AUTODESK UNIVERSITY

AR21415

# Have Insight 360 with Your ReCAP 360 Pro Point Cloud

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**DO NOT PRINT THIS REFERENCE MANUAL – IT IS A LARGE DOCUMENT!**

*TIP: FEEL FREE TO PULL IT UP ON YOUR MOBILE DEVICE IN CLASS*

## Learning Objectives

- Learn how to generate a point cloud with ReCAP 360 Pro
- Learn how to convert the cloud to a model with Revit
- Learn how to bring your model into Insight 360
- Learn how to generate a building performance analysis

## Description

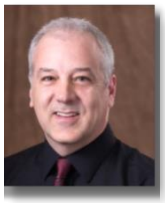
We are going to discuss workflows from ReCAP 360 Pro software to Insight 360 software where we can rapidly generate a building performance analysis starting from a point cloud. How do these cloud services fit in with Building Information Modeling (BIM) workflows and how can you use them side by side with Revit software? This session features ReCAP 360, Revit and Insight 360. AIA Approved

## Your AU Expert(s)

Joshua Benoist, Autodesk, Senior Premium Services Specialist - Primary Speaker

Joshua Benoist is a licensed professional engineer with 10 years' experience as a MEP (mechanical, electrical, and plumbing) design engineer out of Chicago, Illinois. Benoist currently works for Autodesk, in Premium Support Services, and he has been at Autodesk for 11 years.

Joel Harris, Autodesk, Inc., Premium Support Specialist - Co-Speaker



After studying Mechanical Engineering at Caltech, Joel Harris worked for Synthesis, an AutoCAD third-party developer and as an instructor of AutoCAD classes at Bellingham Technical College. He has over 20 years' experience in engineering as a Plant software developer/administrator and he's also the author of Autodesk's "Introduction to Piping Design with Plant 3D" college curriculum. Currently, he is a member of the Autodesk Enterprise Priority Support team of specialists.

# CLASS PRIMER:

## Do NOT Print at AU:

This is a reference guide, as such, it is over 100 pages and unless you want to lug it around AU, we suggest you DO NOT PRINT! Use the PDF on a tablet as a reference.

## What is a BPA, Building Performance Analysis?

How many of you have performed a Building Performance Analysis, or as an HVAC engineer, an Energy Analysis? It's ok if you haven't, but one of the prerequisites of this class is that you are familiar with them or have seen others use software and spreadsheets to do the calculations.

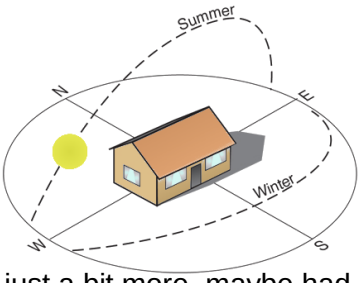
A building consumes… Energy, Water; and a building produces… Carbon, Waste, Sewer. LEED analysis is a whole other ballgame that accounts for materials consumed and recycled during construction and a host of other factors. For simplicity, let's say Building Performance Analysis is a subset of a LEED Analysis. A BPA is more focused on Energy and Indoor Environmental Comfort … Energy Consumption or Production, Water, Waste, Sewer. If a Building MEP System exists, it would be part of this Performance Analysis.

Building Energy Analysis, is a subset of Building Performance Analysis, and focuses on Energy Consumption and Production… NET Energy Balance. Energy is consumed by HVAC Systems, Domestic Water Systems, Electrical Lighting and Power Systems, other Processes.

An energy analysis is necessary in different forms at different stages in the design. Prior to the prevalence of IDP, Integrated Design Process, MEP engineers followed the Architect. The Architect would flesh out a layout first, then bring it to the MEP engineer to start their processes. The HVAC engineer would consider the functional requirements, chew on a few mechanical system approaches and would use some "Rules-Of-Thumb" to approximate the building energy loads. After the layout matures they would run an energy analysis with Energy Plus, DOE2, Trane trace, Carrier HAP.

The Architect would rely on the HVAC engineer's best assessment to make decisions in the early stages. Decisions would be made, like site orientation and window to wall ratio by the Architect. These ARE critical energy factors. Before IDP, these decisions were made without the HVAC engineer and more importantly without any analysis. Site orientation was a "best guess" or made to fit the site.

These factors were set in stone when handed to the HVAC engineer, the HVAC engineer would run their analysis and the energy consumption was "A SINGLE VALUE." That value was what it was, the HVAC engineer could not make it better. The best the HVAC engineer could do at that point, was to find the most efficient HVAC system to meet that energy demand, but that energy demand was "mostly" set in stone.




There were always cases where, IF the building were rotated just a bit more, maybe had a little less window or more shading, we could have downsized the mechanical equipment. For example, with a typical rooftop unit system, the next size down may mean 5 to 20 tons less, depending on manufacturer and their catalog range.

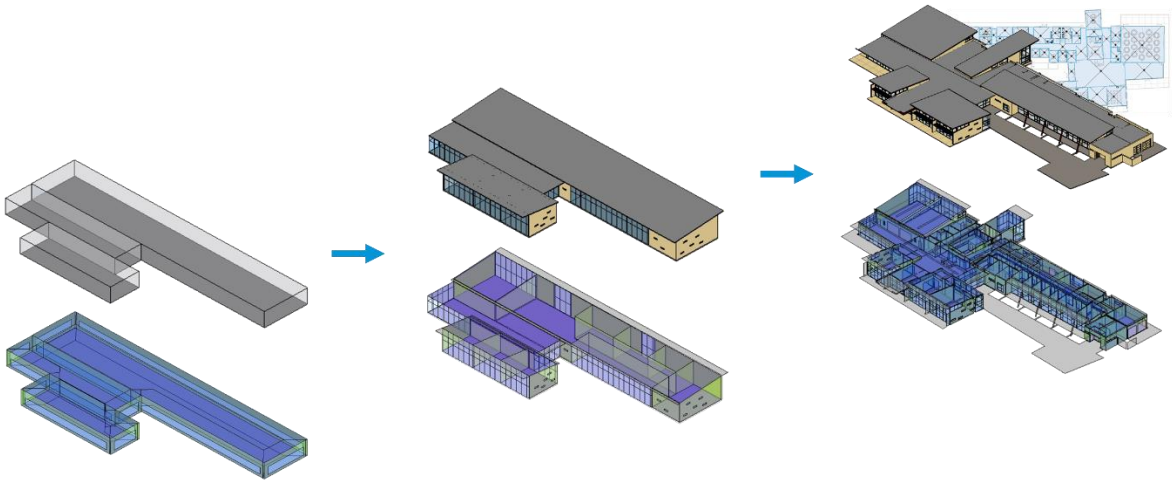
## What is IDP, Integrated Design Process?

The IDP changed everything bringing all project "Stakeholders" together from the start of a building project. Decisions were democratized and shared between the stakeholders. The HVAC engineer no longer followed the architect, but was brought in at the beginning to share in the critical decisions.

The old Energy Analysis tools of yesterday failed to support these early critical decisions like site orientation, windows to wall ratio, shading, etc. for several reasons.
1. These tools were designed for fully fleshed out building layouts where we knew all the details about the design like wall areas, window areas, room square footages, wall compositions, site orientation, etc. The HVAC engineer had to enter all this data into the application to get a single value out. Then make some changes to see if the results improved.
2. These tools were not mobile or collaborative. Ever try to drag Trane Trace into a meeting in front of all the stakeholders, which may include building owner and run reports?
3. These tools yielded pages and pages of text based reports that took a PE to interpret with minimal graphs.
4. These tools were based on FORTRAN and DOS! Therefore, these tools were silo'd on and limited by desktop computing. They were too slow for any IDP critical decisions.

We "need" a tool that is modern, mobile, collaborative, and fast. A tool that delivers just the right data at the right time. A tool that grew with the LOD of the model accepting minimal inputs early in the process, growing out to LOD 400 at the end of the process.

**Scales from Concept to Detail**



i.e. Widely Varying Levels of BIM Detail & Specification

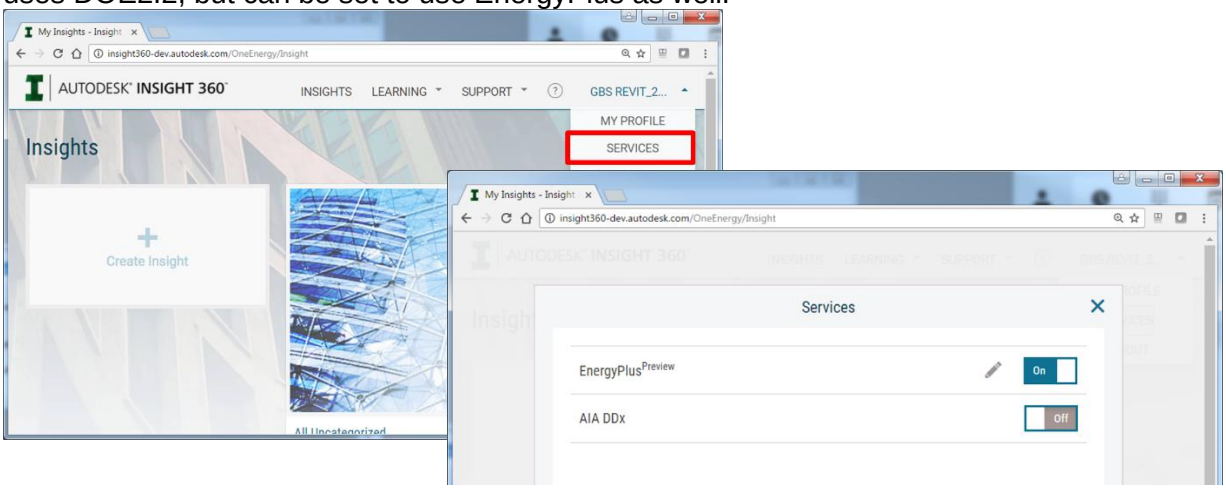
## What is Insight 360?

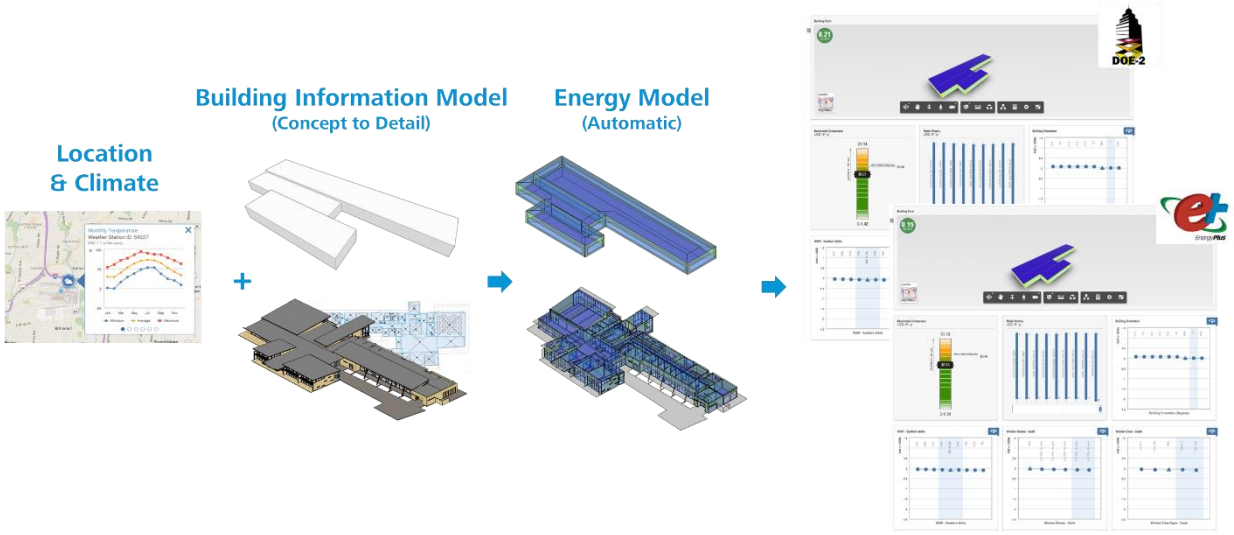
*"This is a Decision Informing Tool, not a Decision Making Tool." – Ed Deal*

It is our answer to the "need" mentioned above. It is much more than that. I've mentioned that the old energy analysis tools give us a "SINGLE VALUE" … like a snapshot, based on the data we know about the building at that exact moment. To test if making a change was an improvement, we had to create multiple "Design Options." Can you imagine testing all 360-degrees, 1-degree per Design Option, to find the optimum site orientation to the sun? It doesn't happen…that's too expensive in time and resources, etc. Even if we did that, any 'optimum' we might find would depend on all the other single value assumptions, meaning it's not actually optimum at all.

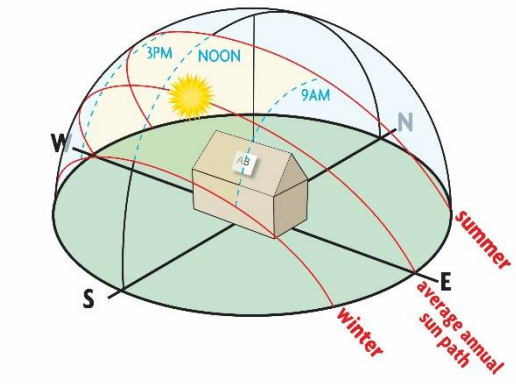
What if we could?

Imagine refactoring EnergyPlus which was based on FORTRAN, and converted it to a modern computer language, like C++ and gave that back to the Department Of Energy? Would the Department be willing to release a C++ version of EnergyPlus? You bet they did! Autodesk volunteered the conversion and the Department released it! Insight 360 uses DOE2.2, but can be set to use EnergyPlus as well.



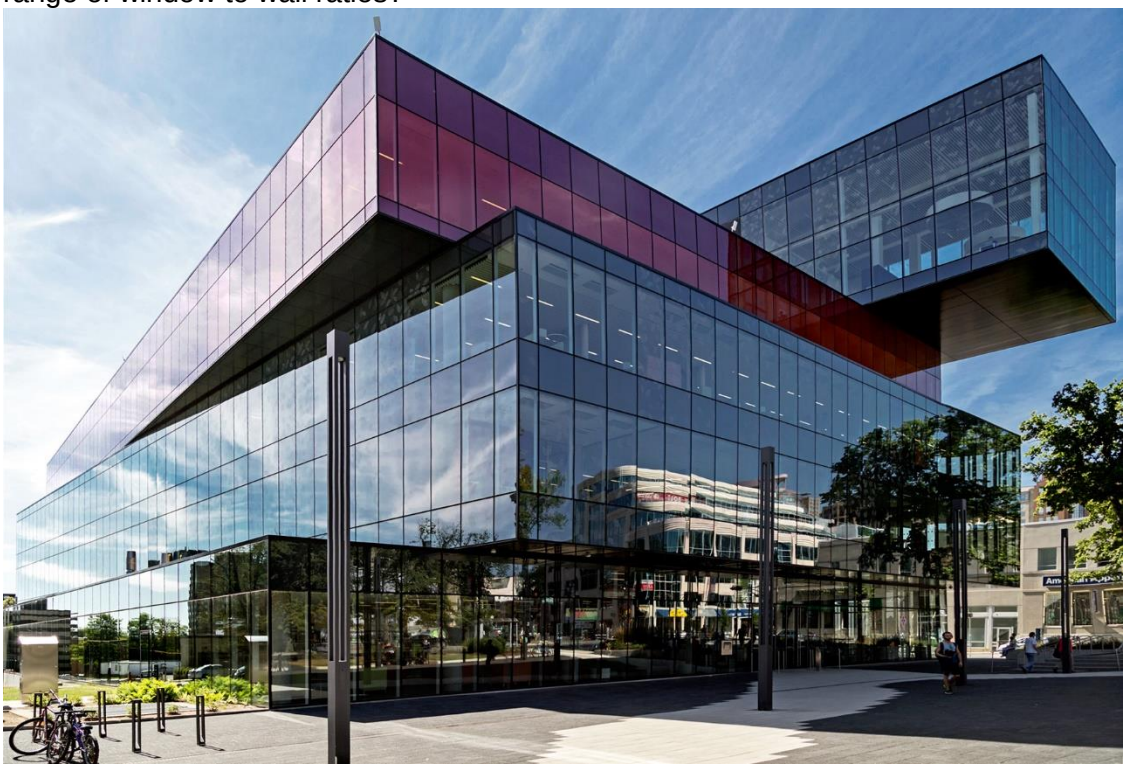
DOE2.2 is significantly faster. We made it mobile and placed it in the cloud where we can throw nearly infinite resources into the calculations, at the moment we run over 300 parametric iterations.




Why not calculate 360 total reports, incrementing the site orientation by 1-degree at a time? We would have 360 energy consumption values. Would that make a nice graph? Stakeholders could take a glance at a graph, identify the optimum site orientation and make quick and "Informed" decisions.

Source: Click image for hyperlink to great article by Nick and Ben Gromicko at NACHI

Why stop at Site Orientation? Why not consume the building shell, and calculate the full range of window to wall ratios?



Start with 100% wall…no window… and range to 100% window…no wall. What does the optimum look like on a graph? Would that graph help the IDP stakeholders make an informed decision?

What other energy factors could we calculate along a "range" to generate a graph? Well, all of them…except maybe the site coordinates and building shape. Those come from Revit or FormIT, which can be parametrically varied using Dynamo and Fractal.

As decisions are firmed up, how does that affect the other factors? Are graphs of "South Wall Composition" more or less important as we rotate the building on the site? Being able to see other factors change as we change factors such as the building rotating on the site, is important. Maybe the "South wall composition" becomes less of a factor resulting in a savings.

*What if we have an existing site or existing building? Could we leverage a point cloud, from ReCAP Pro… to rapidly approximate the shell of this building using Revit … pop it into Insight 360 for Analysis?*

Insight 360 allows us to visualize, interact with, and document building performance data earlier in the design process, allowing the IDP team to track outcomes through the building lifecycle. While Insight 360 is useful for architects and IDP teams early in the design lifecycle, engineers and owners will appreciate the clear performance expectations and the ability to further refine the analysis via GbXML.

*Insight 360 is equally applicable to existing buildings because just like conceptual design there is a lot you don't know about the building. insight's range paradigm is suited for existing buildings.*

Insight 360 is Green Building Studio… more specifically, it is a skin on GBS that takes results of over 300 parametric simulations and computes an energy range from billions of combinations and helps us to understand what is important and what is not.

More info on Insight 360:
Agile Energy Analysis for Integrated Design:
https://www.youtube.com/watch?v=4Hggj7EaHIw&list=PL_6ApchKwjN9e68_Zs36FBkVHyqeIzOpY&index=1

Insight 360 was first introduced last November. We are going to help you understand what Insight 360 is all about.
http://blogs.autodesk.com/insight360/introducing-autodesk-insight-360-2/

If you get a chance before attending class, read this Article about Insight 360:
http://autodesk.typepad.com/bpa/2015/01/why-is-autodesk-investing-in-energy-plus.html

Insight 360 Blog:
http://blogs.autodesk.com/insight360/

Some messages from the Department Of Energy:

http://energy.gov/eere/buildings/articles/autodesk-upgrades-insight360-energyplus-annual-energy-simulations

http://www.energy.gov/eere/buildings/articles/energyplus-logo-debuts-revit-toolbar

## OBJECTIVE 1: Learn how to generate a point cloud with ReCAP 360 Pro

### Capturing Reality and Generating a Point Cloud with ReCAP 360 Pro

The reality about using reality capture technology is this: How much should you capture early on in the project? If you are in the early bid stages, minimizing time and resource investments while maximizing accurate information is vital. The entire project estimate is predicated upon a certain level of detail as well as accuracy of front-end information, and will reduce the possibility for errors in scope definition later in the project. The workflows presented in this class are intended to represent typical project workflows, hence we will cover how to aggregate reality data over time to improve the LOD of information while keeping a watchful eye on the clock.

### Reality Capture – Ideal vs. Reality

Understanding the ideal workflows for ReCap – as with any software – is the first place to begin when creating a project plan. A quick checklist of things to consider before you start will include:

- Will this project be laser scanned, photographed or both?
- Will photography be from grade or via UAV?
- Will site accessibility be an issue (work permits, weather, other site activities, etc.)?
- Will surveyors be identifying and surveying visible targets within the scan area?
- Are there any special areas of higher detail that need to be identified?
- Are the laser scan devices being used produce structured data compatible with ReCap?
- Has the reality capture team visited the site and performed a walkthrough?
- Etc.

The list can be extensive, and experienced scanning teams each will have their own checklist to go through before that first site visit. One question that is missing from the list above is

*"Is the project scope clear enough that reality capture activities can be accomplished in one visit?"*

Chances are that the answer to this question is unknown, or the likelihood of the answer changing is significant enough to include contingency plans for adding additional scans and/or photographs. Although this is not considering the "ideal" workflow, the fact is that it happens frequently. In this class, we will cover how to add laser scan and photograph data to an already processed and completed ReCap project.

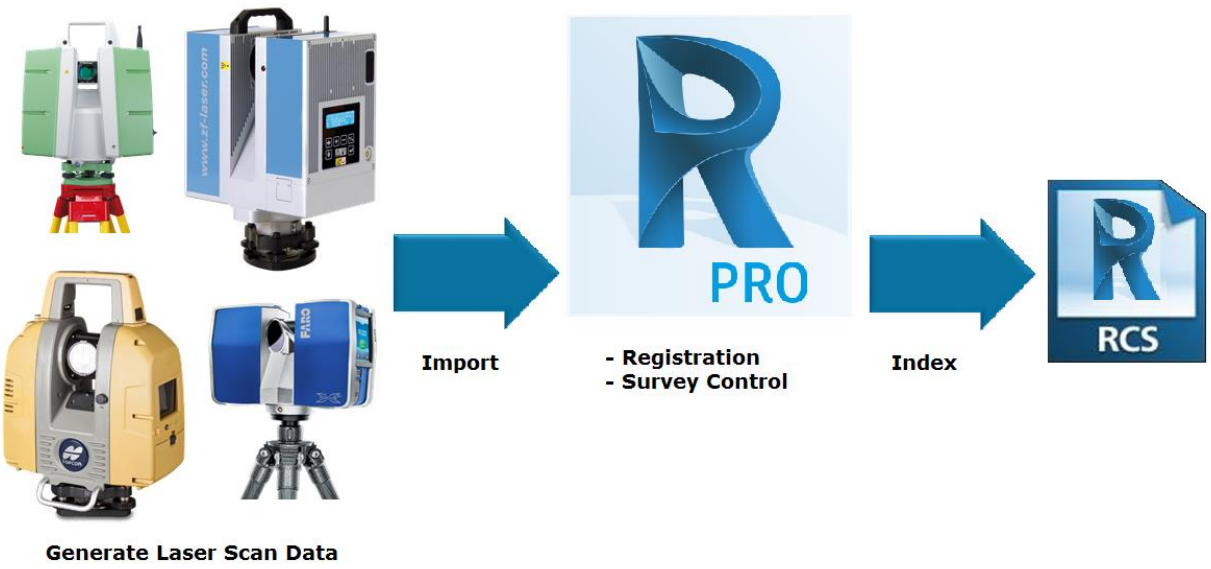
### ReCap Ideal Laser Scan Workflow

After performing a trip to the site with your laser scanner(s) and bringing back the gathered data and field notes, the next step is to import this data into ReCap. ReCap supports many different file formats, however to use some of the advanced features within ReCap (target-less registration, publish to ReCap 360 web, scan to mesh, project cleanup) you must import "structured" scan formats from your scanner to ReCap.

Examples of structured scan data would be the following formats:

- Faro FLS
- Leica PTG & PTX
- Z+F ZFS
- Riegl RSP & RDBX
- Topcon CLR (or CL3 + IJ support file)

These file formats, and some types of binary E57 scan files, are primarily structured scan data, which means the file is formatted in such a way that includes the fixed location of the scanner head along with the scan points, allowing the generation of a panoramic "Realview" in ReCap.




*RECAP LASER SCAN INITIAL WORKFLOW*

Referring to the figure above, let's define some of the terms used in the ReCap workflow:

- Import – Describes the process of taking scan files from an outside source. These could be "raw" files directly from a scanner or scan data files that have been processed by another software before being brought into ReCap. The purpose of importing these files is to perform one or more of the steps below prior to using the data with an Autodesk design (AutoCAD, Revit, Infraworks, etc.) or visualization (3D Studio Max, etc.) software.
- Registration – This is the process of combining multiple scan data files into one-point cloud project. ReCap will align each scan to match the adjacent scans, either through automatic, target-less registration or by allowing the user to manually select the same points in two nearby scans.
- Survey Control – During registration, ReCap allows you to identify targets or simple points and apply survey coordinates to these points. By default, the location of the scanner head of the first scan file that was imported determines the origin (0,0,0) of the point cloud project unless survey points are specified or the origin moved using the ReCap "Update Origin" command.

- Index – This is the process which converts the individual scan files into ReCap's native scan file format (*.RCS). Once the ReCap project (*.RCP) is saved, it will reference the RCS files but not contain them. The RCP file contains information like the coordinate system, units, and ReCap settings.
- Point Cloud – a set of point measurements from 3D space gathered through laser scan or photographic field acquisition and then processed and viewed by software like ReCap 360.
- Cloud – Short for "Cloud computing", this describes a network of servers that can run applications and deliver services to customers via a web browser, email, mobile device, etc.

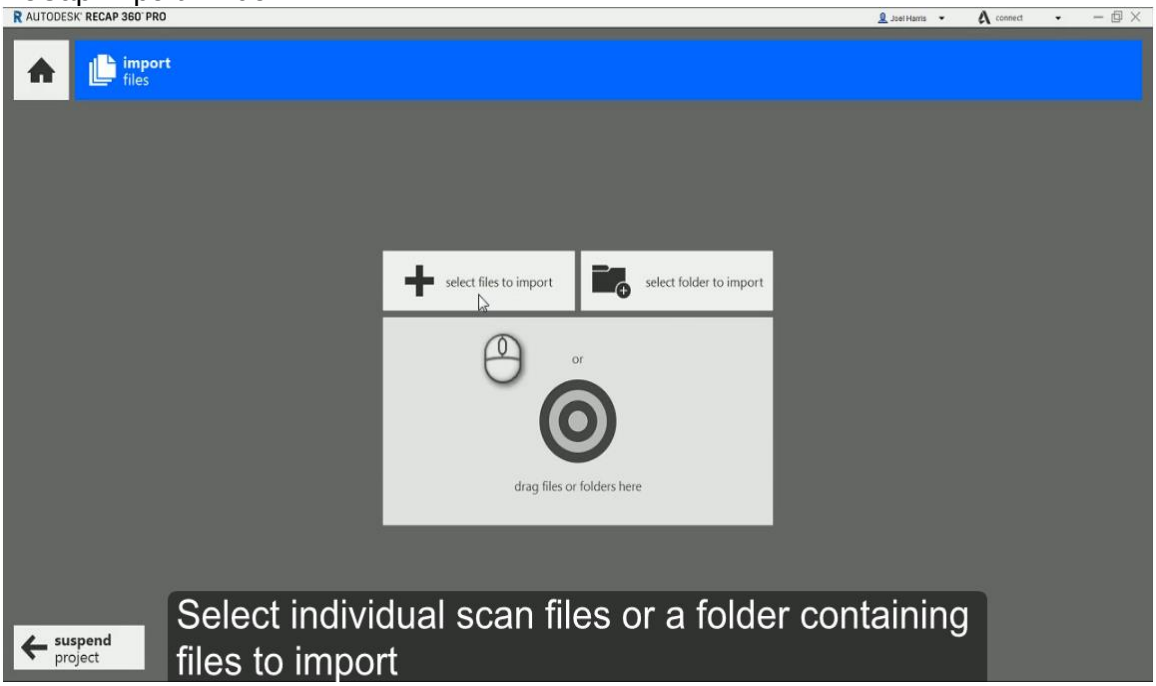
  - Reality Data File Formats: http://forums.autodesk.com/t5/reality-computing/reality-data-file-formats-which-where-amp-how/ba-p/5719928

  - ReCap File Types: http://help.autodesk.com/view/RECAP/2017/ENU/?guid=GUID-9B5661B9-4B67-4574-93F6-A850892FA075

## Importing Scans

After creating a new scan project with ReCap 360 Pro, the first important step is to import the structured laser scan data. This step and each of the subsequent steps listed below has an option to "Suspend Project", which allows you to save all of your work up to that point and exit the project.

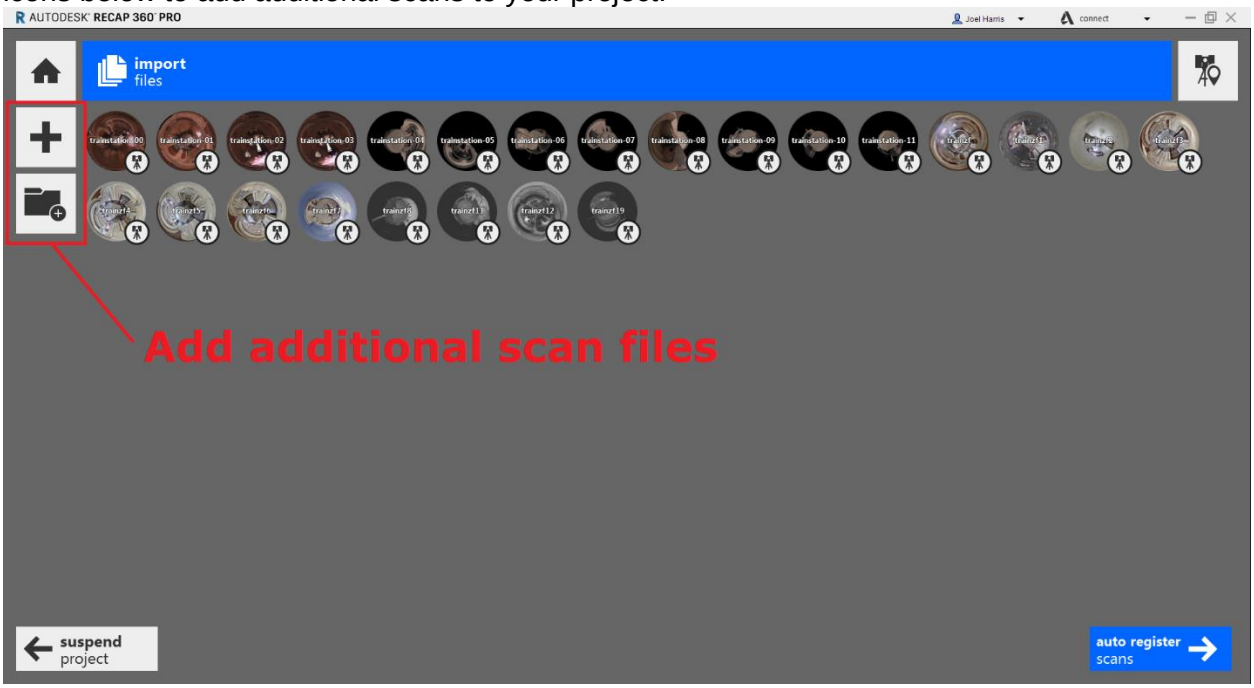
Importing is easily accomplished by selecting the files from your computer from the ReCap Import window:




*RECAP - IMPORT FILES*

ReCap can import a large variety of laser scan file types. The number and size of the files is directly proportional to the amount of time it will take for ReCap to finish the import process. Some tips about importing:
- Be sure you have enough hard drive space for ReCap to create the temporary files necessary for the import process.
- To increase performance, use a solid-state drive for storing and processing ReCap files.
- If one of your scan files in a selection of files will not import, remove it from the selection and re-import it separately. If this doesn't work, investigate the source of the file to see if you can determine whether the file is corrupted and can be replaced.

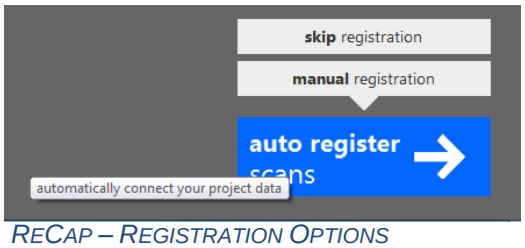
Once ReCap is finished importing the selected files, you will be presented with the screen below showing all of your scans as circular thumbnail images. You can use the icons below to add additional scans to your project:




*RECAP - ADDING FILES*

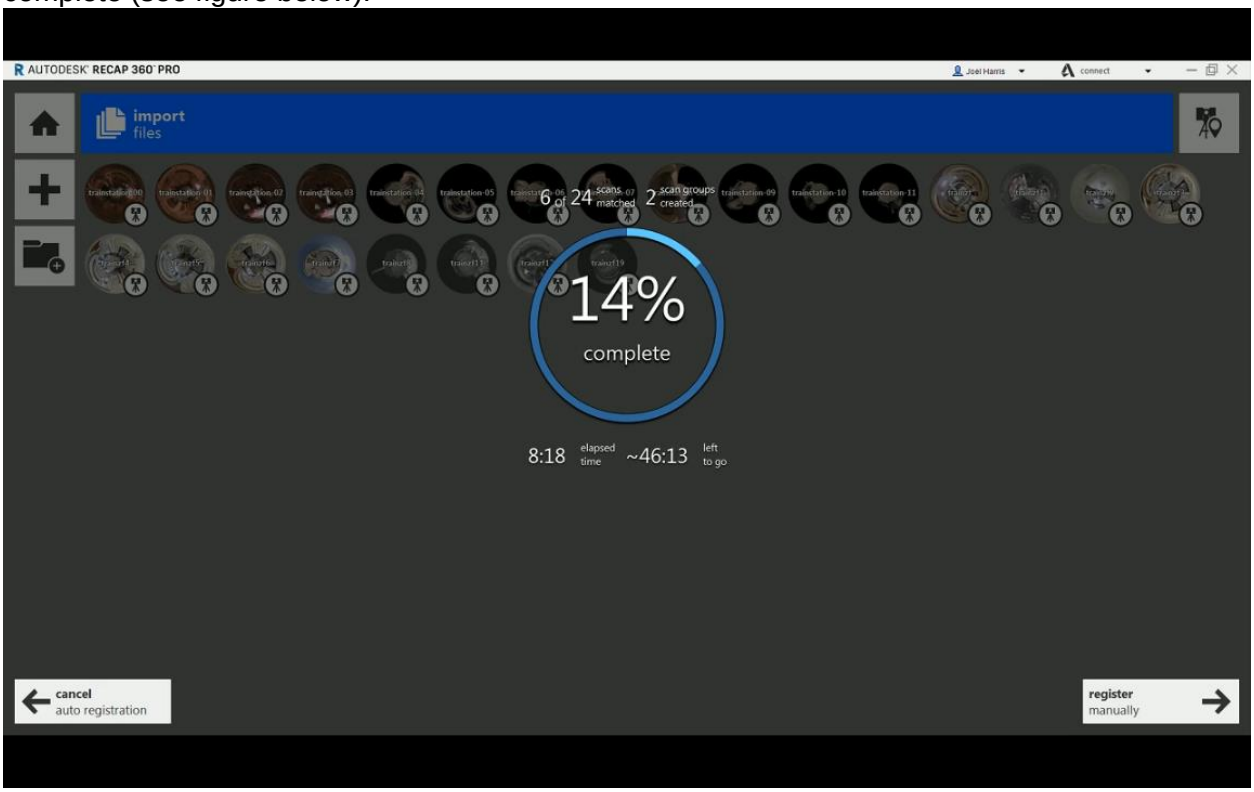
## Registering Scans (Automatic Registration)

The next step after importing is to register the files together into one continuous cloud that is an accurate representation of the site conditions at the time that the scans were taken. If you have used another software program to register the files prior to importing into ReCap you can "Skip Registration" by hovering over the "Auto Register Scans" button in the lower right of the screen (see below). Similarly, if you wish to manually register the files you can do that by hovering over the same button and selecting "Manual Registration".




*RECAP – REGISTRATION OPTIONS*

Since the files from our laser scanner are structured, we can take advantage of ReCap 360 Pro's ability to automatically register the scans together. Registration will take some time, with progress being shown by a circular blue progress bar and percentage complete (see figure below).




*RECAP – REGISTRATION PROGRESS*

In addition to the other progress information, ReCap will display how many scans have been successfully registered and how many registration groups have been created. Finally, it gives an estimated time to complete the registration (this will vary depending upon available computer resources).

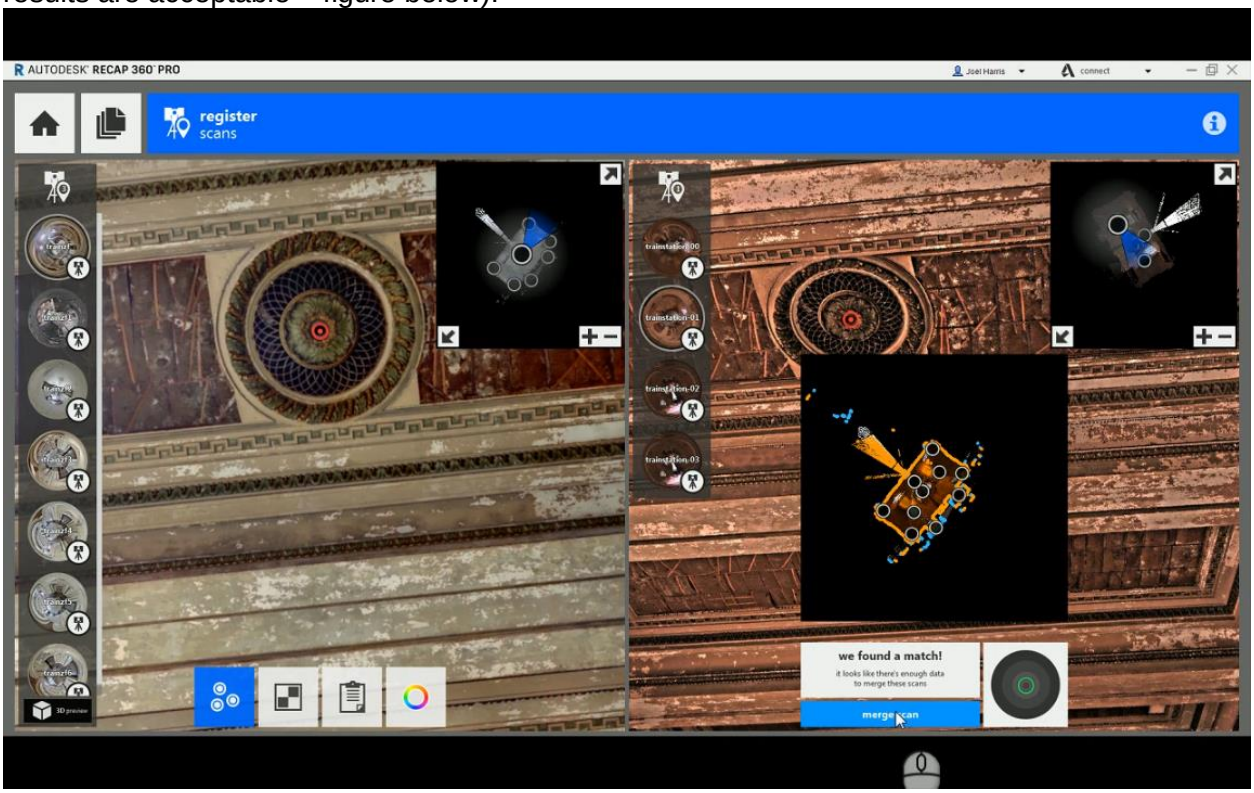
## Registering Scans (Manual Registration)

When the automatic registration is complete, if there are multiple registration groups created you will need to manually select points between scans in the groups to align them with each other and create one final scan group.

This process happens with a split screen arrangement where a scan group on the right side of the screen is merged with the "master" scan group on the left side by selecting matching points from both sides.

- A minimum of three points are required for ReCap to calculate the proper alignment between the scans.
- You don't have to be accurate when selecting points, ReCap only needs you to be in the general vicinity (< 1 meter) of the same point in two scans (one from each group).
- If there are no visible common features between scans you can select another scan from either group to continue.
- For better results, select faces rather than corners of objects.

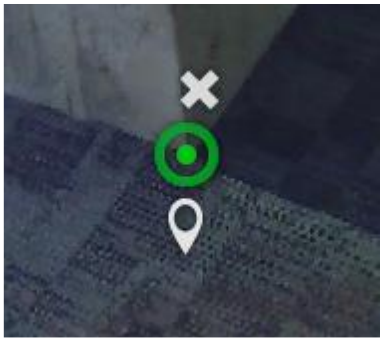
ReCap will take your 3 points and ask for a quality confirmation (“Green” or “Yellow” results are acceptable – figure below).



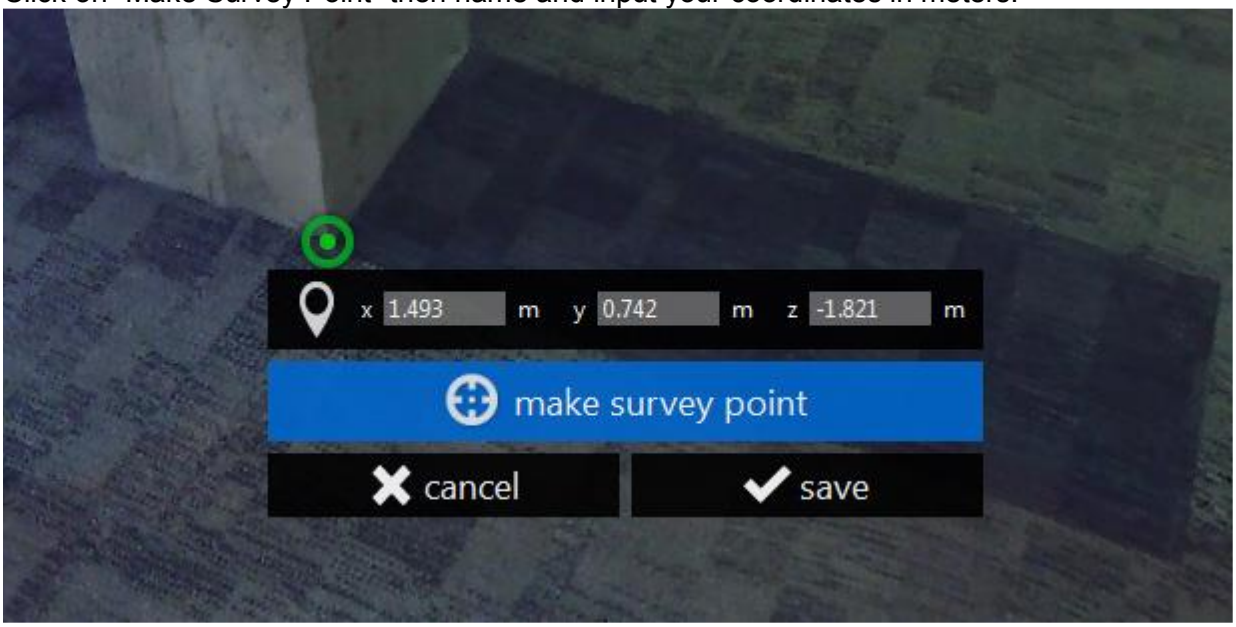

*RECAP – SCAN GROUP REGISTRATION*

## Survey Coordinate Entry

Once all scans are registered, this is the time to add survey coordinate point information as well as a survey coordinate system. To add a survey point, mark a target and click on the icon below the target:



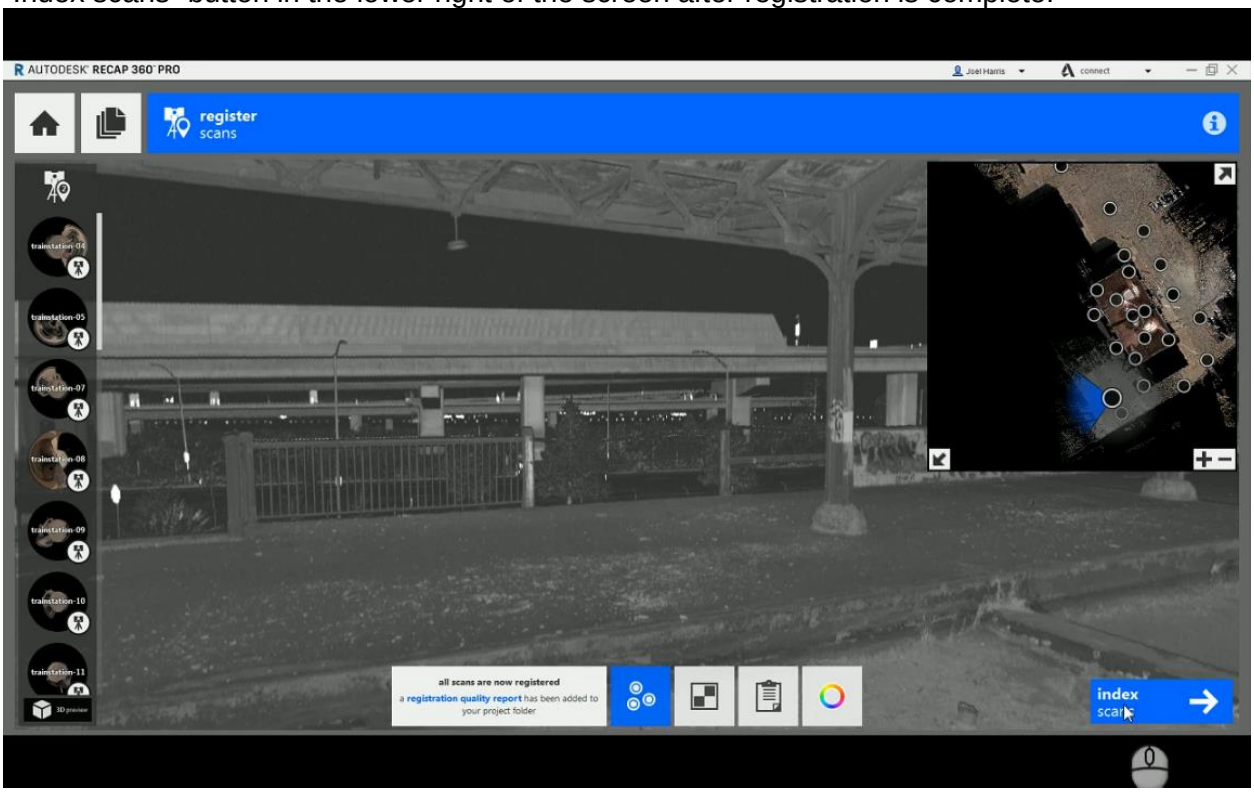
Click on “Make Survey Point” then name and input your coordinates in meters:




*RECAP – ADDING SURVEY POINTS*

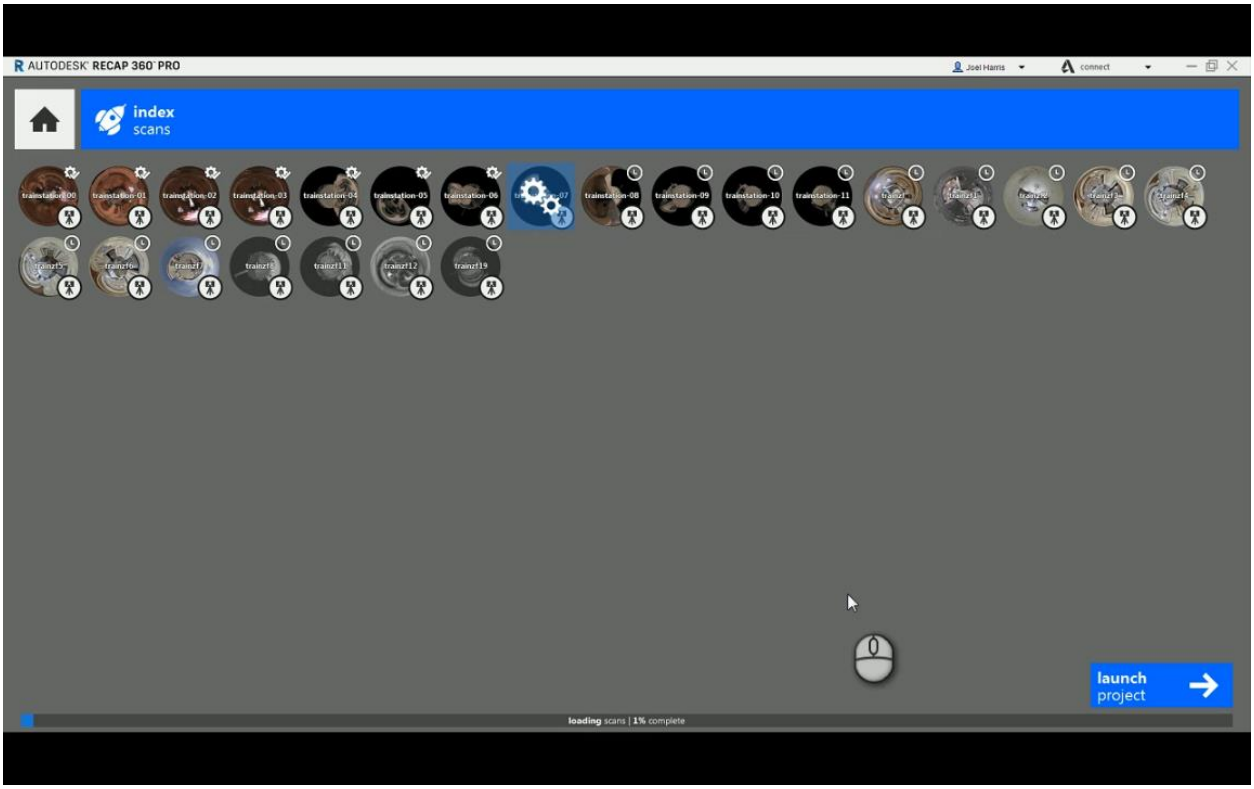
## Indexing Scans

This final step will create the RCS scan files that will be loaded by the ReCap project RCP file and are optimized for use with other Autodesk products. Simply select the “Index scans” button in the lower right of the screen after registration is complete:




*RECAP – START INDEXING SCANS*

When indexing is finished you can begin working with your laser scan data within ReCap (actually, you can select the “Launch Project” button in the lower right before indexing is complete but you still must wait until all scans are indexed to begin working with the ReCap project). In the image below, ReCap is still indexing the 8th scan out of 24, but the “Launch Project” button is selectable.




