Introduction to the School Power Naturally Solar Learning Lab™

Virtual Array Tour: Lesson II in the Series

TEACHER INFORMATION

LEARNING OUTCOME

After experiencing the second of four routes through the Heliotronics SunViewer™ software application, students are able to interpret data from and cite environmental advantages of their school's solar array system.

LESSON OVERVIEW

In this lesson, students continue to investigate the components and functions of a solar array system, and enhance that learning through interpretation of data that helps them answer the question, why choose solar?

GRADE-LEVEL APPROPRIATENESS

This Level II and III lesson is appropriate as an introduction to solar energy for students in grades 5–12.

MATERIALS

A computer or computer lab that has Heliotronics SunViewer™ software installed and receiving data from a Heliotronics Feynman™ data logger
Protractors
Sufficient copies of Student Handouts One and Two

SAFETY

No safety precautions are necessary for this lesson.

ADDITIONAL SUPPORT FOR TEACHERS

There are 64 School Power Naturally (SPN) lessons available for downloading at www.SchoolPowerNaturally.org. Some of the lessons that would mesh well with this solar array tour are listed below, along with a brief description of content. (Note: In addition to this new lesson (lesson II), three other new lessons that are closely related to lesson II are described in the Teaching the Lesson section.)

- SPN Lesson #2, *Our Dependence on Fossil Fuels* (Through a simulation, students become aware of their dependence on fossil fuels.)

- SPN Lesson #3, *To Go Solar or Not to Go Solar* (Through participating in a role-play of a community meeting, students decide on the feasibility of photovoltaics as an alternative source of energy.)
- SPN Lesson #5, *Energy Resources: Where Are They and How Do We Get Them?* (Students learn, through models and interpretive skills, the nature of various energy resources, how they form, and the science that allows them to be discovered and extracted.)
- SPN Lesson #6, *Energy Solutions: A Brochure* (Students communicate to others the benefits of photovoltaic systems as an alternative source of energy, as evidenced by brochures they develop.)
- SPN Lesson #8, *The Absorption of Solar Energy* (Students interact with a simplified model of photosynthesis that explores the relationship between energy transfer and the chemical reactions that produce energy-containing foods in green plants.)
- SPN Lesson #10, *Solar Energy in New York* (Students decide if increasing the amount of energy from photovoltaic systems would be a wise investment in New York State.)
- SPN Lesson #19, *What Is pH and Why Is It Important?* (After using pH paper to test liquids and soluble solids, researching acid deposition, and checking DAS emissions-avoidance data, students explain the comparative relationship of fossil fuels and PV systems to acid deposition.)
- SPN Lesson #20, *Using Environmental Models to Determine the Effect of Acid Rain on an Ecosystem* (After completing a reading on acid precipitation and pH, and conducting small-scale investigations of the effect of acid on ecosystems, students predict the environmental effects of acid precipitation.)
- SPN Lesson #21, *An Environmental Puzzle: The Carbon Cycle* (Through completing readings on our ultimate energy source and completing a carbon dioxide puzzle, students are able to describe the operation of the oxygen–carbon dioxide cycle and relate the use of alternative forms of energy to maintaining levels of oxygen and carbon dioxide in the atmosphere.)
- SPN Lesson #30, *Chemical Consequences of Burning Fossil Fuels* (Students are introduced to the chemical consequences of burning fossil fuels, as they complete chemical reactions such as forming acids, and show that fossil fuel combustion produces acid-forming oxides.)
- SPN Lesson #31, *Avoiding Carbon Dioxide Emissions from Burning Fossil Fuels* (After performing stoichiometric calculations for various alkanes that comprise fossil fuels and working with the emissions-avoidance component of the school's DAS system, students cite quantitative evidence showing how nonfossil fuel sources help to reduce air pollution created by carbon dioxide.)
- SPN Lesson #36, *Fossil Fuels (Part II), The Geology of Oil: Topographic Mapping, Crustal Deformation, Rock Porosity, and Environmental Pollution* (As part of this lesson, students use emissions-avoidance data supplied by the school's DAS system to evaluate the environmental cost of our dependence on petroleum-derived energy.)
- SPN Lesson #37, *Fossil Fuels (Part III), The Geology of Coal: Interpreting Geologic History* (As part of this lesson, students use emissions-avoidance data from the school's DAS system to calculate the environmental cost of coal energy.)

- SPN Lesson #38, *Temperature and the Tomato* (Students are provided experiences that help them predict whether given sets of conditions are conducive to tomato growth. As part of this lesson, they also relate energy production in tomato plants to energy production in photovoltaic panels.)
- SPN Lesson #39, *Where Do Plants Get Their Food?* (In this lesson about the historical development of the scientific method, students replicate van Helmont's classic experiment, and describe the role of light in plant growth.)
- SPN Lesson #40, *A Photosynthesis Timeline* (Students are led to understand that van Helmont's work was limited by the thinking of society at the time and the equipment available to him. They see that even though his conclusion was incorrect, his approach to science and his experiment showing that plants do not obtain food from the soil were significant contributions to our understanding of photosynthesis.)
- SPN Lesson #42, *Permit Trading* (Through a simulation that involves infusing renewable energy resources into the "mix" for electricity generation by employing a "renewable portfolio standard," students explain market-oriented regulation and its impact on the transition to alternative energy sources.)
- SPN Lesson #44, *Prospects for a Sustainable Energy Future* (After exposure to the term *sustainable* as defined by Thomas B. Johansson and José Goldemberg, students are able to cite criteria that characterize a sustainable energy system. They also evaluate the degree of support for sustainability in the recommendations of Johansson and Goldemberg in *Energy for Sustainable Development*.
- SPN Lesson #45, *Heat Pollution and Communities* (Students examine the issue of thermal pollution in the broad context of environmental impact, and distinguish between opinions and claims as opposed to facts and data. As part of this lesson, they also collect and compare data from their school's and other schools' DAS systems, citing differences in waste heat amounts for contrasting environments.)

