Lawrence Berkeley National Laboratory

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Small and Medium Building Efficiency Toolkit and

Community Demonstration Program

Commercial Building Energy Saver (CBES APP): Tutorial

Version 1.1

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Version History

Version	Date	Note
1.0	March 9th, 2015	First Release
1.1	April 20th, 2015	Add Case L1.1 No- or Low-cost Improvement Analysis

Getting started with CBES App

This tutorial provides a step-by-step guide to quickly get familiar with the CBES App. Please refer to the User Manual for more detailed information.

What is CBES

The Commercial Building Energy Saver (CBES) Toolkit is an energy retrofit analysis toolkit, developed by Lawrence Berkeley National Laboratory (LBNL). The CBES Toolkit evaluates the energy use of a building, identifies and evaluates retrofit measures. The toolkit provides a rich set of features for energy benchmarking and retrofit analysis: (1) Energy Benchmarking provides an EnergyStar score for the building and how it compares with its peer buildings; (2) Level 1: No- or Low Cost Improvement Analysis identifies potential building operation improvements using statistical analysis of the building's 15-minute interval electricity use data; (3) Level 2: Preliminary Retrofit Analysis searches a pre-simulated database for retrofit measures based on investment criteria; and (4) Level 3: Detailed Retrofit Analysis performs EnergyPlus simulation to evaluate energy savings of user configurable energy conversation measures considering actual building characteristics and operation schedules.

The CBES retrofit software will analyze the energy performance of user's building for pre- and post-retrofit, in conjunction with user's input data, to identify recommended retrofit measures, energy savings and economic analysis for the selected measures. The software provides the energy benchmarking and three levels of retrofit analysis depending on the degree of the input data provided.

- Energy benchmarking:
  Use of external energy benchmarking software APIs including EnergyIQ and ENERGY STAR Portfolio Manager.

- Level 1: No- or low-cost improvement analysis
  Base load shape analysis based on the statistical models.

- Level 2: Preliminary retrofit analysis
  Retrofit analysis from a database that compiles the pre-simulated energy performance using prototype buildings with retrofit measures, and associated cost data for measures.

- Level 3: Detailed retrofit analysis
  Retrofit analysis from a real time simulation that calculates the energy performance of the building with user configurable retrofit measure(s).

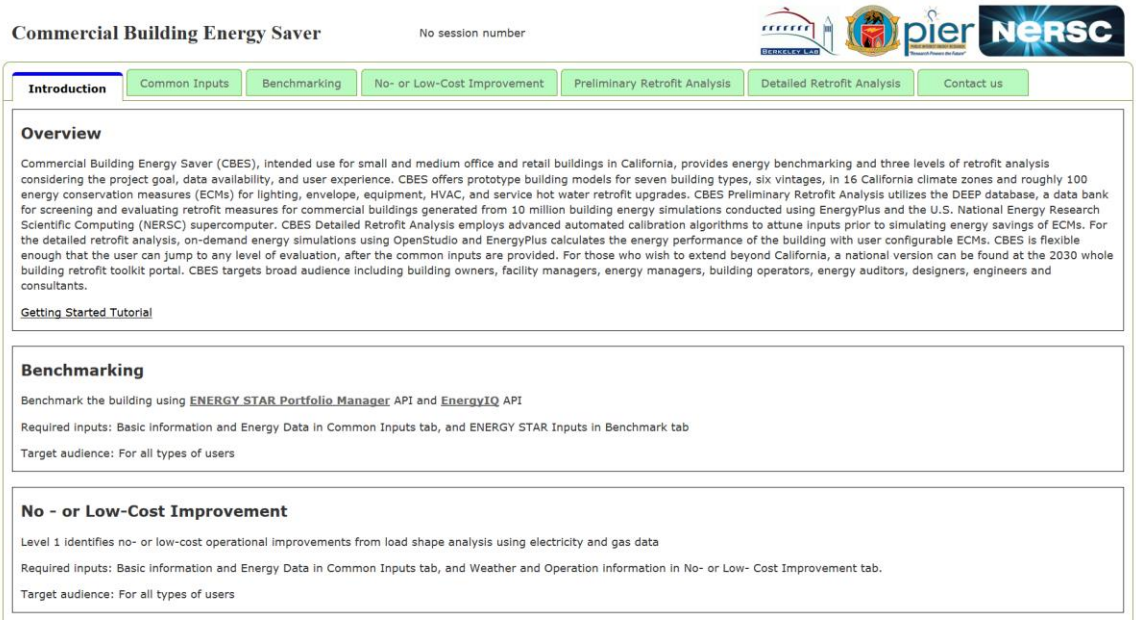


Figure 1 Front page of CBES App

Tutorial Example for running CBES toolkits

Overview

In this tutorial, a building owner has a 1 story small office building located in San Francisco, California (zip code: 94127). The building was built in 1977 and has a floor area of 10,000 ft^2. The building owner would like to benchmark the building's energy consumption with peer buildings in California and nation-wide, and explore potential energy retrofit to reduce energy use and cost.

For this goal, five steps, marked with B.1, L1.1, L2.1, L3.1, and L3.2, are conducted in sequence. The owners firstly benchmark the building's existing energy performance with EnergySTAR and Energy IQ to capture the building's rank (Case B.1). Then he tries to figure out whether there are some no- or low-cost improvement opportunities by analyzing building's 15-minute interval electricity use data (Case L1.1). A preliminary retrofit analysis (L2.1) is undertaken to suggest the effective retrofit measures. Afterwards, detailed retrofit analysis (L3.1) provide concrete retrofit performance of these measures and measure packages in terms of energy saving, energy cost and investment and yield. Last, concerning a local economic incentive for T8 lighting upgrade, L3.2 is conducted to help the building owner make the decision.

Case B.1 Benchmarking

- **Input the information**

Suppose that the building owner has the monthly utility usage, reading as

. He would like to do building energy benchmarking before he does the retrofit analysis. In this case, the building energy benchmarking feature will be tested. All available input information, besides the bill, is shown in **Error! Reference source not found.**.

Table 1 Monthly electricity and natural gas usage

Month	Electricity [kWh / kBTU]	Gas [Therm / kBTU]
January	11805 / 40290	157 / 15728
February	10572 / 36083	98 / 9847
March	12203 / 41648	83 / 8318
April	10971 / 37443	71 / 7100
May	11734 / 40046	38 / 3845
June	11753 / 40111	30 / 3011
July	11683 / 39876	22 / 2203
August	12564 / 42882	24 / 2428
September	11965 / 40837	24 / 2418
October	11793 / 40247	45 / 4507
November	11345 / 38718	93 / 9301
December	11597 / 39579	145 / 14524
Total	139985 / 477760	830 / 83230

Table 2 Information for benchmarking

Items	Information
Building type	1-story office
Zip code	94127
Vintage	1977
Gross floor area	10,000 ft^2

Using URL in a web browser to launch the CBES toolkit, a portal page to the tool should display as **Error! Reference source not found.**. Select the Tab "Common Inputs" and click the "New Analysis" as **Error! Reference source not found.** indicated. A new case will be generated with a session number showing at the upper right side of the page (Figure 3).

Input the information into the corresponding blanks, as Figure 3 demonstrates. Remember to click "update" button at the bottom of each frame to write the information into the system.

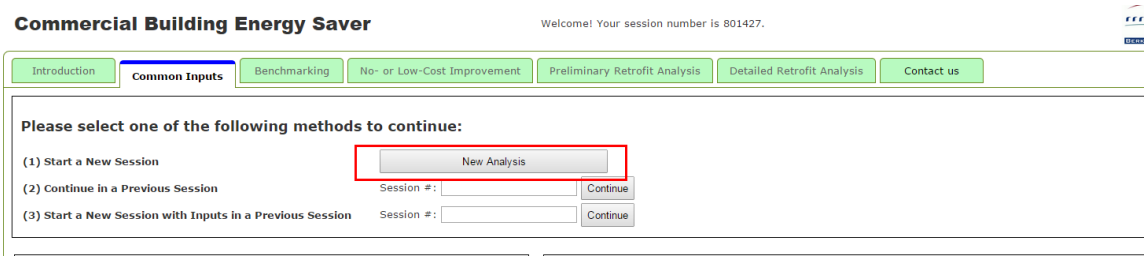


Figure 2 Start new analysis

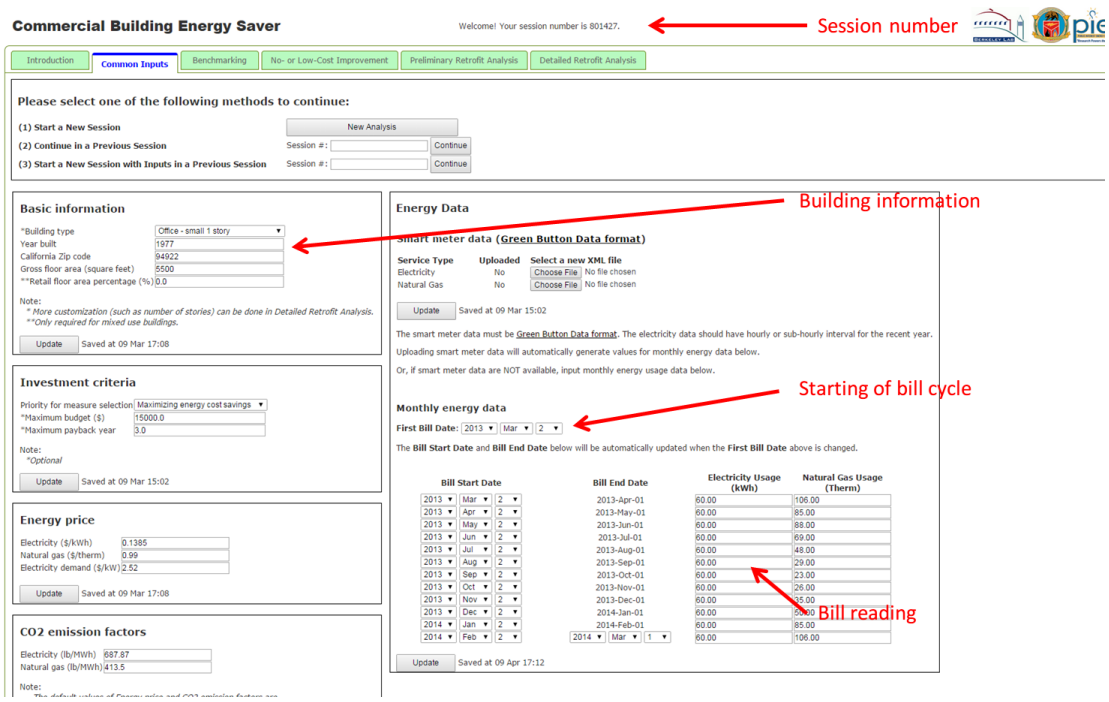


Figure 3 Data input for case B.1

- **Run the benchmarking**

Upon finishing the input in the tab "Common Input", move to benchmarking by clicking the "Benchmarking" Tab.

