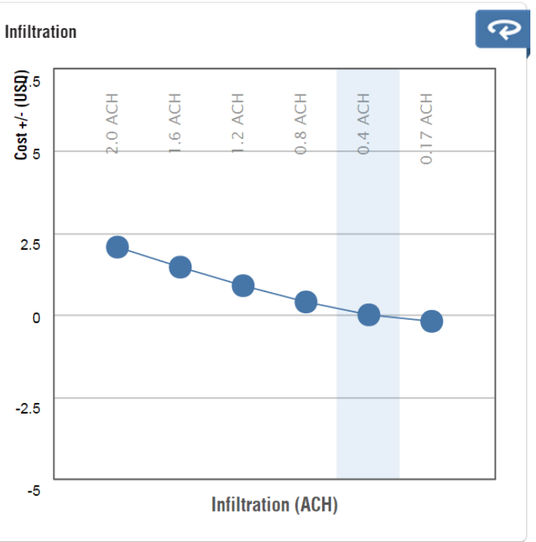
The unintentional leaking of air into or out of conditioned spaces; often due to gaps in the building envelope.

Current Setting:
0.4 ACH







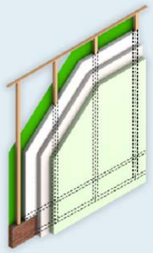


Parametric Adjustment

Wall Construction

Represents the overall ability of wall constructions to resist heat losses and gains.

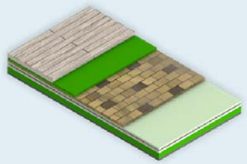
Current Setting:
14-inch ICF



Roof Construction

Represents the overall ability of roof constructions to resist heat losses and gains.

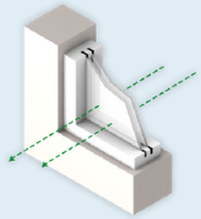
Current Setting:
R38



Window Glass

Glass properties control the amount of daylight, heat transfer & solar heat gain into the building, along with other factors.

