Sustainability Case Studies: Perkins+Will and Johnson Controls

Jarod Schultz

Director of Research and Development

About the speaker

Jarod Schultz, Director of R&D

I help AEC firms streamline bottlenecks and pain points in their daily people, process, and technology workflows. With years of experience in the AEC industry, I have seen good and bad practices first hand. From this experience, I integrate what I have learned to enhance your daily outcomes. These final outcomes will be based on people, process, and technology workflows comprising of documentation, videos, workshops, mentoring, and software customized to that final solution. To start the process, I lead with a business strategy session with key people to assess your current situation. Through my targeted Q/A I can build a goal-oriented plan to start the process of improving your people, process, and technology workflows. My expertise is at; Delivering Creative Solutions | Architecture, Engineering and Construction Software | Strategic Growth, Process, and Workflow Management | Software Development/Documentation | Presentation/Public Speaking | and is a Kaizen Event/Emotional Intelligence Practitioner.

BLD221644 - Sustainability Case Studies: Perkins+Will and Johnson Controls

See how Autodesk sustainability design tools were used for the Architecture 2030 initiative with Perkins+Will, Johnson Controls, and MasterGraphics.aec.

The Perkins+Will case study centers around Director of Research John Haymaker’s "Design Space Construction / Sprout Space" project. Discover how Perkins+Will and MasterGraphics.aec used Dynamo Studio, Fractal, FormIt, Revit software, and Insight to meet design, energy (2030), and view quality requirements.

Learn how Johnson Control’s Clay Nesler (VP of global energy and sustainability) and MasterGraphics.aec used FormIt, Revit, and Insight on the JCI Shanghai HQ project, where they compared the accuracy of their existing process using other competing tools to the Insight workflow. In Mr. Nesler’s words, “this is uncanny”—to see not only how close the results were, but also how few hours were used to generate the schematic design, design development, and construction documents models for the comparison, and that a large ROI was discovered.

BLD221644 - Sustainability Case Studies: Perkins+Will and Johnson Controls

LEARNING OBJECTIVE

Learn how 2 companies are utilizing the Autodesk sustainability tools

LEARNING OBJECTIVE

See how Dynamo, FormIt, Revit, and Insight can be best capitalized on for the Architecture 2030 initiative

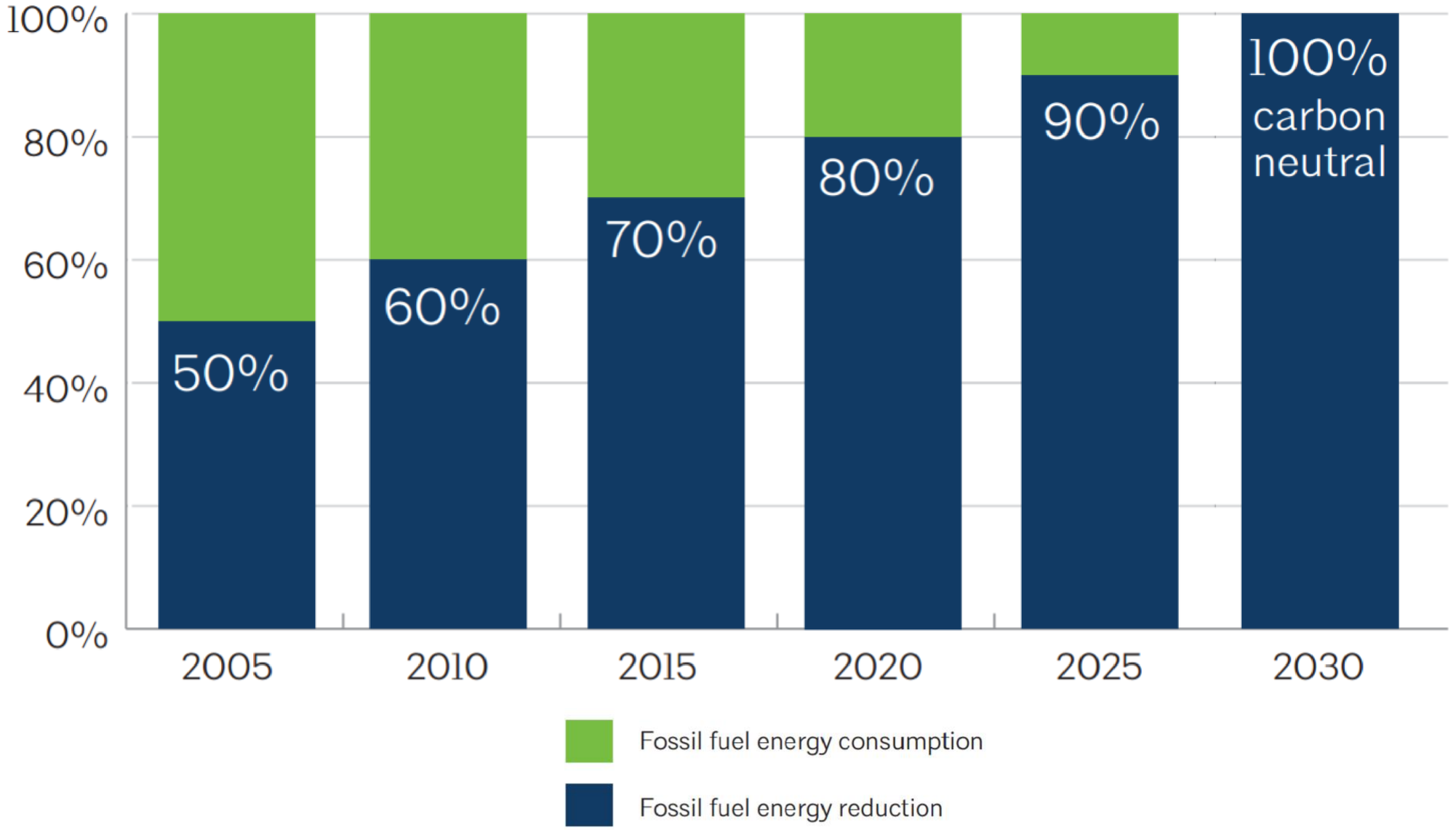
LEARNING OBJECTIVE

Understand how the Insight sustainability workflow can be used by everyone in the firm, not just a select few, when compared to the competing products

LEARNING OBJECTIVE

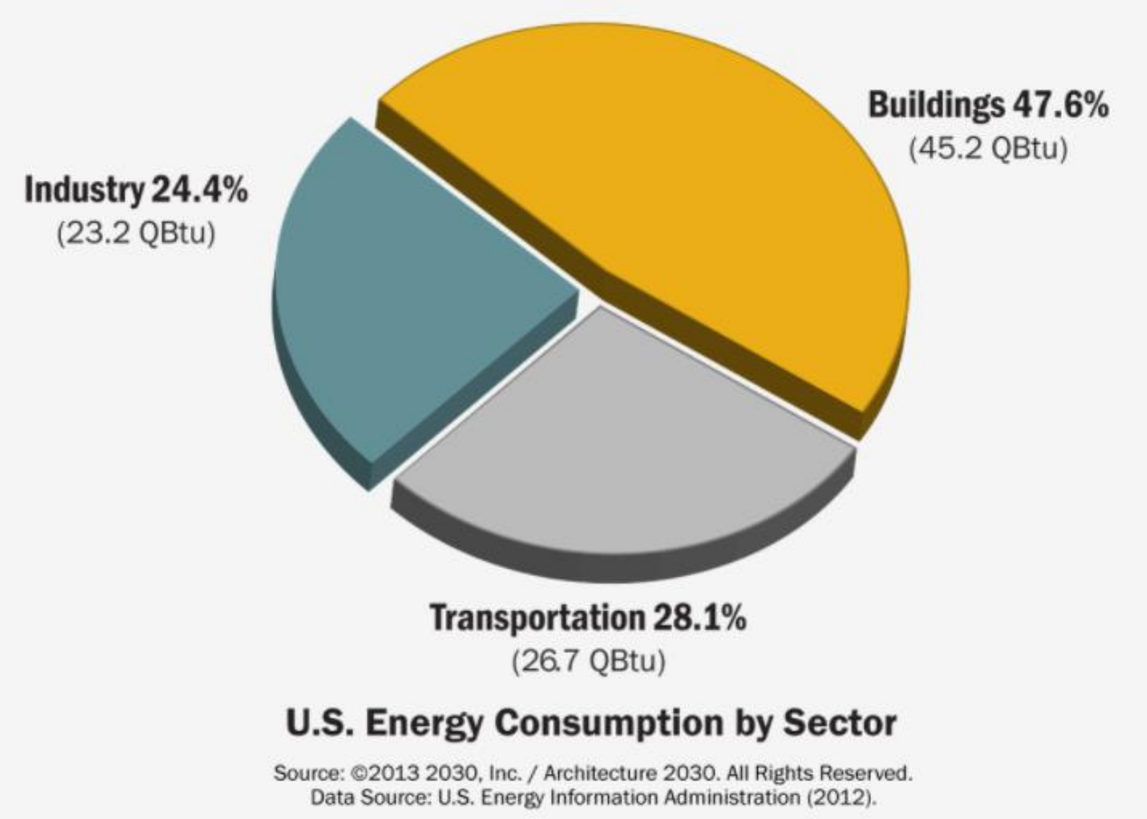
Learn how “accuracy” is the new method to determine energy use intensity (EUI) to better design and build sustainable buildings

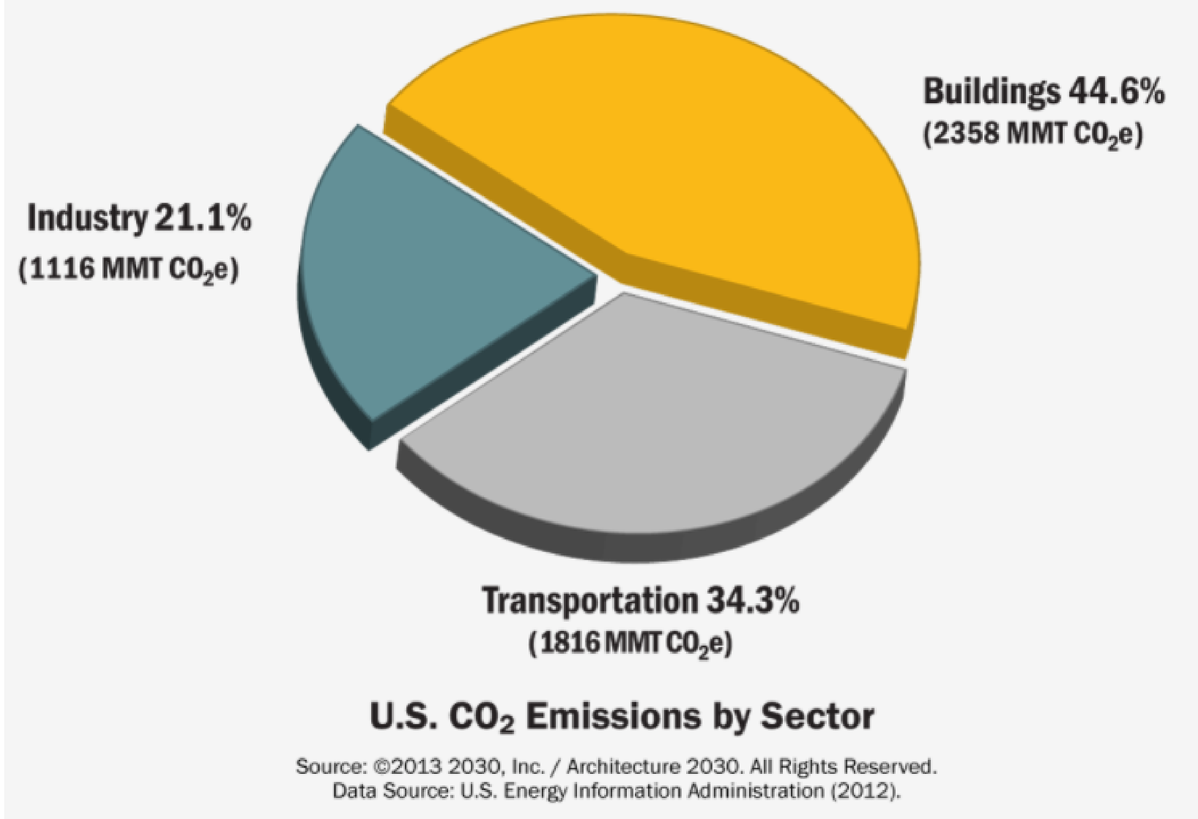
2030 Challenge Goals



BUILDINGS = BIGGEST POLLUTERS + ENERGY CONSUMPTION

Buildings consume nearly half of all the energy produced in the United States
Buildings are responsible for nearly half of US CO2 emissions



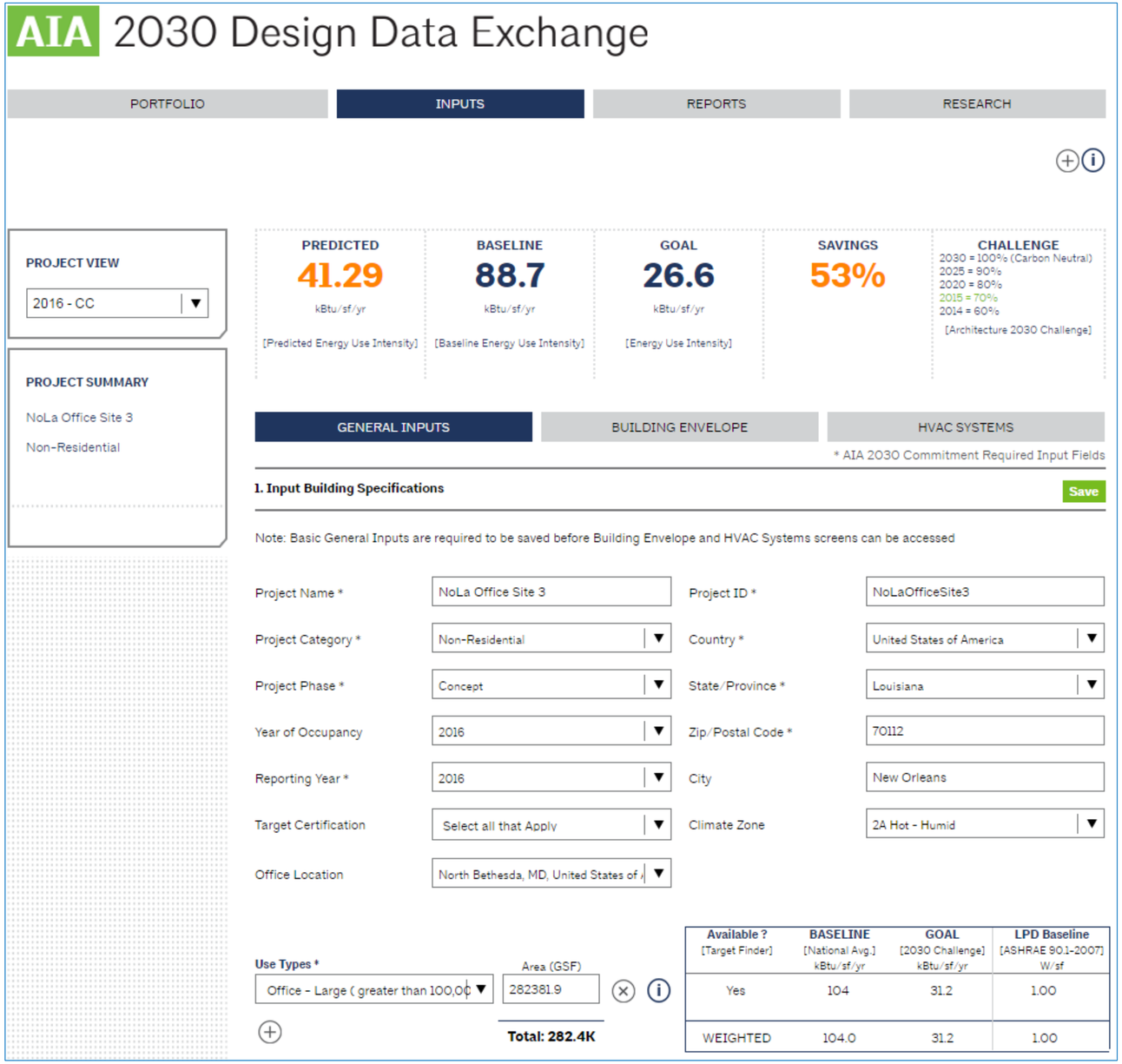


Source: AIA 2030 Commitment 2014 Progress Report

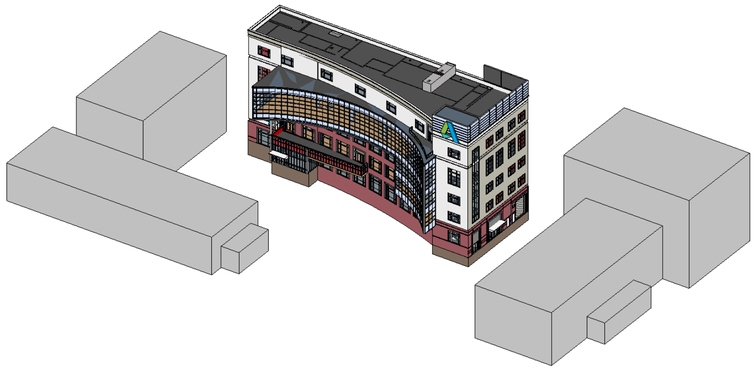
AIA 2030

500 Firms [LINK]

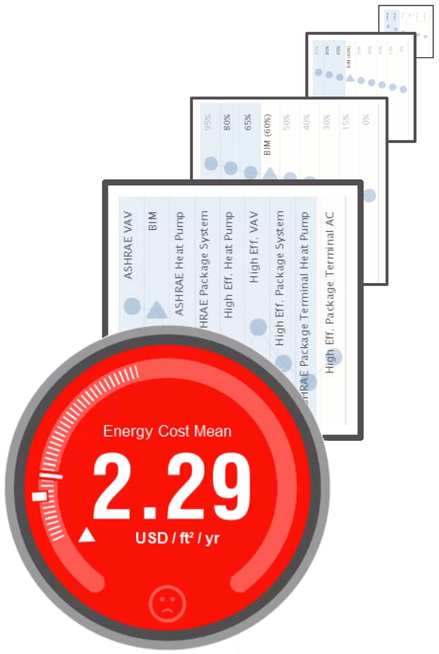
2030 DDx [LINK]



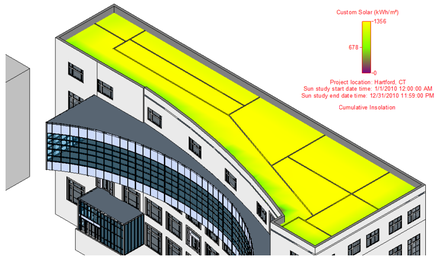
What is Insight?