Leave the optional Energy STAR input blank. Simply click the "Benchmark" button. The results for the B.1 benchmarking should be like Figure 4. The results show that this building has an EnergyStar score of 38 (a score of 75 or higher qualifies a building's Energy Star certification) and consumes more energy than 86.5% of the peer buildings in California.

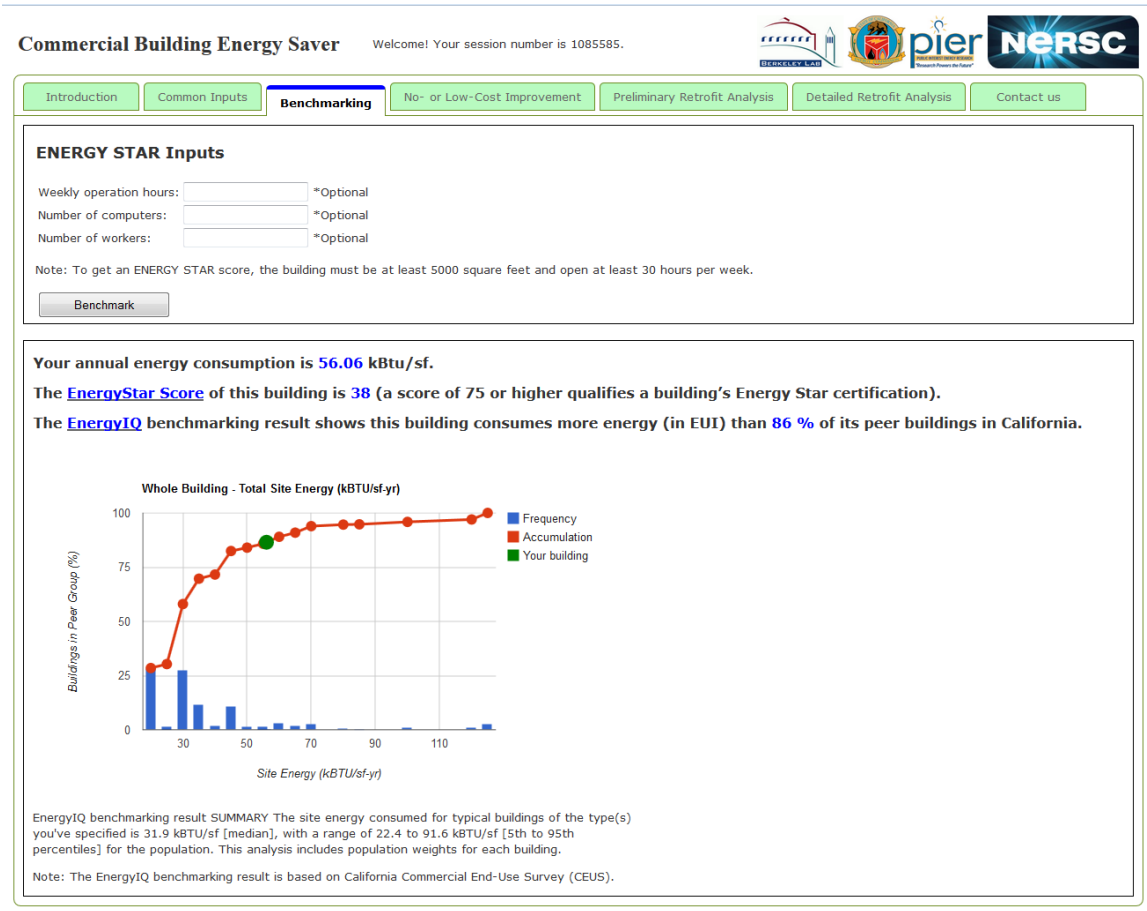


Figure 4 Results for Case B.1 benchmarking

Case L1 No- or Low- Cost Improvement Analysis

The benchmarking above indicates the energy performance of this building is poor. The building owner has the building's 15-minute interval electricity use data saved in an Excel file, and he don't have outdoor air temperature data. He would like to analyze the data and figure out whether there are some no- or low-cost improvement.

- **Input the information**

No- or low- cost retrofit aims to achieve energy savings by analyzing the smart meter data. Normally, these methods include the adjustment of the working schedules, shrinking the working hours, and shutting down the unnecessary lights and appliances.

CBES app helps the users with the brief analysis of the possible no- or low- cost retrofit strategies under the tab "No- or Low- Cost Improvement", as shows in Figure 5.

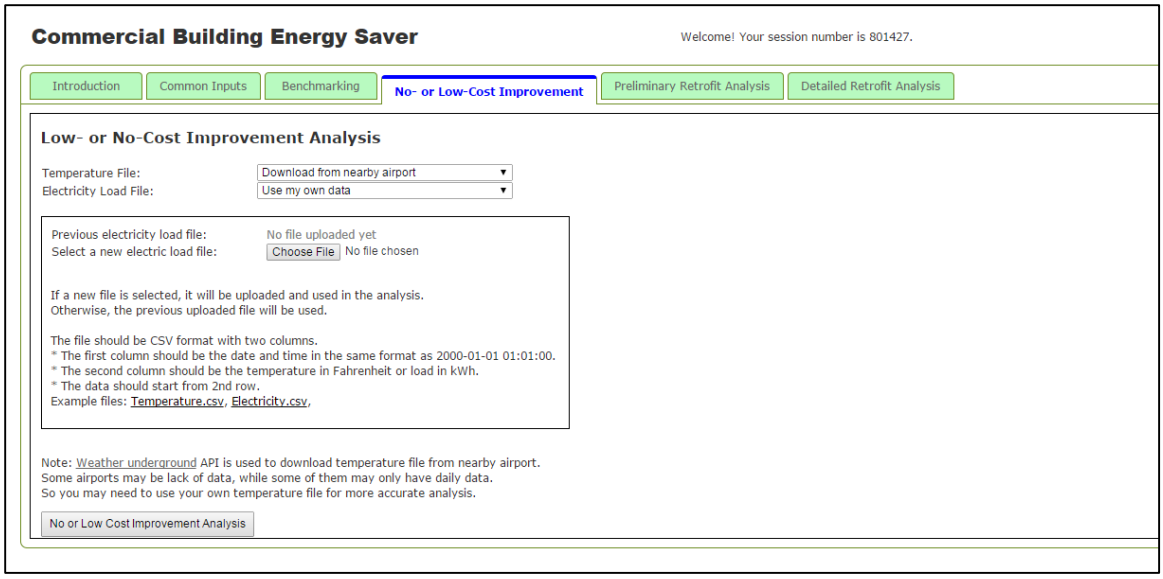


Figure 5 Portal for no- and low- cost improvement

The outdoor air temperature file and the 15-minute interval electricity load file are required to perform the no- or low-cost improvement analysis.

For the temperature file, two options are available, including "Download from nearby airport" and "Use my own data". The building owner don't have the outdoor air temperature information, so he choose "Download from nearby airport". In this case, the CBES Toolkit will download the outdoor air temperature from nearby airport through Weather Underground API (http://www.wunderground.com/). It needs to be pointed out that the download procedure may be time consuming and the resolution of the data may be too low for some of the airport (i.e. one data point per day).

For the 15-minute interval electricity load file, the options are "Use green button data from Common Input tab" or "Use my own data". As the building owner don't have the smart meter data, he choose the "Use my own data". The building owner will see something like Figure 6. The interval data are in Excel format, so he need to generate a CSV file with the required format from the Excel file.

