

Fun in the Sun: Exploring the Power of Solar Energy

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ENERGY CHALLENGES

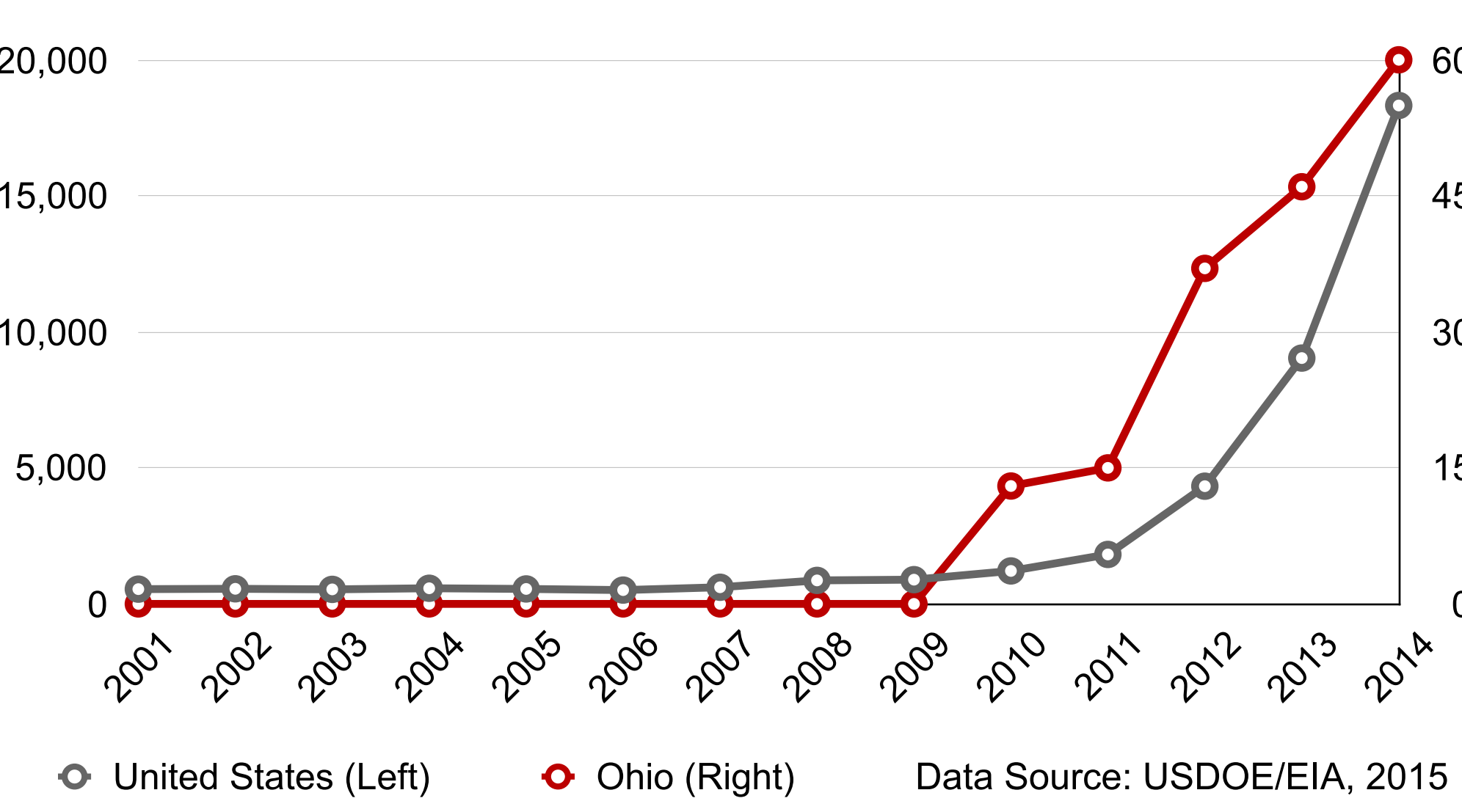
Worldwide energy consumption has grown by 85% over the past 30 years from 283 quadrillion Btu's in 1980 to over 524 quadrillion Btu's in 2012. In recent years, the U.S. has ranked 2nd in the world in total energy consumption, while Ohio is the 6th largest energy consuming state in the nation. Projecting forward, estimates suggest global energy consumption will increase an additional 47 percent by 2040 to 819 quadrillion Btu's. As our demand for energy continues to grow, future generations will face critical issues related to the social, economic and environmental impacts of energy.

For example, in response to environmental impacts of electrical generation from fossil fuel combustion, many states have established energy policies that foster the development of renewable energy technologies. As of 2015, 29 states have established renewable energy portfolio standards, while an additional eight states have adopted renewable energy goals.

