



Precision of Savings – Verification Using IPMVP

Stellar Processes was recently invited to verify energy savings in several buildings in Jamaica using



Jamaica Public Service Company Headquarters

the EZ Sim modeling tool. The World Bank funded all of the projects and, like many government agencies, the World Bank requires verification using the Performance Measurement and Verification Protocol, or IPMVP.

The IPMVP protocol differs from traditional engineering analysis in that the verification report must state the accuracy of the estimate. For example, a savings estimate of 100,000 kWh might have a predicted margin of error of $\pm 5,000$ kWh or 5 percent. This error band is an important indicator of the significance of the estimate. If one were to suggest that the accuracy is

$\pm 200,000$ kWh, then the earlier savings estimate is meaningless.

The error band is so much larger

than the savings, and the actual savings could be zero or even negative. For this reason, IPMVP finds it important to state the error band around any estimate. Although difficult with traditional engineering tools, computation of the likely amount of error is easy with EZ Sim.

The challenges of typical Jamaican buildings

The buildings in the Jamaica program included HVAC improvements, so it was necessary to use calibrated engineering models as the method of verification. In addition, the effects of El Niño weather changed consumption in each building by as much as 10 percent – a change large enough to prevent direct comparison of pre- and post data. Thus EZ Sim also needed to correct for weather variations. It accomplished both with ease.

Overall precision of the EZ Sim

results was quite good. Savings estimates were provided with a standard error (SE) less than 5 percent of annual consumption. This value defines the level of resolution that can be expected from a monthly

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whole-building analysis. In fact, measured savings with only a 5 percent error would be difficult to observe against random noise in the billing data. For the Jamaica projects, the measures were expected to save 15 percent or more of the buildings' energy usage, so there was no problem observing clear evidence of savings.

Accurate predictions, considerable cost savings

The advantages of using EZ Sim are that the cost to implement a billing analysis is low and the results are accurate. EZ Sim uses normal monthly utility bill data — there is no additional cost to collect more detailed data. Sufficiently accurate simulations can be developed from whole-facility billing data at a greatly reduced cost compared to traditional engineering methods.



Normalizing for Weather

One might think that in a tropical climate, such as that in Jamaica, energy consumption would not



Victoria Mutual Building Society

change season to season. In fact, it does. There can be significant changes in the air conditioning loads caused by humidity. Furthermore, during the study period, participants were exposed to unusual El Niño weather effects.

Figure 1 shows the range of daily

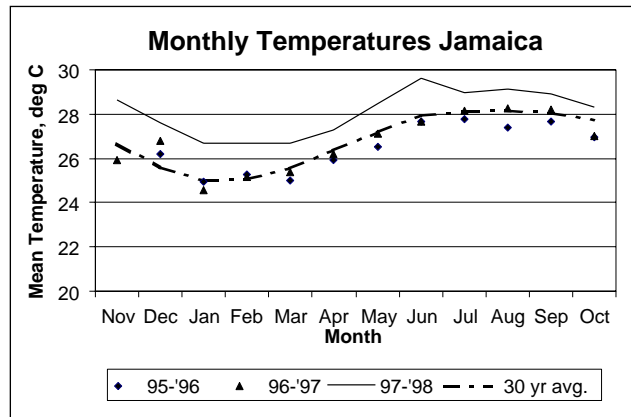


Figure 1. Deviation from Average Weather

temperatures experienced during the pre- and post-retrofit years. Conditions during the pre-retrofit period of 1996 were typical of average weather conditions. But, 1998 was atypically warm. Both temperature and humidity increased about 5 percent. Although the change may seem small, the climate-induced increase in cooling load could result in as much as a 10 percent increase in energy consumption.

The result was a climate effect of about the same magnitude as the



Pegasus Hotel

expected savings of 15 percent. A direct comparison of pre/post bills would not be able to distinguish the savings from the increased energy usage. Thus, some method of normalizing for weather had to be applied in order to accurately measure the savings.

Precision Results

Figure 2 shows estimates of savings along with associated error

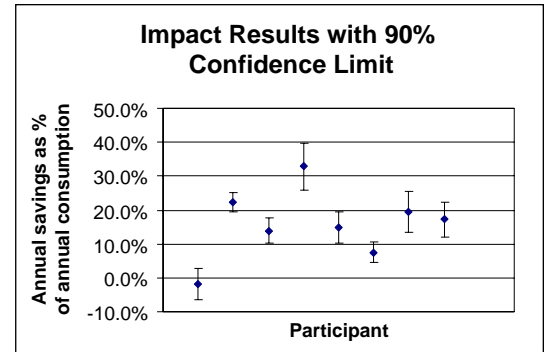


Figure 2. Impact Results and Precision

bands (within a 90 percent confidence limit). That is, we were 90 percent certain that the savings fall within the error band caused by random noise. For the first building, savings were slightly negative and not different from zero. For this project, we determined that the conservation measures were not appropriately installed. For the other buildings, the savings estimates were large relative to the amount of uncertainty.

This study demonstrated that accuracy of simulation modeling is high and cost is less compared to traditional methods. The calibrated simulation method resulted in a high level of accuracy (+4% monthly, +1% annually) at a cost of about 1 percent of the retrofit budget. This is as good a level of accuracy as could be expected from more complicated engineering models, but at a fraction of their 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

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