*RECAP – LAUNCH PROJECT*

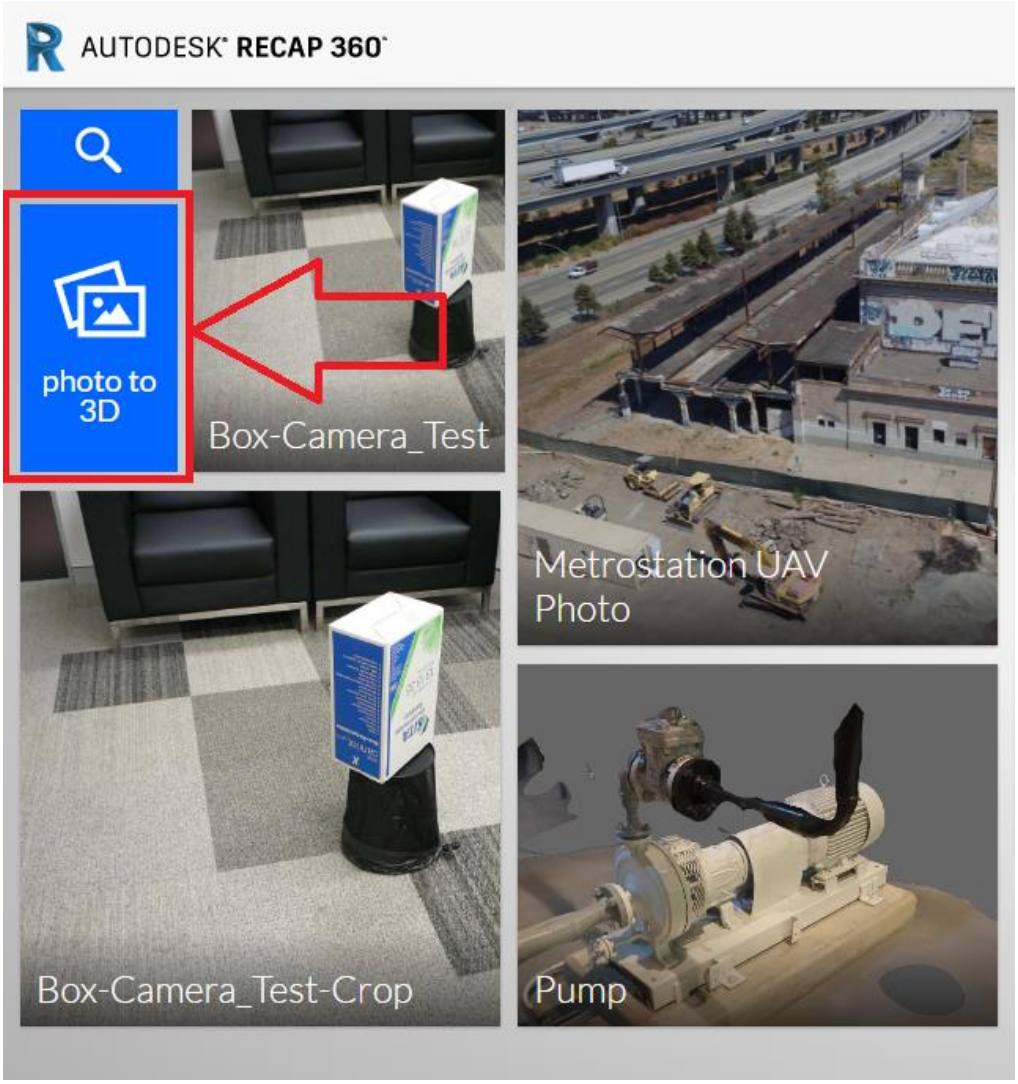
## ReCap 360 Photo to 3D

Now that we’ve covered the basic workflow for bringing terrestrial laser scan data files into ReCap, let’s cover how to use photographic data to create point clouds using ReCap 360 web’s “Photo to 3D” capabilities. Then we will take the point cloud created from those photos and register it with the laser scan data that we created in the previous steps. This last part is made easier thanks to new functionality available in ReCap 360 Pro 3.1.

What’s New in Autodesk ReCap 360 Release 3.1: https://youtu.be/OeS2ptWqM94

If you just watched the video at the link above, or have used ReCap 360 for a while, you probably realize now that ReCap 360 is really two products; one is a desktop program that processes laser scan data and point clouds (and, when licensed, is branded “Pro”) while the other is a browser-based web interface to cloud-processing of photographs and point clouds. This Internet version of ReCap 360 is accessible at https://recap360.autodesk.com, works best with Google Chrome® and only requires an Autodesk Account login (which is free). We refer to this as “web-enabled” software, and the goal is to have data be able to move from the desktop to the cloud and be processed or stored where it makes the best sense to do so.

The home page (or dashboard) of the ReCap 360 web portal displays all of your photo and scan projects. "What scan projects" you say? Well, besides the ability to process photos into point clouds, the cloud features of ReCap 360 include a viewer for desktop-generated point clouds as well, so you can share your ReCap 360 projects with others (through explicit email invitations from you). The cloud also hosts the processing of "Scan to Mesh" and "Project Cleanup" functionality available in ReCap 360 Pro desktop.




*RECAP – WEB PORTAL HOME PAGE*

To begin processing a group of photos into a point cloud or mesh, ReCap 360 web will assume that you have gathered the photographic data using best practices (sufficient overlap between adjacent photos, proper lighting, no photo post-processing, etc.) and are ready to upload them to the cloud. ReCap 360's sister product, ReMake, also leverages the processing power of the cloud to create 3D meshes from photographs.

The workflows for properly taking photographs are the same for each and are covered in this instructional video:

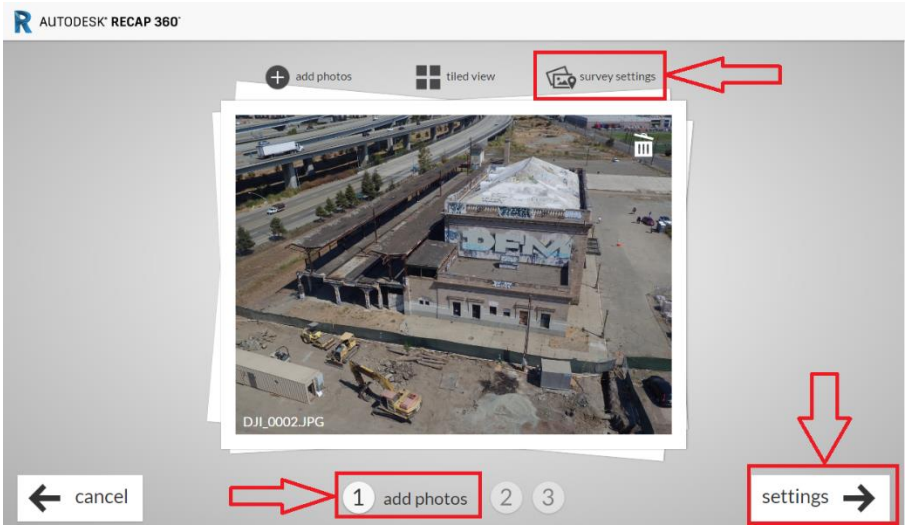
Autodesk ReMake: How to Take Photos for Photogrammetry
https://youtu.be/D7Torjkfec4?list=PLQOxJKbIe-75_cKYBY7oAAyp0qHlyFhuK

From the ReCap 360 web dashboard, we can start a new project by selecting the "Photo to 3D" button shown in the previous figure. This will take you to the first screen in the three-step process of starting a photogrammetry project with ReCap 360:

1. Add Photos – upload your photos (250-maximum per project) to the ReCap 360 secure website
2. Settings – make adjustments to the default project settings to suit your requirements
3. Grab a coffee – let the power of cloud computing take your photos and create a 3D mesh or point cloud that you can download.

*RECAP – STARTING A PHOTO TO 3D PROJECT*

Once you have uploaded your photos, you will have the option of adding more photos, setting "survey settings" or moving on to specify overall project settings:

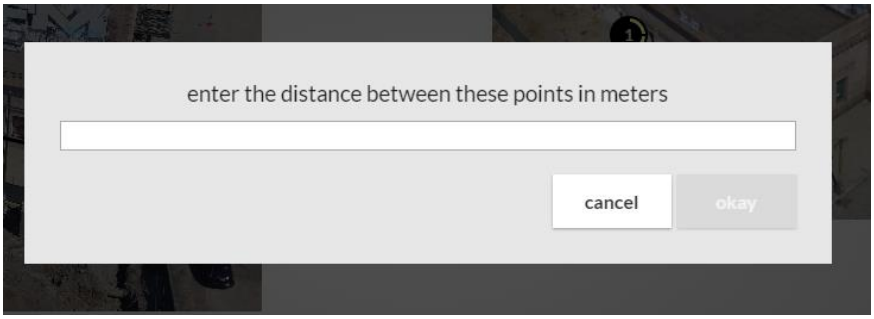



*RECAP – STARTING A PHOTO TO 3D PROJECT*

Setting the survey settings is essentially a process similar to manual registration of laser scans: You can also a scale to your project by picking the same point in side-by-side images (each point will be assigned a unique number and should appear in 4 different images):

*RECAP – ESTABLISHING SURVEY POINTS IN THE PHOTO TO 3D PROJECT*

You can also a scale your project by picking two of your previously specified survey points and entering a distance between those points in meters:

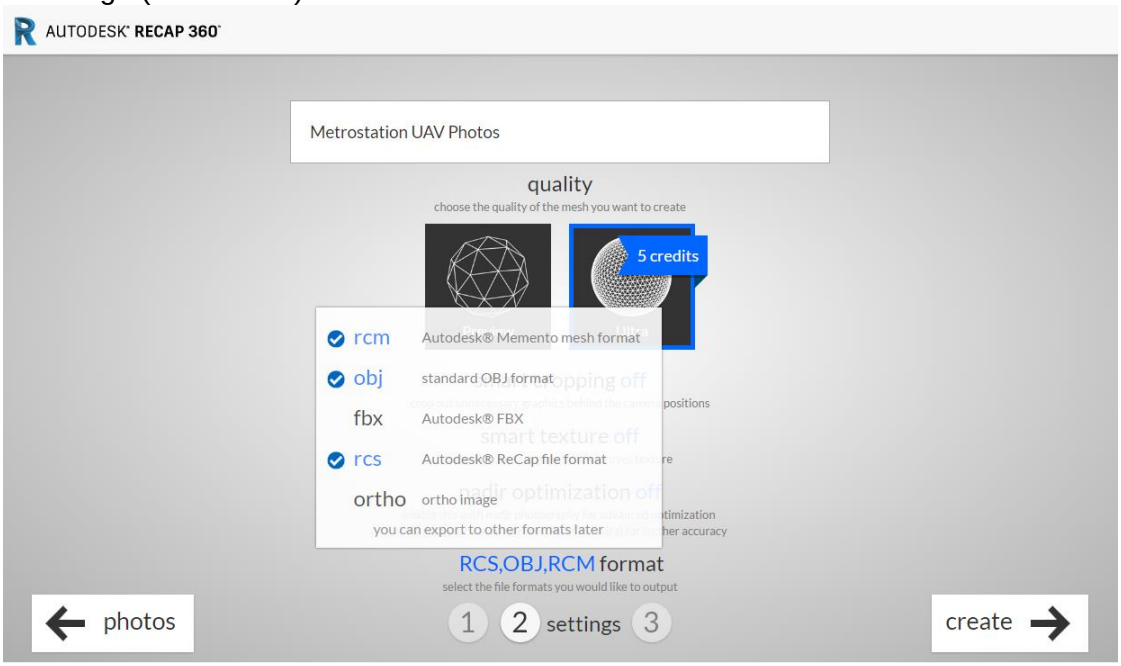



The steps above for locating and scaling your ReCap Photo to 3D project are not necessary if you plan on merging the RCS point cloud that is created from these photos with a registered ReCap 360 Pro desktop laser scan project. Since this is what we are going to be doing in this class example, we can move on to the next (and final) step of defining our project settings.

Defining our project settings will include providing the following:

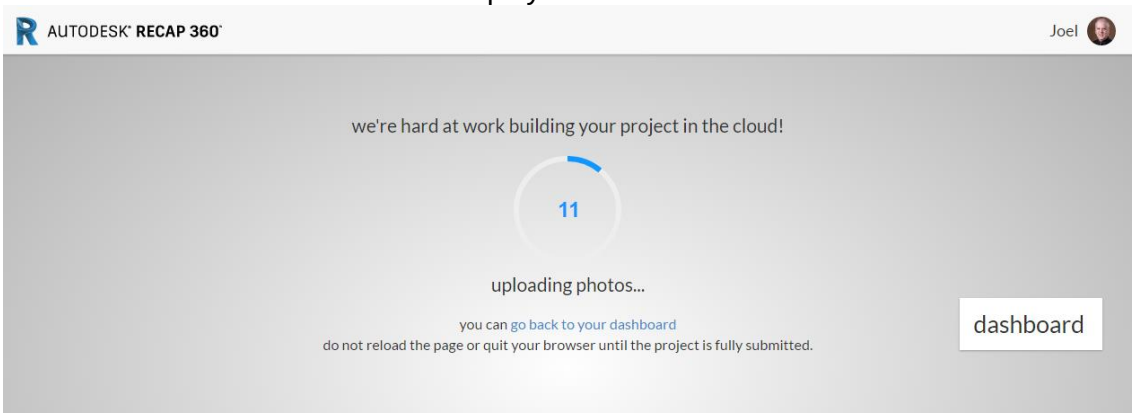
- Project name
- Quality – Either “Preview” or “Ultra”, with the latter requiring a 5 cloud credit purchase per project. (Note: additional photos can be added/removed from a project and the project can be re-processed without incurring additional charges)
- Smart Cropping – A feature to remove objects behind the camera locations that works best with non-UAV projects

- Smart Texture (Ultra mode only) – will improve the quality of textures created for mesh output
- Nadir Optimization – for aerial photogrammetry with accurate EXIF GPS data
- File Formats – RCM and OBJ (Preview mode) or additionally FBX, RCS and Ortho Image (Ultra mode)




*RECAP 360 – PHOTO TO 3D PROJECT SETTINGS*

With all of the desired settings in place we can create our ReCap Photo to 3D project by selecting the "Create" button in the lower right corner of this final screen. This will begin the photo processing – be sure not to reload (F5) the browser page or close your browser while the screen below is displayed:




*RECAP – PHOTO TO 3D INITIAL PROCESSING*

When the ReCap 360 web processing is complete you will receive an email notification that the new project is available on your ReCap 360 web dashboard. From the dashboard you can select which of the produced files - point cloud, mesh or ortho-image – that you want to download.

*RECAP – DOWNLOADING PHOTO TO 3D PROJECT FILES*

## Merging Photogrammetry Data with Laser Scan Data

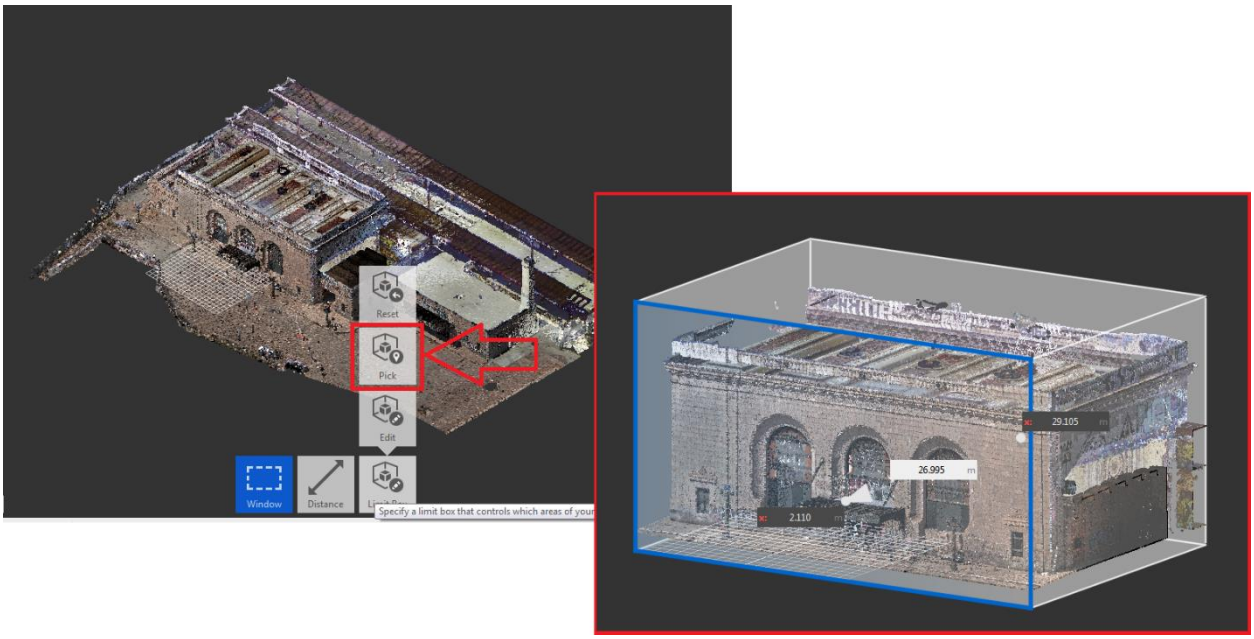
The ReCap 360 Pro 31 release of the desktop program has the ability to take unstructured RCS data created from Photo to 3D data and successfully register it with a ReCap project. By selecting "Import" from the main menu in ReCap 360 Pro desktop, you can add and manually register as many unstructured scans to your project as you need as long as at least one of your project scans is structured.

*RECAP – IMPORTING FILES INTO AN EXISTING PROJECT*

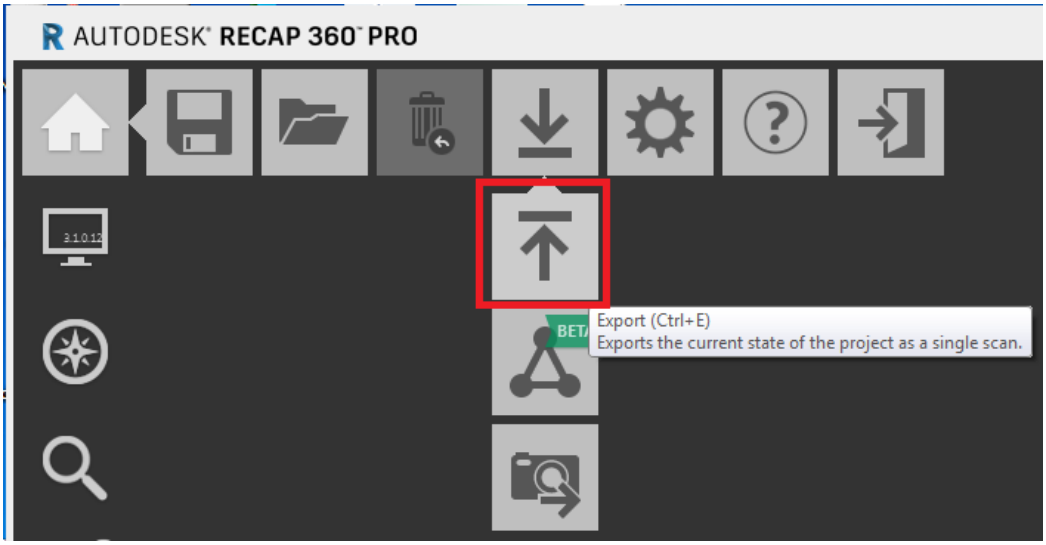
After importing the additional scan(s) you will then want to go through the steps of manually registering the project – auto-registration will not work with unstructured data so jump to manual registration after importing.

## Point Cloud Cleanup and Export

After all scans are registered and indexed, the typical workflow is to clean up the point cloud so that it contains only the information required within the design software (AutoCAD, Revit, Infraworks, etc.). This is done with the intent of optimizing performance and minimizing the amount of clipping required by the designers and engineers. The simplest way to export a subset of scan points from the project is to define a "Limit Box" in ReCap and set its boundaries just outside of the area of interest, and then export the visible points to a ReCap RCS file.




*RECAP – DEFINING A LIMIT BOX*




*RECAP – EXPORTING AN RCS FILE FOR DESIGN USE*

## Reality Capture Summary

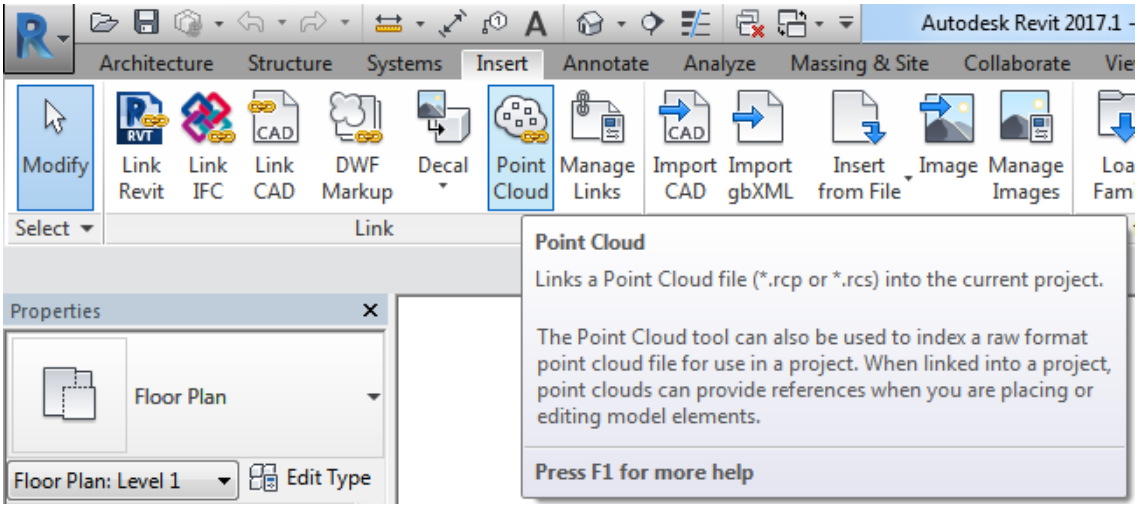
The first part of this class was intended to familiarize you with the basic workflow for capturing site data acquired from laser scanners and cameras and processing that data with ReCap 360 Pro desktop and web to quickly establish a 3D design basis from which to work from. The process using ReCap is flexible and can be iterative as the project scope evolves and gets more clearly defined. The next sections will show you how to incorporate this reality data into Revit and from there into Insight 360.

## OBJECTIVE 2: Learn how to convert the cloud to a model with Revit

### Bringing Reality Into Revit

Let's bring the point cloud into Revit. Then we will discuss how best to convert it to a model that can be used for Analysis.

Importing a point cloud into Revit is simple.




There are multiple ways to process the point cloud after import to make a model.

*There are a few 3rd party programs that will assist in identifying flat surfaces, round pipes, etc.…and processes them into rooms, walls, windows, etc.*

*Those 3rd party applications have an honorable mention at the end of this section, and can vastly speed up the process. But we need to discuss the manual process using native Revit methods.*

OVERVIEW OF WORKFLOW:

1. Create building model using Mass Elements or Walls from point cloud
2. Set Building Location
3. Verify that you have at least one room bounding object, and one level or mass floor.
4. Generate Energy Analytical Model

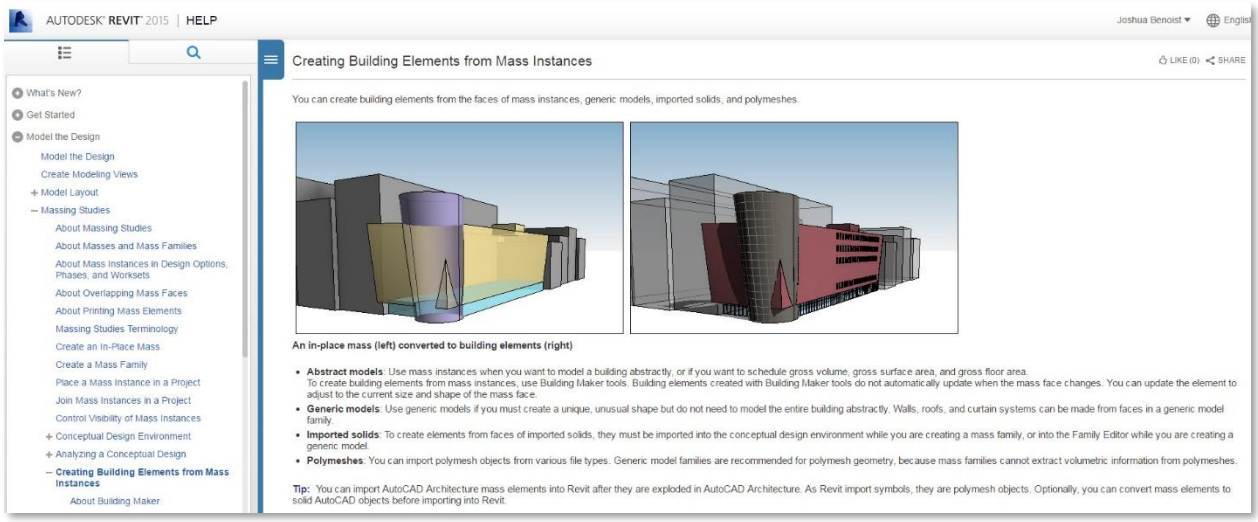
Start with less information to make "informed," scalable decisions along the path to increasing LOD.

STEP 1: If your point cloud was registered, it should import with correct scaling. If the point cloud was generated by photos with ReCap Photo, you can define the distance between two known points right inside ReCap Photo. The resultant point cloud will insert to scale. However, there will be a time that a point cloud is not scaled and Revit has a solution. This is the very first step, check your scaling after import, measure some points in 3D view. If scaling needs to be corrected, select the point cloud and go to the Property Palette. Select on Edit Type, change the "Scale" property. You may need some fraction math to calculate the right scale, or iterate a few times.

STEP 2: Cut a section from a plan view. Not all point clouds are equal. Some that come from laser scans will have all the registered data baked in. They will insert at the correct elevation. Others generated from ReCap Photo, may not know their elevation. Cut a section, you can then see where it ended up at and, if we need to, we can move the point cloud up/down to be at a correct elevation.

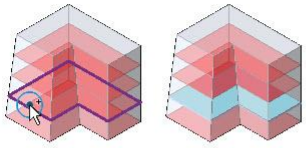
Step 3: While we are in the section view, define the levels. To generate an "Energy Model," we must have a minimum of one level, or when using Mass Elements, we need a "Mass Floor." Insight 360 does shading calculations.

To distinguish between your model for analysis, and objects that are there for shading, we need either one level cutting thru the model or a mass floor. If you have mass elements that represent other buildings, plants, etc. for shading calculations, leave them out of all level bounds. Stretch your level bounds such that your model is within bounds and no more. If your model is a mass element, we need at least one "Mass Floor."
A lot of information can be found in the Help files, for Mass Floors. Here are some screen grabs for reference.



## Create a Floor from a Mass Floor

To create floors from a mass instance, use the Floor by Face tool or the Floor tool.

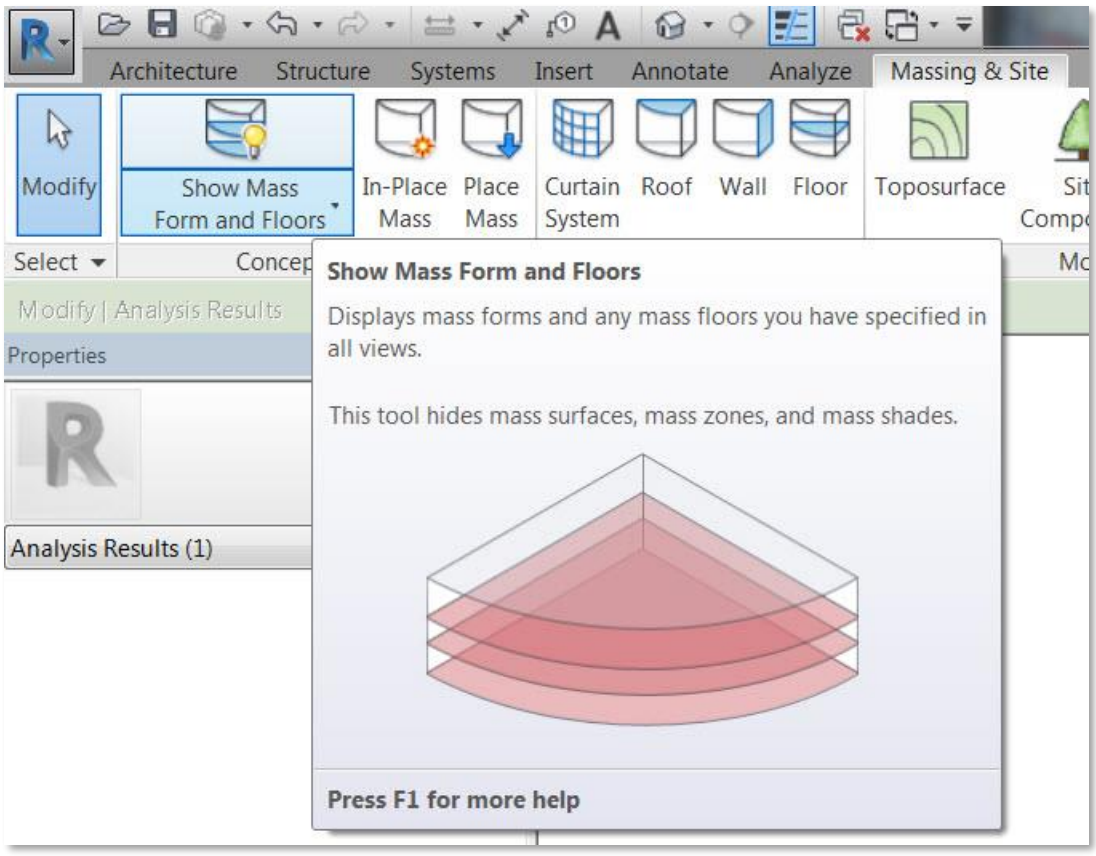


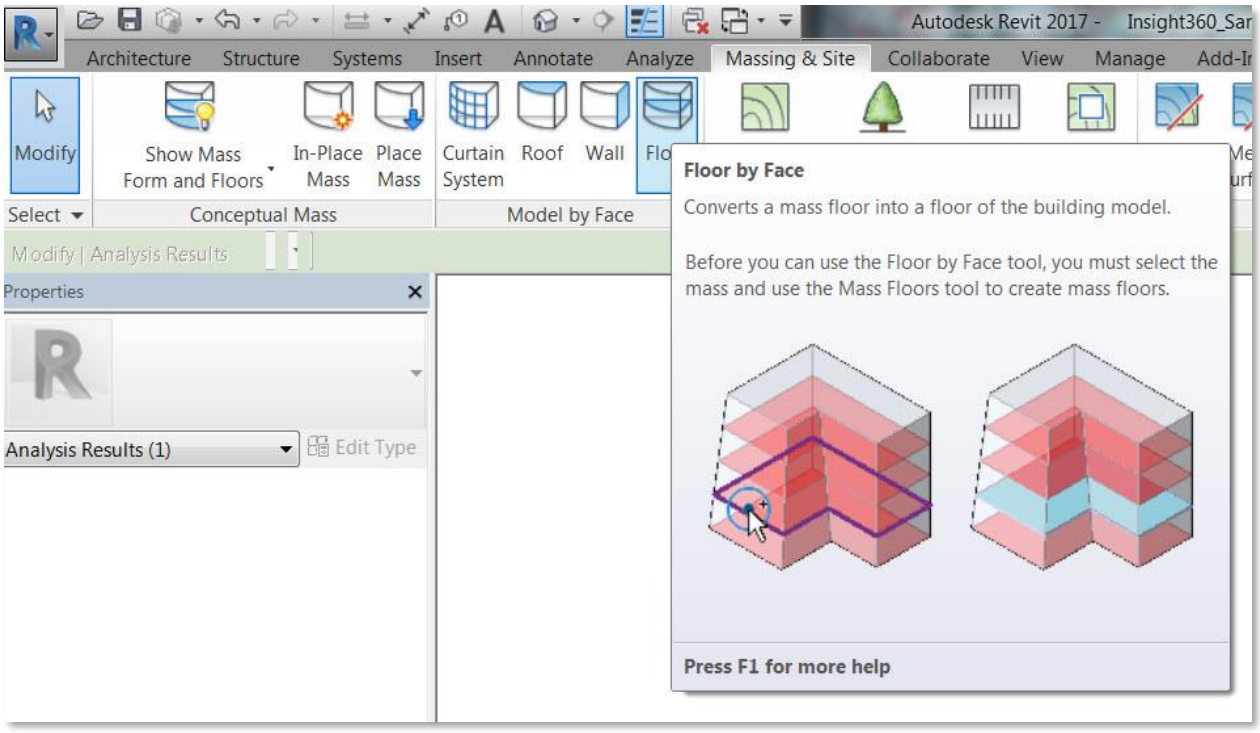
To use the Floor by Face tool, you first create mass floors. Mass floors calculate floor areas in a mass instance.

**To create a floor from a mass floor**

1. Open a view that displays the mass.
2. Click Massing & Site tab ➤ Model by Face panel ➤ (Floor by Face).
3. In the Type Selector, select a floor type.
4. (Optional) To create the floor from a single mass face, click Modify | Place Floor by Face tab ➤ Multiple Selection panel ➤ (Select Multiple) to disable it. (It is enabled by default.)
5. Move the cursor to highlight a mass floor.
6. Click to select the mass floor.
   If the Select Multiple option is cleared, a floor is placed on the mass floor immediately.
7. If Select Multiple is enabled, select more mass floors.
   a. Click an unselected mass floor to add it to the selection. Click a selected mass floor to remove it.
      The cursor indicates whether you are adding (+) or removing (–) a mass floor.
   b. To clear the selection and start over, click Modify | Place Floor by Face tab ➤ Multiple Selection panel ➤ (Clear Selection).
   c. When the desired mass floor are selected, click Modify | Place Floor by Face tab ➤ Multiple Selection panel ➤ Create Floor.

**Parent topic:** Creating Building Elements from Mass Instances

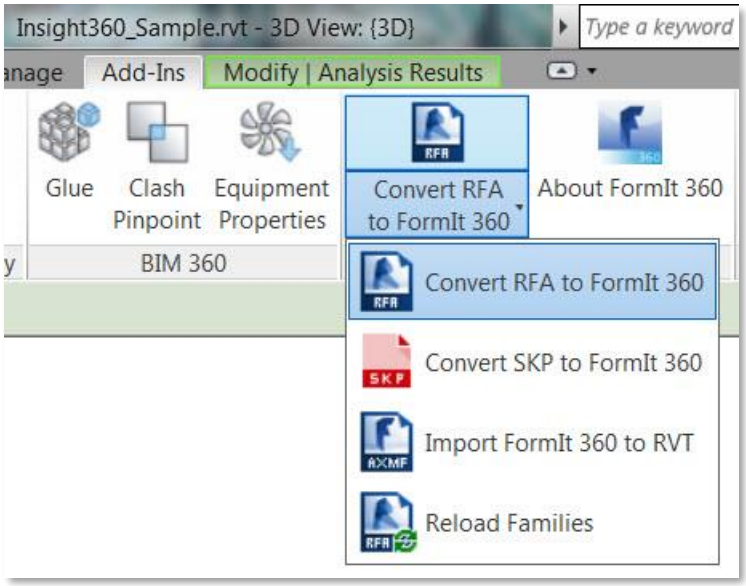





Step 4: Setup the Level Plan views, define the North, South, East, West Elevation markers and limits, and Plan view ranges. This is our catch-all step…do what you would normally do when you start a new project and model. Let's get all the typical stuff out of the way, and after this step we should be at a point where we can start modelling, laying down walls, etc.

STEP 5: If Plan views are setup properly with good cut planes and view ranges, we should see an outline of the walls where we cut through the point cloud. THIS IS A VERY IMPORTANT STEP. At what LOD (Level Of Detail) do we want to start at? We can start as simple as a Mass Element!!! Stay at the conceptual level. This is where very important "Building Energy Optimization" decisions are made like Orientation to the sun, overall shape, size, wall/window ratios… Ok, so if we have a point cloud, maybe that implies we have a pre-existing building… or maybe our point cloud is for the site of our future building. How we use our point cloud is totally situational; your design model will have some interface points with reality. At a minimum, the point cloud helps to "Rough-In" our model. We are going to assume that you went thru the effort of importing a point cloud to aid in making better decisions when modeling. You can start at conceptual modeling with a mass element, or jump straight into higher LOD by tracing over your cloud with walls, windows, doors, rooms, etc. The main point is you can start at any LOD, the Energy Analysis can handle ANY LOD.

You can also start in Revit with a mass element approximating your point cloud, export to FormIt 360 where you refine your mass element quickly and re-Import back to Revit.




For the purposes of this reference manual, we are going to use the Sample Revit Architectural model that we all receive when we install Revit. It has walls, windows, doors, rooms and is fairly detailed. In the AU Class we will use a second model which conforms to the point cloud of our the building. We want to analyze it at the very earliest stage as a simple mass element… a rectangular box. Starting as a simple mass element box has the benefit of starting wth less info to make "informed," scalable decisions. It's also useful when we discuss the fundamentals of Insight 360.

STEP 6: For those with a point cloud of an existing building, start a new wall, trace the point cloud. NOTE: Point cloud walls are not perfectly flat, especially if they are generated from photos. Clouds generated from lasers are highly accurate, but from photos can be up to a half inch off. Trace everything, walls, windows, doors. Setup various views and tile them on your screen. One view has both modeled walls with point cloud, and another view should have just the new modeled walls. That way you can see where you have been, and in other view where you need to go.

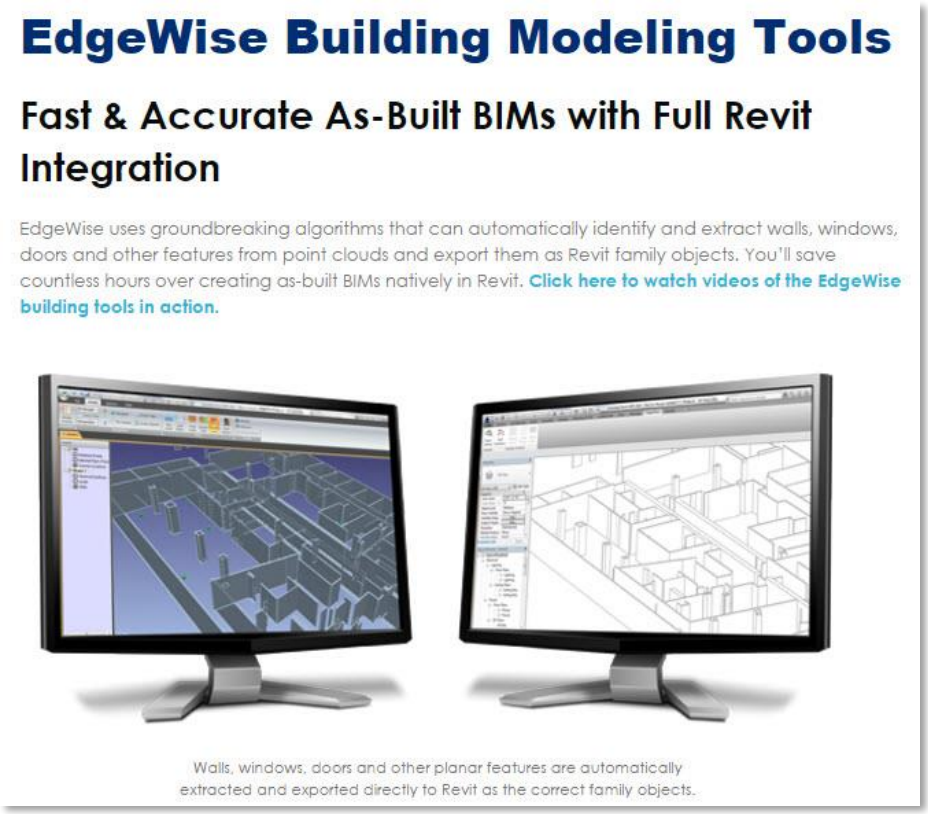
STEP 7: Once we have traced over everything, whether it be mass element or walls, and have a Revit model at the desired LOD, feel free to move on to the next stage where we export to Insight 360.

---

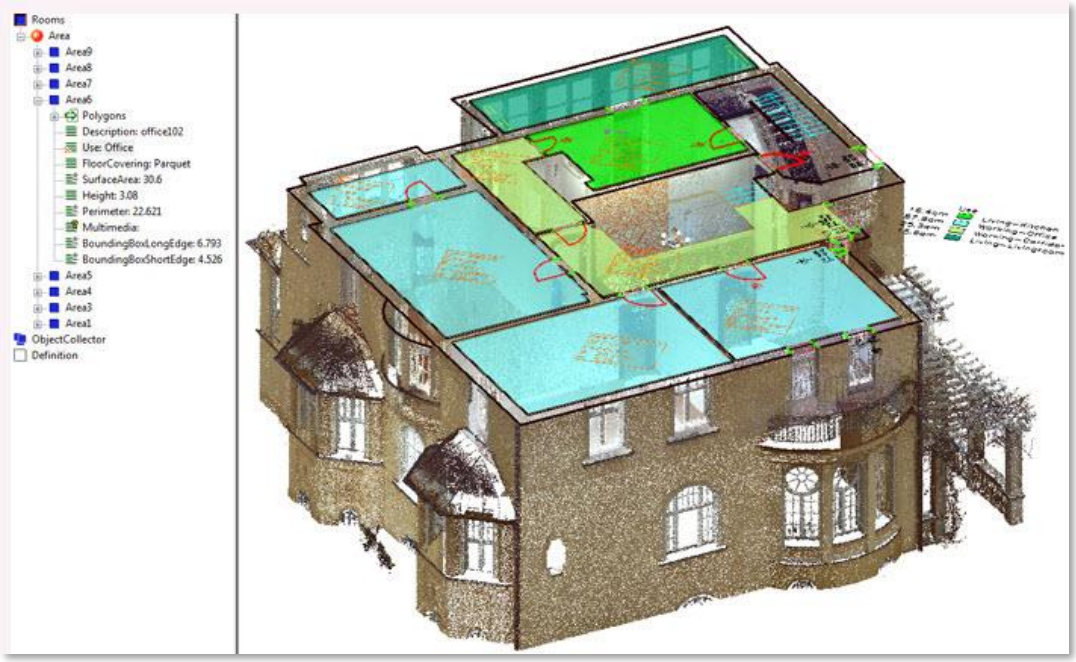
NOTE: On the next page you will find the two 3rd party programs that can automate the point cloud to model conversion.

Nothing below should be considered an endorsement. It's just what I've run across so far.

ClearEdge - Edgewise: http://www.clearedge3d.com/products/edgewise-building/




FARO - Kubit PointSense: http://faro-3d-software.com/CAD/Products/PointSense/



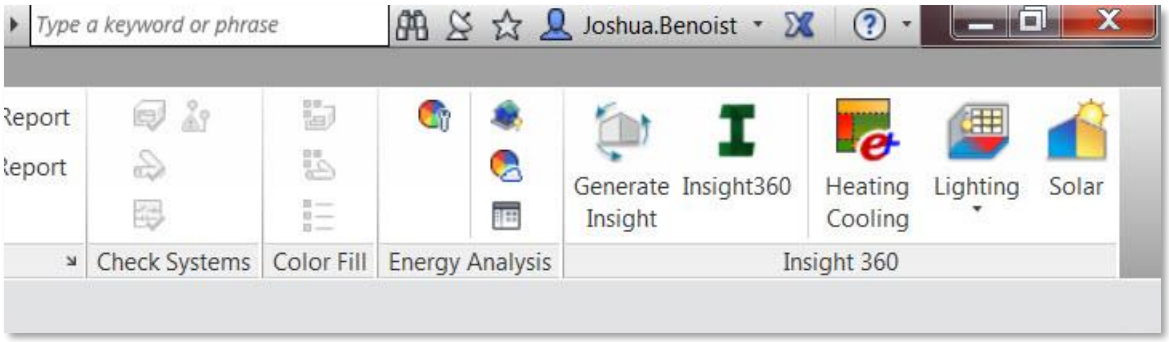
# OBJECTIVE 3: Learn how to bring your model into Insight 360

## Navigating from Revit to Insight 360

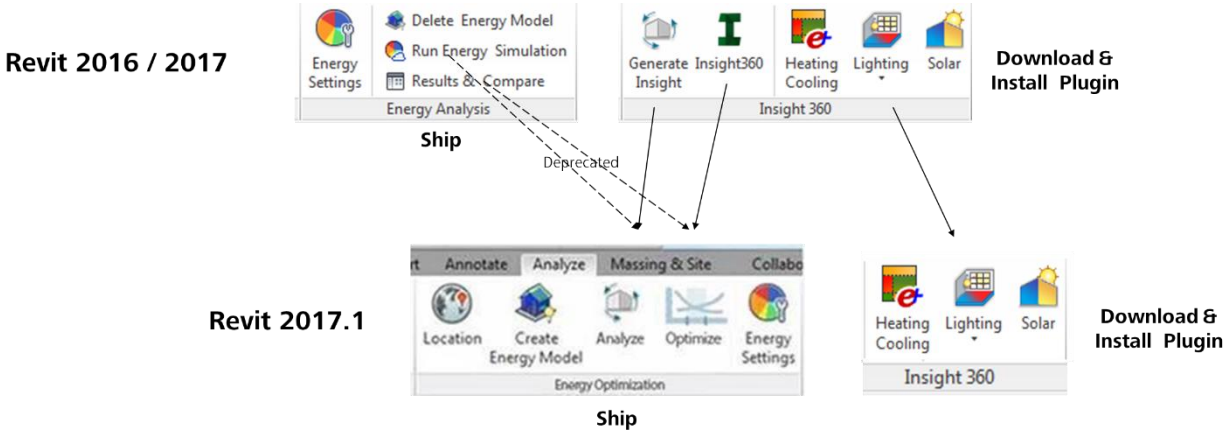
NOTE: See the APPENDIX for assistance in installing the Insight 360 plug-in on your Revit 2016 or 2017 version.

In the Analysis tab of the Ribbon, find panels for both Energy Analysis and Insight 360.

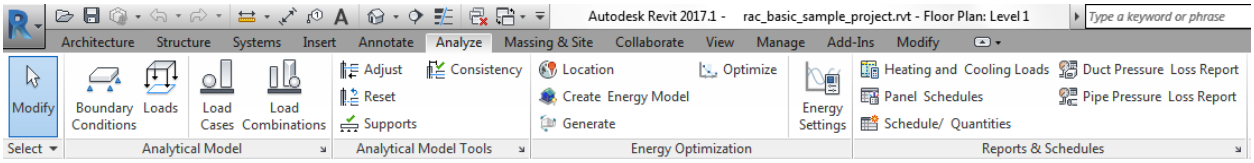
2016 & 2017:

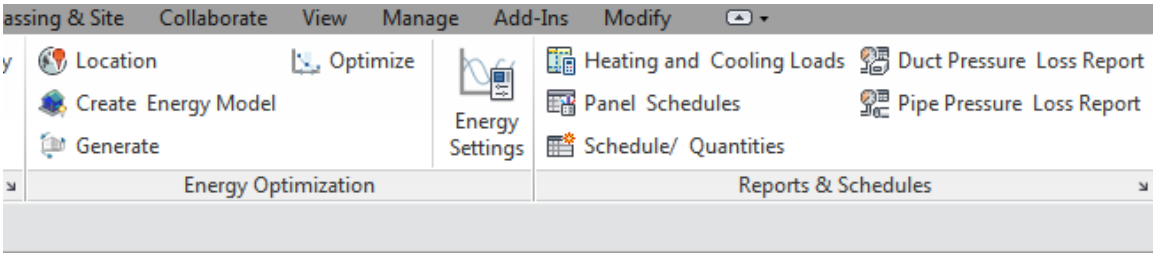


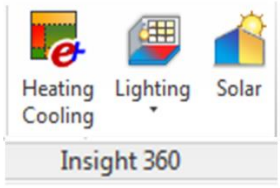

Insight 360 changed on Revit 2017.1. The two buttons seen above labeled “Generate Insight” and “Insight 360” moved to a new Revit built-in Ribbon panel on the Analysis tab labelled “Energy Optimization” as seen below. Seen above, the “Heating Cooling” button, “Lighting and Solar” Analysis buttons now have a separate panel that is installed as a separate plug-in in 2017.1.



2017.1:



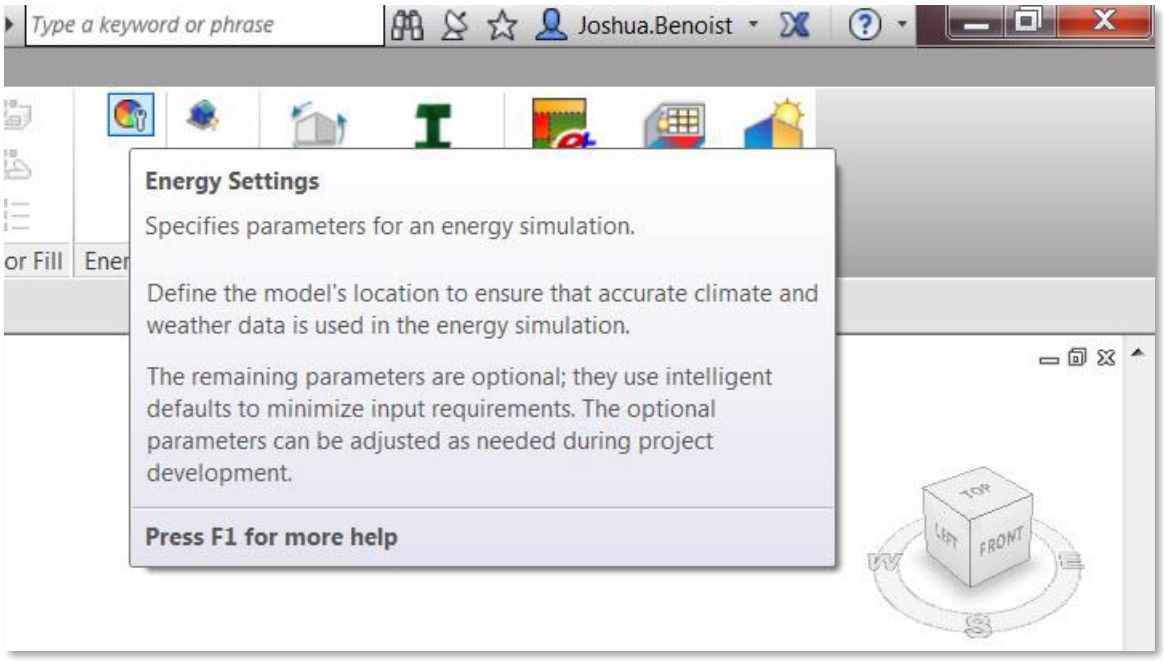



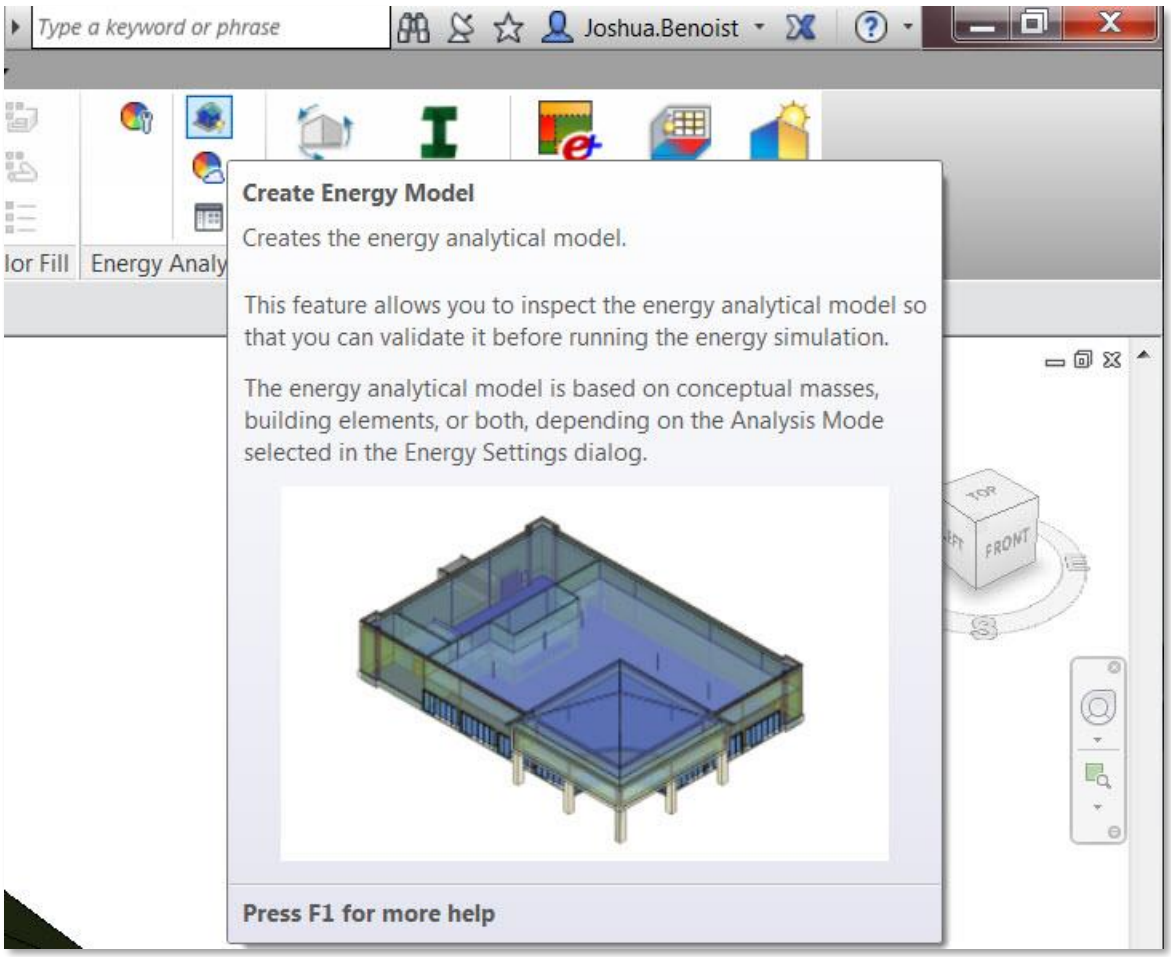



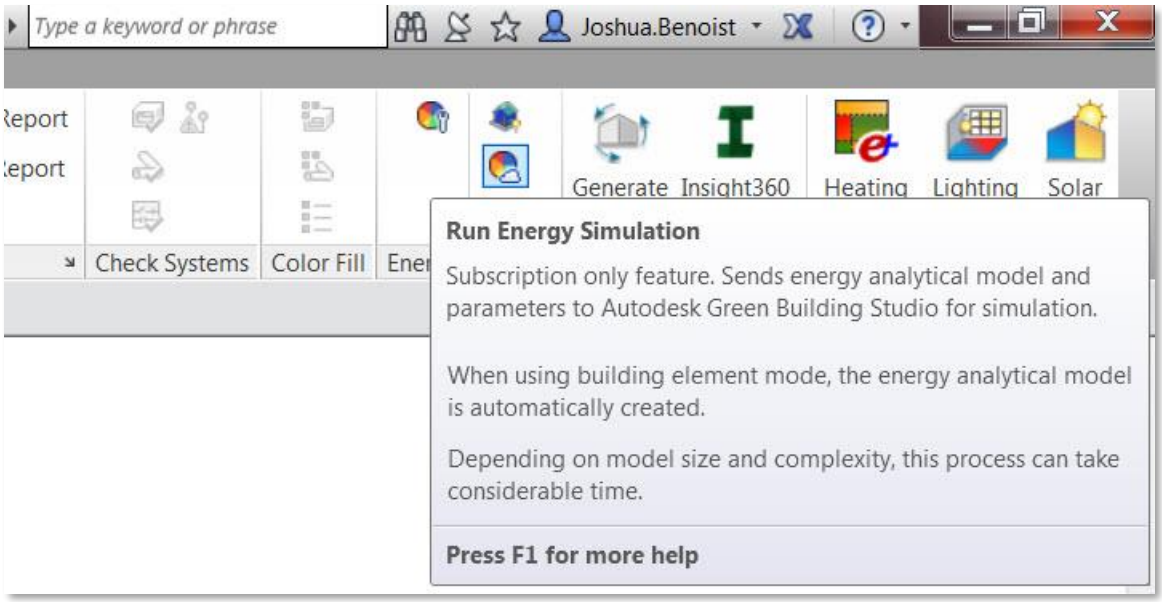

Let's explore what each button does. I took some quick screen captures of the Help: Tooltips…in sequence. Browse thru the next few captures.