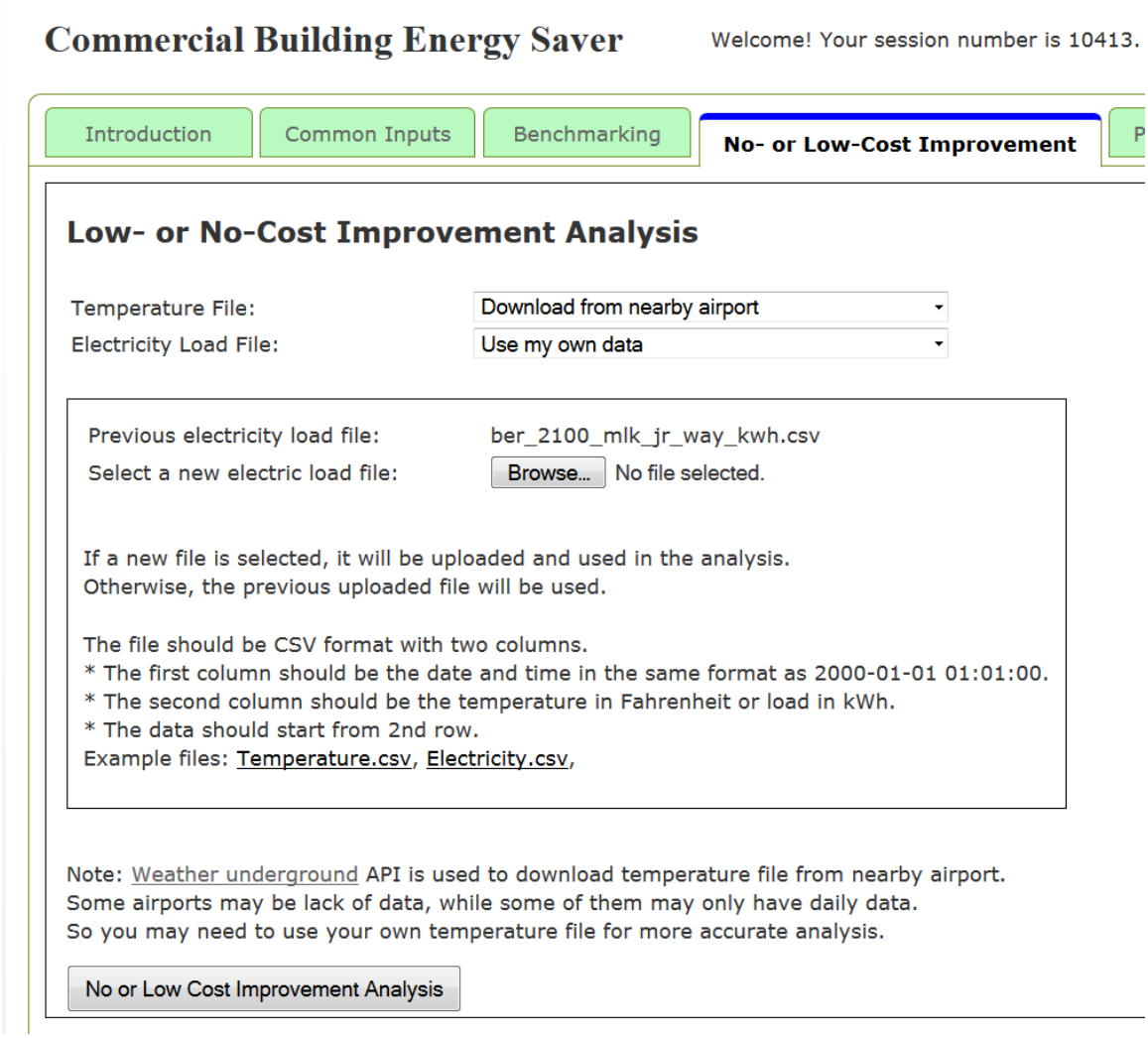


Figure 6 Low- or No- Cost Improvement input

- **Generating required CSV file from Excel file**

Figure 6 shows the required CSV file format. The file should be CSV format with two columns. The first column should be the date and time in the same format as 2000-01-01 01:01:00. The second column should be the temperature in Fahrenheit or load in kWh. The data should start from 2nd row. Some example files are also provided.

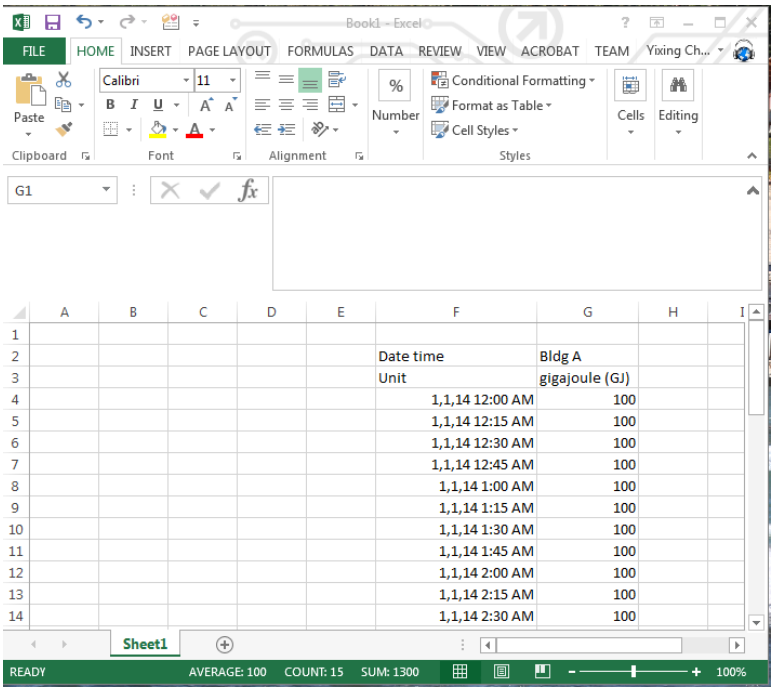


Figure 7 Electricity load in Excel

Figure 7 shows the original data in the excel file. There are some steps to generate the required CSV file.

Step 1: Change the Unit to kWh. Figure 8 shows the unit conversion from GJ to kWh (1 GJ = 277.8 kWh)

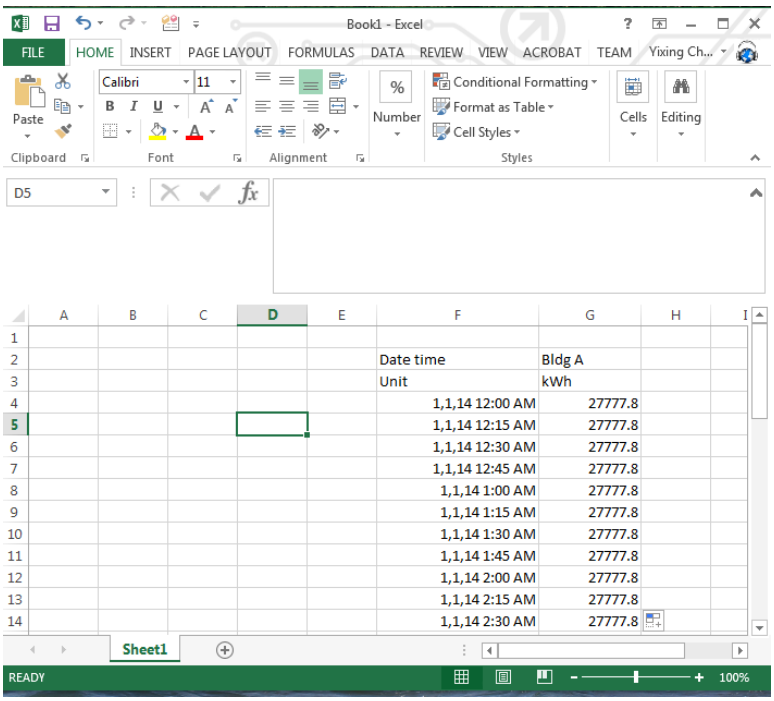


Figure 8 Unit conversion for electricity load in Excel

Step 2. Combine the header lines and move the data to columns A and B. Make sure row 1 is the header and the data starts from row 2 as shown in Figure 9.

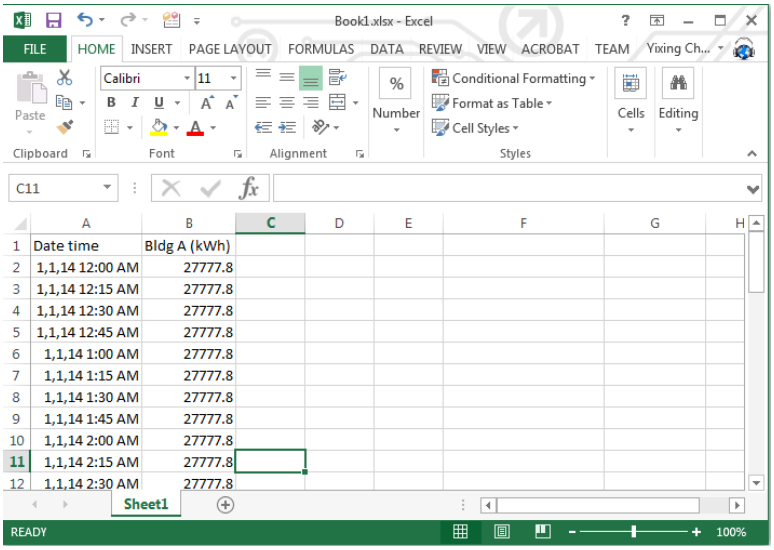


Figure 9 Adjust Columns and Rows for electricity load in Excel

Step 3: Change the date time format. Right click on **Column A** (make sure Column A is selected), and select "Format Cells…" (Figure 10). In the popup window, select Custom from Number Tab, and type "YYYY-mm-dd HH:MM:ss" as shown in Figure 11. Click on and you will see similar results as shown in Figure 12.

