Autodesk® Ecotect™ Analysis 2011

Getting Started with Web Service Tools for Whole Building Analysis

Customers who add subscription to any of the following Autodesk products can access[1] whole building energy, water and carbon analysis tools via the Autodesk® Green Building Studio® web-based service for the duration of their subscription.

- Autodesk® Revit® Architecture
- AutoCAD® Revit® Architecture Suite
- AutoCAD® Revit® Architecture Visualization Suite
- Autodesk® Revit® MEP – Standalone, Japan Only
- AutoCAD® Revit® MEP Suite
- Autodesk® Ecotect® Analysis
- AutoCAD® MEP
- AutoCAD® Architecture
- Autodesk® Design Academy
- Autodesk® Education Master Suite
- Autodesk® Education Suite for Architecture & Engineering
- Autodesk® Education Suite for Civil & Structural Engineering

This document describes how to access your web-service account and manage projects, and provides tips to help you get started.

[1] Access to the Autodesk Green Building Studio web-based service is subject to the terms of use that accompanies the service. For details, visit www.greenbuildingstudio.com/default.aspx.

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Introduction

Autodesk® Ecotect™ Analysis 2011 software is a comprehensive concept-to-detail sustainable design analysis tool, providing a wide range of simulation and analysis functionality through desktop and web-service[2] platforms. Powerful web-based whole-building energy, water, and carbon analysis capabilities converge with desktop tools for visualizing and simulating performance of the building model within the context of its environment.

Use the desktop tools and web-service functionality together to help create more sustainable designs. This document describes how to access your Green Building Studio web-service account and manage projects, and provides tips to help you get started.

Account Setup

Customers can contact their reseller to place any of the above products and/or suites on Subscription. Non-Subscription access can be purchased on the Autodesk Green Building Studio eStore at the end of a trial by clicking on the “Upgrade Your Account” link.

How do I access Autodesk Green Building Studio?

Autodesk Green Building Studio can be accessed at gbs.autodesk.com or through the Autodesk Green Building Studio desktop client, which can be downloaded from the Green Build Studio website.

Subscription users can sign in to Autodesk Green Building Studio with their Subscription Center User ID and Password. Subscription users must have an existing Subscription Center user account that includes one of the products listed above before they can access Autodesk Green Building Studio.

User accounts are created by Contract Managers or Software Coordinators by sending an invitation through the Subscription Center, or by the users themselves using “Create Your Own Account” on the Subscription Center Sign In page.

For more details on how to manage your Green Building Studio account, refer to “Questions and Answers for Autodesk Green Building Studio Subscription Entitlement”.

How the Web-based Service Works

Green Building Studio is an innovative building energy and carbon analysis web-based service, which provides a user-friendly front end to powerful building energy analysis software. All of the computationally intensive hourly simulations are carried out on remote servers, and the results are provided to you in a web browser.

The web-based service will collect data from three sources:

1. **Your Revit® software model.** All the building geometry comes from your model, including the number of rooms, the connections between rooms, and their

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relationship to the exterior, exposure, and aspect to the sun; and the shape and total area of built surfaces or openings.

2. **Your responses to a few basic questions.** In order to explain the building's use or context, you will need to select a building type from a drop-down menu and enter the project location. You will also have a chance to select a weather station for the project, although the closest one is selected to be the default.
3. **Regionalized databases.** Based on the above information, the Green Building Studio web service extracts additional information about local weather conditions, construction, and materials. The service automatically adds any information you have not provided, so it can adapt to your requirements as your design evolves.

Installing the Web-Service Client

To access and run the web-based whole building analysis tools you use the Green Building Studio Desktop client. It submits the green building extensible markup language (gbXML) files created by the Revit software to the web service.

1. Download the zip file containing the Green Building Studio Desktop client from the Downloads page on the Autodesk Green Building Studio website.
2. Unzip the file and double-click the *setup.exe* file.
3. Once installed, the Green Building Studio Desktop client is displayed in your Start Menu.

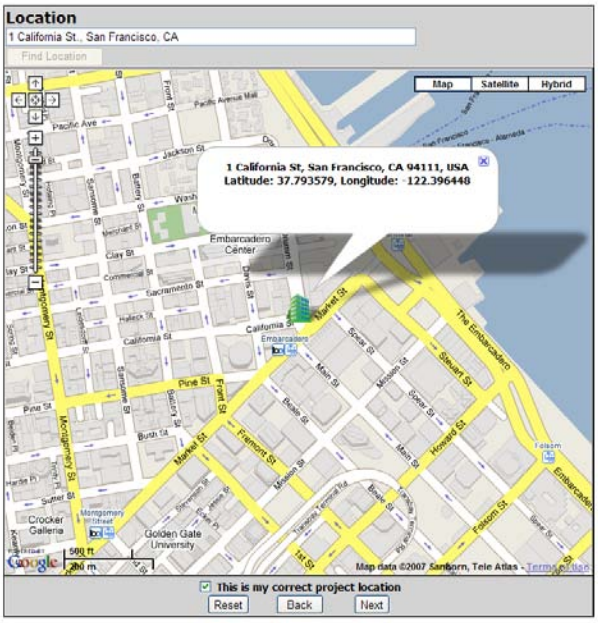
Now you are ready to create new projects on the web service, create designs using the Revit platform for building information modeling (BIM), and analyze the performance of conceptual building designs.