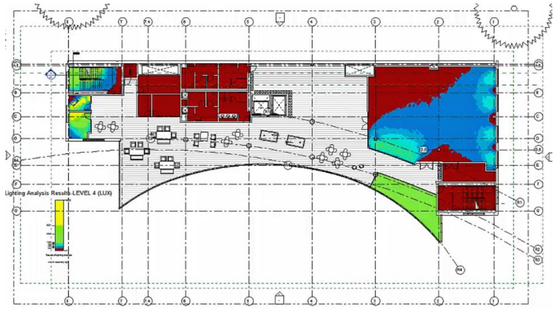
From any Revit Model
(FormIt – Conceptual)



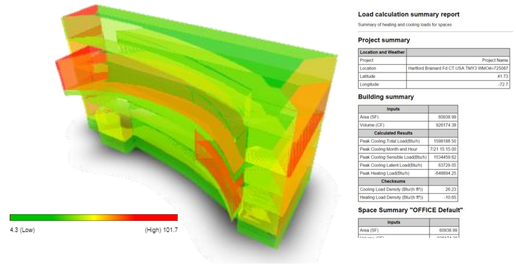
Building Energy



Solar Radiation

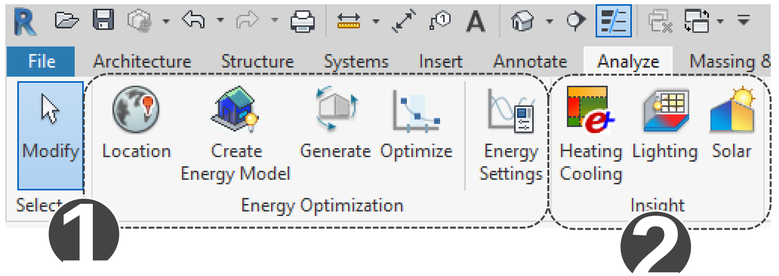


Daylighting



Heating/Cooling

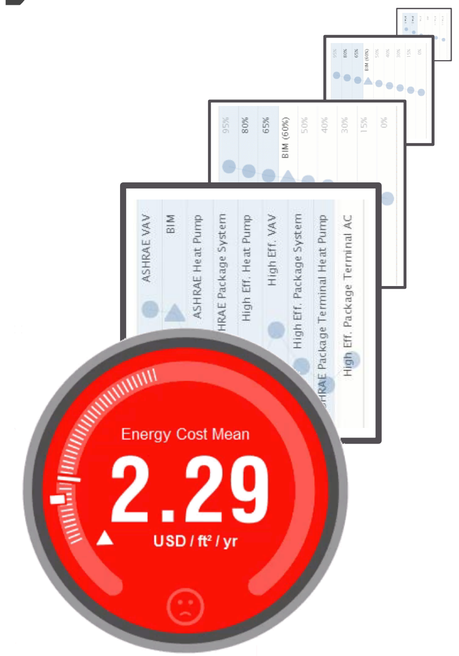
What is Insight?



Revit / AEC Collection Subscription Feature

Installed w/ Revit as 'Energy Optimization'

1



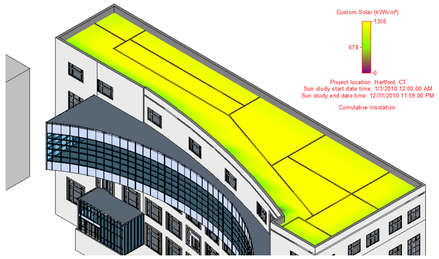
Building Energy

+

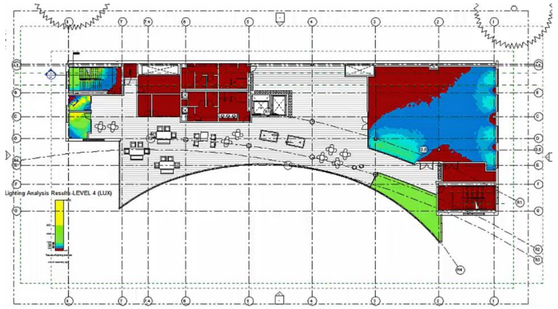
*** Revit 2017.1+**

Download & Install the Revit Plugin

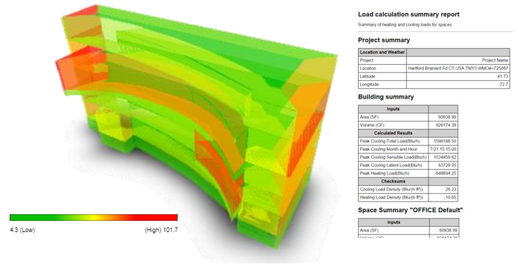
2



Solar Radiation



Daylighting



Heating/Cooling

LINK

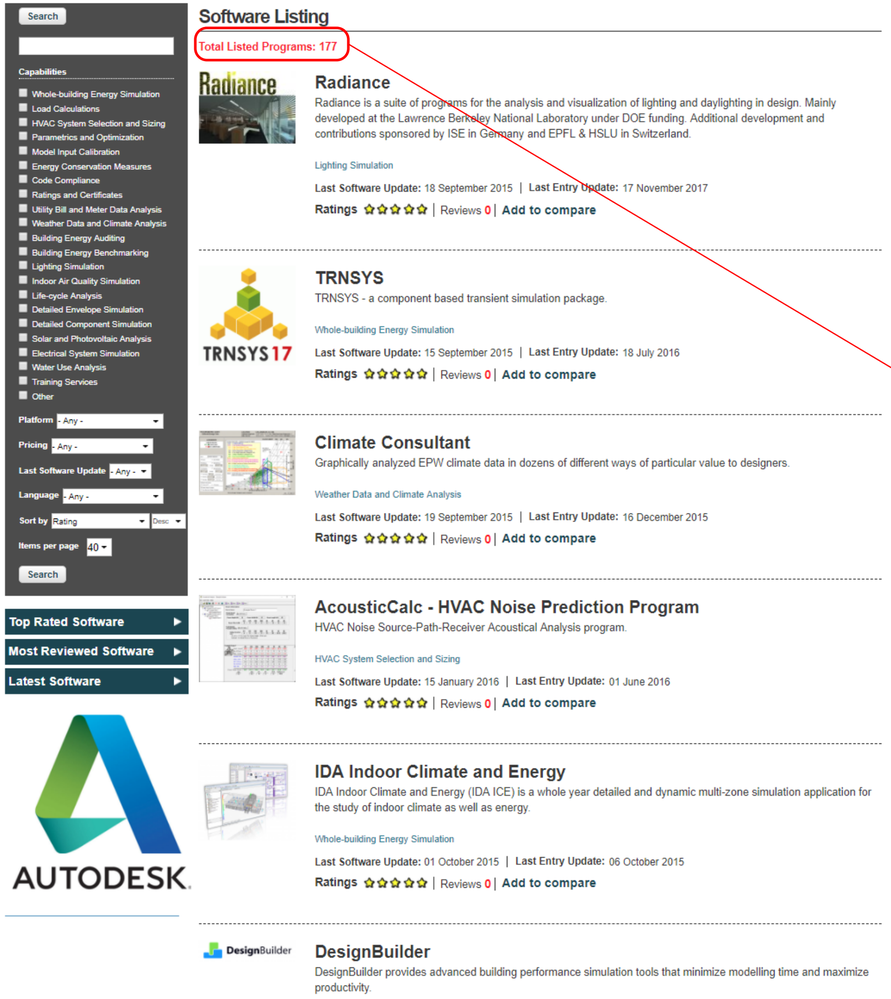
How is Insight Different?

https://www.buildingenergysoftwaretools.com/

BEST Directory

Building Energy Software Tools

Formerly hosted by US Dept. of Energy

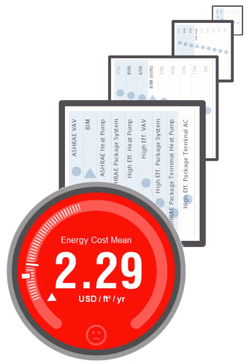


Total Listed Programs: 177

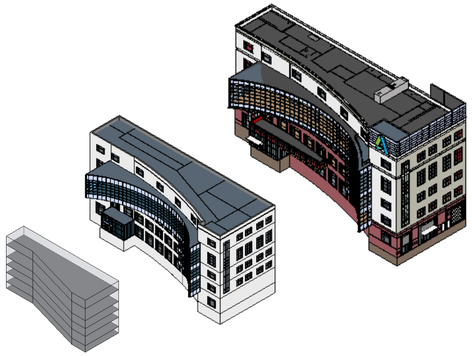
How is Insight Different?

BIM

How is Insight Different?



BUILDING ENERGY

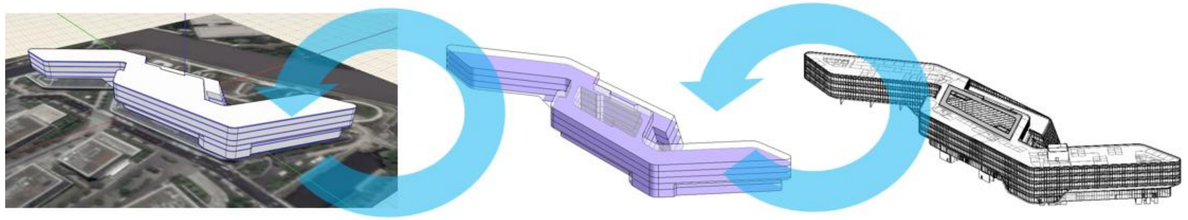


Direction & Accuracy		Position & Precision !
Concept to Detail		Detailed Design !
Architect+Engineer+Client		Specialist/Engineer !
One Model		A Separate Model !
Every Project		Special Projects Only !

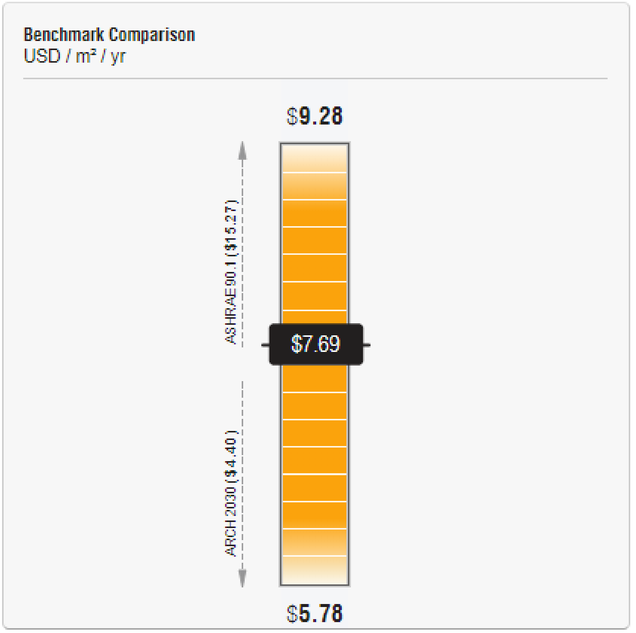
Shanghai HQ

JCI / Autodesk / MasterGraphics.aec

JCI



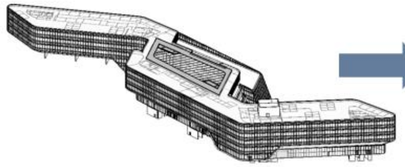
FormIt → Revit



Clay Nesler • 1st

VP, Global Energy and Sustainability at Johnson Controls

Johnson Controls • University of Illinois at Urbana-Champaign



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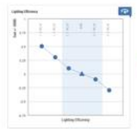
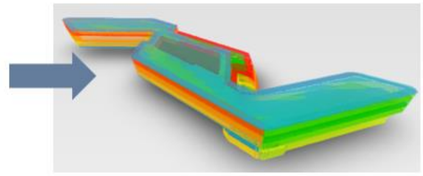
+ ASHRAE 140 validation

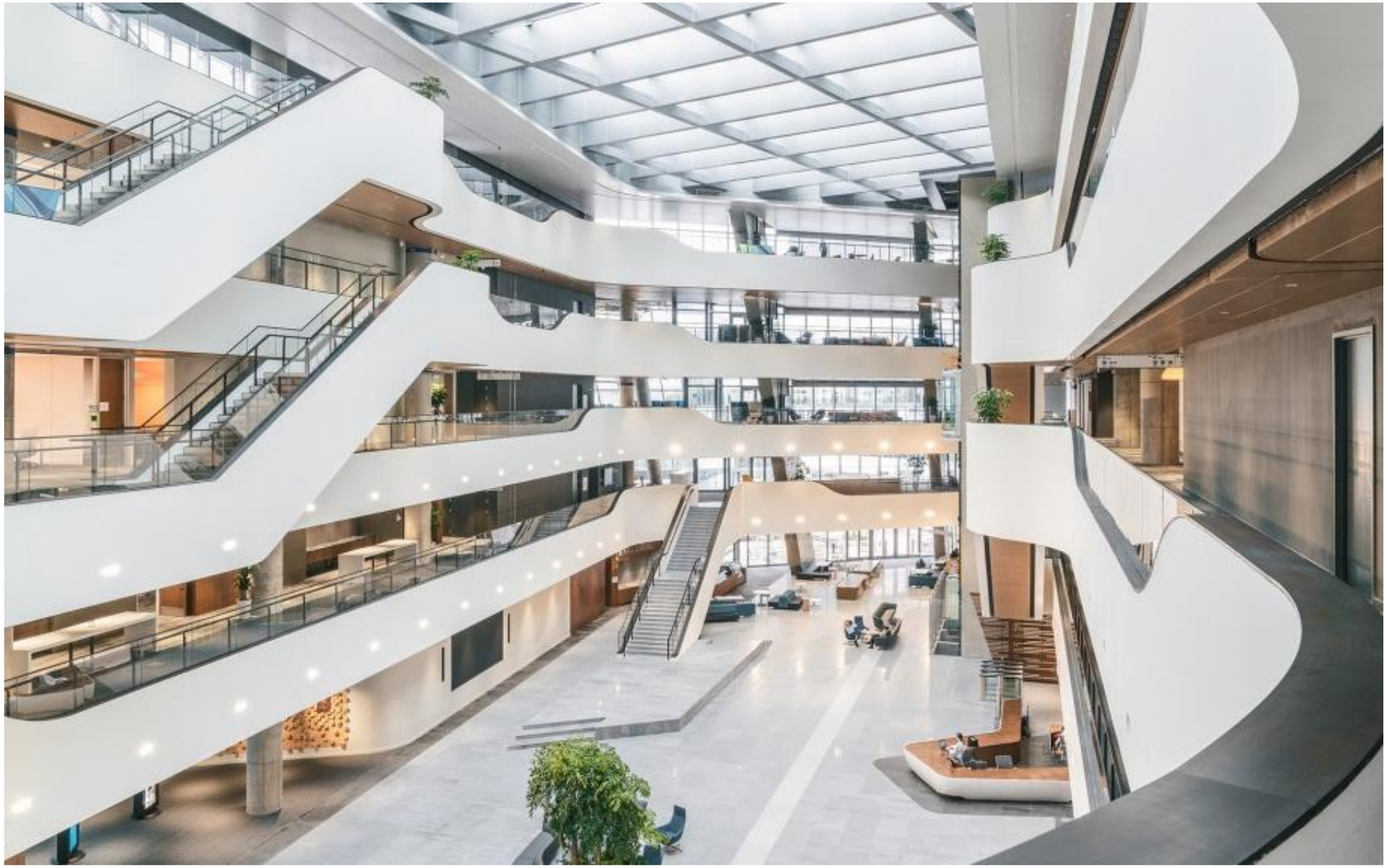




JCI

THE FIRST TRIPLE-CERTIFIED GREEN BUILDING IN CHINA PAVES THE WAY TOWARD A MORE SUSTAINABLE FUTURE

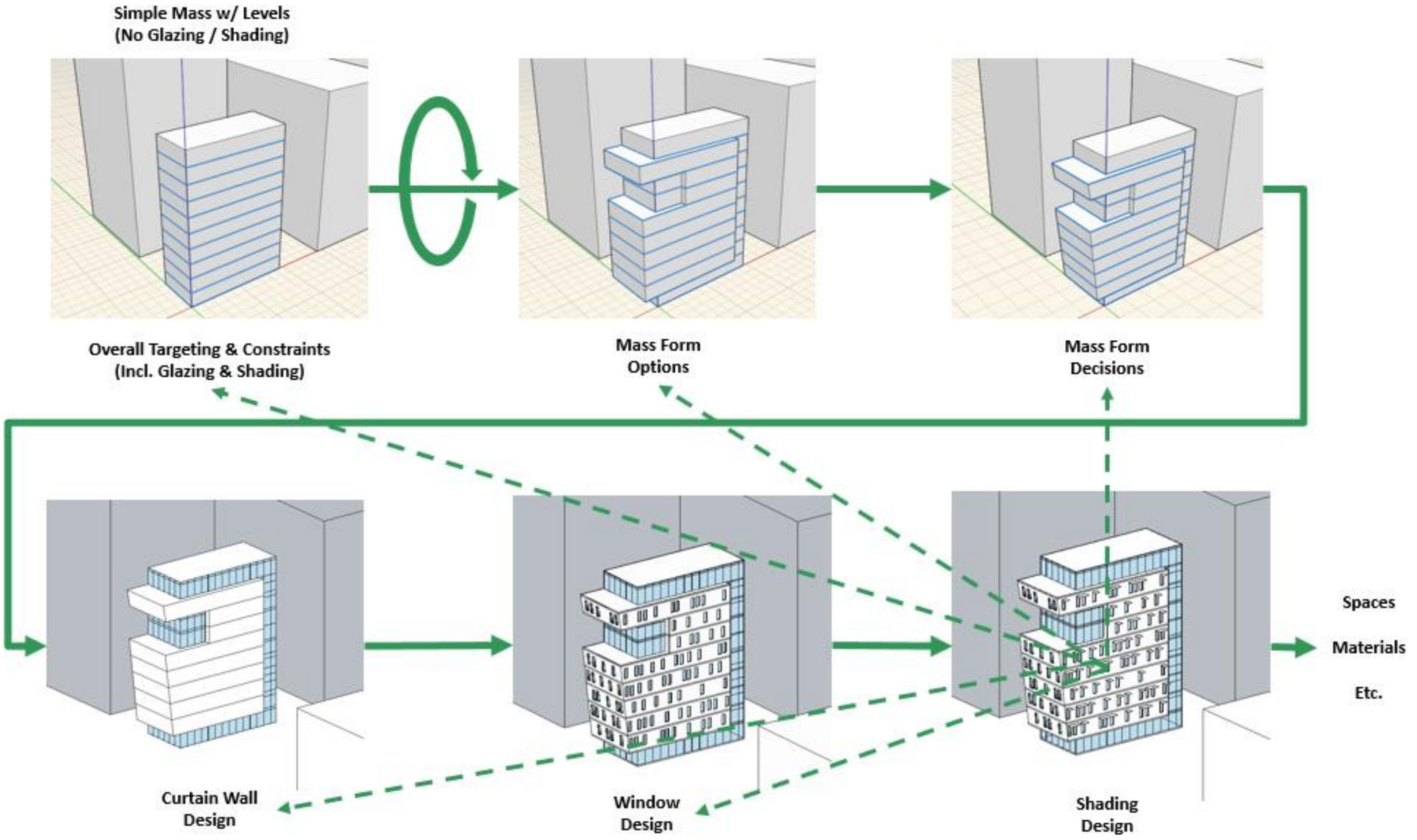
JCI



JCI headquarters, 45,000-square meter building, sets a new standard for green and smart buildings, being the first in China to receive several top global energy efficiency awards including:

- IFC-World Bank Group’s EDGE (Excellence in Design for Greater Efficiencies) Certification
- U.S. Green Building Council’s LEED (Leadership in Energy and Environmental Design) Platinum Certification
- China Green Building Design Label Three Star Certification.