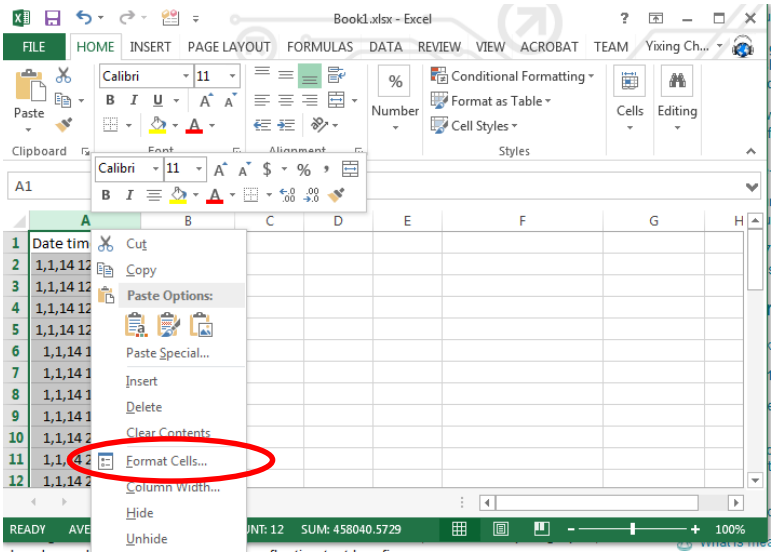


Figure 10 Date time formatting for electricity load in Excel

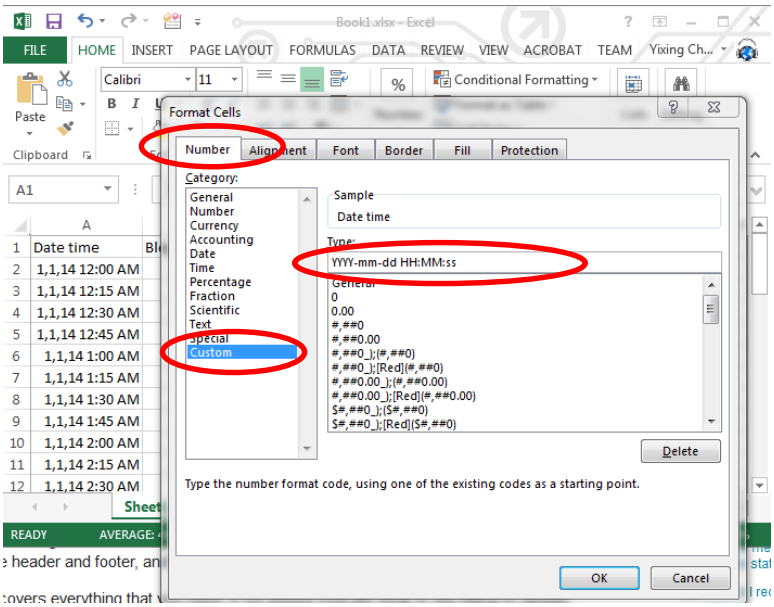


Figure 11 Date time formatting for electricity load in Excel

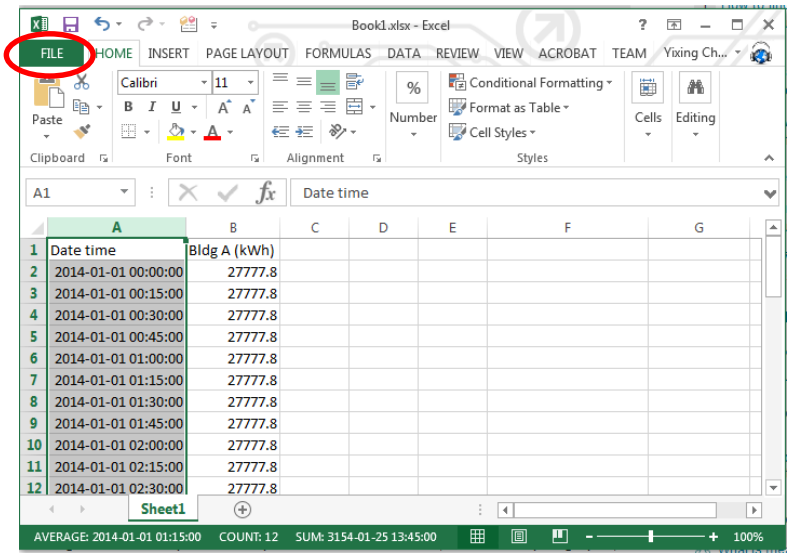


Figure 12 Date time formatting for electricity load in Excel

Step 4: Export the data to CSV format. Click on FILE tab as highlighted in Figure 12. Select “Export”-> “Change File Type” -> “CSV (Comma delimited) (*.csv)” to export the data to required CSV format (Figure 13).

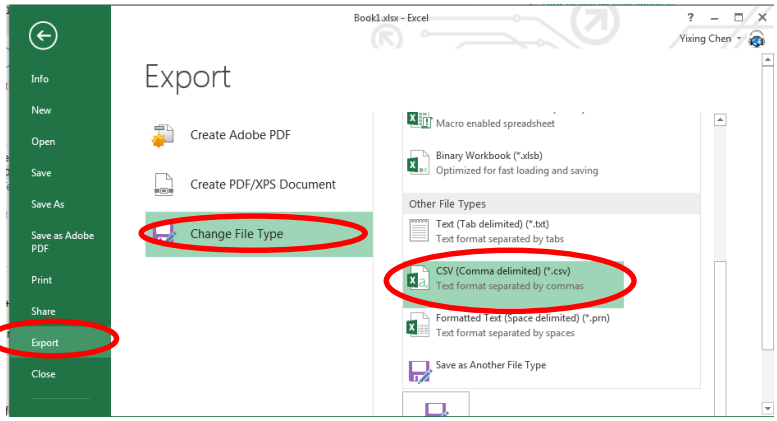


Figure 13 Export electricity load in Excel to CSV file

- **No- or low- cost improvement analysis result**

Upon uploading the two input files, click the "No or Low cost Improvement analysis" at the bottom of the page. Figure 14 shows first page of the analysis results, which indicates the building consumes more electricity in autumn than in winter.

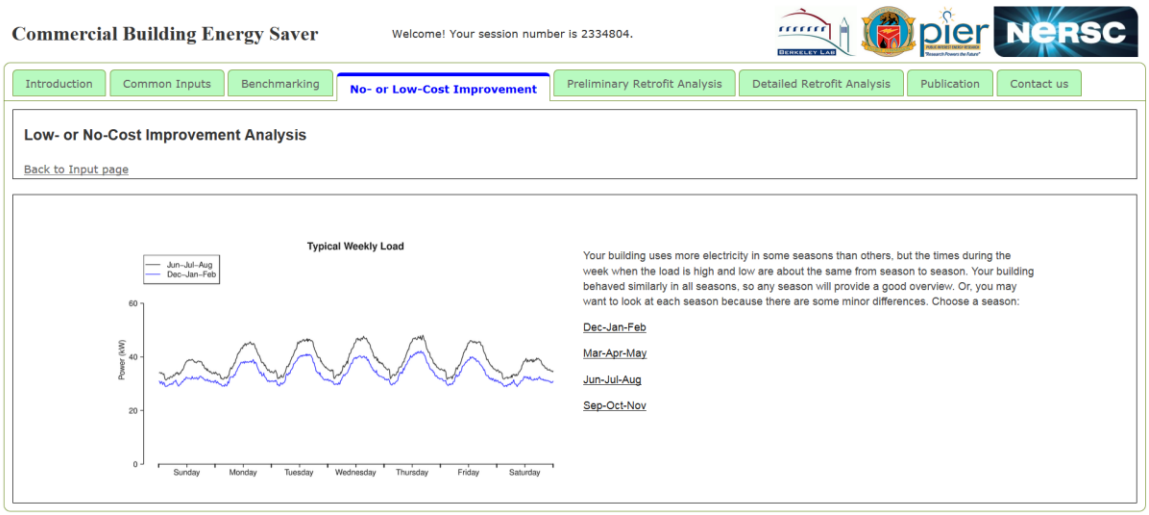


Figure 14 No or Low cost improvement result

Users can click the link on the lower-right to see more detailed results of each season. Figure 15 shows an example of the analysis results from CBES, which calculates the operation and non-operation hours, as well as the average load during those hours. The results indicate that the building has quite high energy consumption during non-operation hours, which may be caused by leaving the lights and/or equipment on during non-operation hours. The building owner checks the building and finds that the HVAC system are not turned off during the night. So he adjusts the settings and reduce the electricity consumption during non-operation hours.

Figure 15 No- or low- cost improvement detailed results for autumn

Case L2.1 Preliminary Retrofit Analysis

After adjusting the HVAC operation schedule based on the results from no- or low- cost improvement analysis, the building owner would like to do some retrofits to further improve the energy efficiency, even though he upgraded the lighting system from 2.0 to 1.2 W/ft^2 in 2005. Now he has $15k to invest. His primary goal is to save energy cost and he wants the payback time to be less than 3 years. So he would like to do a preliminary retrofit analysis to know what retrofit options are available. In this case, the building owner can use Level 2.1: Preliminary Retrofit Analysis.

- **Input the information**

In addition to the input information in the Case B.1, we have the following:

- Investment limit: $15,000;
- Primary goal: energy cost saving;
- Maximum payback year: 3;
- Existing upgrade: lighting power reduction from 2.0 to 1.1 W/ft^2 (1.1 W/ft^2 is the closest upgrade in the pre-simulated database)

To add them into the existing case, switch to tab “Common Input” again and the add first three items in “Investment criteria” as Figure 16 indicates. Then switch to tab “Preliminary Retrofit Analysis” to add the information on existing upgrade, as Figure 17 demonstrated.