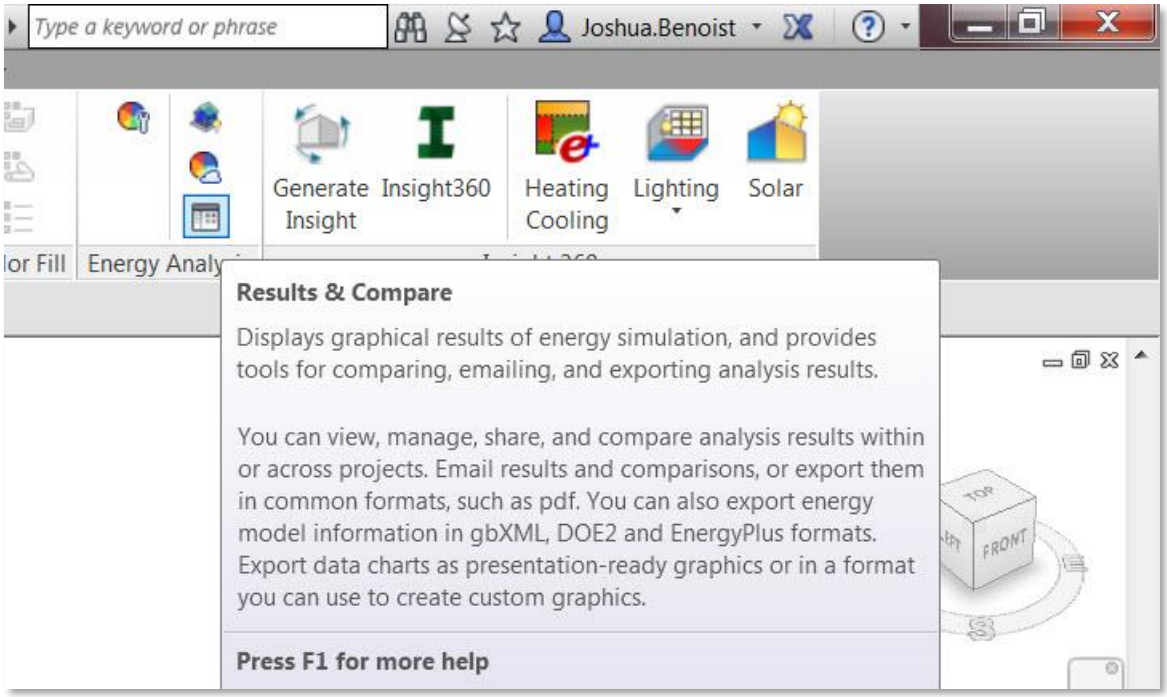
NOTE: We cover the "Heating Cooling" the "Lighting" and "Solar" buttons down in the Appendix.

2016 & 2017:

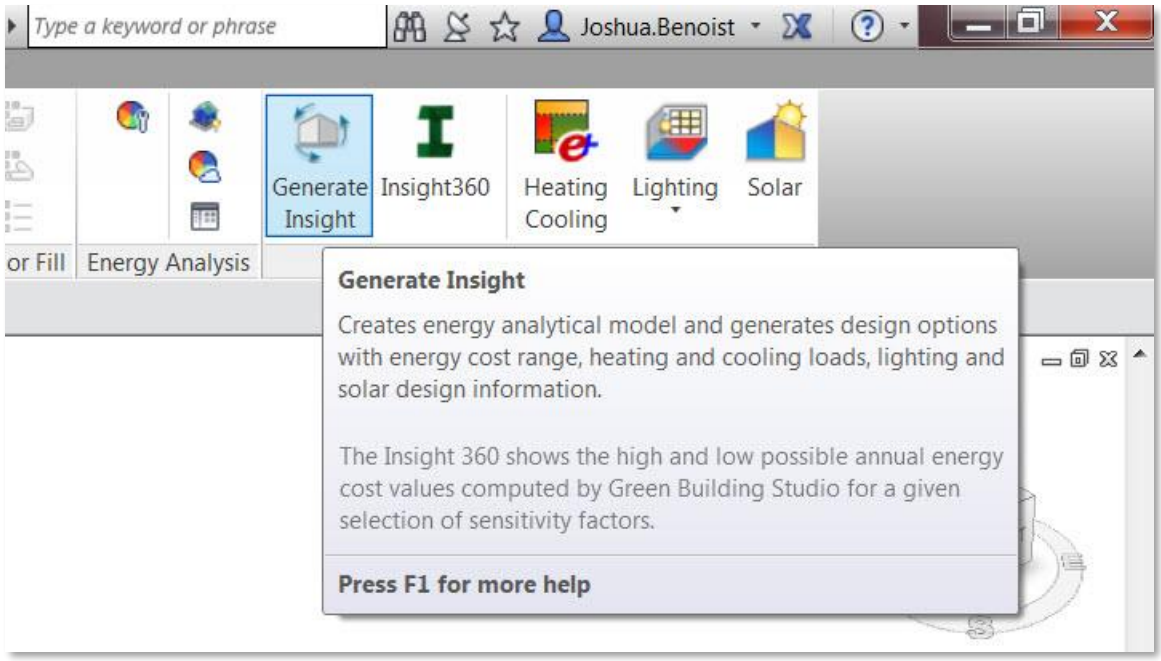

Type a keyword or phrase
Joshua.Benoist
Energy Settings
Specifies parameters for an energy simulation.
Define the model's location to ensure that accurate climate and weather data is used in the energy simulation.
The remaining parameters are optional; they use intelligent defaults to minimize input requirements. The optional parameters can be adjusted as needed during project development.
Press F1 for more help
TOP
LEFT
FRONT


Type a keyword or phrase
Joshua.Benoist
Create Energy Model
Creates the energy analytical model.
This feature allows you to inspect the energy analytical model so that you can validate it before running the energy simulation.
The energy analytical model is based on conceptual masses, building elements, or both, depending on the Analysis Mode selected in the Energy Settings dialog.
Press F1 for more help
TOP
FRONT



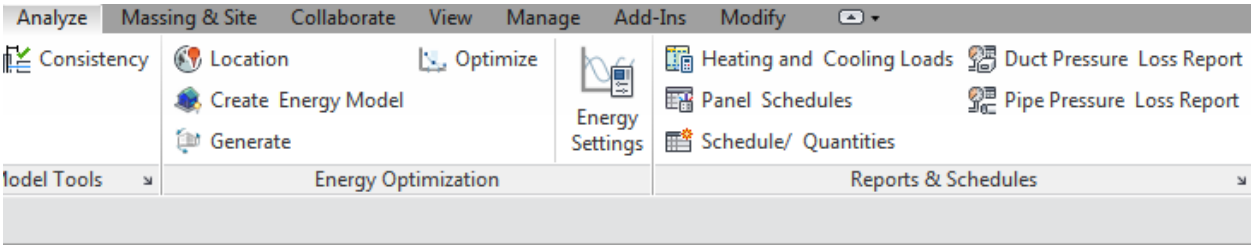

Run Energy Simulation and Results and Compare buttons are no longer available in 2017.1 and won't be available going forward. You will still see these in 2016.

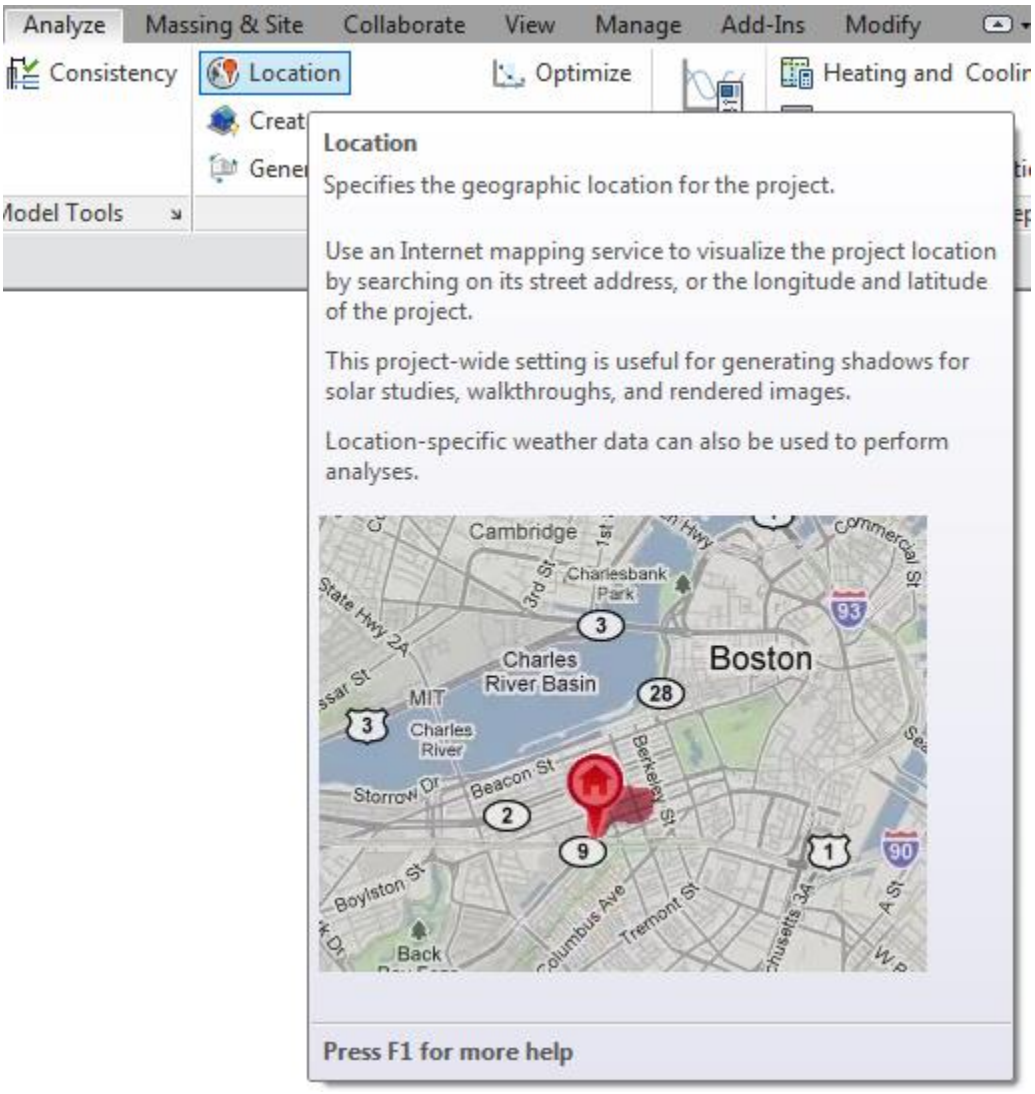


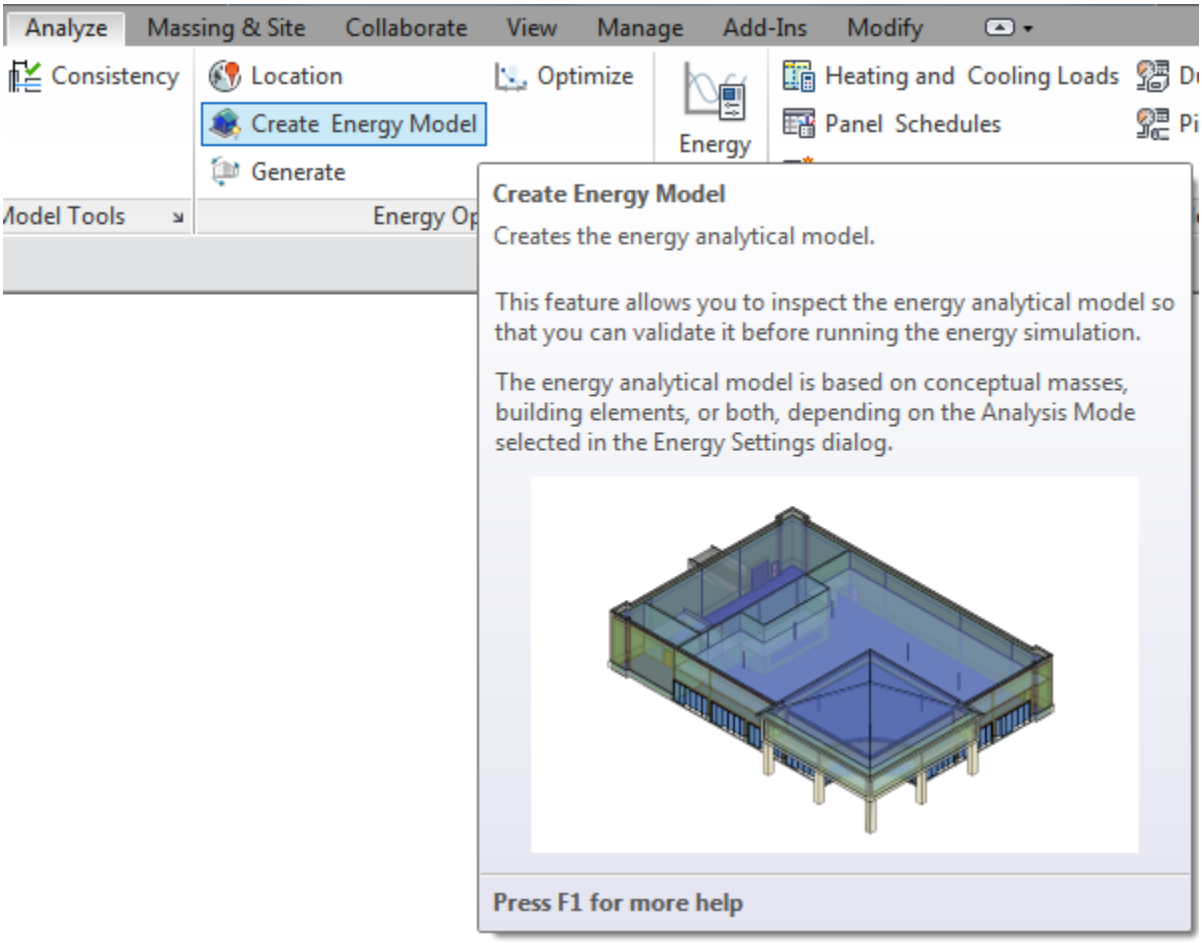

This “Generate Insight” creates the Energy Analytical model, which is then viewed in Insight 360, AFTER selecting on “Insight 360” button. The behavior will be different in 2017.1 as we will discuss later.

The screen captures above cover 2016 & 2017 versions, let’s check out 2017.1…

2017.1:

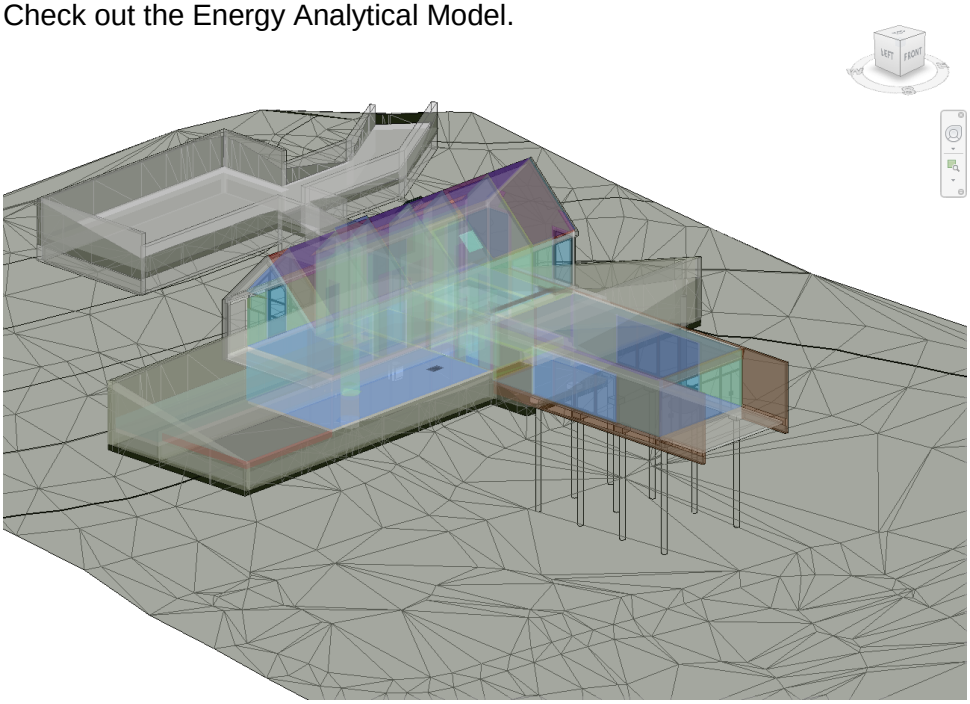

Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify
Consistency
Location
Optimize
Create Energy Model
Generate
Energy Settings
Heating and Cooling Loads
Panel Schedules
Schedule/ Quantities
Duct Pressure Loss Report
Pipe Pressure Loss Report
Energy Optimization
Reports & Schedules


Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify
Consistency
Location
Optimize
Heating and Coolir
Model Tools
Location
Specifies the geographic location for the project.
Use an Internet mapping service to visualize the project location by searching on its street address, or the longitude and latitude of the project.
This project-wide setting is useful for generating shadows for solar studies, walkthroughs, and rendered images.
Location-specific weather data can also be used to perform analyses.
Cambridge
Charlesbank Park
Charles River Basin
Boston
MIT
Charles River
Beacon St
Storrow Dr
Boylston St
Back
Press F1 for more help

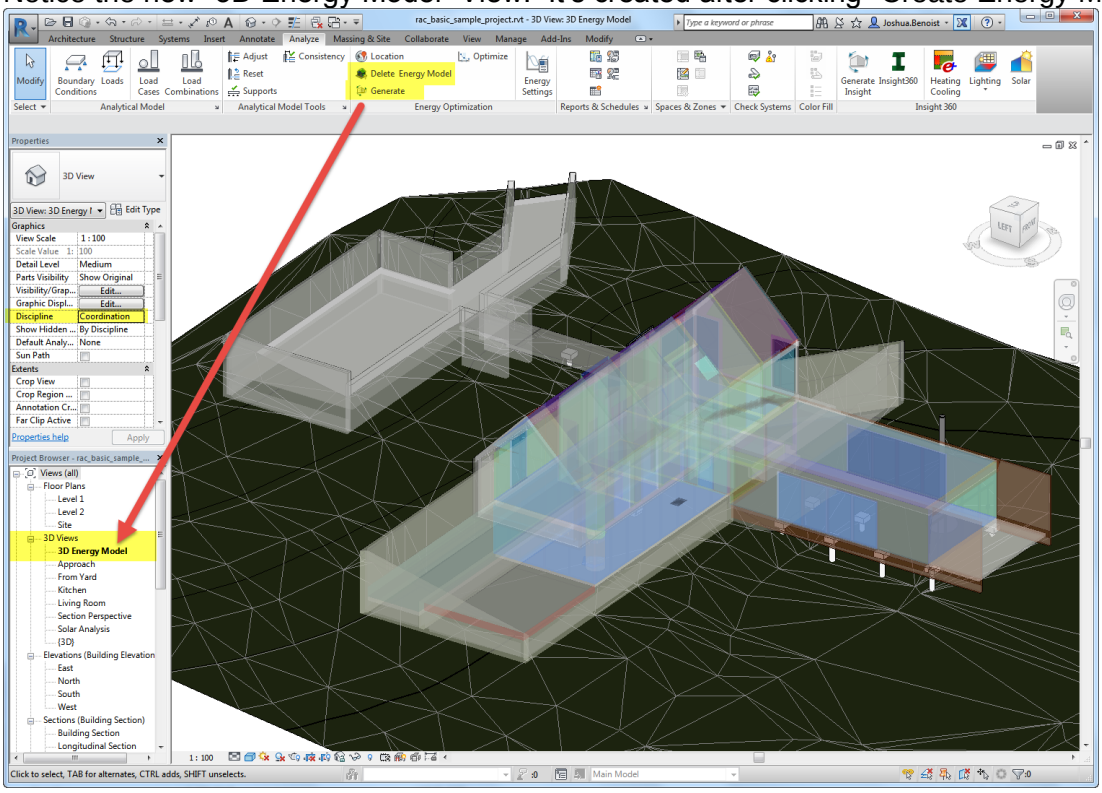



This “Create Energy Model” in 2017.1 does the same as the “Generate Insight” button does in 2016/2017 with one MAJOR difference! It also creates a new View “3D Energy Model” in Revit and displays the Analytical model directly in the Revit View. This is a HUGE improvement where we can preview and make changes directly in Revit before switching to Insight 360.

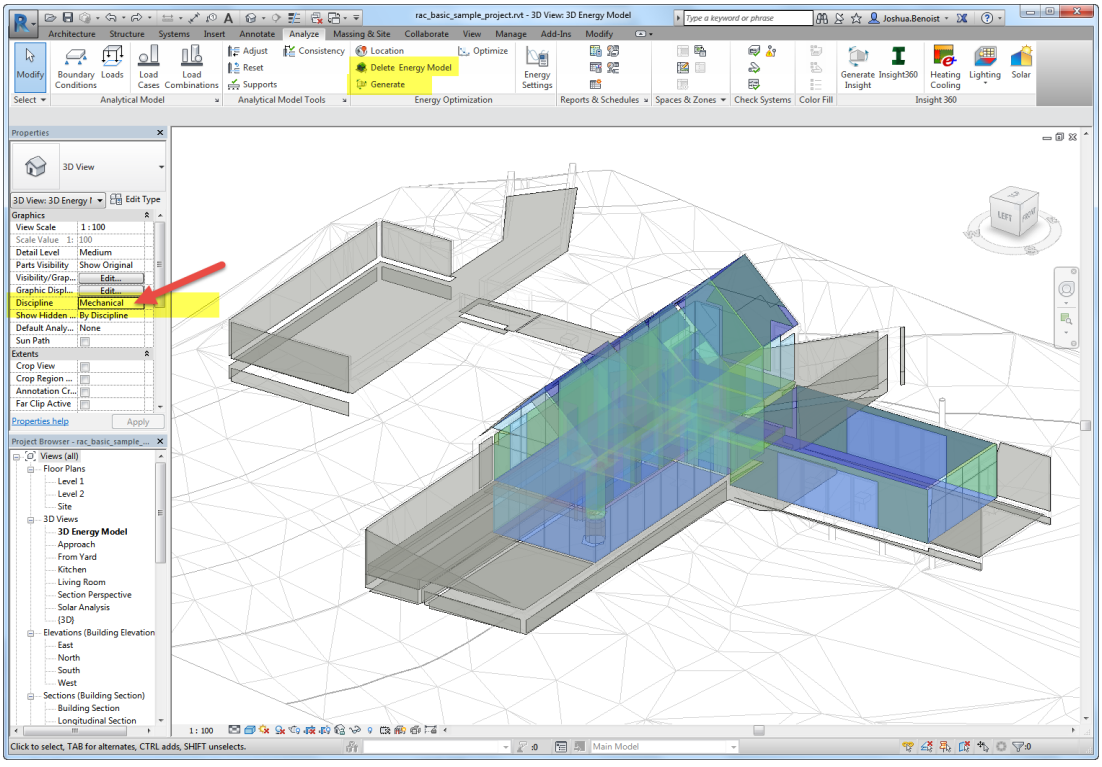
Check out the Energy Analytical Model.

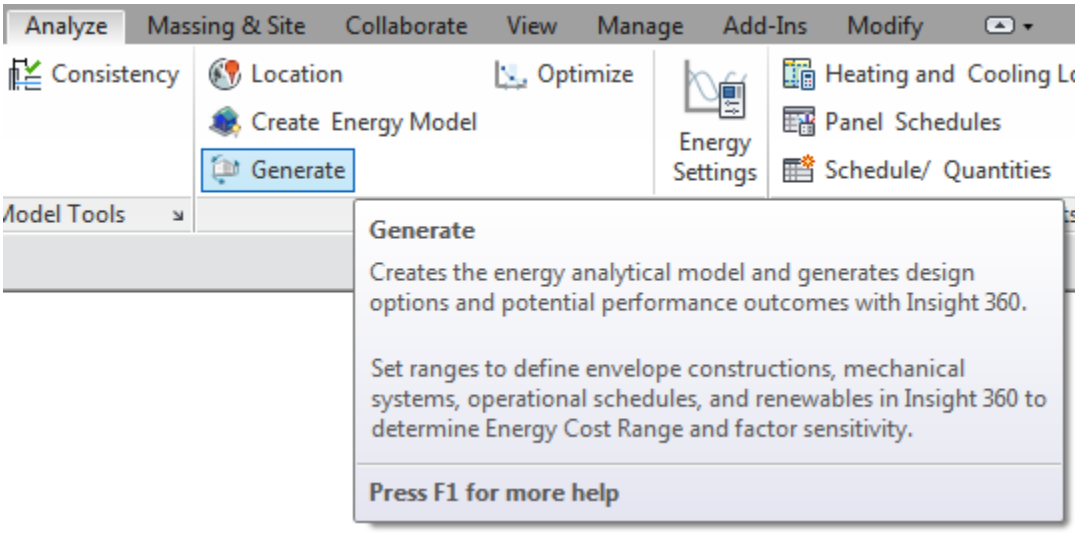


Notice the new “3D Energy Model” View.  It’s created after clicking “Create Energy Model.”

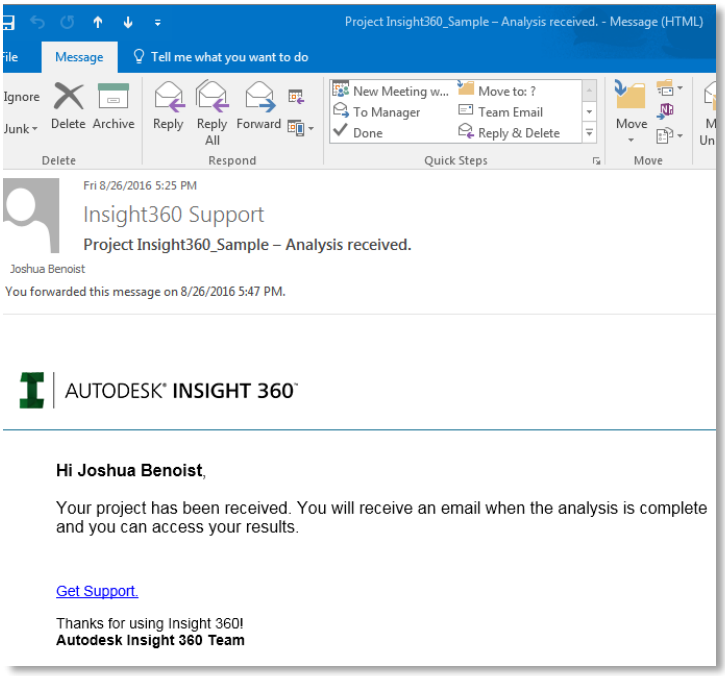


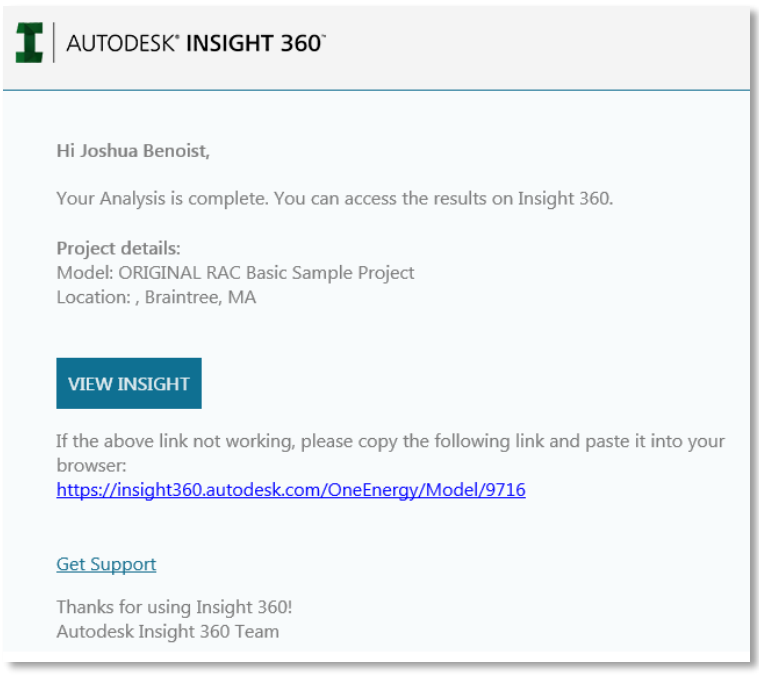

TIP: The default Topo-surface is black and can be changed.  To do so, change the View Discipline property from “Coordination” to become “Mechanical.”



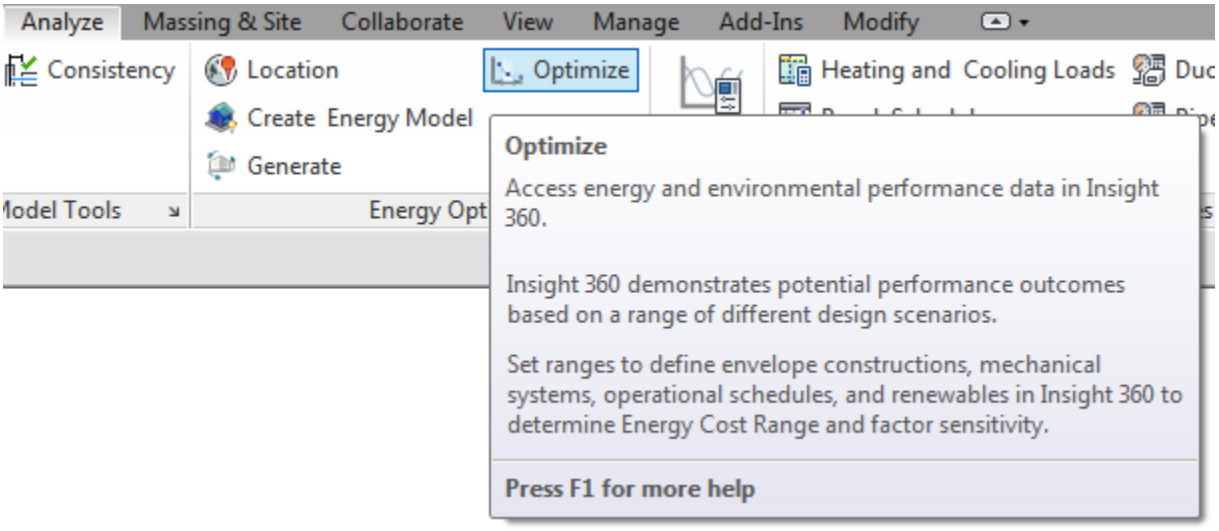



The “Generate” button uploads the Energy Model to Insight 360…and if you forgot to preview and tweak first using the “Create Energy Model” button, it will create the Energy Model.

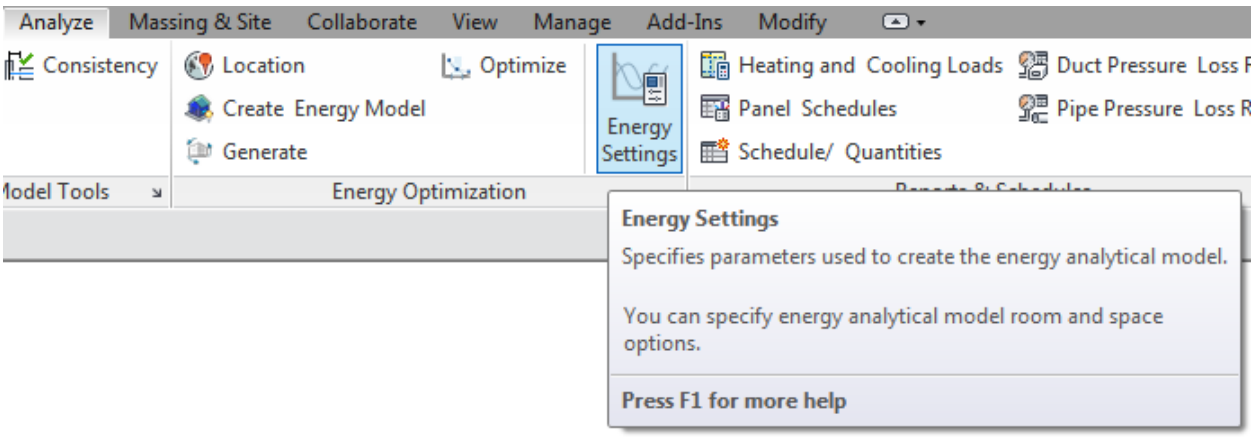


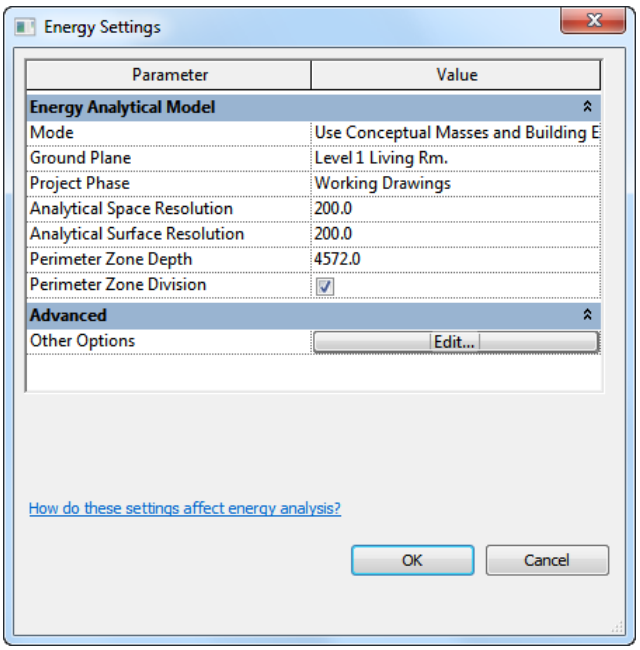

You will receive the above email indicating your model has been uploaded and is being processed, and the next email when complete.

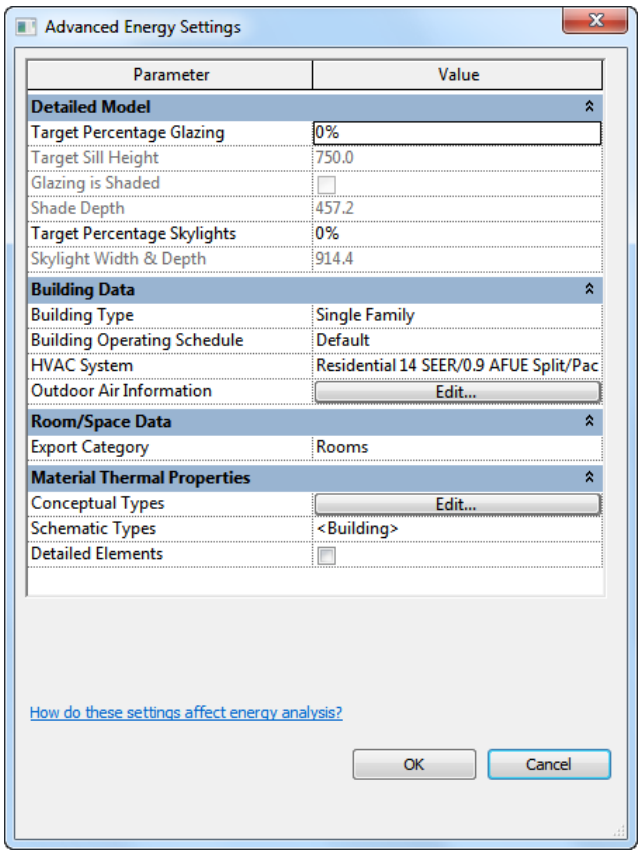



The “Optimize” button in 2017.1 is the same as the “Insight 360” button in 2016/2017. It launches the Insight 360 report viewer.




The Energy Settings button pops up the following dialogs and has been tailored to work with Insight 360 as well as the pre-existing Revit MEP Energy Analysis features.




These Energy Settings, and Advanced Energy Settings are OPTIONAL!!! They refine the analysis, but are not necessary at the initial IDP phases to get results that will assist in making decisions like Site Orientation, Wall to Window Ratio, etc.

It is worth recommending users set their analysis mode to “Use conceptual masses and buildings elements.” A lot of users don’t know to set this, and therefore they have a hard time using the analysis tools.

The key takeaway is that, as the model’s “Level Of Detail” grows, your Insight 360 “Ranges” stop being “Ranges.” As you add windows to the wall, they suddenly know the exact wall to window ratio. No more range, it’s a known value. The same goes for these parameters in the Energy Settings, like “HVAC System.”

With that said, Insight 360 can still be meaningful. We still show the full range; we simply label the “BIM” model’s point on the range. In the graphs, you will see “BIM” and that shows where the current model is on the curve. You will see this in the next objective.

NOTE: The “Energy Analysis” model may leave gaps at the wall ends due to the architecture. This does not affect the energy estimate. However, if you are trying to calculate areas for an accurate wall to glass ratio factor, this "gapping" may affect this calculation.

It depends on the gap size, in one case thick walls may cause large gaps. You can try reducing values of the 'analytical space and surface resolution' to 8" / 4" respectively and try again. Also without any floor or roof, no interior space would be identified. You shouldn’t submit this for analysis because if you do, when it calculates the glass ratio factor (called window to wall ratio) it would throw that off. You can preview / inspect the “Analysis” model in Insight 360, or generate it in Revit from the “Energy Analysis” panel > “Create Energy Model.” Look for gaps and missing roof/floor elements. Iterate as necessary and fix that in your Revit model. Let’s click the “Optimize” button to go to Insight 360.

## OBJECTIVE 4: Learn how to generate a Building Performance Analysis

### Analyzing Reality with Insight 360

The Insight 360 FAQ is a great source of information. For our purposes:

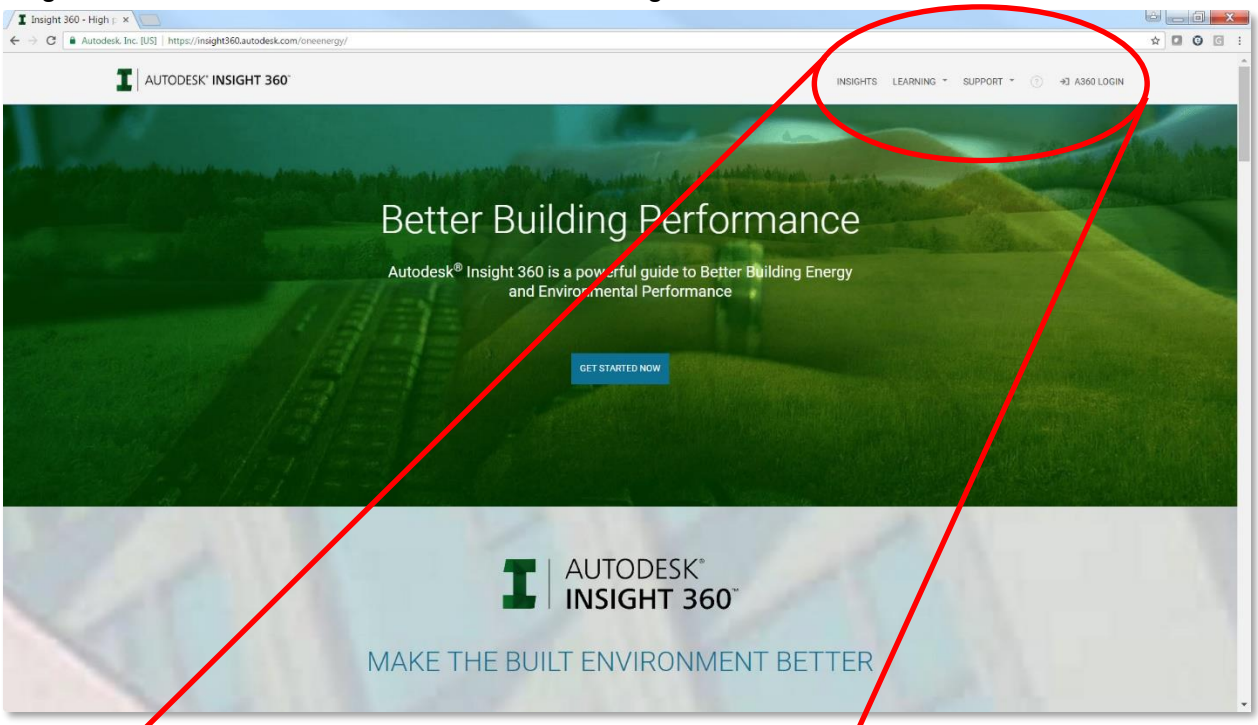
Whole building energy analysis from Revit and Insight 360 is powered by Green Building Studio, which runs in the background to crunch the calculations using the “DOE-2.2” engine run in the cloud, and has been tested against ANSI/ASHRAE 140 the industry standard. Insight 360 is the reporting face of that analysis.

Insight 360 – Heating & Cooling loads uses the “EnergyPlus+” engine for HVAC calculations. This also has been tested against ANSI/ASHRAE 140.

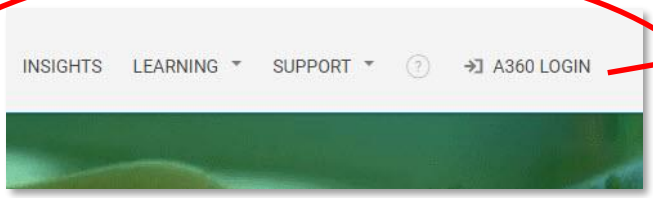
IMPORTANT: On each screen, I’m going to give a walkthrough of the interface first, so that you have context before we discuss workflows.

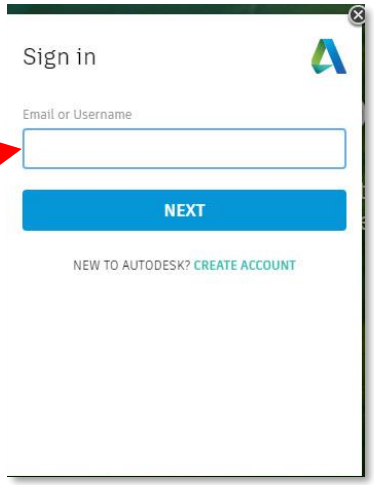
Insight 360 is MOBILE thru the web browser, and looks great on any Platform:

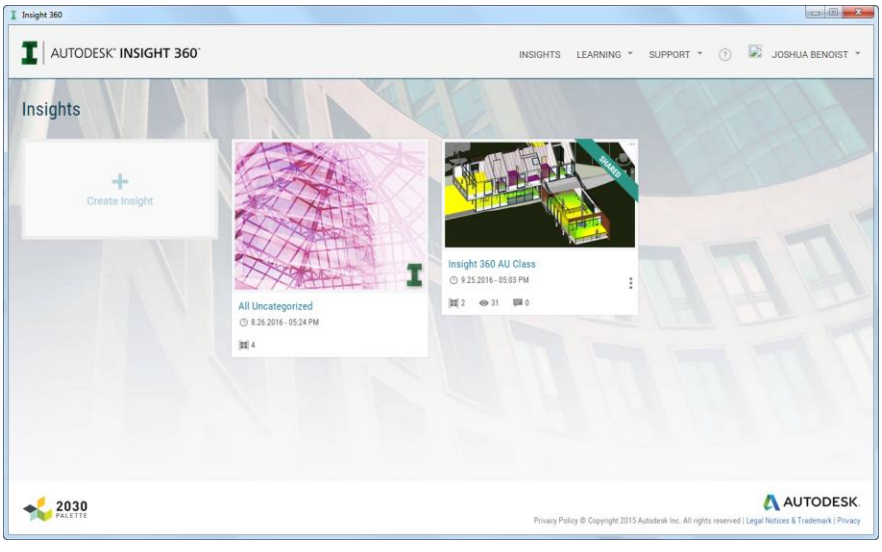
Insight 360 is mobile and collaborative. We can login from the Home screen.




*INSIGHT 360 HOME SCREEN*

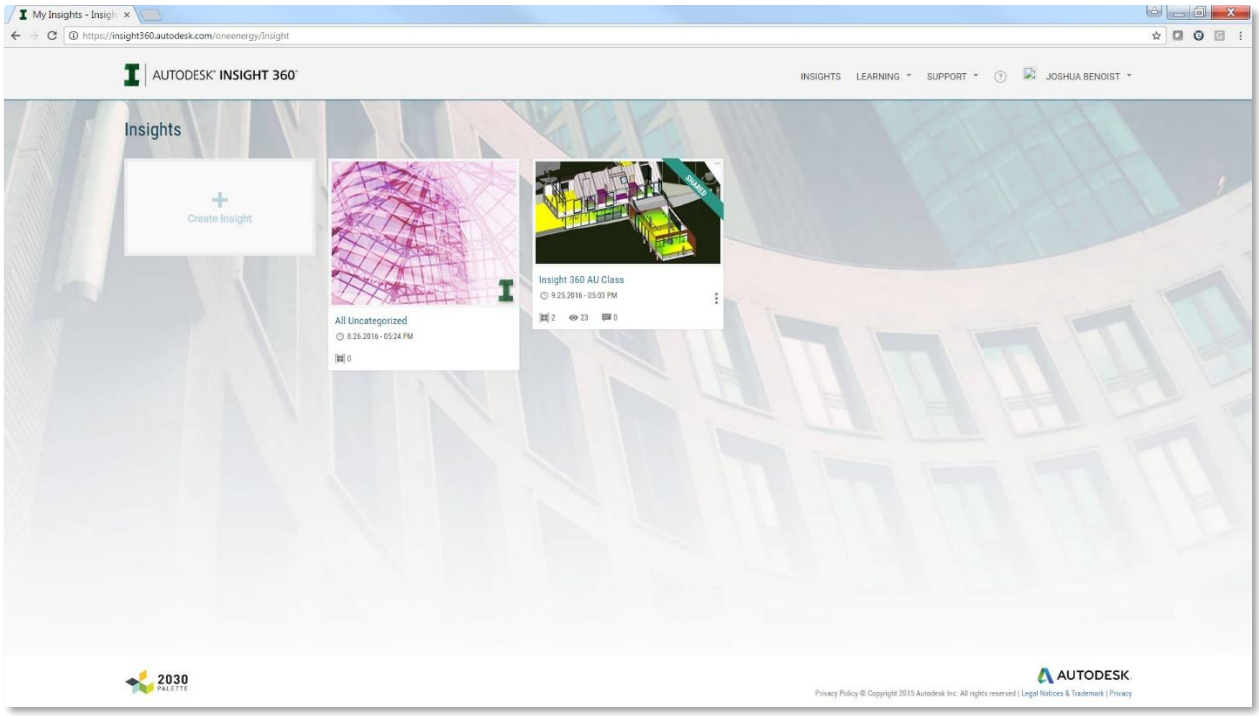


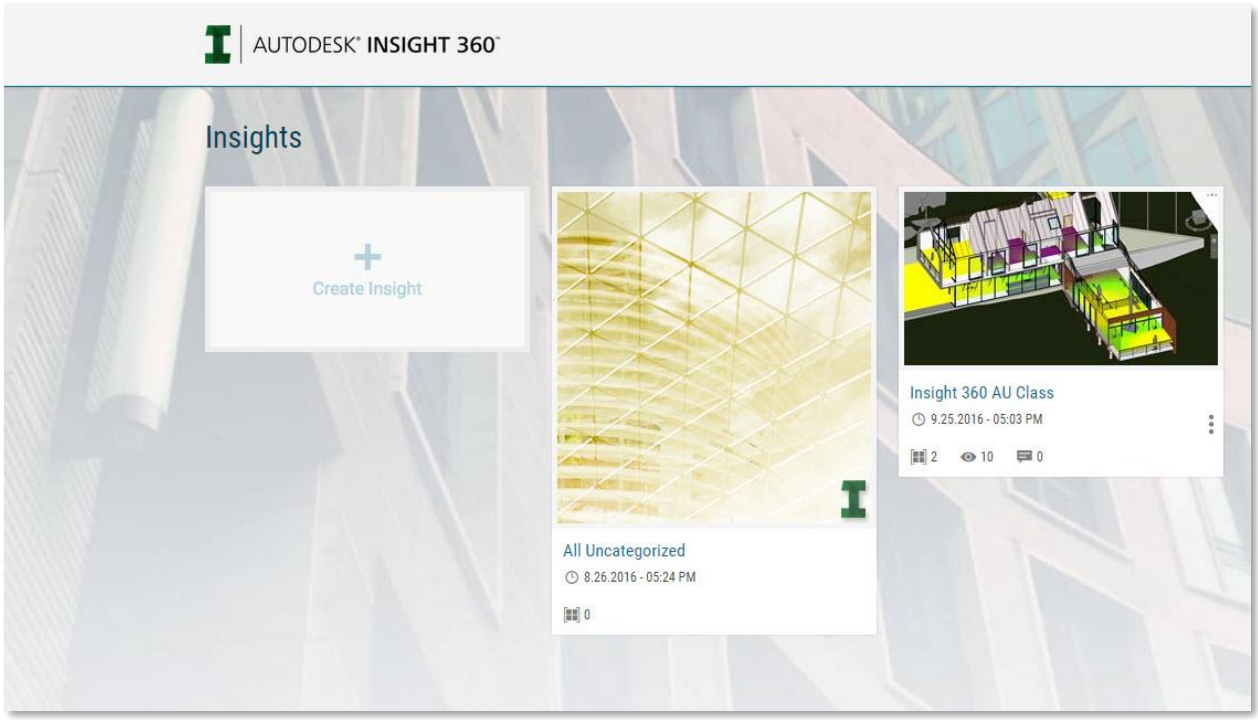

Or we can access it direct within Revit 2017.1. After clicking the Optimize button this interface for the Insights screen pops up.

