EZ SIM
BILLING ANALYSIS SOFTWARE

The "Run Away" Building

EZ Sim showed its versatility and its accuracy when analyzing a building with run away winter energy bills. While the building was initially modeled using a traditional engineering method, EZ Sim provided a quicker alternative to identify the nature of the problem, to quantify the remedies and to verify that the savings would actually occur as planned. Furthermore, EZ Sim's results compared well to the actual energy savings.

The Vantage Pointe building in Salt Lake City, UT. had generally high electric bills. But two exceptionally high heating months, each with an additional 40,000 to 50,000 kwhs of run away usage, caught the attention of the building's facility manager, who asked the local electric utility for technical and financial assistance to correct the problems.

> ***"The big improvement was in comfort. The old system was never working right. It was obsolete and a management burden. We had no end of tenant complaints."***

In a pre-retrofit review of the facility, EZ Sim found that gas bills were lower than expected and electric bills were higher, indicating that the more expensive electric terminal heaters were providing much of the heating for the building. A part of this was correctable. However, another part was due to the building's single duct system, which was not going to be changed out.

Excessive solar gains and infiltration contributed to poor comfort conditions. To deal with this problem, the HVAC system, a variable air volume (VAV) system with dampers, was operated at full volume. The airflow was controlled by the VAV box dampers and not the fan vanes. So, it really was operating more like a constant volume system.

In the commissioning stage of the analysis, EZ Sim compared the actual post-retrofit bills to performance targets. The comparison showed that post-retrofit bills agreed well with predictions, leading to some important observations. The fan control operates very well —- close to the high efficiency expected from complete digital controls — yet there is still a significant amount of terminal reheat. This electric heating is necessary due the single duct confiruation and is not due to a controls malfunction that could be corrected.

As these results demonstrate, the billing analysis tool provides a good simulation of the building's performance and compares closely with more complicated energy simulations models. With EZ Sim, it is possible to predict future consumption and savings with accuracy even in a climate, such as Salt Lake City's, with severe winter and summer conditions.

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The "Run Away" Building

The Vantage Pointe building in Salt Lake City, UT. is a four-story, 45,000 square foot office building. The building's electric bills include two run away months, each with 40,000 to 50,000 kWh of unexplained usage. The building's entire energy systems had been difficult to control and, aside from the two runaway months, the overall electrical usage was generally high as well.

The facility has a single duct distribution system. The single duct is used for heating in the early morning hours using a gas heating deck. During the rest of the day, the duct distributes cool air and resistance heaters in the distribution boxes make up any terminal heating. The fans are off at night.

Although the building's HVAC system is a Variable Air Volume (VAV) system, it was being operated as a Constant Volume (CV) system, with the fans running fully and with air flow controlled by mixing box dampers. In addition, solar gain through the single glass windows was often excessive and infiltration was so bad that papers were sometimes blown off desks. After a couple of months of run away energy performance, the building's management requested technical and financial assistance to improve it's efficiency. Although the project was developed using traditional engineering methods, we demonstrated that EZ Sim can provide similar results with much less time and effort. EZ Sim was able to identify the nature of the problem and to quantify the remedies.

To help control the building, two load reduction changes were suggested. The first was to replace the single-glazied windows with double-glazed windows incorporating increased solar shading to limit solar gains. The second building change was to install energy-efficient lighting to reduce both energy use and internal gains.

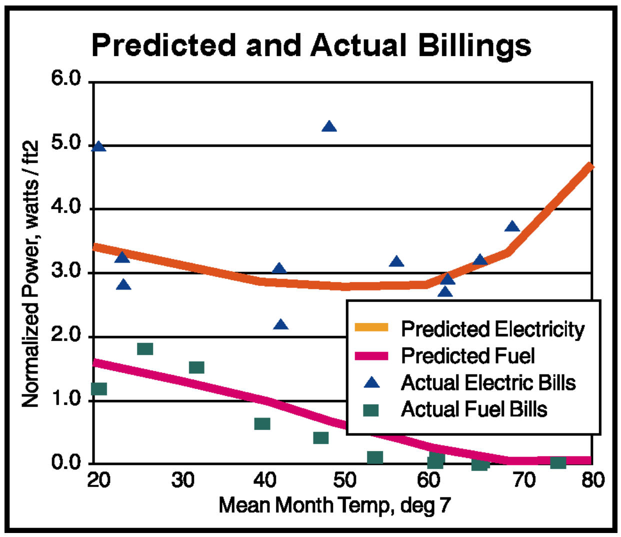

Figure 1. Pre-Retrofit Bills and Model

Pre-Retrofit Review

First, we examined the pre-retrofit performance of the building, comparing the actual bills to a simple model, as shown in Figure 1. This figure shows low gas heating use. Gas, which is a less expensive fuel than electricity, is only meeting about half of the expected heating load, while the other half must be made up with electric consumption. Although the HVAC system was described as variable air volume (VAV) with dampers, observers noted that the fan control vanes were inoperative. The air flow was controlled by the VAV box dampers and not the fan vanes. Thus, it really was operating more like a constant volume system.

Proposal stage

Next, we estimated the savings attributed to the efficiency measures, which were 1) reduced lighting, 2) solar tint glass with lower heat loss, 3) digital control of fans and VAV boxes.