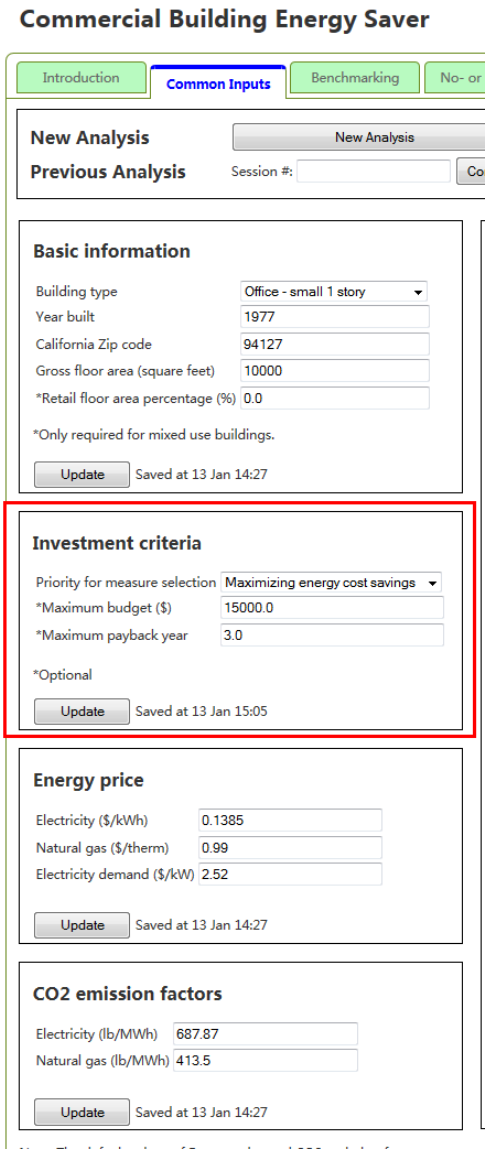


Figure 16 Update the investment criteria

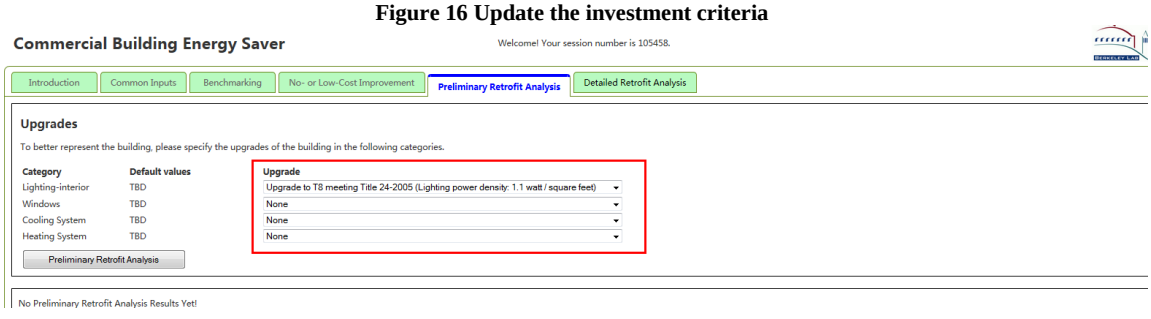


Figure 17 Upgrade information input

- **Run the preliminary analysis**

In the page of "preliminary analysis", click "preliminary analysis" to launch it. Allow several minutes for it to finish. Demonstrated by Figure 18, the results suggest that upgrading lighting system and adding

economizer are the two most cost effective ways to improve the energy performance of this building based on the available budget and required payback year.

Preliminary retrofit results:

The retrofit options are sorted based on the investment criteria in the Common Inputs tab. If less than 10 retrofit options meet the investment criteria, some retrofit options which do not meet the investment criteria are listed.
Measure ID(s) with (*) means the retrofit option does not meet the investment criteria.

Annual site energy and CO2 emissions

	Measure ID(s)	Electricity (kWh)	Natural Gas (therm)	Electricity Demand Charge ($)	Energy Cost ($)	CO2 Emission (lbs)
0	Baseline	113,168	864	1,164	17,636	88,309
1	ECM 45;25;1	90,836	811	1,014	14,352	72,314
2	ECM 45;1	90,836	921	1,014	14,461	73,642
3	ECM 45	102,352	853	1,129	16,098	80,743
4	ECM 45	102,352	853	1,129	16,098	80,743
5	ECM 14;45;25;49;7;53;64;66 (*)	65,521	930	647	10,610	56,346
6	ECM 14;45;25;7;53;64;66 (*)	65,467	968	646	10,640	56,769
7	ECM 14;45;49;7;53;64;66 (*)	65,521	1,066	647	10,744	57,989
8	ECM 14;45;7;53;64;66 (*)	65,467	1,112	646	10,782	58,513
9	ECM 14;45;25;49;7;53;66 (*)	66,137	1,012	656	10,785	57,763
10	ECM 45;25;49;7;53;64;66 (*)	66,606	930	718	10,830	57,092

Annual economic analysis

	Measure ID(s)	Energy Cost Savings ($)	Energy Savings (kWh)	Electricity Cost Savings ($)	Electricity Savings (kWh)	Natural Gas Cost Savings ($)	Natural Gas Savings (therm)	Investment Cost ($)	Payback (Year)
1	ECM 45;25;1	3,284	23,866	3,082	22,332	52	52	9,210	2.8
2	ECM 45;1	3,175	20,653	3,082	22,332	-57	-57	7,868	2.5
3	ECM 45	1,538	11,121	1,493	10,816	10	10	2,014	1.3
4	ECM 45	1,538	11,121	1,493	10,816	10	10	2,014	1.3
5	ECM 14;45;25;49;7;53;64;66 (*)	7,026	45,685	6,575	47,647	-66	-67	124,328	17.7
6	ECM 14;45;25;7;53;64;66 (*)	6,996	44,626	6,583	47,700	-104	-105	105,320	15.1
7	ECM 14;45;49;7;53;64;66 (*)	6,892	41,710	6,575	47,647	-201	-203	123,420	17.9
8	ECM 14;45;7;53;64;66 (*)	6,854	40,408	6,583	47,700	-246	-249	104,413	15.2
9	ECM 14;45;25;49;7;53;66 (*)	6,851	42,666	6,490	47,030	-147	-149	103,774	15.1
10	ECM 45;25;49;7;53;64;66 (*)	6,806	44,599	6,425	46,561	-66	-67	117,888	17.3

Annual energy and cost saving percentage

	Measure ID(s)	Energy Cost Savings (%)	Energy Savings (%)	Electricity Usage/Cost Savings (%)	Natural Gas Usage/Cost Savings (%)
1	ECM 45;25;1	18.6%	17.2%	19.7%	6.1%
2	ECM 45;1	18.0%	14.9%	19.7%	-6.6%
3	ECM 45	8.7%	8.0%	9.6%	1.2%
4	ECM 45	8.7%	8.0%	9.6%	1.2%
5	ECM 14;45;25;49;7;53;64;66 (*)	39.8%	33.0%	42.1%	-7.8%
6	ECM 14;45;25;7;53;64;66 (*)	39.7%	32.2%	42.2%	-12.1%
7	ECM 14;45;49;7;53;64;66 (*)	39.1%	30.1%	42.1%	-23.5%
8	ECM 14;45;7;53;64;66 (*)	38.9%	29.2%	42.2%	-28.8%
9	ECM 14;45;25;49;7;53;66 (*)	38.8%	30.8%	41.6%	-17.2%
10	ECM 45;25;49;7;53;64;66 (*)	38.6%	32.2%	41.1%	-7.8%

Preformance of single measure

Measure ID	Electricity (kWh)	Natural Gas (therm)	Electricity Demand Charge ($)	Energy Cost ($)	CO2 Emission (lbs)	Investment Cost ($)	Payback (Year)
ECM 1 (*)	100,015	927	1045.91	15,766	80,030	6,000	3.21
ECM 14 (*)	108,011	864	1042.06	16,803	84,762	10,687	12.82
ECM 25 (*)	113,168	764	1163.94	17,538	87,105	1,447	14.70
ECM 49 (*)	113,422	833	1163.95	17,641	88,113	19,000	NA
ECM 53 (*)	99,600	924	1032.30	15,692	79,712	8,000	4.12
ECM 64 (*)	113,380	778	1161.07	17,578	87,421	21,484	370.03
ECM 66 (*)	107,851	746	1091.60	16,714	83,228	38,282	41.51
ECM 7 (*)	96,763	944	1016.56	15,305	78,002	29,000	12.44

Description of measures

Measure ID	Category	Component	Description	IEQ Impact	Cost Unit	Total cost per Unit
ECM 1	Indoor Lighting	Lamp Replacement	Replace T12 with T8 lamp and ballast; same troffer.	Replacement of lighting may improve lighting quality and occupant satisfaction.	$/sf	0.60
ECM 7	Indoor Lighting	Lighting Retrofit	Use troffer retrofit kit to convert from fluorescent to LED	Replacement of lighting may improve lighting quality and occupant satisfaction.	$/sf	2.90
ECM 14	HVAC - cooling	Roof Top Air Conditioners	Replace RTU with higher-efficiency unit, EER 12	NA	$/ton	467.00
ECM 25	HVAC - heating	Gas furnace upgrade	Replace gas furnace with higher-efficiency unit AFUE 95	NA	$/kBTU-hour	8.20
ECM 45	HVAC	Economizer	Install economizer on existing HVAC system	Economizers bring in more outdoor air, especially in moderate climates. More building ventilation can improve indoor air quality, and has been shown in offices to reduce sick building symptoms, improve work performance, and may reduce illness absence.	$/ton	88.00
ECM 49	Building Shell	Envelope	Install air sealing	Air sealing can reduce cold drafts and help improve thermal comfort in buildings.	$/sf	1.90
ECM 53	Plug Loads	Plug load controller	Install smart plug strip	NA	$/sf	0.80
ECM 64	Building Shell	Wall	Wall Insulation (R21) - blown fiberglass in wall	Better insulation can help maintain thermal comfort in buildings.	$/sf wall area	3.90
ECM 66	Building Shell	Window	Specifications: Reflective, low VT, low SHGC, Reinforced vinyl Framing	Windows with moderate heat gain and visible light transmittance can help maintain thermal and lighting comfort.	$/sf window area	33.10

Figure 18 Preliminary retrofit results

Case L3.1 Detailed Retrofit Analysis

Based on the preliminary analysis in Case L2.1 which shows significant retrofit benefit for "upgrading lighting" and "adding economizer", the building owner would like to do further detailed retrofit analysis using more specific information of his building rather than the prototype. In this case, the building owner can use Level 3: Detailed Retrofit Analysis.

- **Input the information for baseline building**

Switch to tab "Detailed Retrofit Analysis" and click the "Initializing Detailed Building Information" (Figure 19)

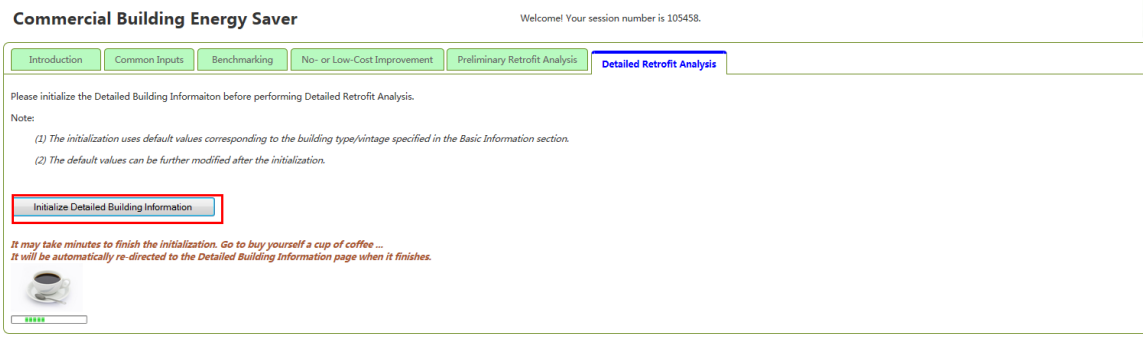


Figure 19 Open the portal for detailed analysis

After the portal page is launched, switch to the geometry page and input the geometry information. Change the building front side facing from North to South Change the length from default 122.47 to 143 ft, and width from 81.65 to 70 ft. Modify the window-wall ration in the four directions to 0.25. Click "update" to save the changes (Figure 20).

