To our teachers:

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Watts On Our Roof, Lesson 2
Prep for Success

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 visualize and learn important solar:
- Principles,
- Concepts, and
- Vocabulary
  - Electrical power
  - Electrical energy
  - Solar azimuth
  - Solar altitude
  - Solar noon
  - Solar window
- Students will begin to interpret solar PV output profiles provided from their school's eGauge

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.

In **Lesson Two, Prep for Success** (video, 27:21), students visualize and learn foundational solar PV principles, concepts, and vocabulary. Good achievement with this lesson prepares students for success in the lessons that follow by providing them (and you) with a common platform and language from which to teach.

Activity and Teacher Notes:

Lesson Two is designed to be used prior to other lessons in this series in which students apply what they learn to understand different characteristics of the photovoltaic performance data produced by a solar array.

Summary Questions provide necessary application 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 27 minutes, 21 seconds in length.

Video Chapter Timeline:
0:42 Introduction and Lesson Objectives
2:28 But First
3:40 Electrical Power and Electrical Energy Defined
5:00 Electrical Power and Electrical Energy On the Solar PV Output Profile
11:42 And In Case You Forgot…
12:20 Array Orientation and Sun Position
17:50 More Solar Vocabulary and the Seasons
24:15 Weather and the Output Profile
26:20 In Review
27:21 End

Answer Key to Lesson 2 Summary Questions

In writing the six definitions that follow, provide the level of detail your teacher requires.

1. Write a definition for electrical power. In your answer, include the unit or label in which it is usually expressed.

"Electrical power **is** ***the rate at which energy is transferred in an electrical circuit.***

An instantaneous measure, the kilowatt (kW) serves as the standard unit for expressing electrical power."

2. Write a definition for electrical energy. In your answer, include the unit or label in which it is usually expressed.

"Electrical energy **is** ***the ability to do work that results from the flow of charged particles, such as electrons, through a conductor.***

The kilowatt-hour (kWh) serves as the standard unit for expressing electrical energy. It's a measure of the total quantity of electrical power a system either consumes or generates over time."

3. Write a definition for solar azimuth. In your answer, include the unit or label in which it is usually expressed.

"Solar Azimuth: The compass degree (0-360) that describes the position of the sun along the horizon at any given time."

4. Write a definition for solar altitude (or elevation). In your answer, include the unit or label in which it is usually expressed.

"Solar Altitude or Solar Elevation: The vertical angle formed between the horizon and the center of the sun's disc at any given time."

5. Write a definition for solar noon.

"Solar Noon:

The moment during the day when the:

- **sun reaches its highest point in the sky—its maximum altitude or zenith**
- **sun is due South—its azimuth is 180° on a compass dial**
- **daylight from sunrise to solar noon is equal to the daylight from solar noon to sunset**

Solar Noon is usually close to, but is seldom the same as clock noon (daylight savings, location within a time zone, etc.)"

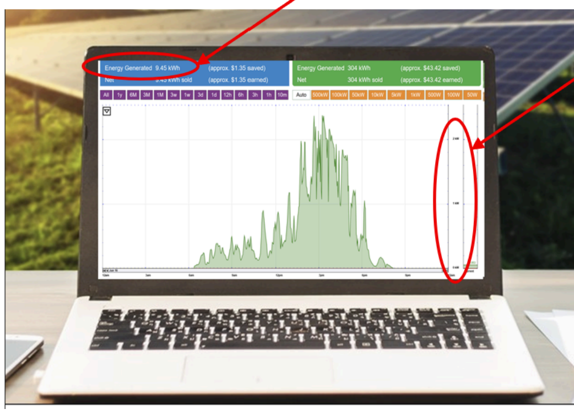
6. Write a definition for solar window. In your answer, include the unit or label in which electrical energy is usually expressed.

“Solar Window: The critical hours of 9:00 am (ST) to 3:00 pm (ST) that are the most important for the conversion of sunlight into electricity for a well-positioned, fixed solar array.”