We simulated the lighting measure with reduced connected load and a lower lighting usage factor due to some added occupancy controls. We also specified the improved glazing with changes to the glazing heat loss factor and the solar transmission coefficient. In this case, the replacement glazing required a new frame and effectively reduced the glazed area. We represented the digital controls

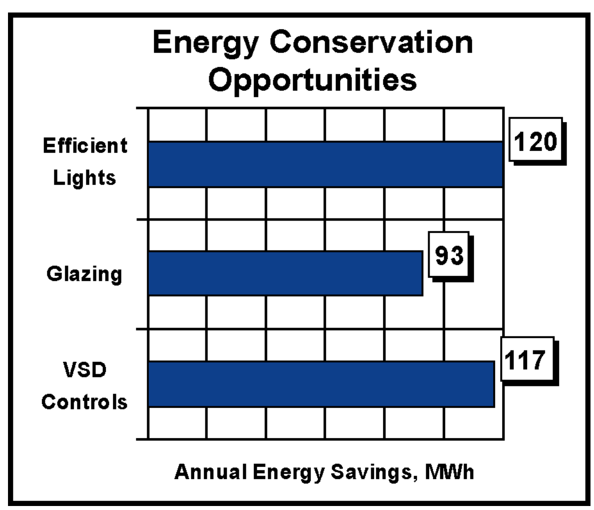

Figure 2. Energy Conservation Savings

by selecting a post retrofit fan control by VSD. The controls include pressure reset, which makes them almost equivalent to a TRAV control system.

The proposed total from all three measures, shown in Figure 2, is approximately 330 MWh/year.

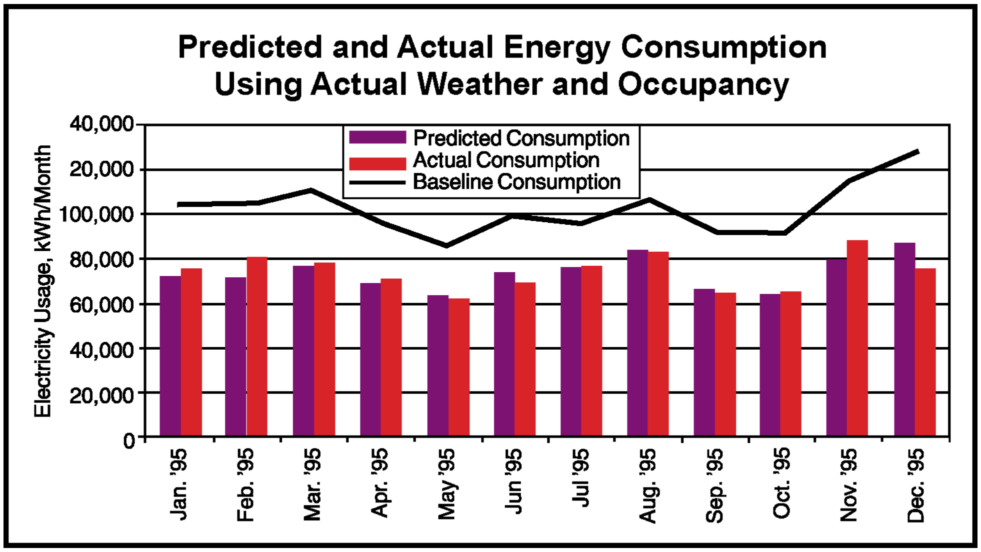

Figure 3. Post-Retrofit Bills

Commissioning stage

In this final stage of the analysis, we compared the post-retrofit billing data to predicted bills or performance targets, as shown in Figure 3. There are two important observations: (1) the fan control is very close to the high efficiency expected from complete digital controls and (2) there is still a significant amount of terminal reheat. This electric heating is necessary to heat the cooled air and is due to the single duct system.

Modeling Parameters

Model Set-up

- Select Gas Heating.
- Set lighting connected load at 2.10 W/sqft, based on lighting survey.
- Set Operating hours at average of 11 hours/day based on site audit.
- Set HVAC system for Single Cooling Duct. Set fan controls to VAV with Damper. Set Minimum Box Flow to 0.4 to reflect leaky dampers.
- Other site specific parameters:
  - change shape factor to 1.3 for geometry of this specific building,
  - include infiltration and U-value of walls/ roof based on energy audit,
  - include window area, U value and Shading Coefficient for existing windows based on energy audit.
- Set window External Shade Factor at 0.65 based on building geometry.

Model Tuning

- Adjust Heating Usage Factor to 0.3 based on calibration to match observed gas consumption.
- Increase Electric Auxiliary for space heating to 0.4 based on calibration to match both electric and gas consumption. This reflects the large ratio of electric reheat to gas heat for this building and remains the same post-retrofit.
- Adjust Cooling Usage Factor to 0.9 based on calibration.

Conservation Measures

- Efficient lighting: use 1.41 W/sq. ft. proposed connected load from lighting survey.
- Decrease Lighting Use Factor to 0.8 to reflect use of occupancy sensors in some areas.
- Efficient glazing changes:
  - reduced window area,
  - better U-value and Shading Coefficient.
- HVAC upgrade changes:
  - change controls to VAV with VSD.
  - increase Pressure Control Factor to 0.8 to reflect high efficiency of digital control system.

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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