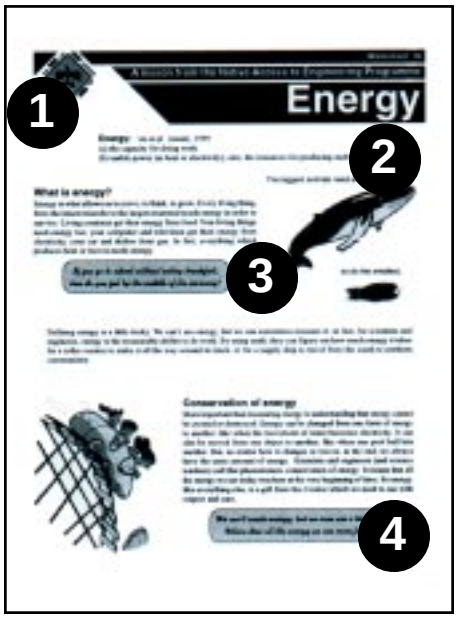
Teachers' Guide 18
to accompany
Energy

Here are some suggestions for how you can work with Worksheet 18, Energy.



1. Vocabulary

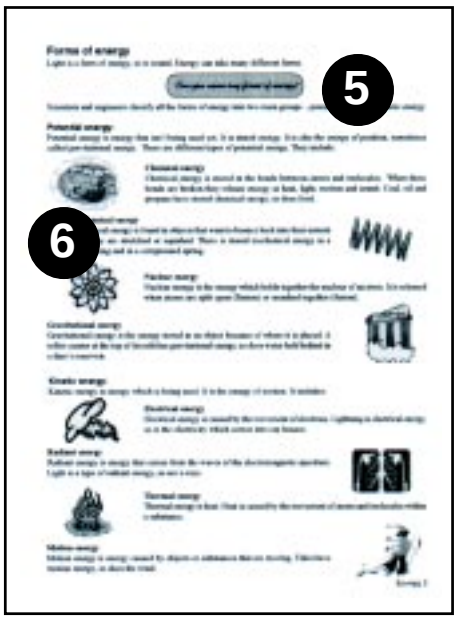
Atom
Battery
Biomass
Carbon compounds
Carbon dioxide
Carbon monoxide
Chemical energy
Conservation of energy
Electricity
Electron
Energy
Energy chain
Energy conservation
Energy of position
Ethanol
Fission
Fossil fuels
Fusion
Geothermal energy
Gravitational energy
Greenhouse gas
Habitat
Kinetic energy
Lumber
Mammal
Methane
Mercury
Microbe
Migration
Molecule
Motion energy
Non-renewable resources
Nuclear energy
Nucleus
Phenomenon
Photosynthesis
Photovoltaic cells
Potential energy
Plutonium
Radiant energy
Reservoir
Renewable resources
Stored energy
Stored mechanical energy
Thermal energy
Transmission line
Work

2. Definition. Do your students understand the definition? Can they use it in a sentence to demonstrate their understanding?

3. If you go to school without eating breakfast, how do you feel by the middle of the morning?
Have a discussion with our students about where humans get their energy. Breakfast is the most important meal of the day because it provides us with the energy we need to wake up and do all the things we need to do. You know that students who don't eat a meal in the morning often drag and lose their concentration sometime before lunch, but perhaps they haven't made the connection. Depending on where you live and the diet of your students you could talk about the following topics.