Creating New Projects

Once you sign in, you are on the My Projects page, and ready to add your first project. Just click the New Project link on the top left of the project list. You must enter the Project Name, select a Building Type from the list of approximately 30 typologies, and optionally select a unique building schedule.

Locate Your Project

The web service incorporates Google™ Maps to facilitate entry of a new project and selection of the appropriate weather file. Enter your project's location (city and state, territory, country or postal code) in the Location text box, and click the Find Location button. Move the green building icon to change the location. When you are satisfied with the selected location, check the checkbox below the map, and click the Next button.



The next New Project screen displays all the

Hints and Tips

The choice you make for Building Type and Schedule can have a significant impact on your results. For example, if you are modeling a mixed-use building and choose retail, the analysis will assume higher interior lighting loads than if you choose office. Furthermore, the default schedules vary by building type. A retail store by default is assumed to be open more hours per year than an office building and hence will use more energy.

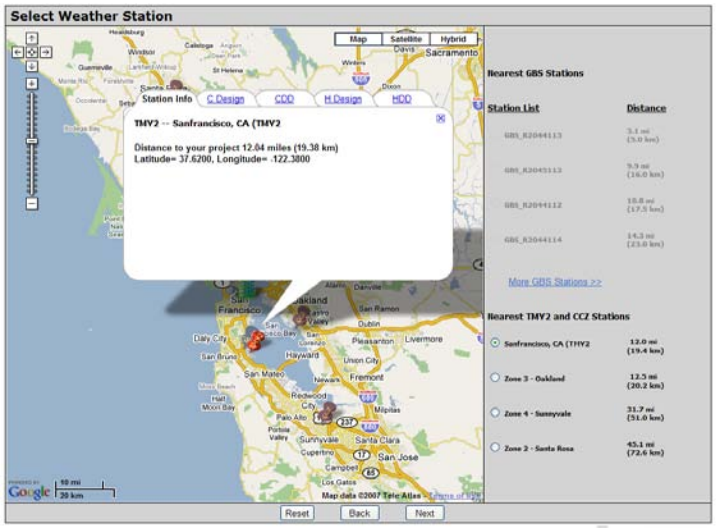
Hints and Tips

C Design and H Design are the outdoor cooling and heating design temperatures typically used to size heating and cooling equipment. HDD and CDD are the heating and cooling degree day totals for the weather location you have chosen. Compare the design and CDD/HDD data for the available weather files to help determine which weather file most closely approximates the weather for your site.

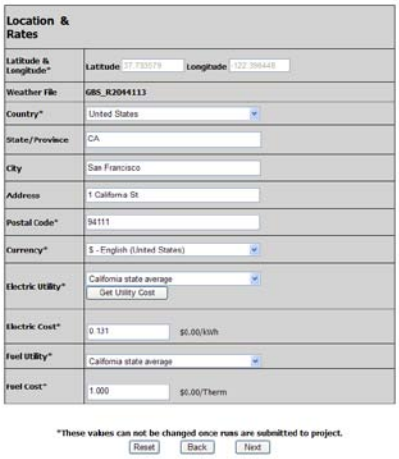
weather files that the web service has in the vicinity of your project. Through this screen you can explore each weather file's degree day and design day characteristics and select the appropriate one, though by default, the station closest to the building is selected.

Stations are based on recent "actual year" weather data rather than TMY2 and CZ2 stations, which are based on 30-year averages of weather data.

Simply select the radio button to the right of the map to select the desired weather file, and click the Next button.

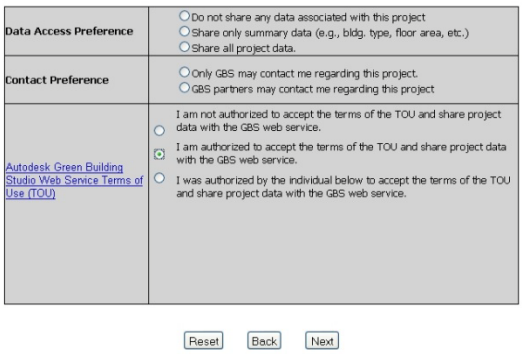


The next screen, Select Weather Station, is where you specify additional address information, as well as utility cost information. Make sure a location is entered, and click the Get Utility Cost button to retrieve the electric and fuel cost defaults. These are based on the previous year's state, territory, or country average prices for fuel and electricity that are published by the U.S. Department of Energy. Modify them if you have more relevant data. In cases where no default utility rates are available, you must enter a value before continuing. Check with your local utility provider for the current rates.



