



Simulating Energy Savings in an Extreme Climate

Extreme weather conditions are as challenging to energy modeling software as it is to people. Yet EZ Sim has proved in a real life situation that its results are as accurate and the software is as easy to use in extreme climates as it is in the milder climates along the Pacific coast.

The Glacier County Courthouse in Cut Bank, Montana, is located in the extreme climate of the Northern Rocky Mountains. The EZ Sim simulation demonstrated good results at modeling and forecasting energy consumption even under harsh winter conditions.

“EZ Sim would work well for a lot of small, rural utilities and for older buildings.”

The reason for analyzing the Courthouse was to verify energy savings for a lighting upgrade that had already been completed. An on-site commissioning study by an engineer would have been too expensive and, as EZ Sim showed, it was unnecessary. EZ Sim provided a low-cost method of verifying that the conservation measures were working and

achieving the energy savings that were expected.

“This is what I need to show my Board of Commissioners. Now they want to see this follow-up information for any future projects,” said Merle Cowell, Maintenance Supervisor for Glacier County.

“EZ Sim would work well for a lot of small, rural utilities and for older buildings,” agreed Jeff

idea of the building’s operations than was available during the lighting audit.

In addition, over the course of a year, staff added simple weatherization measures, such as caulking and weatherstripping windows. The effects of these changes were not apparent until the second winter season because the weatherization was completed gradually throughout the year.



Harris, analyst for the Northwest Power Planning Council.

EZ Sim showed that the follow-up electricity bills agreed with an average operating day of 11 hours, not the 18 hour operating day assumed during the lighting survey done prior to the lighting upgrade. When EZ Sim was calibrated against the actual energy bills, Cowell gained a more precise

“EZ Sim is sensitive enough to pick up the changes due to weatherization activities,” commented Harris. “Now staff can check that picture every year, so they can track and

maintain O&M savings.”

EZ Sim’s results in Cut Bank demonstrate that it can model energy consumption in an extreme climate, can true-up estimates and can forecast to a second year based on results of the first year. This forecasting ability allows facility managers to set performance targets and then check to see that utility bills match expectations. ▶

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Glacier County Courthouse in Cut Bank, Montana is a three-story masonry structure totaling 18,026 square feet. The sheriff's office on one floor is open 24 hours a day. Otherwise, the courthouse operates on an ordinary office schedule. A gas-fired hydronic system provides the building with heat.

The goal of this analysis was to verify the energy savings resulting from a retrofit of the lighting system that had already taken place. For such a small facility, an on-site commissioning study would have been too expensive.

The EZ Sim simulation model is tuned to agree with the pre-retrofit bills, as shown in Figure 1. The actual monthly bills are plotted as points and the engineering simulation as lines.

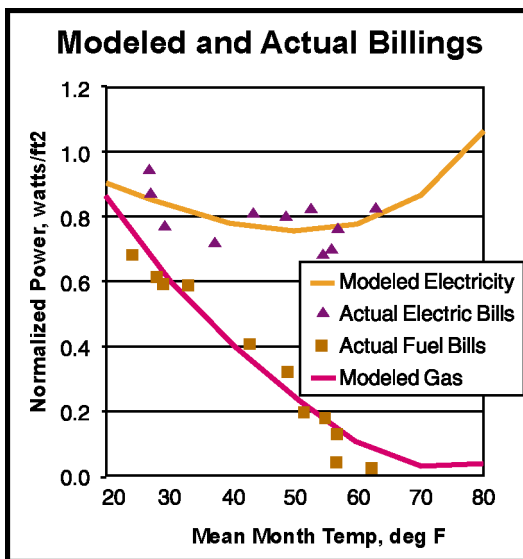


Figure 1. Billing Simulation Model

The important fact is that the observed electricity bills agree with an actual operating day of 11 hours, not the 18 hour operating day assumed during the lighting survey prior to the lighting

upgrade. In calibrating the model against the actual bills, we are gaining a more precise idea of operations than was available during the lighting audit.

The simulation model is then used to estimate energy consumption for a "typical" weather year, looking at both the existing and the new lighting fixtures. The difference in consumption represents savings.