Skip the construction tab, and switch to in internal loads. Change the lighting power density from 2.0 to 1.2 W/ft^2. Change the electric equipment power density from 1.36 to 1.8 W/ft^2 (Figure 21).

For other parameters same as the prototype building, leave them as default.

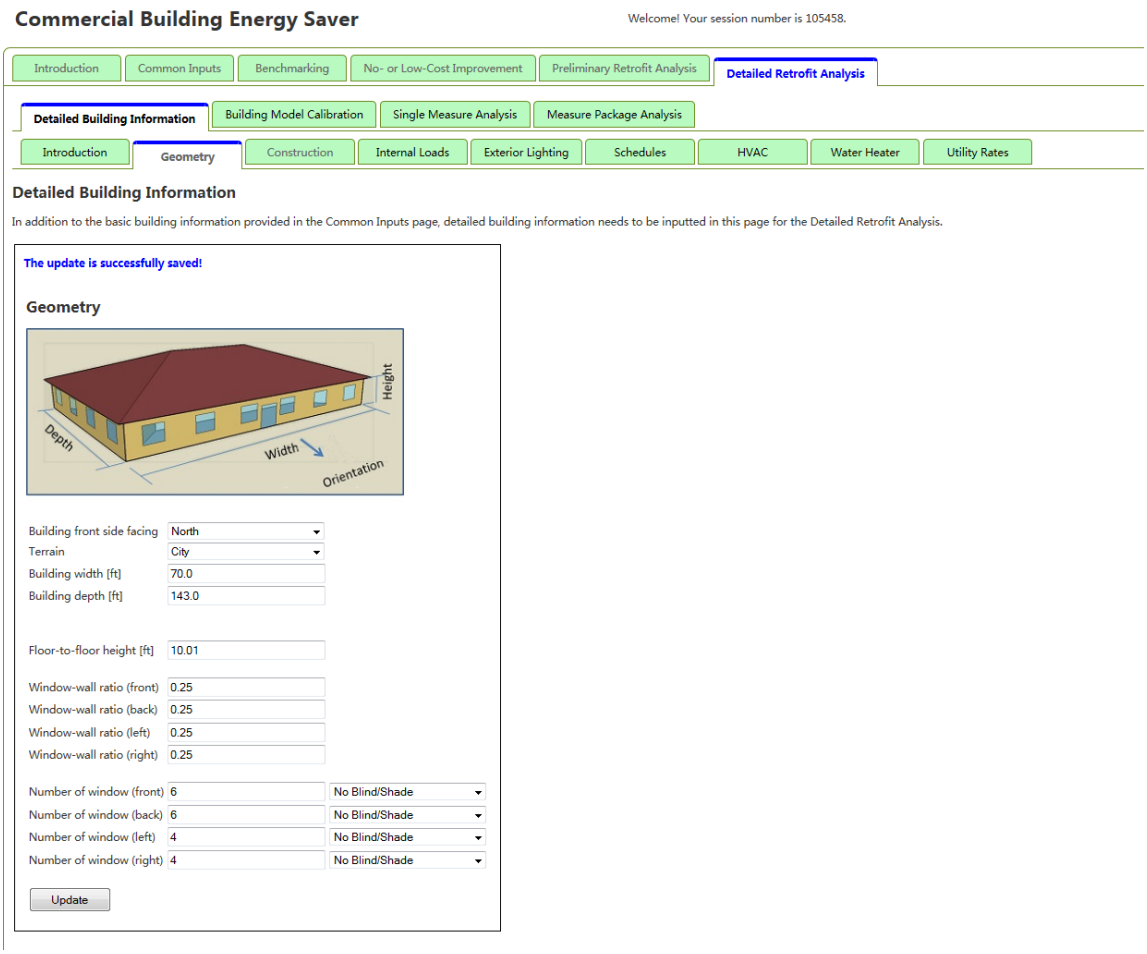


Figure 20 Change the geometry information

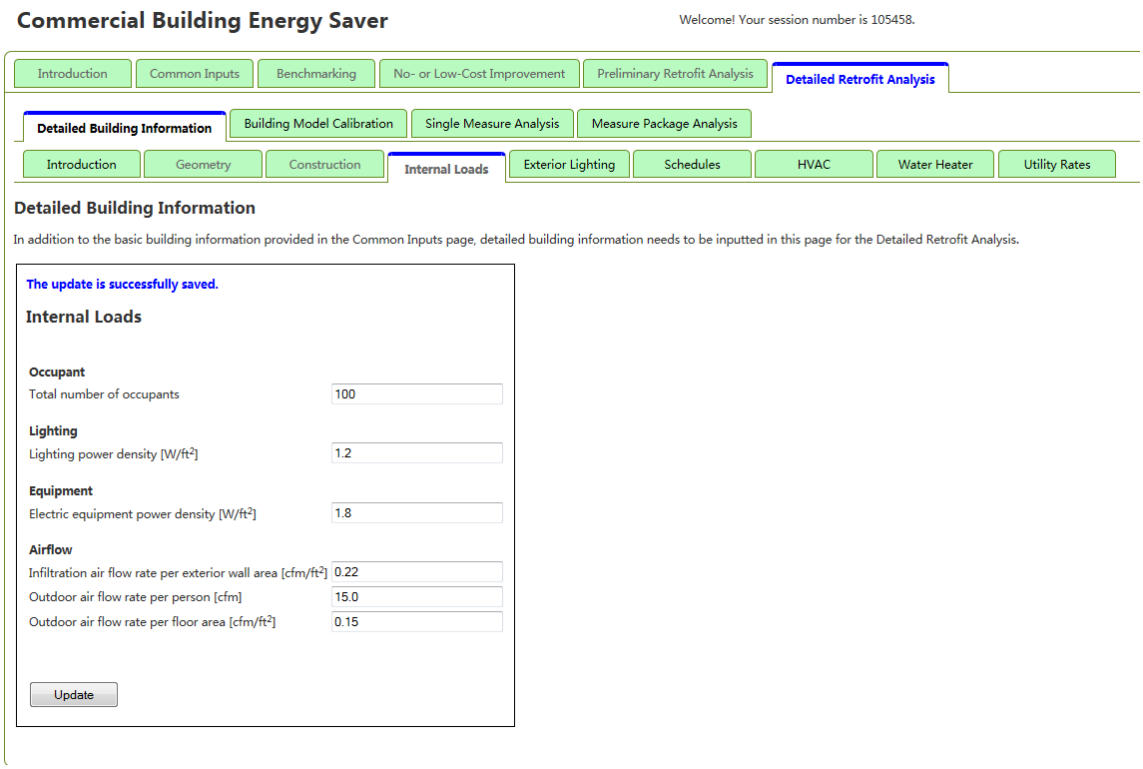


Figure 21 Change the internal load information

- **Model Calibration**

In case users are uncertain about some building information, a model calibration function is provided to better match the utility usage inputs. Switch to tab "Model Calibration", opt for the "Automatic Calibration", click the "Update Calibration Settings" and then click "Perform Model Calibration". An automatically calibration is applied for the case. The results are demonstrated in Figure 22.

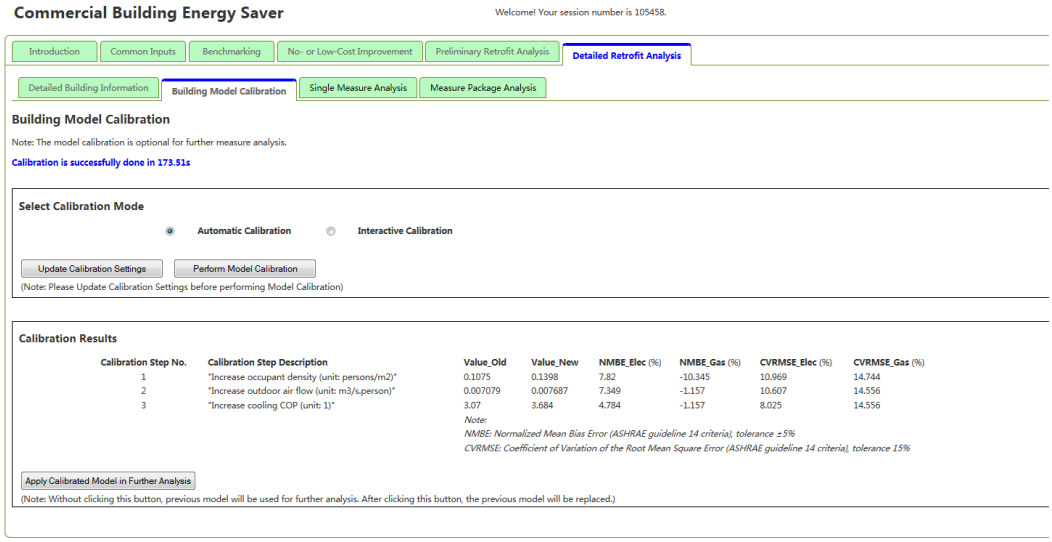


Figure 22 Results of automatic model calibration

By clicking the "Apply Calibrated Model in Further Analysis" button, the detailed building information will be updated using the information from the calibrated model; in other words, the calibrated model will be applied in the further measure analysis. Note that the cooling system COP in the HVAC information bundle has been modified by model calibration, as Figure 23 displays. For sophisticated calibration options, please refer to the manual.