PHOTOVOLTAIC (PV) SOLAR TRENDS

Between 2011 and 2040 renewable energy generation in the U.S. (excluding hydropower) is projected to account for 32% of the overall growth in the electricity generation sector (USDOE/EIA, 2013). Photovoltaic solar is expected to play a significant role in the advancement of renewable energy. More power from the sun hits the Earth in a single hour than humanity uses in an entire year. While U.S. solar installations posted another record year in 2014 with over 195,000 installations, solar only provided 0.39% of the energy used (Chart 1).

Chart 1: Solar Net Electricity Generation (Thousand Megawatt-Hours)



PV SOLAR ANGLE ACTIVITY

Background:
Access to sources of clean, abundant, reliable energy influences all of us each and every day, as well as the communities, organizations, and individuals we serve as educators. By training the next generation of employees to be STEM literate workers, through solar education, we increase the likelihood that solar energy will be used and introduced across Ohio (Educated and Equipped, 2014). To address this need, we explored various energy activities that could be integrated into existing 4-H camps and after school programs. In 2015, our team piloted 5 experiential learning activities with 4-H youth ages 10-14 focused on identifying critical energy trends and an introduction to photovoltaic solar energy.



Learning Objectives:
A basic understanding of energy, energy sources, generation, use, and conservation strategies, empowers individuals and communities to make informed energy decisions. Session participants will:

1. Recognize energy challenges and trends and the connection between energy and the environment.
2. Know the sun produces radiant energy that supports life on Earth.
3. Decipher between renewable and non-renewable resources.
4. Identify the difference between concentrating solar power and photovoltaic solar systems.
5. Make sense of photovoltaic solar technology and how the angle of the sun's rays influences the production of a photovoltaic (solar) cell.
6. Understand how individual energy decisions can impact home energy consumption.
7. Understand how to use a protractor and calculate the internal angles of a triangle.

Materials:
Most of the materials for this activity (Table 1) are items commonly found in an Extension office. Other required items that are energy specific, are inexpensive items that can be sourced or borrowed from the Energize Ohio Signature Program.

Table 1: Materials and Equipment

Common Materials	Energy Specific Materials from Energize Ohio
Pizza box	Solar Mini Panels (\$4 each)
Sharpened pencil with eraser	Digital Volt Meter (\$15 each)
Paperclip	
Protractor	Optional Items (Energize Ohio)
Markers	• Solar Demonstration Unit
Velcro tape or duct tape	• Television w/ USB Input

The Activity - Calculating the Angle:
Using the equipment provided this activity will help the participants understand how a photovoltaic solar panel interacts with the sun and the natural environment. The primary objective of this activity is to identify the angle the sun's photons are striking the earth's surface. Based on the results, participants will use math to calculate what angle they should set their mini solar cell to maximize the electrical production. The main steps of the activity include:

1. Straighten the paperclip and push it into the pencil eraser.
2. Place your pizza box in a flat sunny surface.
3. Place the sharpened end of the pencil on the center of the box surface and use the paperclip wire to hold the pencil.
4. Use the pencil shadow to identify the angle the sun's rays are striking the earth's surface. (Hint: face the pencil eraser towards the sun, adjusting it until there is no shadow)
5. Use the protractor to record the angle of the pencil. This is the angle the sun's rays are hitting the earth.
6. Use a marker to record your findings on the pizza box and use your protractor to calculate the proper angle for the solar panel.



Apply:
When photons strike a PV cell, they may be reflected, pass right through, or be absorbed. Only the absorbed photons provide energy to generate electricity. By identifying the angle the sun's photons strike the earth's surface and understanding how the sunlight interacts with the PV solar panel, you can optimize the performance of your solar system.



1. Use the Velcro to fasten your mini solar cell to the top of your pizza box.
2. Connect the voltmeter to the alligator clips.
3. Experiment by positioning the pizza box top at different angles and note the output on the voltmeter.
4. Use your protractor to set the pizza box top at the angle you identified during the pencil angle activity.
5. Compare the results and discuss.

RESULTS / EVALUATION

Because of the nature of the activity, the presence or lack of sunlight impacted the ability to do successful experiments with the youth. This is a weather dependent activity so summer sessions are ideal then those done in the winter or spring.

One hundred percent of youth who participated gained a new understanding about energy challenges and trends. Most had never thought about what the source of their power was.

Sixty-five percent of youth had not had hands on experience using photovoltaic solar cells prior to this demonstration.

Participants commented:

- "I never realized that the angle of a solar panel can increase the capacity of the solar collection."
- "This was my most favorite activity of Tech camp. I loved racing our solar cars that we built."
- "I want to get a solar charger for my cell phone."

REFERENCES

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