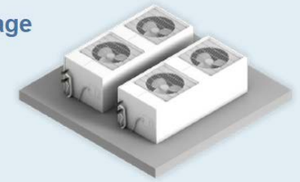
Current Setting:
Dbl LoE

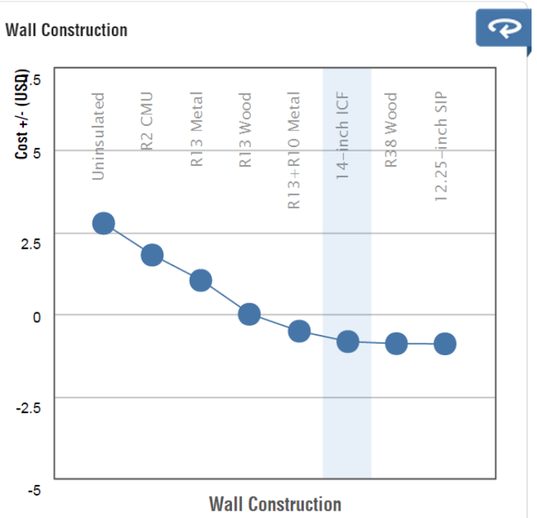


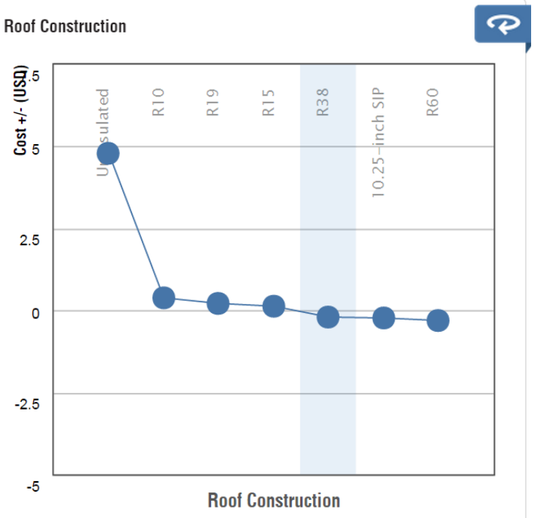
HVAC

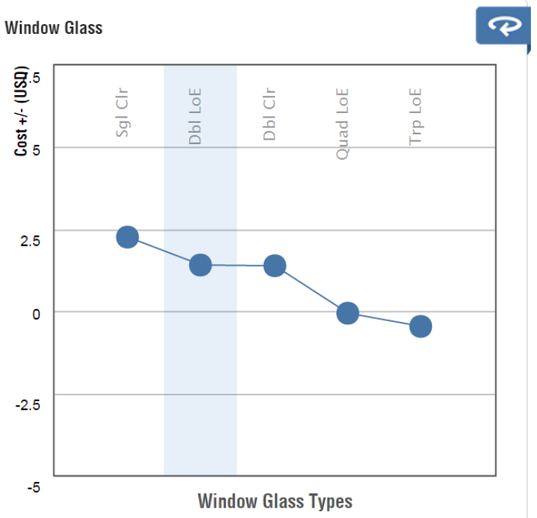
Represents a range of HVAC system efficiency which will vary based on location and building size.

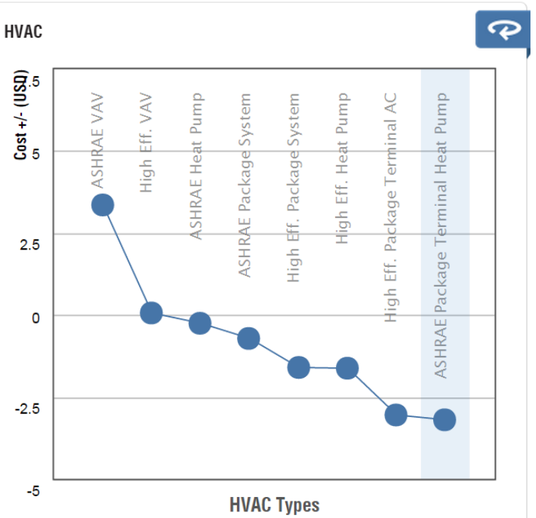
Current Setting:
ASHRAE Package Terminal Heat Pump