Share Project Data

The web-service enables you to share information about your project with design team members and Green Building Studio partners



who may provide more information on how their products can assist you with your building design. The web service needs to know who has authorized you to share project data if you are not the owner of the building information

Hints and Tips

Your local utility may have its current rates posted on its website. In some cases, natural gas is priced per unit volume. If gas is priced per cubic foot, multiply the price per cubic foot by 100 to get the approximate price per therm.

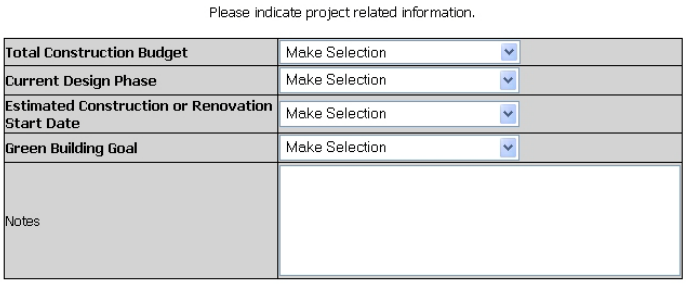
1 therm = 100,000 Btu.

The price of natural gas can vary widely by season. Use the price of gas that is typical during the heating season if most of your gas use is for space heating.

you are submitting. The authorizing agent you specify will also receive a copy of the Autodesk Green Building Studio Terms of Use (TOU).

Project Information
Finally, for new projects you need to specify the budget, current design phase, the estimated construction start date, and if the project has a green building goal.

After you create a new project, you will receive an email containing the Green Building Studio TOU for your records.



Managing Projects

For every project in your list, choices are available to access additional information.

Set Up Project Defaults lets you customize project defaults such as internal gains, construction materials, glazing type, cooling and heating set points, and more. This can be useful when using the Green Building Studio web service to analyze an existing building that has less efficient systems or less insulation, or if the default values do not represent your project.

Edit Project Details allows you to view and edit project information.

Manage Project Members facilitates managing project team members. You can invite other validated subscribers on your design team to participate in the analysis, and you can individually assign them rights to the project (Read-Only, Download and Read-Only, Add Runs or Manager).

Creating a New Dashboard

Green Building Studio uses the concept of a dashboard to allow you to view analysis results from multiple projects at the same time. Dashboards let you access, evaluate and compare energy, carbon, and water analysis results of many different projects side-by-side . You can organize your projects in different dashboards by location, building type, climate, or other important characteristics.

Create a new dashboard by selecting projects from the Projects list and adding them to the dashboard.

1. Click the My Projects tab.
2. Select one or more projects to add to the dashboard.
3. Click Add to Dashboard.
4. Click New Dashboard and enter a name for the new dashboard.
5. Click Continue.

Adding Projects to a Dashboard

You can add projects to a new dashboard or to an existing dashboard. Adding a project adds all runs in that project to the dashboard.

