

# A Case Study: An Energy Audit for a Small Municipality in North Carolina

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**Abstract** - Renewable resources, energy awareness, and energy conservation continue to be areas of concern that cannot be overlooked globally, nationally or locally. Western Carolina University is taking an active role in integrating energy conservation and auditing procedures in the Construction Management and Engineering Technology curricula. Students can be better prepared for entry into the workforce if knowledge and skills related to energy conservation and analysis are in place. This paper will describe an energy audit for a local municipality whose energy costs are reaching budgetary concerns for maintaining current levels of service. A discussion of the process used to conduct the energy audit for the local municipality will be presented, and recommendations to reduce the costs are provided. How the review and methodology is being used as a guide for students in the Kimmel School of Construction Management and Technology for performing energy audits will be presented.

*Keywords:* energy auditing, municipal budgets, community service, classroom enhancement

## INTRODUCTION

Western Carolina University is a regional, comprehensive university and is located in Cullowhee, North Carolina, about 45 miles west of Asheville. There are about 9000 fulltime, undergraduate students attending the University. "Western Carolina University creates engaged learning opportunities that incorporate teaching, research and service through residential, distance education and international experiences. The university focuses its academic programs, educational outreach, research and creative activities, and cultural activities to improve individual lives and enhance economic and community development in the region, state and nation" [1]

The University offers about 120 programs including construction management and engineering technology. Whenever possible, to support the University's mission, professors integrate service and engagement into the courses they teach. Engineering technology and construction management students were introduced to energy auditing during the 2007-2008 academic year when energy costs were rapidly rising, prior to the current economic turndown. This project was performed with student assistance to provide an example to students enrolled in a facilities Management course of how to organize a study with an overview of energy costs.

## REVIEW OF ENERGY BILLS

Students enrolled in CM-424, Facilities Management, are required perform an energy audit to successfully complete the course. To provide a practical energy auditing applications for students and to engage with the community, a review was performed for the city of Sylva, North Carolina. The city manager provided energy bills and building access for the investigators.

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An initial review by the instructor of the Facilities Management course of the energy bills found an annual energy cost to the city of about \$135,000 which included \$5479 for propane, \$34,667 for gasoline, and \$94,566 for electricity. Propane was used by the Fire Department (\$4475) and the Police Department (\$1004). The largest consumer of gasoline was the Police Department (\$17,582). Streetlights cost the city about \$80,903 per year in electricity.

### Propane Consumption Review

Propane is used by the Police Department and Fire Department for heating. Propane deliveries by the Blossman Company and the Freeman Company are made from November to April each year. The annual cost of propane to the city is about \$5479 plus about \$853 for tank rental and maintenance repairs, total \$6332. The Fire Department uses about 80% of the propane purchased by the city. The following questions provided a starting point for the review:

1. Why is consumption of propane by the Fire Department greater than that for the Police Department?
2. The cost of propane per gallon peaked last year during February. If bigger tanks are purchased and propane is bought during the summer months, will a savings be realized?
3. Two tanks are rented by the city at a cost of \$536 per year. Should tanks be purchased? This might also allow more vendor flexibility when purchasing propane since the tanks are rented from Blossman.

The Fire Department should be frequently checked to ensure the thermostat is set at 68 degrees Fahrenheit during winter when propane is used. A possible cost savings of 20% is suggested by the Energy Star program [2] and could amount to \$1266 per year. An Energy Star guide recommends even more aggressive temperature settings for programmable thermostats as shown below [2]:

**Table 1: Acceptable Setpoint Times and Temperature Settings**

<u>Setting</u>	<u>Time</u>	<u>Setpoint Temperature (Heat)</u>	<u>Setpoint Temperature (Cool)</u>
Wake	6 a.m.	70°F	78°F
Day	8 a.m.	62°F	85°F
Evening	6 p.m.	70°F	78°F
Sleep	10 p.m.	62°F	82°F

The city manager could not provide the costs to rent the propane tanks nor could they confirm that their propane vendors would provide better pricing based upon usage, delivery timing and tank ownership. He also stated that he would consider purchasing or renting bigger tanks to allow annual purchases of propane during the warm summer months when propane prices are generally cheaper.