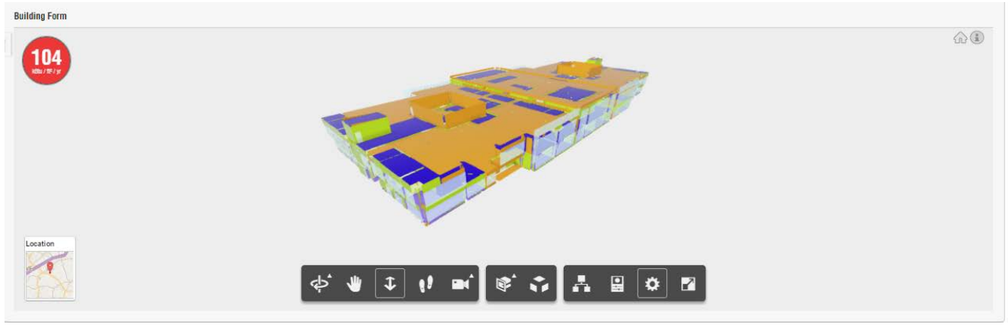


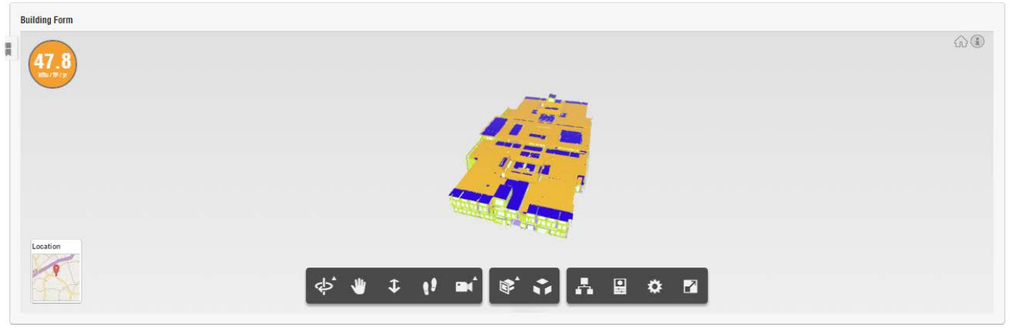


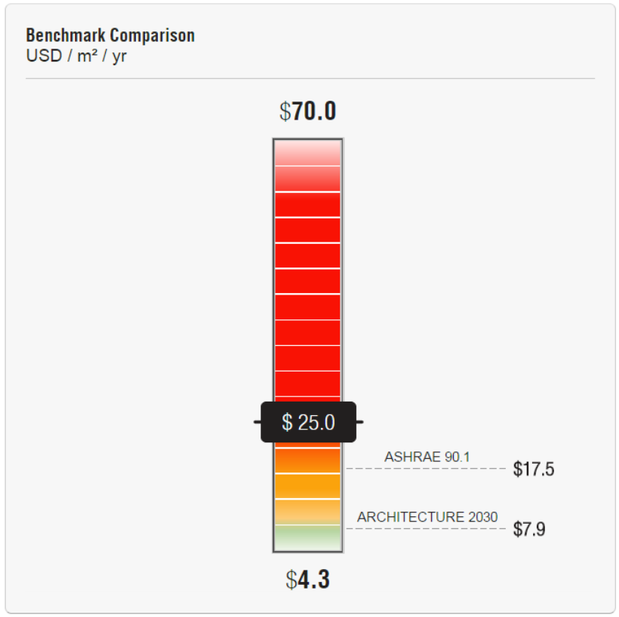




Insight 360 Analysis

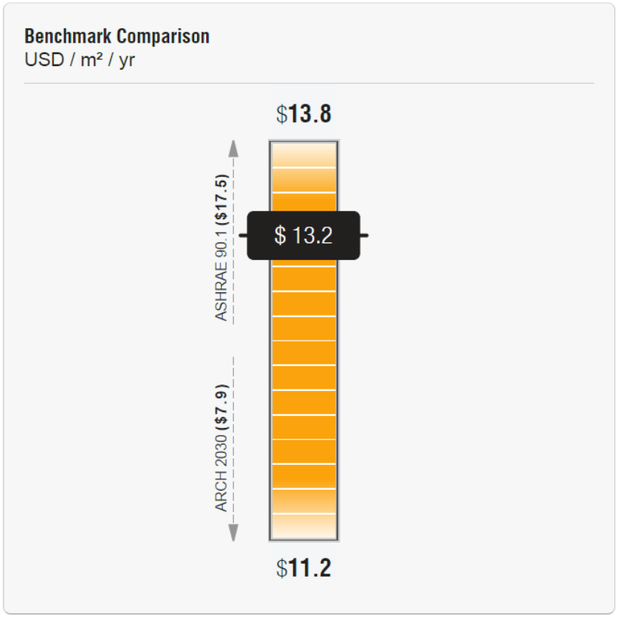




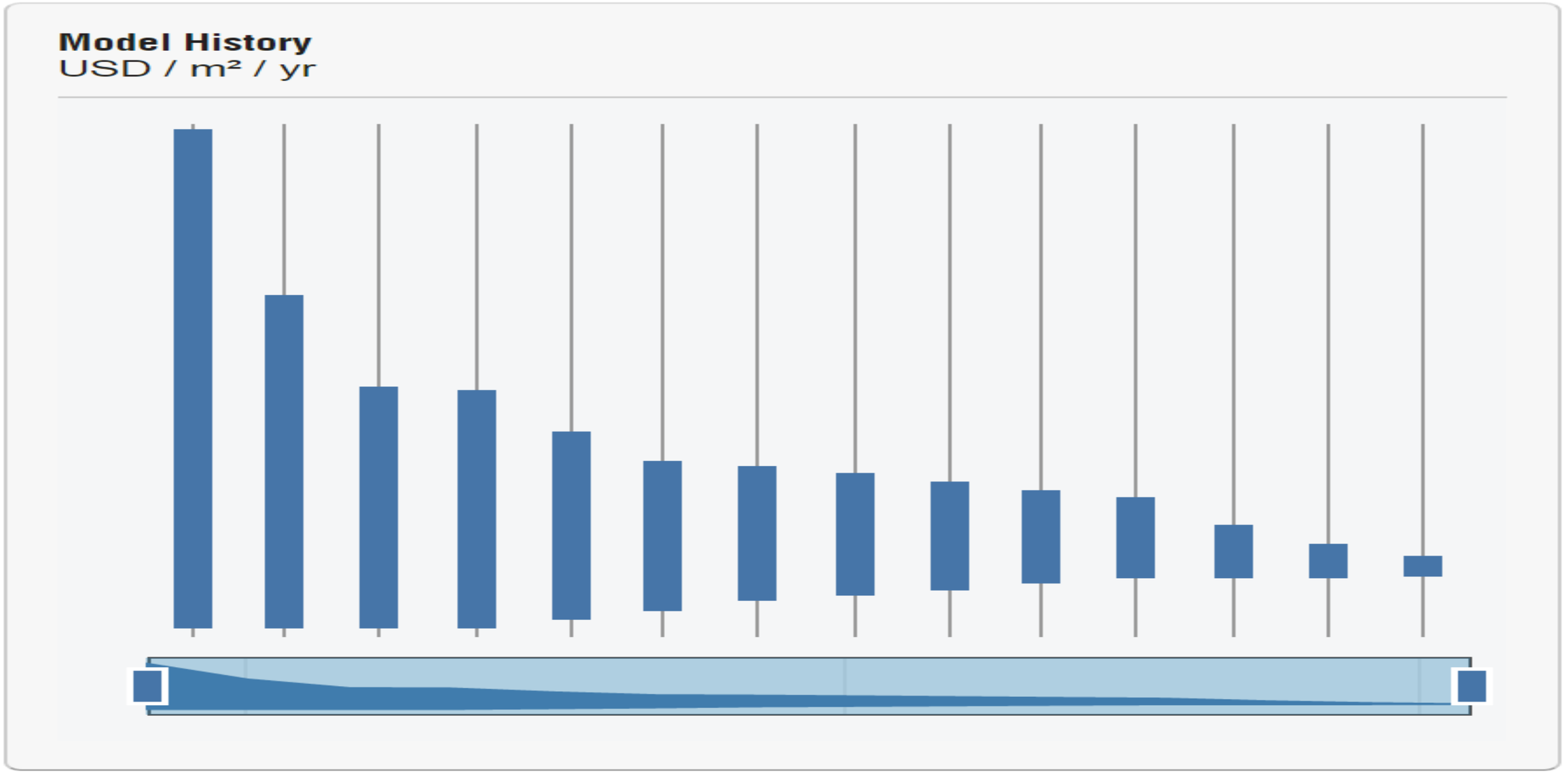