JCI Energy Performance

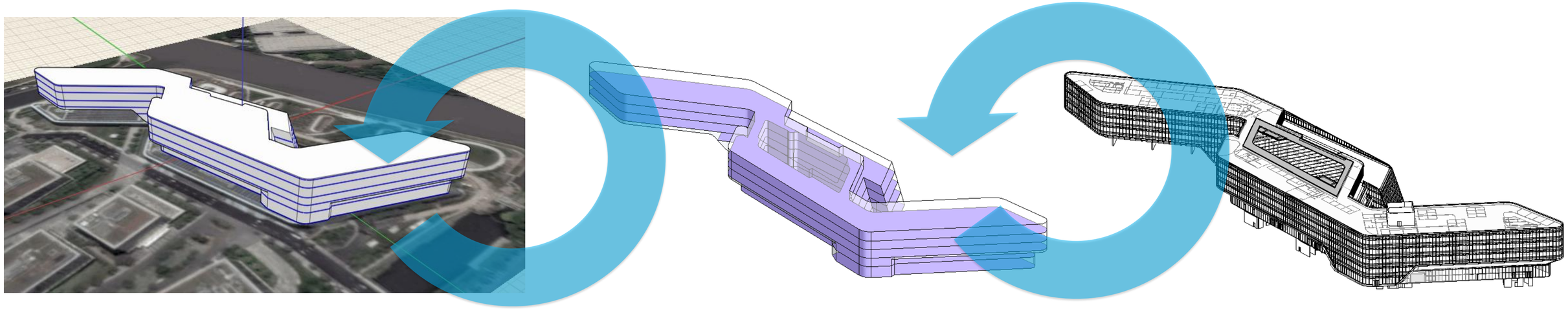


[LINK]

Frictionless, Reliable, Scalable

JCI Energy Performance

Cohesive and Scalable



FormIt → ← **Revit**

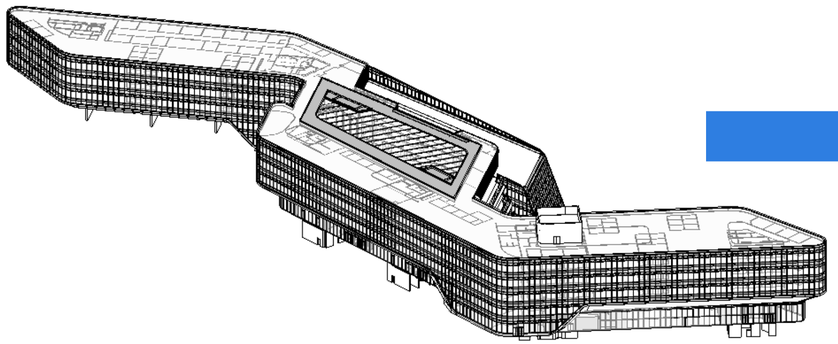
Understand and optimize performance throughout the design process-
Get performance feedback when you need it, not when your model is ready

JCI Energy Performance

Energy Range Paradigm with Real Time Feedback on any Model

AU Class: BLD196888-L

Better Design Insight = Better Building Performance!



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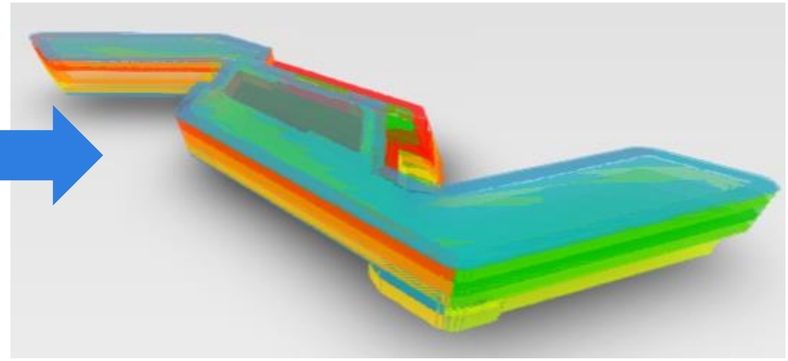


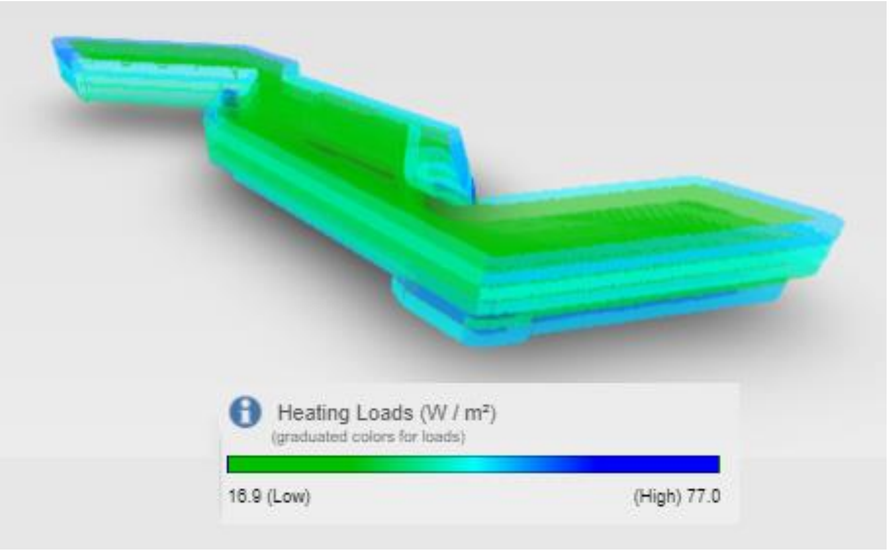
Hundreds of full whole building energy simulations automatically performed.
Providing you with an interactive range of potential design scenarios

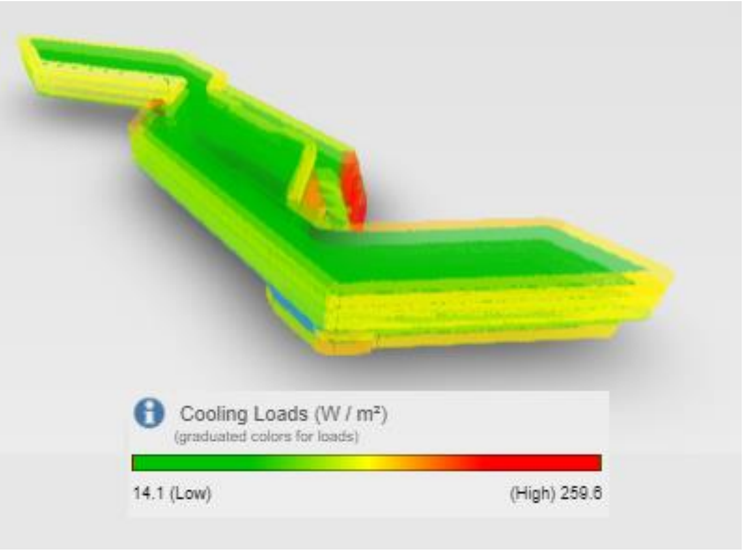
Heating / Cooling Loads Table and Visual

The heating and cooling loads in the baseline model are calculated using EnergyPlus hourly simulation engine for design days.

Building summary

Inputs	
Area (SF)	406421.03
Volume (CF)	6393672.00
Calculated Results	
Peak Cooling Total Load(Btu/h)	6095364.00
Peak Cooling Month and Hour	7/21 16:00:00
Peak Cooling Sensible Load(Btu/h)	5801523.50
Peak Cooling Latent Load(Btu/h)	293837.91
Peak Heating Load(Btu/h)	-4129501.25
Checksums	
Cooling Load Density (Btu/(h·ft²))	15.00
Heating Load Density (Btu/(h·ft²))	-10.16



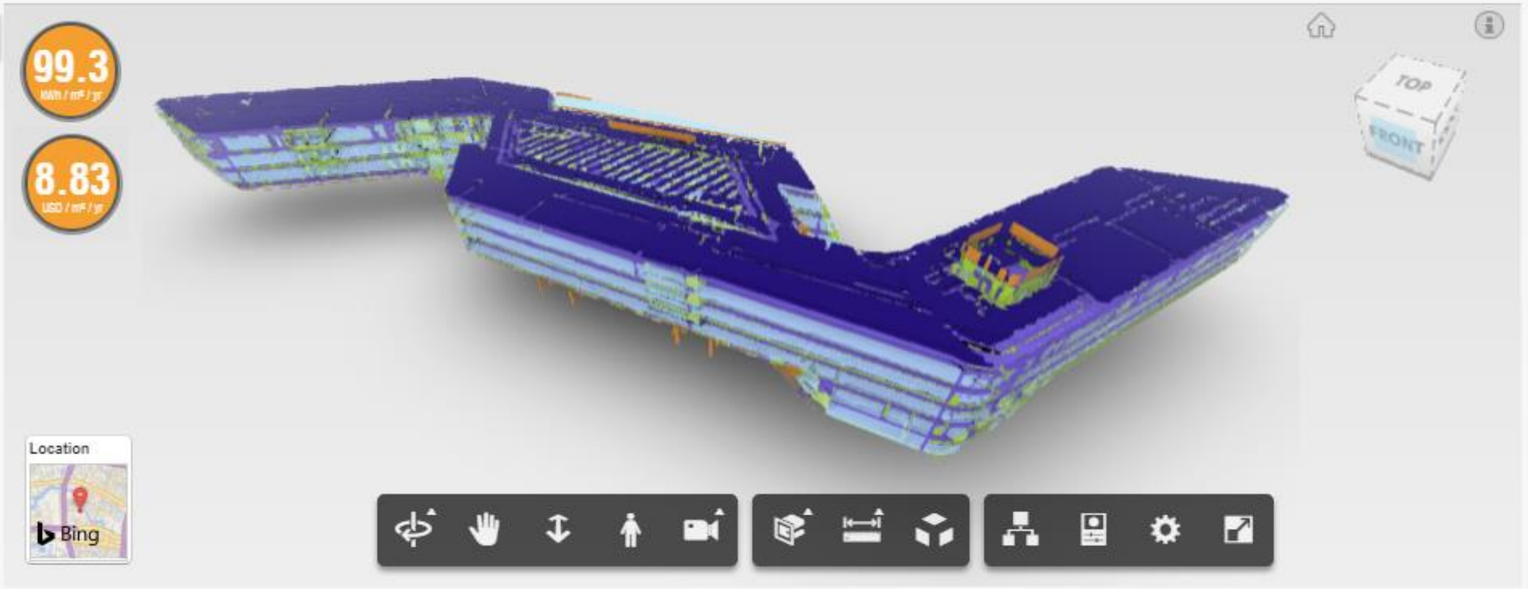


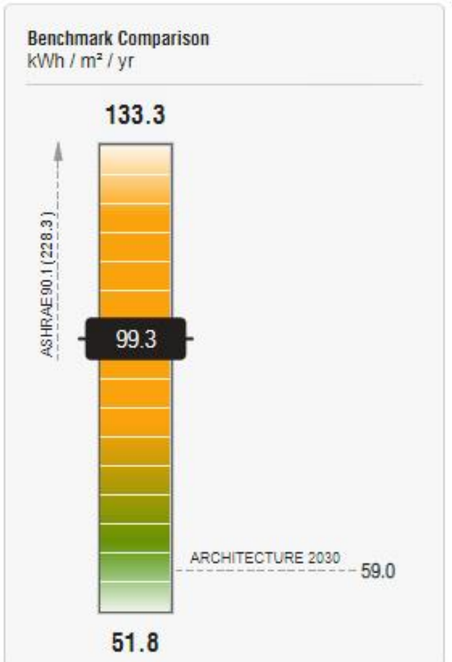
Components	Cooling		Heating	
	Loads(Btu/h)	Percentage of Total	Loads(Btu/h)	Percentage of Total
Wall	-877618.12	-14.40	-864756.19	-14.91
Window	3576154.50	58.67	3366379.25	58.03
Door	0.00	0.00	0.00	0.00
Roof	-768840.94	-12.61	-780564.94	-13.46
Partition	-1016701.31	-16.68	-1016701.31	-17.53
Floor	-509786.25	-8.36	-500759.12	-8.63
Infiltration	257194.95	4.22	212966.80	3.67
Ventilation	0.00	0.00	0.00	0.00
Lighting	2447163.25	40.15	2422644.50	41.76
Power	2181914.00	35.80	2168716.25	37.38
People	805882.75	13.22		
Other	0.00	0.00	0.00	0.00
Total	**6095364.00**	100.0	**5801042.00**	100.0

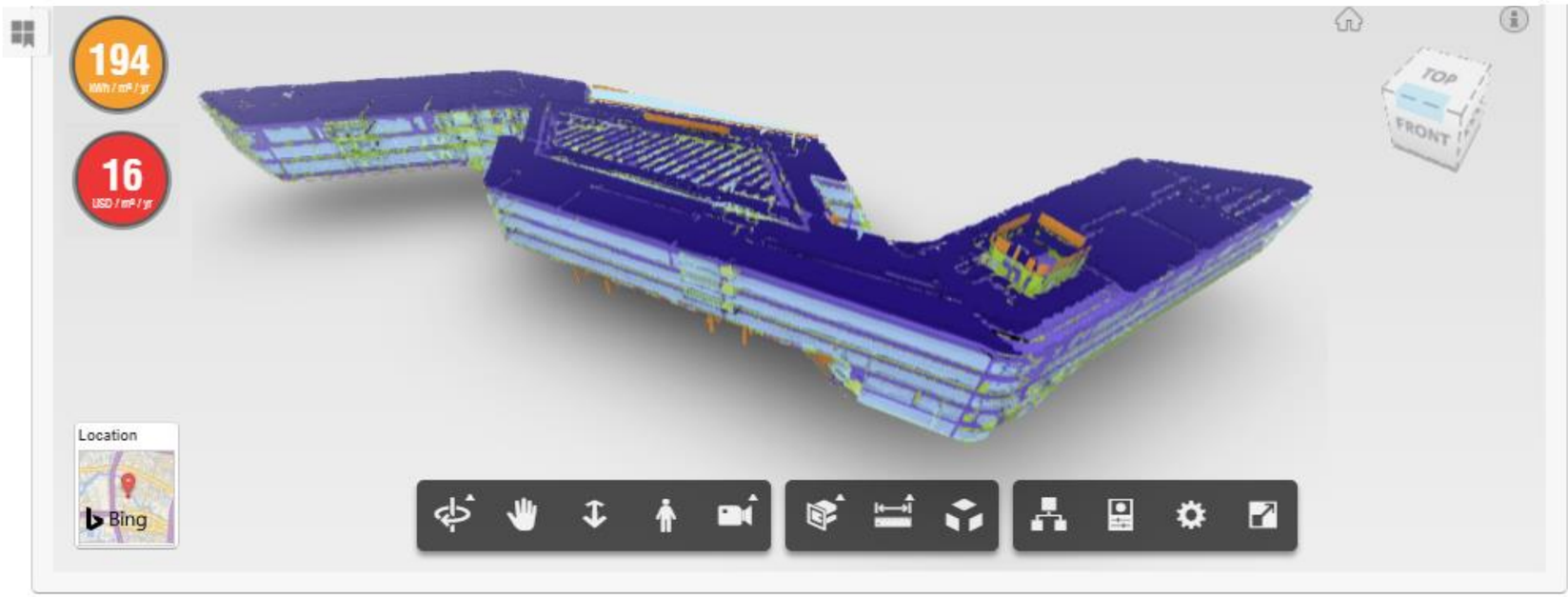
In the default color-coding scheme, blue indicates higher heating loads and green indicates lower heating loads. For the cooling loads, red indicates higher cooling loads and green indicates lower heating loads.