### Gasoline Consumption Review

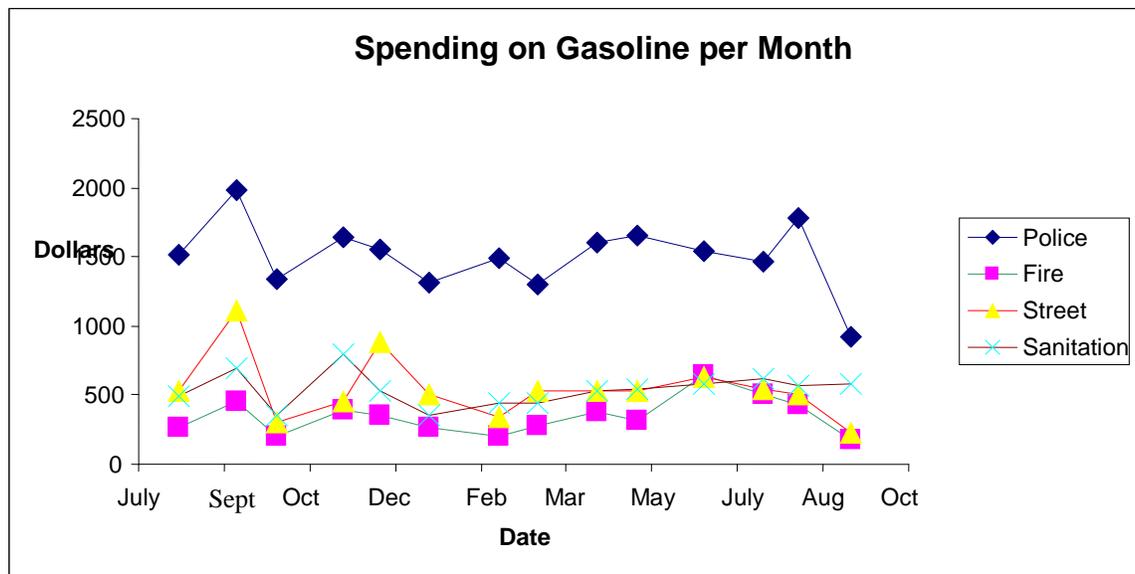
About 15,341 gallons of gasoline were used by city personnel during the one year survey period amounting to \$34,667, averaging about \$2.26 per gallon average price. The breakdown per department is as follows:

<b>Police</b>	\$17,582
<b>Fire</b>	\$4143
<b>Street</b>	\$5976
<b>Sanitation</b>	\$6336

<b>Inspection</b>	\$58
<b><u>Other</u></b>	<u>\$572</u>
<b>Total</b>	\$34,667

The City of Sylva used Fuelman credit cards to purchase fuel until August, 2006 when the City switched to Wright Express credit cards. The limited data is not definitive, but it appears the cost per gallon of gasoline increased when the credit service changed. A review of the purchase procedure for gasoline should be performed by the city manager. Gasoline should be purchased from the cheapest, most reliable vendor. In addition, the full-sized vehicles used by Sylva employees appear to be among the most fuel inefficient models on the road. When replacing vehicles, an effort to purchase more fuel efficient models is recommended where possible. The city manager stated that sometimes fuel is bought by higher priced vendors to maintain good relations.

A 30% savings of fuel costs could amount to about \$10,400. The dollars spent per department on gasoline is tracked by the city manager's office. Spending on gasoline per month by the departments is fairly consistent, see chart below, so tracking the progress of each department would be relatively simple based upon gallons used.