- Health Canada's food guide;
  http://www.hc-sc.gc.ca/hppb/nutrition/
- the energy value of country foods. Good information on this topic is available at Centre for Indigenous Peoples' Nutrition and Environment at McGill
  http://cine.mcgill.ca/TF/index.htm
- The Inuit Tapisirat's Interactive Atlas
  http://itk.ca/sitemap/atlas/CountryFoods/countryfoods.html

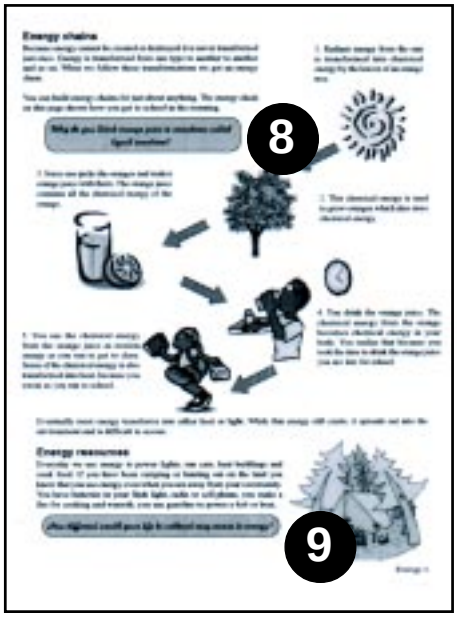
4. Where does all the energy we use come from?
Before moving on in the lesson you may want to have a class discussion about where the energy used in your community comes from. How is it delivered? How is it distributed? What kinds or energy are used?



5. Can you name any forms of energy?
Your students can probably name energy sources - gas, oil, diesel, electricity - but can they name forms or types of potential and kinetic energy?

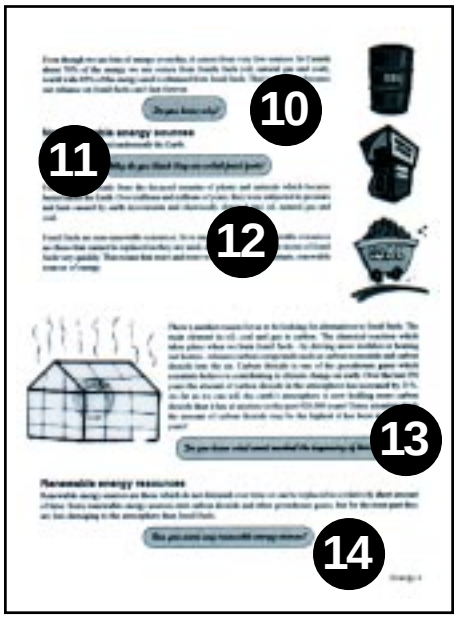
6. Stored mechanical energy and Gravitational energy
It reasonably easy to demonstrate stored mechanical energy and gravitational energy (as well as related energy transformations) in class. To show students stored mechanical energy bring in springs elastics, or even a guitar. Gravitational energy can be demonstrated by the use of marbles and balls, or hot wheels cars and tracks.

7. Energy transformations
a) thermal
b) chemical
c) motion



8. Why do you think orange juice is sometimes called liquid sunshine?
Orange is called liquid sunshine for a few reasons.
- It's colour is similar to the colour of the sun.
- Orange juice is of vitamins, so is sunshine. Orange juice is really high in vitamin C, exposure to sunshine helps produce Vitamin D.
- Both are a great source of energy.

9. How different would your life be without easy access to energy?
Again this question is a point for discussion where the students can think about the impact energy has on their daily lives.



10. Do you know why [our reliance on fossil fuels can't last forever]?
Fossil fuels are non-renewable energy resources.

11. Why do you think they are called fossil fuels?
Fossil fuels get their name because - as far as we know - they are produced by the fossilized remains of animals and plants that died millions of years ago.

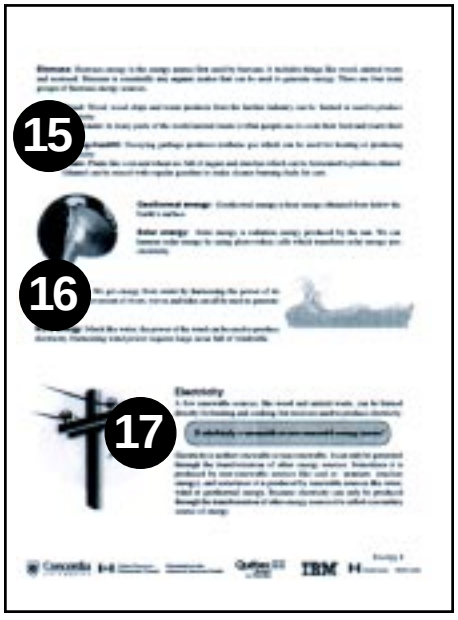
12. Nuclear energy
Nuclear energy isn't something we hear a lot about in Canada, but it used in a number of places. Nuclear energy is considered a non-renewable resources because the fuel for it is a special type of uranium. Uranium is a type of rock found in the earth's crust. All of the Uranium the world was created when the planet was created, so eventually it will run out.