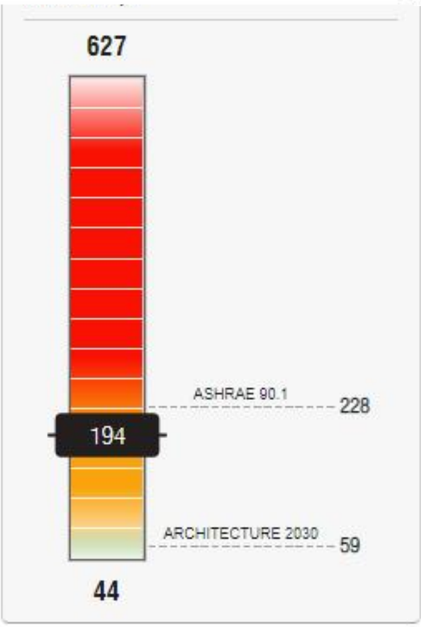
JCI Findings

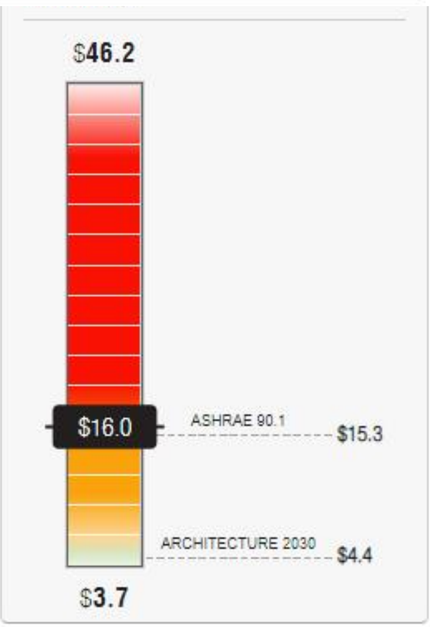
Building Form



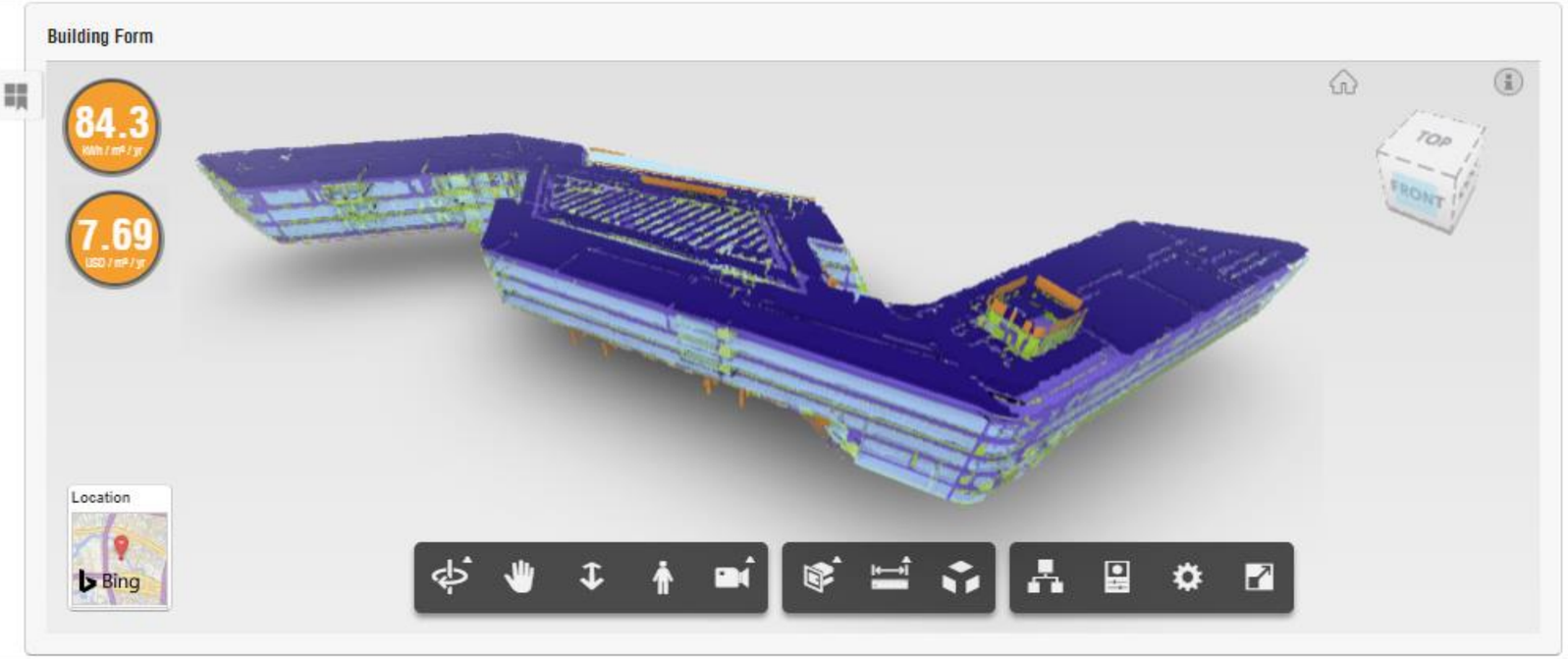


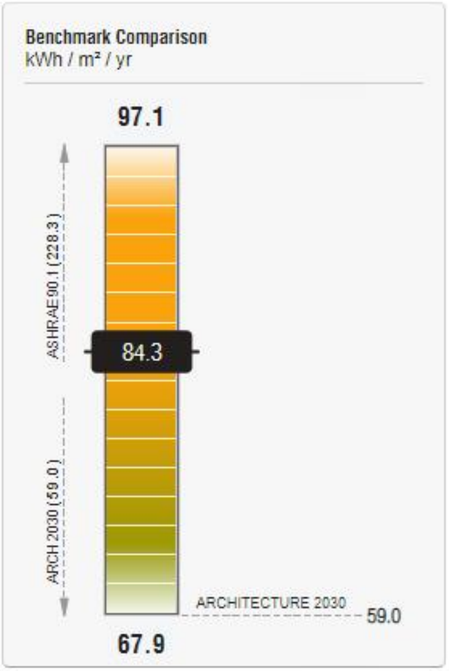


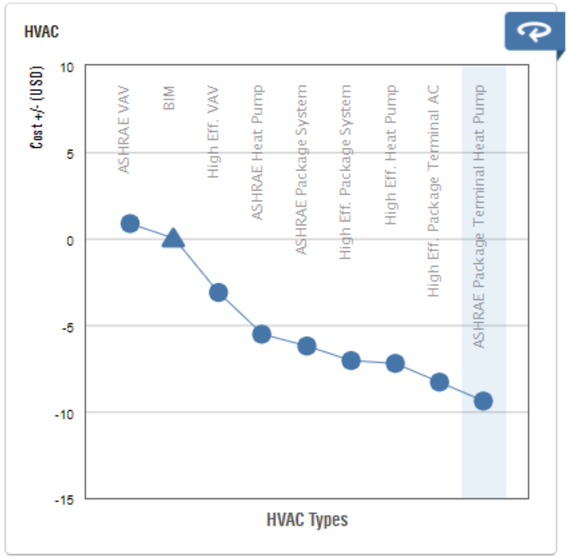


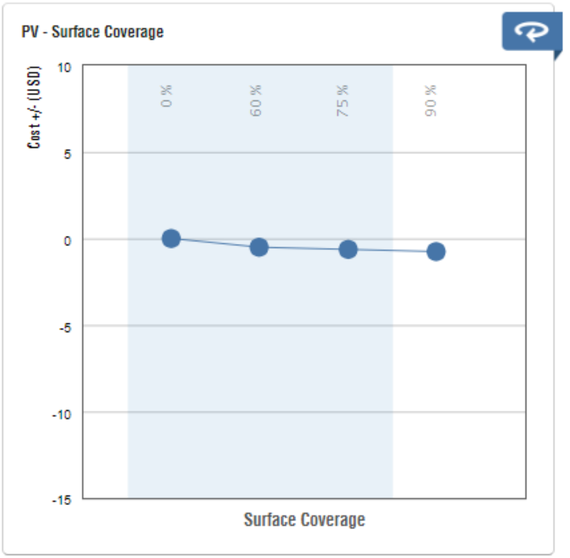


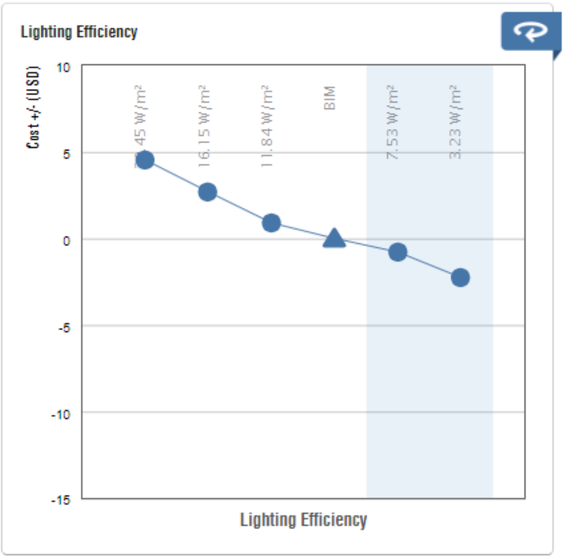
JCI Findings











JCI Energy Performance

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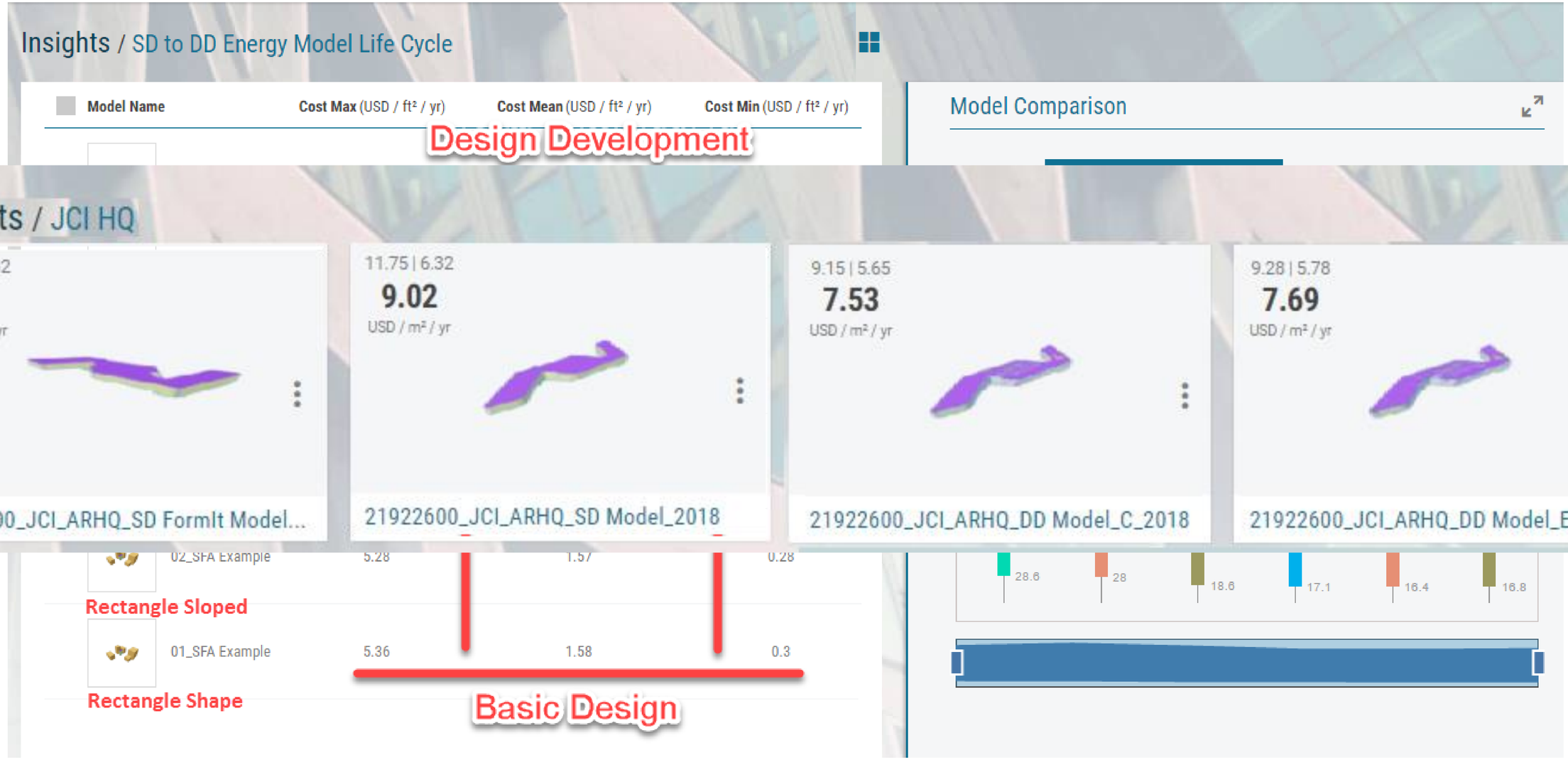
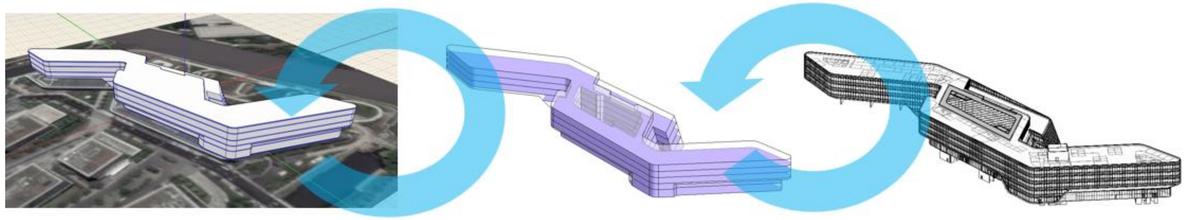
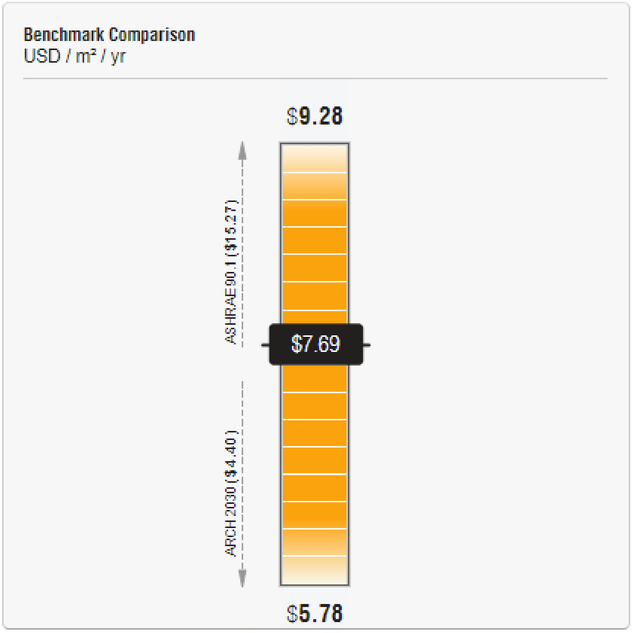


Energy performance—as a *range*

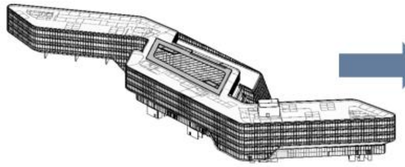
JCI – Summary



FormIt → Revit



Clay Nesler • 1st
VP, Global Energy and Sustainability at Johnson Controls
Johnson Controls • University of Illinois at Urbana-Champaign



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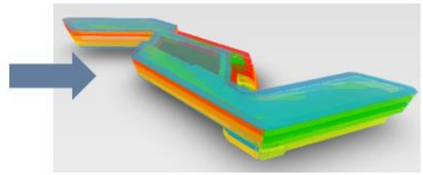


Perkins + Will

Converting existing Grasshopper, Rhino, EnergyPlus, Ladybug, Honeybee, and OpenStudio workflow

The workflow that is shown is based on a Perkins + Will relocatable classroom building (Sprout Space). This was first presented at the ACADIA conference by John Haymaker called “Design Space Construction”

Goals

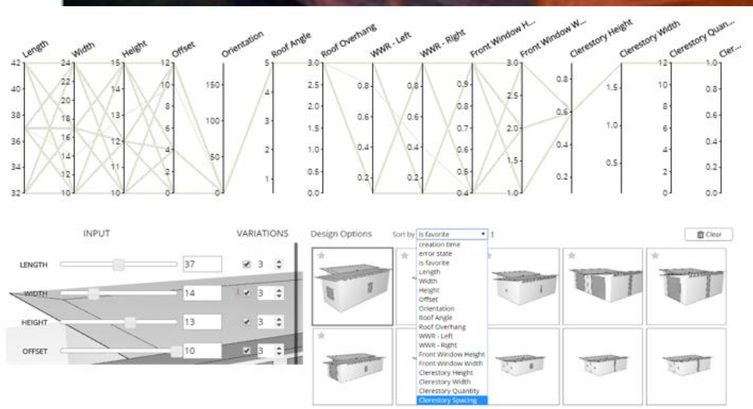
- Alternative Generation
- Minimize Energy Consumption
- Maximize Daylight
- Maximize View Quality

