



REVIEW OF OPERATION OF BLACKHAWK POWER CONDITIONING UNIT IGA STORE WHITECOURT, ALBERTA

Gray Energy Economics Inc. has been retained by Backhawk Energy Saver Corp. to undertake an independent evaluation of the energy savings arising from the installation of a Blackhawk Power Conditioner at the Whitecourt Alberta IGA.

Data was provided to Gray Energy Economics regarding the average daily kW.h consumption at the store for each month from January 2012 to December 2013. Information was also provided regarding known changes in store operation and unit operation and sizing (additional kVAR was added to the installation in two stages.)

The known changes noted were as follows:

- Several refrigeration compressors were not operating during the period January 2012 through April 2012
- Blackhawk unit installed July 2012. Operational 1 week during that month.
- 5 kVAR added September 2012
- 10 kVAR additional added October 2012
- Blackhawk unit turned off November 11 to November 30, 2012.

Data on Whitecourt heating and cooling degree day records for the period were sourced from the Wolfram Alpha computational database.

Results of Analysis

Linear regression analysis of the data was undertaken to isolate the effect of the Blackhawk Power Conditioner from other known causes of changes in energy consumption.

An initial model was formulated using all available variables:

- Energy consumption per day - kW.h/day
- Some Fridges Off - dummy variable for fridge compressor operation
- Blackhawk On - dummy variable for Blackhawk operation
- Plus 5 kVAR - dummy variable for addition of 5 kVAR
- Plus 10 kVAR - dummy variable for addition of 10 kVAR
- Average daily cooling degree days by month
- Average daily heating degree days by month

Results of this formulation are as follows:

	Estimate		Variance
Base Daily Consumption	5106	kW.h/Day	70.6
Effect of Fridge Off	-259	kW.h/Day	69.0
Effect of Blackhawk On	-187	kW.h/Day	112.6
Effect of Plus 5 kVAR	-186	kW.h/Day	129.5
Effect of Plus 10 kVAR	-93	kW.h/Day	89.4
Cooling Degree Day	-109	kW.h/Day	61.6
Heating Degree Day	-11	kW.h/Day	2.9
R Squared	87.7%		

Using this formulation, the combined effect of the three dummy variables for operation of the Blackhawk total to 466 kW.h/day reduction in consumption.

The negative correlation between consumption and heating and cooling degree days suggests that other factors may be more important to store operation than outside temperature. In particular it was noted that there are not many cooling degree days in Whitecourt during the test period, with a maximum of 1.8 cooling degree days per day during July 2012.

The model was reformulated eliminating cooling degree days from the analysis and amalgamating all Blackhawk operation data into one variable Blackhawk On.

Results of this formulation are as follows:

	Estimate		Variance
Base Daily Consumption	5038	kW.h/Day	56.2
Effect of Fridge Off	-229	kW.h/Day	76.2
Effect of Blackhawk On	-445	kW.h/Day	62.4
Heating Degree Day	-8.7	kW.h/Day	2.1

R Squared		81.7%	

Using this formulation, the Blackhawk is estimated to save 445 kW.h/day in electricity consumption.

The negative correlation between consumption and heating degree days suggests that other factors may be more important to store operation than outside temperature. Determining the root cause of that relationship is beyond the scope of this study. Never the less, there is a persistent effect that consumption at the store is reduced slightly when outside temperatures are colder.

In order to completely avoid issues of model formulation arising from the inclusion of weather data, the model was reformulated using only the variable for Fridge Off and Blackhawk on.

Results of this formulation are as follows:

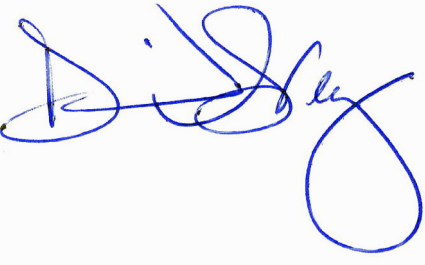
	Estimate		Variance
Base Daily Consumption	4984	kW.h/Day	73.2
Effect of Fridge Off	-332	kW.h/Day	96.6
Effect of Blackhawk On	-504	kW.h/Day	81.4
R Squared	65.5%		

The reduction in R Squared in this final formulation shows that some variance in the data was being accounted for using the Heating Degree Day data. However, it also corroborates the estimate of the daily reduction in consumption arising from the Blackhawk.

Based on my analysis of the data provided, I would estimate that the Blackhawk Power Conditioner is saving between 445 and 504 kW.h per day. These results are statistically significant at greater than a 95% confidence interval.

Using the lower estimated value, 445 kW.h per day, annual savings extend to 162,425 kW.h. At \$0.12/kW.h, it produces savings of \$19,491 per annum. Associated carbon reduction is estimated to be 130 tonnes equivalent (at 800 kG/MW.h).

Please contact myself with any questions at 1-855-3284729.

A handwritten signature in blue ink, appearing to read 'D. Gray', is centered on a light gray rectangular background.

David Gray
President
Gray Energy Economics Inc.
January 23, 2014