

Cool School Challenge



Green Up Your Power!

TEACHER GUIDE

In this activity, students will learn about the concept of green power. They will determine the value of green power for themselves and for their community by measuring personal financial costs and carbon dioxide emissions saved.

Objectives:

Students will be able to:

- Clearly define green power.
- Calculate the cost of purchasing varying amounts of green power.
- Calculate the savings in carbon dioxide emissions of purchasing green power.
- *Optional:* Research a local green power Project [needs Internet access]

Class Time:

- 50 minutes as homework with 30 minutes pre- and post-discussion, *or*
- 100 minutes in-class.

Materials:

- Copy of recent electricity bill
- Green Up Your Power Introduction
- Green Up Your Power Student Worksheet

Teacher Directions:

1. Lead a group discussion using the Introduction to this activity or assign as in-class reading. Either have them look up green power program(s) offered by your local utility or provide that information

Grade level: 7-12

Subjects:

Science; Economics; Math; World / Global Studies; Social Sciences.

Concepts:

Green power, sustainable resources

Washington State EALRs:

Science: 1.2, 3.1, 3.2

Economics: 2.3, 3.1

Math: 1.1, 1.5, 3.1, 3.2, 3.3, 5.2, 5.3

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available to them. You can look up regional and national programs using the U.S. Environmental Protection Agency's Green Power Locator: <http://www.epa.gov/greenpower/pubs/glocator.htm>

2. Make sure students understand how to perform the calculations needed for the Student Worksheet.
3. Assign Student Worksheets as in-class activity or homework. Remind students they will need a copy of a recent electricity bill. (Have samples handy for students unable to procure copies from home -- ideally from your local utility. Otherwise, you can use the enclosed sample from Puget Sound Energy.)
4. Discuss student results and review the Questions on the Student Worksheet.

Extensions:

- Either as homework or in class, have students input their various green power purchase scenarios into the U.S. EPA's Greenhouse Gas Equivalencies Calculator for more perspective on the climate benefit of buying green power. For greatest impact, have students **annualize** the kWh of green power purchased. <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>
- Have students complete the *optional* Research a Renewable Energy activity, enclosed.
- Have students research a rock band that offsets its carbon emissions, and explore why some bands choose to buy green power.

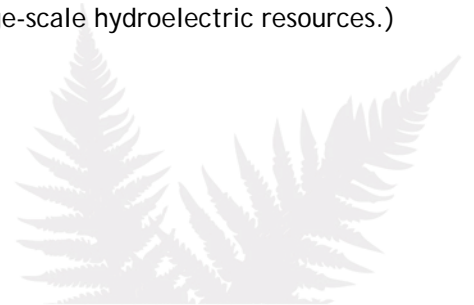
Glossary:

Renewable energy - includes resources that rely on fuel sources that restore themselves over short periods of time and do not diminish. Such fuel sources include the sun, wind, moving water, organic plant and waste material (biomass), and the earth's heat (geothermal). Although the impacts are small, some renewable energy technologies have an impact on the environment. For example, large hydroelectric resources can have environmental trade-offs associated with issues such as fisheries and land use. (*Source:* U.S.

Environmental Protection Agency, Green Power Program.

<http://www.epa.gov/grnpower/gpmarket/index.htm>)

Green power- a subset of renewable energy, representing electricity generated from non-polluting, renewable resources that provide the highest environmental benefit. This includes electricity from solar, wind, geothermal, biogas, biomass and low-impact small hydroelectric sources. (*Note:* green power as defined by the U.S. Environmental Protection Agency does **not** include large-scale hydroelectric resources.)



Resources:

- U.S. Environmental Protection Agency - Green Power Program - <http://www.epa.gov/grnpower/gpmarket/index.htm>
- U.S. Environmental Protection Agency Green Power Program - Green Power Locator <http://www.epa.gov/greenpower/pubs/gplocator.htm>
- The NEED Project Energy Infobooks - <http://www.need.org/EnergyInfobooks.php>
- U.S. Department of Energy - Energy Efficiency and Renewable Energy <http://www.eere.energy.gov/>
- National Renewable Energy Laboratory - <http://www.nrel.gov/>

Puget Sound region green power programs:

- Puget Sound Energy - Green Power Program http://www.pse.com/solutions/foryourhome/Pages/home_greenPower.aspx
- Seattle City Light - green Up!
<http://www.seattle.gov/light/green/greenPower/greenup.asp>
- Snohomish County Public Utility District- Planet Power Program
<http://www.snopud.com/energy/home/plpwrpgm.ashx?p=1793>
- Tacoma Power - Evergreen Options
<http://www.tacomapower.com/greenpower/default.htm>



Cool School Challenge



Green Up Your Power!

