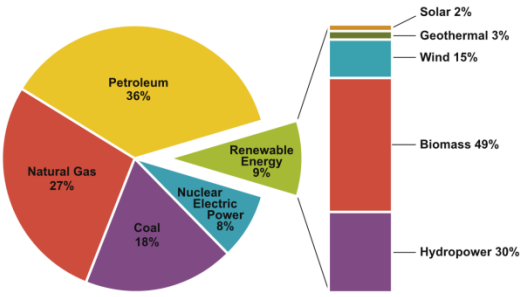
Renewable energy: Why is it so important?

Breakdown of energy sources



United States energy sources for all sectors, 2012*

*US Energy Information Administration, April 2013, Monthly Energy Review, Table 1.3 and 10.1. Accessed: 23 December 2013: http://www.eia.gov/totalenergy/data/monthly/archive/00351304.pdf

SECTION A

Introduction

We all use energy—to travel to school, charge electronics, turn on lights, and even to fill a cup with water. Where does this energy come from? Energy sources fall into two categories: non-renewable and renewable.

Non-renewable energy sources	Renewable energy sources
Coal	Solar
Petroleum	Wind
Natural gas	Hydro
Nuclear	Geothermal

Non-renewable energy comes from sources that cannot be renewed over a short period of time. For example, all the petroleum we use today was formed hundreds of millions of years ago. Any petroleum we might try to make today would not be ready for millions of years. Non-renewable energy sources such as coal, oil, and natural gas generate harmful pollution and contribute to climate change when they are burned.

Renewable energy, in contrast, comes from sources that are replenished in a short period of time. In some places, the sunshine provides usable solar energy on most days. In other regions, the wind blows regularly, making it possible to reliably generate energy from the wind. Finally, in some locations, rivers flow continuously to produce hydro energy. When renewable energy sources are used, they produce very little to no pollution or greenhouse gasses.

In the United States as in South Africa, a majority of the energy consumed was generated using non-renewable resources. Petroleum was the largest source of energy followed by coal and natural gas.
Energy conversion is the process of transforming energy from one form into another. Energy contained in fossil fuels or solar radiation can be converted into other forms of energy (e.g., electrical or kinetic), which are more useful to us. For example, when you travel in a conventional car, the car is converting fossil fuel energy (petrol) into the energy of motion (kinetic and heat). If you heat up food on an electric stove, the stove converts electrical energy into heat.

In this experiment, you will examine how a light bulb converts electrical energy to light energy. Light bulbs are usually sold according to the amount of electrical power they consume. You will investigate the relationship between the power rating of a light bulb and the amount of light it produces

Objectives

- List examples of non-renewable and renewable energy sources and describe the differences between them.
- Learn about energy conversion.
- Gain familiarity with a Light Sensor and data-collection equipment.
- Calculate the reduction of carbon dioxide production when using renewable energy sources
- to generate electricity in place of non-renewable energy sources.

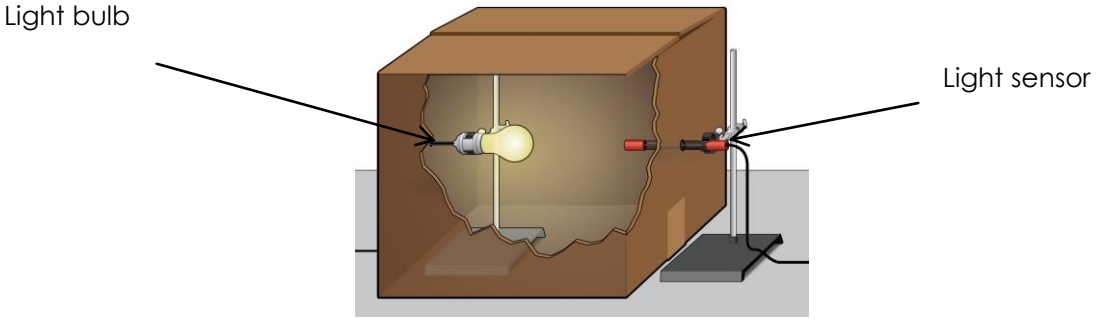
Preliminary Questions

1. What job does a light bulb do? What are the unintended effects of turning on a light bulb?
2. What energy transformations take place when electrical energy is applied to an incandescent light bulb?
3. What factors should be considered when comparing different kinds of light bulbs?

