Watts On Your Mind?

Solar energy educational activities for schools

Activity Overview

Grade Level: 9-12
Activity: HS-2

Description

Students will investigate energy-related products in terms of cost effectiveness. They will also discuss factors that cause people to buy products.

Learning Outcome

Students will learn to evaluate energy-related purchases in terms of cost-effectiveness, i.e., time to "pay back" and "rate of return" on investment.

Subjects

Social Science, Physical science

Process Skills Used

Discussion, application, calculation, data collection, analyzing and computer literacy

Duration

About 2 - 3 class periods

Key Vocabulary

Simple payback, cost benefit analysis, rate of return, life cycle costing

Curriculum Standards

Texas (TEKS): 112.42.b.1
Louisiana (LSCS):
PS-H-F1, SE-M-A6
Arkansas (ASCF): 3.1.34
National (AAAS Project 2061):
The Designed World – 12th

Cost Effective Buying

Materials

- Student worksheet provided

Method

Teacher will explain the concepts to the students. The students will then practice buy/no-buy sample problems on the student worksheet provided. Teacher may also wish to enhance the experience by inviting a salesperson of energy-related products to speak to the class. The teacher should also discuss other criteria which motivate people to buy; e.g. impulse buying, perceived benefits.

Discussion

When we feel impelled to buy a more fashionable garment or an avocational device (e.g. a stereo, a VCR, a boat) we do so with satisfaction in the knowledge that the purchase will enrich our lives. We buy labor-saving appliances because they will minimize our work and give us more time for other activities (e.g. leisure). Consider the motivational factors for purchasing an "energy-saving" heating or cooling system. One might name "convenience," "dependability," "good servicing support," "brand name," "low first cost," "low cost to operate," and "estimated future energy/money savings," as factors influencing the decision to purchase. That last factor, "estimated future energy/money savings," reflects the consumer's awareness of the rising cost of energy and his or her determination to reduce energy bills, save money, and as a result, save energy as well. We expect the heating and cooling system to eventually "pay for itself." We calculate how much time will pass before the monthly savings offset the purchase price. Simple "payback" is the quotient of the total installed cost divided by the first year's dollar savings. If tax credits are available, they should be subtracted from the

installed cost. The inverse of simple payback is the first year's "rate of return." An example will help to clarify this:

> A high efficiency air-conditioner replaces an older model. It costs $360 installed and is estimated to save you $10 each month it operates or $40 a year. Simple Payback is $360 divided by $40/year or 9 years. Rate of Return for first year is ($40/360) 100 or 11.1%

These cost figures enable us to compare one purchase option against another. A more accurate analysis would take into account factors such as interest, tax, and inflation factors. Interest, for example, is always a factor because, even if we pay cash, we must consider the interest our capital would have earned had it been otherwise invested. Taxes are a factor because the interest we pay on a loan (finance charge) may be an allowable deduction on our income tax return and the interest which we may receive on our capital, otherwise invested, is taxable. Inflation is a factor because it has been with us a long time and because the cost of our conventional energy resources, limited in supply, will rise.
A readily available and inexpensive microcomputer program entitled "Cost Benefit Analysis" is available which makes this more accurate calculation which is called a cost benefit analysis. In the program the "present value" concept is used to take into account the time value of money. That is, savings which will accrue to my account next year in the amount of $100 must be discounted to reflect the amount of money today which, because of interest added, would result in $100 next year. The source of this program is given in the Sources section.

Procedure

A. Energy-saving devices depend on different energy sources: e.g. natural gas, electricity. Students should obtain from home the average cost of energy sources used. For example:

1. Electric bills
   C = dollar cost
   H = kilowatt-hours used
   K = cost per kilowatt-hours (kWh)
   C/H = K

2. Natural gas bill (amount used will be in therms or cubic feet).
   a. C = dollar cost
      A = amount of therms used
      T = cost per therm
      C/A = T

b. C = dollar cost
A = amount of 100 cubic feet used (CCF)
F = cost per CCF
C/A = F

Note: If you want to convert these to Btu use the following

1. Kilowatt-hour = 3413 Btu
2. therm = 100,000 Btu
3. CCF = 100 (H.V.) Btu

Where H.V. is the Heating Value in Btu/cubic feet (to obtain the heating value or Btu/cu.ft. of natural gas, contact your gas company.)

1. Student should work sample problems on Student Worksheet provided.
2. (Optional) Obtain the Energy Education Software Series program "Cost Benefit Analysis" from the Energy Division, Alabama Department of Economic and Community Affairs (See Sources). Follow the directions in the program's Teacher's Guide.

EXTENSIONS

1. Visit an appliance store and read the energy- rating label and record the expected annual savings and the dollar costs of three refrigerators. Compute the simple pay back and first year rate of return for each of them.
2. Perform Step (1) using energy-rating label data from three air-conditioners.
3. Perform Step (1) using energy-rating label data from three space heaters.
4. Life Cycle costing is a technique for evaluating purchase options. This is done by comparing the total lifetime cost of buying, installing, operating, maintaining, and salvaging an appliance referenced to the same time value of money. Look up "life cycle costing" and report to the class. What is meant by salvage value? List the factors evaluated in the calculation.
5. Based only on operating costs (e.g. ignoring maintenance cost) determine what the payback would be on a new car of your choice.
6. Have students calculate the Btus for the electric bill and gas bill and discuss factors that explain how they compare to the Btu's of others in the class. (NOTE: Size of home, number in family, direction house is facing, etc.)

COST EFFECTIVE BUYING STUDENT WORKSHEET

The money you save by replacing a worn-out energy consuming system with a more efficient one adds up and will eventually repay you for making the purchase, if the payback time is less than the system's lifetime. Simple "payback" is computed by dividing the total installed dollar cost by the annual dollar savings. The first year "rate of return" is the inverse of the payback time in percent or may be computed by diving the annual dollar savings by the system's total installed dollar cost.

COMPUTE PAYBACK AND THE PERCENTAGE RATE OF RETURN IN THE FOLLOWING PROBLEMS:

1. You can choose one of the following insulations with the following results:

   Insulation #1 Installed Cost = $200 Annual Savings * = $120
   *Savings from reduced fuel bills due to added insulation.

   Insulation #2 Installed Cost =$235 Annual Savings = $145
   Payback: Insulation #1 = ___ yrs. Insulation #2 = ___ yrs.

   Rate of Return on your investment:
   Insulation #1 = ___ % Insulation #2 = ___ %

   Which one do you choose? _____

2. You can choose one of the following water heaters with the following results:

   Water Heater #1 Installed Cost = $325 Annual Savings* = $19
   **Thicker wall insulation in the new water heater.*

   Water Heater #2 Installed Cost = $1475 Annual Savings* = $150
   **Solar water heater that only uses purchased energy when not enough solar energy is available*

Payback:	Water Heater #1 = ___	Water Heater #2= ___
Rate of Return:	Water Heater #1 = ___	Water Heater #2 = ___

   Which one do you choose? _____

3. You can choose one of the following room air-conditioners with the following results:

   Air Conditioner #1 Installed Cost = $220 Annual Savings = $15
   Air Conditioner #2 Installed Cost = $435 Annual Savings = $35

Payback: Air-conditioner #1 = ___ Air-conditioner #2 = ___
Rate of Return: Air Conditioner #1 = ___ Air Conditioner #2 = ___

Which one will you choose? _____

Source: Alliance to Save Energy (Credit: This activity adapted from *What Color Absorbs the Sun's Heat Best*, created by the Solar Energy Research and Education Foundation, www.seref.org.)