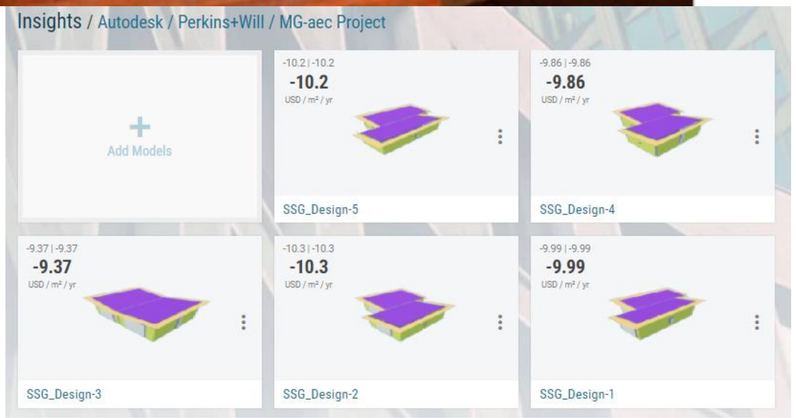
- Sprout Space LINK

- acadia Conference LINK

John Haymaker • 1st
Educator, Researcher, Technologist
Perkins+Will • Stanford University

Director of Research
Perkins+Will
2013 – Present • 5 yrs
Greater Atlanta Area

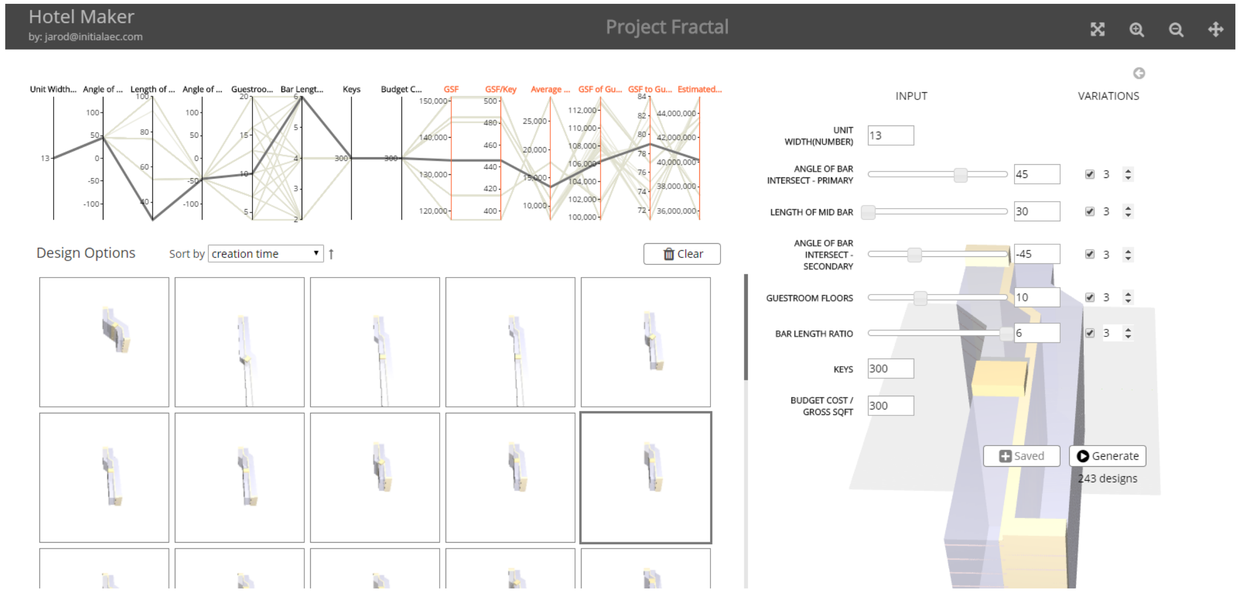


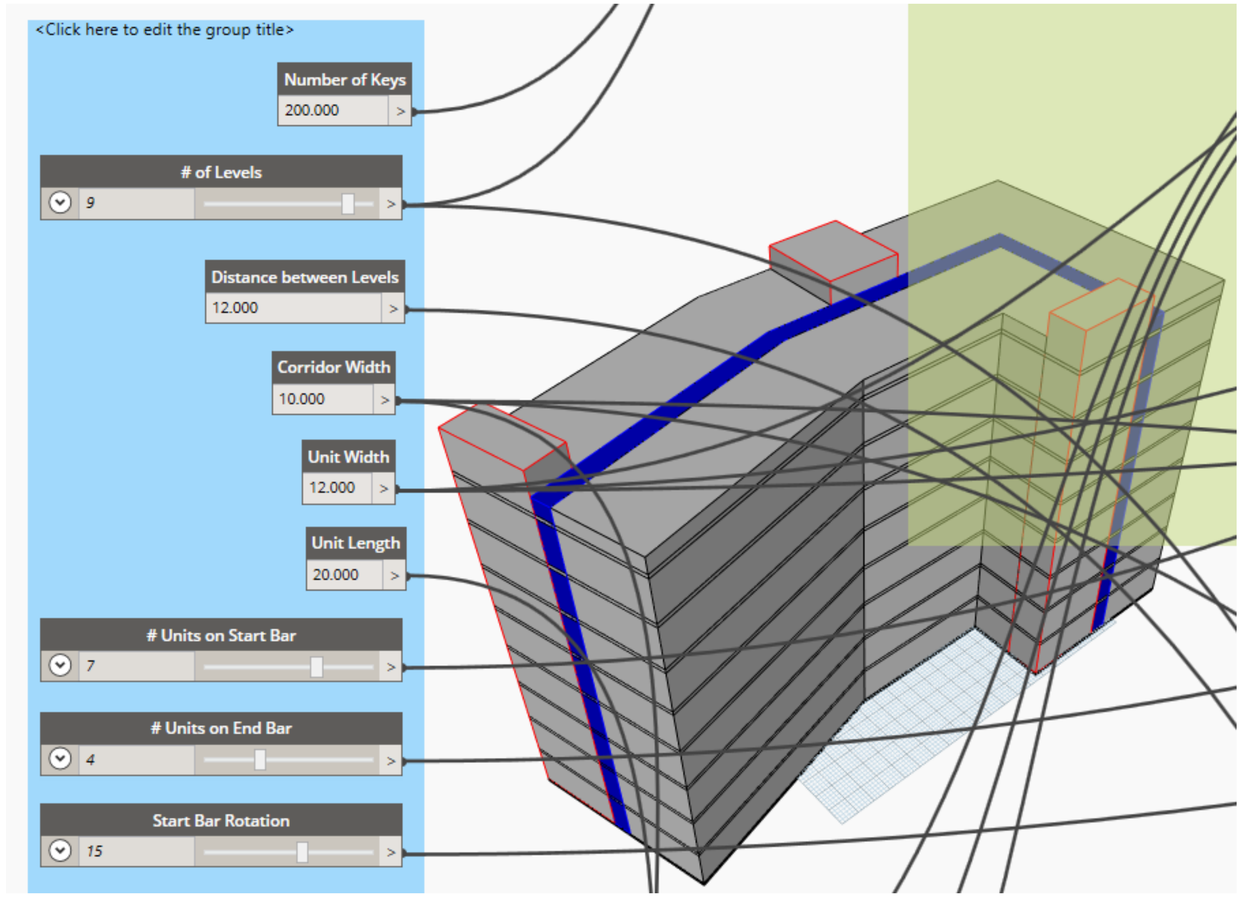


Perkins + Will

Dynamo, Fractal - Informed Decisions about Designs

- Rapid design iteration and broad interoperability
- Lightweight scripting interface
- Fractal – Automating “What If” Decisions
- Sprout Space: 9.5 million Design Alternates





Alternative Generation LINK Sprout Space Fractal LINK Building Maker LINK

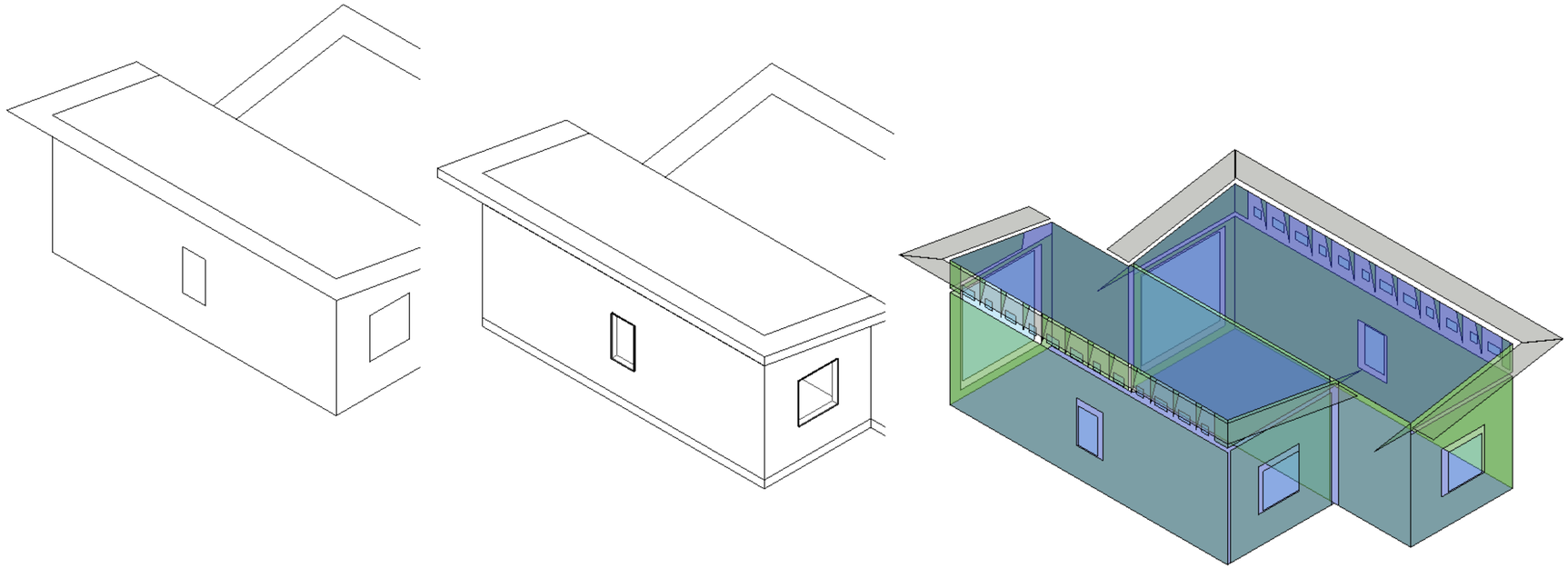
Perkins + Will

Fractal to Revit Mass to Building Elements

Goals

- Revit Centric, didn’t want to use FormIt
- Energy Consumption
- Daylight
- View Quality
- Solar Analysis

- Insight LINK



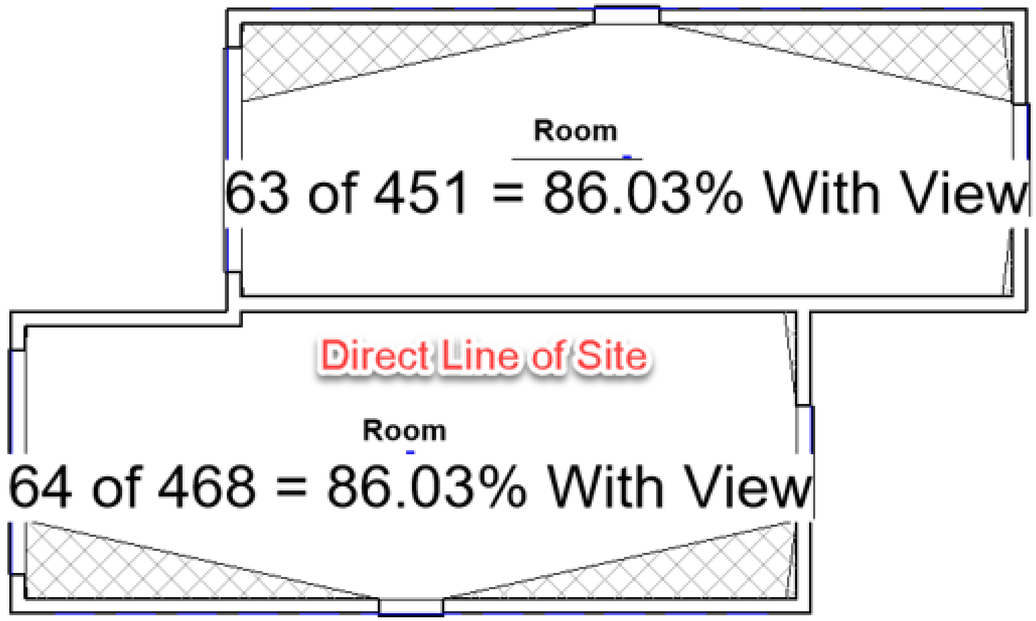
Perkins + Will

View Analysis

The Direct Line of Sight (DLS) that calculates the percentage of the floor area of the building with exterior view

The Dark Areas
The extent of glazing, as viewed in plan, is used to determine the 'areas with no views'. This concept is taken from LEED 4.0:
"Achieve a direct line of sight to the outdoors via vision glazing for 75% of all regularly occupied floor area. View glazing in the contributing area must provide a clear image of the exterior, not obstructed by frits, fibers, patterned glazing, or added tints that distort color balance."

The method that calculates the floor area, is taken from LEED 2009 IEQ Credit 8.2 Daylight and views. In this method, the plan view angle through the glazed area considers the actual wall thickness for punched windows. In plan, two diagonal lines are drawn, one connecting the exterior left wall opening corner to the interior right wall opening corner, and the other connecting the exterior right wall opening corner to the interior left wall opening corner. This is done for each glazed opening. These two diagonal lines are extended towards the interior. Wherever diagonal lines of adjacent windows intersect, the area contained within these diagonal lines and the associated wall or walls is regarded as an 'area with no view' or dark area. The DLS indicator of this case study is 0.830265, or 85%, which is above the recommended reference of 75.



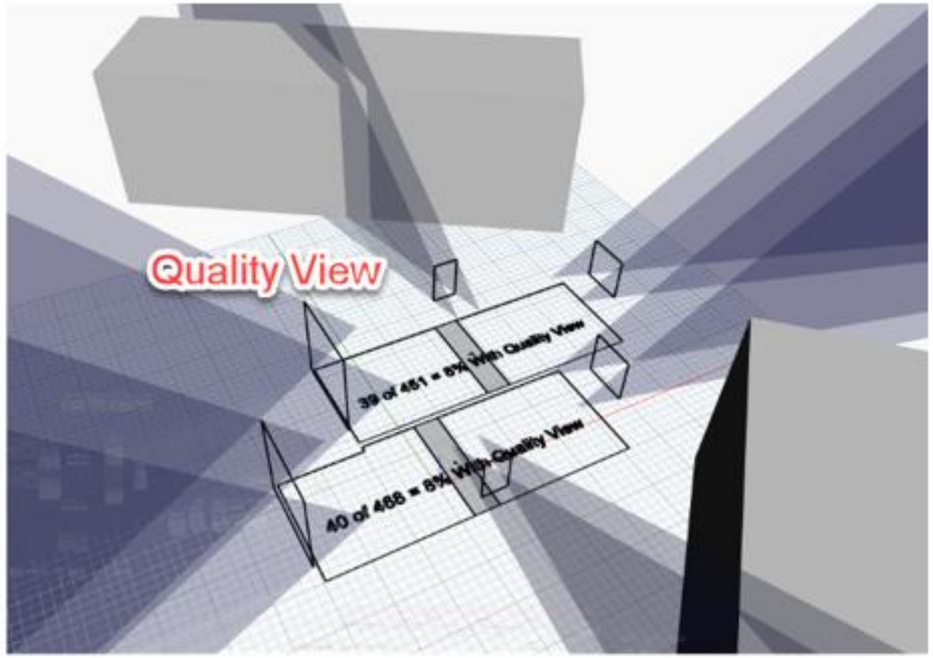
Perkins + Will

View Analysis

Quality View (QV) that calculates the percentage of the area that allow the view of some relevant elements of the landscape.

DLS assures people can see out of the building, but this says nothing about the quality of that view. The QV indicator is inspired by the Quality View definition in LEED V4. It is based on a two-dimensional interpretation of the building. It represents a 2D viewing angle from each sampled view point inside the building, as it would be represented in a section, and computes the intersection of these 2D fields with relevant elements of the landscape, see Figure 3.0 / 3.7.

For the purpose of this case study, the triangular meshes representing the 2D viewing angles are used to intersect elements in the context model of two buildings masses of visual interest. When an intersection is found, it is counted towards a quality view area, represented as a blue area on the center of the space. This method requires a mesh representation of the relevant elements of the landscape. The QV indicator of this case study is 0.237862 that corresponds to almost 24% of the floor plan area of the building.