Whether we access Insight 360 from web or in Revit, the Insights Screen is the same:



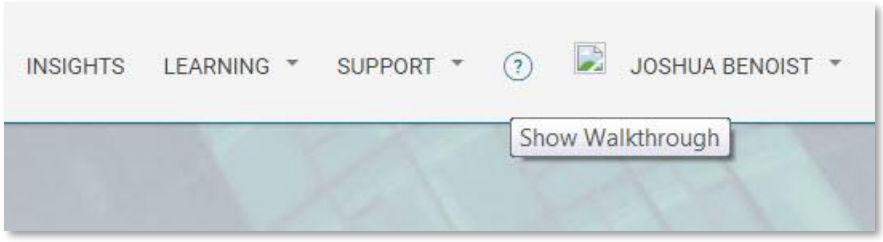

Initially, there are no categories. Any models uploaded will be found in the "All Uncategorized" Insight panel.

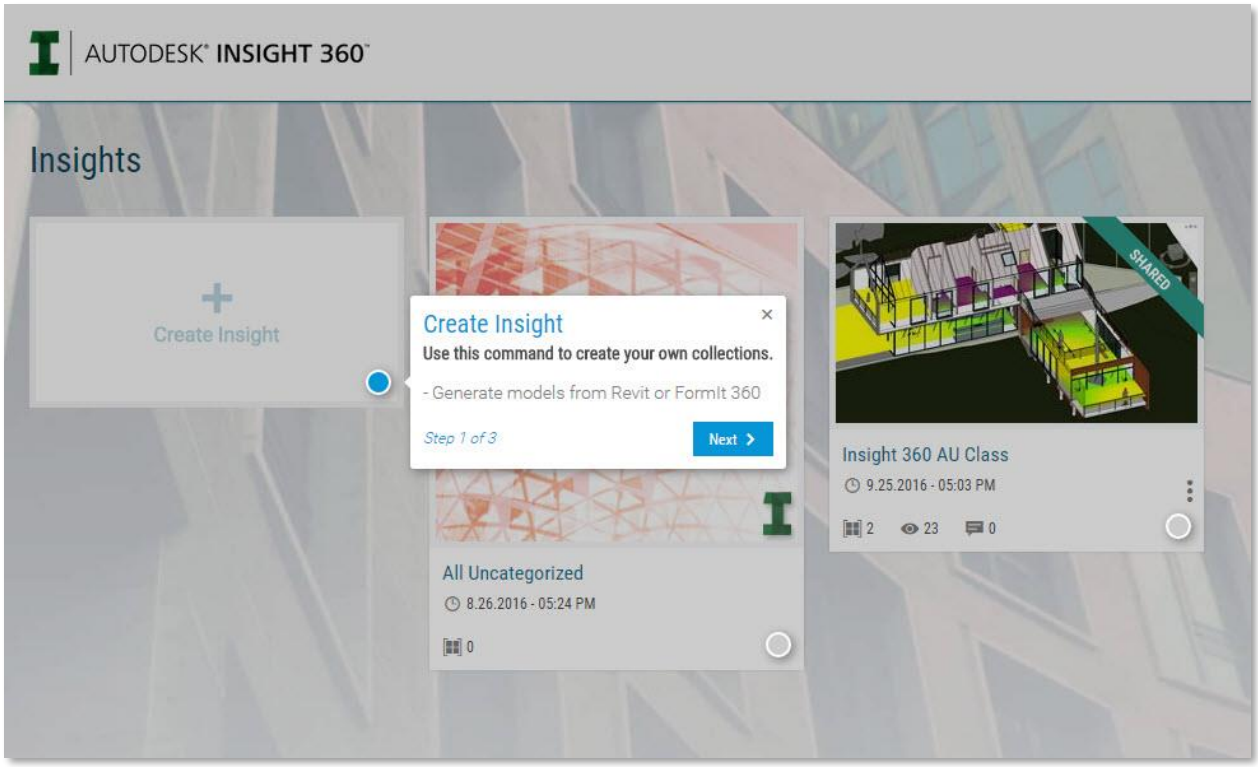
Select on “Create Insight” to start a new “Category” … See my “Insight 360 AU Class” category below.

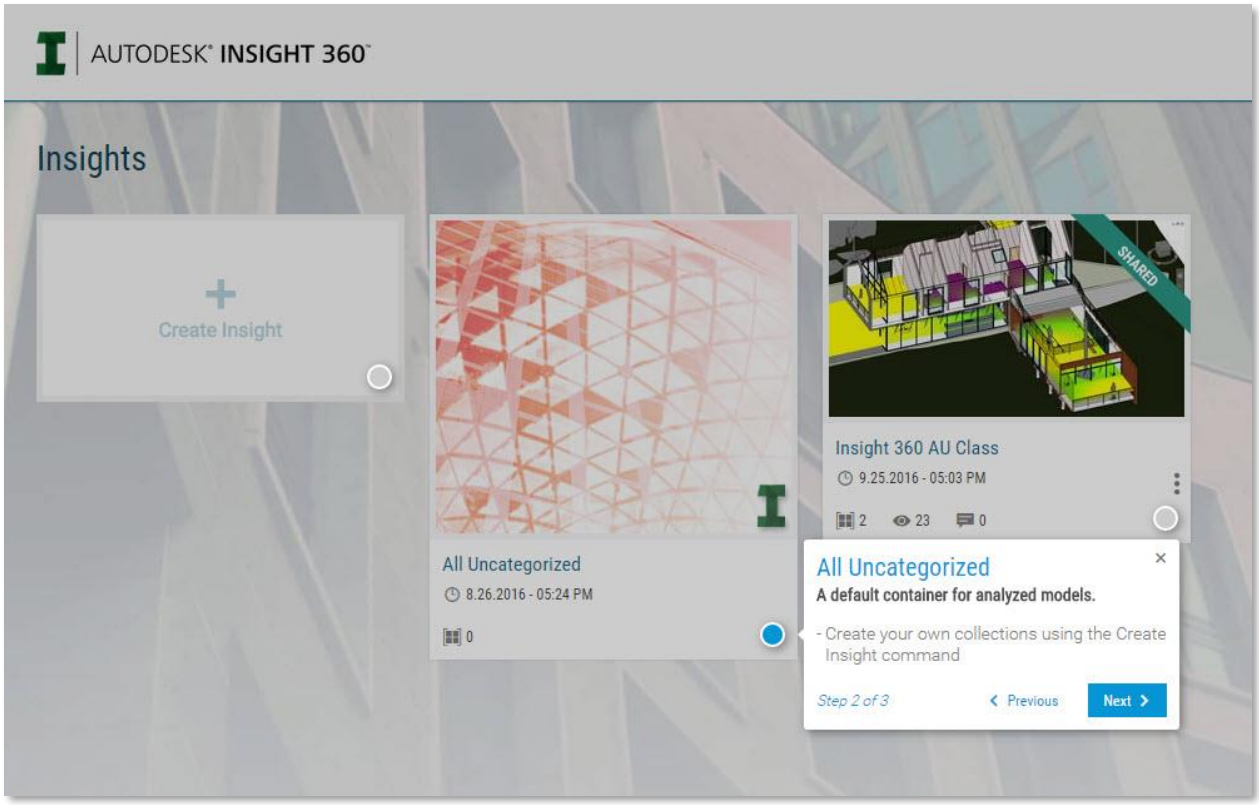


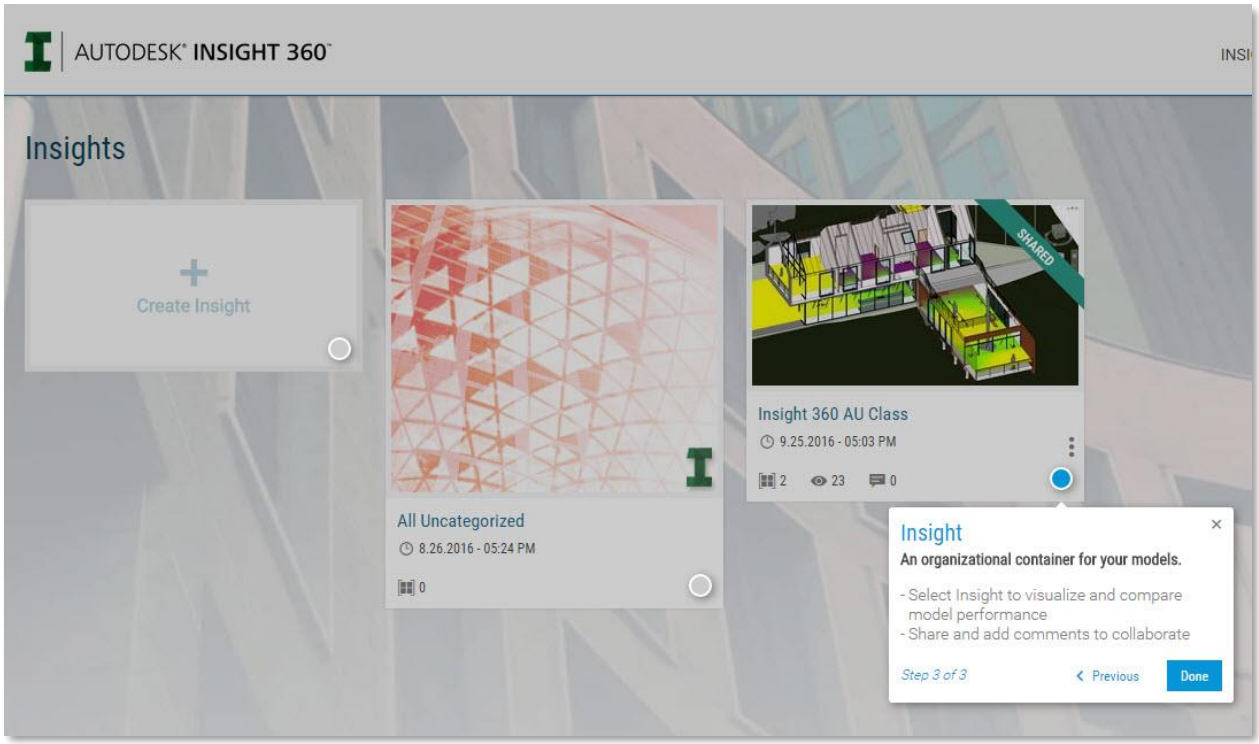

Browsing over the details on my class category… at the bottom, it shows I have 2 models and it has been viewed 10 times, 0 comments. The card shows the latest model image. This is useful in a collaborative IDP team.

The “?” button, does not go to the Help menu but instead will take you on a “Walkthrough.” Let’s do a quick walkthrough to become familiar with the interface, before we discuss workflows.




AUTODESK INSIGHT 360
Insights
Create Insight
All Uncategorized
8.26.2016 - 05:24 PM
0
SHARED
Insight 360 AU Class
9.25.2016 - 05:03 PM
2
23
0
All Uncategorized
A default container for analyzed models.
- Create your own collections using the Create Insight command
Step 2 of 3
Previous
Next

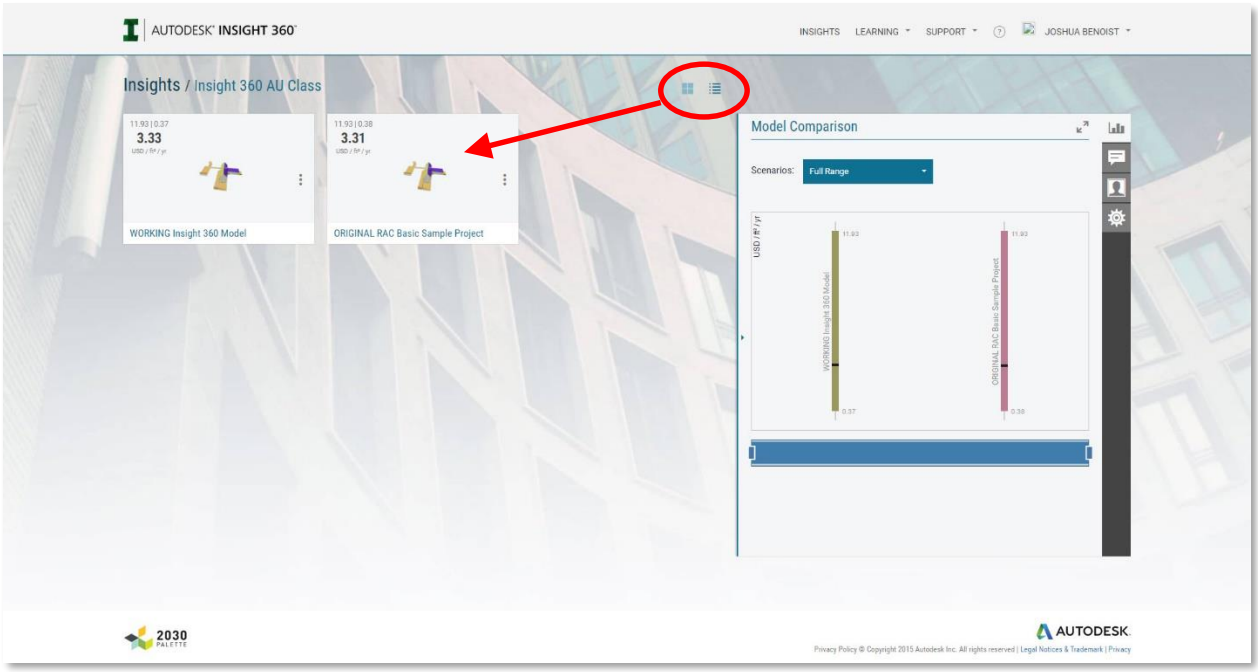

AUTODESK INSIGHT 360
Insights
Create Insight
All Uncategorized
8.26.2016 - 05:24 PM
0
SHARED
Insight 360 AU Class
9.25.2016 - 05:03 PM
2
23
0
Insight
An organizational container for your models.
- Select Insight to visualize and compare model performance
- Share and add comments to collaborate
Step 3 of 3
Previous
Done

Walkthrough ends… let's pick up what it doesn't cover!

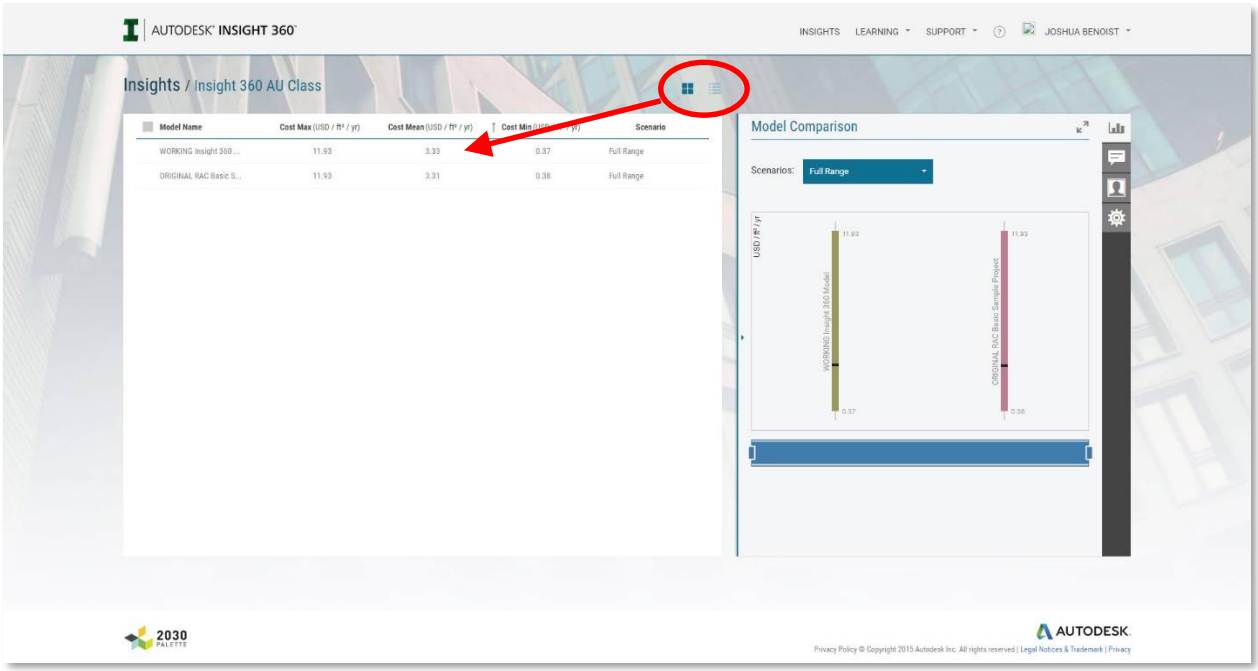
We can add new models here, change the Insight image, and perform basic edits.

When we select directly on the card itself, it opens the following screen on the next page.

Select on these buttons circled below to toggle between “Tile” and “Details”, which provide different ways to compare the models.



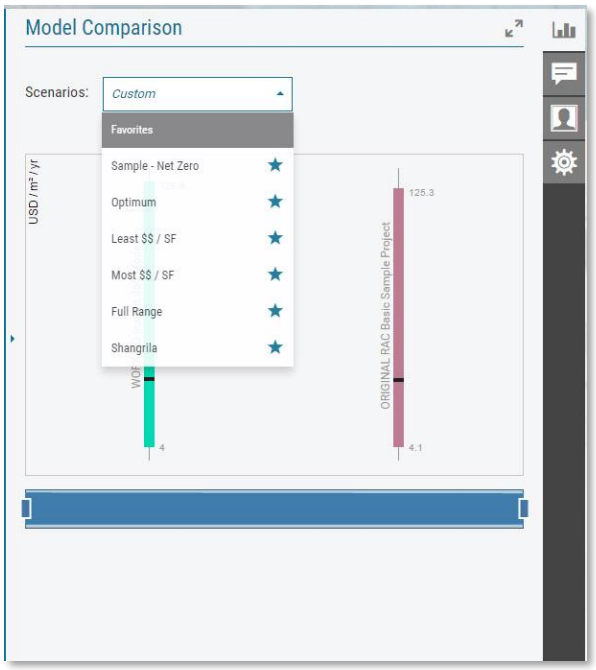

Tiles versus Details…



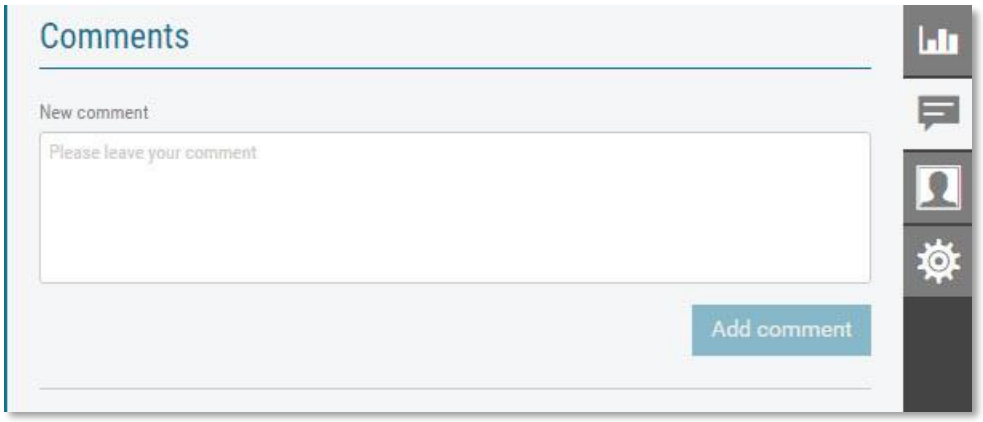

TIP: The “Model Comparison” panel has a Scenario selector…Even though you see it on the right, this also affects the Tiles and Details on the left, for ALL models. A BETTER way to change the scenario one model at a time, is to be on the Details…use the checkbox to select a model, and then change the scenario. It will then only be

changed on the model selected. We haven't discussed scenarios yet and will get to them later.
Let's continue our walkthrough. Here is the Model Comparison graph which shows the cost range of each model. The currency, area and time units are shown along the left margin.

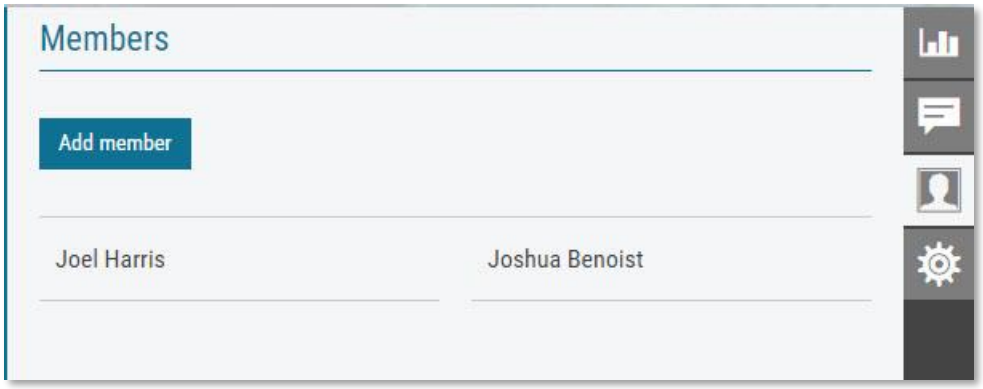
Scenarios are created elsewhere, but can be applied here to the model(s)



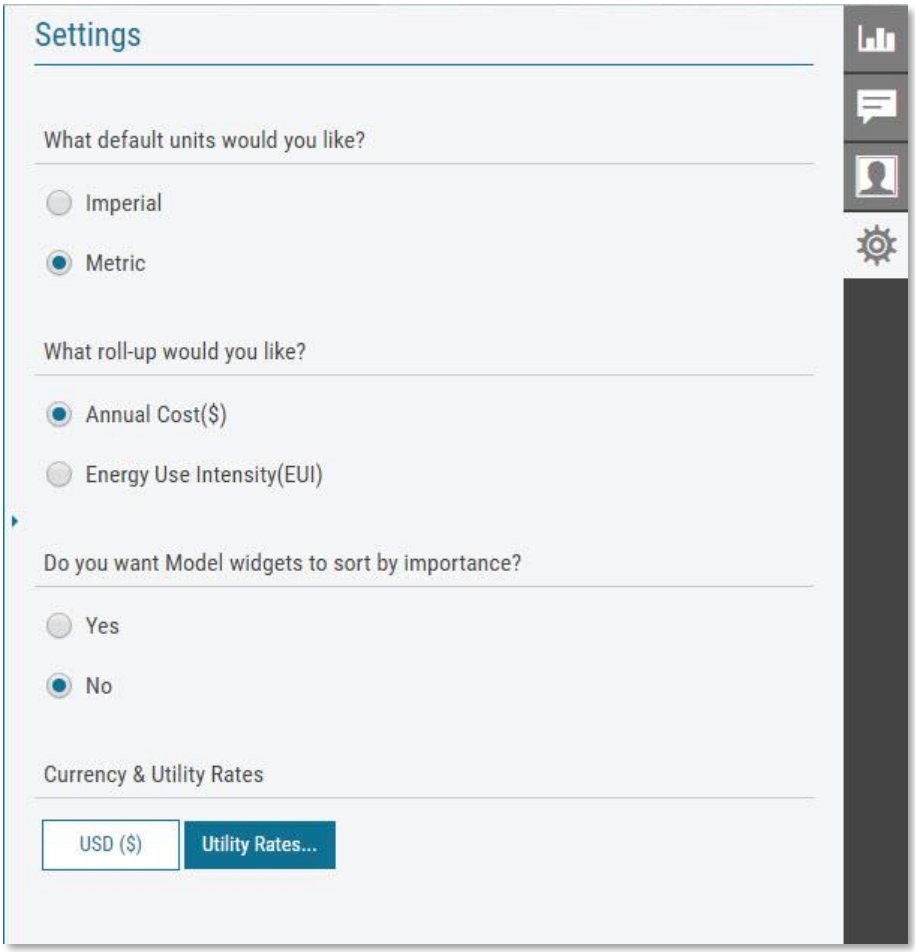
Comments for IDP team collaboration.

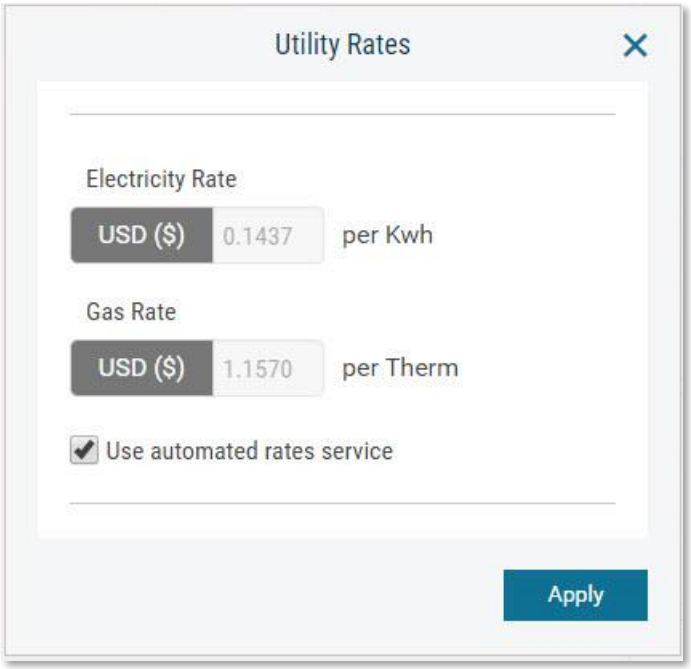



Add team members (via email address) here for access.



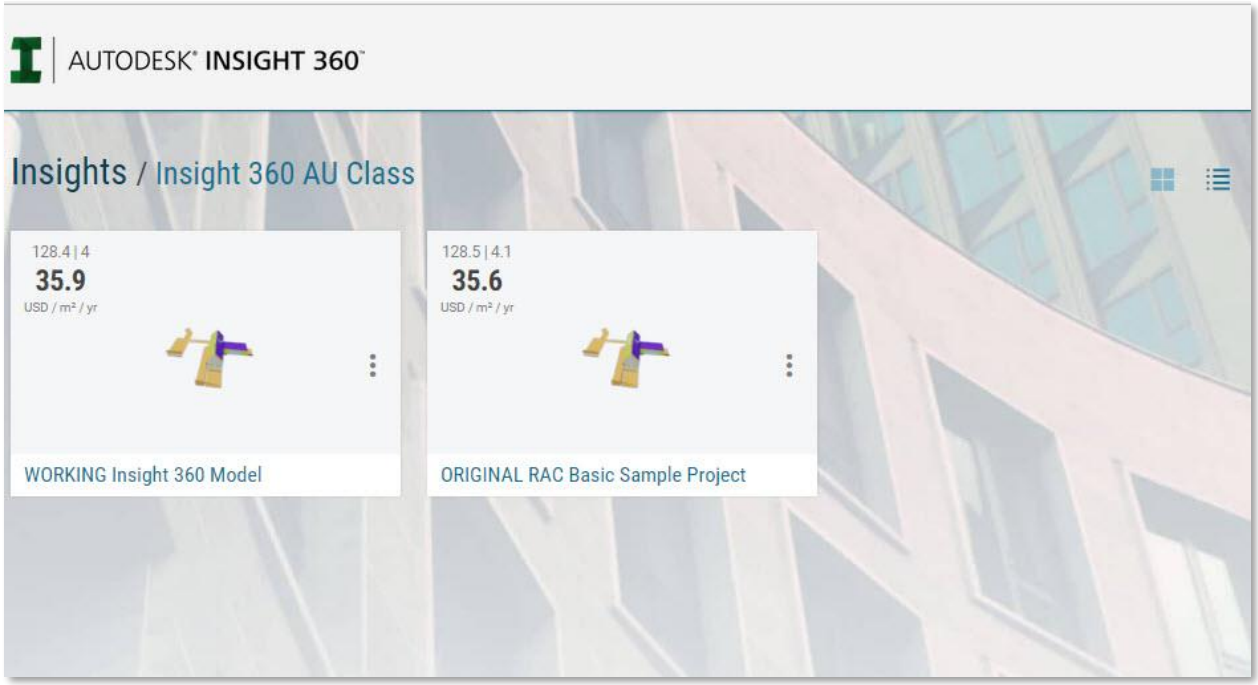
Remember this Settings tab!!! We will use it as part of our workflow to achieve significant Insight in our model.



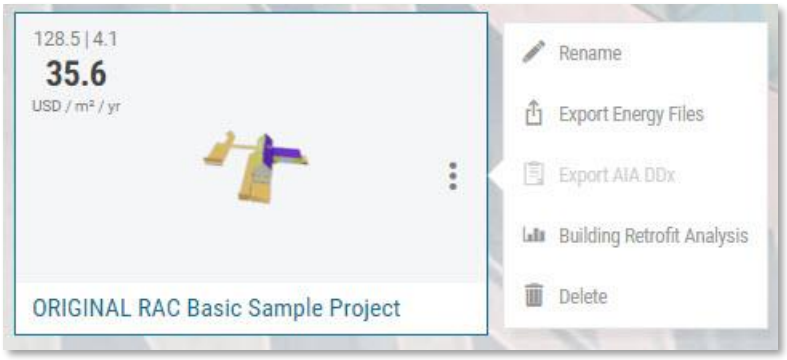

Select on Utility Rates to define currency as well as your project local rates. In order to calculate the energy cost for your project, Insight 360 uses statewide averages for electricity and gas rates. Outside of the US, nationwide averages are used. Now, you can choose to use this average data, or enter more precise rates for your location.

Let's look closer at the Tiles. From the tile, we can see the model geometry, we see the Annual cost per SF, or the EUI (Energy Use Intensity) per SF.

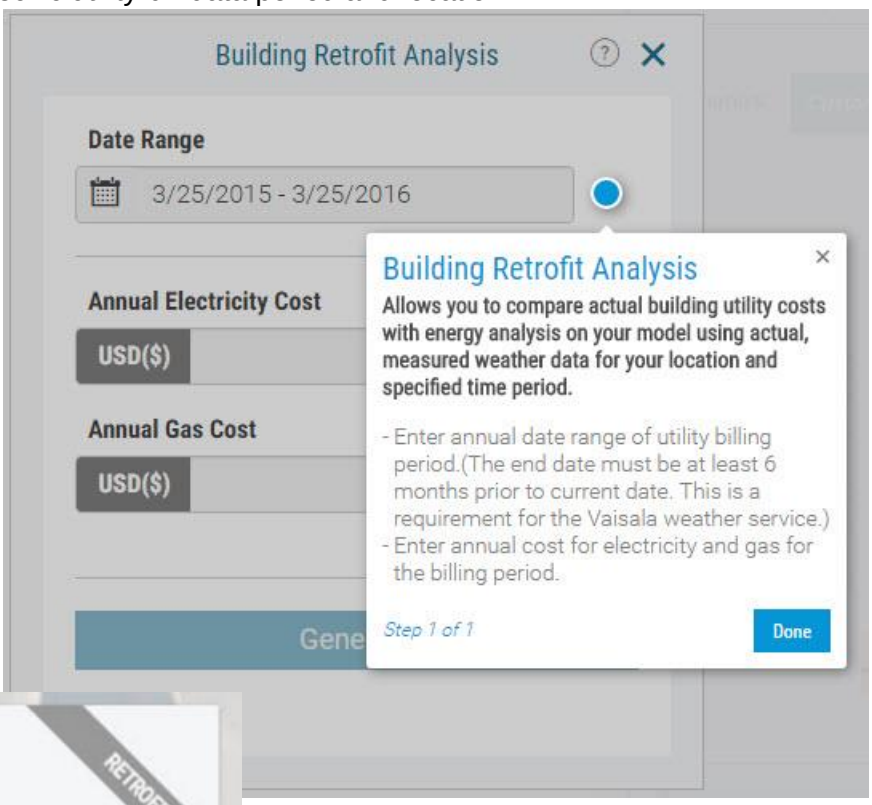


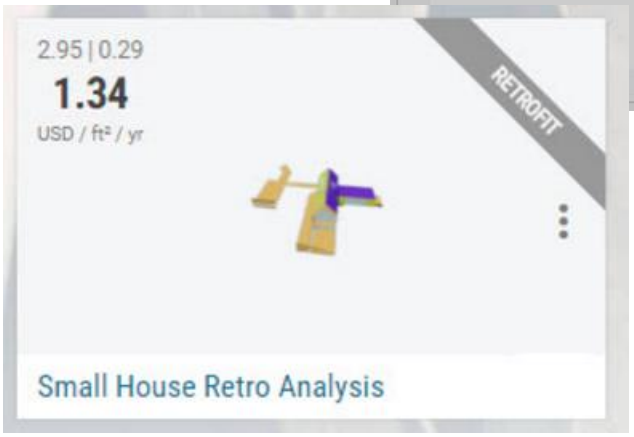

On the Details view, we see the Cost Max, Mean and Minimums, and the applied Scenario. See the checkbox to the left of "Model Name." Enable that checkbox to be able to select an individual model if you need to change the scenario.

Selecting the ellipsis ("…") on the tile, we can Export our Energy File, do basic edits, and apply a Building Retrofit Analysis. We will come back to these later, and want to continue our tour.



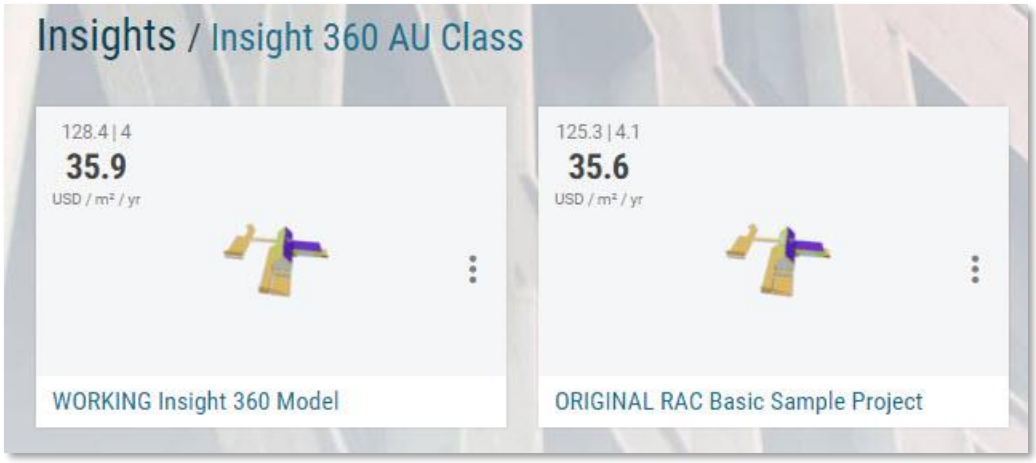

Building Retrofit Tour pulls up this dialog. If you have an existing building with a full year of utility bills, enter the annual costs below. This will validate the energy model, comparing it to actual building energy costs. A new Insight will appear with a tag "Retrofit." This is also useful for calibration. Don't forget this will also apply actual weather data for the specific utility bill data period and location.



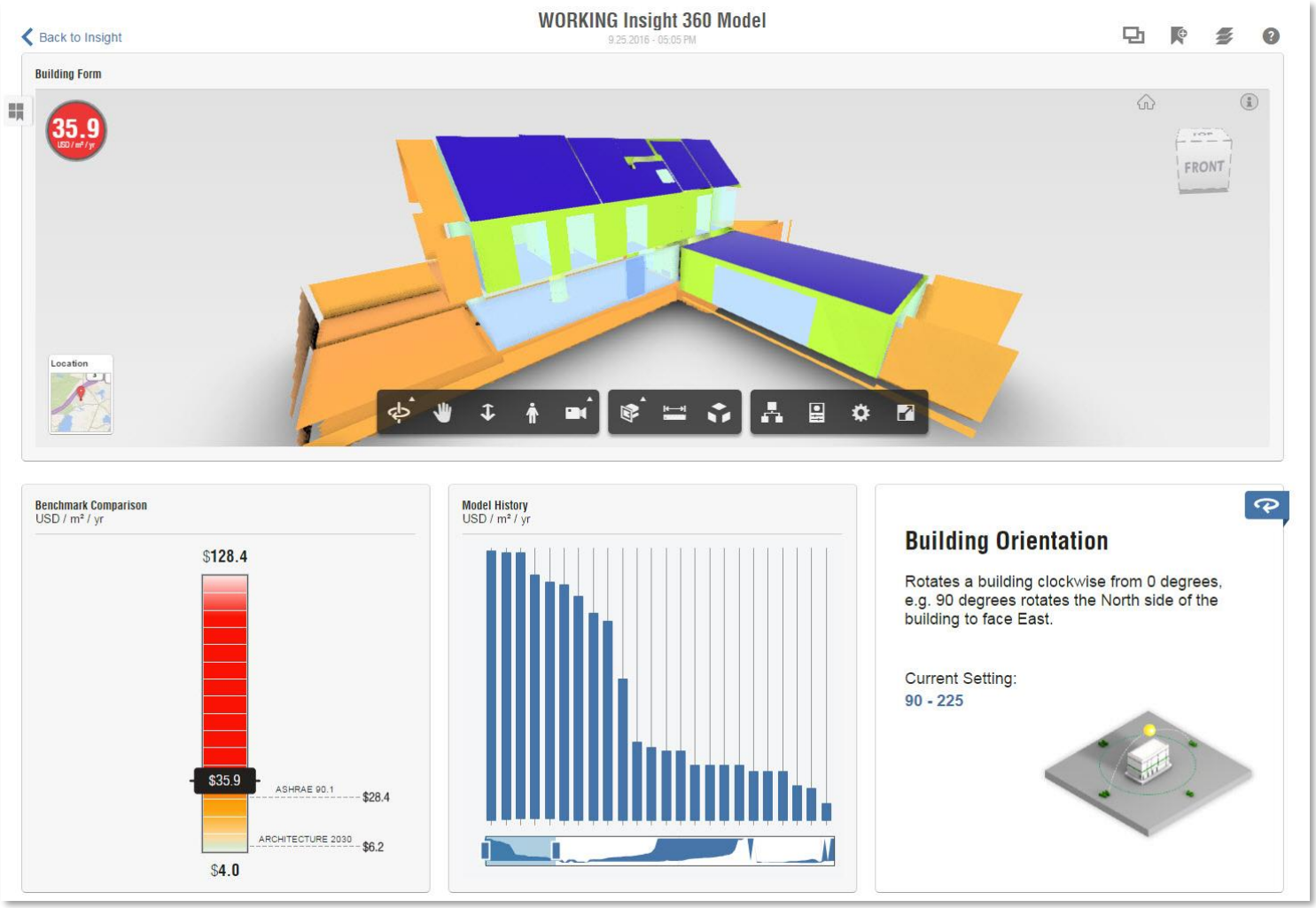



## The Model

Select on the Tile image to get to the good stuff!!




This is the GOOD STUFF!! … That's a technical term…a'hem.



This screen has:

1. The Energy Model Viewer
2. The Tiles of Parameters that Affect the Energy Model Cost
3. The Graphs that aide in “Decision Informing.”
4. Benchmark tile, which shows Max and Minimum, current Cost, Benchmarks
5. Model History Tile to see the energy cost trend over time
   … The Good Stuff…

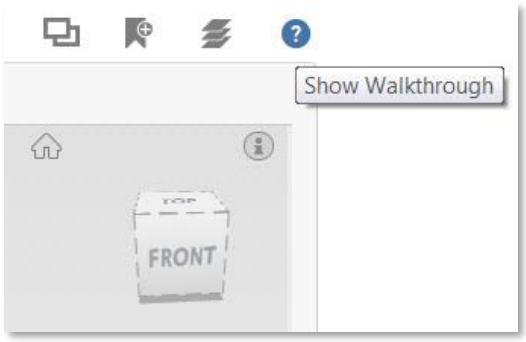
An IDP team consists of many stakeholders with varying backgrounds… Owners, GC’s, Architects, Engineers, etc. If you were to walk up to a building owner and tossed out the phrase “Energy Use Intensity” or EUI, their eyes “might” glaze over. Talk EUI to an Energy Analysis specialist and they likely would know what you were referring to. EUI per SF is how we compare Energy Models.

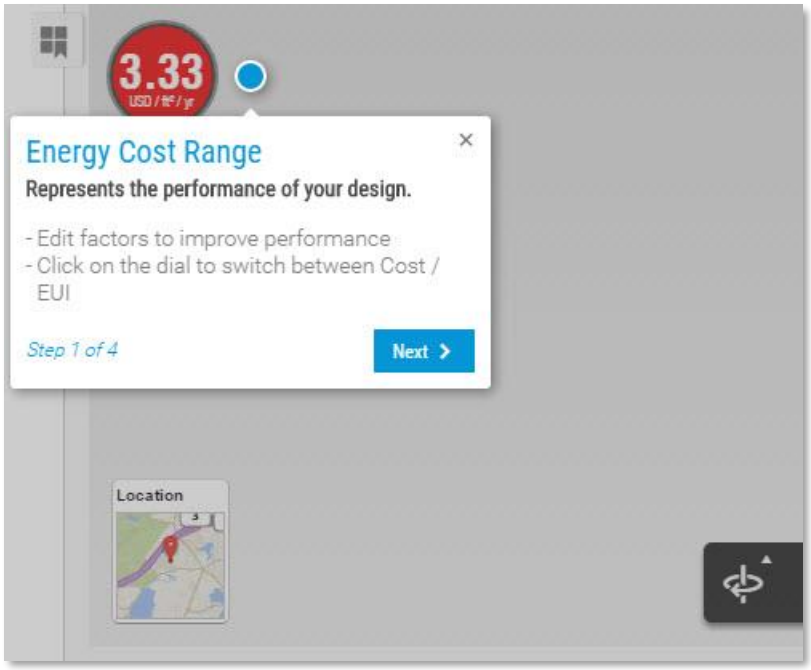
So we need a unit that everyone understands. Most people understand US Dollars… (Substitute favorite currency here)

When an IDP team sits in a conference room, they need a unit that everyone easily understands. So in Insight 360 models, we use USD per SF…

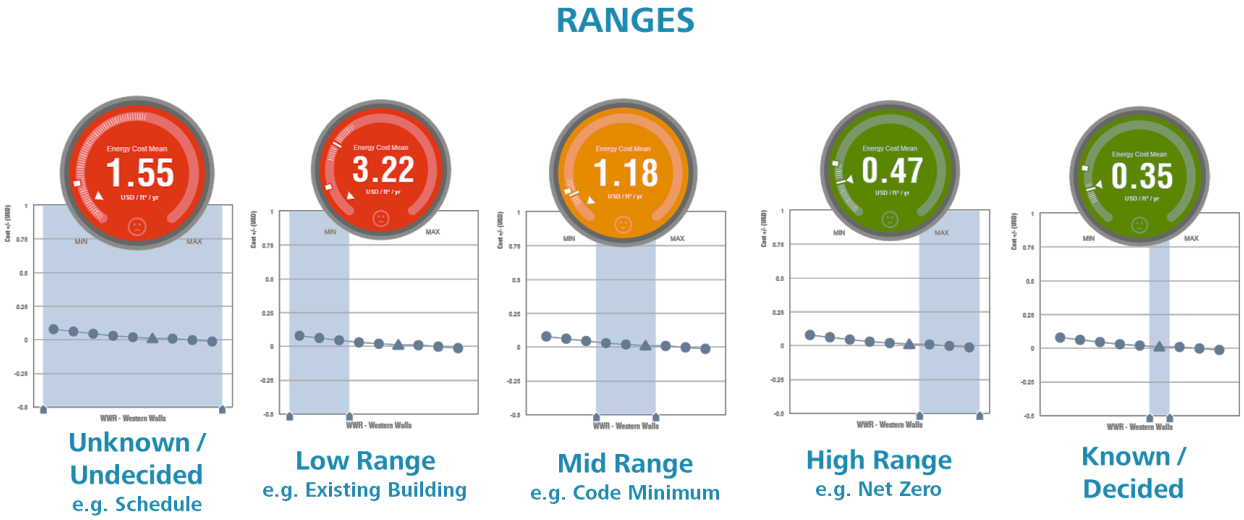
Selecting on the “Energy Cost Range” glyph will swap between EUI and USD per SF.

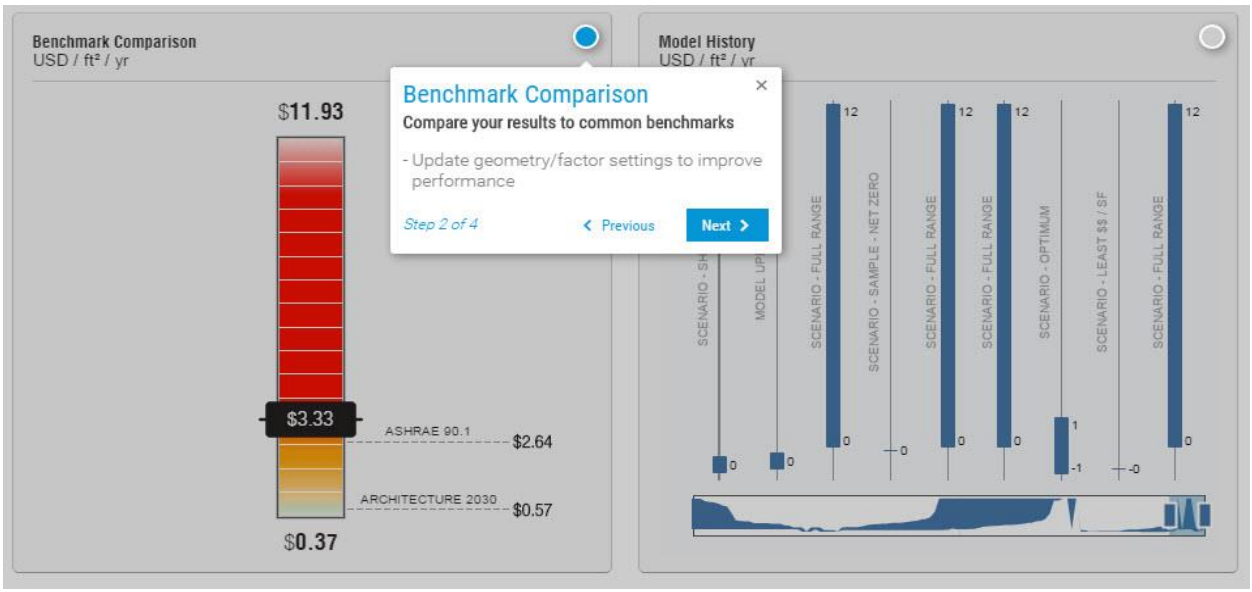
Let's take a quick walkthrough to familiarize ourselves with the interface:

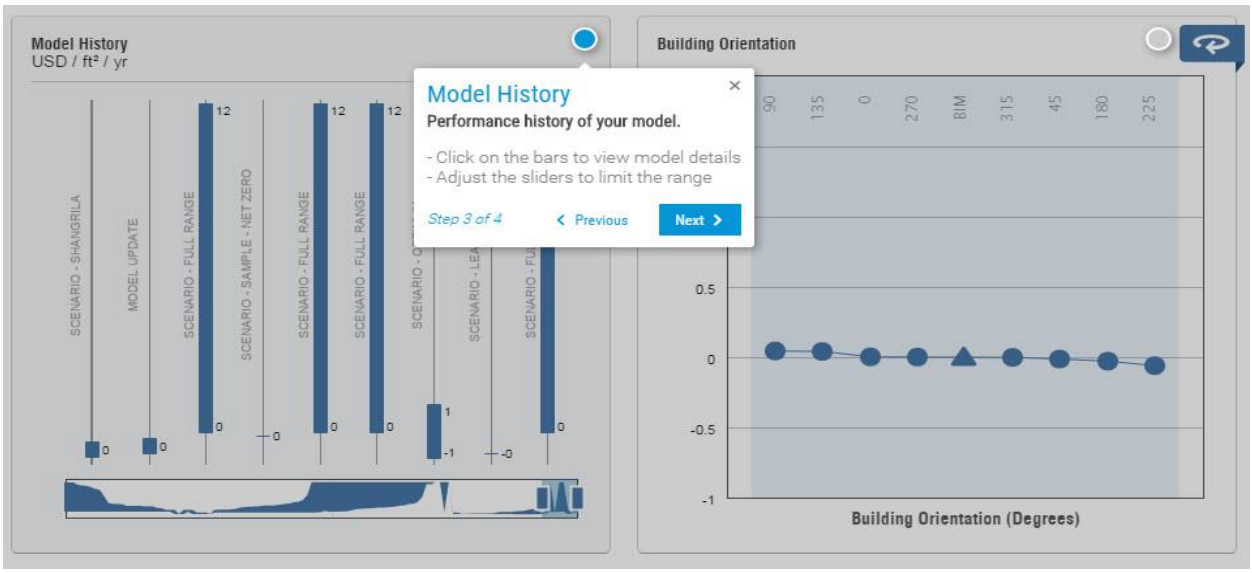


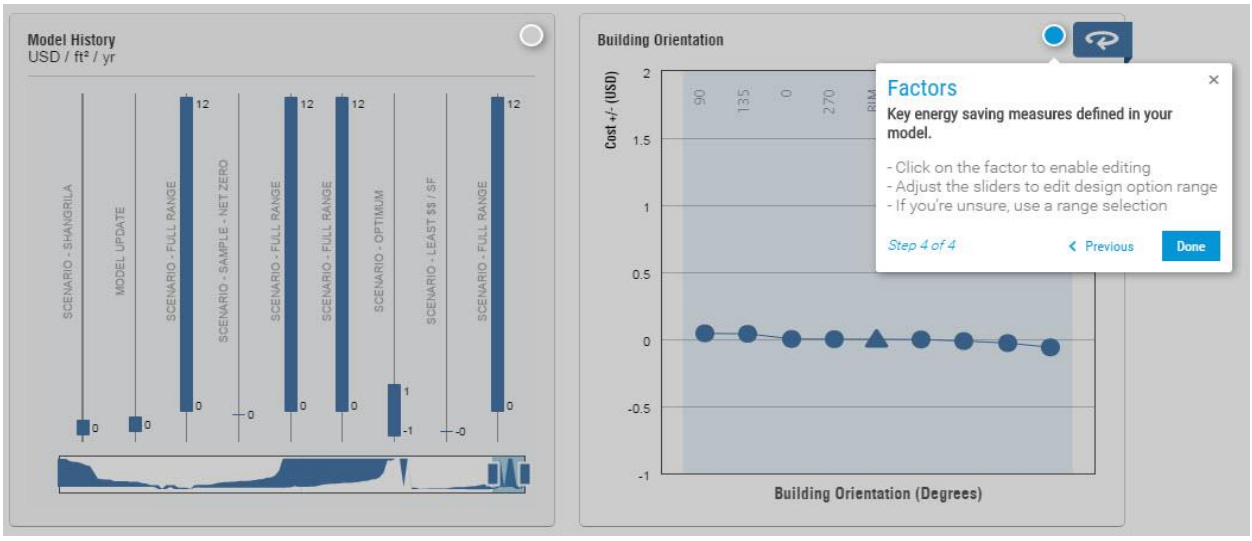



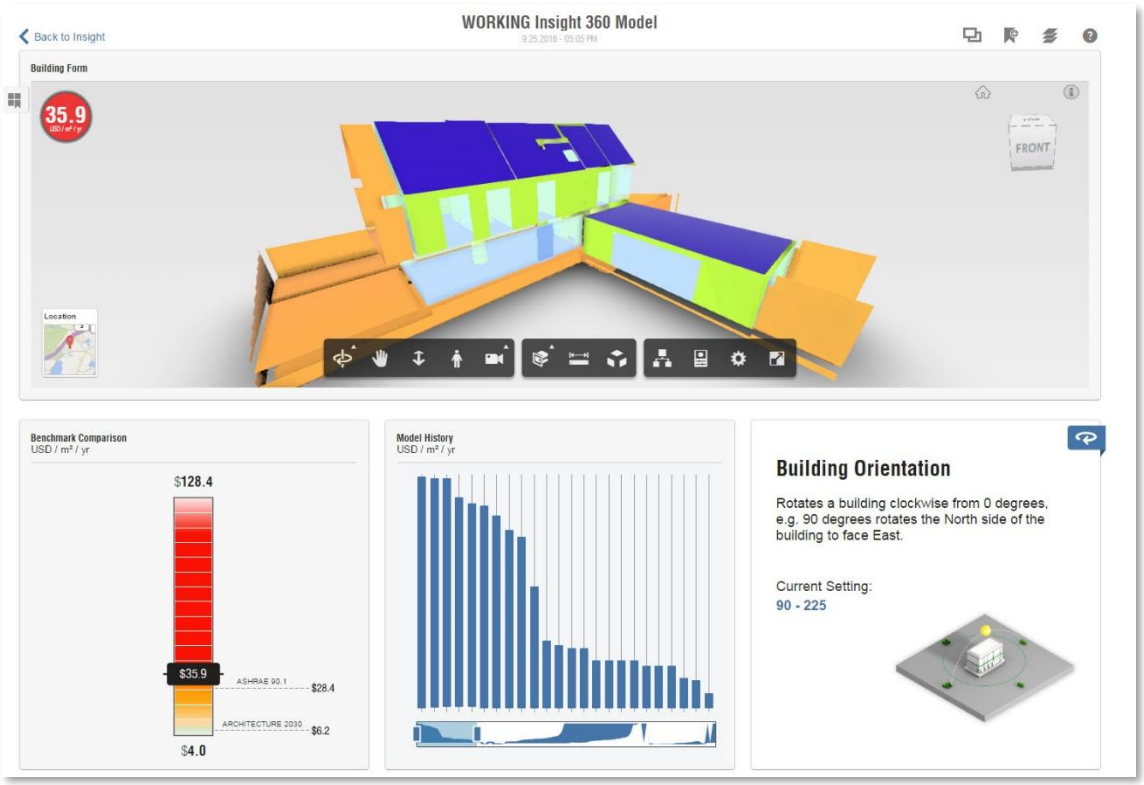

As the Cost improves, at a glance one can see if it is red, yellow or green and instantly know where you stand.



