A Summary of Energy Consumption at MSU

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Abstract:

This research project will investigate Morehead State's use of energy and emission measurements. This research has numerous functions;
1) it allows students, faculty and staff to learn about energy consumption and eventually emissions produced by their energy consumption,
2) provides a link between MSU and the energy efficiency in the state and nation,
3) generate data that would be worthy of presentation.

Current Renovation and Ongoing Efforts:

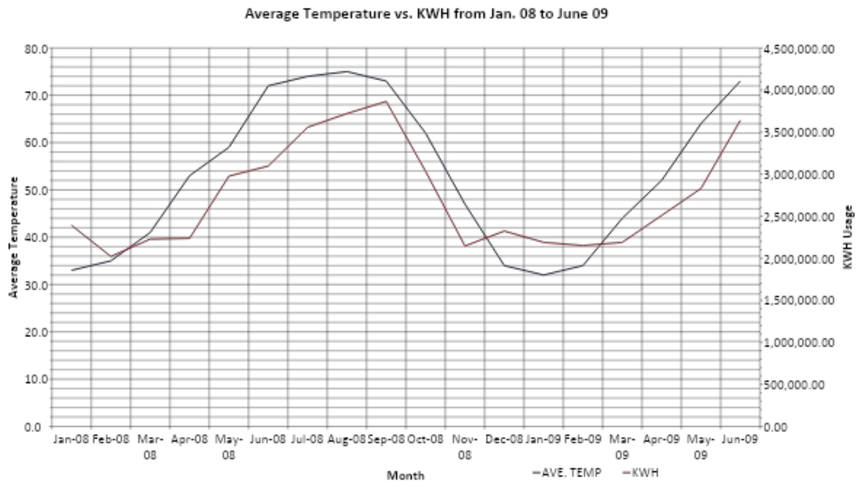
The Morehead Power Plant, which provides steam for heat and hot water in Morehead State (MSU) buildings, is replacing its usage of coal-burning with natural gas. Previously, the MSU Power Plant has utilized two coal boilers and one natural gas boiler. MSU Energy Manager, Robert Cooper, said that the switch to natural gas as the sole fuel source used at the plant was part of their efforts to reduce the carbon pollution impact of MSU on the surrounding area. Undoubtedly, the construction of the natural gas processing plant will lower greenhouse gas emissions. MSU currently runs one boiler and is installing two additional gas boilers to gain capacity to heat the entire campus during the winter of 2012.

Beyond converting from coal to gas, MSU is working on a number of different projects aimed a lowering and improving MSU's energy efficiency. Most notably is the Energy Competition that is being conducted between residents halls. This competition encourages student to conserve energy and the hall that wins gets a prize. Additionally, a new MSU Energy Club is working on forming that will provide a venue for students to learn about different sources of energy.

Methods:

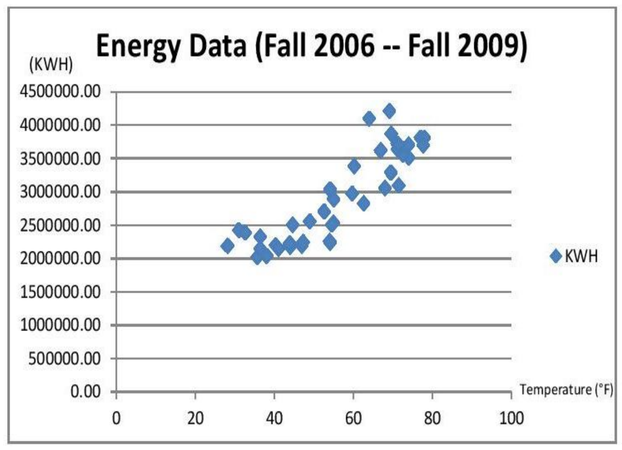
Utilize a linear regression to estimate kilowatt hour (KWH) usages as a function of the average monthly temperature (fahrenheit) for each month between July 2006 and November 2009.

The Durbin-Watson test is then performed in order to detect the presence of autocorrelation (a relationship between values separated from each other by a given time lag) in the residuals (prediction errors) from the regression analysis.



Results :

SUMMARY OUTPUT					
Regression Statistics					
Multiple R	0.877755921				
R Square	0.770455457				
Adjusted R Square	0.7645697				
Standard Error	330074.5338				
Observations	41				
ANOVA					
	df	SS	MS	F	Significance F
Regression	1	1.42616E+13	1.42616E+13	130.9016648	4.94371E-14
Residual	39	4.24902E+12	1.08949E+11		
Total	40	1.85107E+13			
	Coefficients	Standard Error	t Stat	P-value	
Intercept	651097.4889	204532.222	3.183349218	0.002858203	
AVG TEMP	40322.61789	3524.326499	11.44122654	4.94371E-14	



Durbin-Watson Test:

$$d = \frac{\sum_{t=2}^{T} (e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2} = 8.5567 \times 10^{-12}$$

Test for **negative autocorrelation** at significance $\alpha = 0.01$

$$(4 - 8.5567 \times 10^{-12}) > 1.34 = d_{U,0.01}$$

There is **no** statistical evidence that the error terms are negatively autocorrelated.

Test for **positive autocorrelation** at significance $\alpha = 0.01$

$$8.5567 \times 10^{-12} < 1.25 = d_{L,0.01}$$

There is statistical evidence that the error terms are positively autocorrelated. This agrees with average monthly temperatures predicting the temperature values of subsequent months.

Conclusions:

As expected average temperature plays a significant role determining the number of KWH used at MSU. Therefore, as we continue to move forward MSU may want to find more ways to improve the energy efficiency of its building. This could potentially lower the influence of temperature on energy usage.

Difficulties of the Study:

The data for a study like this is more complicated to collect than originally thought and has to be collected from a number of different sources. The data that we currently have only begins to tell the story and as more data is collected this study will improve.

Further Study:

There is a significant amount of data left to collect on KWH on each building, improvements that have been made to each building, square footage of each building and energy provided by source from the two different energy companies MSU purchases energy from.Obtaining data on the energy and number of students in each academic and residence building will allow for improvement of the model. This model may be applied to observe improvements in efficiency for current energy renovations.

References:

[1]SCooper Robert Interview. 19 April 2012.

[2]Daagan, Douglas M. "A Summary of Energy Consumption and Greenhouse Gas Emissions at Middlebury College." Community.middlebury.edu. Middlebury College. Web. <http://community.middlebury.edu/~cri/Emissions_InvD_dagan.pdf>.