

APES in a BOX: The Review Sessions

Renewable Energy

Passive Solar

Passive solar technology directly captures sunlight and converts it into heat. Sunlight can be used to either directly heat air or water. Passive solar design can be incorporated into buildings or stand alone devices can be built. In a home, passive solar can be employed by allowing sun to enter large south-facing windows to warm the house during winter time. This effect can be magnified by incorporating "thermal mass" into the building design. This means that the builder would use stone, water, etc. to store heat when the sun is shining and later release heat when the sun goes down.

Advantages of Passive Solar

It is a highly efficient use of solar energy.

There is relatively low land disturbance.

No fossil fuel is used; therefore, no pollution is associated with fossil fuels.

Disadvantages of Passive Solar

Initial construction and design can be costly.

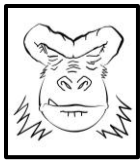
Passive solar works best with clear sunny skies.

Like Ants Under a Magnifying Glass....

In some solar applications the sunlight is magnified using mirrors to direct the energy into a single area. Like a large solar cooker, this method can be used to produce steam for electricity production.

Photovoltaic Cells

PV cells, commonly called solar panels, collect sunlight and convert it to electricity. Sunlight causes the release of electrons in the panel that creates a current. PV Cells can be used to charge batteries allowing the electricity to be stored for later use or they can supply electricity directly to a motor, light, etc. PV cells can be used on a large scale to provide electricity to buildings or in small applications such as solar garden lights or solar calculators. Most of the southwestern United States receives enough solar radiation to make PV cells a viable option for electricity production.



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Advantages of Photovoltaic Cells

No fossil fuels are used, and the air pollution associated with fossil fuels is avoided.

No Greenhouse gas emissions are produced.

They are perfect for remote areas where the infrastructure for power may not exist.

Once the panels are installed, maintenance is low and the electricity is free!

There are no moving parts in a solar panel which leads to less repairs and lower maintenance.

Disadvantages of Photovoltaic Cells

Electricity is only produced when the sun is shining.

Energy is consumed in the production of solar panels.

Pollution is generated in the manufacturing and transportation of solar panels.

The initial cost of solar panels is high.

Outdoor solar panels must be cleaned regularly to maintain efficiency.

Wind

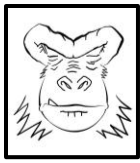
Wind power is the fastest growing source of renewable energy. Windmills have been in use for hundreds of years, harnessing the power of the wind to pump water or power machinery. The modern windmill uses the wind to turn a generator that spins and produces electricity. These wind turbines can be used in isolation for small applications, like single households, or can be linked together in wind farms that are capable of producing considerable amounts of electricity for residential and commercial use.

Advantages of Wind Power

There are many places throughout the U.S. and the world that have winds that are suitable for energy production.

Once the wind turbine is in place, the electricity is free and renewable.

No greenhouse gas emissions, or air pollutants, associated with burning fossil fuels.



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Disadvantages of Wind Power

Wind turbines require a costly initial investment.

Wind turbines only produce electricity while the wind is blowing.

Windmills can be disruptive to migratory birds, and have been shown to kill both birds and bats.

Some consider wind farms to be visually unappealing.

Wind turbines require routine maintenance.

Biomass

Biomass energy production is perhaps the oldest and most widely used method of producing energy for human use. Biomass includes burning firewood, dung, or other waste materials. It also includes decomposing organic material to produce methane and burning plant material to produce steam for electricity production. In its simplest form, wood and dung have been burned to provide heat. In more modern applications, animal waste can be decomposed in large digesters where the resulting biogas can be used for heating, cooking, or electricity production.

Advantages of Biomass Energy Production

Fuel is abundant and locally derived. Wood can be used in wooded areas, dung can be used near livestock, grasses can be used if available, etc...

Waste from sewage plants or feedlots can be used to produce electricity.

Burning biomass releases recently sequestered carbon as opposed to burning fossil fuels which release carbon that has been sequestered for thousands of years.

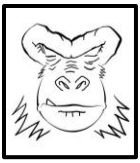
Fuel is relatively inexpensive.

Waste from industry, such as the sludge left over from beer making, can be digested to produce biogas.

Disadvantages of Biomass Energy Production

If not managed properly, resources like forests can be overused for fuel wood and charcoal production.