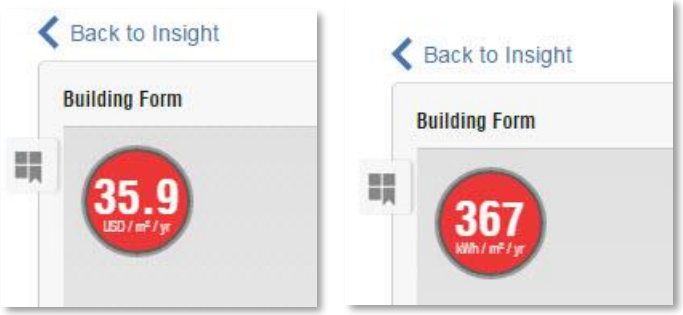

Benchmark Comparison
USD / ft² / yr
$11.93
$3.33
ASHRAE 90.1
$2.64
ARCHITECTURE 2030
$0.57
$0.37
Benchmark Comparison
Compare your results to common benchmarks
- Update geometry/factor settings to improve performance
Step 2 of 4
Previous
Next
Model History
USD / ft² / yr
SCENARIO - SHANGRILA
MODEL UPDATE
SCENARIO - FULL RANGE
SCENARIO - SAMPLE - NET ZERO
SCENARIO - FULL RANGE
SCENARIO - FULL RANGE
SCENARIO - FULL RANGE
SCENARIO - OPTIMUM
SCENARIO - LEAST $$ / SF
SCENARIO - FULL RANGE


Model History
USD / ft² / yr
Model History
Performance history of your model.
- Click on the bars to view model details
- Adjust the sliders to limit the range
Step 3 of 4
Previous
Next
Building Orientation
90
135
0
270
BIM
315
45
180
225
0.5
0
-0.5
-1
Building Orientation (Degrees)

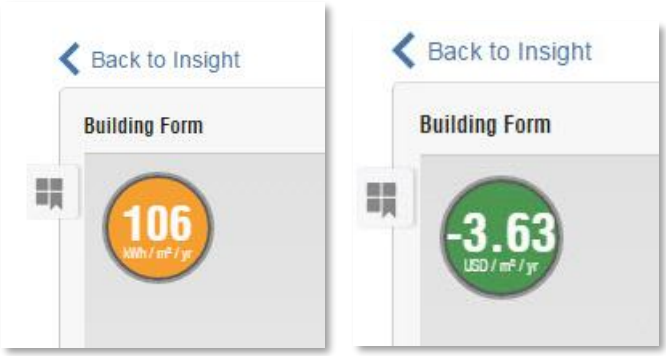

Model History
USD / ft² / yr
SCENARIO - SHANGRILA
MODEL UPDATE
SCENARIO - FULL RANGE
SCENARIO - SAMPLE - NET ZERO
SCENARIO - FULL RANGE
SCENARIO - FULL RANGE
SCENARIO - OPTIMUM
SCENARIO - LEAST $$ / SF
SCENARIO - FULL RANGE
Building Orientation
Cost +/- (USD)
Factors
Key energy saving measures defined in your model.
- Click on the factor to enable editing
- Adjust the sliders to edit design option range
- If you're unsure, use a range selection
Step 4 of 4
Previous
Done
Building Orientation (Degrees)



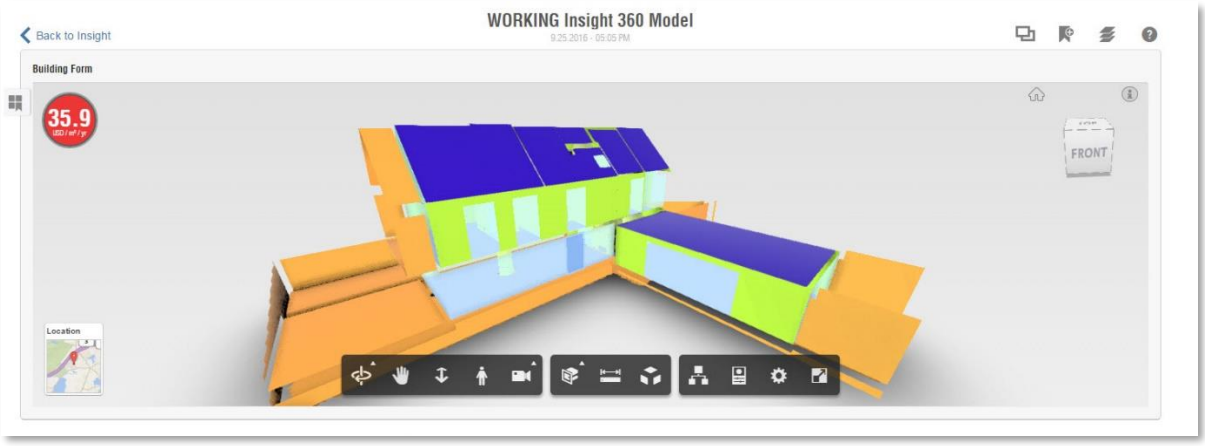

Clicking on the below Glyph, changes the UNITS between Cost/SF and EUI/SF

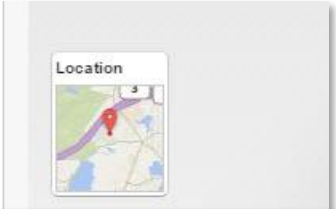



Notice the Glyph changes color as the results get better as the Cost drops:



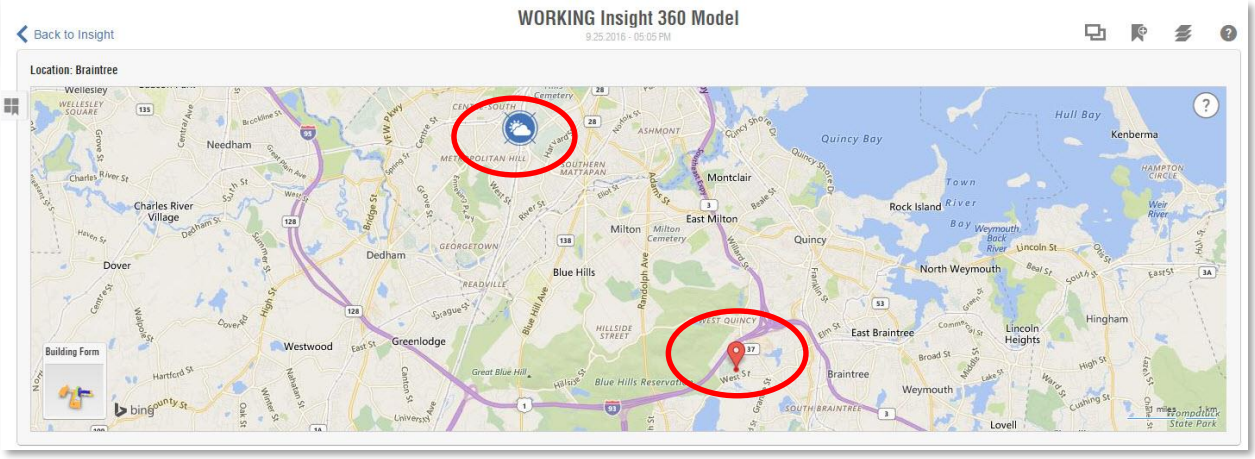
Let's do a walkthrough of the Energy Analysis Model features.



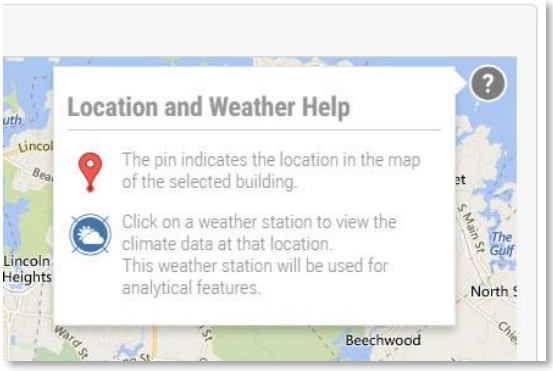



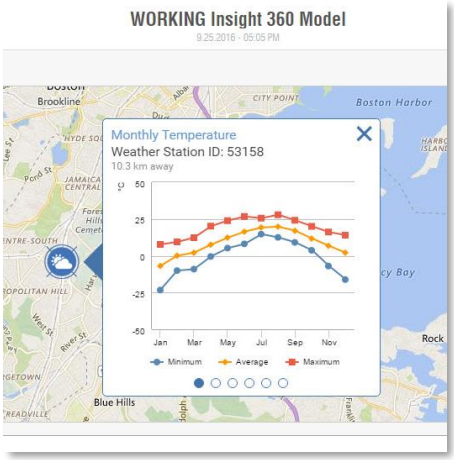

Select on "Location" to pull up the map.

Notice the project site pin and weather stations are marked on the map.

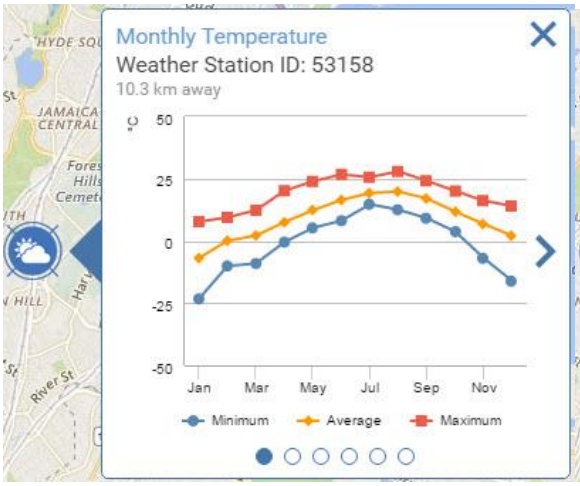


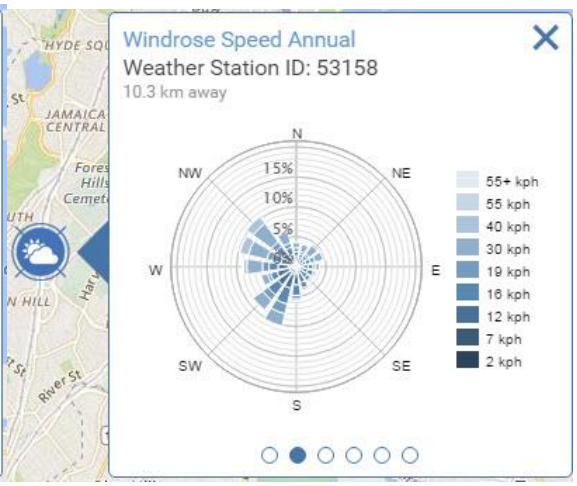

Selecting on a pin allows you to adjust its location.
Selecting on a weather station pulls up statistics about the weather data.

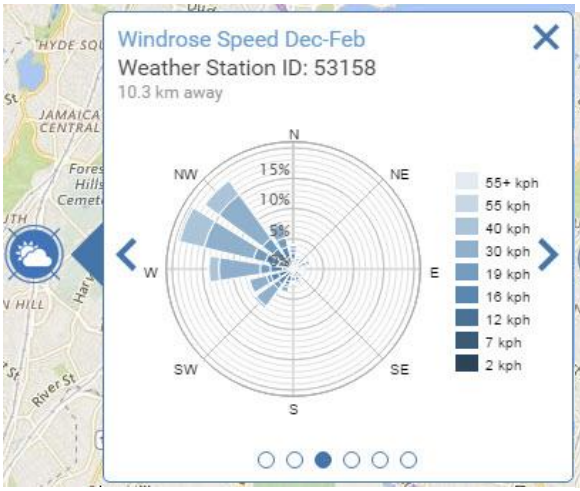


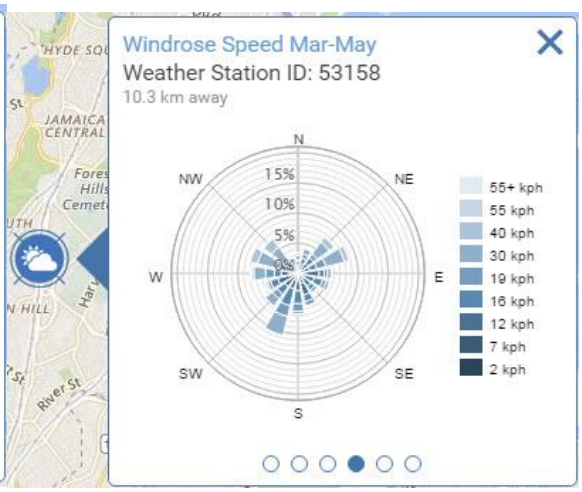



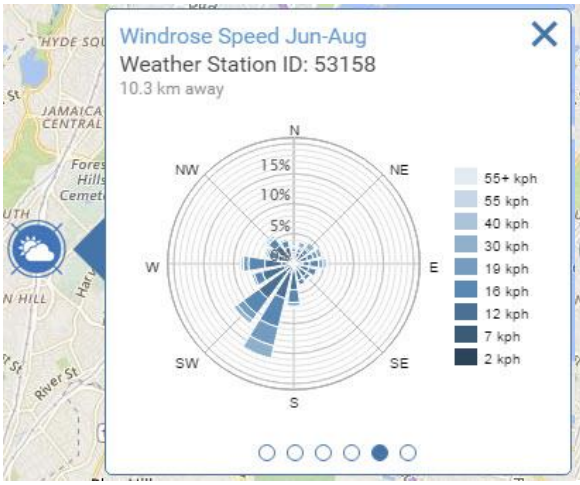
Here is the Weather Data:

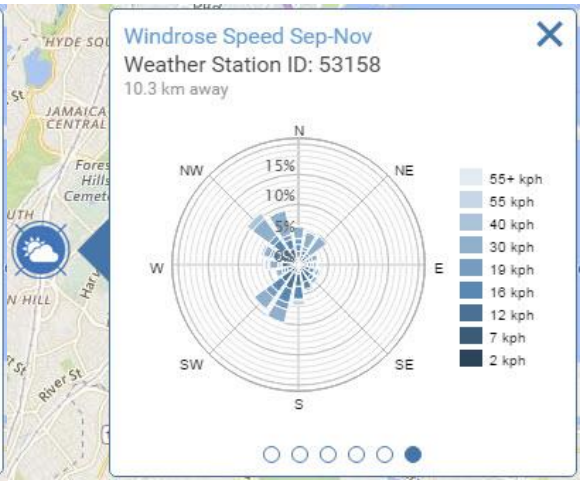


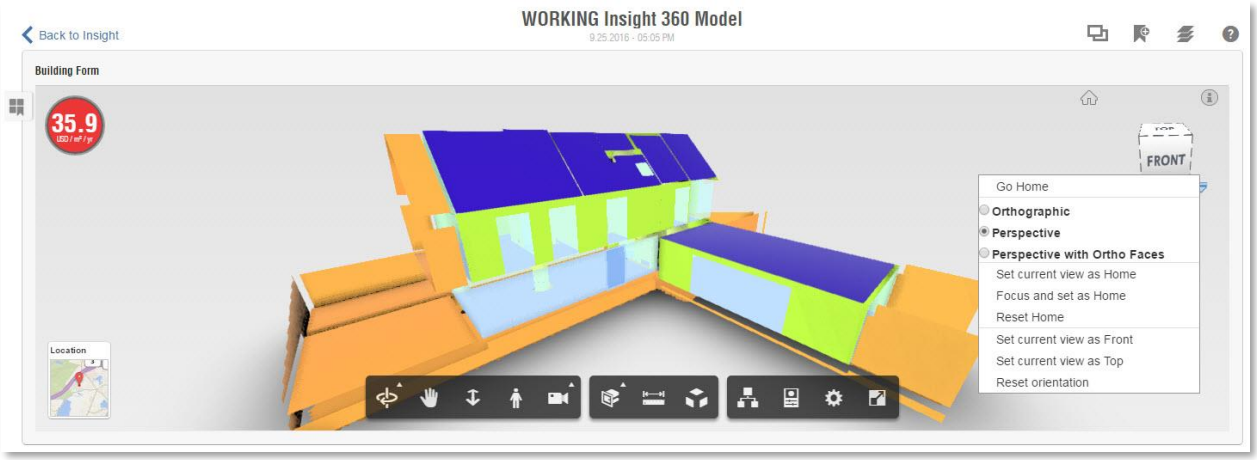



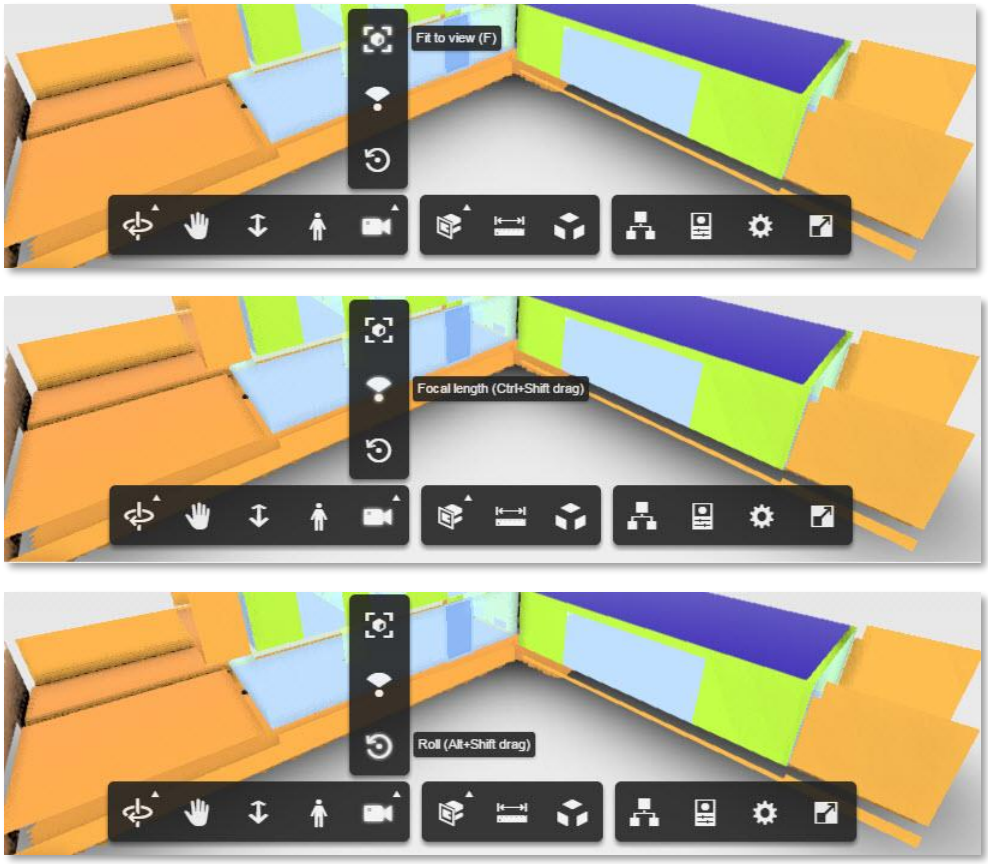



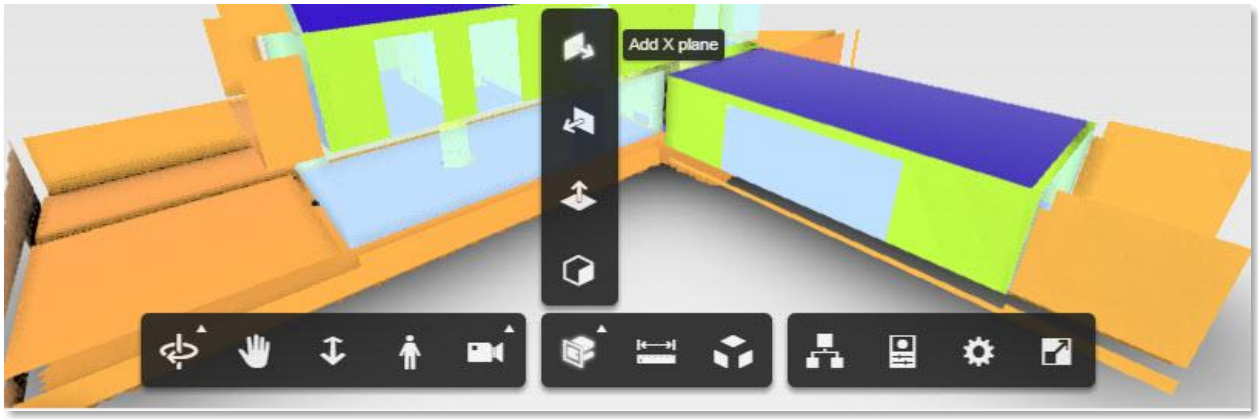
Let's walkthrough the model toolbar and navigation features:

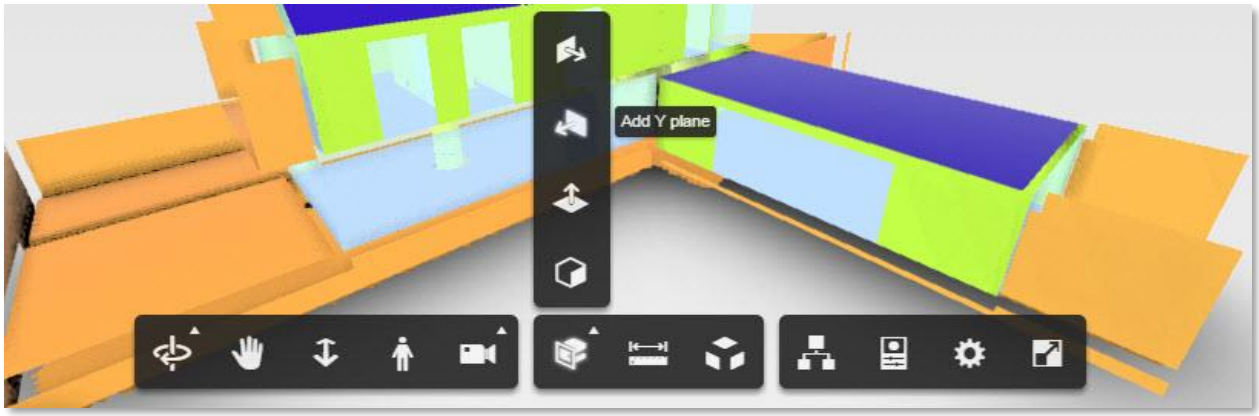


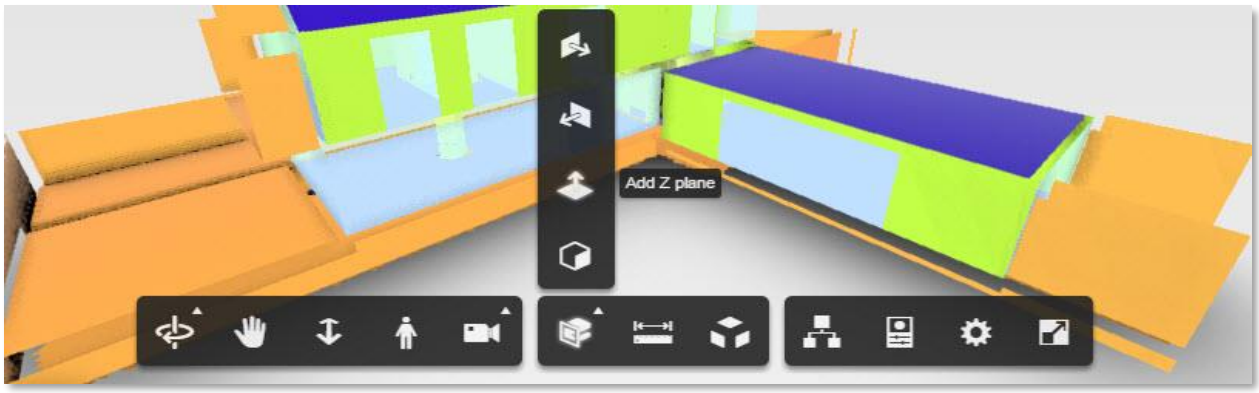

The Tooltips come in useful and are self-explanatory. For your reference…

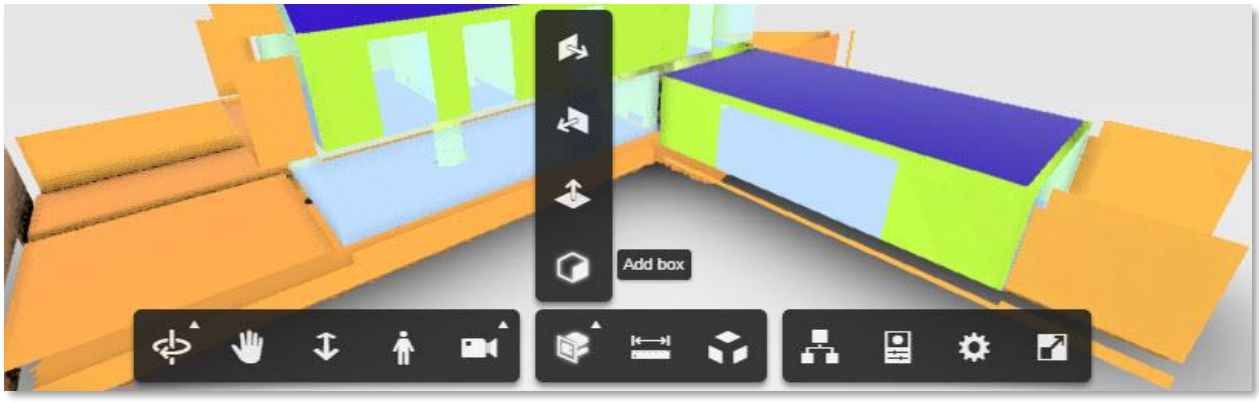

Fit to view (F)
Focal length (Ctrl+Shift drag)
Roll (Alt+Shift drag)

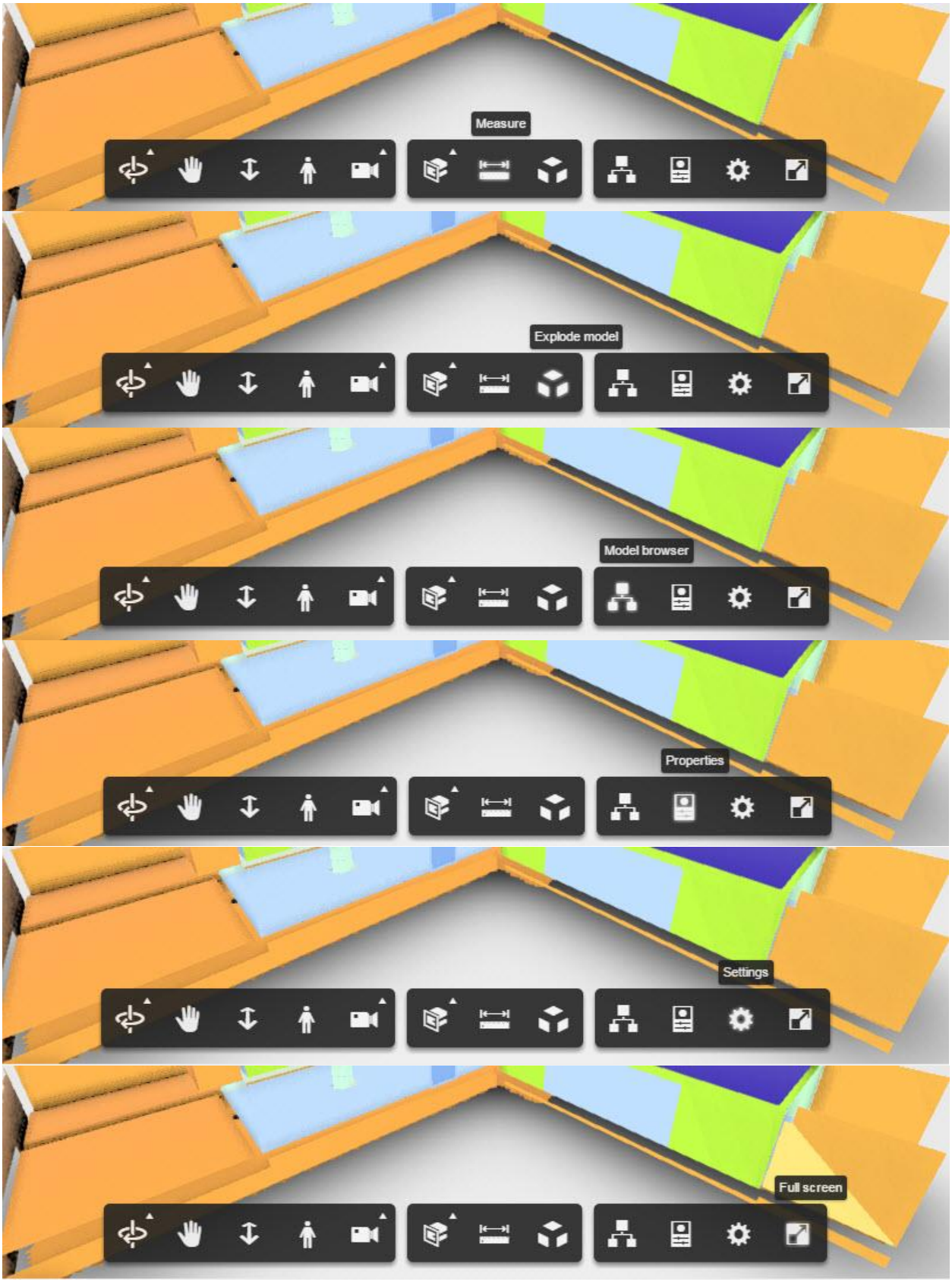
For Sectioning…



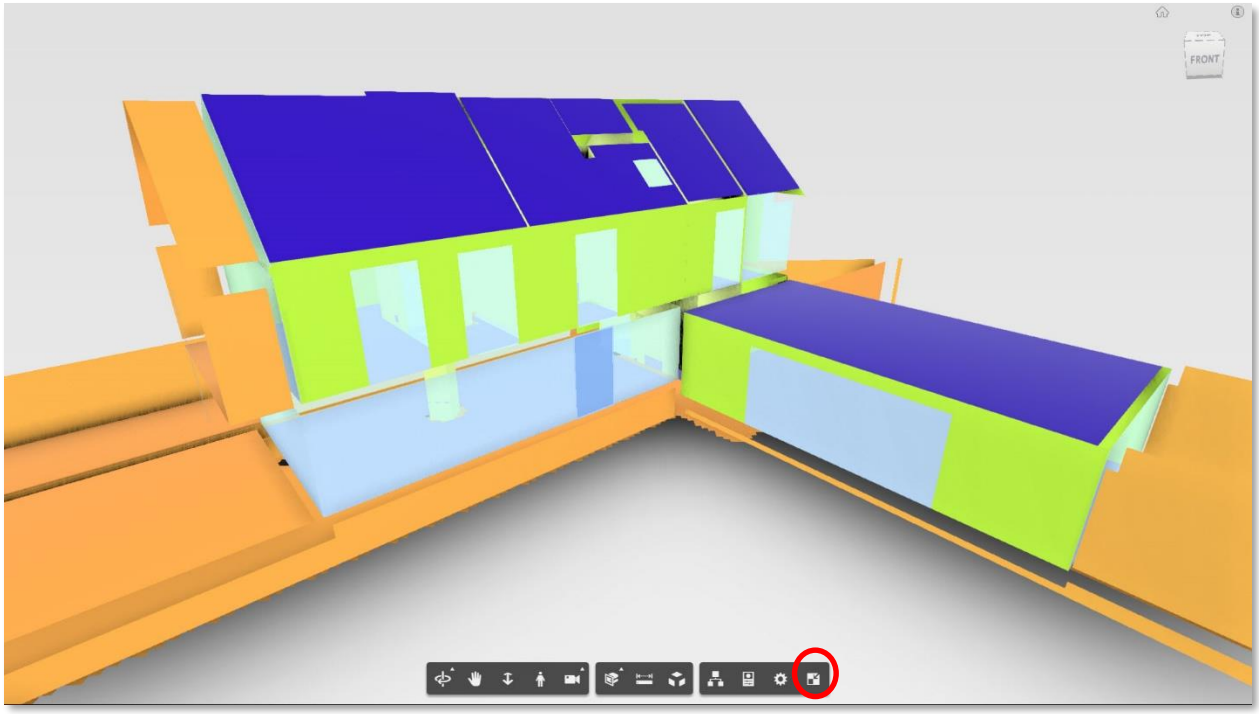



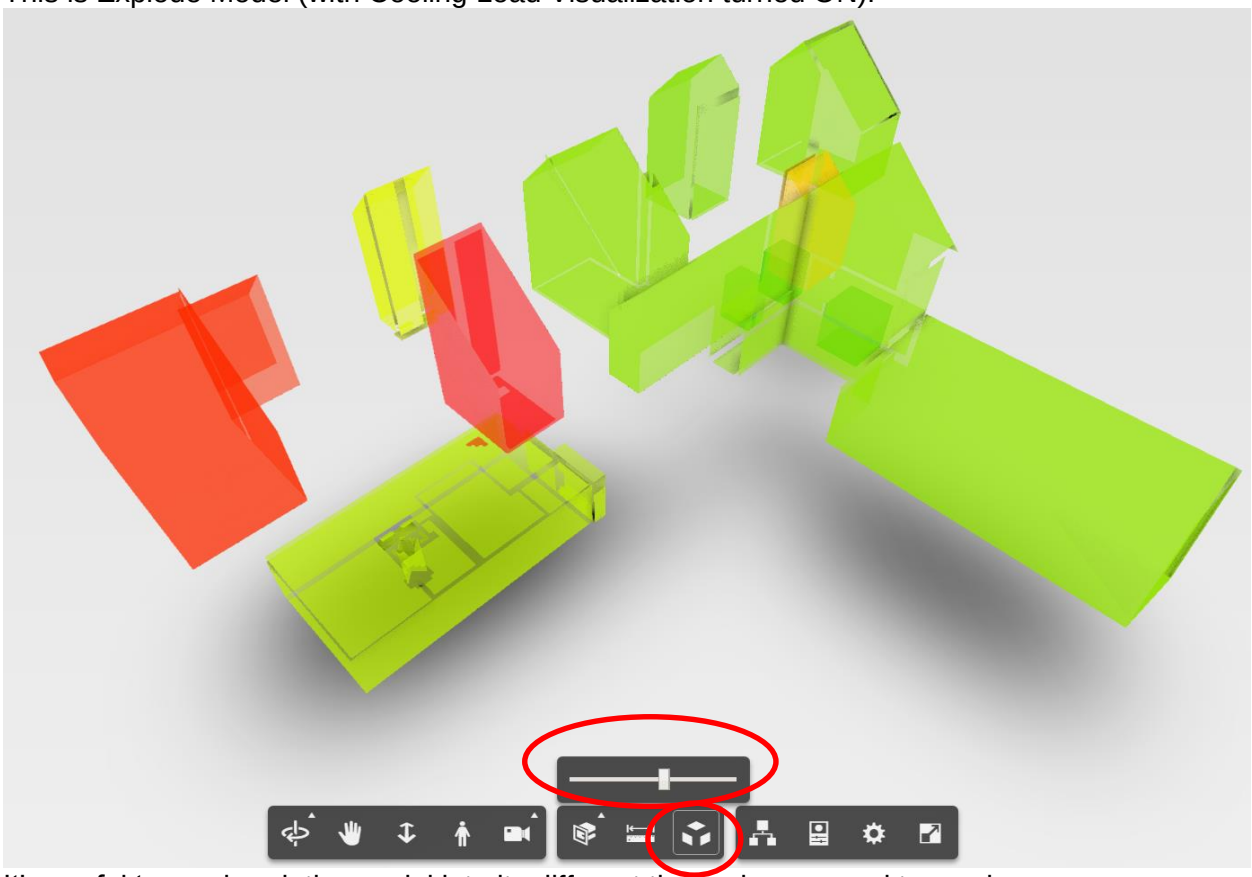




Measure
Explode model
Model browser
Properties
Settings
Full screen

This is Full Screen:

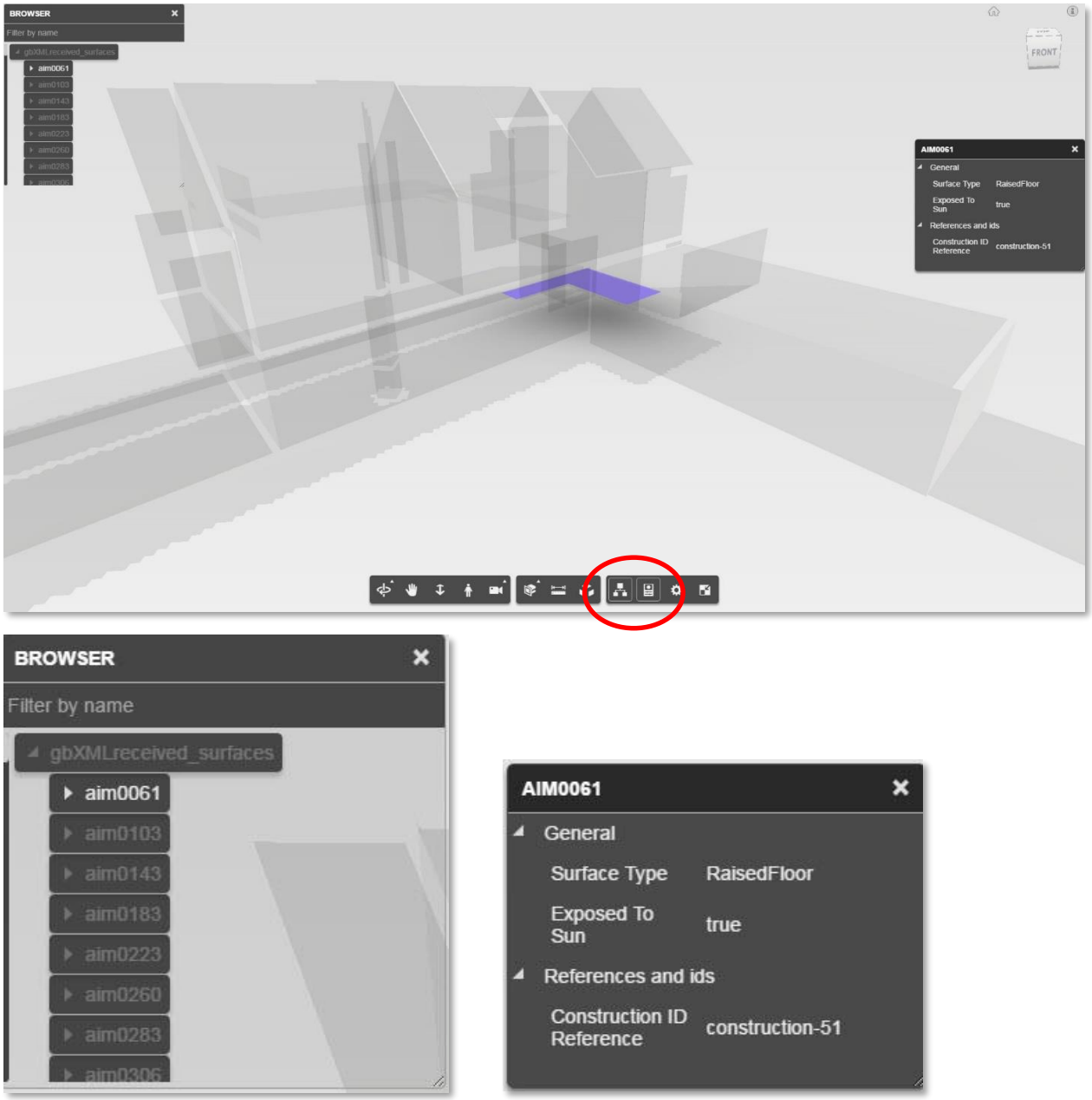



This is Explode Model (with Cooling Load Visualization turned ON):



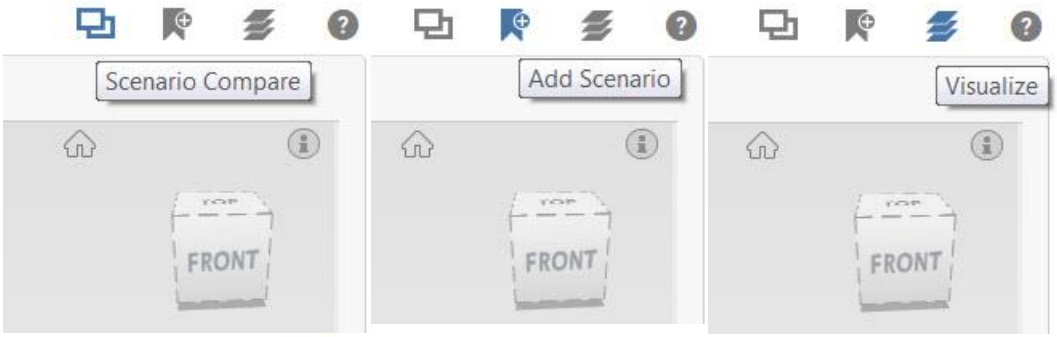
It’s useful to see break the model into its different thermal zones and to see inner rooms.

"Model Browser" with "Properties" palette turned on:



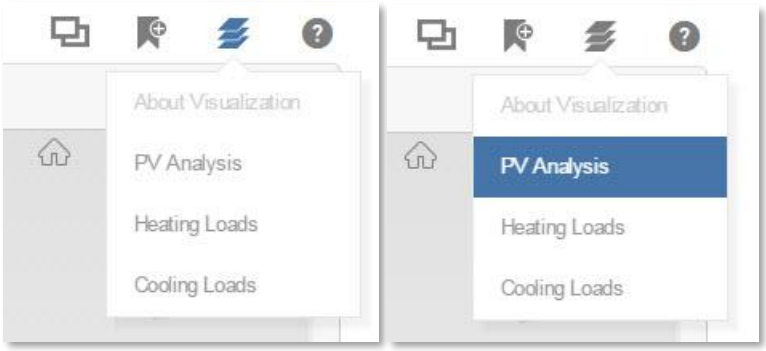

Shows all Level 3 GbXML (Green Building XML) elements. Selecting an element in the browser will highlight the element, making all else transparent, and show its properties in the palette.

Let's visit the buttons in the upper right corner above the model viewer. These are important to our workflows, which we will discuss later.

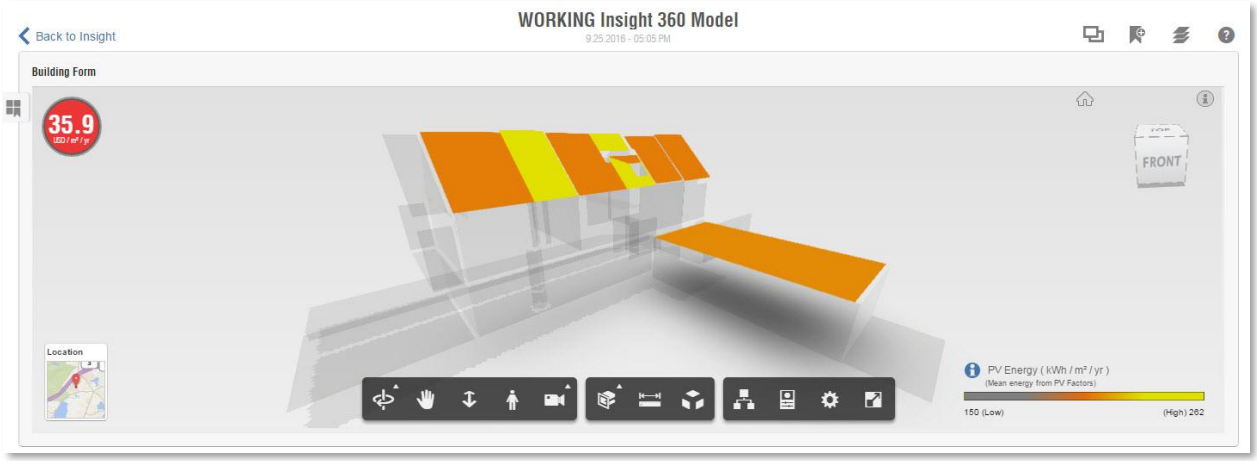


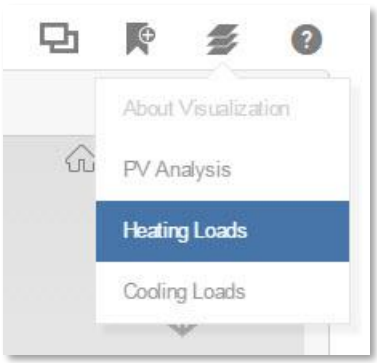
The Scenario Compare and Add Scenario buttons are straightforward. The workflow is: Add a new scenario, monkey with the Energy Parameters… another technical term… Add another Scenario, monkey again, Compare Scenarios!

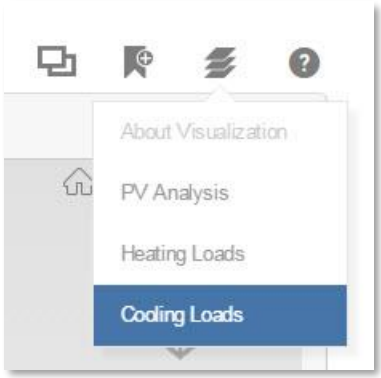
We have already seen the walkthrough on Page 55. Note that it's not a link to Help.



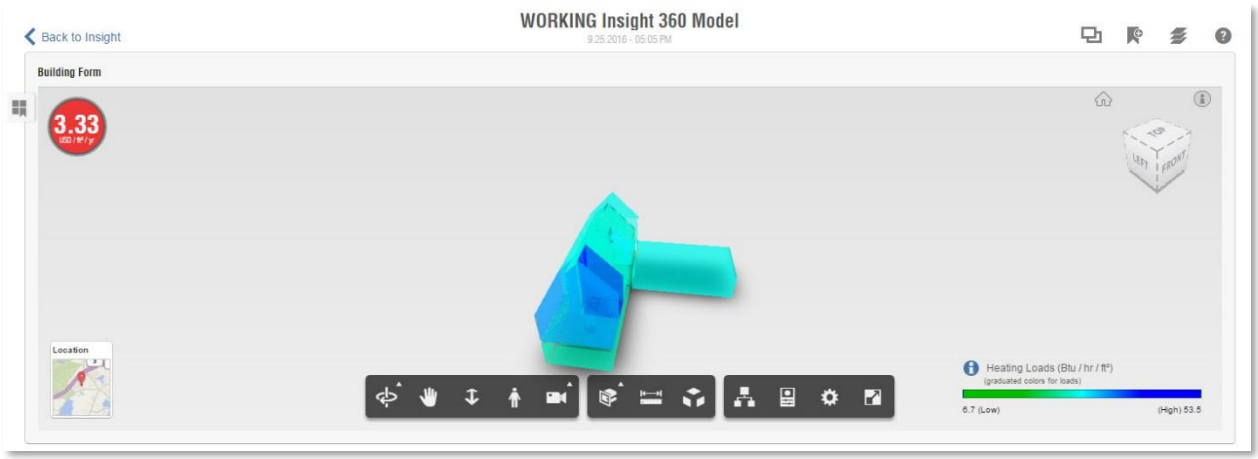

Visualization:
When we select PV Analysis, our Analytical Model contrasts PV Energy on horizontal surfaces:

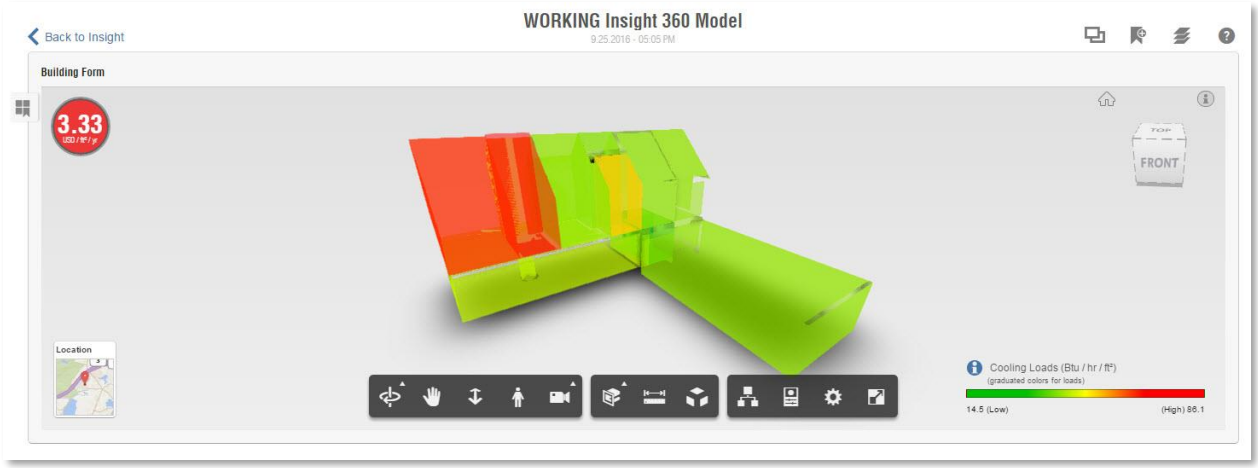




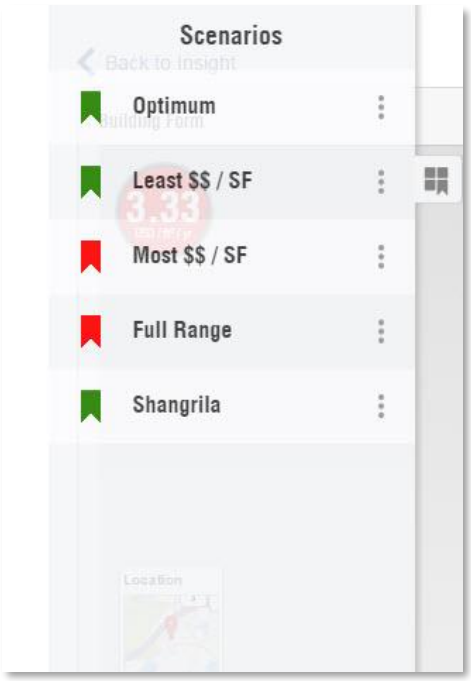



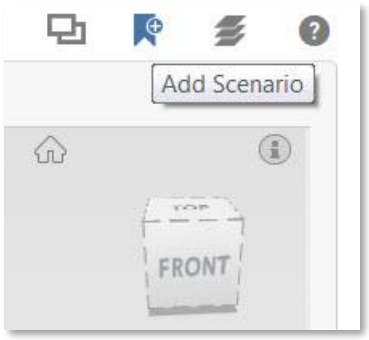

Visualization:
When we select Heating Loads and Cooling Loads, our Analytical Model contrasts areas of high and low loads:

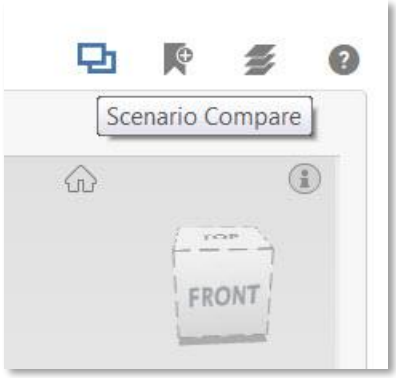


Let's take a closer look at the Add and Compare Scenarios feature:



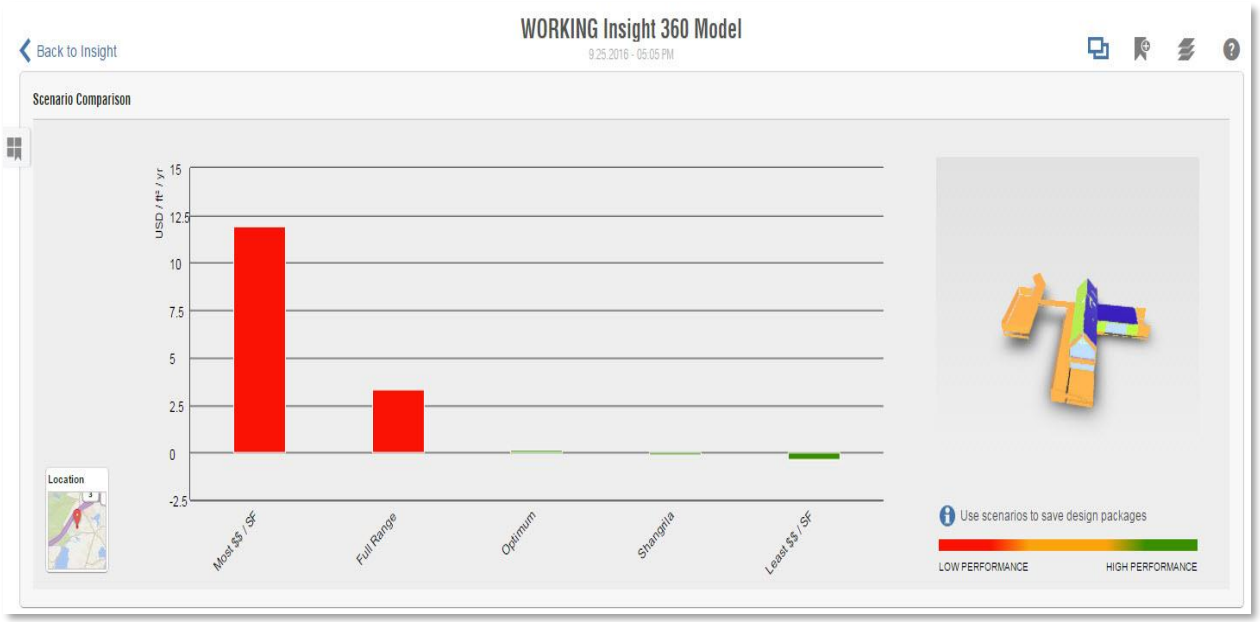




Scenarios show up in the slide-out panel found on the left side of the screen.