**Figure 1: Dollars spent by department**

**Electricity Consumption Review**

Electricity is the most costly energy concern for the City. About \$94,566 was spent during the year long survey period on electricity as shown below:

Budget Code	Description	Dollars
10.590.32	Facility	4946

19.530.13	FD	1831
10.421.13	HP	790
10.562.00	Street Lights	80903
13.620.13	Bryson Park	249
13.620.13	Rec Building	1477
13.720.13	Swimming Pool	3864
<u>10.562.00</u>	<u>Fountain</u>	<u>507</u>
	<b>Totals</b>	<b>\$94,566</b>

There were several items which warranted investigation:

1. Street lights were the most expensive energy issue for Sylva. A review of city lighting strategy with all stake holders (home and business owners) was recommended to determine possible energy savings and cost reductions. A 10% savings could amount to about \$8100. The city manager indicated that they plan to document the location of all city maintained street lights to assist with the review. The city received monthly bills for several hundred street lights, but did not really know which lights for which they were responsible.
2. The city swimming pool used a surprisingly large amount of power, even when it was not in use during the winter months. A detailed audit was recommended for this facility. A 20% savings would amount to \$773. A five minute visit to the clubhouse found that refrigerators, freezers and water pumps were provided power even when the facility was closed during the winter months.
3. The water fountain used \$507 of electricity per year, but there seemed to be considerable variation in monthly usage. A typical monthly use was only \$15, but there were monthly costs in December as high as \$201. When this issue was discussed with the city manager, he indicated that Jackson County personnel have used the receptacle located at the fountain for the annual Christmas Fair for several years. The County, not the city of Sylva should pay for this power.
4. The Fire Department used over \$1800 of electricity per year. A detailed audit was recommended to determine possible areas of savings. A 20% savings could amount to about \$360. Fire Department facilities are occupied at all times.

### **ENERGY AUDIT FINDINGS AND SUMMARY**

The City of Sylva may be able to reduce the city power bill by nearly \$21,000 (16%) by implementing the recommendations outlined in this report. While this amounts to a very small portion of the city budget, it is the right thing to do to for the environment, for city taxpayers and for future energy cost control.

During future budget planning cycles, city officials might consider using government provided energy forecasts to ensure that budgets are adequate to support city services. Energy costs could increase in the future. This is a fact everyone may agree upon, but how much is anybody's guess. But, according to the United States Government projections found during the review, oil prices per barrel decreased as shown below and forecasted by the United States government [3]:

<b>Year</b>	<b>Expected</b>	<b>Hi</b>	<b>Low</b>
2007	55.62	59.26	53.86

2008	52.3	59.87	48.88
2009	50.14	61.12	44.91

Prices per barrel were expected to fall 9.9% from 2007 to 2009 according to government projections. The price per barrel of oil at the time of the review was about \$60 to \$65 dollars per barrel. Upset conditions can occur as was seen when oil prices increased to \$140 per barrel during 2008.

### **Educational Merit**

Educational merit was also shown by the uniqueness of this approach. It is worth noting that these skills are not always explicitly taught in construction management curricula where the focus has been on content and analytical skills of specific construction management disciplines. Industry and the Accreditation Board for Construction Management nonetheless do expect graduates to have well developed skills in the areas of facilities management including energy auditing and review.

All students who enroll in the Facilities Management course at Western Carolina University must perform an energy audit of a non-residential facility to complete the requirements of the course. These student audits are graded first for grammar and spelling and then for content accuracy. The specific project described in this discussion was used to provide students with an example of a possible approach methodology to initiate their own audits. In addition, students were used to collate and organize the paper copies of bills and other data provided by the city manager. Once organized, the data and assessment were provided for students enrolled in the Facilities Management course.

### **SUMMARY AND CONCLUSION**

The approach of actual energy audits and reviews implemented in the construction management program at Western Carolina University provides a logical and systematic method for building on theory and effectively implementing project based learning methods. Through immediate feedback, students can gain a better understanding of problem definitions, logical solutions, and application techniques. Further, as evidenced by student feedback, the ability to apply theory and knowledge gained from lectures was demonstrated in a more positive manner when compared to traditional methods and the use of only textbook examples. Based on the positive feedback from the local municipality and students, this approach was successful and provides an alternate means to teach the procedures for conducting energy audits.

### **REFERENCES**

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