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S1_8 Energy Saving In the Home

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Abstract

This article explores some of the major contributors to energy consumption within the student household and investigates various ways of reducing this consumption fairly easily and thus saving money. It is found that a house of three students will save approximately £295.65 per student over four years.

Introduction

Let's face it, students are always looking at ways to save money, and quite often, the planet along the way. By the time a student reaches the fourth year of a degree with a £24000 debt in their pockets, you can see why one would be keen to not spend unnecessary money. One way to do this is to save money within the home. Due to length restrictions on this article only a few ideas are approached and investigated, however, if the reader wishes to learn more about saving within the home see reference [1].

Investigation

Using a local 3-person Howard Road household as an example student home, we have investigated the annual money saved by using energy saving options such as changing light bulbs, having showers instead of baths, installing double-glazed windows instead of single (the installation costs of course paid by the landlord).

First we look at light bulbs. The normal wattage for a room light bulb is 60watts. For a three person house we estimate that, on average, four bulbs are used for a total of 6 hours a day (assuming that there are no particular dark and cloudy days). The electricity cost is approximately 14.4 pence per kW hour [2]. Now the equivalent energy saving light bulb to a 60W traditional bulb uses 12W [3]. Using simple calculations (see below) we can see that switching light bulbs saves a fairly significant (being ~£20 per student per year) amount of money.

Using the formula:

$$KptN \times 365$$

where N=4 and represents the number of bulbs, p is the pence per kilowatt hour, K is the power of the bulbs, and t=6 and is the operation time in hours. A traditional bulb costs £76.00 per year whilst an energy saving bulb costs just £14.72. This is a saving of approximately £61.28 per year per house. Therefore, a student at university using energy saving bulbs instead of traditional ones for four years would save approximately £81.72.

Next the difference between shower and bath power consumption is investigated. Severn Trent approximates that a 5 minute shower uses approximately 40 litres of water whilst an average sized bath uses about 100 litres (this excludes power showers which can use more water than a bath) [4].

Approximating the temperature of a comfortable bath as 50^0c and the incoming water to be 10^0c, the energies for a bath and a shower are calculated in equations (1) and (2) as follows;

$$\begin{aligned} Q_{bath} &= cm\Delta T \\ &= 4200JL^{-1}K^{-1} \times 100L \times 40K \\ &= 16.8MJ = 4.67\ kWH \\ &= 65.38p \text{ per bath} \end{aligned} \tag{1}$$

$$\begin{aligned} Q_{shower} &= 4200JL^{-1}K^{-1} \times 40L \times 40K \\ &= 6.72MJ = 1.87kWH \end{aligned} \tag{2}$$

= 26.18p per shower

where m is the mass of water, c the specific heat, and ΔT the change in temperature. By replacing 1 bath per week with a shower, this would save approximately £20.39 per person per year. Again, for a four year course this saves a student a total of £81.56.

Replacing single glazing windows with double glazing creates an extra insulating barrier between the windows. This barrier is in fact trapped air and it helps to reduce heat loss, noise and condensation. The following calculations work out the heat loss through single and double-glazed windows. The equation for heat loss through the window is [5]

$$Q=U\Delta TA \qquad (3)$$

where U is the 'U-value' of the material in W/m^2K, ΔT the change in temperature across the window, and A is the surface area of the window. Again, taking Howard road as a typical student property we approximate the total surface area of windows in the house to be 6 multiplied by $1.5m^2$. The U-value for single-glazed windows is 4.8 and for double-glazed 3.1 (with a 6mm air-filled gap between panels) [6]. So, during the winter (when heating is used in the house) the heat loss for single-glazed windows is

$$Q_{single}=4.8W/m^2K \times 20K \times 9m^2 = 950.4\text{Watts}. \qquad (4)$$

The 20K comes from the temperature difference across the window where $22^{o}c$ is comfortable room temperature whilst $2^{o}c$ would be a typical winter weather temperature. The heat loss for a double-glazed window is

$$Q_{double}= 3.1 \times 22 \times 9 = 613.8W \qquad (5)$$

Using a model where the thermostat comes on whenever the temperature drops below $22^{o}c$ so that the temperature is always ~$22^{o}c$ in the house, the total energy loss over 24hours can be found (Remembering that the total energy supply and energy rate is different). So, from equation 4 the total energy supply and thus the total spend in a day can be found for single-glazed windows.

$$\text{Energy supply}= 950.4W \times 86400sec \qquad (6)$$
$$= 82.0MJ = 22.8kWH$$

Therefore, the price for heating for one day is £3.19. For an identical house with double-glazing instead, the energy supplied is

$$613.8 \times 86400 = 53MJ \qquad (7)$$
$$= 14.7kWH.$$

So the price of a day's heating is £2.06. This equates to a saving of £1.13 per day with double glazing instead of single. As the winter period lasts about 3 months this would be a saving of approximately £101.70 a year for the house (assuming you don't have the heating on during the spring, summer and autumn periods). So in the 4 years of study this equates to an approximate saving of £406.80 per house and £135.60 per person.

Conclusion

Overall, using all the energy saving options that have been suggested in this article, a 4 year student would save a total of £298.88 by the end of the course. Obviously, this is a significant amount to save for any student which could be spent on other worthwhile investments. In fact, the writer has established that about 119 extra beers could be bought with this saved money (with the average price of a student beer being £2.50).

References

[1] http://www.energysavingtrust.org.uk
[2] https://www.utilitywarehouse.co.uk/home/Energy/
[3] http://www.lightbulbs-direct.com/article/energy-saving/
[4] http://www.stwater.co.uk/upload/pdf/Guide_to_saving_water_20070214115454.pdf
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[6] http://www.puravent.co.uk/AppendixA_UValues.pdf