1. Click the Dashboards tab.
2. Select the projects to add to the dashboard.
3. Click Add to Dashboard.

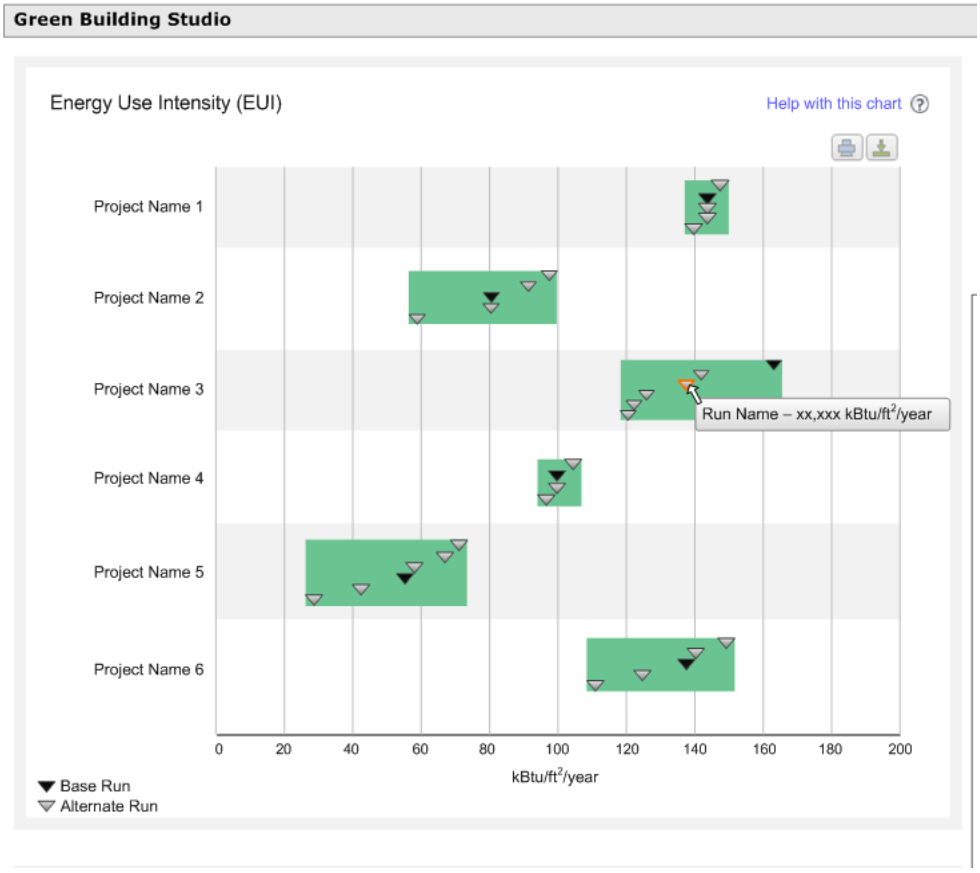
Managing Dashboards

You can remove projects from dashboards, selectively add new project runs to a dashboard, delete dashboards, and edit display options. Refer to the online Green Building Studio Help for more details.

Understanding Dashboard Results

The dashboard results can be displayed graphically. Four different charts are available: Energy Use Intensity (EUI); Annual Energy Consumption; Annual Energy Cost; and Average Energy vs Degree Days.

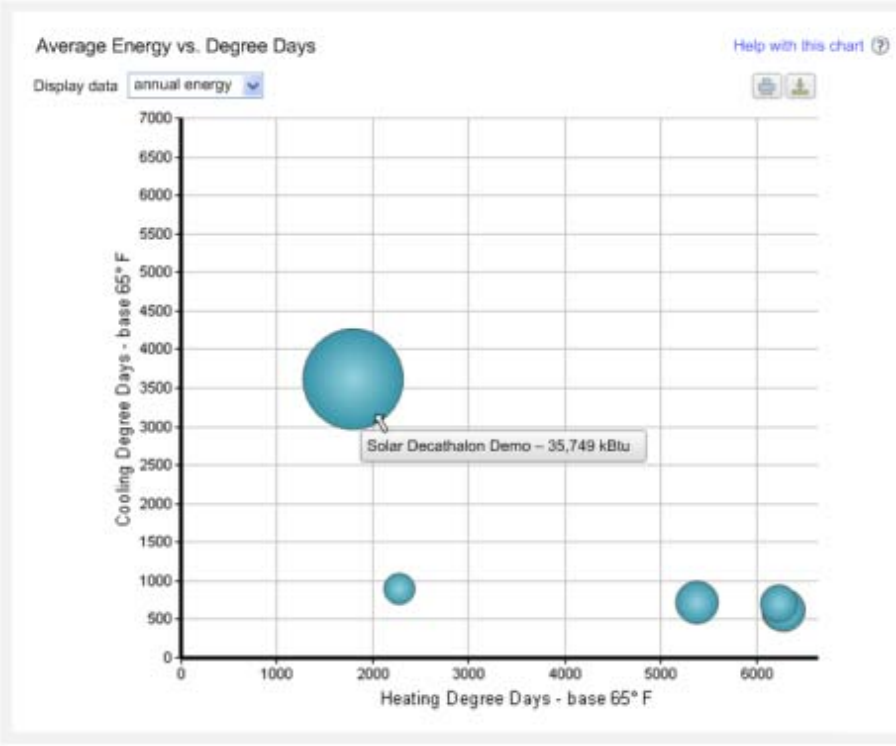
The first three charts display each project in your dashboard along the Y axis, and the results for each run within that project along the X axis. The baseline run is shown as a black triangle and the alternative runs are grey triangles.



When alternate run results (triangles) are located fairly close to the baseline result, there is not much difference between run data. This type of result indicates that the alternates explored may not offer much opportunity for making significant reductions in energy use. In this case, additional runs may need to be explored to find additional energy-saving scenarios. When alternate run results (triangles) are farther apart from the baseline, there is probably a greater opportunity for making significant reductions in energy use. These are the projects that warrant further investigation and analysis because they can most likely produce the greatest reductions in energy use.

The Average Energy vs Degree Days chart shows how much energy relative to the annual cooling and heating degree days is required annually on projects. It illustrates the possible relationship between how much energy a project uses annually, and the weather. Circles on the chart indicate the average energy cost for each run in a project relative to the other projects on the chart. The left side of the chart lists Cooling Degree Days, and the bottom shows Heating Degree Days. Mousing over a circle displays the project name and the annual energy usage.

The diameter or size of a project's circle varies depending to its average energy cost; the higher the cost, the larger the circle. A project with circles located on the lower right side of the chart indicates a building model that is in a heating dominated climate; in other words, it could have a need for a lot of heating, but not much need for cooling. Generally, one would expect buildings located in regions with very high heating and/or cooling



degree days use more energy to heat and cool the building, as compared to buildings located in milder climates. The opposite is a project showing results (circles) on the upper left side of the chart, this indicates a building model that is probably located in a cooling dominated climate; in other words, it has a need for a lot of cooling, but not much need for heating.

Hints and Tips

A location's Heating Degree Days (HDD) is a metric related to heating energy. It is calculated using the daily mean temperature. The daily mean temperature is the sum of the maximum and minimum temperatures divided by two. For a 65 degree Farenheit (65 °F) threshold, each degree of the mean temperature that is below 65 °F is counted as one Heating Degree Day.