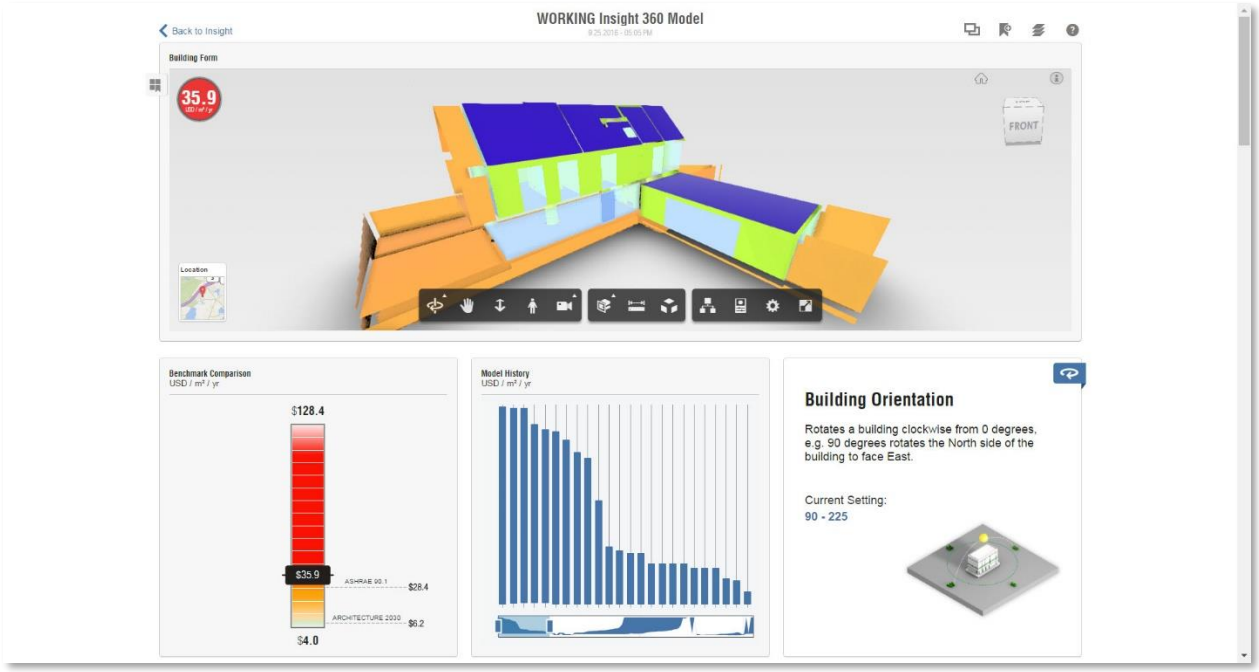
Scenarios are collections of the "Factor Design Options" and their "Ranges." We will be introduced to the "Factor Design Options" soon.

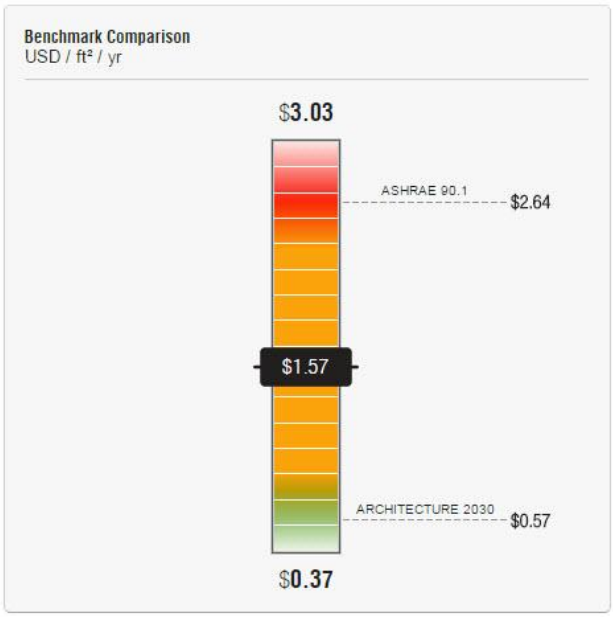
With Scenario Compare, this is how results look below.

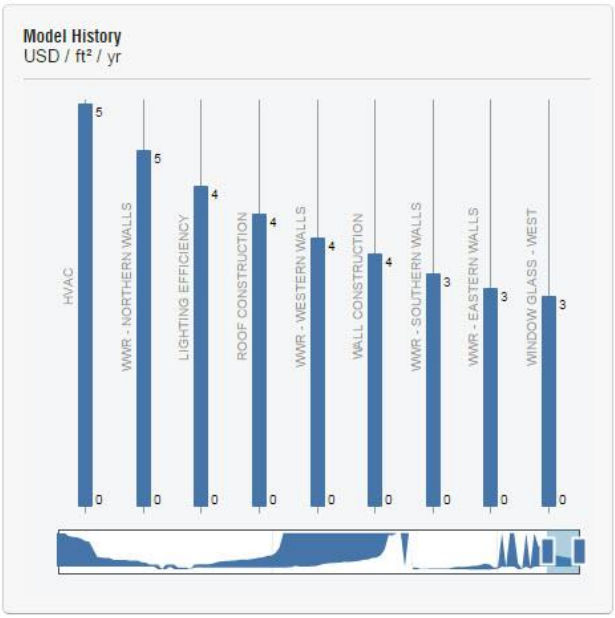


## Analysis

Let's walkthrough the panels below the Energy Analysis Model, which contain the "Factor Design Options," Benchmarks and Model History.




The Benchmark shows where the current Scenario stands against the Maximum, Minimum, and Stretch Codes and Standards like Net Zero, ASHRAE 90.1, and Architecture 2030. It also shows where the scenario compares to the BIM Model as it stands in Revit.

The Model History as a feature is a work in progress and may change in the future to be more useful. As it currently stands, each bar reflects a change to a "Factor Design Option."

Let's walkthrough the "Factor Design Options"

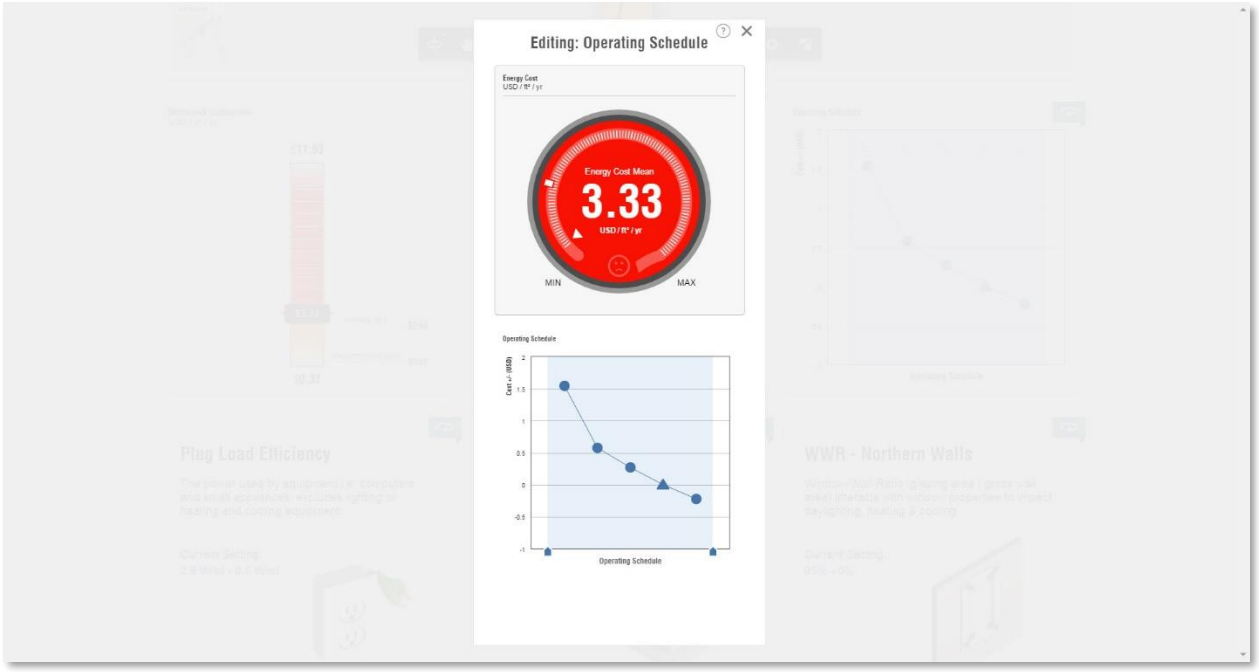
Click on this icon to FLIP the "Factor Design Option" card.

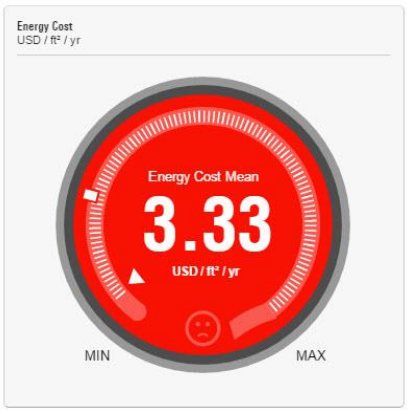
In the middle is the triangular point labeled "BIM." It reflects "Known" factors in the BIM model in Revit.

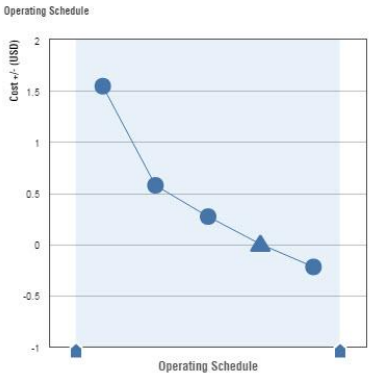
To the left is the Highest point. On the Y-Axis, is "Cost." So the higher the point, the more expensive it is.

To the right is the Lowest point. It will typically be the lowest energy "Cost" or consumption… Except when the curve is FLAT!

When we select directly on the “Factor Design Option” card, it takes us to an Edit screen:

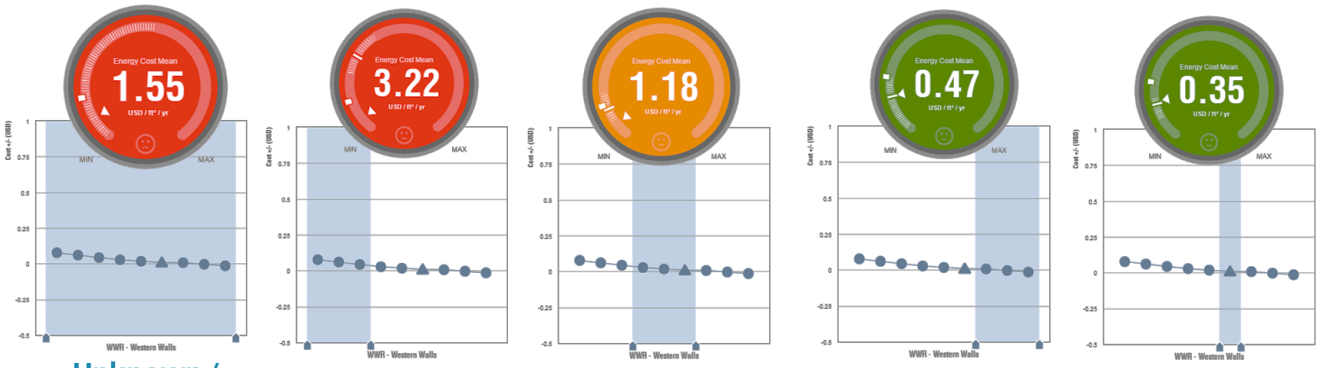



The top is for feedback.

The bottom is the adjustable “Range.”




**Unknown / Undecided**
e.g. Schedule

**Low Range**
e.g. Existing Building

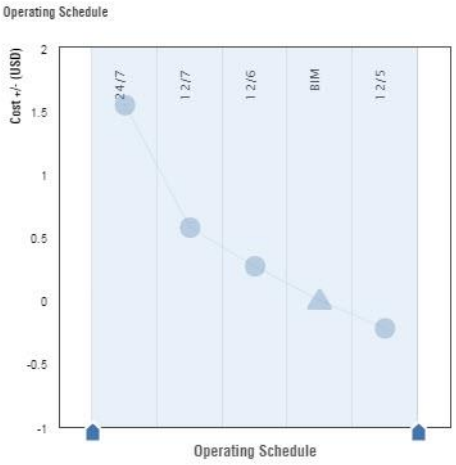
**Mid Range**
e.g. Code Minimum

**High Range**
e.g. Net Zero

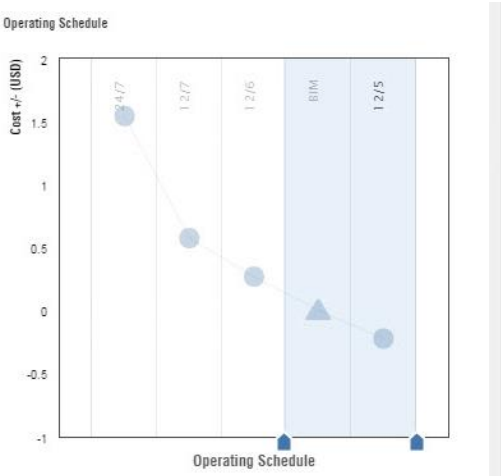
**Known / Decided**

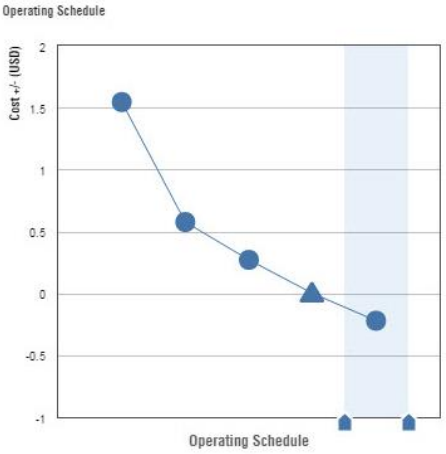
We adjust the “Range” to see how it affects the EUI or Cost.

Unselected, looks like the above.



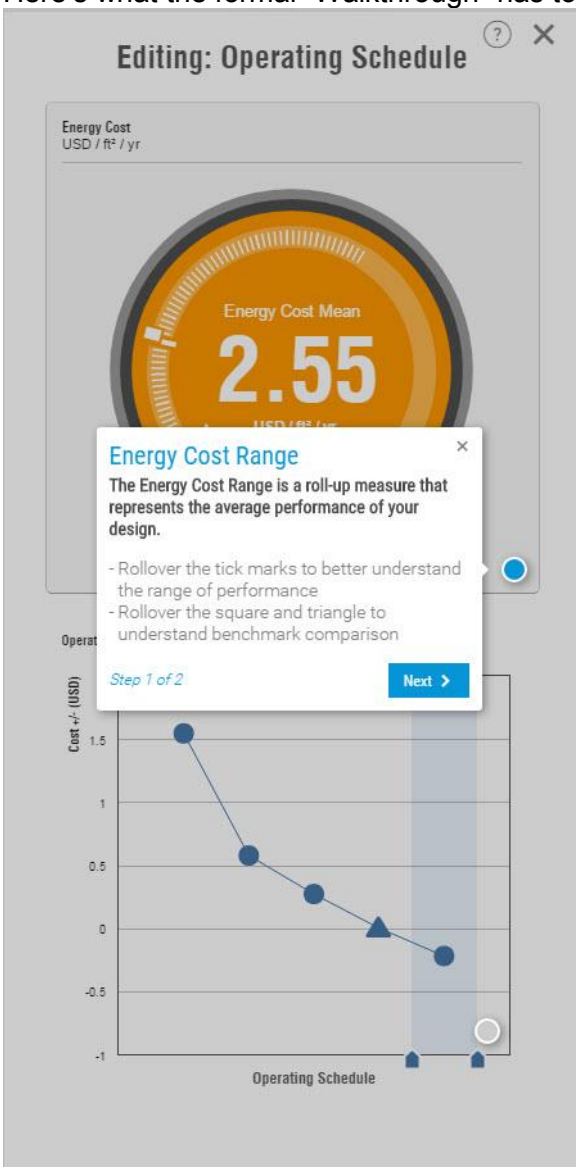

Selected, we see the choices above.

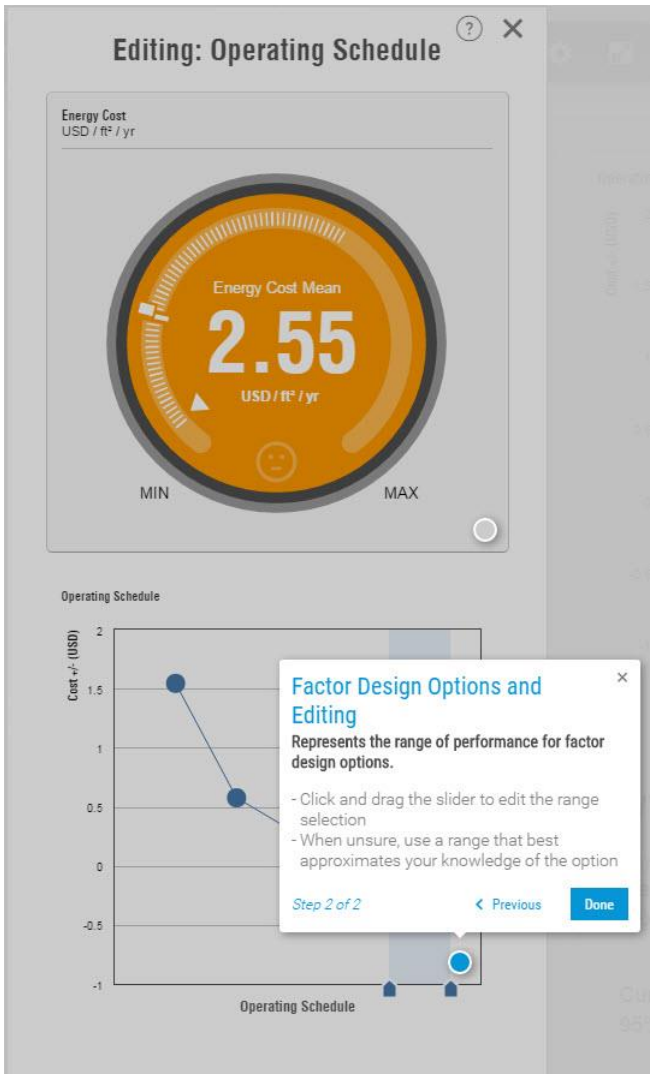


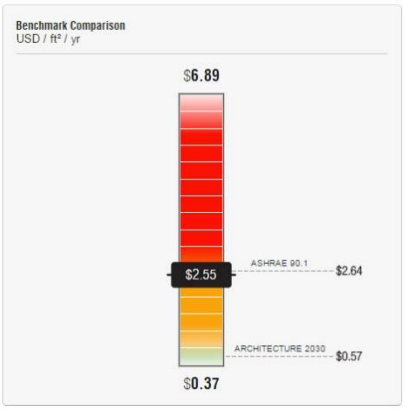

We can drag the sliders over to select the desired range. Then watch the “Energy Cost Range” change.

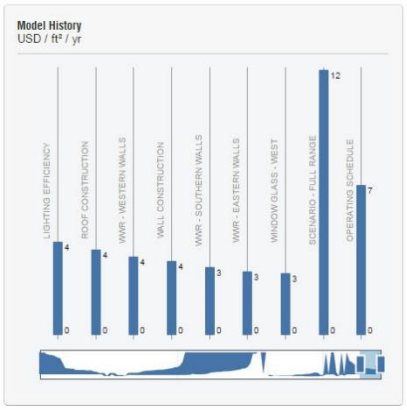
Here's what the formal "Walkthrough" has to say:

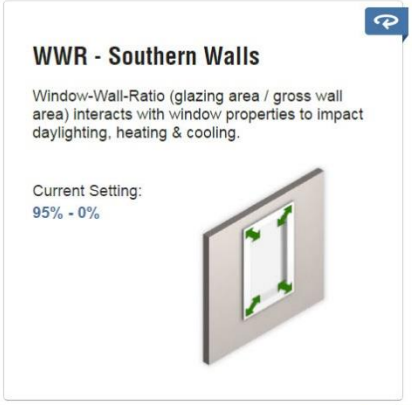


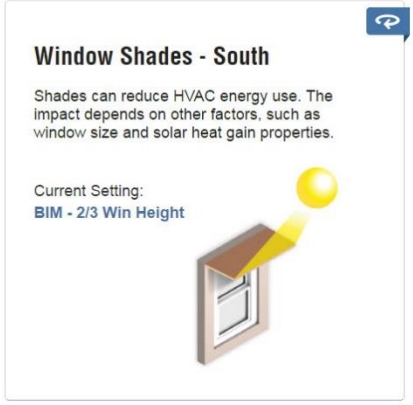



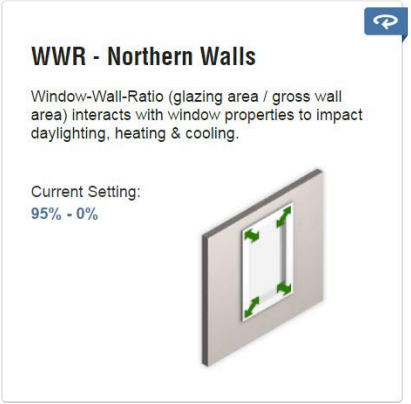
For Quick Reference, Here Are All “Factor Design Option” cards – Front Face:

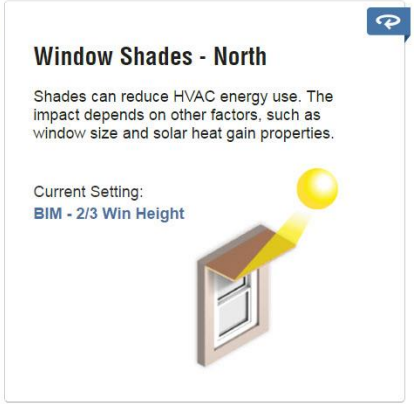


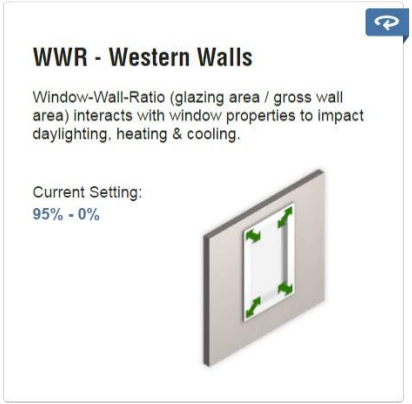









### WWR - Eastern Walls

Window-Wall-Ratio (glazing area / gross wall area) interacts with window properties to impact daylighting, heating & cooling.

Current Setting:
95% - 0%

### Window Shades - East

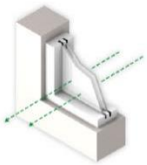
Shades can reduce HVAC energy use. The impact depends on other factors, such as window size and solar heat gain properties.

Current Setting:
BIM - 2/3 Win Height

### Window Glass - East

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

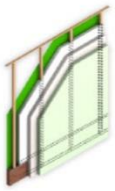
Current Setting:
Sgl Clr - Trp LoE



### Wall Construction

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

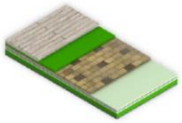
Current Setting:
Uninsulated - R38 Wood



### Roof Construction

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

Current Setting:
Uninsulated - R60



### Infiltration

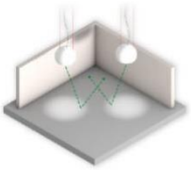
The unintentional leaking of air into or out of conditioned spaces; often due to gaps in the building envelope.

Current Setting:
2.0 ACH - 0.17 ACH

### Lighting Efficiency

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

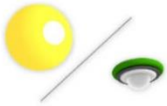
Current Setting:
1.9 W/sf - 0.3 W/sf



### Daylighting & Occupancy Controls

Represents typical daylight dimming and occupancy sensor systems.

Current Setting:
None - Daylighting & Occupancy Controls



### Plug Load Efficiency

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

Current Setting:
2.6 W/sf - 0.6 W/sf

### HVAC

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

Current Setting:
ASHRAE VAV - High Eff. Package Terminal AC

### Operating Schedule

The typical hours of use by building occupants.

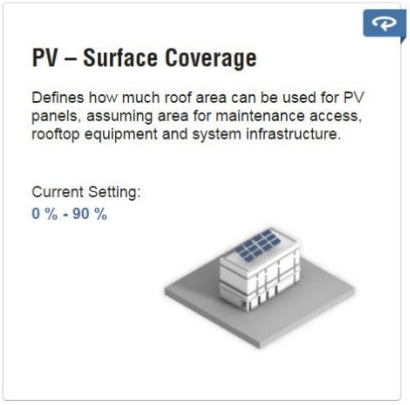
Current Setting:
12/5

### PV – Panel Efficiency

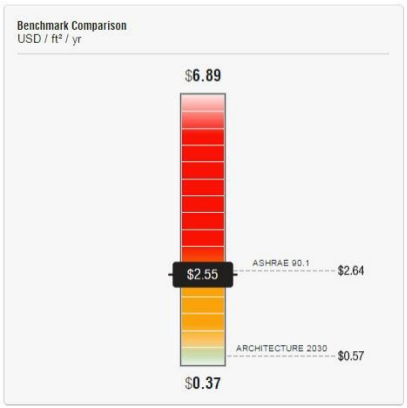
The percentage of the sun's energy that will be converted to AC energy. Higher efficiency panels cost more, but produce more energy for the same surface area.

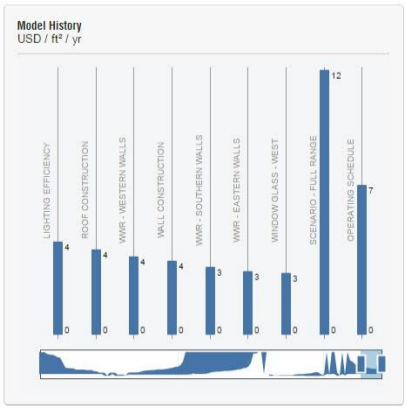
Current Setting:
16 % - 20.4 %

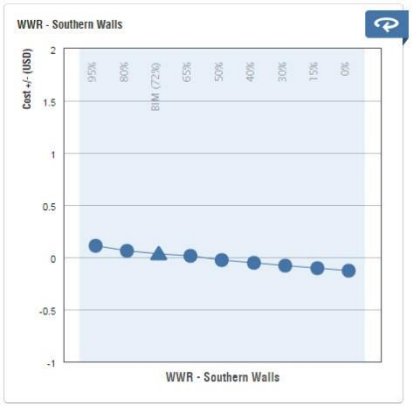
PV – Payback Limit
Use the payback period to define which surfaces will be used for the PV system. Surfaces with shading or poor solar orientation may be excluded.
Current Setting:
10 yr - 30 yr

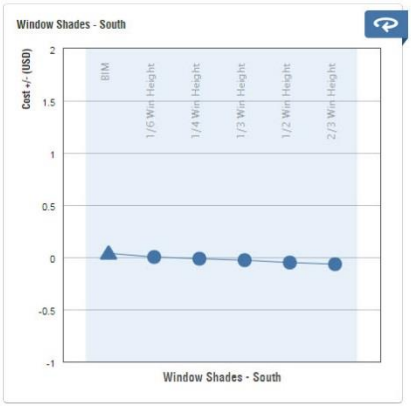

PV – Surface Coverage
Defines how much roof area can be used for PV panels, assuming area for maintenance access, rooftop equipment and system infrastructure.
Current Setting:
0 % - 90 %

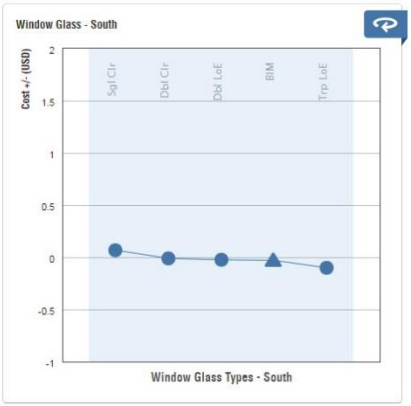
For Quick Reference, Here Are All “Factor Design Option” cards – Back Face:

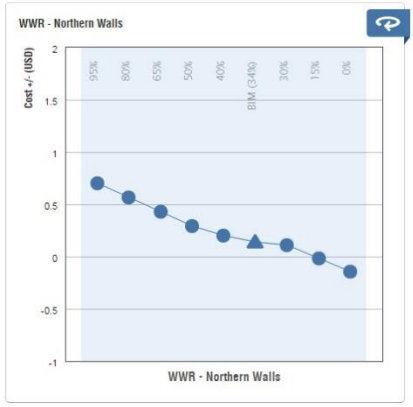


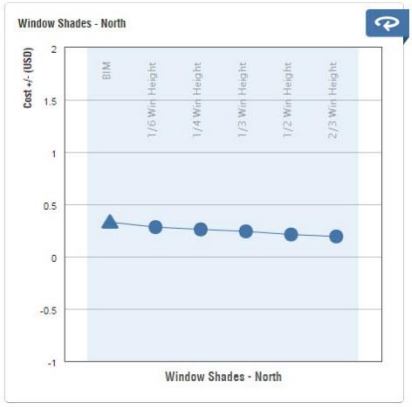



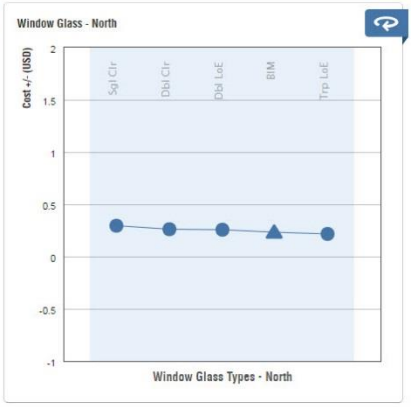


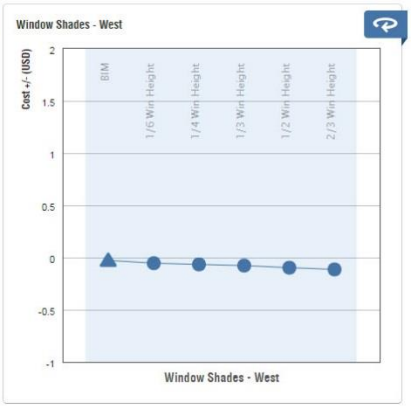



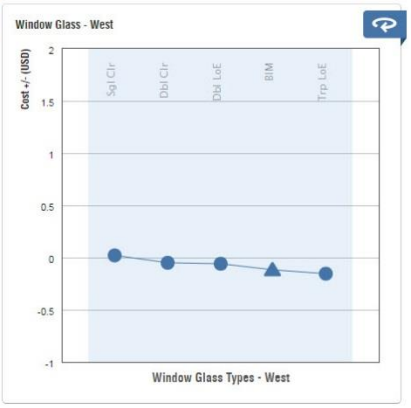



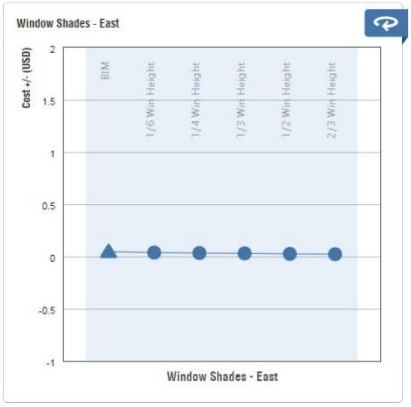



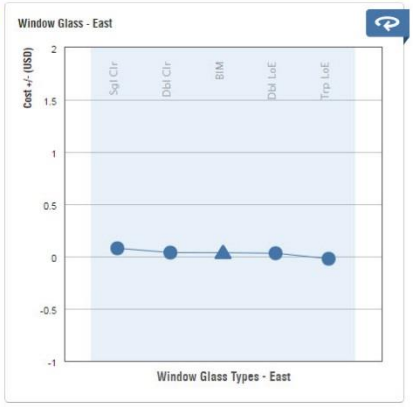



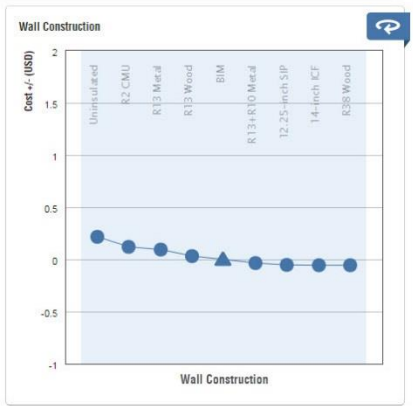


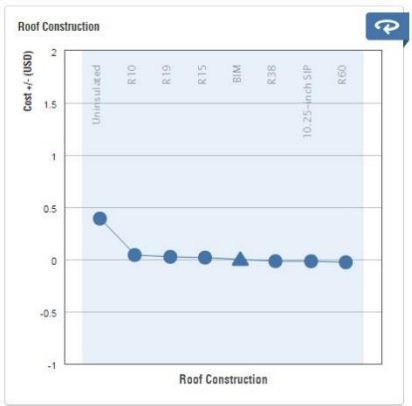



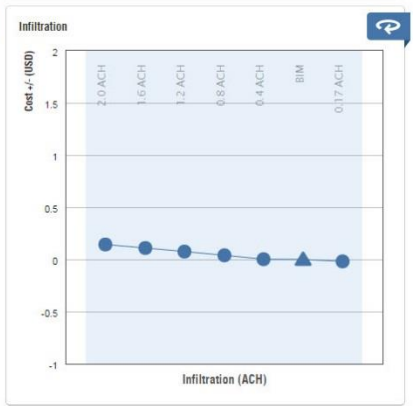
WWR - Eastern Walls
Cost +/- (USD)
95%
80%
65%
50%
40%
BIM (32%)
30%
15%
0%
WWR - Eastern Walls

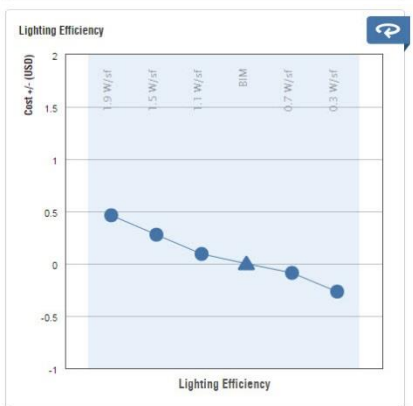

Window Shades - East
Cost +/- (USD)
BIM
1/6 Win Height
1/4 Win Height
1/3 Win Height
1/2 Win Height
2/3 Win Height
Window Shades - East

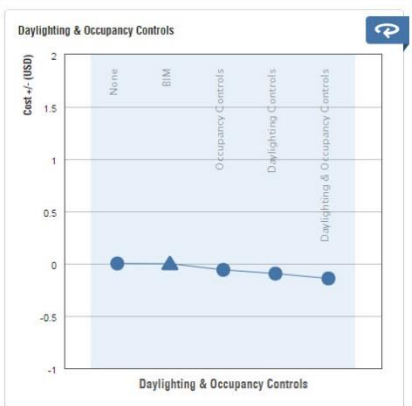

Window Glass - East
Cost +/- (USD)
Sgl Clr
Dbl Clr
BIM
Dbl LoE
Trp LoE
Window Glass Types - East

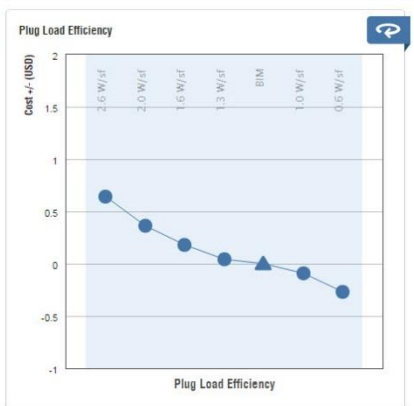

Wall Construction
Cost +/- (USD)
Uninsulated
R2 CMU
R13 Metal
R13 Wood
BIM
R13+R10 Metal
12.25-inch SIP
14-inch ICF
R38 Wood
Wall Construction

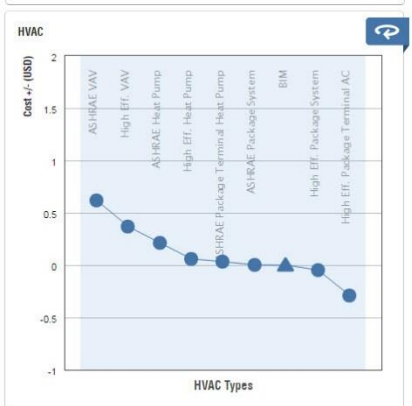

Roof Construction
Cost +/- (USD)
Uninsulated
R10
R19
R15
BIM
R38
10.25-inch SIP
R60
Roof Construction

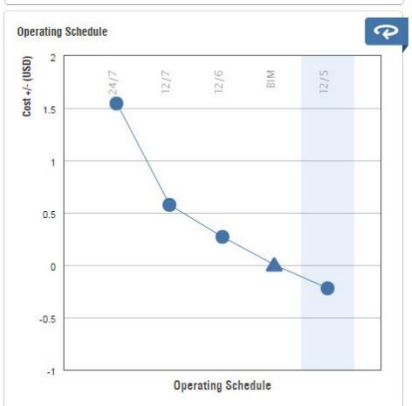

Infiltration
Cost +/- (USD)
2.0 ACH
1.6 ACH
1.2 ACH
0.8 ACH
0.4 ACH
BIM
0.17 ACH
Infiltration (ACH)

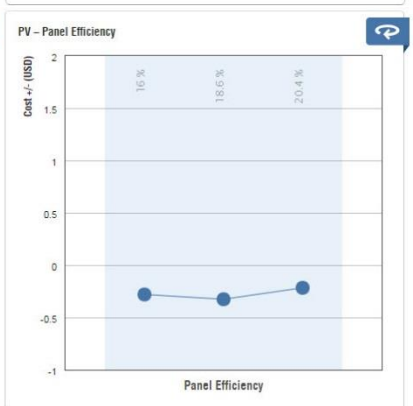

Lighting Efficiency
Cost +/- (USD)
1.9 W/sf
1.5 W/sf
1.1 W/sf
BIM
0.7 W/sf
0.3 W/sf
Lighting Efficiency

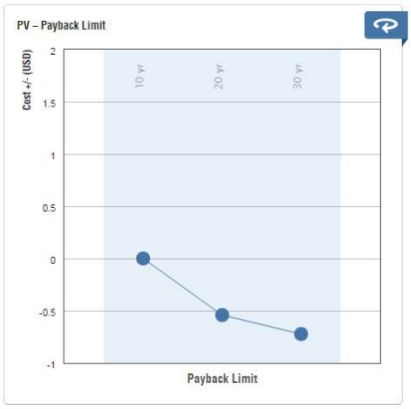

Daylighting & Occupancy Controls
Cost +/- (USD)
None
BIM
Occupancy Controls
Daylighting Controls
Daylighting & Occupancy Controls
Daylighting & Occupancy Controls

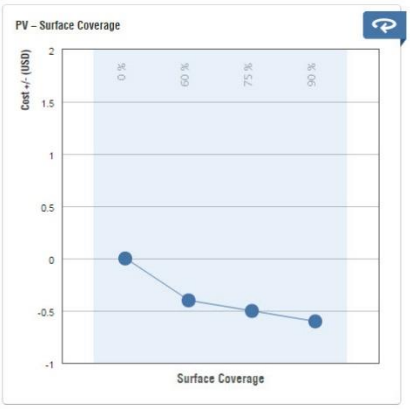

Plug Load Efficiency
Cost +/- (USD)
2.6 W/sf
2.0 W/sf
1.6 W/sf
1.3 W/sf
BIM
1.0 W/sf
0.6 W/sf
Plug Load Efficiency


HVAC
Cost +/- (USD)
ASHRAE VAV
High Eff. VAV
ASHRAE Heat Pump
High Eff. Heat Pump
ASHRAE Package Terminal Heat Pump
ASHRAE Package System
BIM
High Eff. Package System
High Eff. Package Terminal AC
HVAC Types


Operating Schedule
Cost +/- (USD)
24/7
12/7
12/6
BIM
12/5
Operating Schedule


PV – Panel Efficiency
Cost +/- (USD)
16 %
18.6 %
20.4 %
Panel Efficiency




NOTE: You model will have different slopes… Costs… Different Insights…

NOTE: Because PV Factors are not “Consumption” but “Additive” and thus “OPTIONAL” we separate these to the very bottom. They do not partake when sorted by “Importance.”

## THE GOOD STUFF: WORKFLOWS AND ANALYSIS

Now that we have covered a walkthrough the interface, you should be familiar enough with it to discuss strategy for analysis… How do we optimize the design to meet:

Overarching Design Goals
- Stretch Codes and Standards: Net Zero, Architecture 2030
- Best In Class: DOE High Perf Bldg Database
- Technical and Energy Potential: Highest Affordable Energy Potential

Quantifiable Metrics
- EUI per SF
- USD per SF
- Lighting Power Density (Watts per SF)

IPD is Collaborative, Iterative and performed on the whole system.
Recall our discussion at the beginning…

We "need" a tool that is modern, mobile, collaborative, and fast. A tool that delivers just the right data at the right time without requiring information that we don't have at the time.

Why not calculate 360 total reports, incrementing the site orientation by 1-degree at a time? We would have 360 energy consumption values. Would that make a nice graph? Stakeholders could take a glance at a graph, identify the optimum site orientation and make quick and "Informed" decisions… That's Rapid Energy Modeling!!

*This is "AGILE" Design. Start with enough information to move forward. Start with LESS information to make "Informed" scalable decisions. – Ian Molloy, Energy Analysis Engineer*

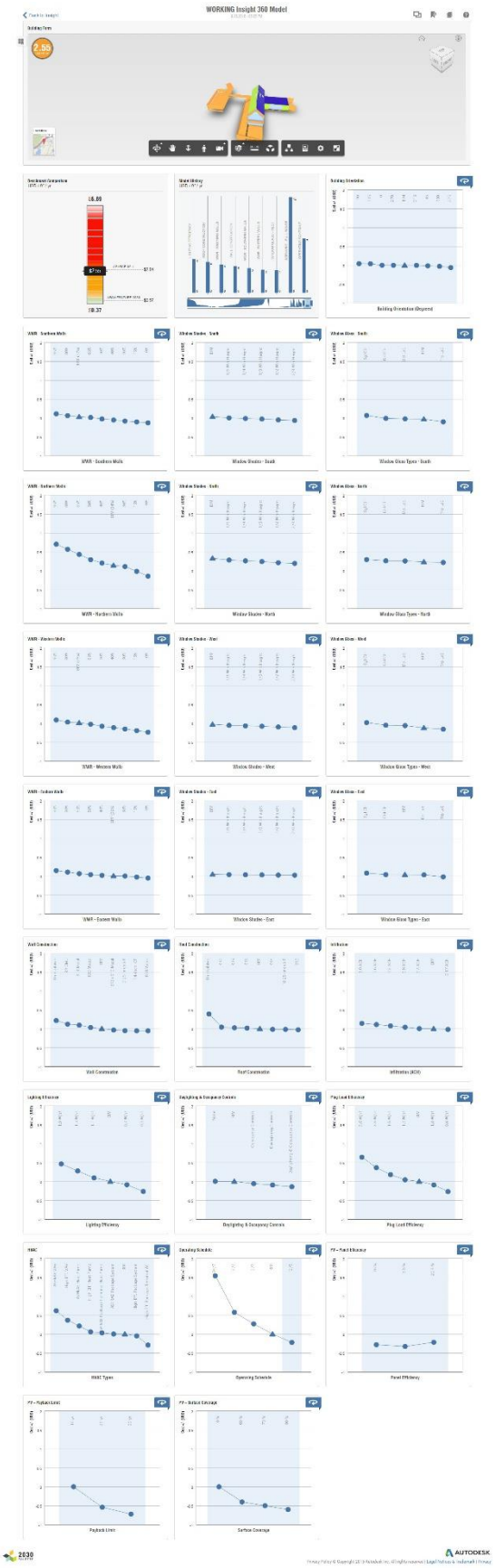
As decisions are firmed up, how does that affect the other factors? Are graphs of "South Wall Composition" more or less important as we rotate the building on the site?

Insight 360 allows us to visualize, interact with, and document building performance data earlier in the design process, allowing the IDP team to track outcomes through the building lifecycle.

At the start of any project, are we certain about any Design Factor? No. Our "Ranges" acknowledges that uncertainty. When factors are unknown, they likely fall within the "Range" which takes uncertainty out of the equation. The goal of the IDP team, over time, is to collaborate, discuss those ranges, tighten them up over time. Eventually, those factors will be "known" and your BIM model will reflect that.

If a "Range" curve is FLAT… i.e. it has no IMPACT on the Energy Cost Factor, would you pour money into that factor? Heck NO!

Quick example: If Wall Composition had a flat curve… To the left is cheap wall construction, to the right is an expensive wall construction with lots of insulation.
Would you invest in the most expensive wall to keep energy down? No.
No Bang For The Buck! As we rotate the building, or change the wall to window ratio, that Wall Composition curve may become more of a factor!




Look close at the graphs on the left. We discussed how the vertical axis is COST.

The horizontal axis reflects the various options in the range.

These horizontal axis factors are sorted from Most Costly to Least Costly… and this is important…Cost is in terms of USD per SF. When we flip this to EUI, the graphs may appear more jagged as they are not sorted by EUI.

OBSERVE: Some graphs are FLAT and some have SLOPE

As your eyes scan from top to bottom of this deck of cards… the slopes are all random. Some of the steepest curves are near the bottom, but they are mixed throughout.

WHAT IF…

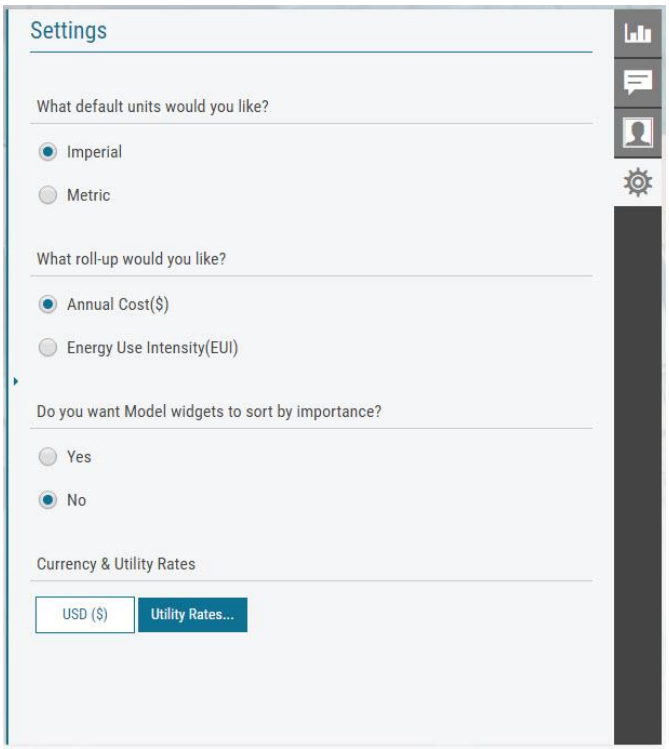
WHAT IF…

What If we could sort these by IMPORTANCE… by Steepest Slopes first.

After all, those are the BIGGEST BANG FOR YOUR BUCKS

Target the most important.

These Ranges, help to understand what's important and what's not.