INTRODUCTION

Every time you turn on a light, plug in your iPod, or flick on the television, you probably don't spend too much time thinking about where your electricity is coming from or how it's generated - let alone what 'color' it is! But the resources used to generate electricity have an impact on air quality and the climate, which is why all across the country, more and more utilities are now investing in 'green' power. Green power refers to electricity that comes from non-polluting, renewable resources such as wind, sun, biomass and geothermal heat. These sources of energy are constantly replenished - naturally - and never run out. They also do not generate air pollution or greenhouse gases. Compared with nonrenewable resources such as coal, natural gas and oil (which are limited in supply, generate air pollution and greenhouse gases, and often need to be imported from overseas), green power is a more sustainable source of electricity for the future. So in many ways, investing more in green power makes a lot of sense. But *-does it make cents?*



In this activity you will explore the answer to this question, by taking a look at green power programs offered by your local utility company. You'll compare the added cost of buying cleaner, greener power to the environmental benefit.

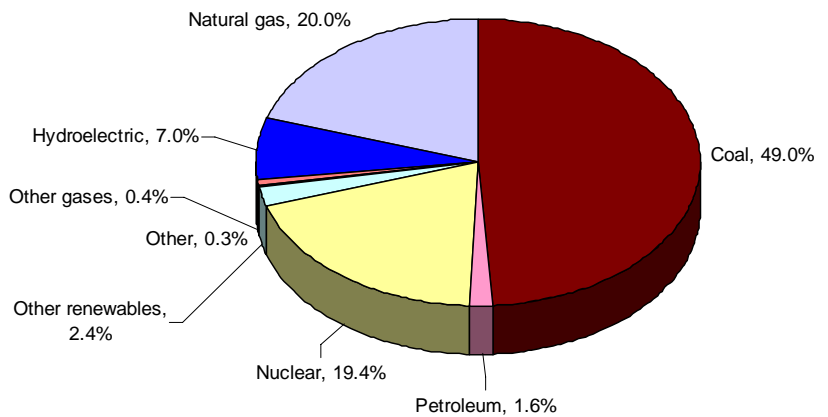
Electricity generated from renewable resources is usually more expensive than nonrenewable sources. This is partly because cultivating a new energy resource requires more up-front investment, and the technology is newer and more expensive. It costs more to build a new wind farm than to just buy power from an existing coal power plant. Some renewable resources are also dependent on nature: windmills can only generate power when the wind is blowing; solar arrays don't collect as much energy when it rains, for example.

Currently less than ten percent of our nation’s electricity is generated from hydroelectric power or other renewable resources (see pie chart, below). The goal of green power programs is to help boost investment in renewable technologies and increase their contribution to the energy grid. Green power programs allow utility customers to *choose* to purchase green power for an added cost, or premium, to their electricity bill. The revenue collected from green power programs is then used by your utility to purchase more of its electricity from renewable resources.

So is it worth it?

How much green power do you need to buy to make a difference? How much more will it cost? Is it worth it? In this activity you take a look at the green power programs are offered by your utility or in your region, calculate how much it would add to your electric bill to buy between 10 - 100 percent green power, and ultimately determine whether the extra cost for supporting renewable energy is “worth it” to you.

U.S. Electric Power Industry Net Generation, by source | 2006



Before you begin:

1. For this activity you will need a copy of a recent electricity bill. If you cannot obtain one from home - your teacher will have spares on hand.
2. Familiarize yourself with the bill and make sure you know the following:
 - ⇒What is your utility?
 - ⇒How many kilowatt-hours (kWh) were used for that billing cycle?
 - ⇒What is the length of the billing cycle? Is it for one month, two, more? Ultimately you'll want to know how many kWh are used for **ONE** month.



Name: _____

Class: _____

Date: _____

Green Up Your Power!

Student Worksheet

Instructions

1. Be sure to have your electricity bill handy. In Column 1 of Table 1, enter the kWh of electricity used by your household **per month**.
2. Find out about the green power program(s) offered by your local utility.
 - o *You can look up the green power options available to you using the U.S. Environmental Protection Agency's Green Power Locator at: <http://www.epa.gov/grnpower/pubs/gplocator.htm>*
3. What is the 'premium' per kWh of purchasing green power through that program? Enter this in Column 2.
4. Now use this information to calculate the added cost to your electric bill from purchasing green power.

Calculate the cost of green power - is it worth it?

1. If your household were to purchase just 10 percent of its power from renewable energy sources, how many kWh would that be? Enter this value in Column 4.
2. How much would purchasing 10 percent green power add to your electric bill? Show your calculations below, and enter the total in Column 5.