Baseline Model

Proposed Model



Parametric Adjustment

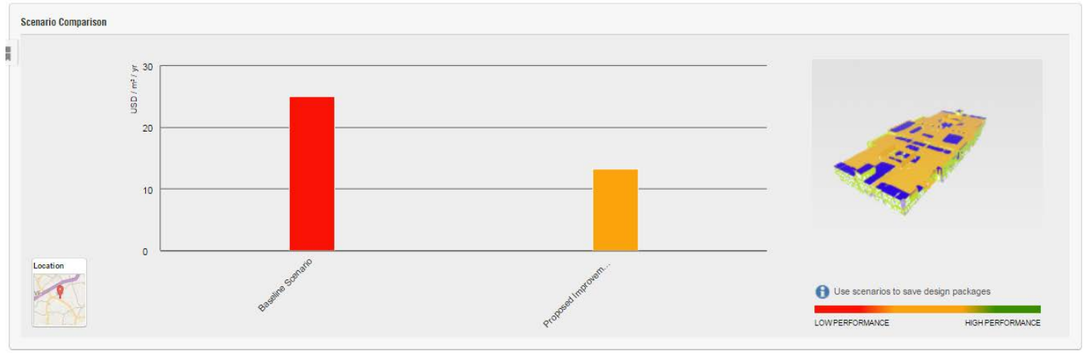


Benchmark

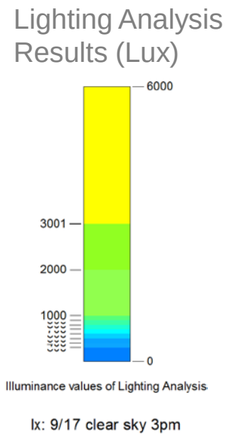
2030	$7.9 USD/m²/yr
ASHRAE 90.1	$17.5 USD/m²/yr
Proposed	$13.2 USD/m²/yr