For example, if the maximum temperature is 70 °F and the minimum temperature is 52 ° F, the Heating Degree Days total is four days:

70 + 52 = 122; 122 ÷ 2 = 61; 65 - 61 = 4

If the daily mean temperature is 65 °F or higher, the Heating Degree Days total is zero.

A similar metric, Cooling Degree Day, is used regarding cooling energy requirements. For example, using a 70 °F Cooling Degree Day threshold, each degree of mean temperature above 70 °F is counted as one Cooling Degree Day.

For example, if the maximum temperature is 90 °F and the minimum temperature is 68 °F, the Cooling Degree Days total is nine days:

90 + 68 = 158; 158 ÷ 2 = 79; 79 - 70 = 9

If the daily mean temperature is 70 °F or lower, the cooling degree day total is zero.

Exporting to the Web Service from Autodesk Revit-based Software for BIM

1. Export the gbXML by going to the Revit start icon, choose Export>gbXML
2. From your computer's start menu, launch the Green Building Studio Desktop client.
3. Enter your Autodesk ID and Password and click the Sign In button. You must be connected to the internet for this to work.
4. If you have projects in your Green Building Studio account, they are listed in the Project list. Simply select the project to which this model is assigned.
5. Select the gbXML file you exported from Revit.
6. Click Create New Run to initiate the simulations and get results.

The web-based service first checks your Revit model for missing data or errors, and if problems are found, an error message appears. Assuming there are no errors, a browser window opens presenting you with the status of your whole building energy, water, and carbon analysis.

The length of time it takes to run the simulations using the web service typically varies from less than a minute to 5 or 10 minutes. The run time depends on the server traffic, complexity of the model, and the number of surfaces, windows, rooms, spaces, and zones. Most runs are complete within minutes. Very large models (with gbXML files more than 8 to 12 MB) may take up to an hour to run. This is a good reason to start analysis in the early stages of design with a simple model. Once your run is complete you will see a results page.

Understand the Analysis Results

The results pages provide accurate yet easy-to-understand summary information on building energy and resource use, carbon emissions, simulation assumptions, performance metrics, and costs. These results can be used to compare the energy costs of multiple building design scenarios at the conceptual design stage. The following serves as a guide to help you interpret the results effectively.

Energy and Carbon Results

The general information section at the top of the page describes the project scenario, building type, geographic location, and gross floor area.

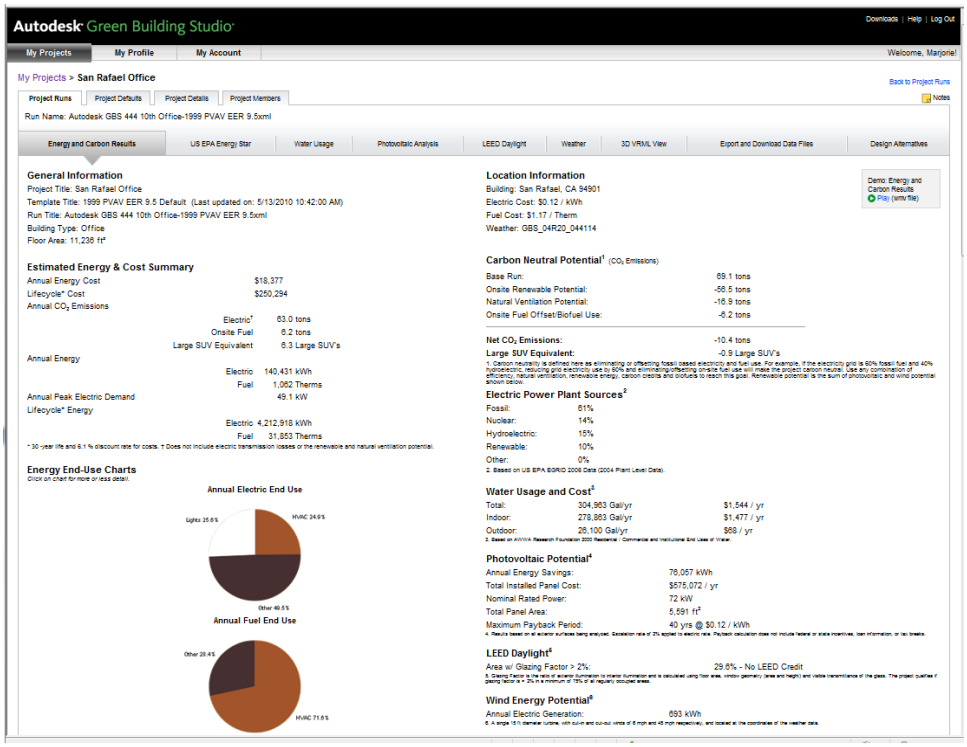
Estimated Energy and Cost Summary

Most building energy cost comparisons and early compliance decisions can be made using annualized energy cost and consumption information. Costs are estimated using statewide, territory, or country average utility rates, or the customized rates you may have applied to the project.