Direct Line of Sight Data

	A	B	C	D	E
1					
2		Room	Dark Area	Room Area	Percentage with View
3		Room 1	81.24487918	433.7777778	82
4		Room 2	81.63543519	452.8888889	82

Quality of View Data

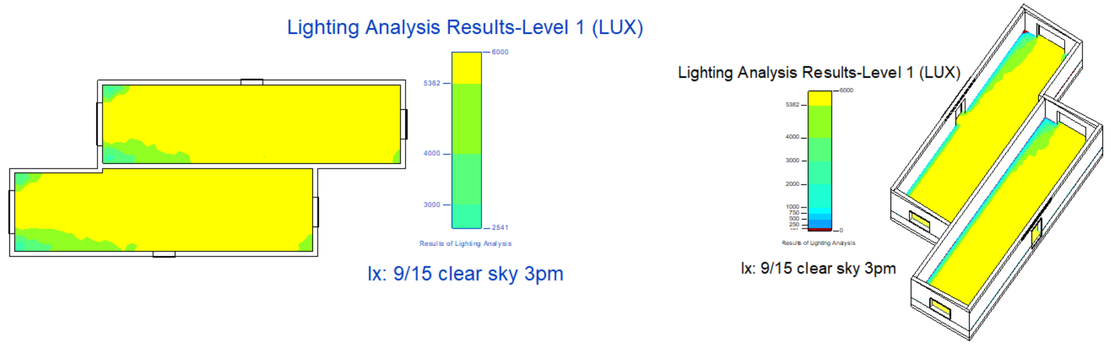
	A	B	C	D	E
1					
2		Room	Area with View	Room Area	Percentage with Quality View
3		Room 1	32	433.7777778	7
4		Room 2	34	452.8888889	7
5					

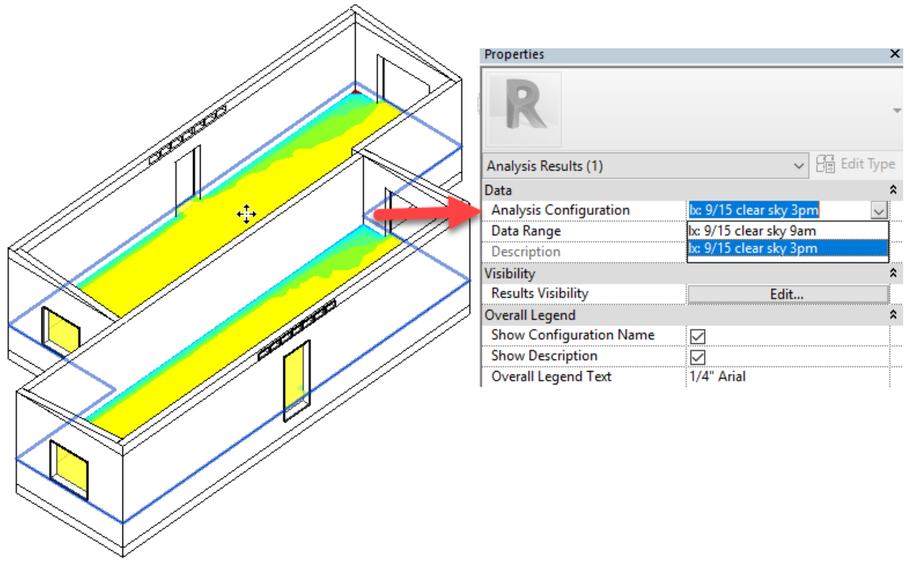
Perkins + Will

Lighting Analysis

The daylight simulation calculates the daylighting quantity and quality within the spaces of the building. This analysis calculates the Daylight Factor - the ratio between the interior and exterior illuminance levels of natural lighting. This plug-in provides “LEED IEQc8.1 2009” and “LEED v4 EQc7 opt2” results for most models in less than 15 minutes once the analysis is started.

Analysis Type	Description
Illuminance Analysis	Full custom control over date, time, threshold, and analysis plane height
Daylight Autonomy (sDA preview)	Sample calculation for LEED v4 EQc7 opt1 (sDA & ASE) Reduced cost & calculation time
LEED 2009 IEQc8 opt1	Automated settings for LEED 2009 IEQc8 opt1 settings
LEED v4 EQc7 opt1	Automated settings for LEED v4 EQc7 opt1 (sDA & ASE) settings
LEED v4 EQc7 opt2	Automated settings for LEED v4 EQc7 opt2 settings
Solar Access	Customizable hours of sun study





<_Lighting Analysis Room Schedule>

LEED v4 EQc7 opt2 Whole Building Results: 16315 Grevillea Ave, Lawndale, CA 90260

9am: 1% within & 3pm: 0% within thresholds

Solar Values (W/m2): 9/21 9am GHI: 486, DNI: 641, DHI: 89 & 9/21 3pm GHI: 454, DNI: 619, DHI: 88

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
						9am threshold results						3pm threshold results					
						within threshold		above threshold		below threshold		within threshold		above threshold		below threshold	
Level	Name	Number	Area	Include In Daylighting	Automated Shades	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area
Level 1	Room	1	434 SF	☑	☐	2	7 SF	99	427 SF	0	0 SF	1	2 SF	100	432 SF	0	0 SF
Level 1	Room	2	453 SF	☑	☐	1	5 SF	99	448 SF	0	0 SF	0	2 SF	100	451 SF	0	0 SF

Perkins + Will

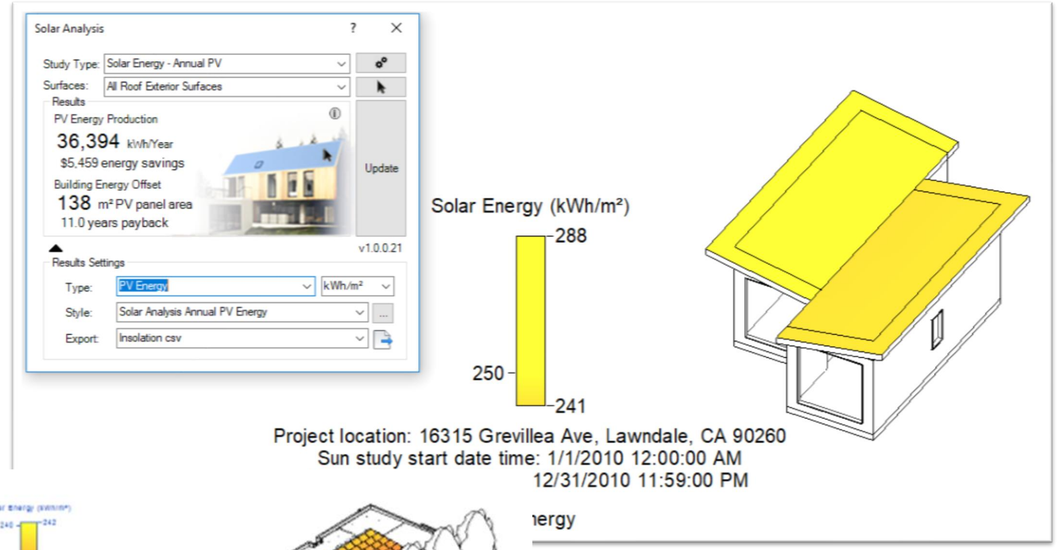
Solar Analysis

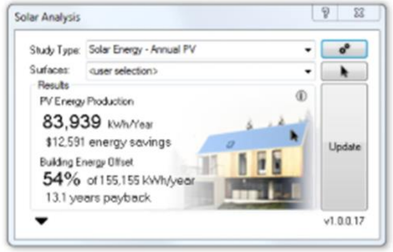
Insight Solar Analysis provides in context solar radiation analysis results to help you track solar energy throughout your design. Insight Solar Analysis with Revit uses the Perez Solar Model. For solar analysis studies you can use a conceptual mass, detailed building element model, or even a hybrid of the two.

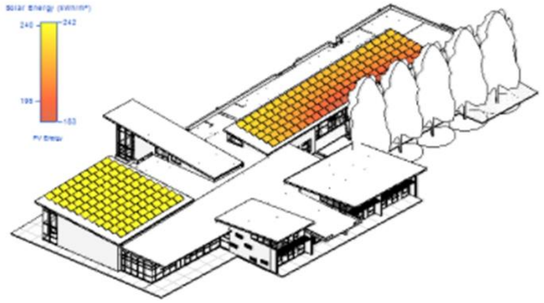
This model is used by the National Renewable Energy Lab (NREL) and their PVWatts® tool. Results from Insight Solar Analysis have been validated directly by NREL and findings conclude that differences between the results were less than 1% for surfaces oriented horizontal, east facing vertical, and south facing with latitude tilt angle.

Analysis Type	Description
Solar Energy – Annual PV	Annual simulation for determining PV energy production estimates
Custom	Customizable simulation for general solar insolation studies

It's important to note that Revit uses a variety of weather data for analysis, not just typical meteorological year (TMY) data. When comparing Insight Solar Analysis results to those from other tools, consider weather data sources and varying calculation methods when comparing results.







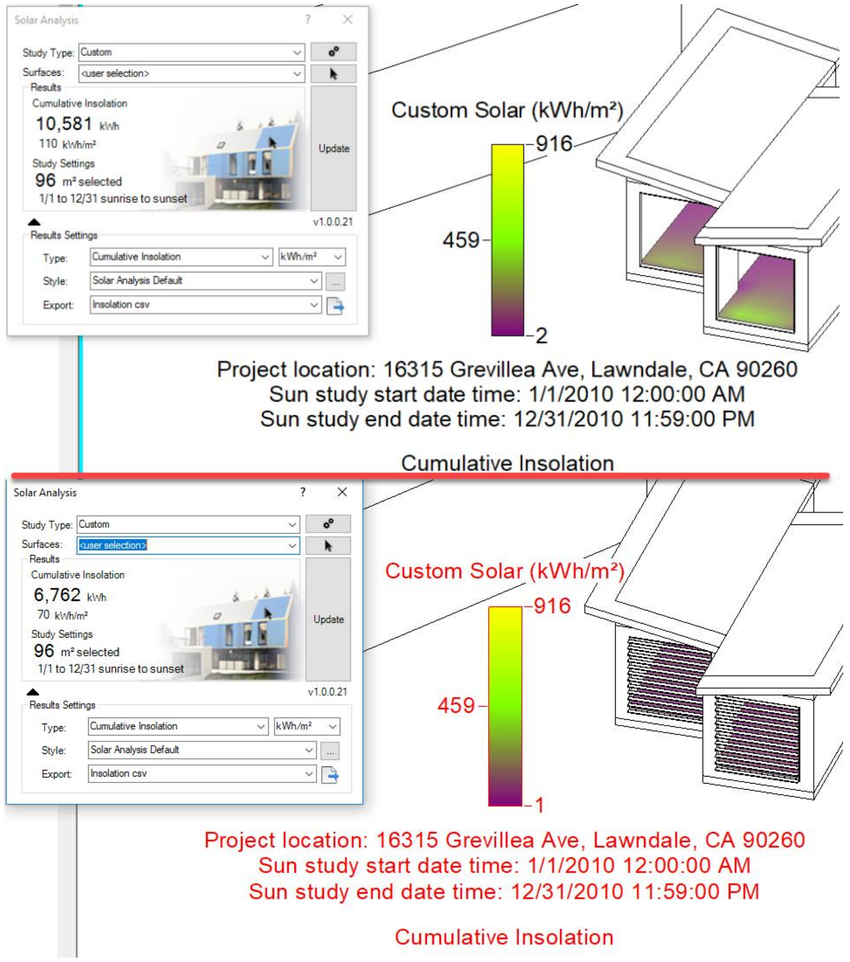
Perkins + Will

Louver Analysis

Below is an example of using the “user selection” option to select the inside floor surface to see how the “Model In-Place” shade device is affecting that surface.

Currently some firms use curtain mullions to represent shade devices but if you are wanting to see how the solar analysis is affecting the interior surfaces that process won’t work. Hopefully a future release will fix this but for today we will need to use a “Model In-Place” component to represent the shade device.

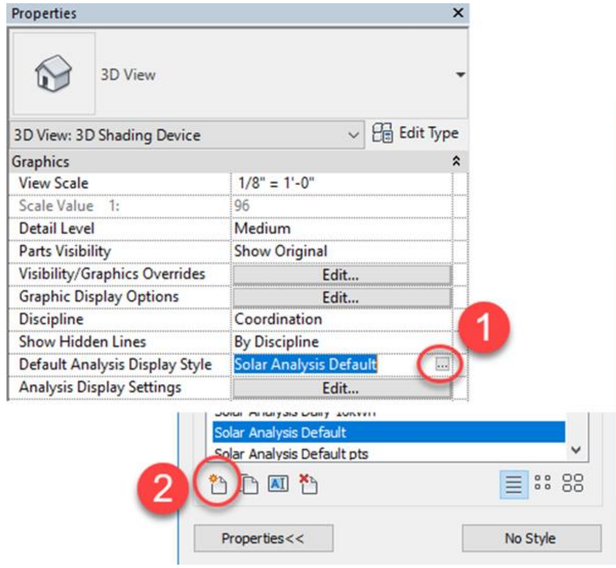
Surface Selection	Description
All Roof Exterior Surfaces	When selected for a model with building elements, this option automatically selects all Roof elements
All Mass Surfaces	When selected for a model with conceptual masses, this option automatically selects all mass faces
User Selection	This option allows you to select your own mass and building element surfaces for analysis

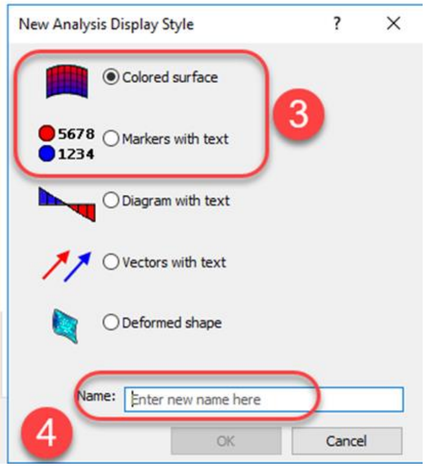


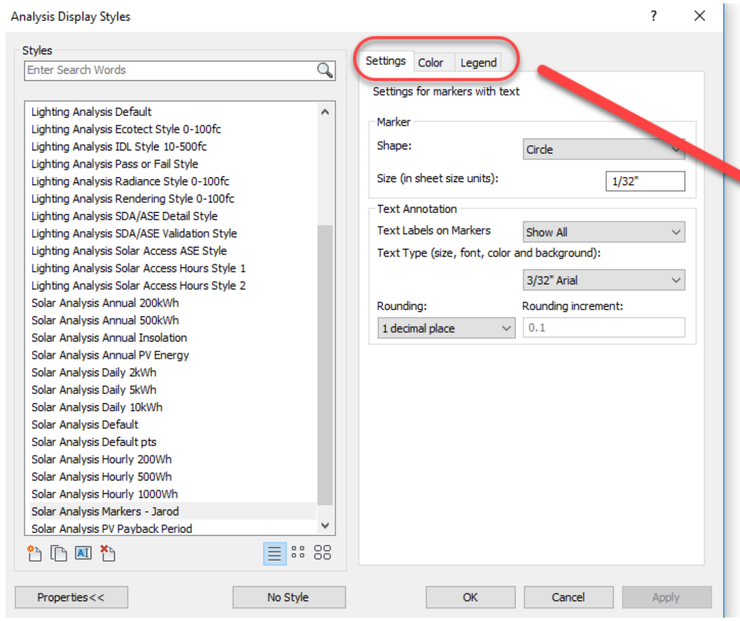
Perkins + Will

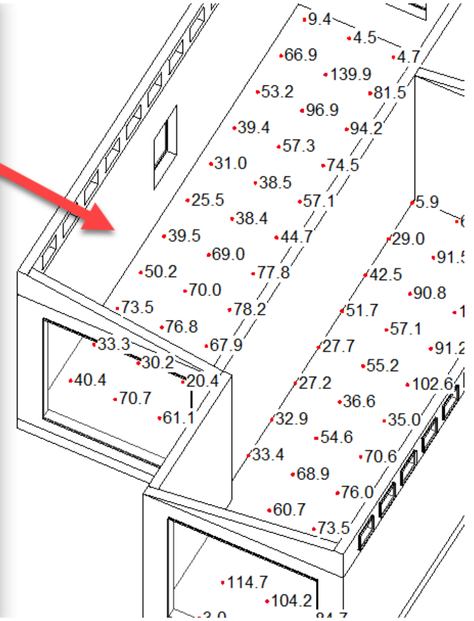
Analysis Visual Styles

For all analysis types, default analysis display styles are used to visualize results. Control the “Settings”, “Color”, and “Legend” in the respective tabs. Adding values associated with specific colors will allow you to highlight specific thresholds

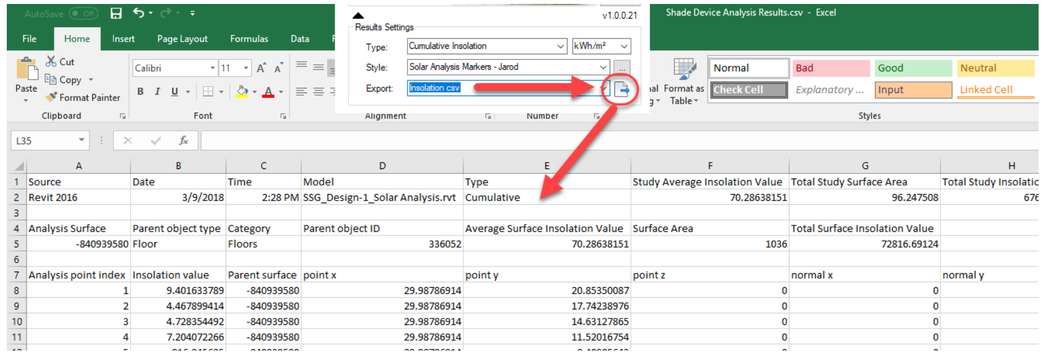








Once results have been generated in your 3D view, you can export analysis point location and associated data as a CSV. The resulting CSV will produce a summary of the simulation and list values of individual analysis points and their location in the model.