TEACHING THE LESSON

This is the second in a series of three tour lessons that make use of the Heliotronics SunViewer™ software application. (A fourth lesson makes use of inquiry teaching and learning, using the online School Power Naturally database [SunViewer.net™] developed by Heliotronics. This database presents and archives data from your school's solar array and that of other participating schools throughout New York State.)

The first lesson in the series features a virtual array tour that includes screen shots and commentary. In this, the second lesson, the software application is used to facilitate navigation through, and understanding of, the second of four pathways—"Why Choose Solar?"—which provides students their first look at data from an operational photovoltaic array and prompts them to see how *their* solar array is having a positive impact on the environment. The third lesson features pathways 3 and 4 and includes a projected set of images and pages that relate to data display. In the fourth lesson, such things as portions of the software application that display real time and stored operational data are explored.

Lesson I usually is completed before lesson II is begun.

In advance, run copies of the Student Handouts for the students in your classroom.

In some portions of this lesson, the information provided for teachers suggests that the students expand their learning using the Internet. Typically, ideas have been offered for criteria to be entered into search engines. When dealing with more advanced students, the teacher may not want to provide the search criteria, but rather allow the students to come up with their own. Search criteria in this section are identified with the following font style: *SEARCH CRITERIA.*

The third lesson in the series explores such things as portions of the software application that display real time and stored operational data. The pathways "What Is It Doing?" and "How Well Is It Working?" are included in this lesson.

If you did not launch the Heliotronics SunViewer™ software application as part of the initial tour, do so now. Find the SunViewer™ icon (see figure 1).

Figure 1

Click the icon to launch the Heliotronics SunViewer™ software application. Watch the home page pop up (see figure 2):

Figure 2

Locate the “end” button (see figure 3):

Figure 3

You may click “end” to end the program now, or if you have time, follow the pathway suggested for this lesson. Note that you may end the program at any time by clicking the “home” button and then “end.” For now, let’s go on. We see that there are four buttons (see figure 4) on the home page:

Figure 4

This lesson is limited to the “Why Choose Solar?” pathway (the other three pathways are for use in the other lessons in the series). So we will click the “Why Choose Solar?” button. This takes us to figure 5:

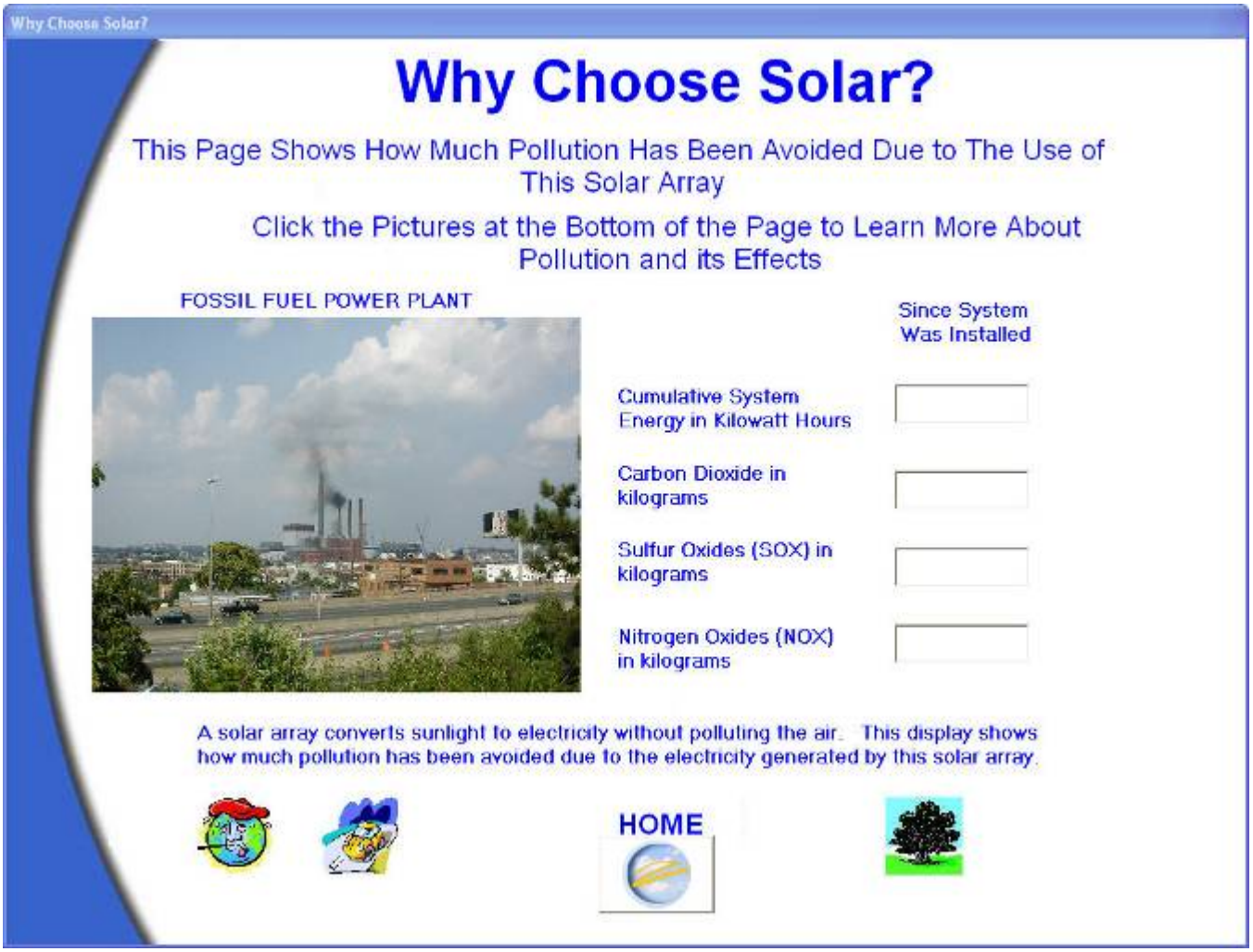

Figure 5

The text boxes on the "Why Chose Solar?" page provide data on the electrical energy production of your solar array and the pollution that it prevents:

- Cumulative system energy (energy production)
- Carbon dioxide (pollution prevented)
- Sulfur oxides (pollution prevented), and
- Nitrogen oxides (pollution prevented).

Since your school's solar array is producing some of the electricity used by your school, the school does not need to purchase that amount of electricity from the utility company. Therefore, the utilities' fossil fuel power plants do not need to produce quite as much electricity, and the noxious emissions from those plants are reduced by the amounts shown.

Distribute Student Handout One, and have your students copy the data from the screen graphic (figure 5) onto the appropriate locations. Either carry out the following discussion now, or come back to it after you complete the "Why Choose Solar?" pathway of the tour. Guide the students by asking the following questions:

- How was the quantity recorded beside "Cumulative System Energy in Kilowatt-Hours" arrived at? (See figure 5.1 note, page 12.) Will the quantity increase, decrease, or stay the same over time? (See figure 5.2 note, page 12.)
- How were the quantities for the next three items—carbon dioxide in kilograms, sulfur oxides in kilograms, nitrogen oxides in kilograms—determined? (See figure 5.3 note, page 12.)

Have students solve the three items listed on page 3 of Student Handout One to determine how much carbon dioxide (as well as sulfur oxides and nitrogen oxides) is saved by the production of one kWh of electricity from solar energy. (See item 3 below and figure 5.4 note, page 12.)

Discuss with your students how electricity is typically produced in your area. Follow these steps as you lead the discussion:

1. Use brainstorming and a chart, chalkboard, or overhead projector to generate a list of possible methods by which your electricity is generated at the present time. A site that will provide teachers and students with a useful overview of energy generation types is http://www.powerfrontiers.com/index.html. Have the students list the generation types (e.g., "fossil fuel plants") in three columns—Conventional, Renewable, Other—on Student Handout Two. (See electricity production note #1, page 12.)
2. Using the list generated by the students, discuss which of these are available now and which are still being researched or are in pilot use. Strive to find out from students which are available in your area, which are not, and why. (See electricity production note #2, page 13.)
3. Have the students use the website http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html
   to determine the current mix of energy sources for generating electricity for your zip code.
4. Have your students use the circle provided on Student Handout Two, along with protractors, to make a pie chart that represents your energy mix for generating electricity. For a review of pie charts, go to http://bdaugherty.tripod.com/KeySkills/pieCharts.html. (See electricity production note #3, page 13.)
5. Now have your students think about some other areas of the country that might be of interest to them, and also might have different proportions in their mix of energy sources. Use the website listed in step #3 above to learn more. Compare the mix that is present in your area with that of other areas and see if the students can explain the differences. For instance, proximity to Hoover Dam or to Niagara Falls could explain an increase of hydroelectricity in the mix and reduced emission of pollutants. (See electricity production note #4, page 13.)

Now that the students have accumulated knowledge about electricity generation and the mix of energy resources for your region, you should be able to prompt them for the question, why choose solar?, and expect an enhanced response to the question,—percentage increases in the component alternative energies within the mix of resources used to generate energy lessens degradation of the environment.

When you are ready to return to the tour, there are three graphics on this window that serve as buttons to choose from (see figure 6):

Figure 6

Click the first graphic on the left (see figure 7):

Figure 7

That choice results in the following window, which relates how global warming occurs and describes the long-term effects of solar warming (see figure 8):

Figure 8

You may want to have your students research and report on the long-term effects of global warming (typically referred to as "global climate change") that are described in figure 8.