The following estimated information is provided:

- Annual energy cost.
- Lifecycle energy costs (30 year).
- Annual energy consumption (electric and gas).
- Peak electric demand (kW).
- Lifecycle energy consumption (electric and gas).

- CO2 emissions are based on the on-site fuel use and the fuel sources for the electricity in the region.
- An equivalency using an SUV (driven 15,000 miles/year) is given to put the building's CO2 emissions into perspective.



Energy End-Use Charts

Further breakdowns of estimated energy use for major electric and gas end uses, such as lighting, HVAC, and space-heating are provided in graphical format. Additional details associated with each category can be seen by clicking on the pie charts.

Getting to Carbon Neutral

In addition to energy use and cost, the web service provides additional information required to help design a carbon neutral building. *This additional information includes the following:*

Carbon Neutral Potential

This section will summarize the estimated CO_2 emissions for your building design and identify the options to help reduce them. If your net CO_2 emissions are less than zero, there is a high potential for this building to be carbon neutral.

Electric Power Plant Sources

The U.S. Environmental Protection Agency has historical records for all the fuel and emissions of all power plants in the United States and the Carbon Monitoring for Action (CARMA) database has the carbon emissions data of more than 50,000 power plants world-wide. This section summarizes the fuel sources for electricity generated in this region. In order for a project to be carbon neutral, electricity consumption must be reduced or offset using renewables by an amount equal to the portion of the electricity that comes from fossil fuels.

Water Usage and Cost
A summary is given of the estimated water use in the building based on the number of people in the building as well as the building type. Note that the water consumption is not related to the number of fixtures.

Photovoltaic Potential
The web service automatically analyzes every exterior surface of the building, including roofs, walls, and windows, for their estimated potential to generate electricity using photovoltaics. Exterior shades are not currently included in the photovoltaic analysis. The results of this analysis are summarized in this section. Note that this analysis assumes that PVs can be installed on vertical as well as horizontal surfaces as long as the surface generates significant amounts of PV power. See the PV tab for details on the surfaces that are analyzed.

LEED Glazing Score
The LEED glazing score is the percentage of regularly occupied floor area that has a Glazing Factor greater than 0.02. Note that the tool assumes the entire floor area of your project to be regularly occupied unless you have defined some spaces through Revit MEP as restrooms, corridors, storage, mechanical rooms, or other spaces not considered to be regularly occupied by LEED. The score must be more than 75 percent to score LEED points and achieve full benefit from daylighting controls throughout the building.

Wind Energy Potential
The estimated annual amount of electricity that can be generated from one 15-foot-diameter wind turbine of conventional design.

Natural Ventilation Potential
The tool approximates the annual operating hours and energy required to mechanically cool and ventilate the building. It also estimates the annual number of hours that outdoor air could be used to naturally ventilate the building. Potential energy savings associated with not running the mechanical cooling and ventilation system during this period are projected, and finally, the net hours that cooling is required, even with natural ventilation, are estimated.

Building Summary
Detailed statistics, assumptions, and information on building constructions are also provided. This information allows the building designer to get an early assessment of code compliance and rough estimates of equipment sizing requirements for heating, cooling, and water heating, as well as window, wall, and floor area breakdowns.

Export and Download Data Files

The Green Building Studio web service provides the user with file download capabilities that can be used to share information with other members of the design team who are performing detailed engineering analyses, such as equipment sizing or design. The user simply clicks on the links to access these items to download or navigate. Each file or link is described below.

gbXML File
This link is to the fully populated gbXML file that contains the building information necessary for an advanced energy simulation as well as the results from the Autodesk Green Building Studio simulation. The gbXML file also includes information on the BIM

model and the local assumptions and building code information brought in through Green Building Studio. This file can be used with design tools such as Trane's Trace™ 700 application.

VRML File
Click this link to open the 3D VRML view in a new window or right-click it and choose Save Target As… to download the file. See the "3D VRML View" section below for more information.

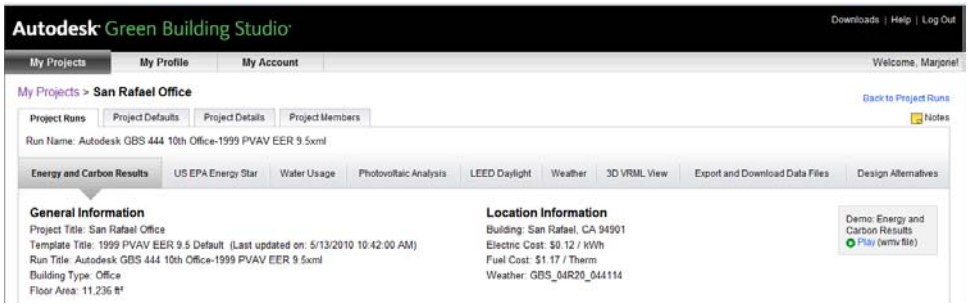
DOE-2 File
This link exports the geometrically accurate DOE-2.2 input file that was generated by the web service for the energy simulation. It can be used downstream as the starting point for other more detailed engineering analysis. This file can be directly imported into the free eQUEST DOE-2 application at www.doe2.com.