7. On the eGauge output profile graph in the picture below:

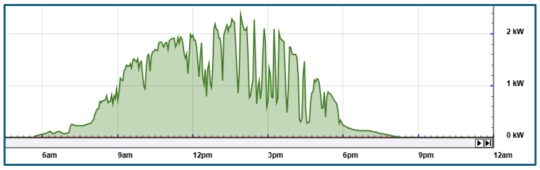
    7-1. Circle and label where the measurement of <u>electrical power</u> may be found.

    7-2. Circle and label where the measurement of <u>electrical energy</u> may be found.

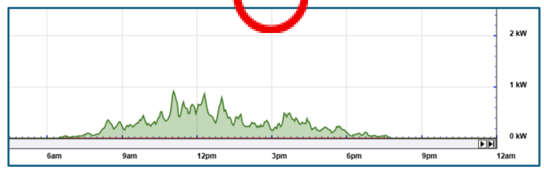


8. * Which output profile shown below best matches this weather description:
Dense clouds (maybe even stormy) throughout the entire day.

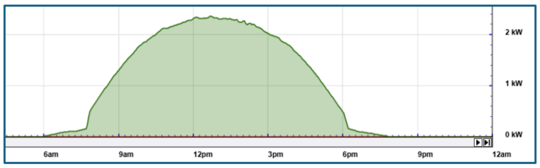
a.



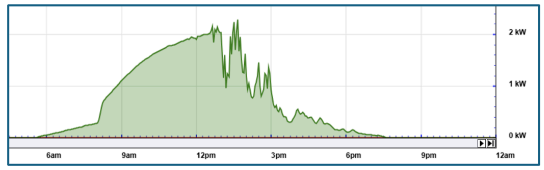
b.



c.

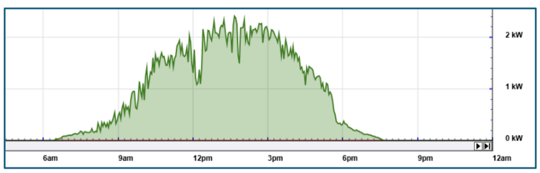


d.



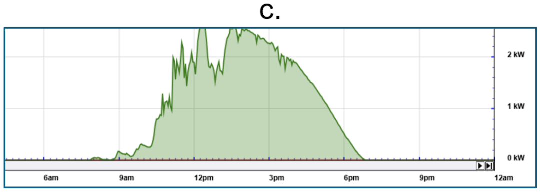
9. * Which output profile shown below best matches this weather description:
Very few or no clouds throughout the day.

a.

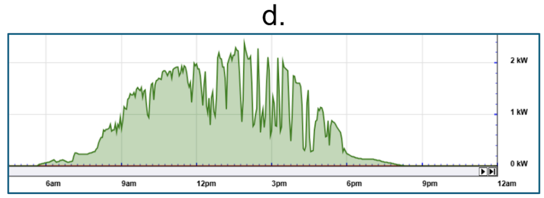


b.

c.

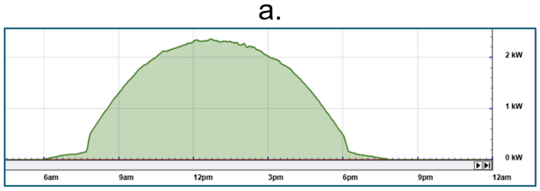


d.

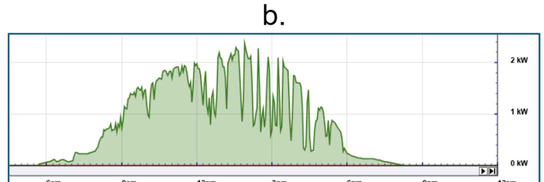


10. * Which output profile shown below best matches this weather description:
Sunny in the morning, cloudy (maybe even stormy) in the afternoon.

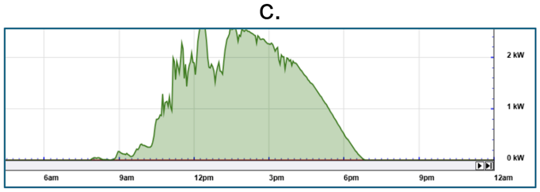
a.



b.