Click "close," and then choose the second graphic as the one to click (see figure 9):

Figure 9

The window that comes up provides a narrative on emissions from automobiles (see figure 10):

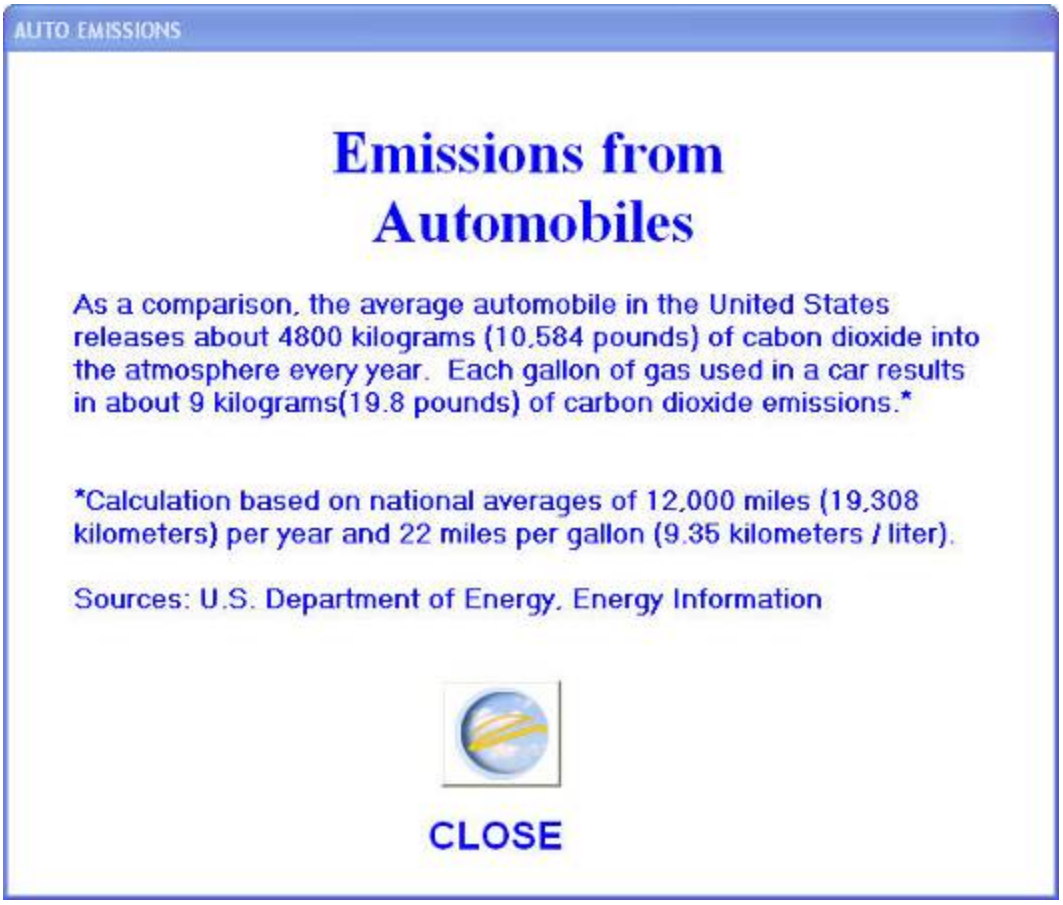

Figure 10

The narrative for figure 10 describes the typical emissions from an automobile. Help the students see that reducing carbon dioxide emissions by 4,800 kilograms through the use of solar energy is equivalent to taking one car off the road for a year.

You might want to have the students record the cumulative amount of CO_2 avoided by your solar array (go back to figure 5 to get this figure). A month from now, have them record the amount again and determine the difference to reinforce the positive environmental impact of using renewable solar energy. (See figure 10 note, page 14.)

Click “close” to return to the previous window, and then select the third graphic to click (see figure 11):

Figure 11

Clicking that graphic will bring up figure 12, “Plants and Carbon Sequestration”:

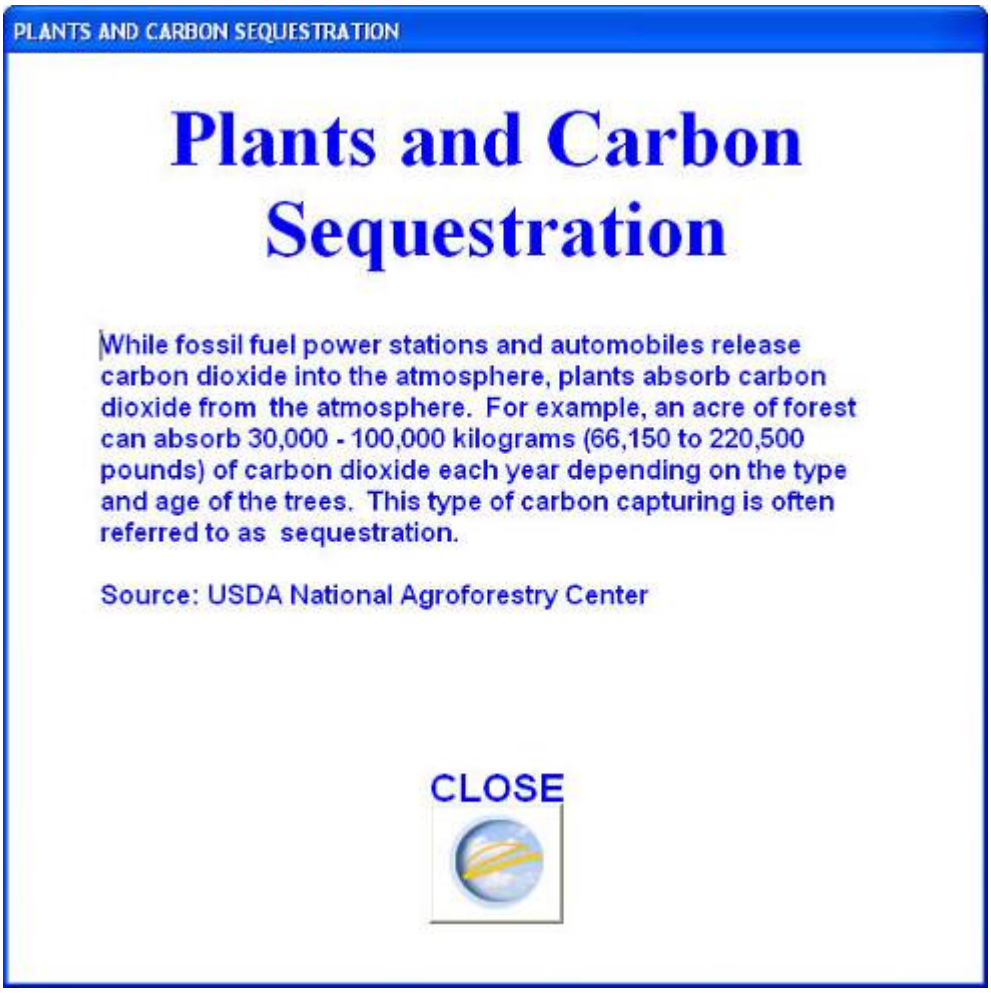

Figure 12

You might want to consider using the following SPN lessons, which deal with plants and carbon sequestration:

- SPN Lesson #8, *The Absorption of Solar Energy*
- SPN Lesson #38, *Temperature and the Tomato*
- SPN Lesson #39, *Where Do Plants Get Their Food?*

Click “close” and then “home” to end this tour.

Invite the students into a classroom discussion about why this pathway is entitled “Why Choose Solar?” Some ideas that may help you guide the discussion follow:

- The use of solar energy might impact climate change.
- PV-generated electricity is usually two to three times more expensive than conventionally generated electricity.
- Use of PV doesn’t pollute.

- PV systems are like flat-panel computer displays and other manufactured products, in terms of how production is related to expense: the more you produce, the less expensive each item becomes.
- Some areas offer subsidies to help pay for solar energy. What are the arguments for and against this? See whether students can name some industries that are vital to the economy that have or are receiving subsidies. (See subsidy note #1, page 14.)

BACKGROUND INFORMATION

Virtual Tour Notes for the Teacher

Figure 5.1 Note: *A component of the photovoltaic array measures and records the amount of electrical energy produced by the solar array.*

Figure 5.2 Note: *It is a cumulative amount so it will increase.*

Figure 5.3 Note: *If students know the components of their solar array, they will realize that no component of the solar array directly measures and records quantities for these items. You might have to ask the students leading questions to get them to realize that, since the display states that these pollutants have been avoided due to electricity being generated by the solar array, the array's software must be able to mathematically estimate and record how much of each pollutant has been avoided. There is a direct relationship between the solar energy produced and the fossil fuels containing pollutants whose use has been avoided.*

Figure 5.4 Note: *If, in figure 1 of Student Handout One, the "Cumulative System Energy in Kilowatt-Hours" reads 34,567, and "Carbon Dioxide in Kilograms" reads 12,904, how much carbon dioxide would be saved by the next kWh of solar energy produced?*

34,567 kWh are equivalent to 12,904 CO_2 kg

1 kWh is equivalent to **x** *kg CO_2*

Solving the equation for **x** *gives an answer of .37 kg of CO_2 per kWh.*

Electricity Production Note #1: *Older students should be able to come up on their own with lists that resemble the following:*

a. *CONVENTIONAL (Fossil fuel plants heat water to spin turbines, which turn generators. Such plants also burn gas to turn turbines similar to those that power jet planes. These turbines, in turn, turn electrical generators.)*
    i. *Coal-fired power plant (COAL-FIRED POWER PLANT)*
    ii. *Oil-fired power plant (OIL, ELECTRICITY)*
    iii. *Gas-fired power plant (GAS ELECTRICITY GENERATION)*
    iv. *Gas turbine (COMBINED CYCLE GAS TURBINE)*
b. *RENEWABLE*
    i. *Wind (ELECTRIC WIND TURBINE MW MEGAWATT)*

ii. *Solar photovoltaic cells*
    1. *Flat plate (GRID-CONNECTED PV)*
    2. *Tracking (PV TRACKING ARRAYS)*
    3. *Concentrating (PV CONCENTRATORS)*
iii. *Solar thermal*
    1. *Parabolic trough (PARABOLIC TROUGH)*
    2. *Dish Stirling (DISH STIRLING)*
    3. *Power towers (SOLAR POWER TOWER)*
iv. *Biomass (BIOMASS POWER GENERATION)*

c. *OTHER*
    i. *Nuclear (NUCLEAR POWER PLANT)*
    ii. *Geothermal (GEOTHERMAL POWER GENERATION)*

The classification of geothermal energy as "other" is debatable in that this kind of energy has been typically considered renewable. Discuss why the classification is debatable, asking questions such as the following: Where is the energy coming from? How does it renew? Can it be depleted? This likely will invite a discussion of physical geology.