EnergyPlus File
This link exports the EnergyPlus™ file that was generated by the web service. It can be used as a starting point for more detailed engineering analyses. The EnergyPlus simulation program can be downloaded for free at www.energyplus.gov.

Weather File (Binary and CSV)
The DOE-2 binary weather file used in the simulation can be downloaded for further analysis off-line using eQUEST. The comma separated values (CSV) file can also be downloaded for use in other applications as well as conversion to other simulation engine weather formats such as EnergyPlus.

Navigation Links

Simply click on the links to access these items or navigate.



Run List Link
This link returns you to the list of runs for this project.

Design Alternatives Link
This link will take you to the design alternative screen where you can change design assumptions for this run and assess the impact of those changes. See the next section for details on the Design Alternatives feature.

Notes Link
If you want to make or view comments about this run, click on the Notes link.

Navigation Tabs

At the top of each results page are navigation tabs that allow the user to view additional information about their building design.

U.S. EPA ENERGY STAR

This tab will display the estimated ENERGY STAR score and associated data that can be used to benchmark the building design's total energy use performance relative to the U.S. EPA's ENERGY STAR requirements. Buildings that receive an ENERGY STAR score above 75 from the EPA qualify for "Designed to earn the ENERGY STAR" and recognition from the EPA.

Water Usage

The water usage tab allows the user to apply a variety of water saving measures, including efficient fixtures, water catchments, native vegetation, and others. It also summarizes the potential LEED points available for these measures.

Photovoltaic Analysis

The details of the photovoltaic (PV) potential analysis are listed in this tab showing the individual PV potential for every exterior surface in the building. Estimated price per watt for the PV system can be made on this tab to account for rebates or other regional differences that affect PV system cost. See the VRML view tab to determine the building surface associated with each result.

LEED Glazing

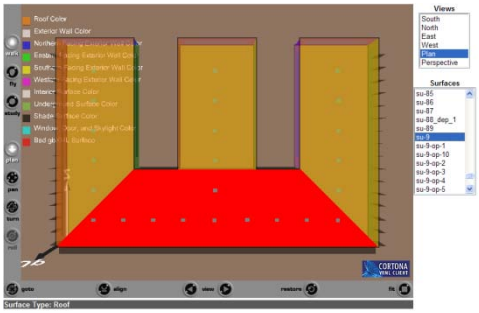
This tab lists all the spaces in the building and their individual Glaze Factor value. This data can be used to determine what spaces in the building could qualify for LEED daylighting credits.

Weather

This tab contains a variety of weather data graphs and charts. These graphs can also be set for specific data types over specific periods of time.

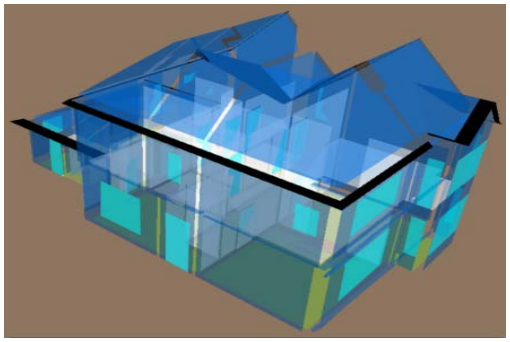
3D VRML View

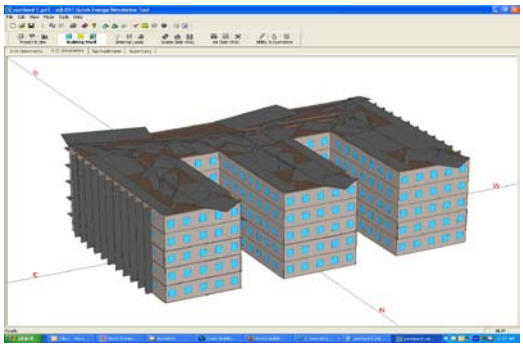
The 3D VRML View tab allows the building designer to review the gbXML geometry data in 3D, and rotate it to review the placement of walls, windows, floors, and other spaces. It requires a VRML Viewer program that is available for free, such as the free Cortona VRML client at www.parallelgraphics.com for Windows® operating systems, and the FreeWRL VRML/X3D Viewer at www.apple.com for Mac® operating systems to view these files. Click on the surfaces in the list at the right of the window to identify them. When selected, a surface will highlight in red in the 3D view, and its surface type will be displayed at the bottom of the window.



The VRML Model

One of the download formats available on the results web page is a VRML file (see example above, right). This is a 3D model that shows what the gbXML export has extracted from your project. Viewing the VRML file is a useful way for you to establish that your simulation is an accurate representation of the whole building. Rooms or surfaces that are missing or that have been incorrectly identified (for example, a roof shown as a shading surface) will be more apparent in this model. In the VRML (below left) the black edges along the roof have been exported to Green Building Studio as shading surfaces and not roof surfaces. The image on the right is an example of a DOE-2 file opened in eQUEST. Notice there are several shades on the roof—this is because the upper limit of the room objects on the top floor is not high enough to contact the roof. To solve this, extend the room object's top surface to above the roof's top surface.