	A	B	C	D	E	F	G	H
1	Source	Date	Time	Model	Type	Study Average Insolation Value	Total Study Surface Area	Total Study Insolatic
2	Revit 2016	3/9/2018	2:28 PM	SSG_Design-1_Solar Analysis.rvt	Cumulative	70.28638151	96.247508	67
3								
4	Analysis Surface	Parent object type	Category	Parent object ID	Average Surface Insolation Value	Surface Area	Total Surface Insolation Value	
5	-840939580	Floor	Floors	336052	70.28638151	1036	72816.69124	
6								
7	Analysis point index	Insolation value	Parent surface	point x	point y	point z	normal x	normal y
8	1	9.401633789	-840939580	29.98786914	20.85350087	0	0	
9	2	4.467899414	-840939580	29.98786914	17.74238976	0	0	
10	3	4.728354492	-840939580	29.98786914	14.63127865	0	0	
11	4	7.204072266	-840939580	29.98786914	11.52016754	0	0	

Perkins + Will

Converting existing Grasshopper, Rhino, EnergyPlus, Ladybug, Honeybee, and OpenStudio workflow

The workflow that is shown is based on a Perkins + Will relocatable classroom building (Sprout Space). This was first presented at the ACADIA conference by John Haymaker called “Design Space Construction”

Goals

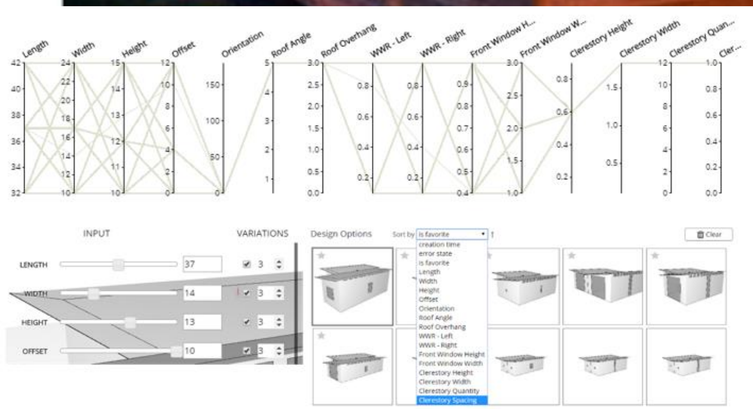
- Alternative Generation
- Minimize Energy Consumption
- Maximize Daylight
- Maximize View Quality

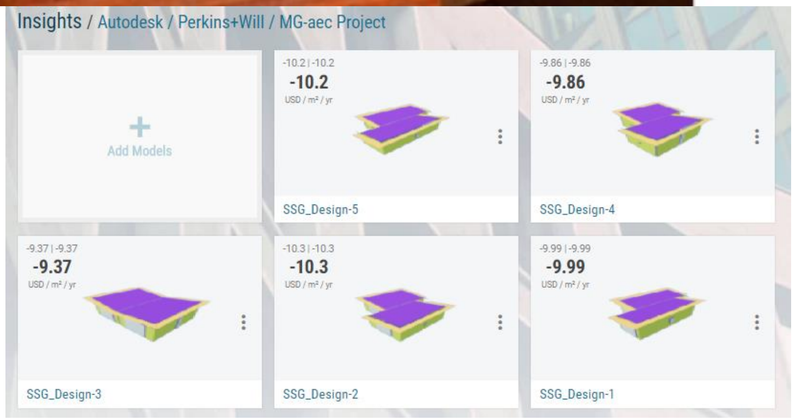
- Sprout Space LINK

- acadia Conference LINK

John Haymaker • 1st
Educator, Researcher, Technologist
Perkins+Will • Stanford University

Director of Research
Perkins+Will
2013 – Present • 5 yrs
Greater Atlanta Area

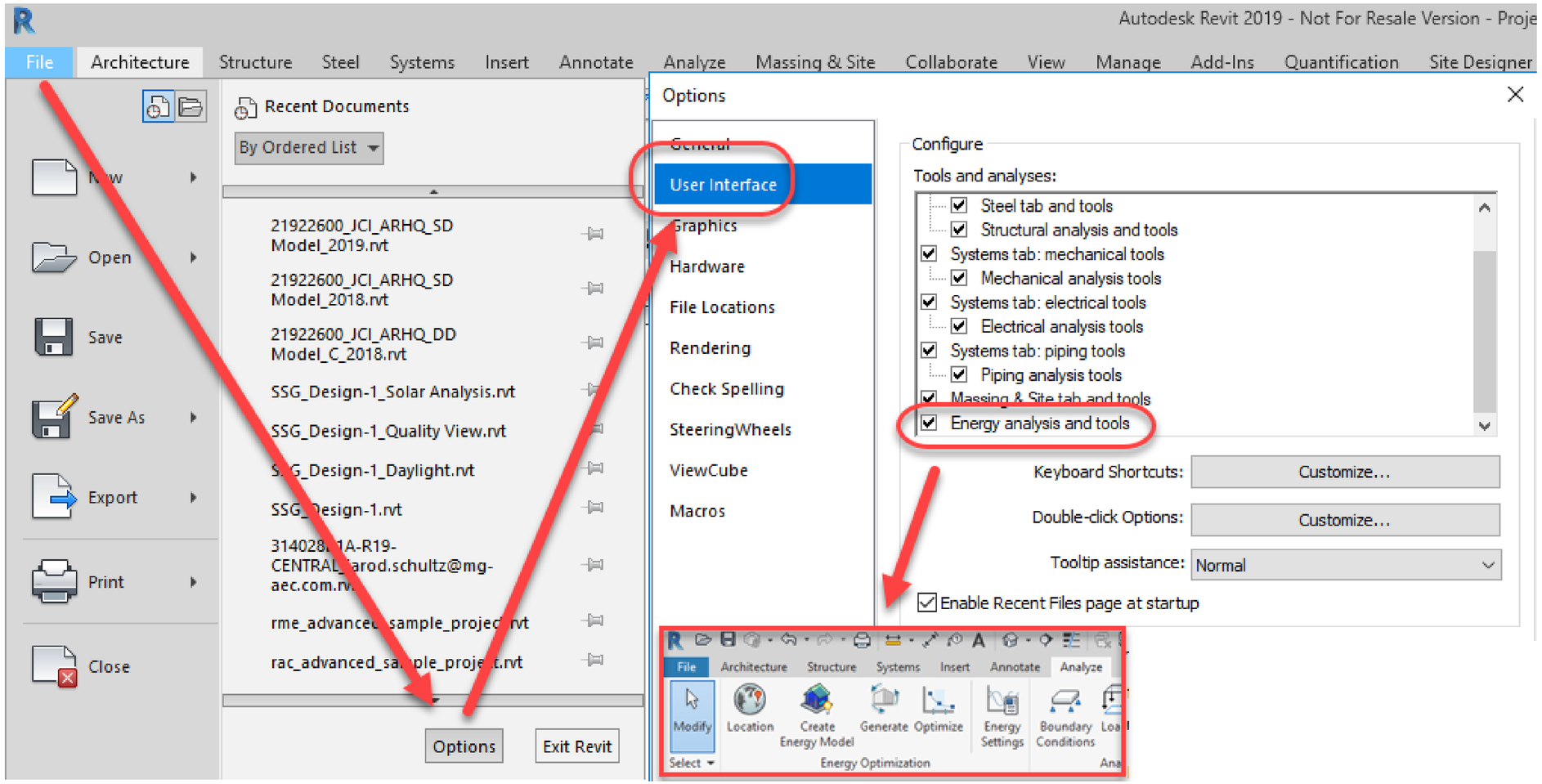




How To Get Started

Best Practices to get started with Insight

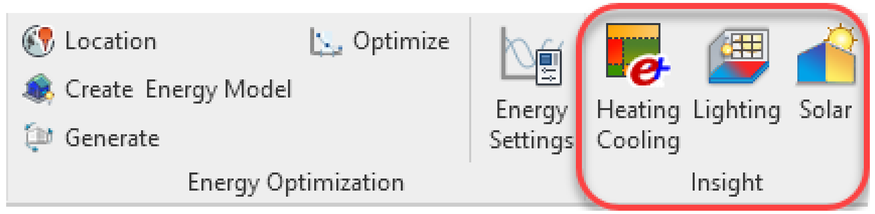
- Check Energy Analysis is enabled



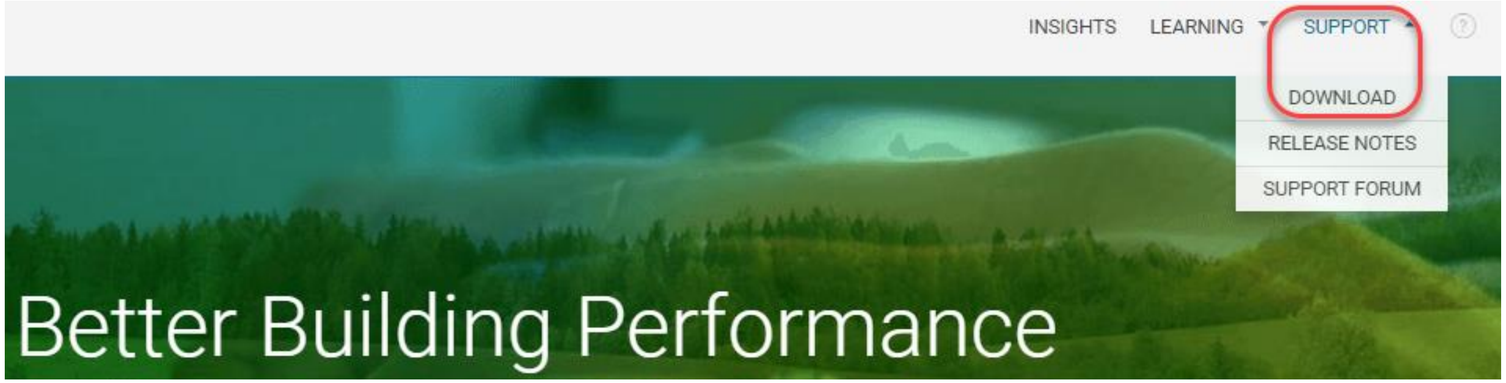
How To Get Started

Best Practices to get started with Insight

- Check Energy Analysis is enabled
- Check if you have the plugin OR download and install



Or Go to: https://insight.autodesk.com

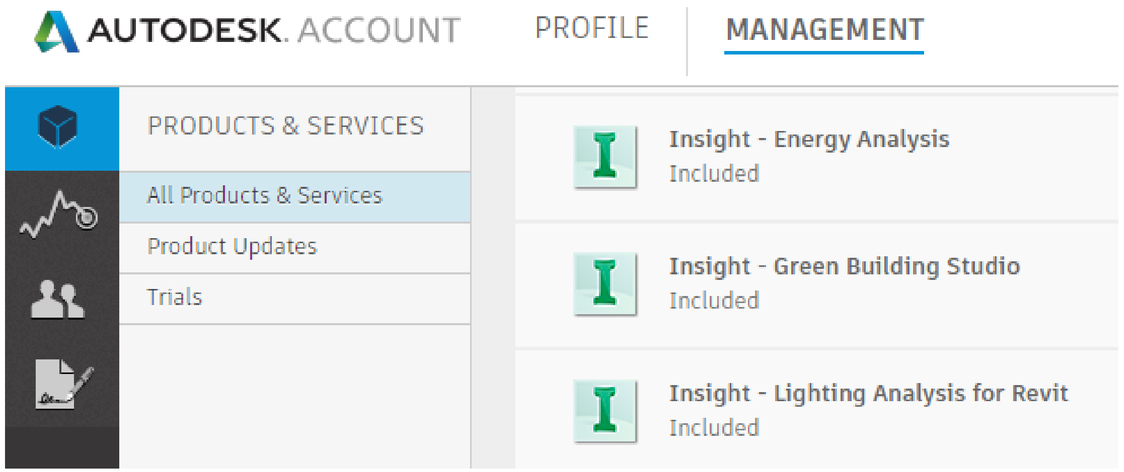


How To Get Started

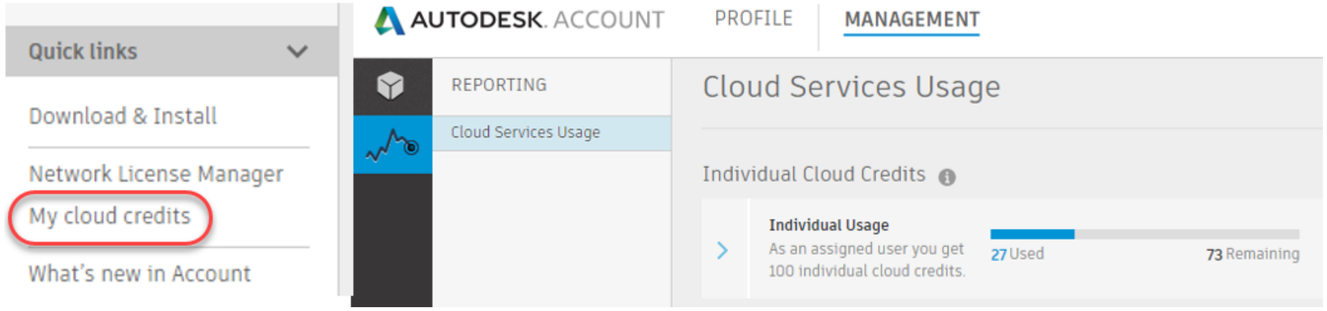
Best Practices to get started with Insight

- Check Energy Analysis is enabled
- Check you have the plugin OR download and install
- Check you have entitlements (and cloud credits for Lighting Analysis)

Go to: https://manage.autodesk.com



For Lighting Analysis Only:



How To Get Started

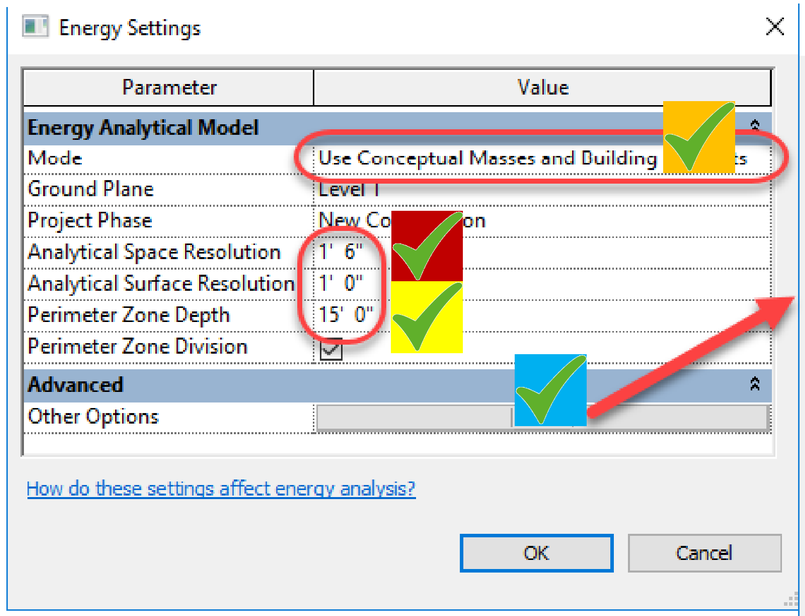
Best Practices to get started with Insight

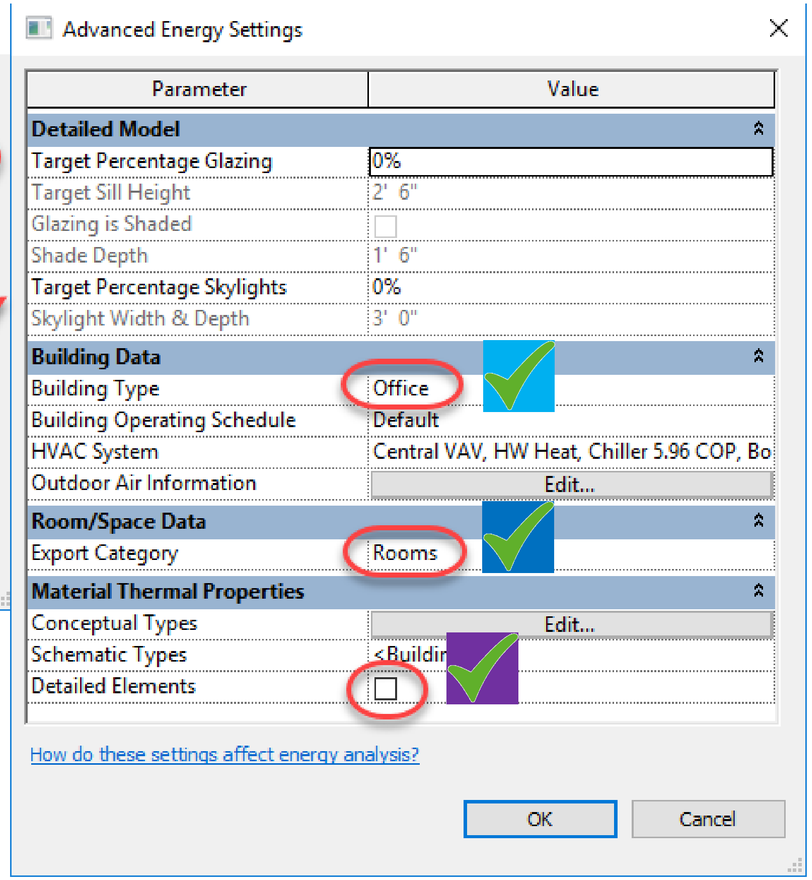
1. ALWAYS set model to ‘Use Conceptual Masses and Building Elements’
2. Start with the default Analytical Space and Surface Resolution
3. Set Perimeter Zone Depth Y/N?
4. ‘Advanced’ Options:

a) Set Building Type

b) Room/Space Data

c) Disable Detailed Element Material Thermal Properties

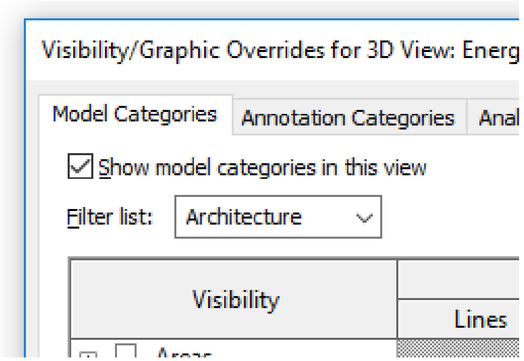




How To Get Started

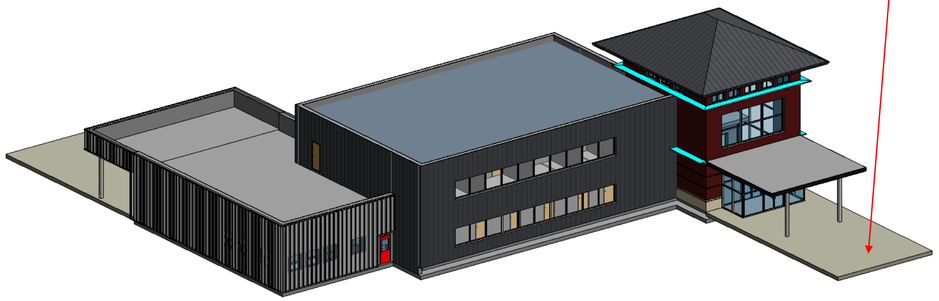
Best Practices to get started with Insight

1. Create a new 3D view and isolate key architectural elements used
2. Disable unnecessary elements (optional but faster processing)
3. LINK



- ✓ Ceilings
- ✓ Columns
- ✓ Curtain Panels
- ✓ Curtain Wall Mullions
- ✓ Doors
- ✓ Floors
- ✓ Mass
- ✓ Roofs
- ✓ Shaft Openings
- ✓ Site: Pads
- ✓ Structural Columns
- ✓ Walls
- ✓ Windows

Set to Non-Room Bounding

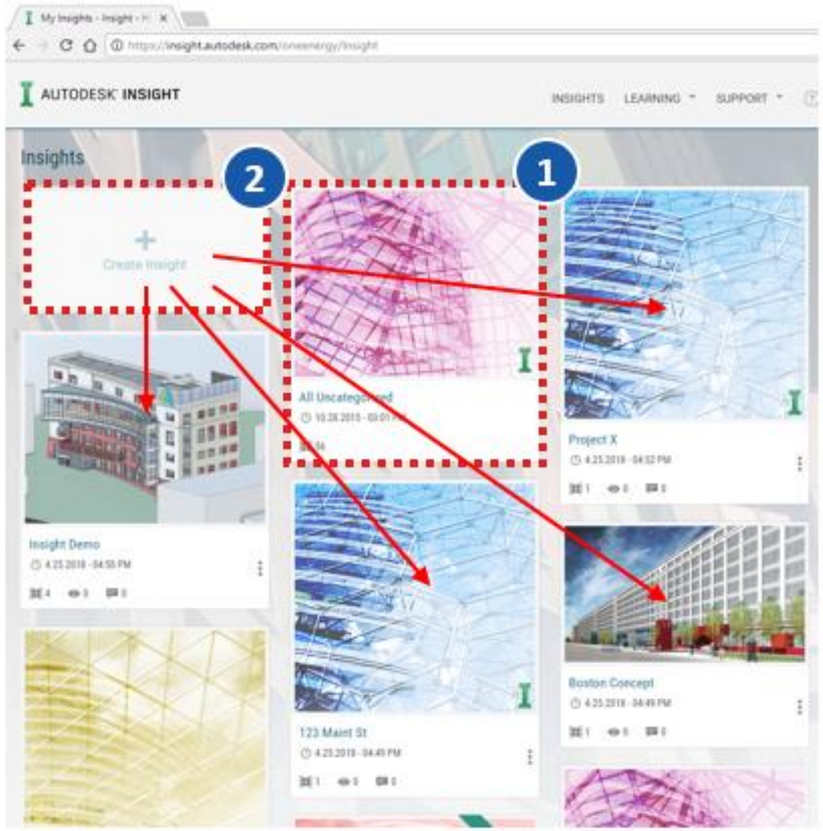


The purpose of the view is to enable a visual check.