A similar review of the post-retrofit bills revealed a puzzle. Consumption increased briefly in the second year during October. After talking with the facility manager about this increased consumption, we discovered that this period coincided with a construction project to install an entry with handicapped access. This increase was then included as an extra process load during the construction period.

The next step is to check the actual utility bills following the retrofit to see if they show the expected decrease in energy consumption.

To do this, we operate the simulation model using the actual weather and the other operational changes of the post-retrofit year. We can use EZ Sim to compute what energy consumption would have been (the baseline) with the old lighting, as well as what it should be after the installation.

Comparison of the results is shown in Figure 2. In this graph, the baseline is shown as a line, while the predicted and actual bills are shown as bars for each



month. The predicted bars are performance targets. An effective project is indicated when the actual bars match predicted bars.

In general, the bars match closely. We observed savings that were 88% of expectations.

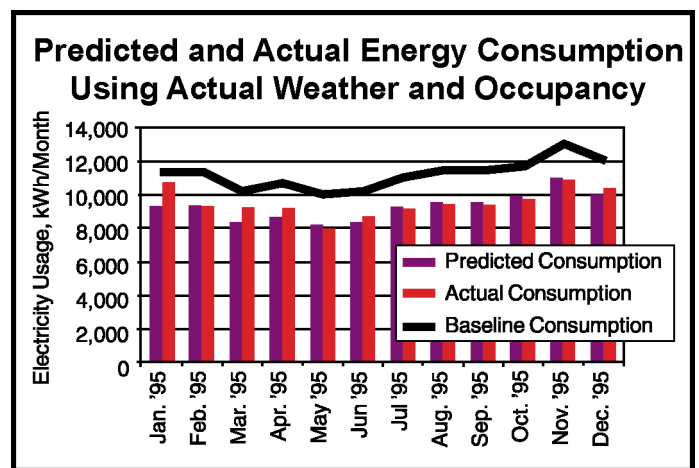


Figure 2. Post-Retrofit Results

EZ Sim's comparison of actual consumption against performance targets worked well as an effective and affordable commissioning check, showing that the new lighting fixtures were installed and operate correctly. While there is a difference from the amount of savings estimated during the light-

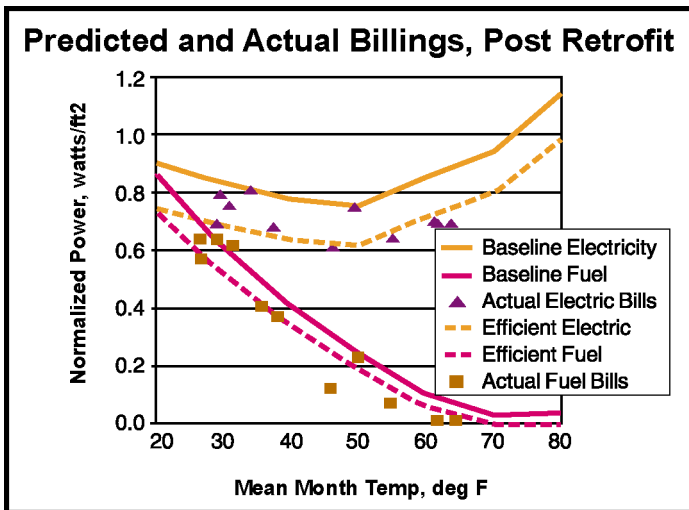


Figure 3. Post-Retrofit Bills Compared to Both Models

ing audit, that difference can be explained by the more precise estimate of operating hours afforded by the billing simulation analysis.

Another way to show the change in the building's performance is displayed in Figure 3. In this case, the data points show the bills following the retrofit. The solid lines show the baseline energy performance and the dashed lines show the performance predicted after the efficiency measures. In Figure 3, it is apparent that the billing points are in reasonable agreement with the performance targets (dashed lines), which indicates that the efficiency measures are achieving expected savings.