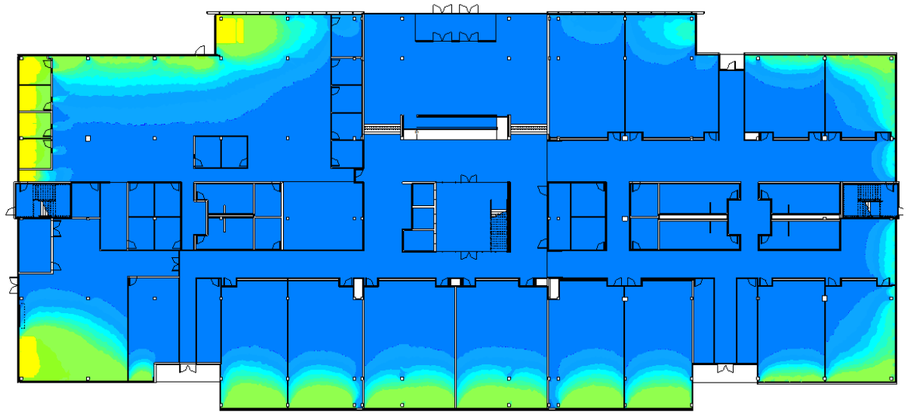
25%

Below ASHRAE 90.1

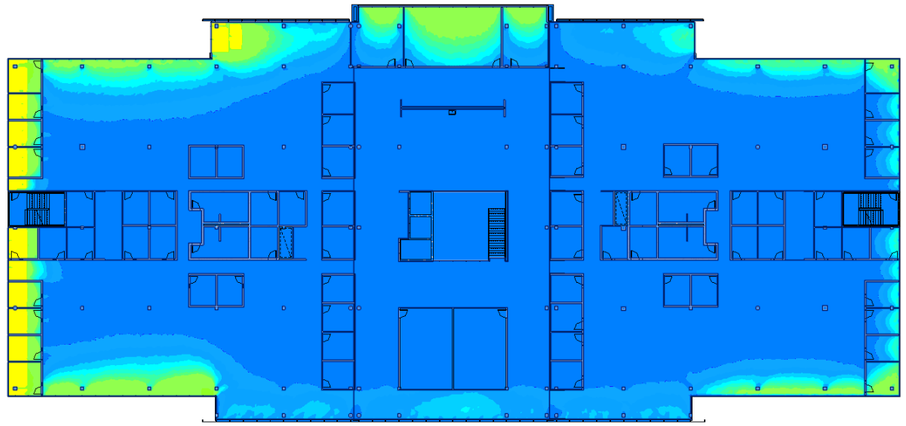


Lighting Analysis

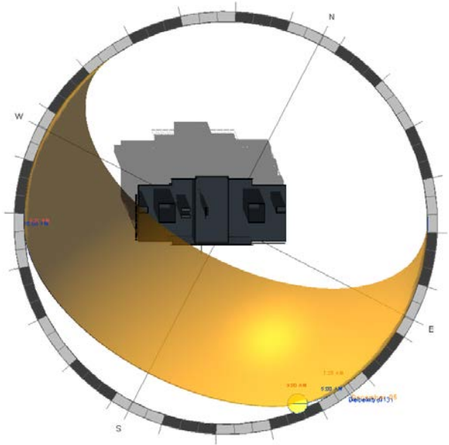




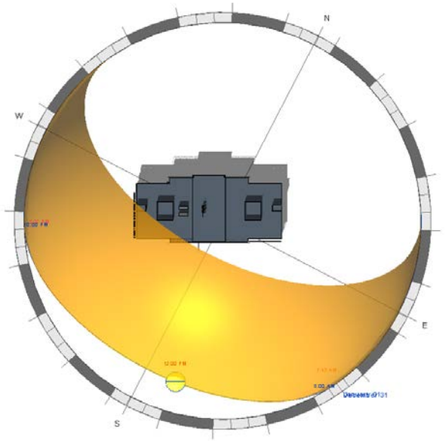
Level 1



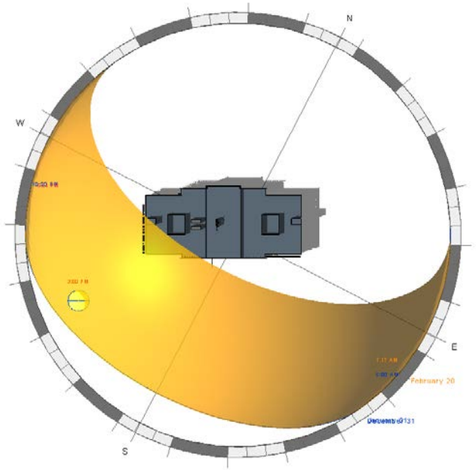
Level 2



Feb 21