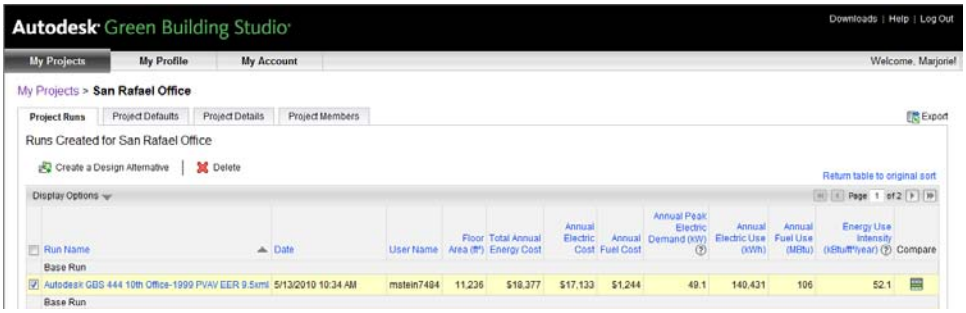




Design Alternatives

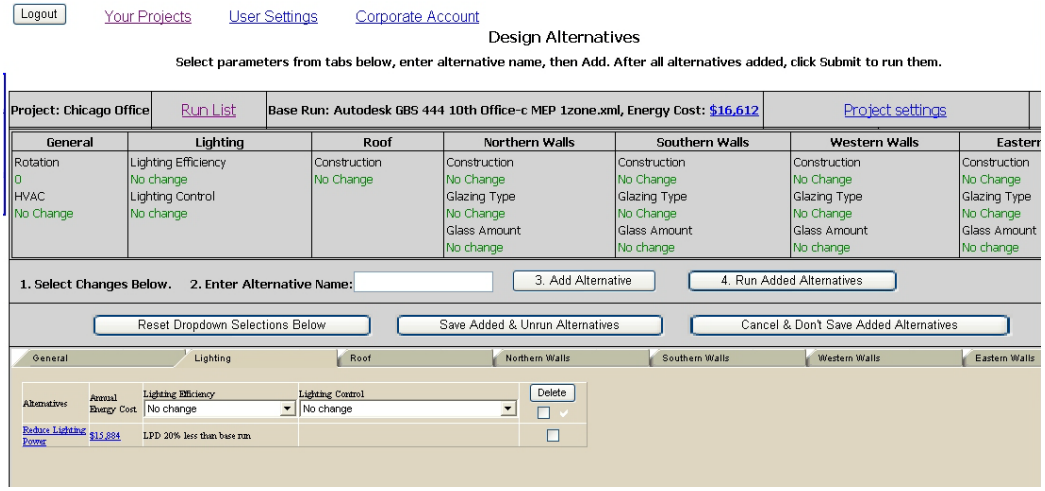
The design alternative feature allows you to modify the base case assumptions and then run a simulation so that you can estimate the impact of these modifications on energy efficiency. This feature helps you make significant design decisions more quickly.

The design alternative feature can be accessed in two ways. From the main "Energy and Carbon" results page link as described in the previous section, by clicking on the "Design Alternative" tab, or from the Projects Run page by selecting the run you'd like to create an alternative for, and then selecting "Create a Design Alternative". Clicking on either the Energy and Carbon results page Design Alternatives link or the Run List page Design Alternatives button will take you to the Design Alternatives page.



The Design Alternatives Page

The top portion of the table has standard links to the Run List, the results page for the base run associated with these Design Alternatives. The section directly below lists the values for all the parameters that have been modified for the currently modified design alternative or the design alternative selected by the user.



Adding Design Alternatives

Go to the Design Alternative screen associated with the run. Begin making the modifications you would like to analyze by selecting a tab and choosing the drop-down list value you would like to be applied for this alternative. Enter an Alternative name, and then click the Add Alternative button. Continue doing this until all the desired Design Alternatives are added.

Select the Run Added Alternatives button to place the alternatives in the run queue. Depending on the model complexity, server load, and the number of alternatives you are analyzing, it will take between a few minutes and an hour to complete your runs. Users can also add and run alternatives individually as they are defined, or as described above, add a group of alternatives and run the group at one time. Once all the alternatives are run, you can review their results either on the Design Alternatives or the Run List page.

Hints and Tips

If your model is large and complex it will take longer to run. Try submitting design alternatives individually as they are defined. While that alternative is running, define and submit additional design alternatives.

Summary

Architects and engineers can use digital design information to help analyze and understand how their projects will perform before they are built. Developing and evaluating multiple alternatives simultaneously makes comparison easier and helps inform better sustainable design decisions. Building information modeling (BIM) is core to Autodesk's sustainable design approach for building performance analysis and simulation.

Autodesk®