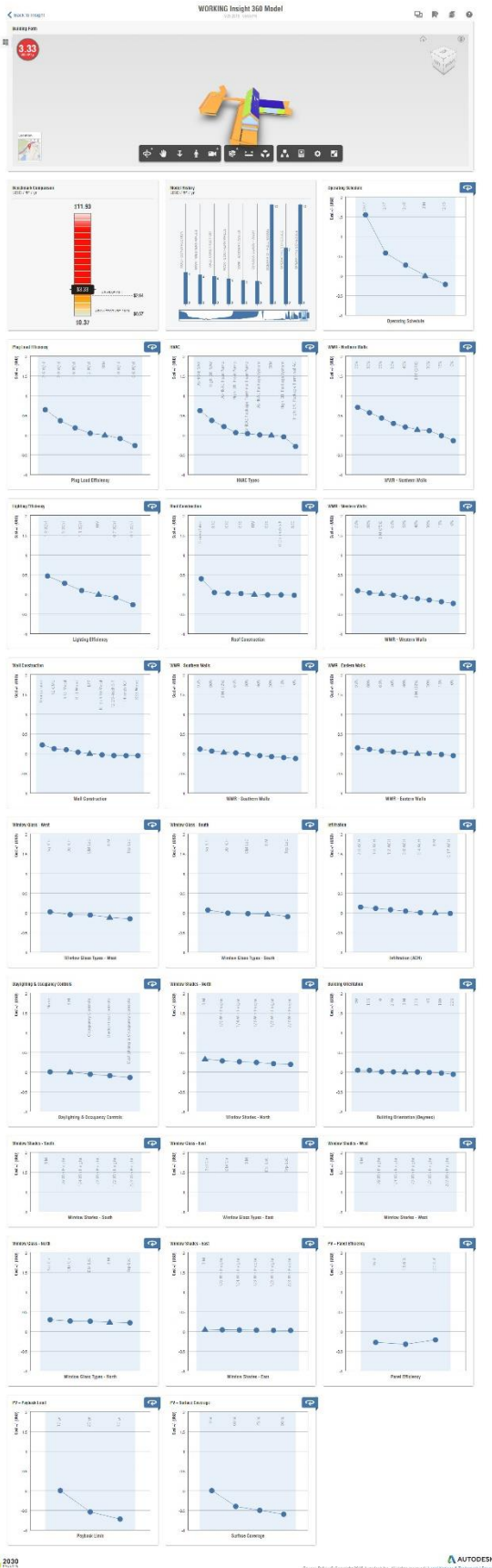

Let's back out of the Insight to the Main screen, where we find the Model Comparison tab. Switch to the Settings tab.

Remember this note in prior pages:

"Remember this Settings tab!!! We will use it as part of our workflow to achieve significant Insight in our model."

There is an important setting here:
"Do you want Model widgets to sort by Importance?"

Set that to YES!



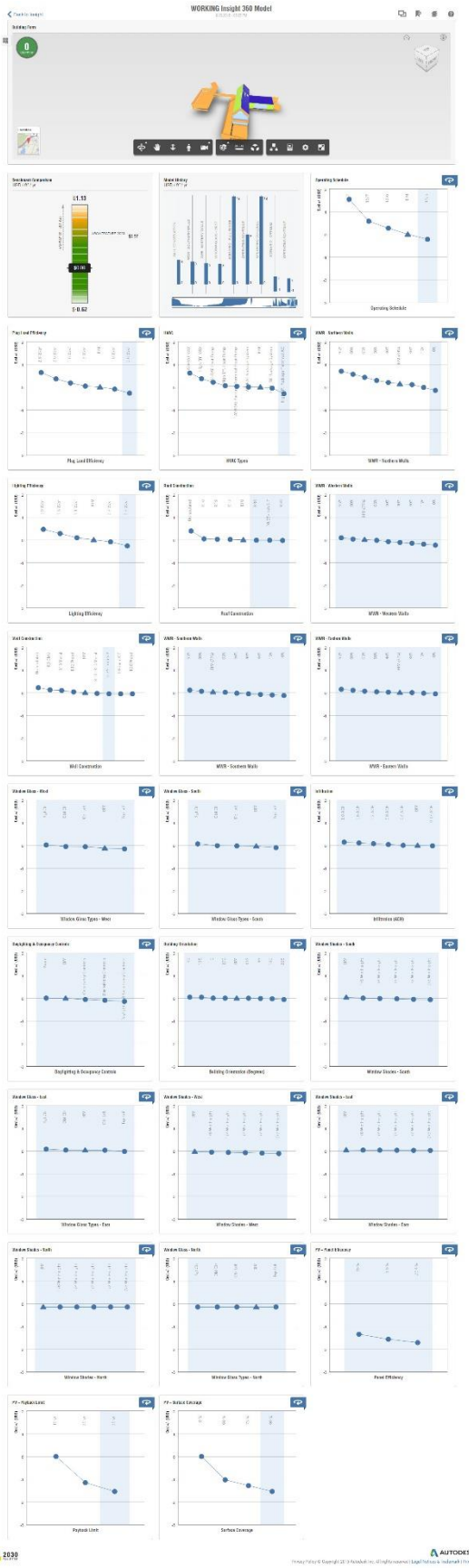

BINGO!!!

OBSERVE: All graphs are SORTED. Widgets with Steepest Slopes to the top.

EXCEPTION: Since PV is OPTIONAL, they stay at the bottom, but do notice that since they SUPPLY energy to the model, they have a high impact and steep slopes.

Also note that as you adjust some factors, they affect other factors. Imagine how Site Orientation to the Sun, would affect factors dependent on North, South East, West such as wall compositions. Point is that the sequence of importance will change over time, and important to keep an eye on it.

Next Stop Strategy…




Strategy:

This allows the IDP team to focus on factors that are important.

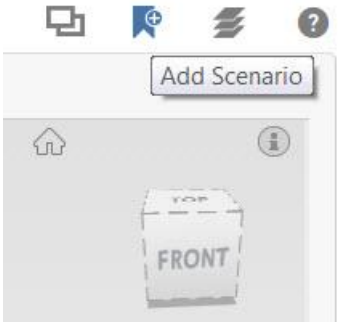
Should we take all “Ranges” and shove them to the far right? This minimizes Energy “Cost” … Those horizontal options may also mean increased construction cost…

By sorting these by “Importance” we know what factors have impact, and which ones are flat.

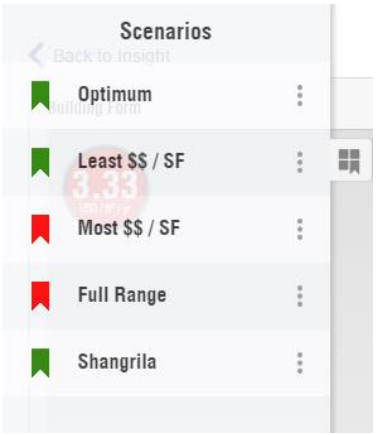
OBSERVE: The graphs on the left are sorted by importance, but I have also targeted only those graphs at the top that show Impact… I’ve adjusted the “Range” to the far right, while leaving the flat graphs alone.

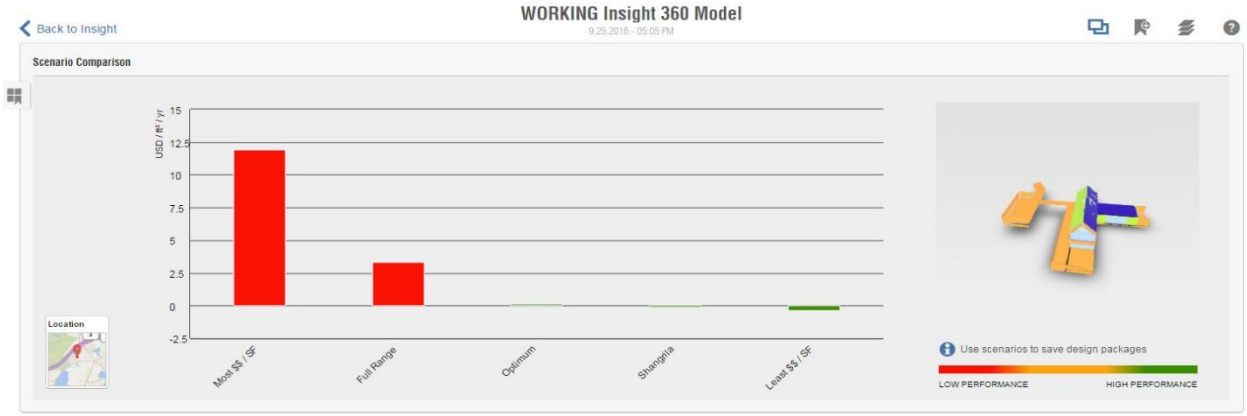
*“OPTIMUM” IS WHERE WE GET THE SAME RESULT, WITH MINIMUM CHANGES. THIS RESULTS IN COST SAVINGS!!!*

Let's revisit Scenarios.



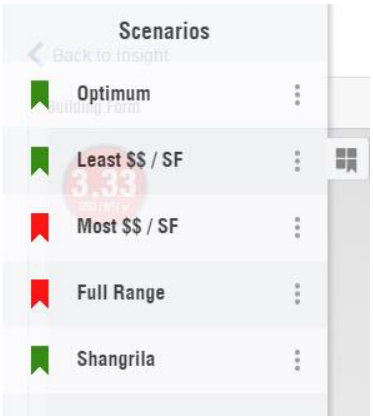
I like to create Scenarios because they can be quickly applied to other models (Design Options) for comparison. They also bookmark my widget settings if I want to revise them wholesale.





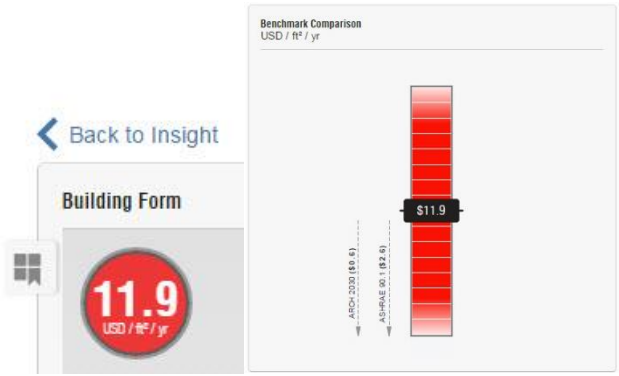

Every IDP will have different Goals which can be bookmarked as "Scenarios." I created some generic Scenarios mostly to compare and contrast… or in case someone asks the inevitable question… "What happens if we shove the Ranges to the Far Right…the Far Left… etc"
So my scenarios cover these:

| | |
|---|---|
| Shoving ALL ranges to far left, results in: | "Most $$ / SF" |
| Shoving ALL range to far right, including PV: | "Least $$ / SF" |
| Clean Slate, nothing adjusted: | "Full Range" |
| Range reduced to middle value(s): | "Middle Range" |
| Only those values with IMPACT adjusted to far right: | "Optimum" |
| Net Zero Energy, Cost = 0: | "Shangri-La" or "Net Zero" |




Here's how the Scenarios played out Cost Wise…

Most $$ / SF:



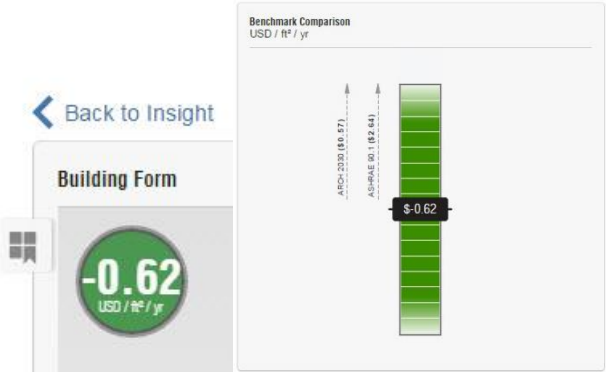

Full Range:

Middle Range:

Shangri-La / NET ZERO:

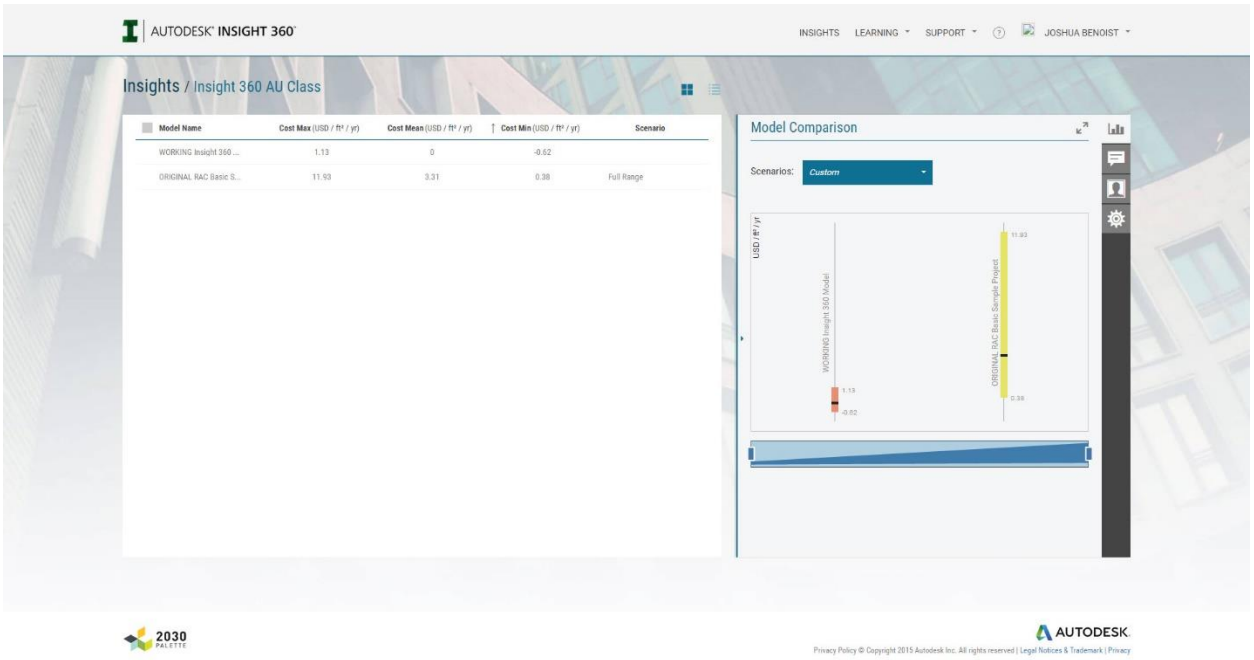
Optimum:

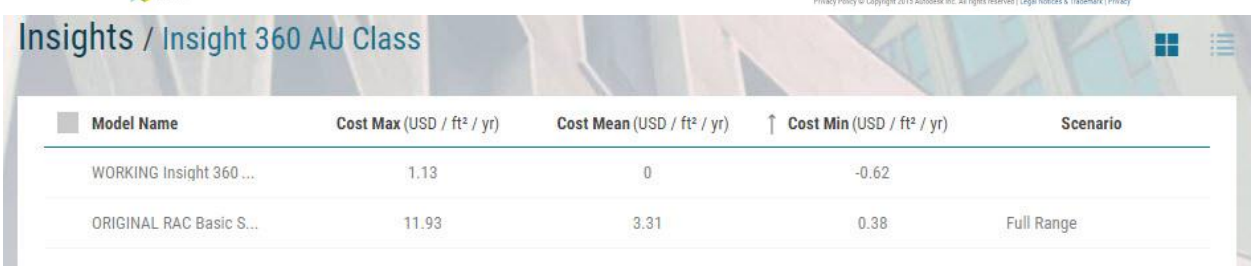
Absolute Lowest $$ / SF:



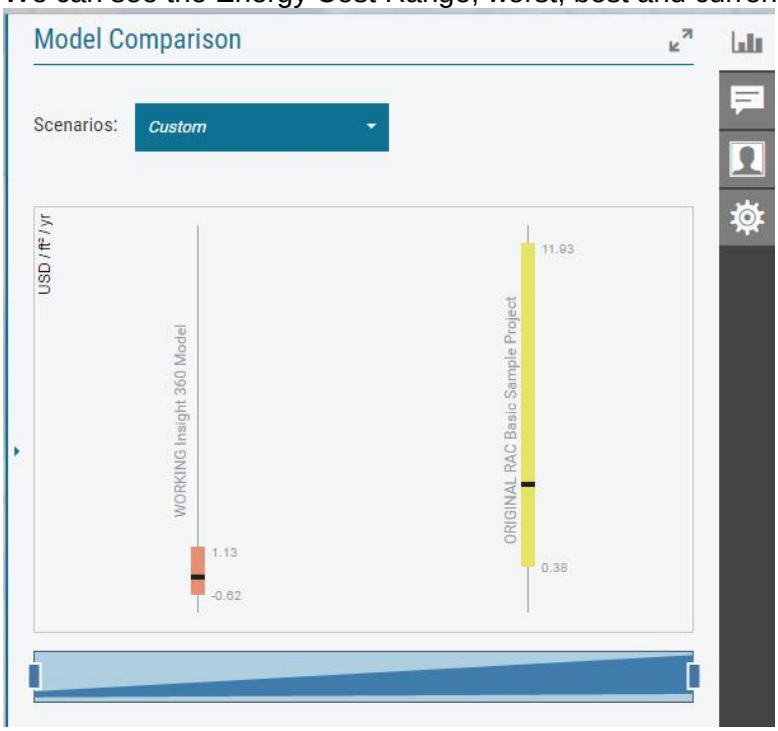
Well, this strategy is all good for optimizing one building model… but what about comparing similar model geometries to find the optimum?

Let's step back to the Main screen. We have the ability to apply the scenarios to all models, or selected models.

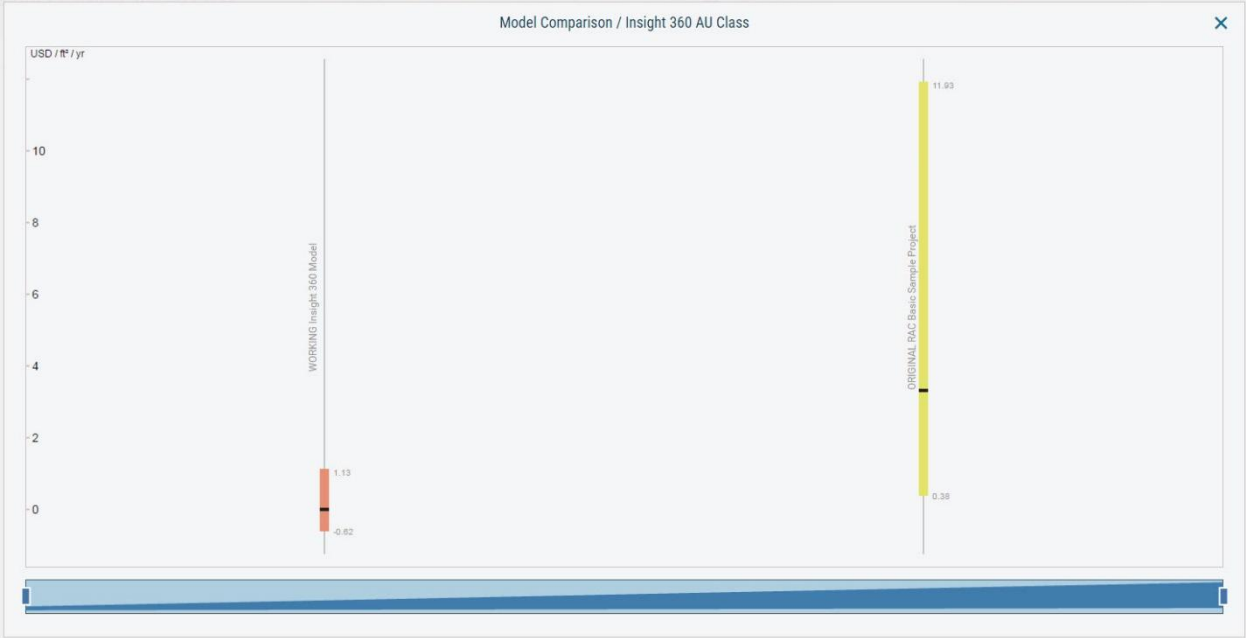


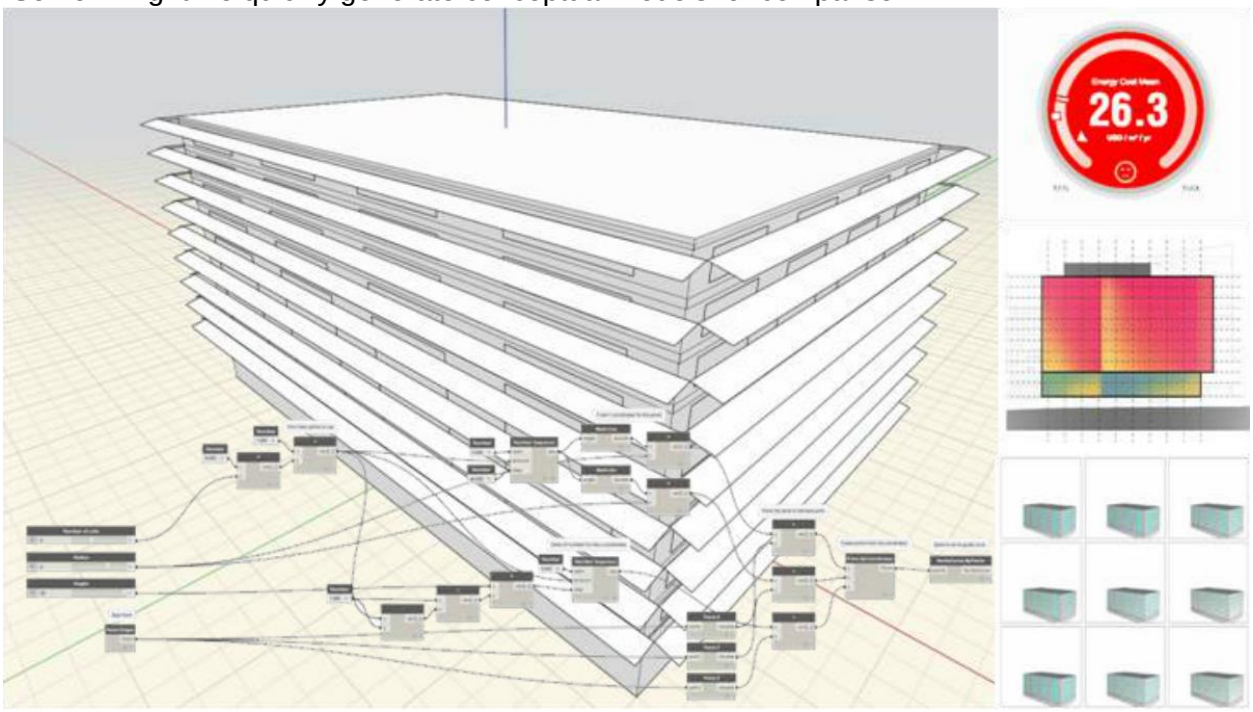
We can see the Energy Cost Range, worst, best and current state of that scenario.



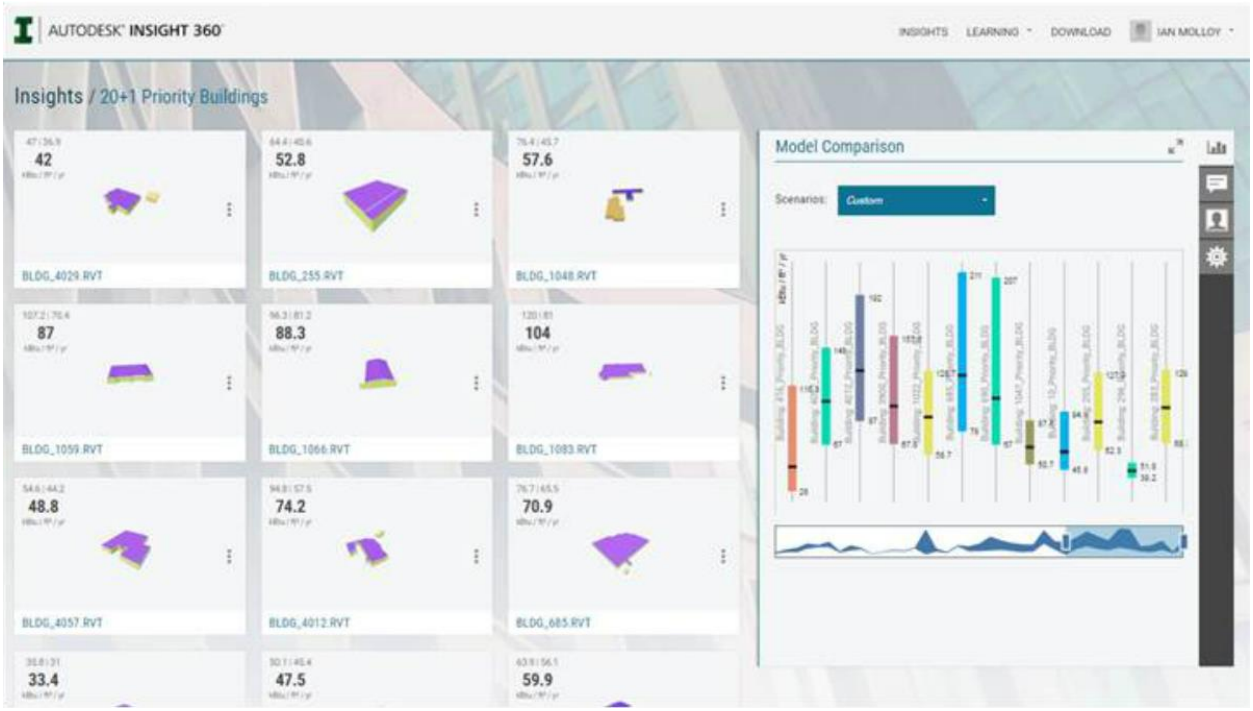

When you have many models to compare, this graph can be maximized full screen.



So how might we quickly generate conceptual models for comparison?

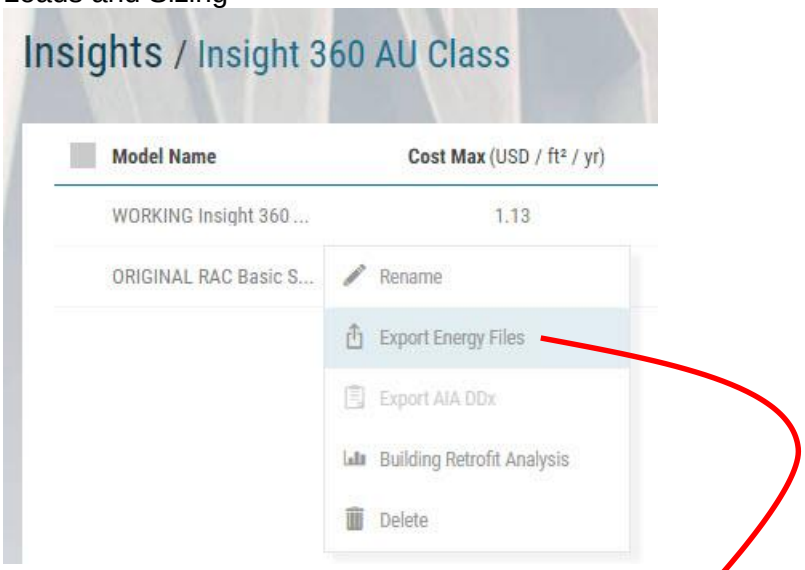



Imagine what DYNAMO can do with Insight 360!!! We would be able to iterate thru various building geometries with Generative Design!!! Dynamo is in Revit!! FormIT and Fractal are also options.

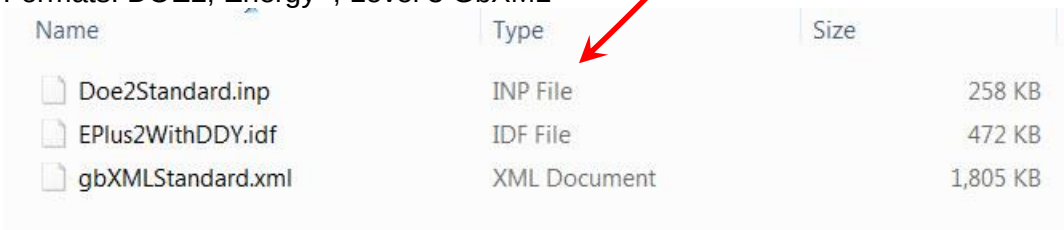



**Next Analyze!!! See if you can spot the most efficient.**

It doesn't stop there. Let's export to your preferred 3rd party analysis package, maybe for HVAC Loads and Sizing

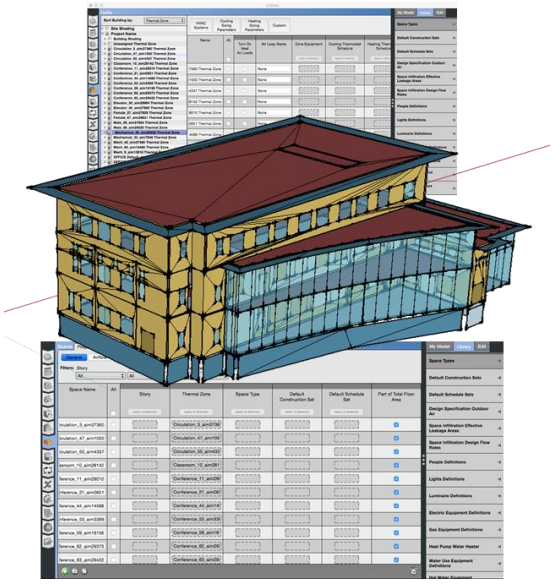



Formats: DOE2, Energy+, Level 3 GbXML




## Continuity & Consistency with Other Tools & Workflows

e.g. OpenStudio



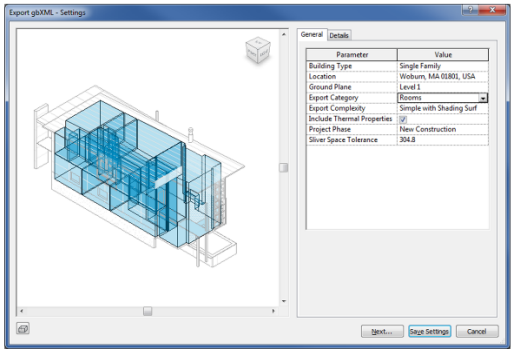
Revit has come a long way in the past two releases. In prior releases, when we export to GbXML, the model could be consumed by Carrier HAP, Trane Trace… but was not "clean" and required a lot of "re-work."

# Those days are GONE!!!

# Revit is Level 3 Certified by GbXML.org

## What is Green Building XML (gbXML)?

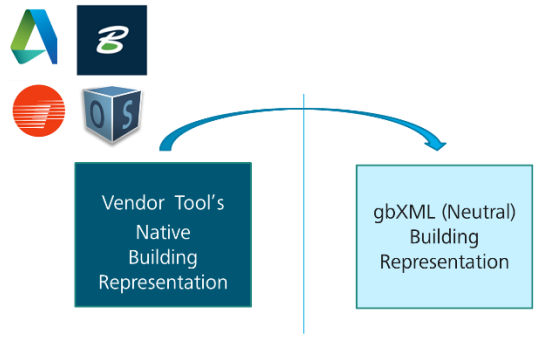
An open XML schema that allows for the exchange of building data from modeling to analysis software tools and back



- Interoperability is the key to successfully using BIM software tools
- It minimizes the human involvement and translation errors

## Certification Process Background

- Certification is a process that gives vendors who export gbXML from their tools ("producers") a stamp of approval from gbXML.




## Levels of Certification

Increasing Levels of Sophisticated Automation

**Level 1 Compliance**

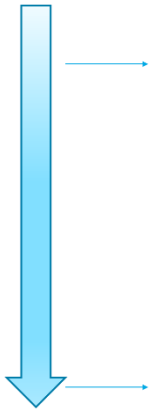
Validating that a gbXML file is a well formed XML

**Level 2 Compliance**

Validating a gbXML file against 8 to 10 geometric "test-cases" that are based upon ASHRAE Research Project 1468

**Level 3 Compliance**

Vendor tool automation that goes far above and beyond Levels 1 and 2 compliance



Architects with basic domain proficiency

Energy and mechanical engineers, expert energy modelers

Our competitive edge over other energy modeling tools, is that this analysis tool is integrated with our BIM model… and it's free, built right into Revit 2017.1

## APPENDIX: The good stuff…

### Installation of Insight 360

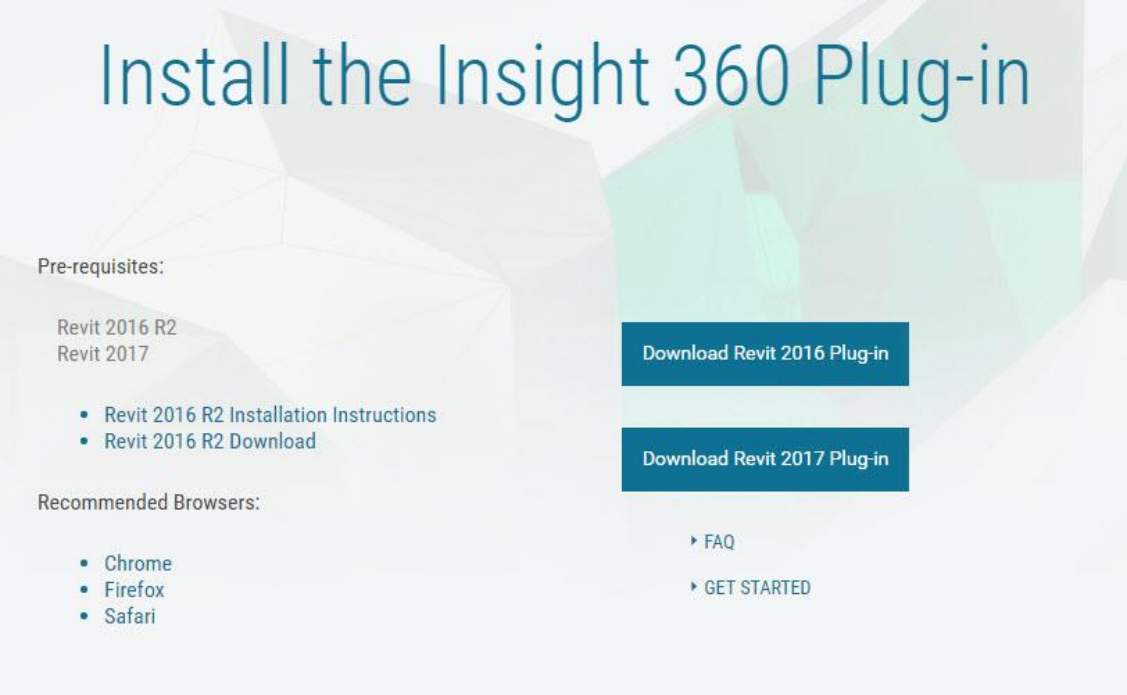
Log onto Insight 360 here:

https://insight360.autodesk.com

Recommended Browsers:

- Chrome
- Firefox
- Safari

Navigate to:



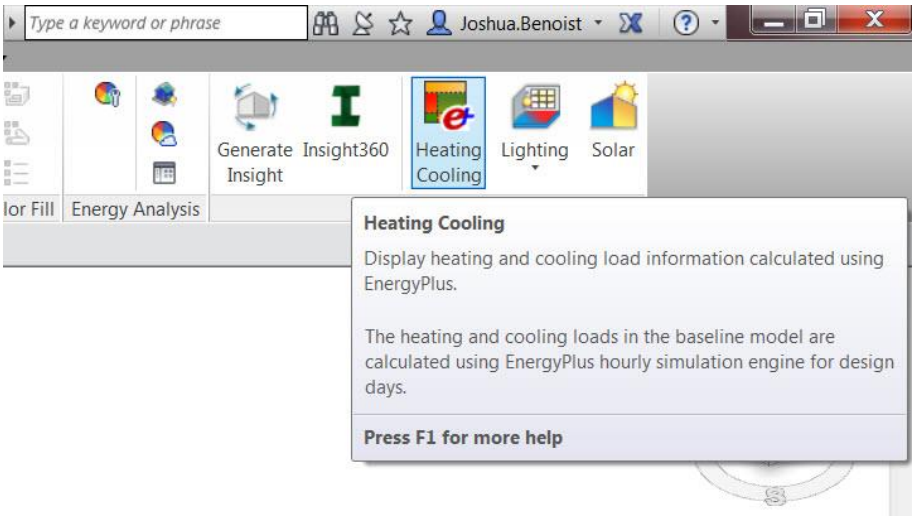

Pre-requisites:

Revit 2016 R2
Revit 2017

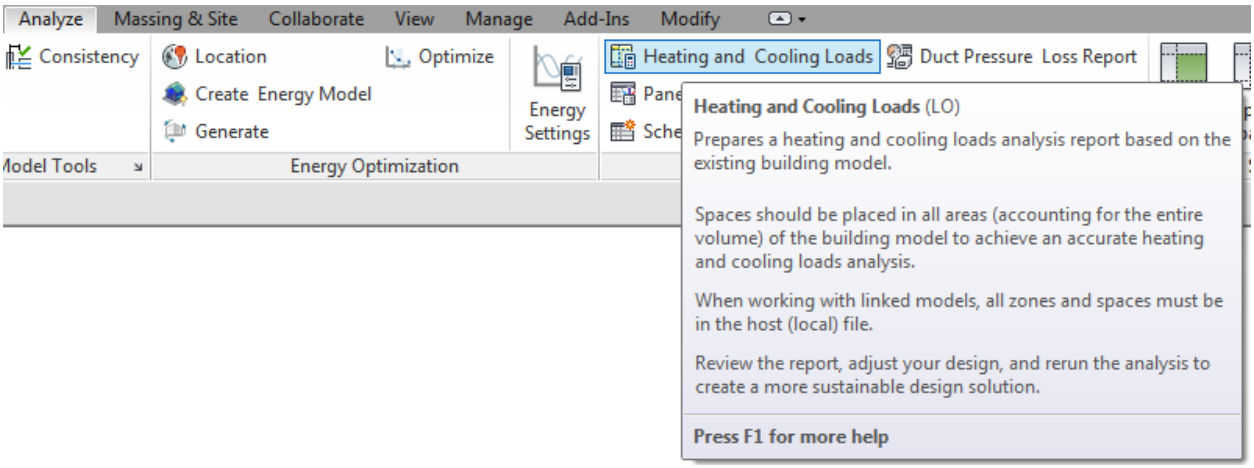
## Heating and Cooling Analysis

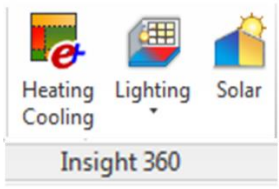
Insight 360 does more than the BPA Analysis, it has an HVAC Analysis using the Energy+ engine for calculations.

2016 & 2017:




2017.1:




The main difference between the above and below “Heating and Cooling” buttons is in the calculation engine. The above is the original Revit MEP energy analysis, and the one on the Insight 360 plugin panel, uses the new EnergyPlus analysis.

A full Sample Report has been provided as “Additional Material Handout,” but here is a snippet.

## Load calculation summary report

Summary of heating and cooling loads for spaces

### Project summary

| Location and Weather | |
|---|---|
| Project | Sample House |
| Location | Norwood Memorial MA USA TMY3 WMO#=725098 |
| Latitude | 42.18 |
| Longitude | -71.2 |

### Building summary

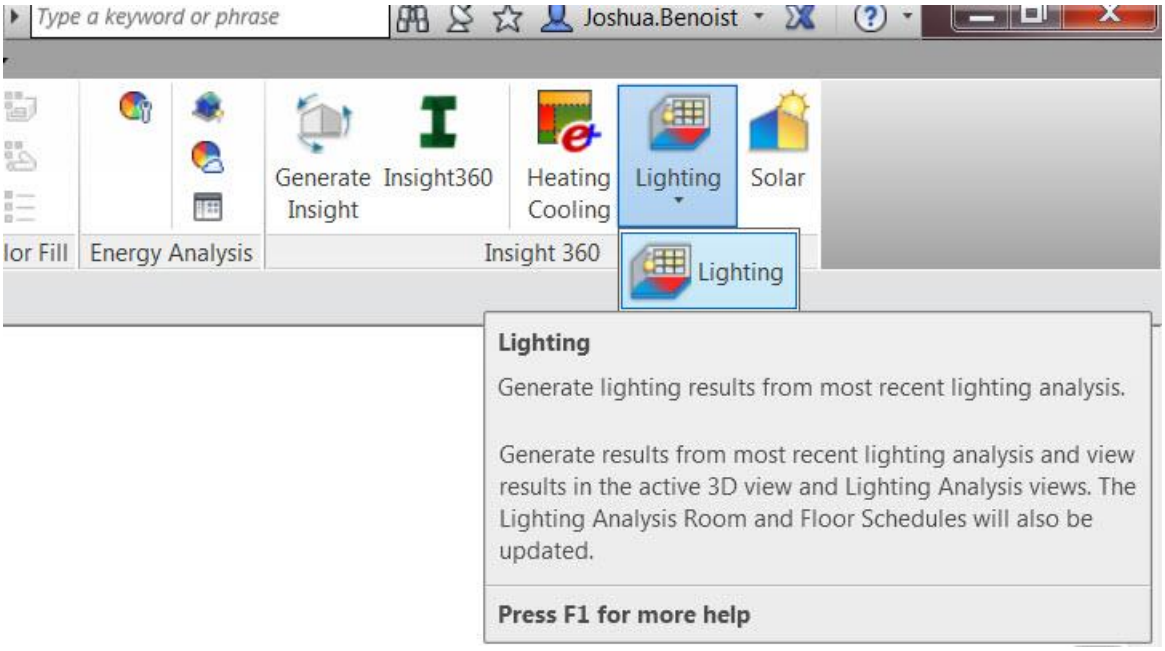
| Inputs | |
|---|---|
| Area (SF) | 2895.46 |
| Volume (CF) | 31226.87 |
| **Calculated Results** | |
| Peak Cooling Total Load(Btu/h) | 119087.44 |
| Peak Cooling Month and Hour | 7/21 16:15:00 |
| Peak Cooling Sensible Load(Btu/h) | 116689.41 |
| Peak Cooling Latent Load(Btu/h) | 2398.04 |
| Peak Heating Load(Btu/h) | -74838.90 |
| **Checksums** | |
| Cooling Load Density (Btu/(h·ft²)) | 41.13 |
| Heating Load Density (Btu/(h·ft²)) | -25.85 |

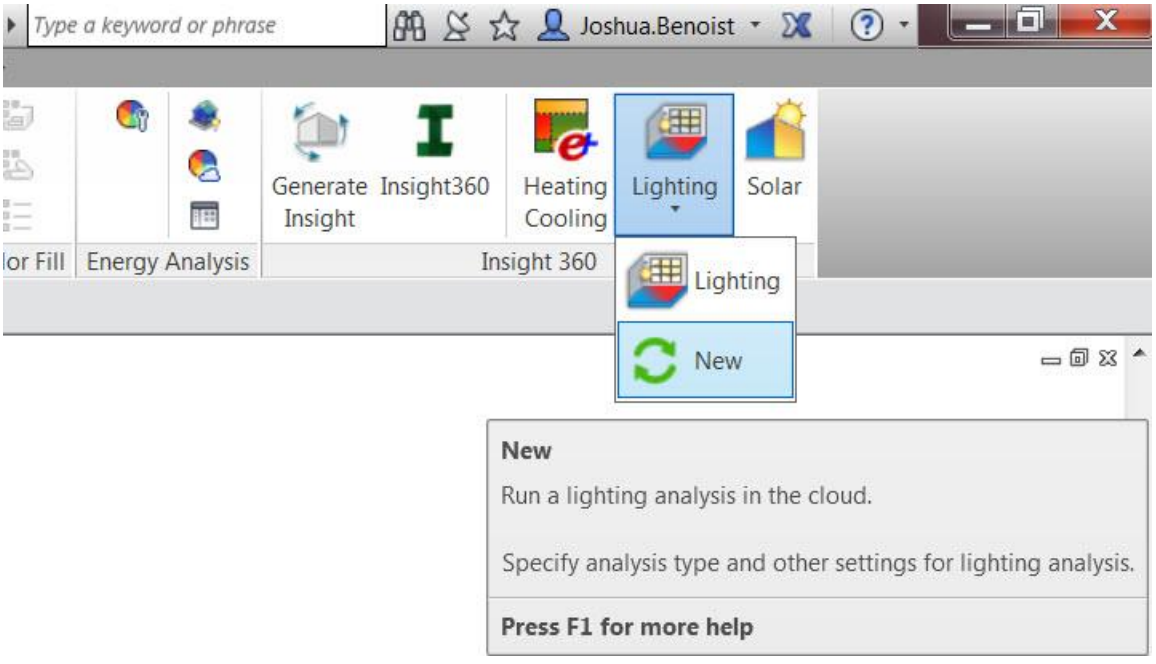
### Space Summary "Entry_Hall_201"

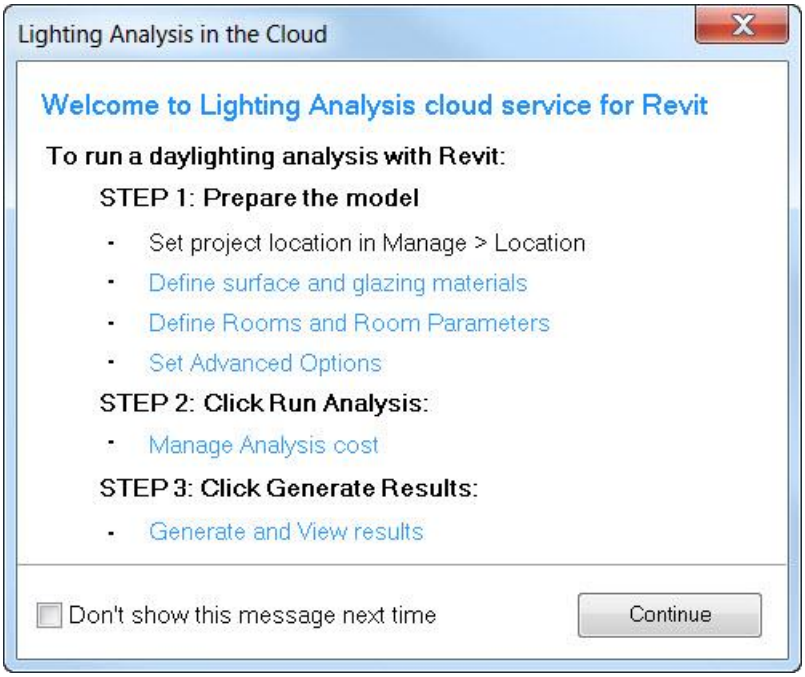
## Lighting Analysis

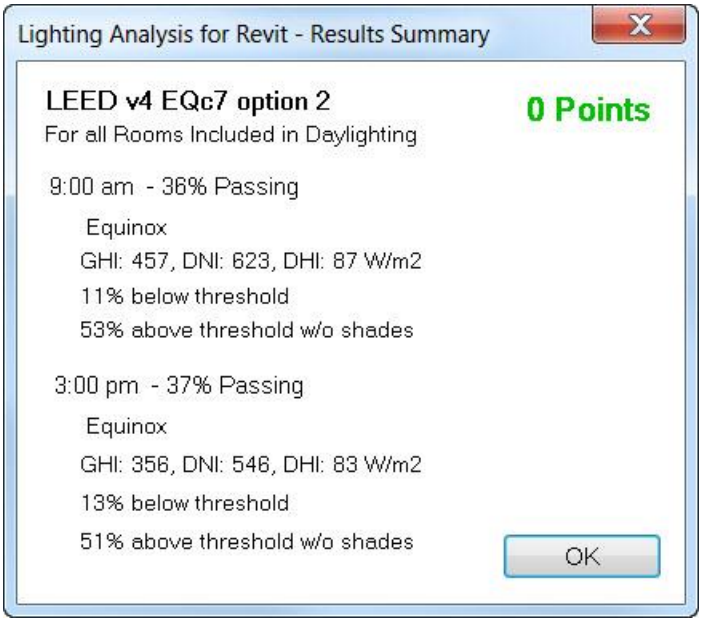
Insight 360 does more than the BPA Analysis, it has a Lighting, a Solar and an HVAC Analysis. We will get to the other analyses later.

