

Study Guide for Unit 29: Renewable Energy

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Sustainable Energy

Read the following sections of Unit 29 (Renewable Energy):

- *Sustainable Energy*
- *Fossil Fuels vs. Renewable Sources of Energy*
- *Sustainable Sources of Energy and External Costs*
- *Renewable Energy Use in the United States*

1. How is sustainable energy different from renewable energy?

2. Complete the following sentence:

In a sense, most sources of energy are renewable. The problem with fossil fuels that leads us to classify them as nonrenewable is that they renew too _____. In other words, using fossil fuels is unsustainable, because we use so much energy that we use them much _____ than they renew.

3. Renewable sources of energy like solar and wind often have an excellent EROEI (Energy Return on Energy Invested). In other words, they generate a lot more energy than it takes to gather or produce the energy. Why, then, are the sources of renewable energy often more expensive than energy generated using fossil fuels?

4. What is the big advantage that fossil fuels have over wind power and solar power for generating electricity? What makes these sources of renewable energy more expensive for generating electricity but is not a problem for fossil fuel power plants?

5. What are the primary sources of renewable energy?
 6. Which sources of renewable energy depend upon energy from the Sun, either directly or indirectly?
 7. Which renewable source of energy is NOT ultimately powered by energy from the Sun?
 8. What are primary sources of nonrenewable sources of energy?
 9. Which kinds of electricity generation CANNOT be used in many places, because the local conditions do not allow them to generate enough electricity (to generate all the energy we need)?
 10. Which kinds of energy can be easily transported so they can be used in most places as primary energy sources?
 11. Which kinds of energy generation depend on weather and climate? In other words, they will sometimes produce more energy and sometimes produce less energy due to changes in weather and climate?
 12. Which kinds of energy generation do NOT depend upon the weather and climate?
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Fossil Fuels vs. Renewable Sources of Energy

Read the following sections of Unit 29 (Renewable Energy):

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13. Which of the following statements are true?

- *One of the major reasons fossil fuels like coal, oil, and natural gas are cheaper sources of energy than renewable sources of energy like solar and*

wind is that the damage mining and burning fossil fuels does to human health and ecosystem services is NOT included in their price.

- Supplying our energy needs from many different sources (e.g., fossil fuels, wind, solar, nuclear) makes our energy supply more reliable and stable.*
- Supplying our energy needs from many different places (e.g., different countries) makes our energy supply more reliable and stable.*
- We do NOT need fossil fuels to supply our energy needs and maintain our standard of living. We can afford to switch over to renewable sources of energy right now.*

14. What is the percentage of energy (electricity, vehicles, and so on) used in the United States comes from fossil fuels? (Use the 2017 statistic.)

15. What percentage of energy (electricity, vehicles, and so on) used in the United States comes from renewable sources of energy? (Use the 2017 statistic.)

16. What percentage of electricity used in the United States comes from fossil fuels? (Use the 2019 statistic.)

17. What percentage of electricity used in the United States comes from renewable sources of energy? (Use the 2019 statistic.)

18. Which are the TWO kinds of renewable energy that we use the most in the United States?

19. Which kind of renewable energy is projected to give the United States more and more energy over time?

20. Which renewable source(s) of energy are already or soon will be producing as much electricity as they can for us? In other words, which ones will NOT be producing much more energy in the future than they already are?

Hydropower

Read the following sections of Unit 29 (Renewable Energy):

- *Generating Energy from Wind and Water*
- *Hydropower*

21. How or why can we use winds and rivers to generate electricity?

22. Which of the following statements about electricity generation using hydropower are true?

- *Hydropower CANNOT be used to generate much power in flat places (plains).*
- *Hydropower CAN make more electricity or less to meet consumer demand, unlike wind and solar electrical generation.*
- *Unlike wind and solar electrical generation, the amount of electricity hydropower can generate does NOT depend on CLIMATE.*
- *Hydropower dams can be used for flood control (to reduce or preventing flooding).*
- *Hydropower dams can DECREASE our fresh water supplies, because in warm climates a lot of water evaporates.*
- *The construction of hydropower dams causes habitat destruction and often harms local people: a lot of land is needed to create the reservoir behind the dam, so people and animals must move.*
- *Hydropower dams harm river ecosystems, because they make it impossible (or much harder) for animals to migrate upstream or downstream.*
- *Hydropower dams harm river ecosystems, because they block the flow of water, so some of the time the river downstream of the dam does not have enough water.*

- *Hydropower dams help reduce nutrient pollution. The dam makes it convenient and easier to clean the water flowing through it.*
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Wind Power

Read the following sections of Unit 29 (Renewable Energy):

- *Generating Energy from Wind and Water*
- *Wind Power*

23. Consider the following statement: Is it true or false?

- *Winds blow due to energy that the Earth receives from the Sun. Thus, wind power can be considered a kind of solar power.*

24. What conditions are necessary to create winds at the Earth's surface?

25. Where does air rise, at the warm spot or the cold spot? Why?

26. Where does air sink, at the warm spot or the cold spot? Why?

27. Does the air at the surface of the Earth (the surface winds) move towards the warm spot or towards the cold spot? Why?