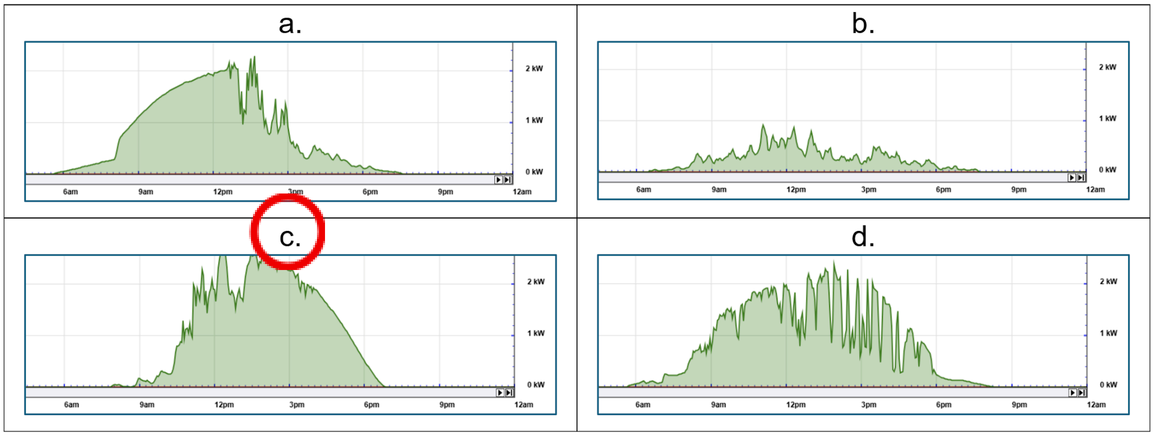


c.

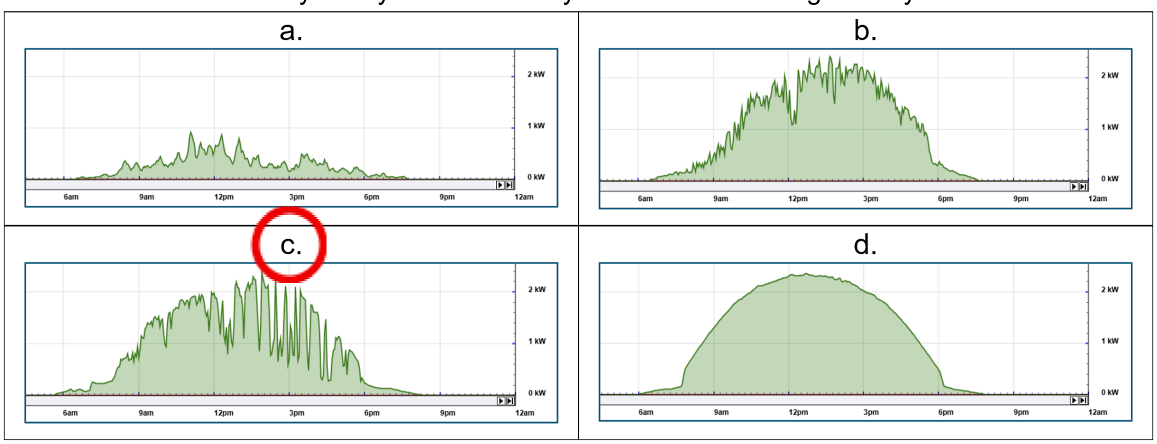


d.

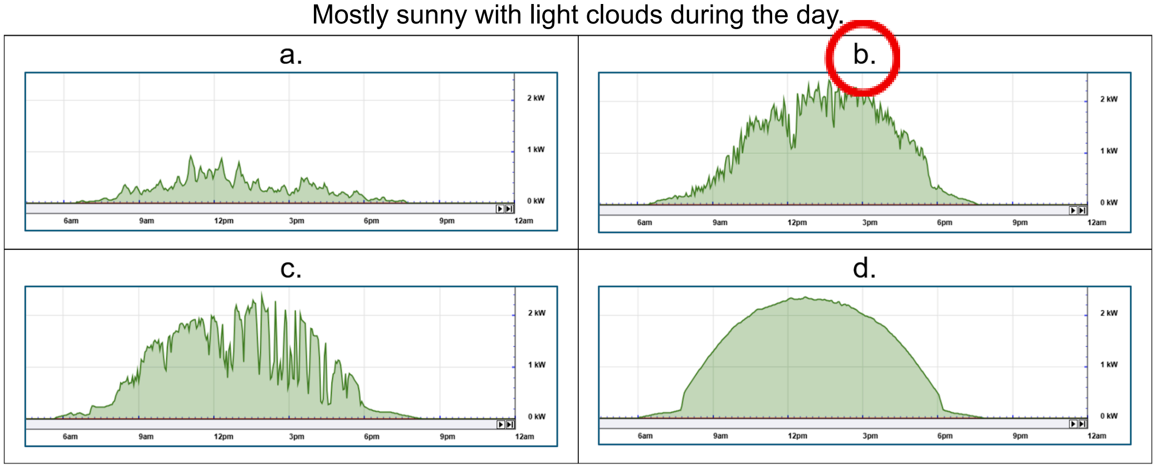
11. * Which output profile shown below best matches this weather description:
Cloudy (maybe even stormy) in the morning, sunny in the afternoon.