Green Up Your Power, continued...

3. How many pounds of CO₂ emissions would your household prevent by purchasing green power? Refer to the CO₂ conversion factor for your utility in the chart to the right, or use the national average if your utility isn't listed. Record your result in Column 6.

CONVERSION FACTORS

Pounds (lbs) of CO₂ per kilowatt-hour (kWh) of electricity generated
by utility

| Utility | Lbs of CO ₂ per kWh |
|--------------------------|--------------------------------|
| Puget Sound Energy | 1.0 |
| Seattle City Light | 0.1 |
| Snohomish County PUD | 0.2 |
| Tacoma Power | 0.1 |
| Washington state average | 0.5 |
| National average | 1.4 |

Source: State of Washington Department of Community, Trade, and Economic Development (CTED), 2006

4. Repeat this process to compare results of purchasing 20, 25, 50 and even 100% renewable power. Record your findings in Table 1.

TABLE 1: COMPARISON OF GREEN POWER COST & CLIMATE BENEFIT

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 |
|--------------------------|--------------------------------|-------------------------------|--------------------|--------------------------|-------------------------------|
| Total kWh used per month | Green power "premium" (\$/kWh) | Percent green power purchased | kWh of Green Power | Cost of green power (\$) | CO ₂ savings (lbs) |
| _____ kWh | \$___ per kWh | 10% | | | |
| | | 20% | | | |
| | | 25% | | | |
| | | 50% | | | |
| | | 100% | | | |

Green Up Your Power, continued...

Questions:

1. Comparing the added cost with the climate benefit, do you think buying green power is worth it? Would you buy it? Why or why not?
2. Why do you think more people don't participate in green power programs? What might motivate them to sign up?
3. Which do you feel is a better long-term solution to reducing carbon dioxide emissions: using less electricity (conservation) or buying green power? Why?
4. Some companies offset their carbon emissions by purchasing green power and these companies often advertise their "greenness". Would you be more likely to do business with a "greener" company? Why or why not?

Name: _____

Class: _____

Date: _____

Research a Renewable Energy Project

Student Worksheet

The Bonneville Environmental Foundation supports and monitors renewable energy projects across the country as part of an effort to increase community awareness of the benefits of renewable energy technology. In this assignment you will research one of these projects and learn about its climate impact.

Instructions

1. Go to the Bonneville Environmental Foundation website and take a look at the some of the different projects.
⇒ <http://www.b-e-f.org/renewables/>
2. Many of the projects are “monitored” and sending live data to the BEF website. Choose one of these monitored projects and answer the questions that follow below.

Questions

1. What is the project?
2. When was it placed in service?
3. What is its capacity in kWh?
4. How many kWh is it producing right now?
5. How many kWh has it produced in the last week?

STATEMENT SUMMARY AS OF FEB 13, 2008

Account No.

Account Balance

| | |
|-----------------------------------------|---------------------|
| Balance as of last billing | \$94.14 |
| Thank you for your payment(s) | <u>\$95.00CR</u> |
| Balance Forward | \$.86CR |
| Current Charges | <u>\$205.77</u> |
| CURRENT TOTAL AS OF FEB 13, 2008 | \$204.91 |

Statement Due Date Mar 05, 2008

| | |
|----------------------------------|-----------------|
| AMOUNT DUE THIS STATEMENT | \$204.91 |
|----------------------------------|-----------------|

Electric Detail:

| Rate/Dates | Meter Number | Pres Read | Prev Read | Pres Date | Prev Date | Mult | KWH (Usage) | Bill Demand | KVAR Hours | Code | Amount |
|------------------------------------|--------------------------------------|-----------|-----------|-----------|-----------|------|-------------|-------------|------------|------|-----------------|
| 17E | 1653 | 01450 | 02/12 | 01/12 | 10 | 2030 | | | | ACTL | |
| 01/13/08 02/12/08 | Customer Charge | | | | | | | | | | \$6.02 |
| 01/13/08 02/12/08 | Energy Charge | | | | | | | | | | \$44.78 |
| 01/13/08 02/12/08 | Energy Charge | | | | | | | | | | \$132.19 |
| 01/13/08 02/12/08 | Electric Conservation Program Charge | | | | | | | | | | \$3.66 |
| 01/13/08 02/12/08 | Power Cost Adjustment | | | | | | | | | | \$6.59 |
| 01/13/08 02/12/08 | Energy Exchange Credit | | | | | | | | | | \$0.00 |
| 01/13/08 02/12/08 | Wind Power Production Credit | | | | | | | | | | \$2.85CR |
| 01/13/08 02/12/08 | Federal Way City Tax | | | | | | | | | | <u>\$15.38</u> |
| Current Electricity Charges | | | | | | | | | | | \$205.77 |

A late fee of 1% will apply to overdue charges, if any. Please see the reverse side for details on late payment charges.