Uranium is relatively abundant, but the kind needed to produce energy, uranium-235, is much rarer. Uranium-235 is mined and then processed into pellets about the size of a Life Saver. One pellet contains as much energy as a tonne of coal.
Atomic Energy of Canada Limited, Kids' Zone
http://www.aecl.ca/kidszone/atomicenergy/nuclear/index.asp
Nuclear energy
http://www.eia.doe.gov/kids/non-renewable/nuclear.html

13. Do you know what event marked the beginning of this increase [in carbon dioxide]?
The amount of carbon dioxide in the atmosphere started to increase when large scale industry began during the Industrial Revolution. Scientist have figured this out by measuring the amount of carbon dioxide in ice samples from the Antarctic.

14. Can you name any renewable resources
Again this question can form the basis for a discussion which can bring the lesson to the local level. Renewable resources are those which replace themselves over relatively short periods of time. Although on the whole, renewable resources are "cleaner" than fossil fuels, it doesn't necessarily mean they are the best kind of energy to use in any given situation. What kind of renewable energy resources are used in the community where you teach?

15. Use of solid waste as an energy source
While it might sound pretty gross, many people in developing countries use animal dung (and other biomass) as their primary energy source. Animal dung works, but is really inefficient. It is usually burned in open fires or ovens and most of the energy escapes into the surrounding air. There is a way to make animal dung into a more efficient energy source called biogas. With the number of cows in India, it is estimated that biogas could meet the cooking energy needs of nearly 40 percent of rural households of the country.



16. Water energy
Canada has one of the few tidal power stations in the world. Find out more about tidal power at
http://www.nspower.ca/AboutUs/OurBusiness/PowerProduction/HowWeGeneratePower/TidalPower.html

17. Is electricity a renewable or non-renewable energy resource?
Electricity is neither renewable or non-renewable. It can only be generated through the transformation of other energy sources. Sometimes it is produced by non-renewable source like coal or uranium (nuclear energy), and sometimes it is produced by renewable sources like water, wind or geothermal energy. Because electricity can only be produced through the transformation of other energy sources it is called a secondary source of energy.

18. Resources

Want more energy resources for your students? Try these web sites.

Alliance to Save Energy
Although based on imperial units and US data the Alliance to Save Energy (ASE) has some great lesson plans that bring energy use home to kids.
http://www.ase.org/educators/download.htm

New UNESCO Teachers Source book
A 200+ page book containing great ideas for science teaching and learning on many topics. Download it from
http://www.unesco.org/education/ste/learn_mat/ressour_mat.shtml

Notes

Solutions

Question 1a. Graphing

I. What do you know?

- The prices in each community as provided in Table 1.
- You need to make a graph showing how prices compare.