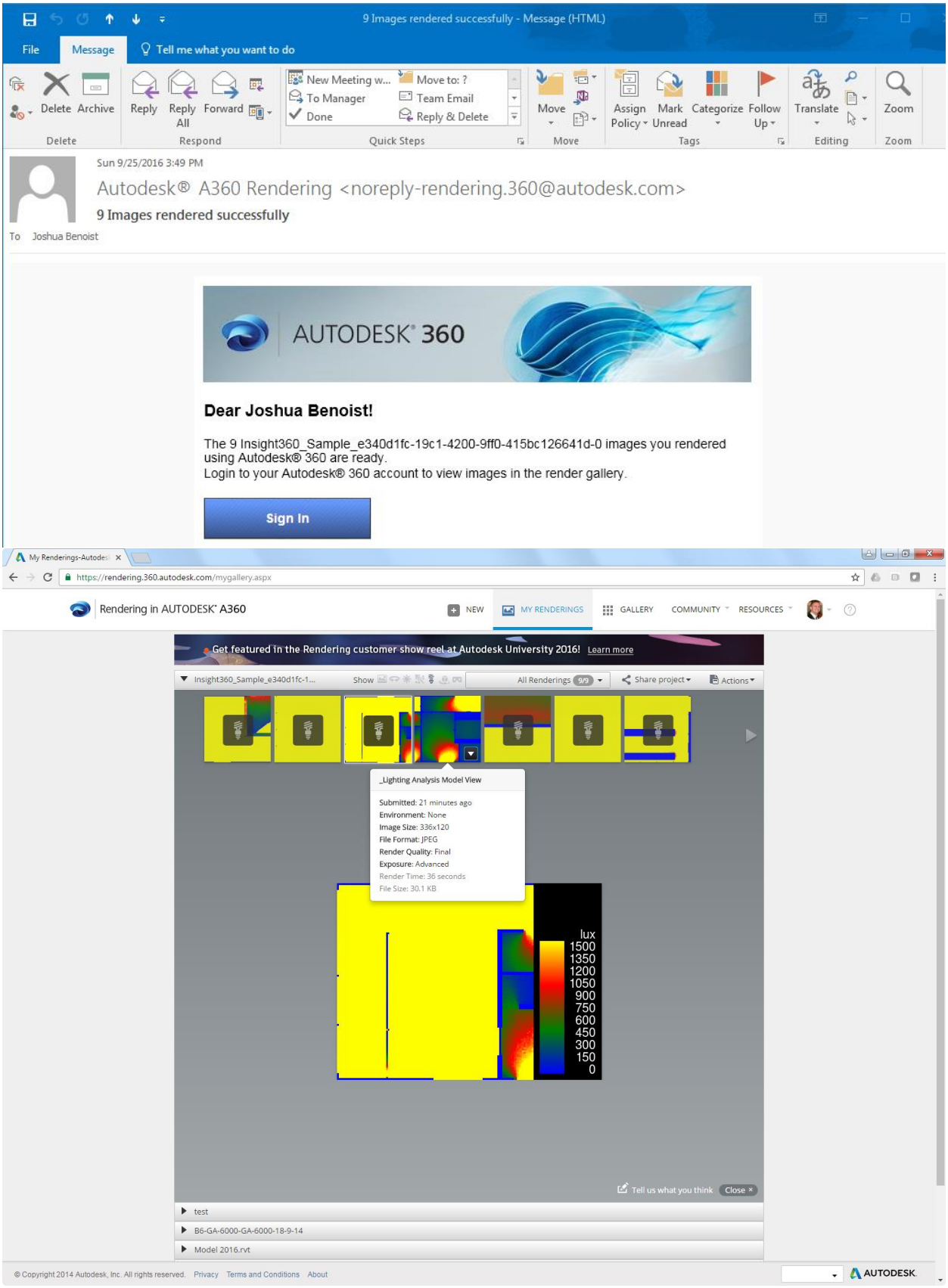
Check out this getting started guide and skip ahead to page 15 for how to use the lighting analysis tool.
http://forums.autodesk.com/autodesk/attachments/autodesk/19/366/1/Insight%20GSG_0306.pdf




Lighting Analysis in the Cloud
Welcome to Lighting Analysis cloud service for Revit
To run a daylighting analysis with Revit:
STEP 1: Prepare the model
Set project location in Manage > Location
Define surface and glazing materials
Define Rooms and Room Parameters
Set Advanced Options
STEP 2: Click Run Analysis:
Manage Analysis cost
STEP 3: Click Generate Results:
Generate and View results
Don't show this message next time
Continue


Lighting Analysis for Revit - Results Summary
LEED v4 EQc7 option 2
0 Points
For all Rooms Included in Daylighting
9:00 am - 36% Passing
Equinox
GHI: 457, DNI: 623, DHI: 87 W/m2
11% below threshold
53% above threshold w/o shades
3:00 pm - 37% Passing
Equinox
GHI: 356, DNI: 546, DHI: 83 W/m2
13% below threshold
51% above threshold w/o shades
OK


9 Images rendered successfully - Message (HTML)
File
Message
Tell me what you want to do
Delete
Archive
Reply
Reply All
Forward
New Meeting w...
To Manager
Done
Move to: ?
Team Email
Reply & Delete
Move
Assign Policy
Mark Unread
Categorize
Follow Up
Translate
Zoom
Delete
Respond
Quick Steps
Move
Tags
Editing
Zoom
Sun 9/25/2016 3:49 PM
Autodesk® A360 Rendering <noreply-rendering.360@autodesk.com>
9 Images rendered successfully
To Joshua Benoist
AUTODESK® 360
Dear Joshua Benoist!
The 9 Insight360_Sample_e340d1fc-19c1-4200-9ff0-415bc126641d-0 images you rendered using Autodesk® 360 are ready.
Login to your Autodesk® 360 account to view images in the render gallery.
Sign In
https://rendering.360.autodesk.com/mygallery.aspx
Rendering in AUTODESK® A360
NEW
MY RENDERINGS
GALLERY
COMMUNITY
RESOURCES
Get featured in the Rendering customer show reel at Autodesk University 2016! Learn more
Share project
Actions
_Lighting Analysis Model View
Submitted: 21 minutes ago
Environment: None
Image Size: 336x120
File Format: JPEG
Render Quality: Final
Exposure: Advanced
Render Time: 36 seconds
File Size: 30.1 KB
lux
1500
1350
1200
1050
900
750
600
450
300
150
0
Tell us what you think
Close
test
B6-GA-6000-GA-6000-18-9-14
Model 2016.rvt
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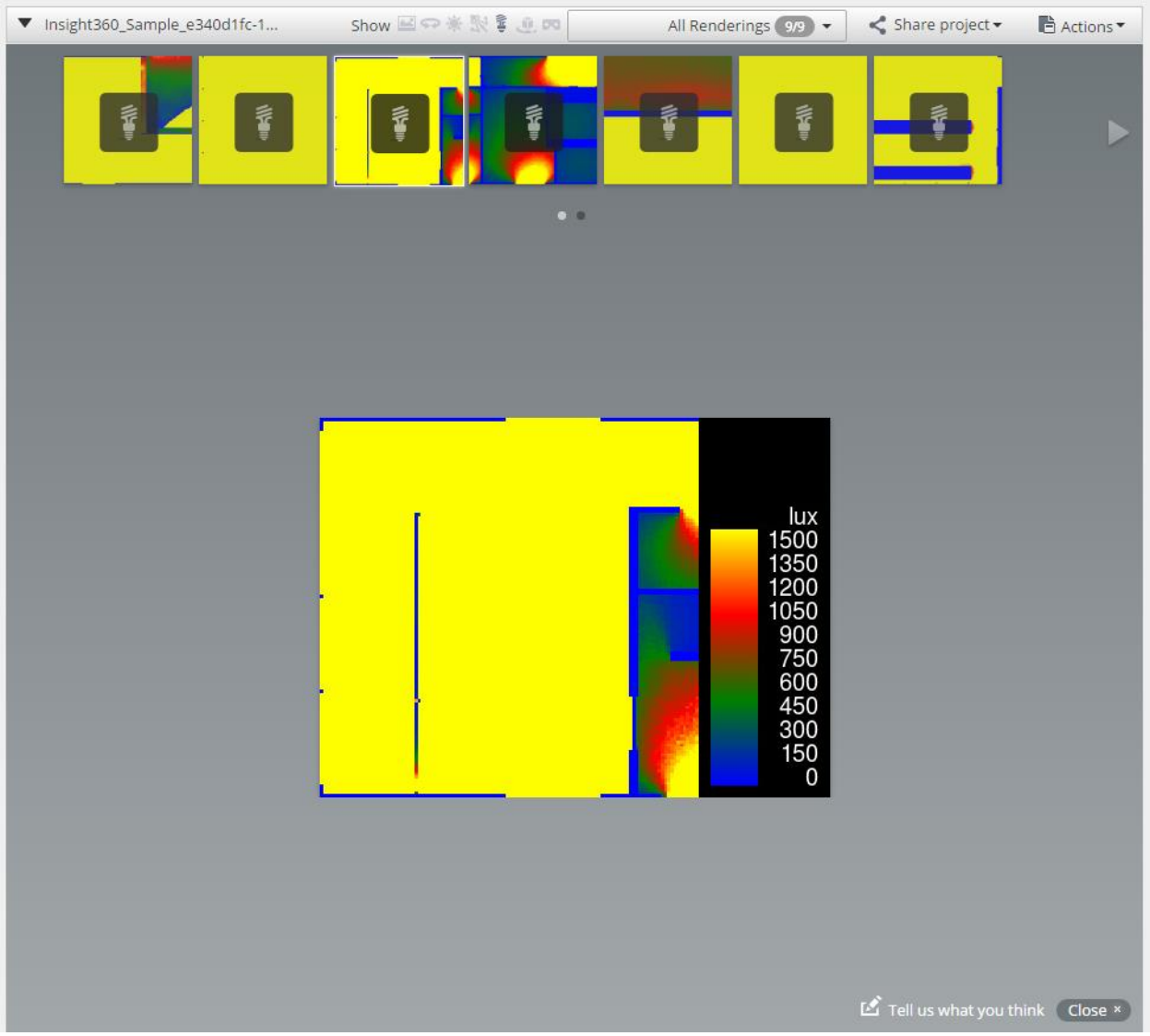
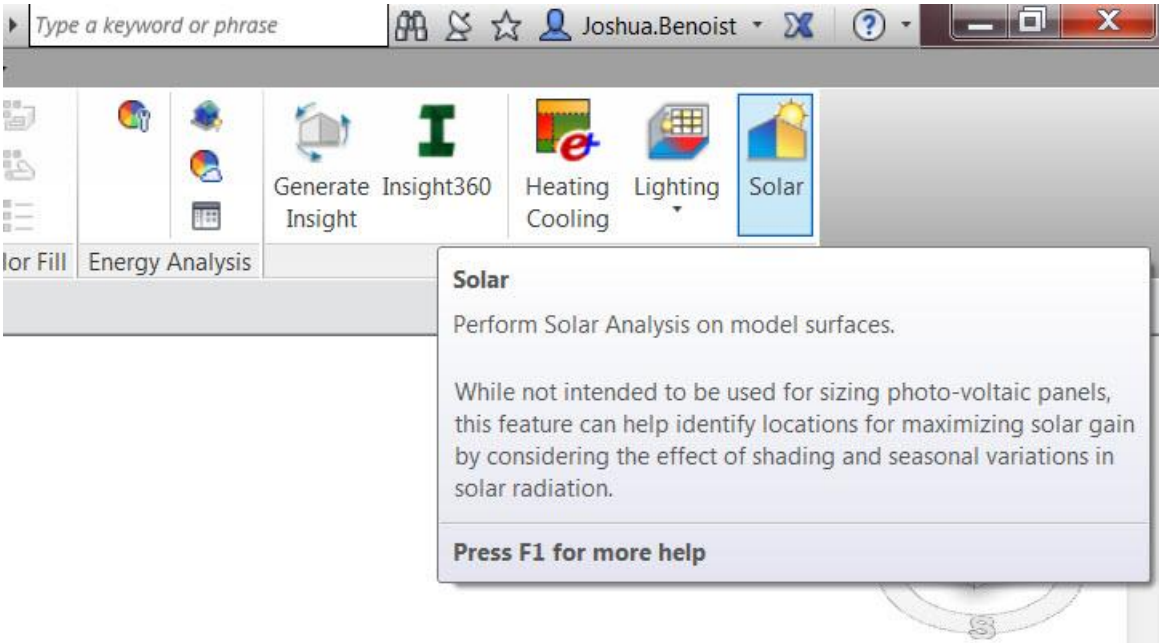
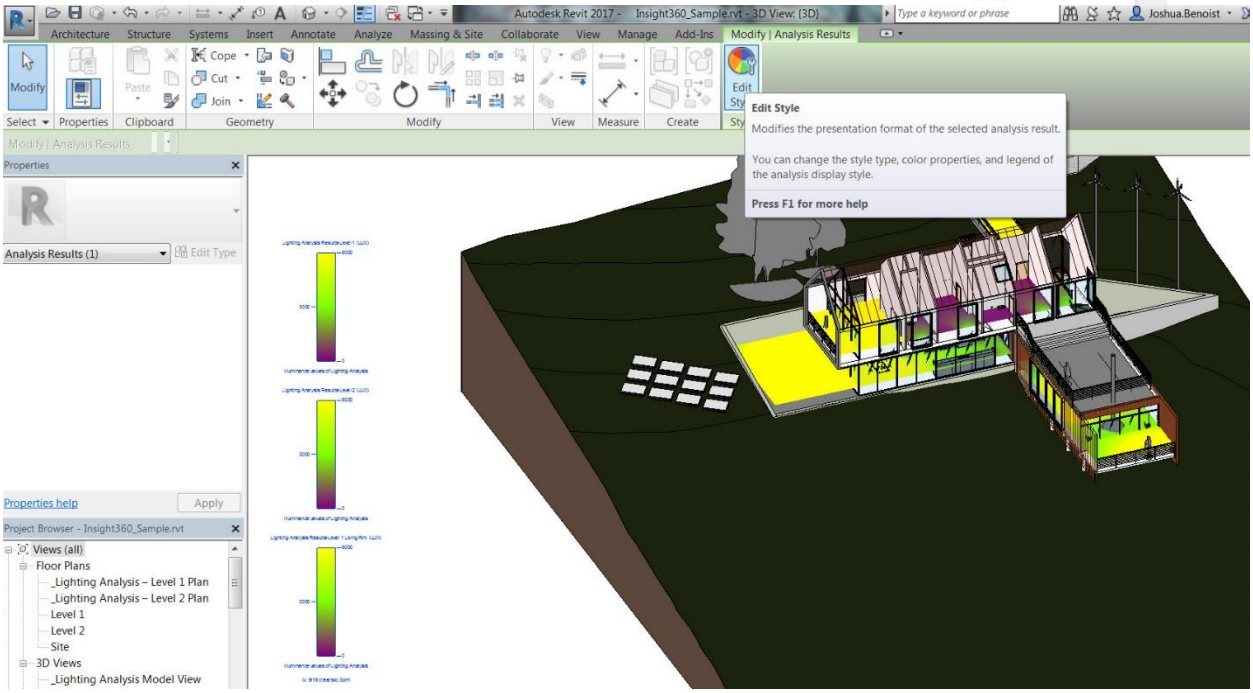
Privacy
Terms and Conditions
About
AUTODESK.

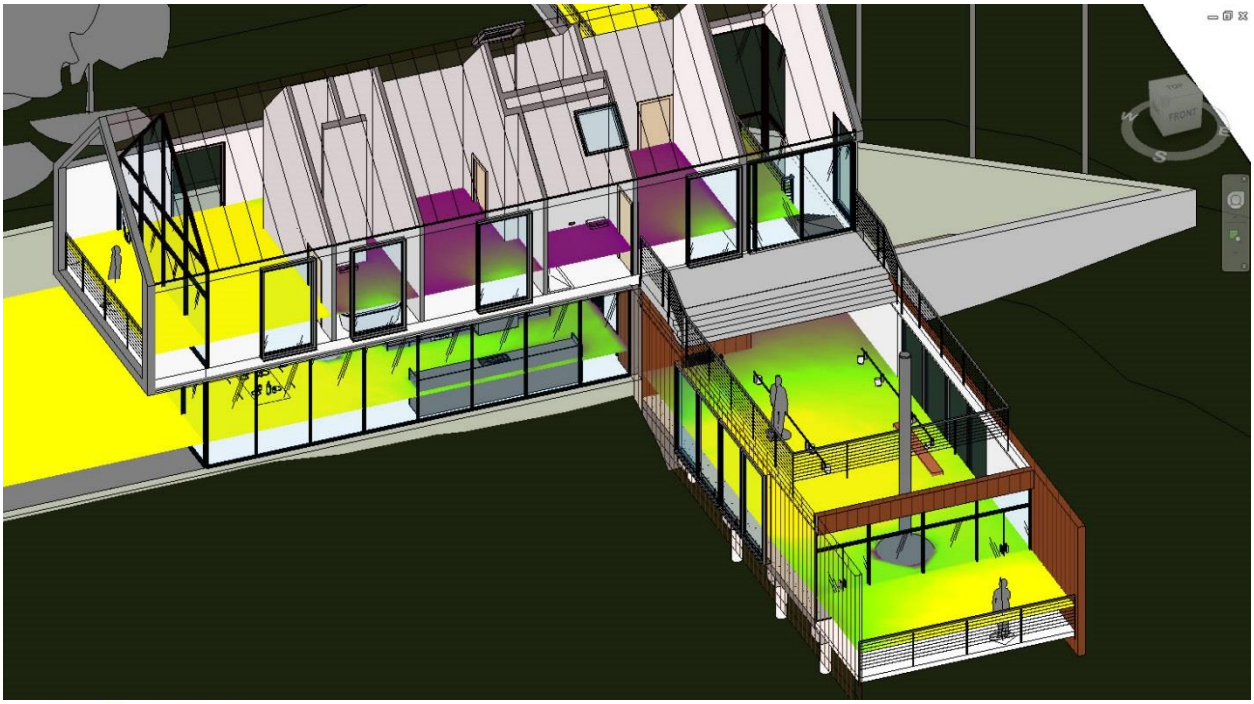

Insight360_Sample_e340d1fc-1...
Show
All Renderings 9/9
Share project
Actions
lux
1500
1350
1200
1050
900
750
600
450
300
150
0
Tell us what you think
Close

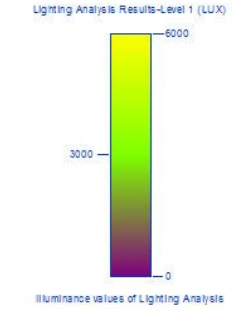
## Solar Analysis

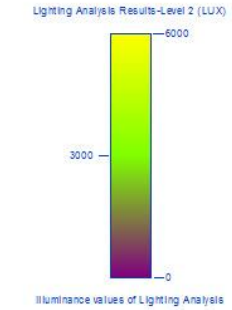
Insight 360 does more than the BPA Analysis, it has a Solar Analysis.

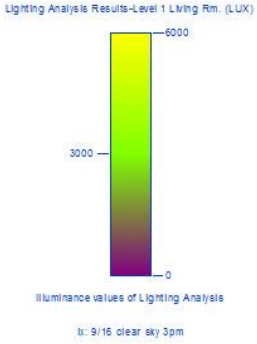


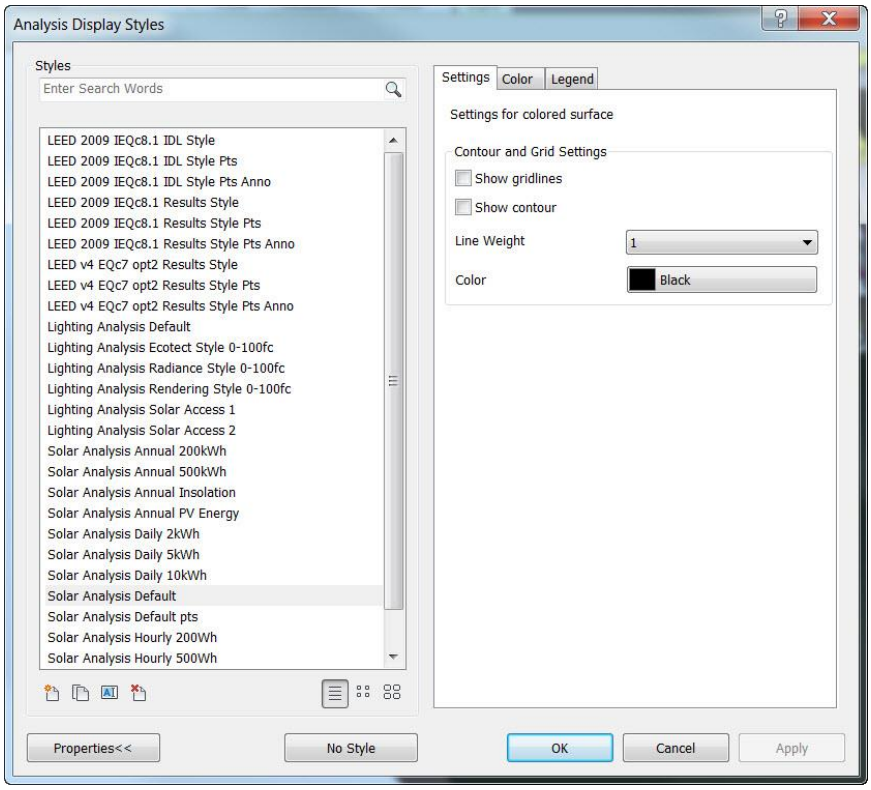






Lighting Analysis Results-Level 1 (LUX)
6000
3000
0
Illuminance values of Lighting Analysis


Lighting Analysis Results-Level 2 (LUX)
6000
3000
0
Illuminance values of Lighting Analysis


Lighting Analysis Results-Level 1 Living Rm. (LUX)
6000
3000
0
Illuminance values of Lighting Analysis
lx: 9/16 clear sky 3pm


Analysis Display Styles
Styles
Enter Search Words
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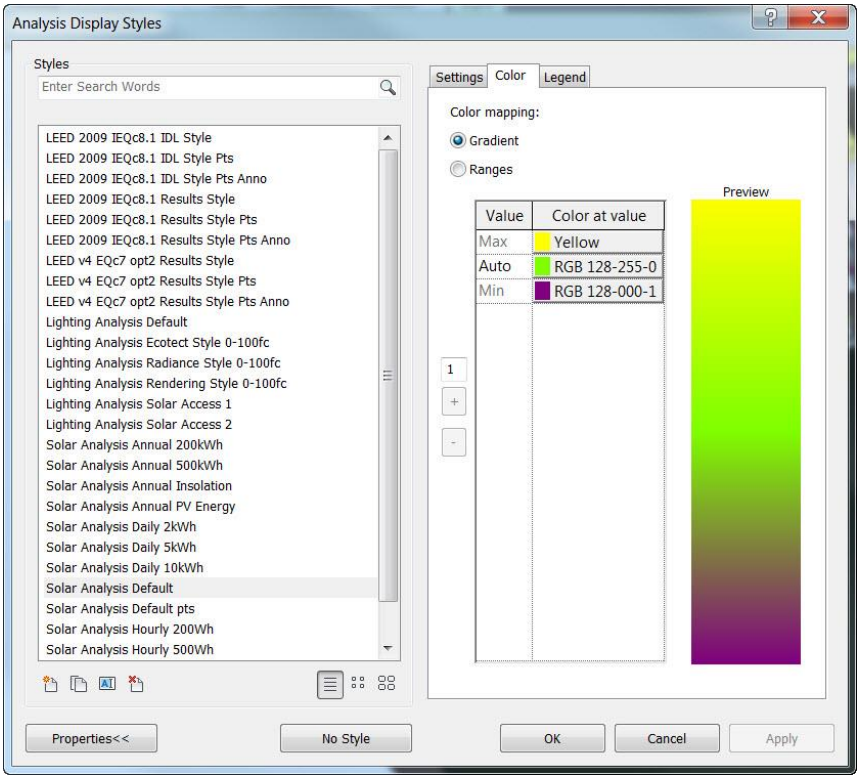
LEED 2009 IEQc8.1 IDL Style Pts
LEED 2009 IEQc8.1 IDL Style Pts Anno
LEED 2009 IEQc8.1 Results Style
LEED 2009 IEQc8.1 Results Style Pts
LEED 2009 IEQc8.1 Results Style Pts Anno
LEED v4 EQc7 opt2 Results Style
LEED v4 EQc7 opt2 Results Style Pts
LEED v4 EQc7 opt2 Results Style Pts Anno
Lighting Analysis Default
Lighting Analysis Ecotect Style 0-100fc
Lighting Analysis Radiance Style 0-100fc
Lighting Analysis Rendering Style 0-100fc
Lighting Analysis Solar Access 1
Lighting Analysis Solar Access 2
Solar Analysis Annual 200kWh
Solar Analysis Annual 500kWh
Solar Analysis Annual Insolation
Solar Analysis Annual PV Energy
Solar Analysis Daily 2kWh
Solar Analysis Daily 5kWh
Solar Analysis Daily 10kWh
Solar Analysis Default
Solar Analysis Default pts
Solar Analysis Hourly 200Wh
Solar Analysis Hourly 500Wh
Settings
Color
Legend
Settings for colored surface
Contour and Grid Settings
Show gridlines
Show contour
Line Weight
1
Color
Black
Properties<<
No Style
OK
Cancel
Apply


Analysis Display Styles
Styles
Enter Search Words
LEED 2009 IEQc8.1 IDL Style
LEED 2009 IEQc8.1 IDL Style Pts
LEED 2009 IEQc8.1 IDL Style Pts Anno
LEED 2009 IEQc8.1 Results Style
LEED 2009 IEQc8.1 Results Style Pts
LEED 2009 IEQc8.1 Results Style Pts Anno
LEED v4 EQc7 opt2 Results Style
LEED v4 EQc7 opt2 Results Style Pts
LEED v4 EQc7 opt2 Results Style Pts Anno
Lighting Analysis Default
Lighting Analysis Ecotect Style 0-100fc
Lighting Analysis Radiance Style 0-100fc
Lighting Analysis Rendering Style 0-100fc
Lighting Analysis Solar Access 1
Lighting Analysis Solar Access 2
Solar Analysis Annual 200kWh
Solar Analysis Annual 500kWh
Solar Analysis Annual Insolation
Solar Analysis Annual PV Energy
Solar Analysis Daily 2kWh
Solar Analysis Daily 5kWh
Solar Analysis Daily 10kWh
Solar Analysis Default
Solar Analysis Default pts
Solar Analysis Hourly 200Wh
Solar Analysis Hourly 500Wh
Settings
Color
Legend
Color mapping:
Gradient
Ranges
Preview
Value
Color at value
Max
Yellow
Auto
RGB 128-255-0
Min
RGB 128-000-1
1
Properties<<
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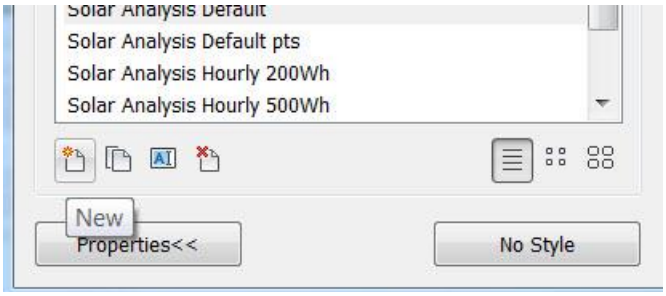
OK
Cancel
Apply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Solar Analysis Default pts
Solar Analysis Hourly 200Wh
Solar Analysis Hourly 500Wh
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Properties<<
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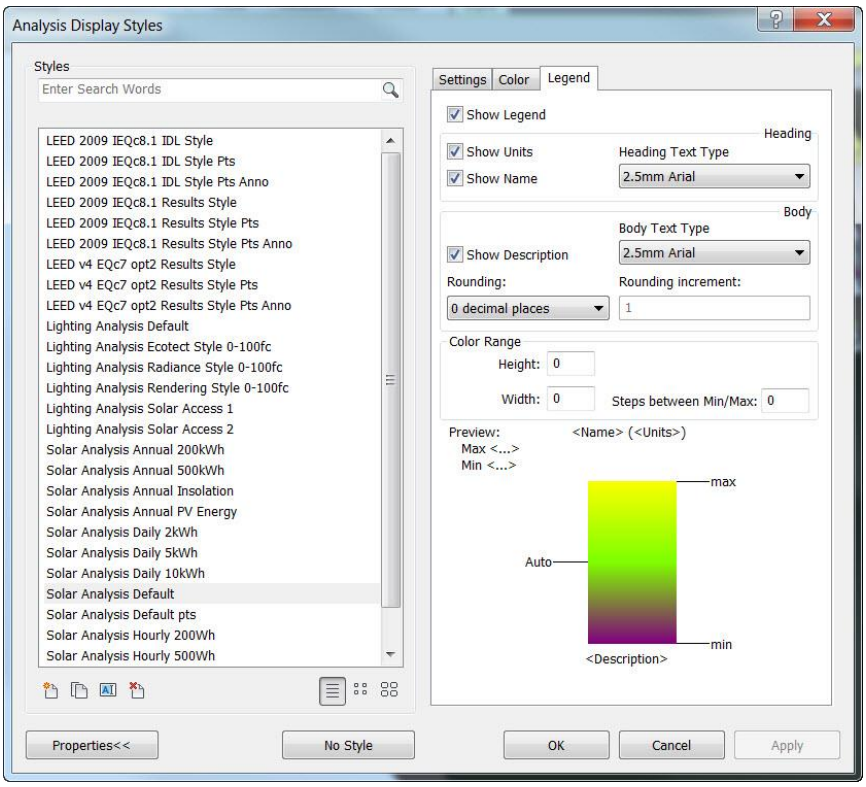
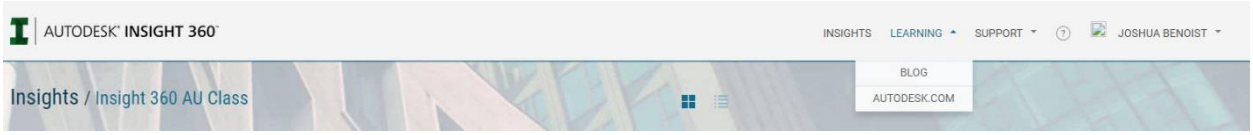

Analysis Display Styles
Styles
Enter Search Words
LEED 2009 IEQc8.1 IDL Style
LEED 2009 IEQc8.1 IDL Style Pts
LEED 2009 IEQc8.1 IDL Style Pts Anno
LEED 2009 IEQc8.1 Results Style
LEED 2009 IEQc8.1 Results Style Pts
LEED 2009 IEQc8.1 Results Style Pts Anno
LEED v4 EQc7 opt2 Results Style
LEED v4 EQc7 opt2 Results Style Pts
LEED v4 EQc7 opt2 Results Style Pts Anno
Lighting Analysis Default
Lighting Analysis Ecotect Style 0-100fc
Lighting Analysis Radiance Style 0-100fc
Lighting Analysis Rendering Style 0-100fc
Lighting Analysis Solar Access 1
Lighting Analysis Solar Access 2
Solar Analysis Annual 200kWh
Solar Analysis Annual 500kWh
Solar Analysis Annual Insolation
Solar Analysis Annual PV Energy
Solar Analysis Daily 2kWh
Solar Analysis Daily 5kWh
Solar Analysis Daily 10kWh
Solar Analysis Default
Solar Analysis Default pts
Solar Analysis Hourly 200Wh
Solar Analysis Hourly 500Wh
Settings
Color
Legend
Show Legend
Heading
Show Units
Heading Text Type
Show Name
2.5mm Arial
Body
Body Text Type
Show Description
2.5mm Arial
Rounding:
Rounding increment:
0 decimal places
1
Color Range
Height: 0
Width: 0
Steps between Min/Max: 0
Preview:
Max <...>
Min <...>
<Name> (<Units>)
max
Auto
min
<Description>
Properties<<
No Style
OK
Cancel
Apply

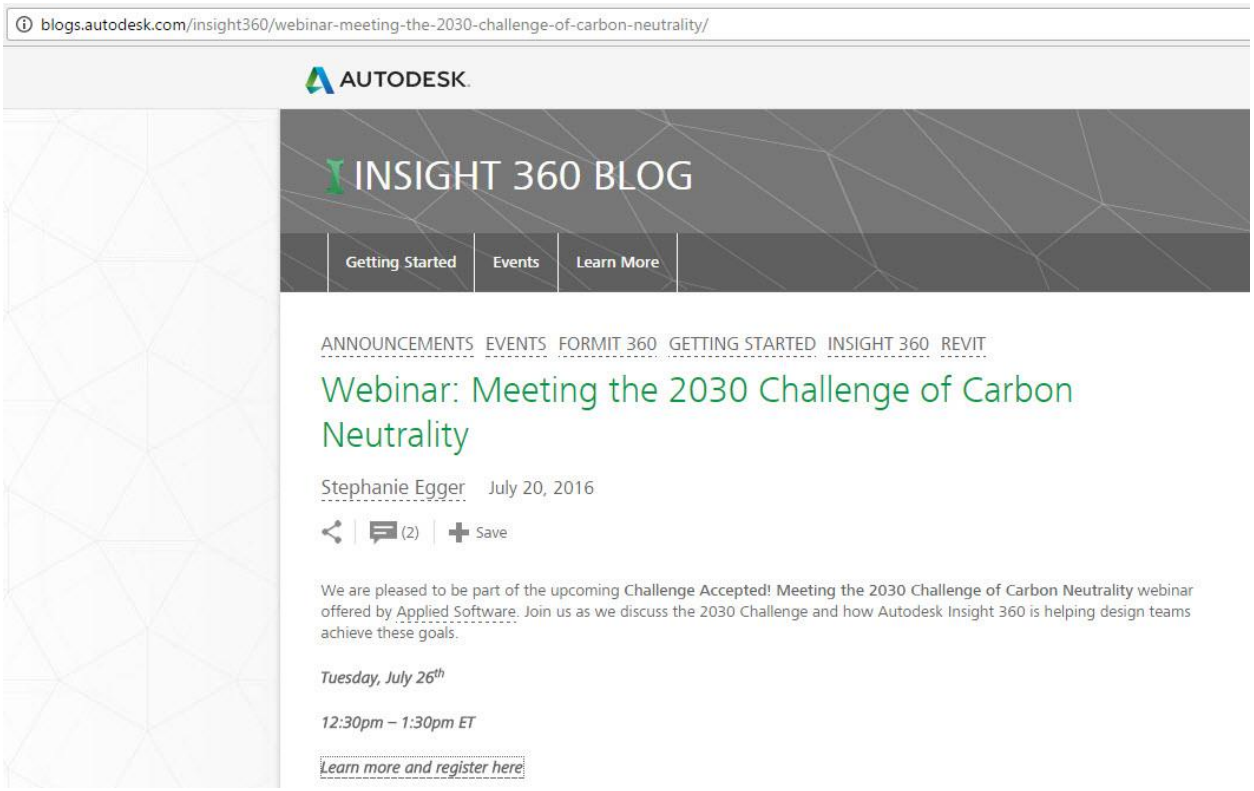
## Tips N Tricks:

This section will include random info that could be useful.

Here are some great places to find more information, log into Insight 360 and navigate to the “Learning” menu here:



The BLOG:


blogs.autodesk.com/insight360/webinar-meeting-the-2030-challenge-of-carbon-neutrality/
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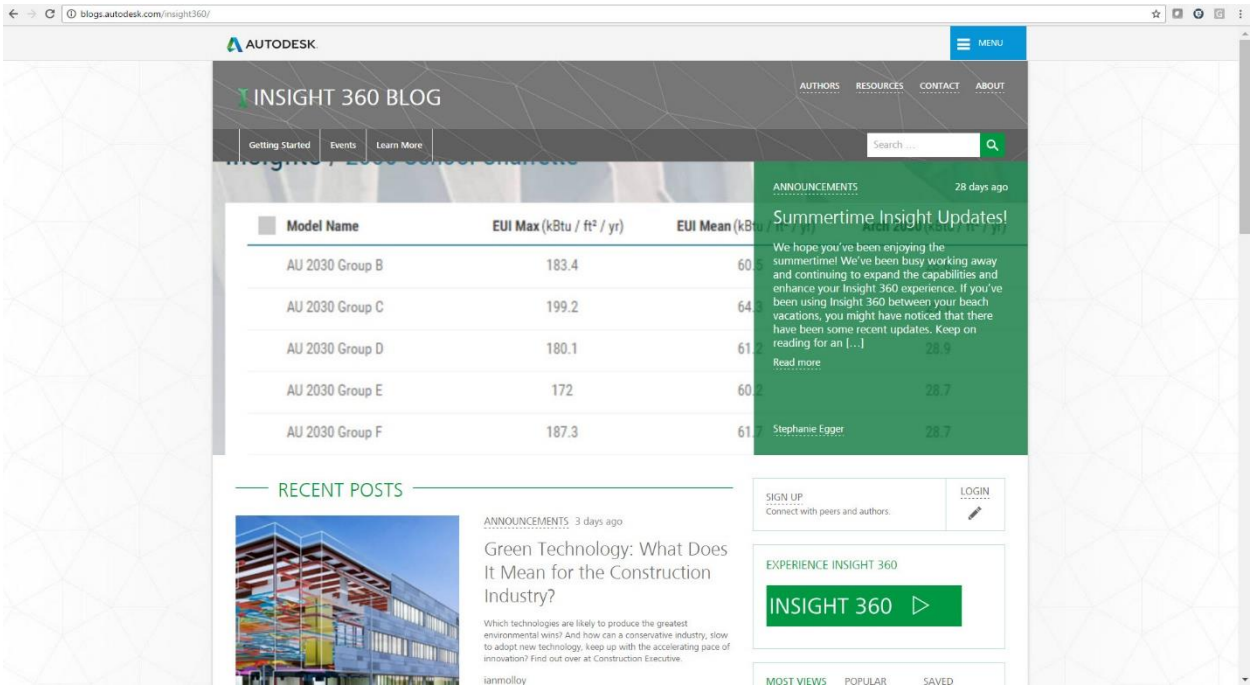
Webinar: Meeting the 2030 Challenge of Carbon Neutrality
Stephanie Egger July 20, 2016
(2)
Save
We are pleased to be part of the upcoming Challenge Accepted! Meeting the 2030 Challenge of Carbon Neutrality webinar offered by Applied Software. Join us as we discuss the 2030 Challenge and how Autodesk Insight 360 is helping design teams achieve these goals.
Tuesday, July 26th
12:30pm – 1:30pm ET
Learn more and register here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AU 2030 Group C 199.2
AU 2030 Group D 180.1
AU 2030 Group E 172
AU 2030 Group F 187.3
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Summertime Insight Updates!
We hope you've been enjoying the summertime! We've been busy working away and continuing to expand the capabilities and enhance your Insight 360 experience. If you've been using Insight 360 between your beach vacations, you might have noticed that there have been some recent updates. Keep on reading for an [...]
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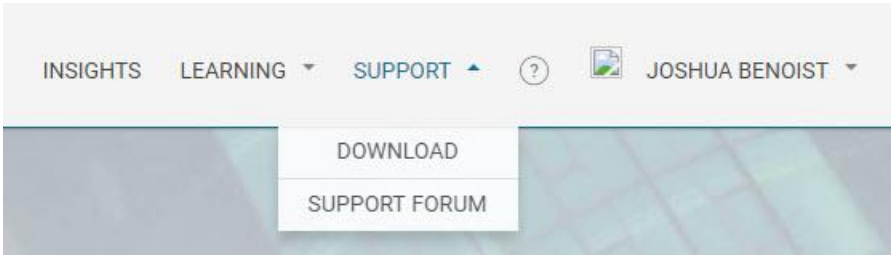
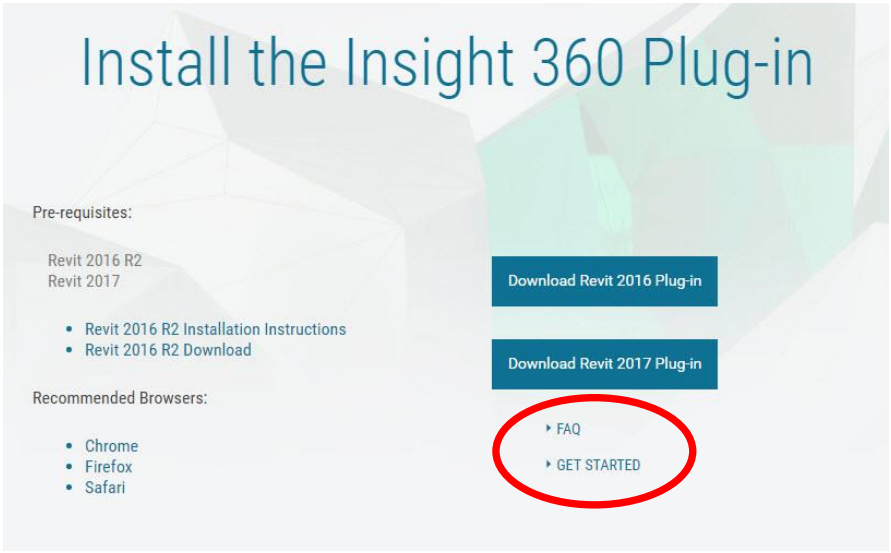
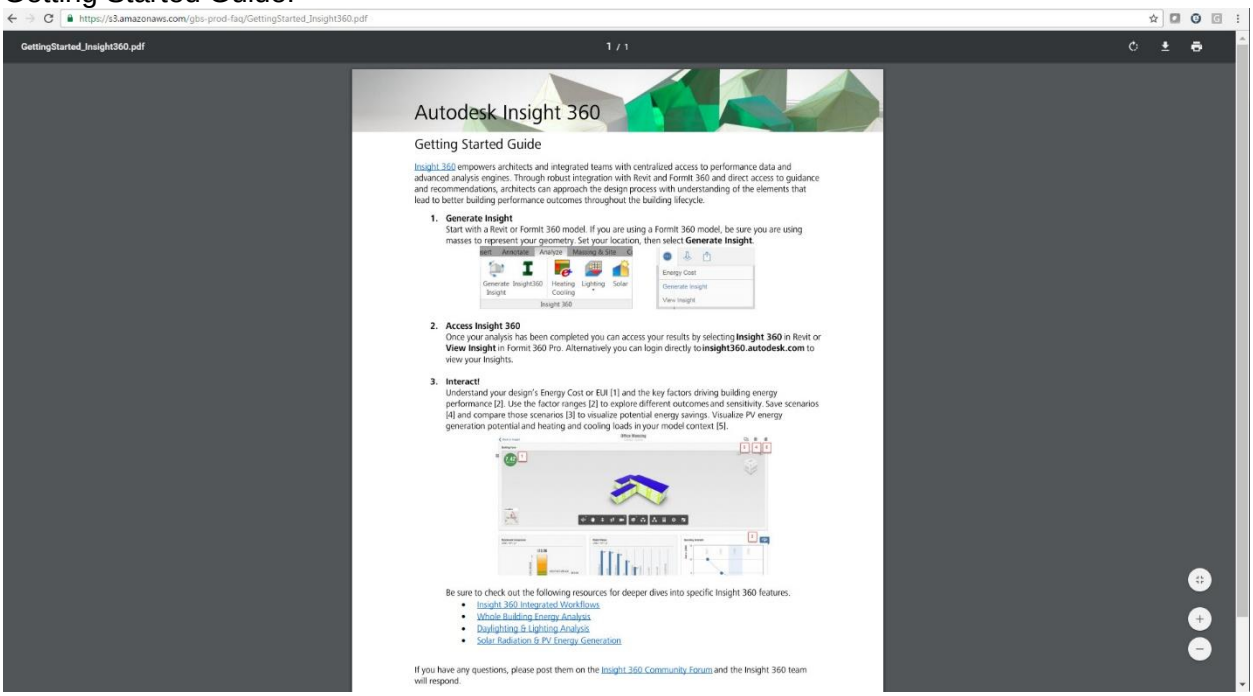
More Info SURPRISINGLY Here:




After selecting “DOWNLOAD”, find the FAQ and Getting Started Guide…Invaluable!



Getting Started Guide:



GettingStarted_Insight360.pdf

# Autodesk Insight 360

## Getting Started Guide

Insight 360 empowers architects and integrated teams with centralized access to performance data and advanced analysis engines. Through robust integration with Revit and Formit 360 and direct access to guidance and recommendations, architects can approach the design process with understanding of the elements that lead to better building performance outcomes throughout the building lifecycle.

1. **Generate Insight**
   Start with a Revit or Formit 360 model. If you are using a Formit 360 model, be sure you are using masses to represent your geometry. Set your location, then select **Generate Insight**.

2. **Access Insight 360**
   Once your analysis has been completed you can access your results by selecting **Insight 360** in Revit or **View Insight** in Formit 360 Pro. Alternatively you can login directly to **insight360.autodesk.com** to view your Insights.

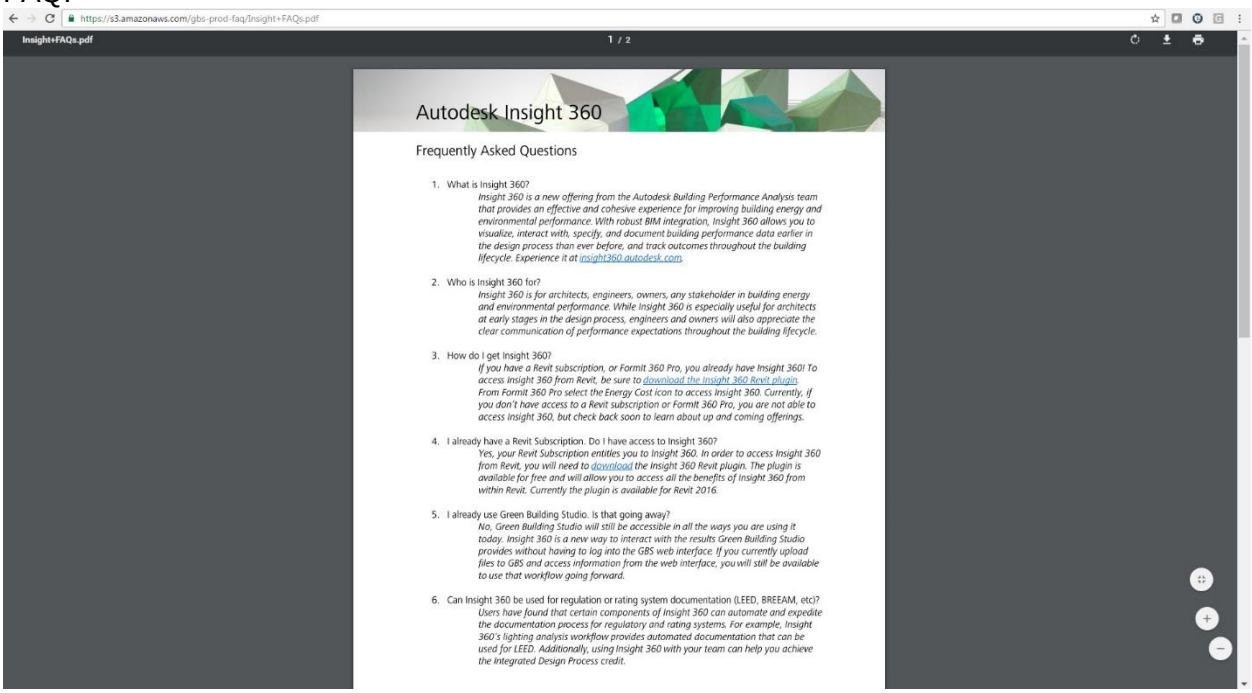
3. **Interact!**
   Understand your design's Energy Cost or EUI [1] and the key factors driving building energy performance [2]. Use the factor ranges [2] to explore different outcomes and sensitivity. Save scenarios [4] and compare those scenarios [3] to visualize potential energy savings. Visualize PV energy generation potential and heating and cooling loads in your model context [5].

Be sure to check out the following resources for deeper dives into specific Insight 360 features.

- Insight 360 Integrated Workflows
- Whole Building Energy Analysis
- Daylighting & Lighting Analysis
- Solar Radiation & PV Energy Generation

If you have any questions, please post them on the Insight 360 Community Forum and the Insight 360 team will respond.

FAQ:



Insight+FAQs.pdf

# Autodesk Insight 360

## Frequently Asked Questions

1. What is Insight 360?
   *Insight 360 is a new offering from the Autodesk Building Performance Analysis team that provides an effective and cohesive experience for improving building energy and environmental performance. With robust BIM integration, Insight 360 allows you to visualize, interact with, specify, and document building performance data earlier in the design process than ever before, and track outcomes throughout the building lifecycle. Experience it at insight360.autodesk.com.*

2. Who is Insight 360 for?
   *Insight 360 is for architects, engineers, owners, any stakeholder in building energy and environmental performance. While Insight 360 is especially useful for architects at early stages in the design process, engineers and owners will also appreciate the clear communication of performance expectations throughout the building lifecycle.*

3. How do I get Insight 360?
   *If you have a Revit subscription, or Formit 360 Pro, you already have Insight 360! To access Insight 360 from Revit, be sure to download the Insight 360 Revit plugin. From Formit 360 Pro select the Energy Cost icon to access Insight 360. Currently, if you don't have access to a Revit subscription or Formit 360 Pro, you are not able to access Insight 360, but check back soon to learn about up and coming offerings.*

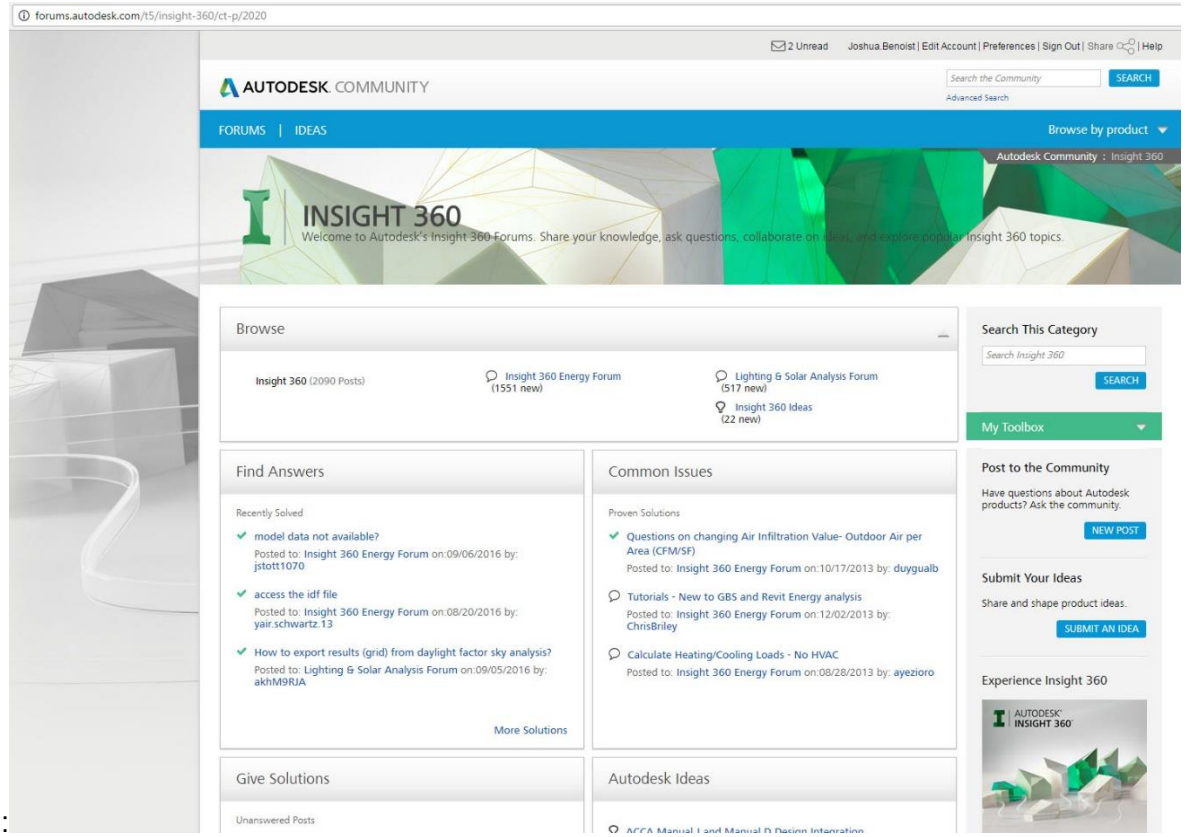
4. I already have a Revit Subscription. Do I have access to Insight 360?
   *Yes, your Revit Subscription entitles you to Insight 360. In order to access Insight 360 from Revit, you will need to download the Insight 360 Revit plugin. The plugin is available for free and will allow you to access all the benefits of Insight 360 from within Revit. Currently the plugin is available for Revit 2016.*

5. I already use Green Building Studio. Is that going away?
   *No, Green Building Studio will still be accessible in all the ways you are using it today. Insight 360 is a new way to interact with the results Green Building Studio provides without having to log into the GBS web interface. If you currently upload files to GBS and access information from the web interface, you will still be available to use that workflow going forward.*

6. Can Insight 360 be used for regulation or rating system documentation (LEED, BREEAM, etc)?
   *Users have found that certain components of Insight 360 can automate and expedite the documentation process for regulatory and rating systems. For example, Insight 360's lighting analysis workflow provides automated documentation that can be used for LEED. Additionally, using Insight 360 with your team can help you achieve the Integrated Design Process credit.*

Don’t forget the easy link to the Insight 360 Support Forum:

http://forums.autodesk.com/t5/insight-360/ct-p/2020

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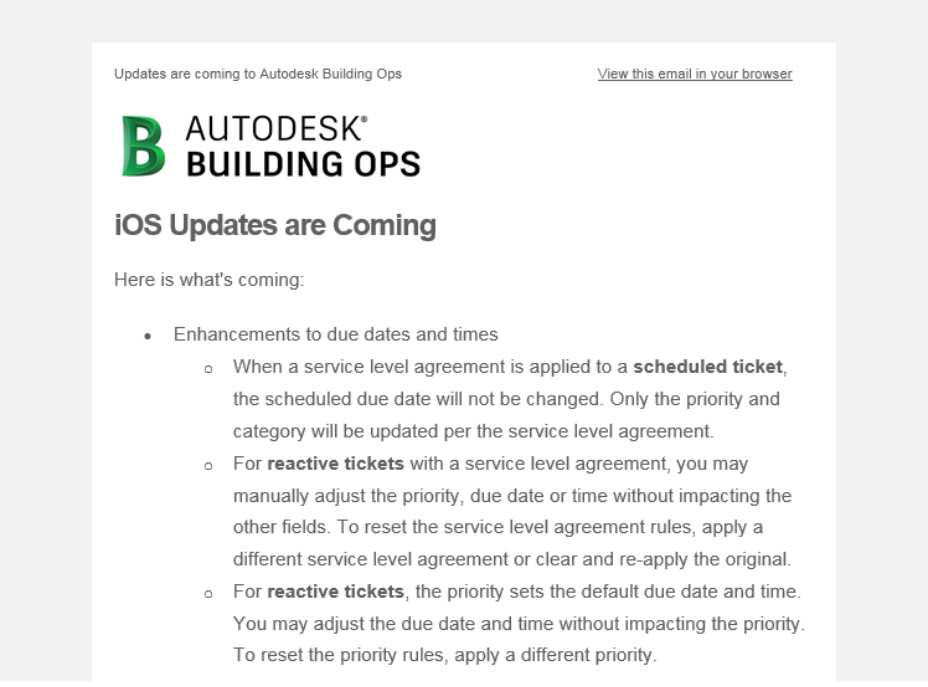
Insight 360 is a CLOUD based platform, and thus receives regular updates that are automatically there next time you log on. Here is a clip from a similar cloud service. After it has been updated, we receive this by email.



Updates are coming to Autodesk Building Ops  View this email in your browser

AUTODESK® BUILDING OPS

**iOS Updates are Coming**

Here is what's coming:

- Enhancements to due dates and times
  - When a service level agreement is applied to a **scheduled ticket**, the scheduled due date will not be changed. Only the priority and category will be updated per the service level agreement.
  - For **reactive tickets** with a service level agreement, you may manually adjust the priority, due date or time without impacting the other fields. To reset the service level agreement rules, apply a different service level agreement or clear and re-apply the original.
  - For **reactive tickets**, the priority sets the default due date and time. You may adjust the due date and time without impacting the priority. To reset the priority rules, apply a different priority.

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