A 3.873% state utility tax is included in electric rates charged.

For information, emergencies, to report an outage or for changes to your account, please call 1-888-225-5773 or from out-of-state, 1-425-452-1234.

When paying in person, please present both portions. When mailing remittance, please mail to Puget Sound Energy, BOT-01H, P.O. Box 91269, Bellevue, WA 98009-9269

Please detach here and return this portion with your payment



Account: :

Current Bill Due Date

Mar 05, 2008

Total Amount Due

\$204.91

Yes, I want to give \$ _____ to the Warm Home Fund.

Please make checks payable to Puget Sound Energy

**C098

Puget Sound Energy
 BOT-01H
 P.O. Box 91269
 Bellevue, WA 98009-9269

0001 01 00003840790004 000000020577 000000020491

STATEMENT SUMMARY AS OF FEB 22, 2008

Account No.

| | |
|-----------------------------------------|-------------------|
| Balance as of last billing | Account Balance |
| Thank you for your payment(s) | \$222.26 |
| Balance Forward | <u>\$222.26CR</u> |
| | \$.00 |
| Current Charges | <u>\$205.11</u> |
| CURRENT TOTAL AS OF FEB 22, 2008 | \$205.11 |

Statement Due Date Mar 13, 2008

| | |
|----------------------------------|-----------------|
| AMOUNT DUE THIS STATEMENT | \$205.11 |
|----------------------------------|-----------------|

Gas Detail:

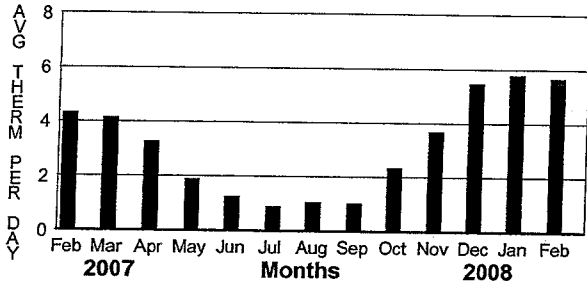
| Rate/Dates | Meter Number | Pres Read | Prev Read | Pres Date | Prev Date | CCF | BTU Factor | Therms (Usage) | Price per Therm | Code | Amount |
|-------------------|---------------------------------|-----------|-----------|-----------|-----------|--------|------------|----------------|-----------------|------|----------------|
| 23G | 06945 | 06789 | 02/21 | 01/22 | 156 @ | 1.0865 | 169.49 | | | ACTL | |
| 01/23/08 02/21/08 | Customer Charge | | | | | | | | | | \$8.25 |
| 01/23/08 02/21/08 | Delivery Charge | | | | | | | | | | \$51.62 |
| 01/23/08 02/21/08 | Cost of Gas | | | | | | | | | | \$131.07 |
| 01/23/08 02/21/08 | Gas Conservation Program Charge | | | | | | | | | | \$1.34 |
| 01/23/08 02/21/08 | Edmonds City Tax | | | | | | | | | | <u>\$12.83</u> |

Current Gas Charges

\$205.11

A late fee of 1% will apply to overdue charges, if any. Please see the reverse side for details on late payment charges.

A 3.852% state utility tax is included in gas rates charged.



| ENERGY USAGE COMPARISON | | | |
|-------------------------|-----------|-----------|--------|
| For Bill Period | This Year | Last Year | Change |
| Jan-Feb | | | |
| No. of days | 30 | 30 | 0 |
| THRM use | 169.5 | 129.4 | 40.1 |
| Avg. THRM use per day | 5.6 | 4.3 | 1.3 |
| Avg. temp. per day | 41F | 45F | -4F |

For information, emergencies, to report an outage or for changes to your account, please call 1-888-225-5773 or from out-of-state, 1-425-452-1234.

When paying in person, please present both portions. When mailing remittance, please mail to Puget Sound Energy, BOT-01H, P.O. Box 91269, Bellevue, WA 98009-9269

Please detach here 7 and return this portion with your payment



Account: _____

Current Bill Due Date

Mar 13, 2008

Total Amount Due

\$205.11

Yes, I want to give \$ _____ to the Warm Home Fund.

Please make checks payable to Puget Sound Energy

**C061

Puget Sound Energy
 BOT-01H
 P.O. Box 91269
 Bellevue, WA 98009-9269