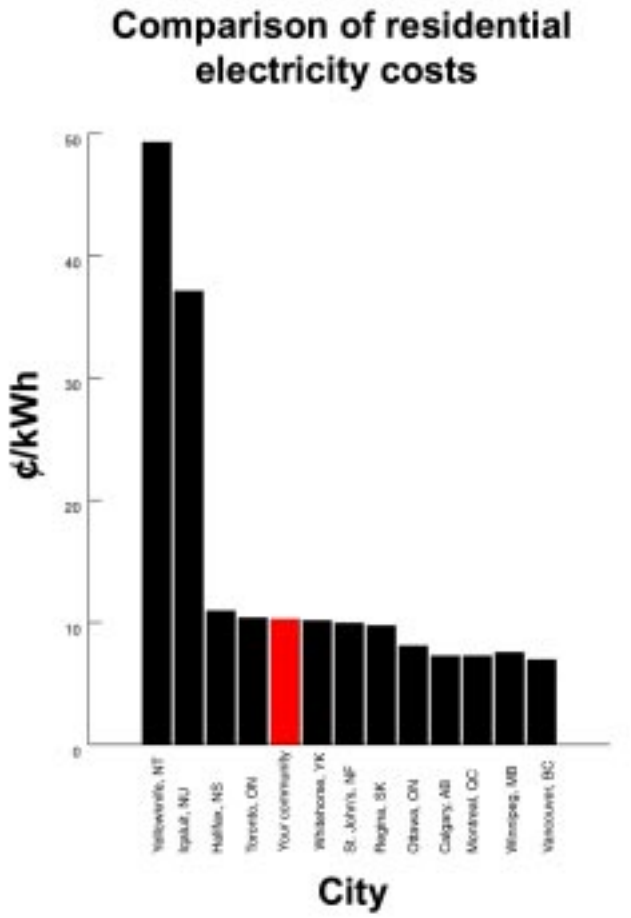
II. Decide what type of graph to make.
Different types of graphs are used for showing different comparisons.

Pie graphs show how things compare to each other with respect to the total number of things you have.
Line graphs demonstrate change, or trends, usually over time.
Bar graphs show how things compare to each other.

You probably want to use a bar chart for this graph.

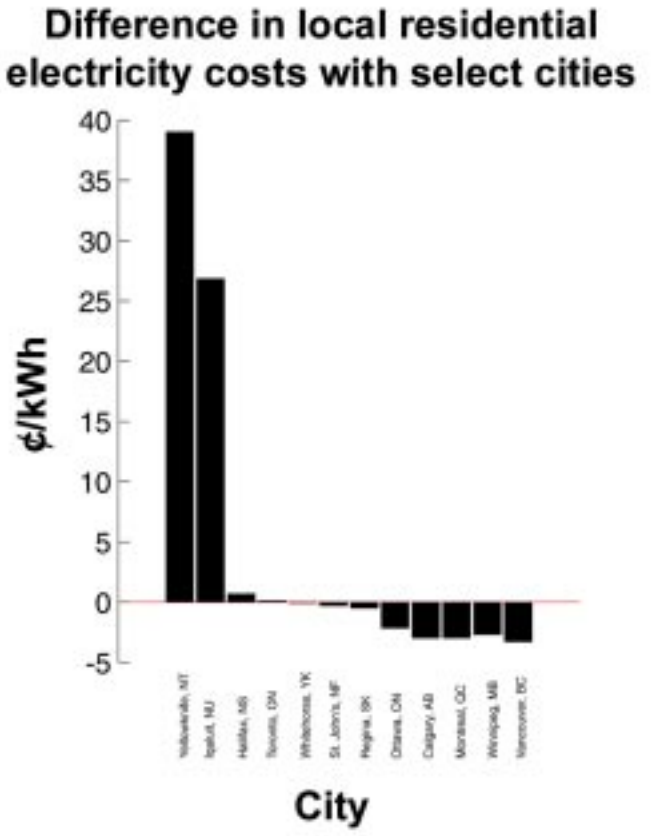
III. Choose what kind of bar chart you need.

Bar graphs can be used to show comparisons in a few ways. Here you need to show how the price people pay for residential electricity in your community compares with other cities and towns. There are at least two ways to do this.



i) Make a graph where the bars show the price of electricity for each community, including your own. You may want to the make the bar for your community a different colour so it sticks out. You should end up with a graph that looks something like the graph to the left.

ii) Make a graph where the bars show the difference in price between electricity in your community and electricity in other communities. This will actually be easier to do after you make the table in question 1B. You should end up with a graph which looks something like this one. The zero line is actually equal to the cost of electricity in your community. The bars show how much more or less people in other cities pay for residential electricity.