Electricity Production Note #2: *For example, dish Stirling engines are being deployed in commercial quantities in California but not in the East. In the East, the diffuse irradiance from frequent cloud cover renders such engines uneconomical. But in the Southwest, sparse cloud cover yields direct sunlight that is readily concentrated using mirrors; abundant sunshine makes the use of these engines very effective.*

Electricity Production Note #3: *Pie charts are circles sliced into segments whose areas represent proportions. Should you prefer not to work with protractors, have the students simply estimate and then check their estimates, or have them compare and correct each other's estimates. For instance, you might ask the question, approximately how much of our electricity is generated from nuclear energy? Then you could elicit that, for instance, 22% is a little less than one-fourth of the whole, and ask them to mark a little less than one-fourth of the circle as nuclear. Should oil and gas turn out to be 46%, which is a little less than half, they should make the oil and gas part a little less than half of the circle. Coal is likely to be most of the remaining part of the circle. Let's say that coal is 31%, which is a little less than one-third, so the coal wedge will be slightly less than one-third of the circle. Remind students to leave a little space for hydro, which might be 1%. If something is off, they can try again, adjusting the size of the wedges as necessary.*

Electricity Production Note #4: *For example, students might look up the zip codes 97221(Portland, OR), 02173 (Lexington, MA), or 80002 (Denver, CO). Expect your students to come up with other sites to check, and have them use search engines to look them up. You might want to prompt students with questions such as:*

- *Why does Portland have low CO_2 emissions?*
- *What is a city name that interests you and what is its zip code?*
- *What are the relative proportions of the various power sources for that area?*
- *How do the emissions for that area relate to the national average? Why is this so?*

Figure 10 Note: *To determine the difference, subtract the two to determine how much CO_2 has been avoided due to the power production from the solar array. Then have the students consider how many miles would have to be driven to produce that same amount of CO_2.*

Subsidy Note #1

Against Subsidies: *Subsidies skew the market. Some say "let the market decide" and feel that subsidies are harmful to the economy. This assumes that we have a free market that monetizes all aspects of a purchase decision.*

For Subsidies: *In many cases, not all aspects of the purchase decision are monetized. For example, nuclear power producers only are required to insure for $500 million to cover accidents. In the unlikely event that a large accident were to occur, there could be $10s of billions in damages. Cleanup for larger accidents will be paid for by the federal government. So this risk is borne by the taxpayer even if they choose renewable energy that does not have this risk. In a fully monetized market, the nuclear power plant operator would be required to carry much more insurance and the cost of that insurance would be passed on to the ratepayer. And if someone chose a renewable energy source for their electricity, they would not need to pay for the insurance.*

Those who favor subsidies point out that it is impractical to monetize all aspects of the purchase transition so it is typically easier to frame things differently and build in subsidies designed to achieve objectives such as cost reduction of clean energy. The majority of infrastructure industries that are of vital importance to our economy have been or are being subsidized. Examples include electric, aviation, rail, banking, farming, the Internet, housing, forestry, and auto.

SOURCE FOR THIS ADAPTED ACTIVITY

This activity is based on the Heliotronics SunViewer™ software that was provided to SPN-participating schools.

LINKS TO MST LEARNING STANDARDS AND CORE CURRICULA

Standard 1—Analysis, Inquiry, and Design: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

M1.1b: Identify relationships among variables including direct, indirect….

M1.1c: Apply mathematical equations to describe relationships among variables in the natural world.

S1.1a: Formulate questions about natural phenomena.

S3.1a: Organize results, using appropriate graphs, diagrams, data tables, and other models to show relationships.

S3.2h: Use and interpret graphs and data tables.

T1.2: Locate and utilize a range of printed, electronic, and human information resources to obtain ideas.

Standard 4—Science: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

4.1a: The Sun is a major source of energy for Earth. Fossil fuels contain stored solar energy and are considered nonrenewable resources. They are a major source of energy in the United States. Solar energy, wind, moving water, and biomass are some examples of renewable energy resources.

4.1b: Fossil fuels contain solar energy and are considered nonrenewable resources. They are a major source of energy in the United States. Solar energy, wind, moving water, and biomass are some examples of renewable energy resources.

4.1c: Most activities in everyday life involve one form of energy being transformed into another. For example, the chemical energy in gasoline is transformed into mechanical energy in an automobile engine. Energy in the form of heat is almost always one of the products of energy transformation.

4.1d: Different forms of energy include heat, light, electrical, mechanical, sound, nuclear, and chemical. Energy is transformed in many ways.

4.4d: Electrical energy can be produced from a variety of energy sources and can be transformed into almost any other form of energy.

4.5a: Energy can not be created or destroyed, but only changed from one form into another.

5.1d: The methods for obtaining nutrients vary among organisms. Producers such as green plants use light energy to make their food….

6.1c: Matter is transformed from one organism to another and between organisms and their physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and nonliving environment.

6.2a: Photosynthesis is carried on by green plants and other organisms containing chlorophyll. In this process, the Sun's energy is converted into and stored as chemical energy in the form of sugar….

7.1e: The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of the environment and individuals requires the monitoring of soil, air, and water and taking care to keep safe.

7.2c: Industry brings an increased demand for and use of energy and other resources including fossil and nuclear fuels. This usage can have positive and negative effects on humans and ecosystems.

7.2d: Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources.

Standard 5—Technology: Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

Standard 7—Interdisciplinary Problem Solving: Students will apply knowledge and thinking skills of mathematics, science and technology to address real-life problems and make informed decisions.

1.1: Make informed consumer decisions by seeking answers to appropriate questions about products, services, and systems, determining the cost-benefit and risk-benefit trade-offs; and applying this knowledge to a potential purchase.