There were also savings in natural gas consumption, as shown in Figure 4. During this same time period, staff sealed leaks around windows and continued their process of facility improvement. This change was not apparent until the second winter season because the weatherization measures were completed gradually throughout the year.

The figures demonstrate that EZ Sim can model energy consumption in an extreme climate and, more importantly, can forecast to a

second year based on results of the first year. This forecasting ability allows facility managers to set

performance targets and then check to see that utility bills match expectations.

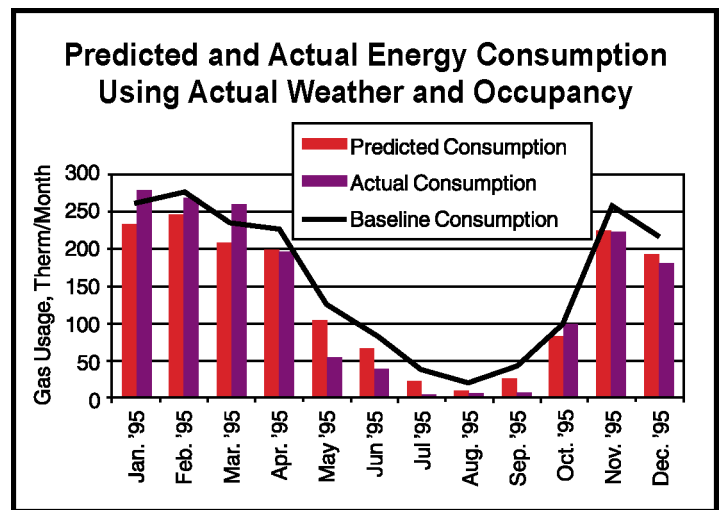


Figure 4. Post-Retrofit Gas Consumption

Modeling Parameters

Model Set-up

- Select Gas Heating
- Set lighting connected load at 0.7 W/sqft based on lighting survey.
- Other site-specific parameters: add small amount (0.02 W/sqft) of gas as external process load, based on summer consumption. This may be standby operation of the heating plant.
- Increase unoccupied ventilation rate to 0.20 ACH, reflecting partial use at night.

Model Tuning

- Set operating schedule at 11 hours per day, based on average for the building.
- Adjust heating slope factor to calibrate. Change heating use factor to 0.2 based on calibration. This is the same value pre- and post-retrofit.
- Include estimate of construction project (0.07 W/sqft) as external process load. Note it occurs only in specific months, starting in June and finishing by December.

Conservation Measures

- Efficient lighting: use 0.33 W/sqft proposed connected load from lighting survey.
- Reduce passive infiltration from 0.03 ACH to 0.01 ACH for weatherization and sealing. Eliminate process load (standby operation of heating plant).

Energy Analysis at your fingertips

EZ Sim billing analysis software

EZ Sim is the next step in energy accounting. Using actual utility bills, it reveals the patterns of use in commercial buildings.

EZ Sim:

- Diagnoses energy patterns and consumption
- Calibrates savings estimates to agree with actual energy usage
- Estimates energy end-uses within the facility
- Verifies vendor claims for energy products and services
- Generates performance targets and compares against actual energy bills

EZ Sim is a quick spreadsheet tool that is equivalent to a sophisticated engineering analysis, but you

don't have to be an engineer to use it. It's designed for resource conservation managers and facility operators.

EZ Sim uses actual energy bills and available information, so the cost to operate **EZ Sim** is almost nothing.

EZ Sim lets you use utility bills to calibrate a simulation of a commercial building in an interactive graphic window. **Once it matches the building's utility bills, the simulation model provides reliable and realistic estimates of potential conservation savings.**

With **EZ Sim**, the calibration process reveals how energy is used within the facility to **help diagnose the reasons for excessive consumption or poorly functioning components.**

Best of all, **EZ Sim** can be used to predict what future utility bills should be and can help you set performance targets to determine if installations are on track. **This is the simplest form of building commissioning — and at very little cost.**

STELLAR PROCESSES, INC.

Stellar Processes is a company of consulting engineers specializing in energy economics, measurement and verification. Experts in monitoring and commissioning large facilities as well as diagnostic evaluation of small buildings.

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