Question 1b. Making a table. Arithmetic.

I. What do you know?
- The prices in each community as provided in Table 1.
- You need to make a table.

II. What are you trying to find out?
You are trying to figure out 2 different things here:
- how much more or less people in other cities pay for residential electricity compared with your community.
- that difference as a percentage.

III. Build the table.
To start list all the cities you are using in the comparison and the cost of electricity in those cities.

In order to build the table, you need to calculate the two quantities you are presenting. So, add a column to the table for the first quantity.

The difference between electricity costs is a simple subtraction.

Cost of electricity in community x - cost of electricity in your community.

A	B	C
City	**¢/kWh**	**Difference with your community**
		Column B - 10.26
Yellowknife, NT	49.30	
Iqaluit, NU	37.12	
Halifax, NS	10.96	
Toronto, ON	10.38	
Whitehorse, YK	10.16	
St. John's, NF	9.95	
Regina, SK	9.75	
Ottawa, ON	8.09	
Calgary, AB	7.27	
Montreal, QC	7.27	
Winnipeg, MB	7.56	
Vancouver, BC	6.96	

If the answer is positive the people in community x are paying more for electricity. If the answer is negative, the people in community x are paying less for electricity. Since you are interested in comparing differences, it is really important you include the +/- sign.

Now add a column for the percentages.

A	B	C	D
City	**¢/kWh**	**Difference with your community**	**% difference with your community**
		Column B - 10.26	(Column C/10.26)x100
Yellowknife, NT	49.30	+39.04	
Iqaluit, NU	37.12	+26.86	
Halifax, NS	10.96	+0.70	
Toronto, ON	10.38	+0.12	
Whitehorse, YK	10.16	-0.10	
St. John's, NF	9.95	-0.31	
Regina, SK	9.75	-0.51	
Ottawa, ON	8.09	-2.17	
Calgary, AB	7.27	-2.99	
Montreal, QC	7.27	-2.99	
Winnipeg, MB	7.56	-2.70	
Vancouver, BC	6.96	-3.30	

You calculate the percentage difference by using the following formula:

$$\frac{\text{Cost of electricity in community x - cost of electricity in your community}}{\text{cost of electricity in your community}} \times 100$$

You already have the amount for the numerator in the column C. so your formula becomes:

$$\frac{\text{Column C}}{\text{cost of electricity in your community}} \times 100$$

The final table will look something like this:

A	B	C	D
City	**¢/kWh**	**Difference with your community**	**% difference with your community**
		Column B - 10.26	(Column C/10.26)x100
Yellowknife, NT	49.30	+39.04	+380%
Iqaluit, NU	37.12	+26.86	+262%
Halifax, NS	10.96	+0.70	+6.82%
Toronto, ON	10.38	+0.12	+1.17%
Whitehorse, YK	10.16	-0.10	-0.97%
St. John's, NF	9.95	-0.31	-3.02%
Regina, SK	9.75	-0.51	-4.97%
Ottawa, ON	8.09	-2.17	-21.2%
Calgary, AB	7.27	-2.99	-29.1%
Montreal, QC	7.27	-2.99	-29.1%
Winnipeg, MB	7.56	-2.70	-26.3%
Vancouver, BC	6.96	-3.30	-32.2%

Question 2a. Graphing

I. What do you know?
- The amount of each energy in petajoules produced by each type of renewable energy source.
- You need to make a pie graph.

II. Calculate percentages.

Pie graphs show how things compare to each other with respect to the total number of things you have. In other words, they show percentages. So the first thing you have to do is calculate the total amount of energy produced from renewable energy sources in 1997.

