To our teachers:

You may delete this page from the document that follows after reading it.

At the bottom of this page we've reproduced the "human-readable summary" of the copyright we adopted from Creative Commons. Consult this summary if you intend to copy and redistribute our material in any medium or format, or adapt, remix, transform, or build upon it.

Click here to view and read the same plain, readable summary of the Creative Commons copyright license we've adopted online. The online version provides additional information on some of the terms in the summary.

Neither summary is a legal substitute for our actual Creative Commons license, which may be found by clicking here.

The human-readable, Creative Commons copyright license summary:

"

You are free to:

- **Share** — copy and redistribute the material in any medium or format
- **Adapt** — remix, transform, and build upon the material

The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

- **Attribution** — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
- **NonCommercial** — You may not use the material for commercial purposes.
- **ShareAlike** — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.

No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

"

WPS SolarWise® for Schools

CREATE Energy Center

Name *

Date * Class Hour *

Watts On Our Roof, Lesson 6
PVWatts Comparison

Instructor Guide and Answer Key

Grade Level:	High School, Technical College, Community College
Lesson Length:	1-2 hours, depending on planning, coverage, emphasis, and student assessment method
Author:	Scott Liddicoat
Created:	February, 2026

Objectives:

Students will determine the actual, annual production of their solar array
Students will determine the theoretical, annual production of their solar array
Students will calculate the % difference between these two values
Students will consider reasons for any significant variance between these values
Students will understand how professionals estimate the performance of a solar PV array before installing it

The Main Thing

Watts On Our Roof is a series of lessons in which students work with the photovoltaic performance data produced by a solar array.

Lesson Six in this series is **Comparison** (video, 15:42). In this lesson students compare their array's actual solar PV production to its theoretical production from the PVWatts online solar PV estimator. In addition, students get two for the price of one with this lesson. One, they learn how to use PVWatts and why it is such a useful tool in the solar industry. Two, in using PVWatts, they begin to understand how professionals estimate the performance of a solar PV array before installing it.

Students will get actual solar PV energy production data by accessing their school's eGauge portal. They'll snip or screenshot the output profiles called for in the video to determine their actual solar production during the Solar Window.

Taking screenshots, making calculations, and completing the Summary Questions provide vital applications and follow up for this lesson and must be used in support of the video.

Activity and Teacher Notes:

Lesson Six is designed for students to compare their array's actual solar PV production to its theoretical production from the PVWatts online solar PV estimator.

To complete this lesson, students will need to access their school's solar PV array eGauge portal (or that of the school you've chosen for them to study). Consult our document titled **WPS SolarWise for Schools eGauge Installations** for the appropriate link to your school's portal. A second list of the same schools on that document provides data on the age of each array, its size, azimuth orientation, and tilt angle.

Students will get actual, annual solar PV energy production data by accessing their school's eGauge portal. They'll snip or screenshot the output profile called for in the video to display the actual, annual solar production of their array.

Students also access and use the PVWatts website, taking a screenshot of their array's theoretical results to complete this lesson:

https://pvwatts.nlr.gov/

Taking screenshots, making calculations, and completing the Summary Questions provide vital applications and follow up for this lesson and must be used in support of the video.

The teacher of this lesson has flexibility in how to teach it and will have to make several decisions on how to proceed through the lesson before beginning. Class, class size, the grade level of the students, time, and the materials available will all play a role in these decisions.

Naturally, teachers of this lesson must carefully watch the video in advance of its use in the classroom.

Advance viewing will enable you to make decisions on:

1. How to deliver the lesson video in the classroom
    - Teacher led video presentation
    - Self-paced, watched in cooperative groups
    - Self-paced, watched individually
2. How to perform student assessment
    - Will assessment be completed digitally or paper / pen(cil)?
    - Use some, or all of the provided assessment questions
    - Add additional questions
    - Have students complete the assessment while watching the lesson video
    - Have students complete the assessment at the conclusion of the lesson video

Video is 15 minutes, 42 seconds in length.

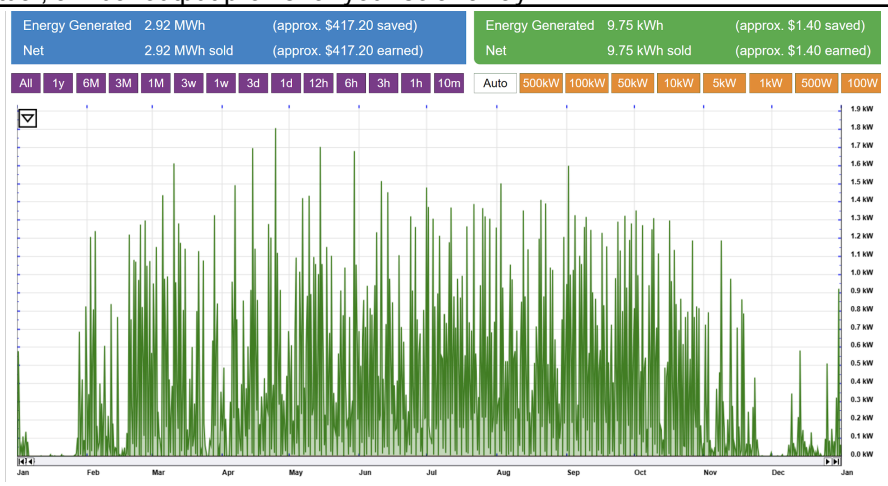
Video Chapter Timeline:

00:55 Intro and Lesson Objectives
01:50 Determine the actual annual production of your solar PV array
02:45 Determine the theoretical annual production of your solar PV array
12:50 Calculate the difference between these two values
14:15 In Review

Answer Key to Lesson 6 Summary Questions

1. Provide screen shots or snips of the graphs and tables you found and used to complete this activity, below. Crop them neatly. Change them in size so they both fit on this page.

1a. The actual, annual output profile for your solar array.



1b. The theoretical, annual production table for your array calculated in PVWatts.

RESULTS

Print Results

3,086 kWh/Year*

System output may range from 2,816 to 3,156 kWh per year near this location.
Click HERE for more information.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)
January	2.02	137
February	3.62	222
March	4.65	299
April	5.32	316
May	5.87	347
June	5.86	328
July	6.84	392
August	5.88	338
September	4.62	264
October	3.24	201
November	2.04	128
December	1.68	113
Annual	4.30	3,085

2a. What is the actual, annual production for your school's solar PV array? Provide the number with its unit label.
*** If your students have followed directions well, everyone should have correct, matching answers in mega-Watt hours, mWh.**

2b. What is the theoretical, annual production for your school's solar PV array? Provide the number with its unit label.
If your students have followed directions well, they should have correct, closely matching answers in kilowatt-hours, kWh, or Megawatt hours, MWh.

2c. What is the percent difference between these two values? Show your math work completely.
If they haven't already, students will have to convert kWh to MWh to calculate the % difference. If your students have followed directions well, they should have correct, closely matching answers expressed in percent. You may have to review how to calculate the correct percent difference. You may have to review what you would like to see for math work.

2d. Are there any obvious, potential explanations for the difference between these two values?
There might not be anything obvious. Or the percent difference might be small. Because of what's in the video, students should study their graph of annual production to see if there is anything that looks problematic. Some students might reply in this question that some characteristics of their array don't match well with PVWatts System Information prompts,

3. A solar PV array is underperforming. You've been hired to find out why. What are three reasonable potential causes for the disappointing performance?
Provide a short label or reason for each of your three possible causes. Then add a one sentence explanation of how each cause might potentially affect solar PV performance.

The following are common answers. There are other possibilities.

3-X. **Unusual weather**
The weather overall, was well above or below average for the year.

3-X. **Instrumentation**
The array may be producing well, but the eGauge is not reporting it accurately.

3-X. **Unexpected shading**
Trees (especially fast-growing trees), buildings (especially new construction), or other obstructions (new, or that weren't properly anticipated) may shade the array.

3-X. **Snow or soiling**
Unexpectedly high or unanticipated snow shading or soil shading.

3-X. **Equipment malfunction(s)**
Unanticipated inverter, wiring, module, or other equipment problems

4. Seldom are estimates of anything spot on. Do some research, describe what you found and where you found it. What's an industry-acceptable percent difference between actual and theoretical (or estimated) solar PV values?
5-10% will be a commonly researched answer. However, it should be pointed out that solar estimators almost always want slightly underestimate performance, and never, ever overestimate. They commonly say, "We'd rather under promise and overproduce."

5. Write a short essay explaining how PVWatts may be used for solar estimating purposes. Your explanation should be understandable and accessible to someone who hasn't heard of PVWatts before. Your essay must satisfy these criteria:
   - Three paragraphs (introductory, explanation, concluding).
   - Explain PVWatts, how it works, and how it's useful for estimating solar array performance to a customer who may be interested in installing a PV system.
   - Complete sentences are required.
   - One page maximum. Be concise.

   Here is a simple AI-inspired answer, based on the information in the lesson:

   PVWatts is an online tool created by the National Renewable Energy Laboratory. It's designed to help users estimate the energy production of a proposed solar photovoltaic power system. PVWatts offers an approachable way to understand what a solar installation might mean for your home or business.

   Its user-friendly interface allows you to enter basic information such as location, system size, tilt, and orientation to quickly generate an estimate of yearly and monthly energy output. The tool works by using weather data and solar radiation information specific to your geographic location. When you input details about your prospective solar system, PVWatts combines this data with the system specifications to model how much electricity the system is likely to produce under typical conditions. This makes PVWatts especially valuable for customers who want to compare options or determine whether investing in solar is worthwhile before reaching out to installers.

   PVWatts simplifies the process of solar estimation, making it accessible to individuals without technical expertise. By providing realistic performance estimates, it empowers users to make informed decisions about solar energy investments.

6. Describe the most important idea, concept, principle, or fact you learned while completing the lesson. Explain why it is important for you (and probably other people) to know and understand.

   This is a judgement question. The primary requirements for a good answer are good sense and reasoning relating to the concept of the Solar Window.