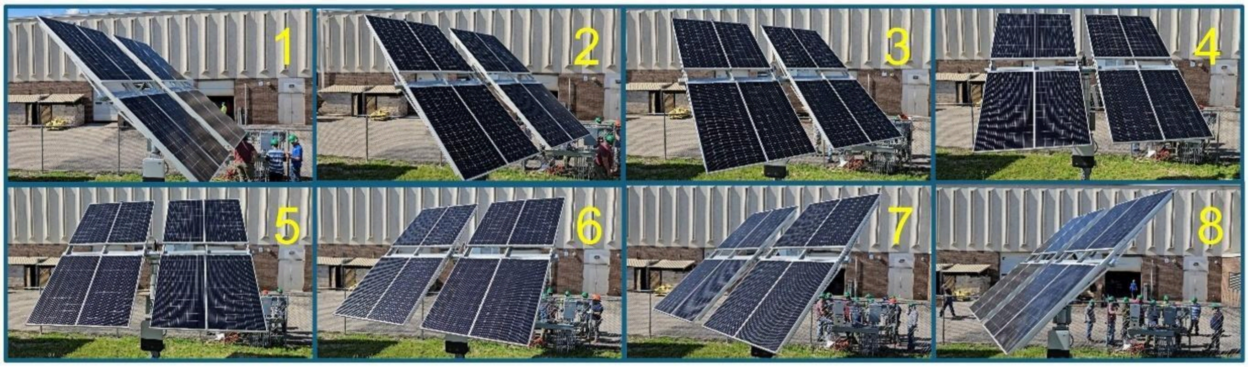
12. * Which output profile shown below best matches this weather description:
Mostly sunny with some very dense clouds during the day.



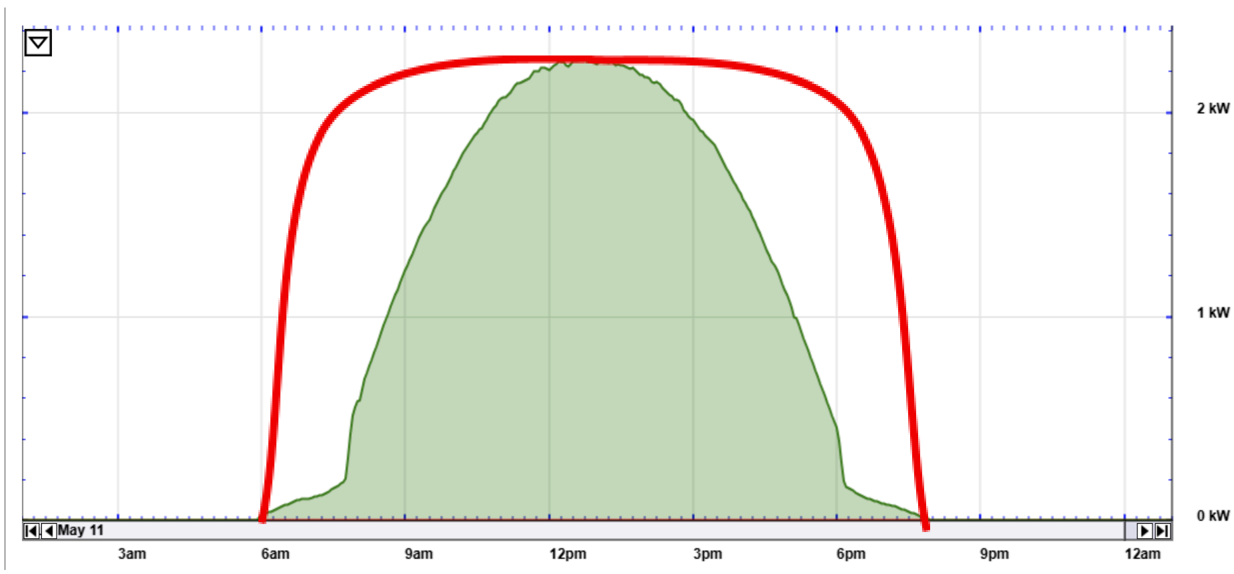
13. * Which output profile shown below best matches this weather description:
Mostly sunny with light clouds during the day.