How To Get Started

Best Practices to get started with Insight

- ‘Uncategorized’ vs ‘New Insight’ ✓
- Model Menu → Rename, Move etc. ✓
- Use Energy Cost or Energy Use (EUI)?
- Benchmark Comparison
- The ‘BIM’ Setting and Energy Range Paradigm
- Explore Opportunity & Embrace Uncertainty!
- Use Scenarios and Scenario Compare
- Use Model Compare – Settings, Members, Comments & Scenarios
- Export options incl. AIA 2030 DDx



1 New Models go to ‘Uncategorized’ by Default

2 Use ‘New Insight’ to Store as Required e.g. by Project or Design Stage

How To Get Started

Best Practices to get started with Insight

- ‘Uncategorized’ vs ‘New Insight’ ✓
- Model Menu → Rename, Move etc. ✓
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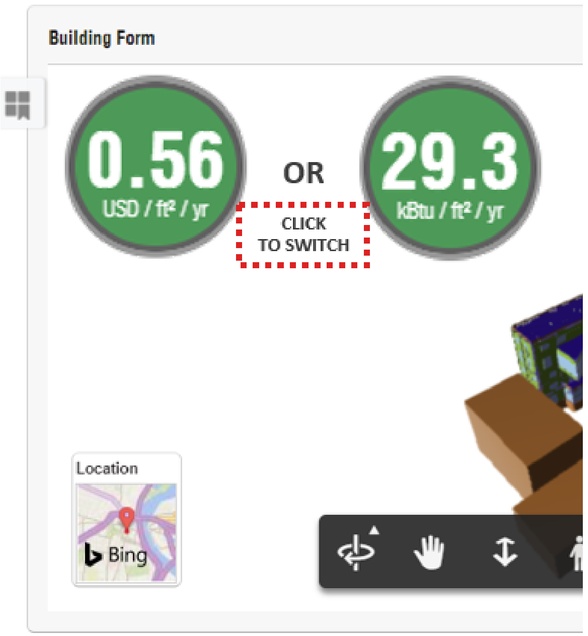
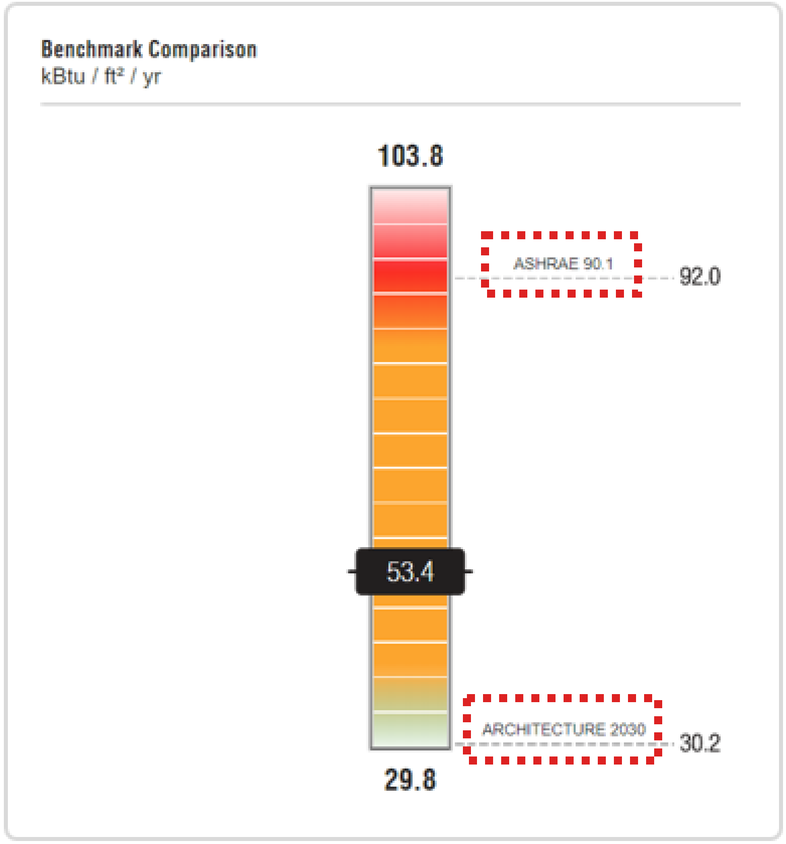


Cost is More Tangible and Re
Actual Value to the Building



How To Get Started

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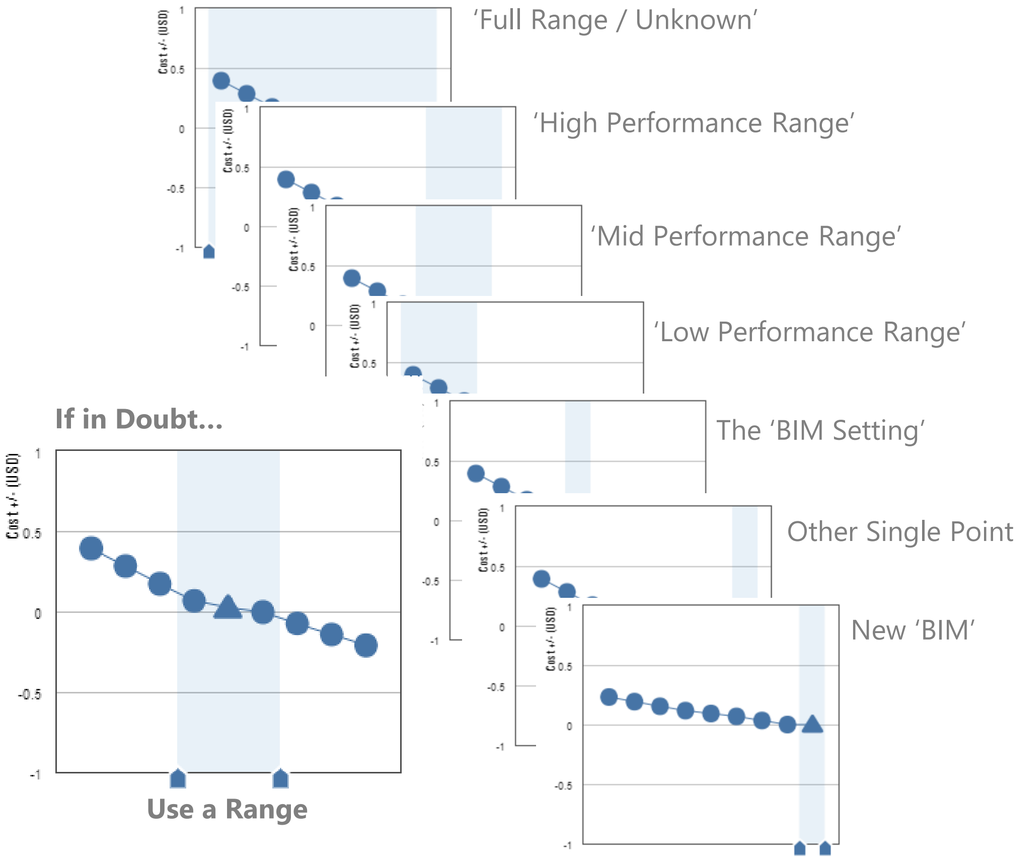

How To Get Started

Best Practices to get started with Insight

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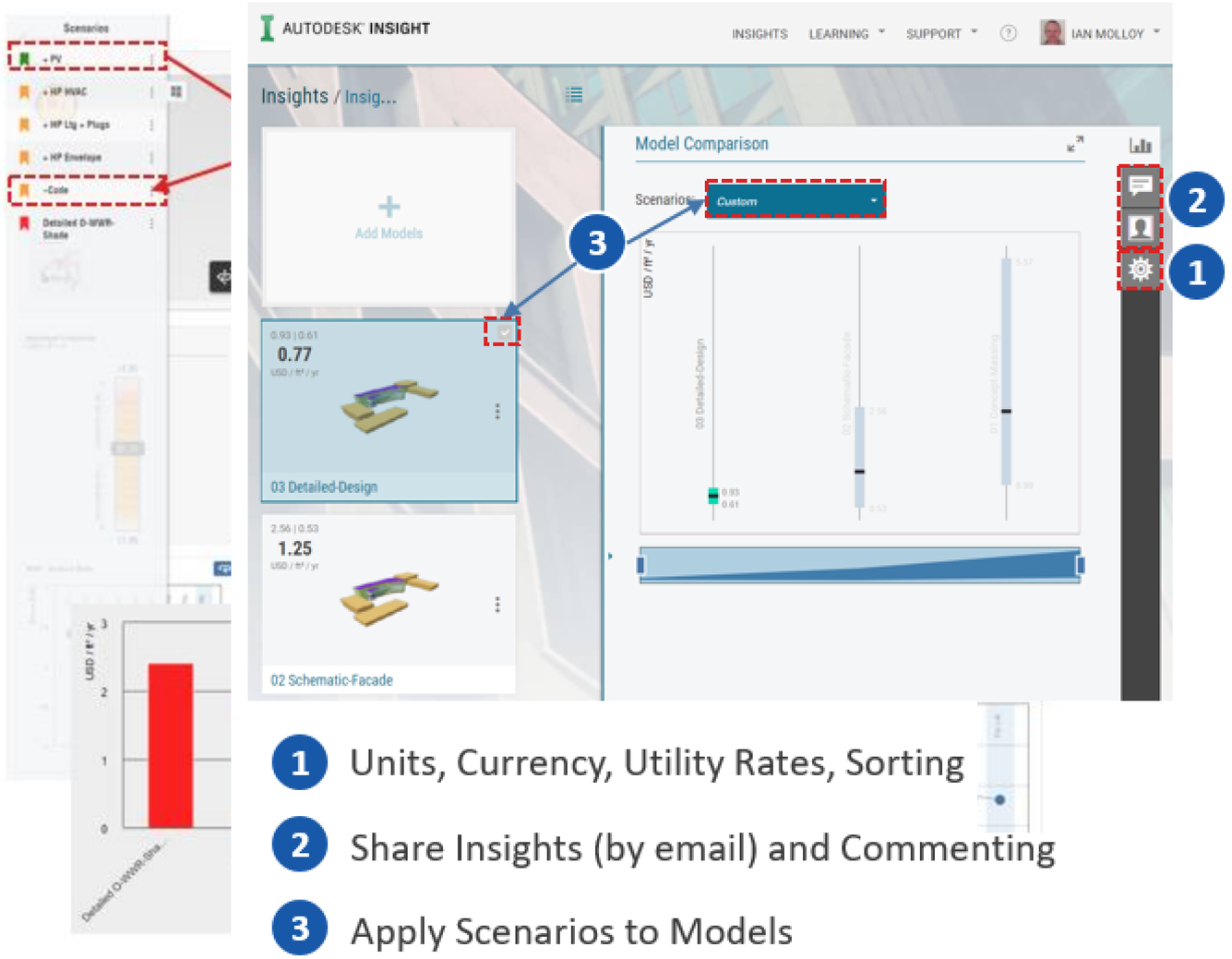
- Model Menu → Rename, Move etc. ✓
- Use Energy Cost or Energy Use (EUI)? ✓
- Benchmark Comparison ✓
- The ‘BIM’ Setting and Energy Range Paradigm ✓
- Explore Opportunity & Embrace Uncertainty! ✓
- Use Scenarios and Scenario Compare ✓
- Use Model Compare – Settings, Members, Comments & Scenarios ✓
- Export options incl. AIA 2030 DDx

A ‘Scenario’ is a Saved Combination of Factor Settings



How To Get Started

Best Practices to get started with Insight

- ‘Uncategorized’ vs ‘New Insight’
- Model Menu → Rename, Move etc.
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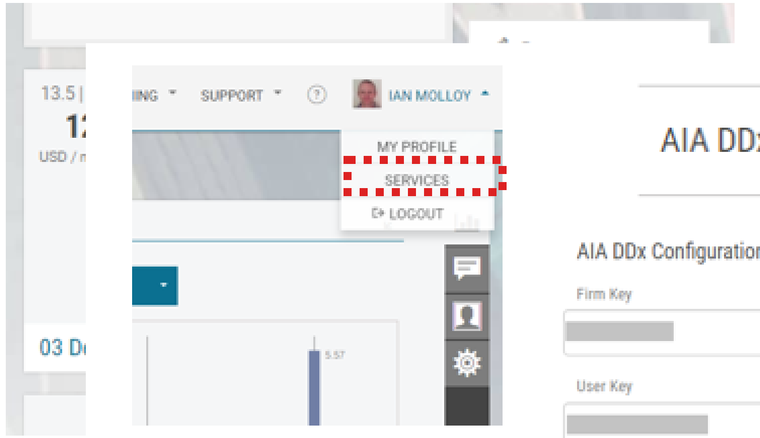
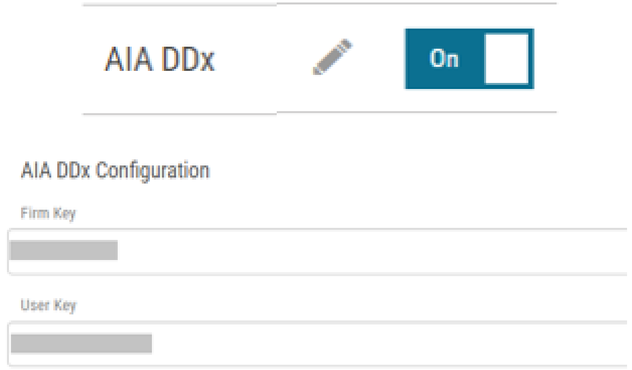
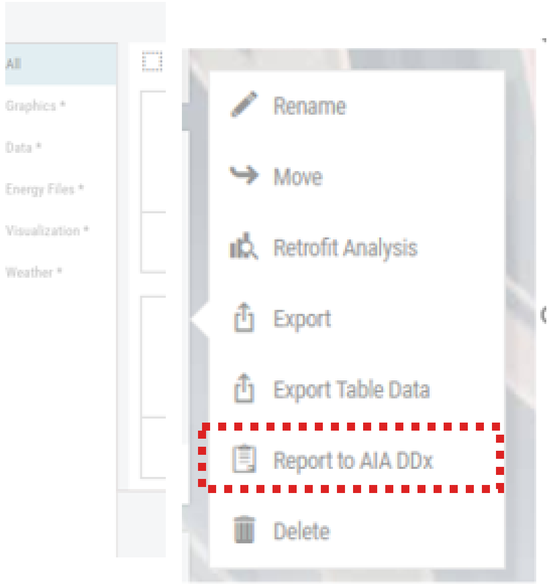
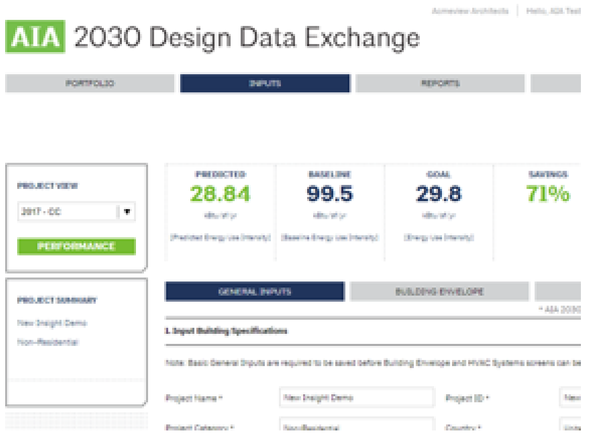
- Use Model Compare – Settings, Members, Comments & Scenarios
- Export options incl. AIA 2030 DDx





Email 2030commitment@aia.org
for your firms key (free)





QUESTIONS???

Sustainability Case Studies: Perkins + Will and Johnson Controls

Jarod Schultz

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