@9 am



Feb 21
@12 pm

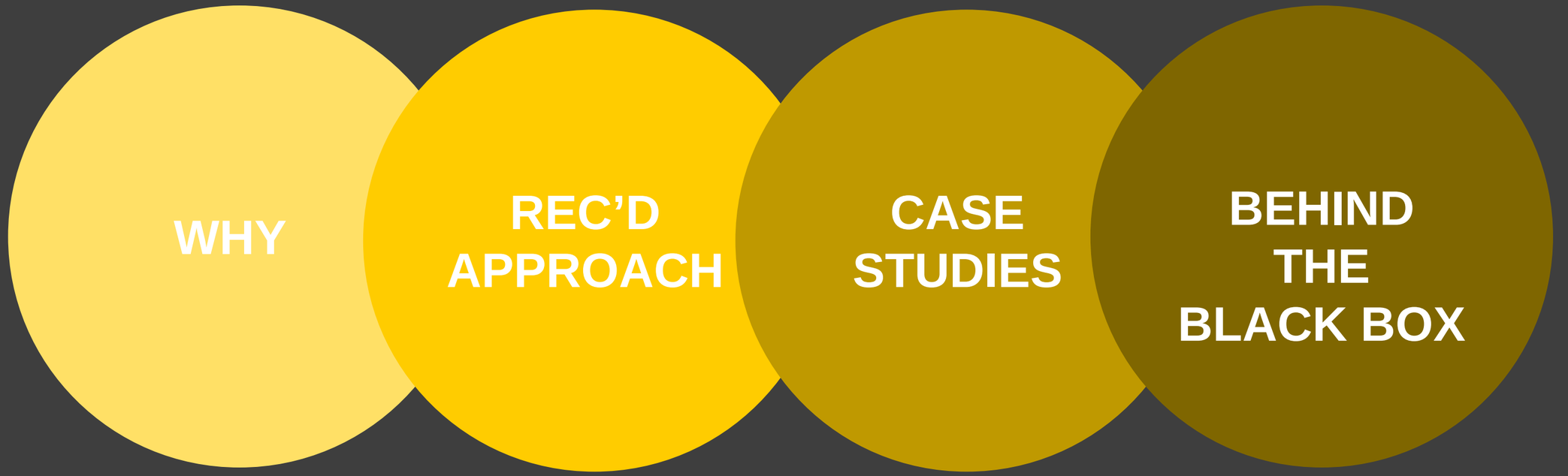


Feb 21
@3 pm

Baseline Façade Design

Proposed Façade Design – Option A

Proposed Façade Design – Option B

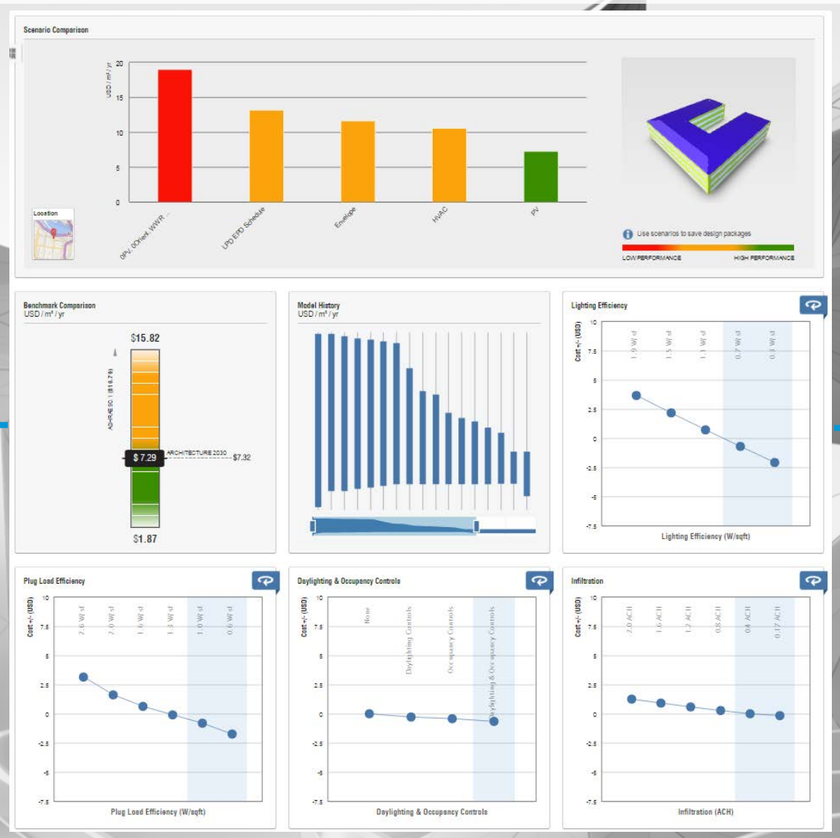

WHY
REC'D APPROACH
CASE STUDIES
BEHIND THE BLACK BOX