14. The eight photos just below show a two-axis tracking solar PV array “following” the sun throughout the day. From sunup to sundown, this type of array adjusts its azimuth and tilt angle to keep its modules facing directly at the sun.



Below is a solar PV output profile for a fixed-in-place solar PV array on a very sunny day. It’s like several profiles you’ve already seen. On top of this profile, sketch the PV output profile for a two-axis tracking solar array on the same sunny day. Assume both arrays are identical in every other way (type of module, location, wiring, etc.).



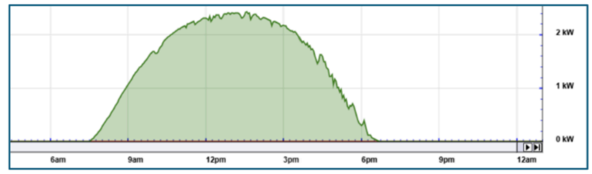
15. Use the three sunny day solar PV output profiles to the right to answer the following three questions:

15-1. **C** Which is a profile for a sunny day in December (wintertime)?

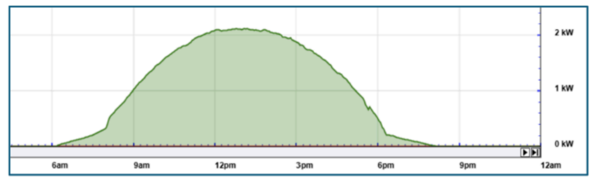
15-1. **A** Which is a profile for a sunny day in March (springtime)?

15-1. **B** Which is a profile for a sunny day in July (summertime)?

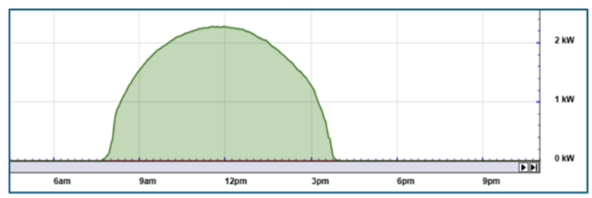
a.



b.



c.



16. Below are two seasonal solar output profiles for the same fixed PV array. Each one shows daily profiles for all the days of a particular season. Which one is the profile for winter? Which one is the profile for summer? Explain fully and completely how you know.

A is the profile for summer. B is the profile for winter. There are at least three observable reasons.

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1. Through the summer season (in the Northern hemisphere) more energy will be produced than during the winter. During season a, 951 kWh of energy were produced, compared with only 628 kWh for season b. A must be summer.

2. The numerous daily profiles represented throughout season a are "wider" than season b. This indicates there were more hours of daylight each day of the season, which is true of summer. A must be summer.

3. (Harder to discern)The relationship between temperature and electrical potential (Volts) is as follows: The lower the temperature, the higher the electrical potential. The higher the temperature, the lower the electrical potential. Since Volts X Amps = Watts, when Volts are higher, Watts are higher. When Volts are lower, Watts are lower.

For this reason, electrical potential, and therefore Watts, are both higher during cold winter days when modules stay cold even when it's sunny. During the summer on sunny days, modules get hot. Electrical potential, and therefore Watts, are both lower during sunny summer days.

Several days are above 2 kW for season b. Season b must be winter.
Not one day is above 2 kW for season a. Season a must be summer.