Total energy = Hydro + Tidal + Biomass + Earth Energy Systems + Geothermal + Wind + Solar
= 1255 PJ + 0.1PJ + 1066.5PJ + 1.5 PJ + 0.003 PJ + 1.2 PJ + 0.21 PJ
= 2324.513PJ

Now calculate the percentage that each energy source contributes to the total.

$$\% = \frac{\text{Energy production (PJ)}}{\text{Total energy}} \times 100$$

$$\%\text{hydro} = \frac{\text{hydro production}}{\text{total energy}} \times 100 = \frac{1255\ \text{PJ}}{2324.513\ \text{PJ}} \times 100 = 53.989\% \sim 54\%$$

Using the same method, the other percentages are:

% Tidal = 0.0043%

% Biomass = 45.88%

% Earth Energy Systems = 0.065%

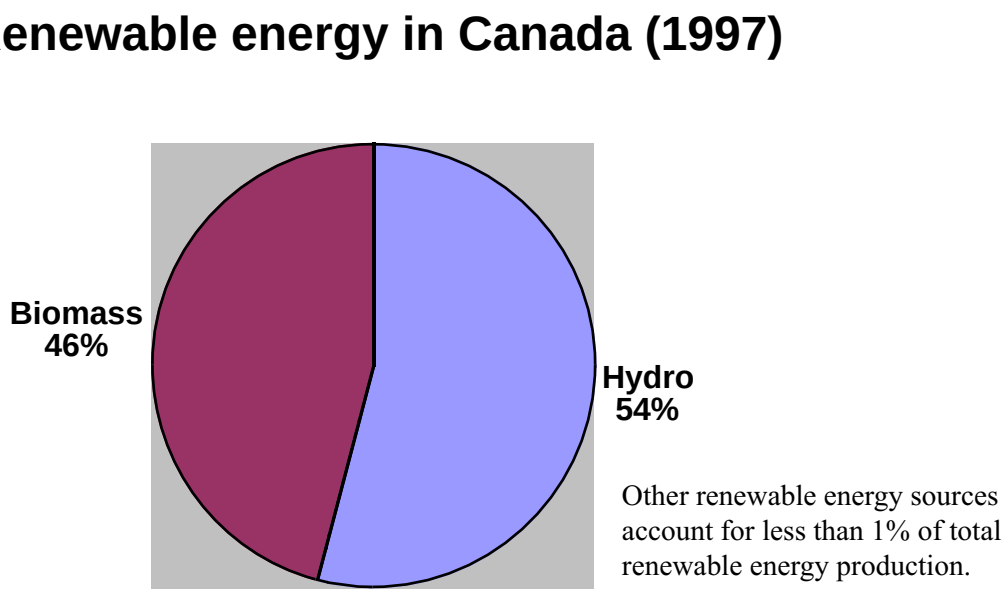
% Geothermal = 0.00012%

% Wind = 0.052%

% Solar = 0.009%

III. Draw the graph

The final graph will look something like this.



Question 2b. Small percentages in pie graphs.

I. What do you know?

- Many of the percentages calculated in question 2a are very small.

II. Answer the teacher.

Because Pie charts show percentages, really small amounts are hard to show. Often small amounts are grouped together in a category called "other." In this case, even grouping the small amounts together only gives us 0.13%. The best thing to do would be to make a not next to the graph which says, "Other renewable energy sources account for less than 1% of total renewable energy production."

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Question 2c. Algebra.

I. What do you know?

- Renewable energy resouces accounted for about 20% of energy consumption in Canada in 1997
- Renewable energy sources accounted for 2324 PJ of energy production in 1997.

II. Make an assumption.

To solve this problem you have to make an assumption. In order to solve problems, engineers have to make assumptions all the time. The assumption you make is that all of the energy produced from renewable enrgy resources was consumed in Canada. In reality, some of the energy produced by hydro is exported to the US. Since, we are only looking for an approximate answer it is a good assumption to make.

III. Figure out the total amount of energy consumption in 1997.

This is an algebra problem.

0.2 (Total energy consumption) = 2324 PJ

$$\text{Total energy consumption} = \frac{2324\ \text{PJ}}{0.2} = 11620\ \text{PJ}$$

Total energy consumption in 1997 was approximately 11620 petajoules.