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www.nyserda.org

Special thanks to Heliotronics, Inc. for their contribution
in developing the content for this lesson

Should you have questions about this activity or suggestions for improvement,
please contact Bill Peruzzi at billperuz@aol.com

(STUDENT HANDOUT SECTION FOLLOWS)

Name _____

Date _____

Introduction to the School Power Naturally Solar Learning Lab™

Virtual Array Tour: Lesson II in the Series

STUDENT HANDOUT ONE

Background Information

Your school, which participates in the School Power Naturally (SPN) program, has been provided:

- a Solar Learning Lab™, which includes a solar array that generates electricity from sunlight
- an educational data-monitoring system that monitors and displays the energy and power production of the solar array, the meteorological quantities that affect its output and the emissions avoided by use of the solar array
- a site license for Heliotronics SunViewer™ educational data display software.

In addition, archived data has been displayed on the Internet for viewing by anyone in the world.

Your teacher has been introducing you to the Solar Learning Lab by conducting a virtual tour by means of the Heliotronics SunViewer™ software application. This lesson is a continuation of that tour.

DEVELOP YOUR UNDERSTANDING

Materials

A computer or computer lab that has Heliotronics SunViewer™ software installed
Protractors
Sufficient copies of Student Handouts One and Two

Procedures

1. When your teacher pauses in the tour and tells you to record the numbers displayed on the "Why Choose Solar?" screen graphic, use figure 1 on Student Handout One to do so. Then use those numbers to respond to the three other items on page 3 of Student Handout One.

2. When your teacher pauses in the tour and asks you to gather information to construct a pie chart, use Student Handout Two for that purpose. Your teacher will expect you to gather information on energy resources for generating electricity in your area and the percentages of that energy mix in order to construct the pie chart.

Name _____

Date _____

WHY CHOOSE SOLAR?
Avoiding Pollutants

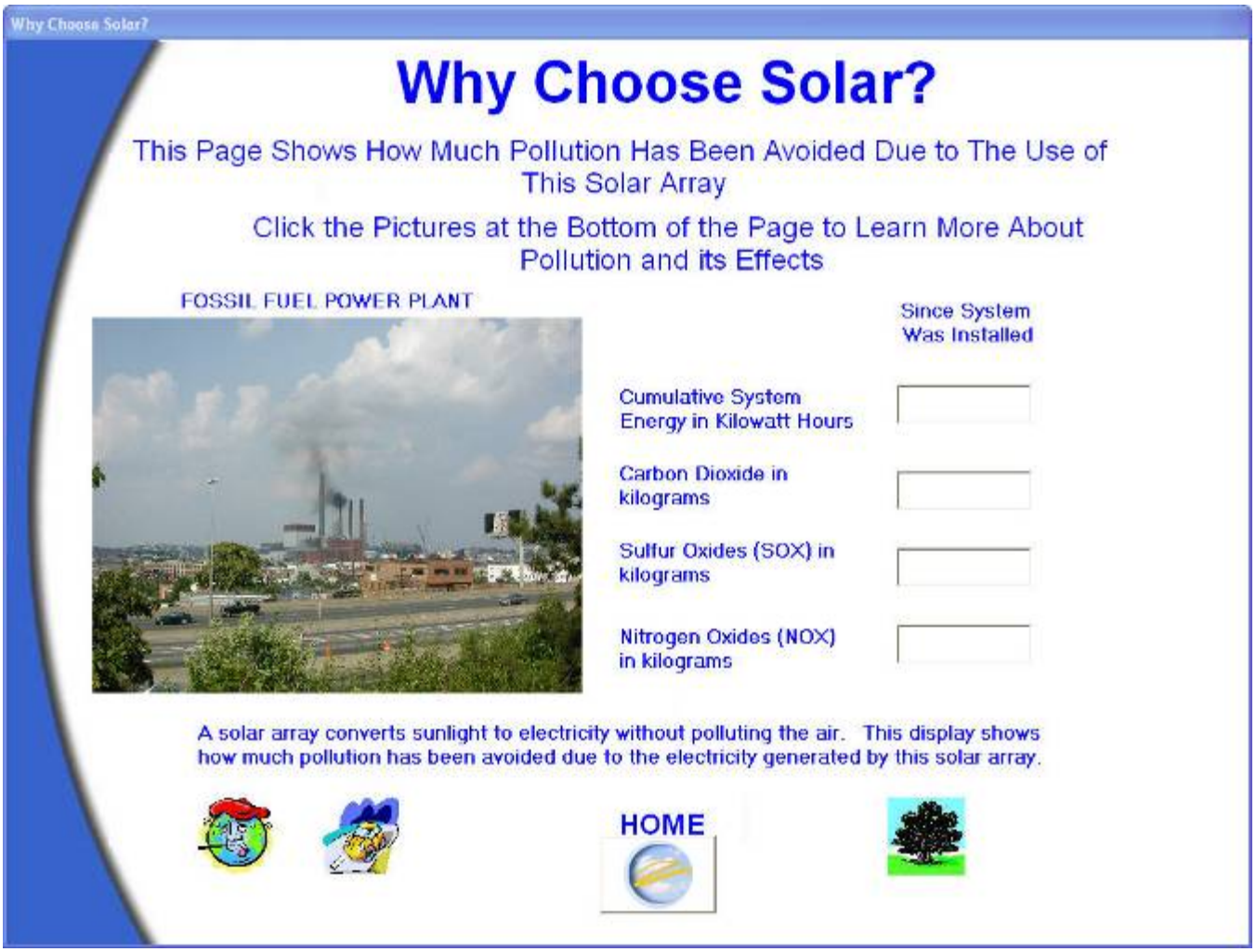

Figure 1

Use the array tour's figure 5 to fill in the blank areas on figure 1 above. Consider that recorded information in responding to these items:

1. 1 kWh is equivalent to _____kg CO_2

Show your work here:

Then, use the actual figures you recorded in figure 1 to complete items #2 and #3 below. Again, show your work.