Autodesk Insight 360…

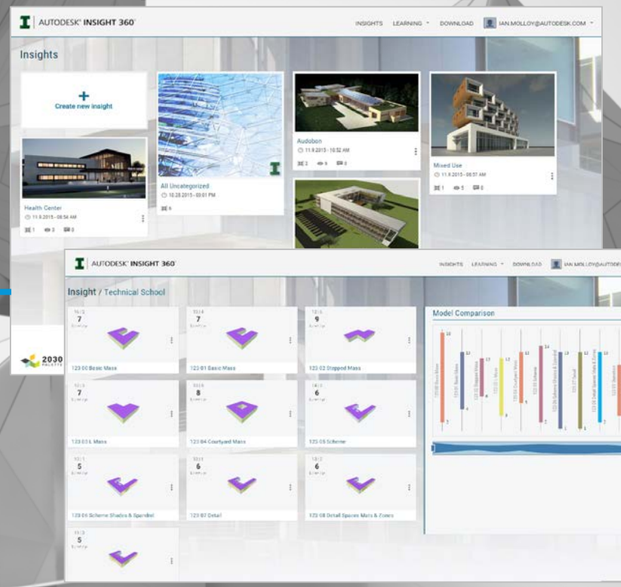
A Fast, Intuitive Outcome Driven Guide to Better Building Energy & Environmental Performance.

Energy Cost Range & Benchmarks

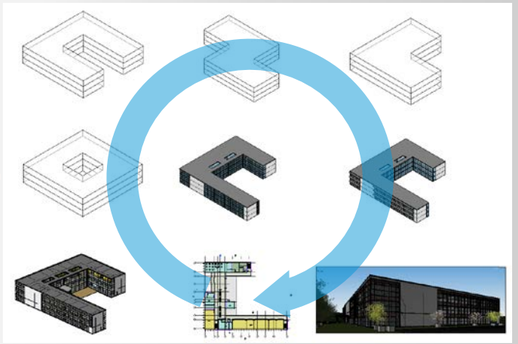
Factors & Ranges, Heating, Cooling, Lighting & Solar