28. Which of the following statements about wind power are true?

- *One advantage of wind power is that one does not need to build large facilities. One can build small turbines to generate small amounts of electricity for local use.*
- *One problem with wind power is that some places do not have much wind, so wind power cannot generate enough electricity for them. Some other kinds of electricity generation will be needed.*
- *One problem with wind power is that the winds are not steady. Sometimes they generate more electricity than can be used and other times they do not generate enough electricity.*

- *One problem with wind power is that winds are stronger on some days than on other days. Sometimes they generate more electricity than can be used and other times they do not generate enough electricity.*

- *One problem with wind power is that the winds may be strong at times when we do not need much electricity (e.g., night time) and weak when we need more electricity.*

29. Sustainable energy generation is supposed to cause little or no harm to local ecosystems. What is the biggest way in which wind power harms local ecosystems?

30. Consider the following statement. Is it true or false?

- *Scientists have studied the wings, fins, and flippers to find clues on how to make better turbine blades.*

Solar Power

Read the following sections of Unit 29 (Renewable Energy):

- *Solar Power*
- *Ways in Which Your Home is Already or Can Be Solar Powered*

31. Which of the following statements about solar power are true?

- *One advantage of solar power is that one does not need to build large facilities. One can use small solar panels to generate small amounts of electricity for local use.*

- *The great thing about solar power is the Sun shines everywhere, so solar power can be used to generate enough electricity for everyone, no matter where they live.*

- *Solar power generates electricity when energy consumption (energy demand) is highest.*

- *Wind power and solar power work well together, because solar power generates electricity during the day (when there is more sunlight) and wind power generates more electricity at night (when winds are strongest).*
- *Even places that are cold near the Poles can benefit from solar power during their summers, in part because the Sun shines 24 hours a day (or close to it).*
- *The Earth receives far more energy from the Sun each day than the total electrical energy needs of every person on the Earth to live like someone in the United States.*
- *Solar panels are the most expensive part of solar energy production.*
- *More people still work in the fossil fuel energy production industry than in the solar power energy production industry in the United States.*

32. Why are solar panels becoming less and less expensive to buy?

33. What are the top TWO biggest external costs associated with solar power?

Geothermal Power

Read the following sections of Unit 29 (Renewable Energy):

- *Geothermal Power*
- *Why is the inside of the Earth hot?*

34. Which of the following statements about electricity generation using geothermal sources of heat are true?

- *Geothermal power plants are relatively cheap to build. You just have to drill a few holes.*
- *Geothermal power plants create little or no air pollution.*

35. Which of the following statements about electricity generation using geothermal sources of heat are true?

- *Geothermal power plants emit a very small amount of greenhouse gases into the atmosphere.*
- *Huge facilities must be created to effectively use geothermal heat to generate electricity.*
- *Geothermal heat rarely is able to generate enough electricity for local needs. Other sources of electricity generation are almost always needed.*
- *Electricity cannot be generated from geothermal heat everywhere. Only certain special places have hot rock close enough to the surface.*

36. In geothermal heat pumps (ground source heat pumps), water is pumped down into the ground below a house. The water exchanges heat with the Earth, and then is brought up. Can this water be used to cool the house in summer? Can the water be used to warm the house in winter?

37. Is the following statement true or false?

- *Geothermal heat pumps to heat and cool homes can be installed just about anywhere.*

38. How is producing energy from geothermal heat (heat from inside the Earth) like producing energy from nuclear power?

Energy Conservation, The Grid, and Power from the Ocean

Read the following sections of Unit 29 (Renewable Energy):

- *Energy Conservation*
- *Electric Vehicles as the Batteries We Need*
- *Power from the Ocean*

39. Is the following statement true or false?

- *Old fashioned incandescent light bulbs use more electricity to generate heat than they do to generate light.*

40. About what percentage of the energy used in the average home in the United States is used to provide light?

*41. What is a smart grid? How would it be different from the grid that we have now?

42. Is the following statement true or false?

- *A smart grid will make it easier for renewable supplies of energy like wind and solar to become part of our electricity generation system.*

43. True or false?

- *A smart grid would allow us to direct electricity to essential services like hospitals, firefighters, and the police to make sure they have power during disasters.*

44. For us to rely upon renewable energy like solar and wind instead of fossil fuels, we probably need people to buy a lot of powerful batteries to store the renewable energy for later use. What kind of consumer product containing such batteries is becoming more and more common for ordinary people to own?

45. How do we hope to use the ocean to generate electrical power in the future?