2. 1 kWh is equivalent to _____kg sulfur oxides

Work:

3. 1 kWh is equivalent to _____kg nitrogen oxides

Work:

Name _____

Date _____

STUDENT HANDOUT TWO

WHY CHOOSE SOLAR?
Renewable Energy

What are the ways by which electricity is generated in your area at the present time? List the generation types (e.g., "fossil fuel plants") for your area in the three columns below:

CONVENTIONAL	RENEWABLE	OTHER
Fossil Fuel Plants		

Once you know how electricity is generated in your area, your teacher will help you determine the amounts for the energy mix that produces electricity in your area. Record those amounts below as percentages, arranging them from greatest to smallest. The energy mix percentages for your area are as follows:
(Note: You may need more or less than five sources and percentages.)

Source 1 and percentage:

Source 2 and percentage:

Source 3 and percentage:

Source 4 and percentage:

Source 5 and percentage:

Using those percentages for your various energy sources, convert the circle below into a pie chart that displays the sources and their percentages:

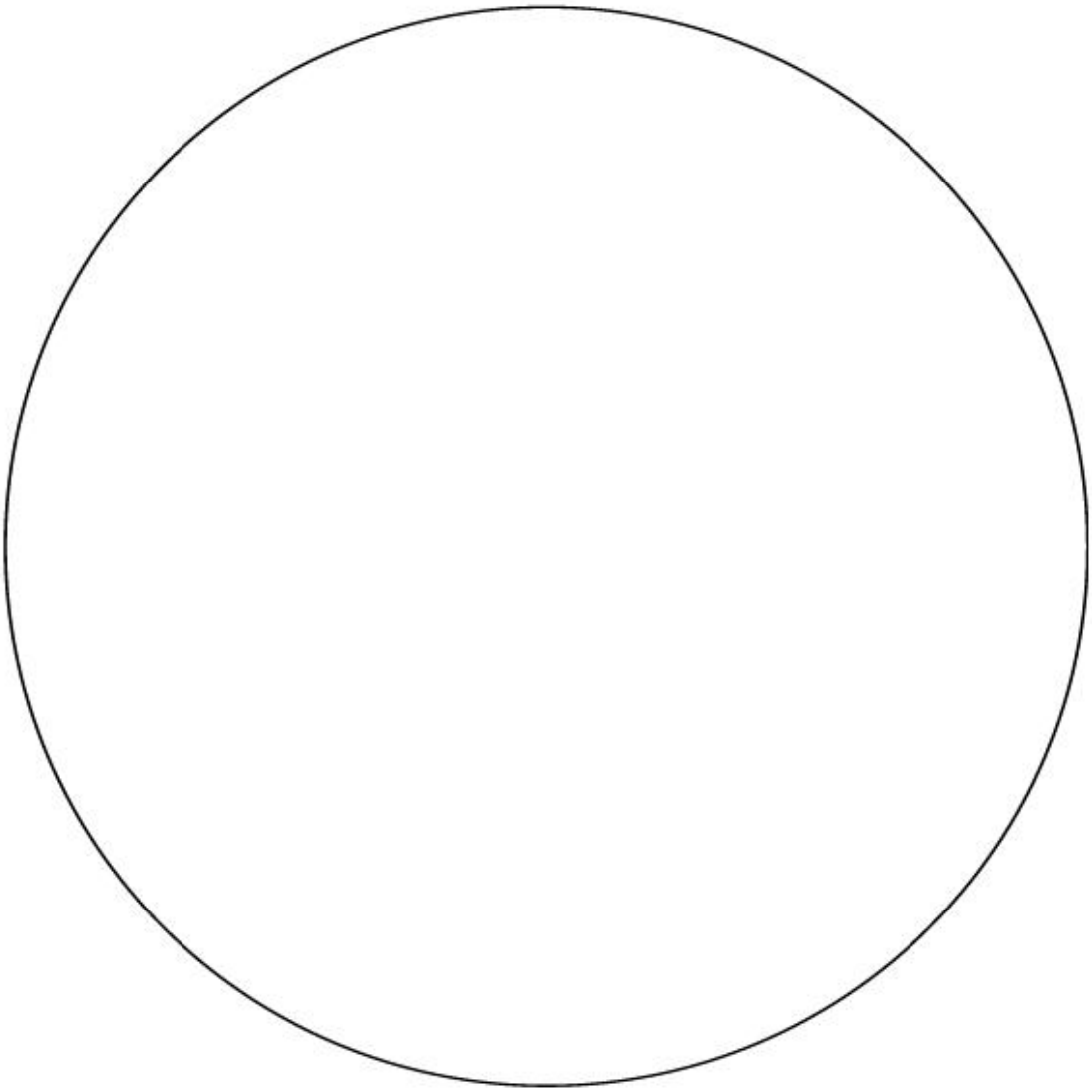

Figure 2. Energy Mix Pie Chart