Insights & Models

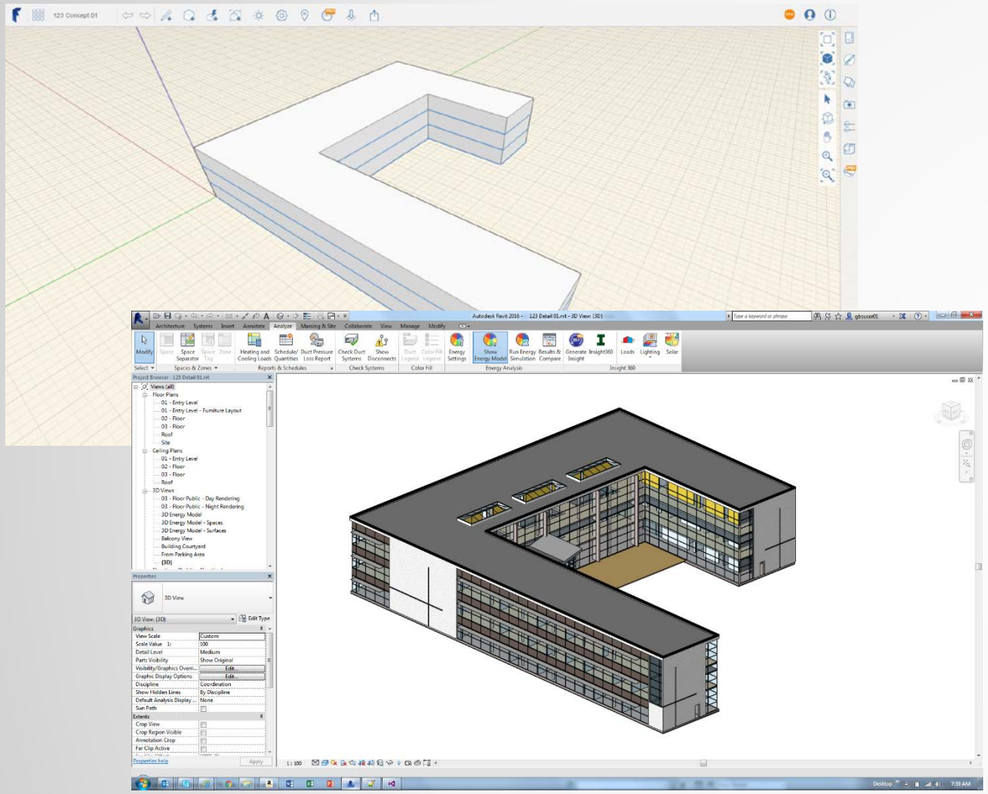


Revit and FormIt 360



Workflow…

FormIt 360 Pro and/or Revit Subscription…

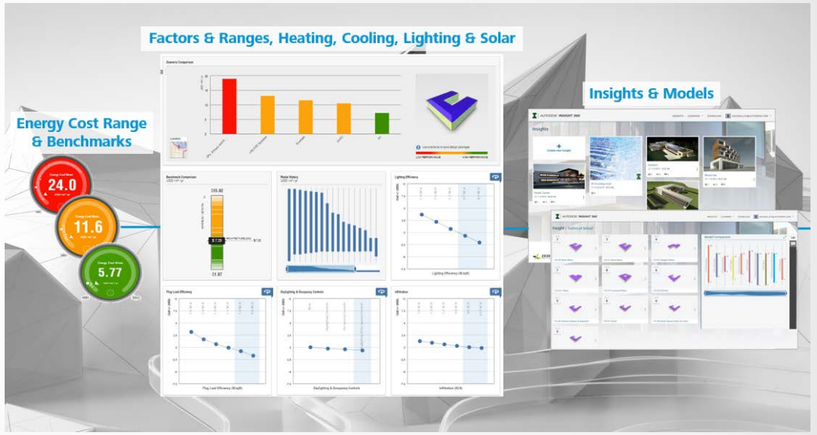


1. Set Location

2. Create Insight

- Automatic Energy Analytical Model creation
- Millions* of whole building energy simulations

3. Open Insight 360…



4. Explore Energy Cost Range, Factors & Savings

5. Visualize Heating, Cooling, Solar & Lighting Performance

6. Repeat 2-5 continuously towards better performance

* Innovative computational techniques provide the equivalent of millions of simulation results in a fraction of the time

Upcoming Technology and Application Trends

Upcoming Technology and Application Trends

1. Morphed Weather File
2. BIM2BPA
   Building Information Modeling to Building Performance Analysis
3. Data Visualization
4. Visual/Augmented Reality in Building Performance

Questions?

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