SECTION B Experiment

- Equipment
- Computer
- Logger Pro
- Light Sensor
- 60 W, 75 W, and 100 W incandescent bulbs
- 2 Ring stands
- 2 Utility clamps
- large box with a small hole in the side

Set up the equipment as shown below:



PROCEDURE

1. Set the range switch on the Light Sensor to 0–6000 lux and connect the Light Sensor to the interface. Start Logger Pro and choose New from the File menu.
2. Prepare for data collection.
   a. Clamp a lamp fitted with a 60 W incandescent bulb to one ring stand using a utility lamp.
   b. Place the light bulb and ring stand into a large box.
   c. Insert the Light Sensor in a hole directly opposite the light bulb.
   d. Clamp the Light Sensor to the other ring stand using a second utility clamp.
3. Turn on the lamp.
4. Click ▶ Collect to start data collection.
5. When data collection is complete, choose statistics from the Analyze menu. Record the illumination value (in lux).
6. Turn off the lamp and allow the bulb to cool. Caution: The bulb will be very hot.
7. Once the bulb is cool to the touch, replace it with the 75 W bulb. Repeat Steps 3–6.
8. When the bulb is cool to the touch, replace it with the 100 W bulb. Repeat Steps 3–6.

Results Table

Light Bulb (W)	Illumination (lux)	How many bulbs needed for 9000lux	Total electricity usage for 8 hr/day for 20 days (kWh)	Cost (R)

Questions from the data

1. Assume you want a light level of 9000 lux in a room. Calculate how many bulbs of each wattage are needed. Record the answers in the data table.
2. In a typical classroom, lights are on for 8 hours/day for 20 days in a month. Based on the number of light bulbs needed for each wattage, calculate the total electricity usage in kilowatt-hours (kWh) to run the bulbs for 8 hours/day for 20 days.
   Note: 1 kW=1000 W
3. Use the electricity cost from your region to calculate the cost to run the bulbs for 8 hours/day for 20 days.
   (Assume that the cost of electricity is R1.75 per kilowatt hour (kWh))

SECTION C

ANALYSIS QUESTIONS

1. Which wattage of light bulb would you choose to use to create a light level of 9000 lux? Why?

2. Determine the carbon dioxide production to generate electricity to light the light bulbs that you need to produce 9000 lux for 8 hours/day for 20 days. Perform calculations for the two types of fossil fuel in the table below.

Type of fossil fuel	Light bulb (W)	Total electricity usage for 8 hr/day for 20 days (kWh)	CO_2 production[4] (lbs CO_2/kWh)	CO_2 production from energy production (lbs)
Natural Gas	60		1.22	
Natural Gas	75		1.22	
Natural Gas	100		1.22	
Coal	60		2.08	
Coal	75		2.08	
Coal	100		2.08	

3. Electricity generation from non-renewable energy sources produces higher carbon dioxide levels than electricity generation from renewable energy sources.
   Determine how much carbon dioxide would be produced to light the bulbs for 8 hours/day for 20 days if you were to use wind or solar to produce electricity. How does this compare to the amount of carbon dioxide that would be produced if electricity was generated using natural gas as the energy source?

When performing your calculations, imagine your classroom is set up using the light bulb configuration that produces the least amount of carbon dioxide based on your data from the previous question.

Energy source	CO_2 production[5] (lbs CO_2/kWH)
Wind	0.03
Solar	0.15

SECTION D

Further Questions- Extension/Project

1. Some lights have coatings to affect the quality of the light, making the light "soft," "bright,"or "daylight." Using a selection of light bulbs with the same wattage rating, compare light levels.
2. Research the mix of energy sources that are used to produce electricity in your region. Are renewable options available?
3. Research the environmental impact associated with producing and disposing of different types of light bulbs. You can also examine cost and expected life time of different types of bulbs. Write a letter to your school or family making recommendations for replacing the light bulbs in your classroom or house.

Wanneer die berekeninge gedoen word, moet jy aanneem dat jou klaskamer se gloeilampe die kleinste hoeveelheid koolstofdioksiedgas vrystelling lewer soos bepaal deur die vorige vraag.

Energiebron	CO_2 vrystelling[5] (lbs CO_2/kWH)
Wind	0.03
Son	0.15

AFDELING D

Verder Vrae - Uitbreiding/Projek

1. Sommige ligte het 'n bedekking wat die kwaliteit van die lig affekteer sodat die lig meer "sag", "helder", of "daglig" vertoon. Gebruik 'n verskeidenheid van gloeilampe met dieselfde watt-waarde en vergelyk dan die liguitset.
2. Doen navorsing oor die verskeidenheid van energiebronne wat in jou omgewing gebruik word om elektrisiteit op te wek. Is hernubare opsies beskikbaar?
3. Doen navorsing oor die impak wat die vervaardiging en vernietiging van gloeilampe op die omgewing het. Jy kan ook ondersoek instel na die kostes om verskillende gloeilampe te vervaardig en die verwagte leeftyd daarvan. Skryf 'n brief aan jou skool of jou familie waarin jy voorstelle maak om die gloeilampe in jou klaskamer of in jou huis te vervang.