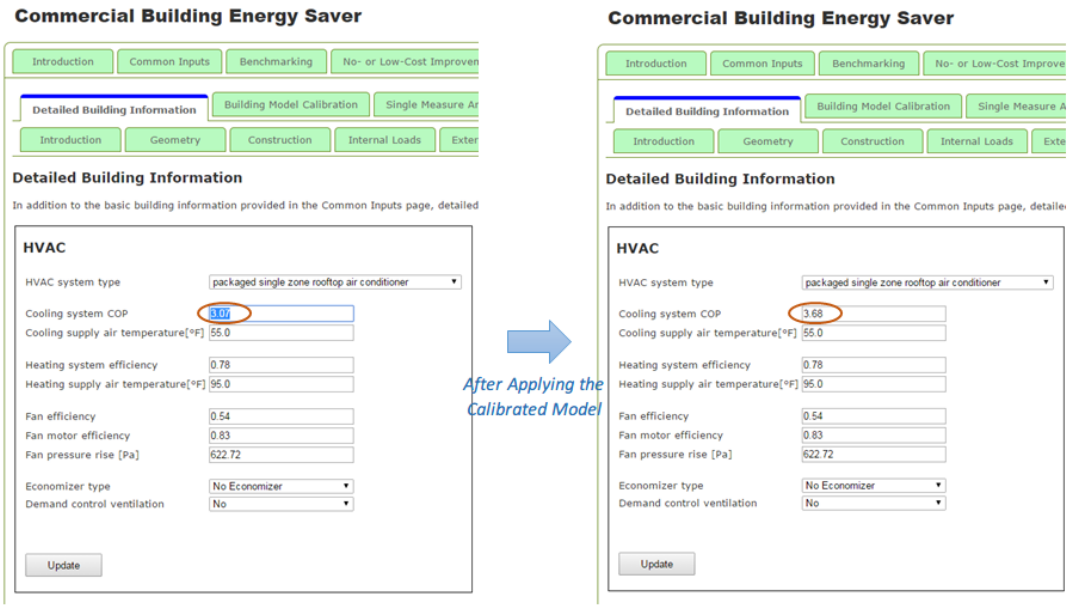


Figure 23 Parameter changed by auto calibration

- **Evaluate single retrofit measure**

Regarding the retrofit measures, suppose that the building owner wants to choose one measure to apply from the options in Table 3, he/she could use the tab "Single Measure Analysis" to input details of each measure.

Table 3 Retrofit measures

Retrofit measures	Detail
Switch lightings to T8	Power density of 0.70 W/ft2 (7.53 W/m^2)
Switch lightings to T5	Power density of 0.67 W/ft2 (7.21 W/m^2)
Switch lightings to LED	Power density of 0.60 W/ft2 (6.46 W/m^2)
Add Economizer	-

Under "select measures to add", choose the category that fits the measures in the drop-down menu, and subsequently choose the exact measures provided by the tool. Then click "Add selected measure to the measure list" to add the selection into a formulated list.

Figure 24 demonstrates the measure listed in the app for a single measure evaluation. Building owners may instinctively try to combine measures of different categories into a package for a comprehensive analysis. For this, users can use the "Measure Package Analysis". Simply click that tab, and all previously added measures will be listed to be combined into a package. Select the wanted measures by checking the corresponding box to form one package, and user can customize the name of package. Note that measures

that belongs to the same category can't be chosen simultaneously, for it is obviously against the logic. Figure 14 demonstrates the three possible package for this case.

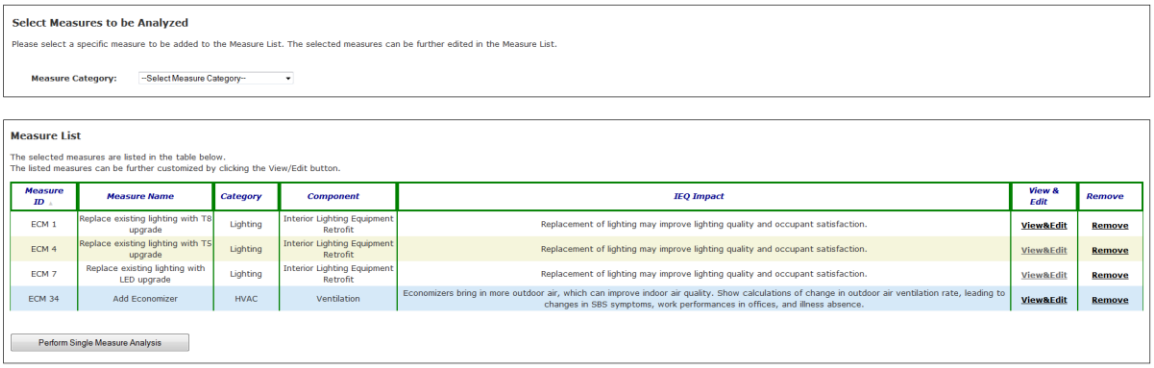


Figure 24 Measure lists for evaluation

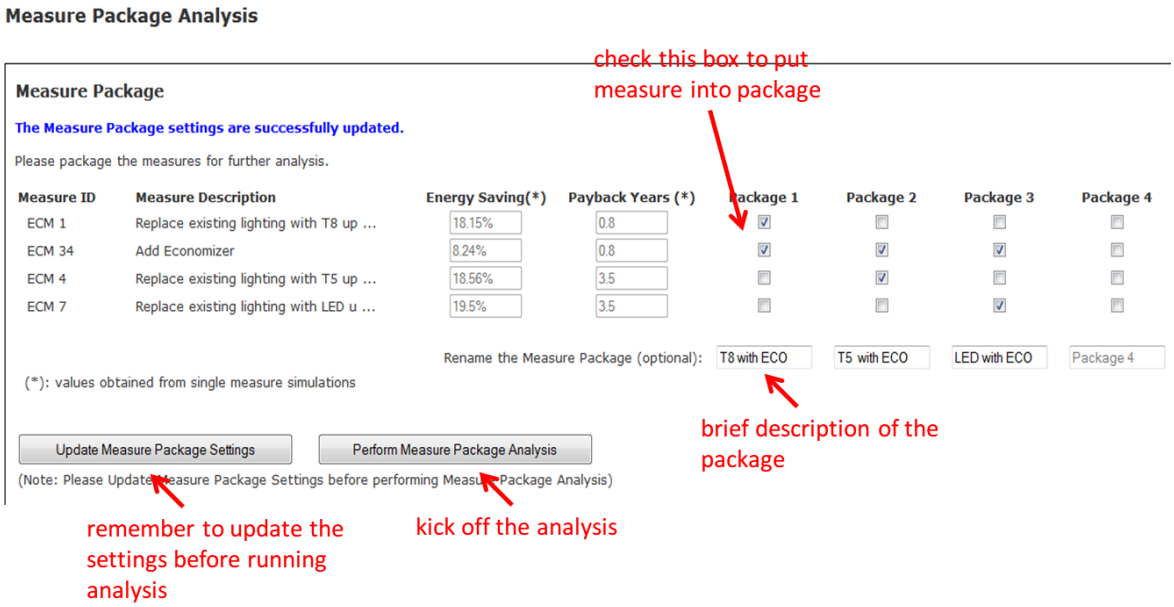
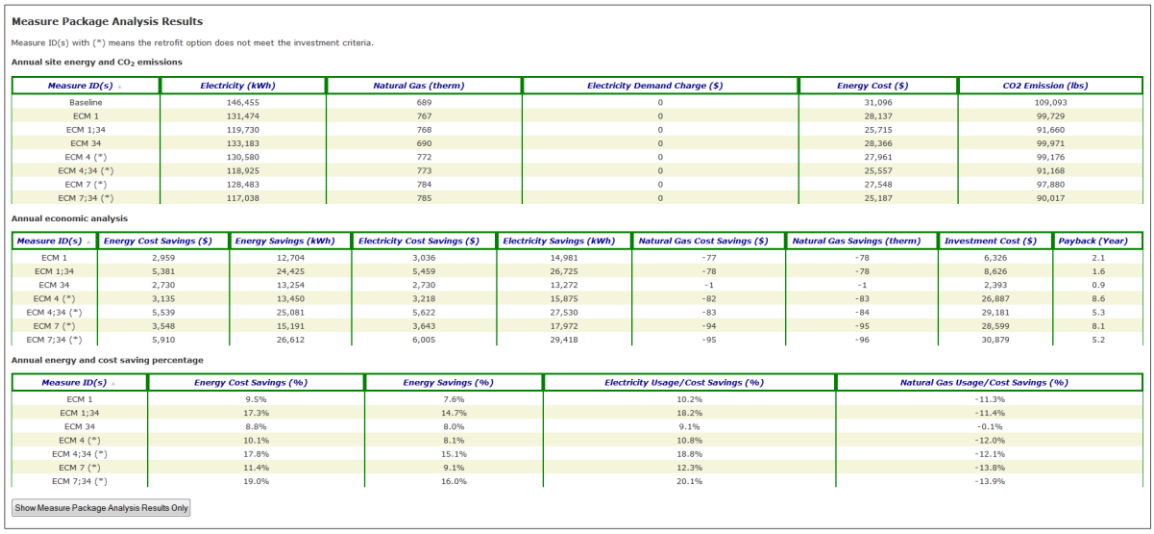


Figure 25 Create measures package for analysis

The results are demonstrated as Figure 26. Note that packages are also compared with single measures if the "include single mearsure analysis results here" is clicked. In this case, the results show that the best option for the building owner is to invest in upgrading the lighting to T8 and also adding an economizer.



Measure Package Analysis Results

Measure ID(s) with (*) means the retrofit option does not meet the investment criteria.

