To our teachers:

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Center for Renewable Energy Advanced Technological Education

SOLAR SITE ANALYSIS: THE PVWATTS® CALCULATOR

INSTRUCTOR'S GUIDE

Grade Level: High School, Technical College, Community College
Lesson Length: 1-3 hours, depending on coverage and emphasis
Author: Scott Liddicoat
Created: March, 2024

Learning Goals:

Students will understand that the electricity produced with a solar photovoltaic system is generated renewably.

Students will understand how to use the National Renewable Energy Laboratory's PVWatts® Calculator.

Students will use the PVWatts calculator to estimate the electricity production of a grid-connected solar PV system for several places across the globe.

Students will collect, graph, and objectively analyze relevant data to draw valid conclusions.

Students will understand basic characteristics governing the site selection and placement of a solar PV array.

Students will learn solar parameters that must be maximized to install a solar array for best performance.

Students will learn and use relevant earth science and solar photovoltaic vocabulary.

Students will analyze valid economic and carbon dioxide offset information for the placement of a solar PV array and consider the significance of this data.

Materials, Resources, and Technology Required:

- Computers with internet connection for each student in the classroom
- Presentation unit and screen

A global look at this lesson:

SOLAR SITE ANALYSIS: THE PV WATTS® CALCULATOR is a web-based activity, designed to be completed by students individually. Students will use the **National Renewable Energy Laboratory's PV Watts® Calculator** to estimate the electricity production of a grid-connected solar PV system for several locations across the globe.

Naturally, the best way to learn how to teach the lesson is to perform the activity in detail before teaching with it. It's not an especially difficult lesson, but there are many moving pieces. You need to be acquainted with all of them to use them effectively.

Students will work with **PVWatts** on the internet at the same time they are performing internet research. They'll work with their instructions (**Student Activity Guide**), data tables and graphs (**PV Watts Student Spreadsheet**), and assessments (**Student Response Guide**).

If you teach this as a self-directed lesson, students will also use the **Student Introduction to the PV Watts Calculator** PowerPoint. Otherwise, you may use it to launch your students into the lesson.

You'll probably want to demonstrate how to manage some parts of the lesson on a classroom projection screen. Keep the projection screen available to demonstrate how to overcome any problems your students encounter. When not teaching or demonstrating, circulate among your students to give "over the shoulder" guidance, answer questions, and help individual students solve problems.

While using **PVWatts**, students find and input a cost of electricity for each of three locations. The first of those is your location. The lesson instructs students to obtain a state average from the US Energy Information Administration.

[http://www.eia.gov/electricity/state/]

Alternately, you may provide the exact cost of electricity at your location and provide it to your students. With your students all using the same cost, and with all other input information the same, you can determine early in this lesson whether or not your students are using PV Watts and their spreadsheet correctly by checking their results.

Students will have to research the cost of electricity for Quito (Location 2). You may wish to do this research as a class. Once again you benefit with everyone using the same cost number and getting the same results in their spreadsheet.

Students choose the third location they'll survey in PV Watts. They'll have to research the cost of electricity for their third location on their own (or with your assistance).

You must consider ahead of time how you will allow students to approach Location 3. What if they select a location south of the equator? Will you tell them ahead of time to change their constant azimuth to 0°? Will you let them figure this out on their own? If so, that will take time. You may avoid this difficulty by restricting your students to locations in the northern hemisphere. No matter what you decide, you'll need to work discussion on the topic of ideal azimuth in the southern hemisphere vs. the northern hemisphere into this activity at some point.

Select questions from the **Student Response Guide** you wish to use to assess your students. The remaining questions may be removed and used as quiz or test assessment questions. Carefully consider the quality and depth of understanding you expect in your student answers. Use that expectation to provide guidance on the length of time you will spend with your students on this activity.

Students interact with this activity digitally. For this reason, the **Student Response Guide** is structured for digital submission and grading digitally. You will have to revise the document to have students work with it any other way. Provide directions and guidance on how you want their **Student Response Guide** organized so you may read it easily when submitted.

Available to you is a document titled **Solar Location Analysis: The PV Watts Calculator Answer Key**. It provides answer guidance and example answers for you for grading the **Student Response Guide**.

Introduction to the activity:

There are many ways to introduce this activity. It may be that very little introduction is needed if this lesson is a follow-up to lesson you've just done on solar PV with your students. If not, the introduction written for the **Student Activity Guide** provides good hints on how to start. Another good start: Let's find out if it makes sense to put up solar panels here in [your city] or here at [your school]! Then: Ok, what do we need to know before we begin? Follow this with a quick presentation on **PVWatts**, perhaps from the PowerPoint provided.

Part 1: Critical Definitions and **Part 2: Working With the PV Watts Calculator**

Our PowerPoint (**Student Introduction to the PV Watts Calculator**) moves students through the first part (**Part 1: Critical Definitions**) of the activity,. **Part 2: Working**

With the PV Watts Calculator introduces students to PV Watts and how to use it (and their other tools) to complete the activity.

Starting here, the activity becomes mostly self-directed for students. You may want to provide your students with certain checkpoints--places in the activity where they must check in with you. This way you may verify that they are completing the activity correctly as they move through it.

Then get students started and make the change from lesson teacher to activity coach.

Show What You Know

Upon concluding the activity, students use their **Student Response Guide** to **Show What You** (they) **Know**. In it, they analyze, synthesize, conclude, and write the assessments for this activity. As students finish the activity, remind them how you want their **Student Response Guide** organized so you may read it easily after it's been submitted.

Extending PV Watts

Note the **Student Introduction to the PV Watts Calculator** PowerPoint has two parts at its end that may be of interest and use to you. One is a set of example graphs that may be used for classroom discussion purposes. The second shows students how **The PV Watts Calculator** can be integrated with the **Solar Pathfinder** to produce an extremely accurate estimate of annual PV energy production at any specific location. Be sure to take students through that portion of the PowerPoint if they have previously completed our **Solar Pathfinder** lesson!

Extending Further

Your maintenance department probably has lots of replacement ceiling tiles. Consider making a compass to place on the ceiling of your classroom to help you teach about solar azimuth. The compass is a great renewable energy conversation starter any time of year. [The red lines are the sun's azimuth at sunrise and sunset for the first day of summer and winter at this location.]