Annual site energy and CO_2 emissions

Measure ID(s)	Electricity (kWh)	Natural Gas (therm)	Electricity Demand Charge ($)	Energy Cost ($)	CO2 Emission (lbs)
Baseline	146,455	689	0	31,096	109,093
ECM 1	131,474	767	0	28,137	99,729
ECM 1;34	119,730	768	0	25,715	91,660
ECM 34	133,183	690	0	28,366	99,971
ECM 4 (*)	130,580	772	0	27,961	99,176
ECM 4;34 (*)	118,925	773	0	25,557	91,168
ECM 7 (*)	128,483	784	0	27,548	97,880
ECM 7;34 (*)	117,038	785	0	25,187	90,017

Annual economic analysis

Measure ID(s)	Energy Cost Savings ($)	Energy Savings (kWh)	Electricity Cost Savings ($)	Electricity Savings (kWh)	Natural Gas Cost Savings ($)	Natural Gas Savings (therm)	Investment Cost ($)	Payback (Year)
ECM 1	2,959	12,704	3,036	14,981	-77	-78	6,326	2.1
ECM 1;34	5,381	24,425	5,459	26,725	-78	-78	8,626	1.6
ECM 34	2,730	13,254	2,730	13,272	-1	-1	2,393	0.9
ECM 4 (*)	3,135	13,450	3,218	15,875	-82	-83	26,887	8.6
ECM 4;34 (*)	5,539	25,081	5,622	27,530	-83	-84	29,181	5.3
ECM 7 (*)	3,548	15,191	3,643	17,972	-94	-95	28,599	8.1
ECM 7;34 (*)	5,910	26,612	6,005	29,418	-95	-96	30,879	5.2

Annual energy and cost saving percentage

Measure ID(s)	Energy Cost Savings (%)	Energy Savings (%)	Electricity Usage/Cost Savings (%)	Natural Gas Usage/Cost Savings (%)
ECM 1	9.5%	7.6%	10.2%	-11.3%
ECM 1;34	17.3%	14.7%	18.2%	-11.4%
ECM 34	8.8%	8.0%	9.1%	-0.1%
ECM 4 (*)	10.1%	8.1%	10.8%	-12.0%
ECM 4;34 (*)	17.8%	15.1%	18.8%	-12.1%
ECM 7 (*)	11.4%	9.1%	12.3%	-13.8%
ECM 7;34 (*)	19.0%	16.0%	20.1%	-13.9%

Show Measure Package Analysis Results Only

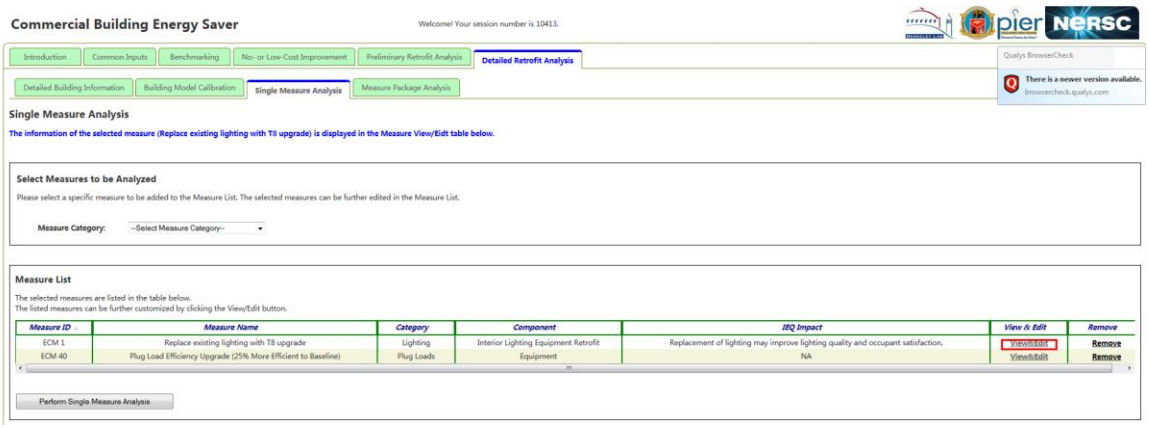
Figure 26 Measure package analysis results

Case L3.2 Detailed Retrofit Analysis with local economic incentives

Suppose that the local economic incentive for the T8 lighting upgrade program is 0.2 \$/ft^2, then the cost will be 0.432 \$/ft^2 rather than the default of 0.632 \$/ft^2, then the building owner needs to re-evaluate those upgrade plans.

Under the tab "single measure analysis", click the "View & Edit" for "ECM1- Replace existing lighting with T8 upgrade" (Figure 27), and as Figure 28 displays, change the measure cost to 0.432 and update the measure information.

Re-run the single measure analysis and the measure package analysis, the results under the new T8 incentive is shown in Figure 29.



Commercial Building Energy Saver

Welcome! Your session number is 10413.

Introduction | Common Inputs | Benchmarking | No- or Low-Cost Improvement | Preliminary Retrofit Analysis | Detailed Retrofit Analysis

Detailed Building Information | Building Model Calibration | Single Measure Analysis | Measure Package Analysis

Single Measure Analysis

The information of the selected measure (Replace existing lighting with T8 upgrade) is displayed in the Measure View/Edit table below.

Select Measures to be Analyzed

Please select a specific measure to be added to the Measure List. The selected measures can be further edited in the Measure List.

Measure Category: --Select Measure Category--

Measure List

The selected measures are listed in the table below.
The listed measures can be further customized by clicking the View/Edit button.

Measure ID	Measure Name	Category	Component	IEQ Impact	View & Edit	Remove
ECM 1	Replace existing lighting with T8 upgrade	Lighting	Interior Lighting Equipment Retrofit	Replacement of lighting may improve lighting quality and occupant satisfaction.	View&Edit	Remove
ECM 40	Plug Load Efficiency Upgrade (25% More Efficient to Baseline)	Plug Loads	Equipment	NA	View&Edit	Remove

Perform Single Measure Analysis

Figure 27 Modify the information for ECM

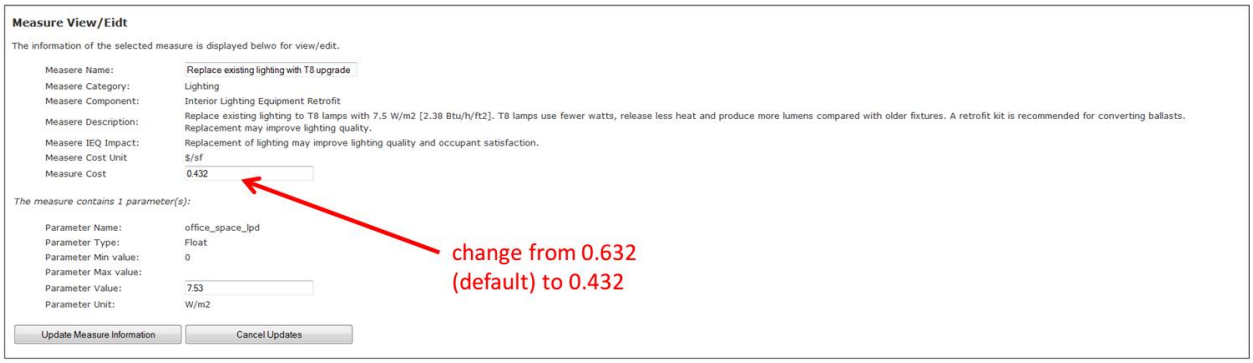
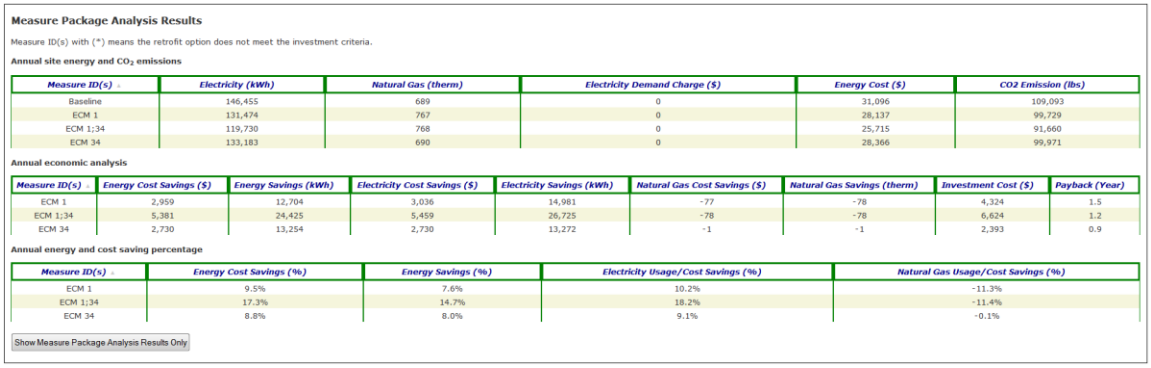


Figure 28 Change the information for T8 upgrade



Measure Package Analysis Results

Measure ID(s) with (*) means the retrofit option does not meet the investment criteria.

Annual site energy and CO_2 emissions

Measure ID(s)	Electricity (kWh)	Natural Gas (therm)	Electricity Demand Charge ($)	Energy Cost ($)	CO2 Emission (lbs)
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ECM 1	131,474	767	0	28,137	99,729
ECM 1;34	119,730	768	0	25,715	91,660
ECM 34	133,183	690	0	28,366	99,971

Annual economic analysis

Measure ID(s)	Energy Cost Savings ($)	Energy Savings (kWh)	Electricity Cost Savings ($)	Electricity Savings (kWh)	Natural Gas Cost Savings ($)	Natural Gas Savings (therm)	Investment Cost ($)	Payback (Year)
ECM 1	2,959	12,704	3,036	14,981	-77	-78	4,324	1.5
ECM 1;34	5,381	24,425	5,459	26,725	-78	-78	6,624	1.2
ECM 34	2,730	13,254	2,730	13,272	-1	-1	2,393	0.9

Annual energy and cost saving percentage

Measure ID(s)	Energy Cost Savings (%)	Energy Savings (%)	Electricity Usage/Cost Savings (%)	Natural Gas Usage/Cost Savings (%)
ECM 1	9.5%	7.6%	10.2%	-11.3%
ECM 1;34	17.3%	14.7%	18.2%	-11.4%
ECM 34	8.8%	8.0%	9.1%	-0.1%

Show Measure Package Analysis Results Only

Figure 29 Results under new T8 incentive