The energy content of biomass is relatively low when compared to fossil fuels



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Biodiesel / Ethanol

Ethanol is produced by fermenting sugar or starches. When fermentation is finished, the resulting liquid is distilled to make ethanol. Ethanol makes up a small percentage of domestic fuel use. The good thing about ethanol is that it is produced locally which reduces foreign oil imports. Unfortunately, ethanol production involves large amounts of cropland which are already stressed for food production. As more corn and other agricultural products are purchased for fuel, the price for corn-based food products also increases. Ethanol produces less air pollution than its fossil fuel counterparts, but is also very energy intensive to produce. Ethanol will continue to be used as a fuel additive, and for special applications, but it is highly unlikely that it will ever represent a major portion of U.S. fuel consumption.

Biodiesel is produced by mixing plant oil with an alcohol. The resulting biodiesel runs in any diesel engine. Biodiesel has great promise for small scale local fuel solutions because almost any type of plant oil can be used to produce it. Recycled vegetable oil from restaurants can be used to make biodiesel, as long as you don't mind your car exhaust smelling like French fries!

Moving Water Energy Production

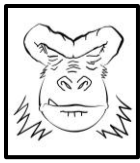
For ages, moving water has been used to turn waterwheels which drove machinery. This same concept can be applied to the production of electricity. Hydroelectric power is generated by flowing water turning a turbine that is connected to an electrical generator. As the generator spins, it produces electricity. In some cases, fast moving rivers can be harnessed to produce electricity. More often than not, a dam is built on a river to create a reservoir on the upstream side of the dam. The trapped water is then allowed to flow through the generators.

Advantages of Hydroelectric Power

When a dam is built, land is flooded upstream to create the reservoir for drinking water and recreation.

Hydroelectric power does not produce any CO₂ emissions or air pollution.

It is a highly efficient, low cost source of electricity.



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Disadvantages of Hydroelectric Power

The newly created reservoir destroys habitat, which leads to a loss of biodiversity.

Sand and silt are not allowed to flow freely downstream. This results in beach erosion due to the lack of new deposition of sediment, and minimizes the deposition of natural fertilizing sediment downstream.

Dams require maintenance to function properly.

Hydrogen Fuel Cells

Hydrogen fuel cells have been widely anticipated because of their very high efficiency when compared to an internal combustion engine. In a hydrogen fuel cell, hydrogen's proton and electron are separated. The proton passes through a membrane, and ultimately combines with oxygen to form water. Water is the waste product of a fuel cell, which makes it an attractive alternative from a pollution standpoint. The separated electrons produce electricity which can be used to drive an electric motor or any other electrical device.

Advantages of Hydrogen Fuel Cells

Hydrogen fuel cells are very efficient.

There are no harmful emissions.

Hydrogen can be produced by splitting water and is relatively easy to store.

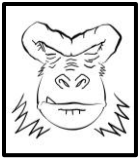
Disadvantages of Hydrogen as a Fuel Source

Fuel Cells are very expensive.

There is little to no hydrogen gas found in nature. Energy has to be used to create hydrogen by splitting water molecules. The most promising method of creating hydrogen would be to use wind or solar power to split the water molecules.

Hydrogen is a way to store energy, but not an energy source in itself.

There is no infrastructure in place to deliver hydrogen to the consumer.



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Renewable Energy Review Questions

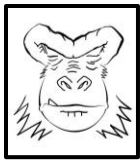
1. Which of the following involves directly capturing the sun's energy to heat air or water?

- A) Photovoltaic Energy
- B) Tidal Energy
- C) Geothermal Energy
- D) Passive Solar Energy
- E) Wind Turbines

2. Which of the following are advantages of using photovoltaic cells to produce electricity?

- I. No greenhouse gasses are produced while using PV cells.
- II. Once the panels are installed relatively little maintenance is required.
- III. There are no moving parts in a PV cell leading to less need for repair.
- IV. No fossil fuels are consumed while operating PV cells.

- A) I only
- B) I and II only
- C) I and III only
- D) I, II, and III only
- E) I, II, III, and IV



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Use the following answer choices for questions 3-7

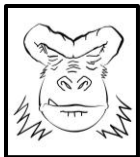
- A) Photovoltaic Cells
- B) Wind Energy
- C) Biomass Energy
- D) Hydroelectric Power
- E) Hydrogen Fuel Cells

3. Fastest growing source of renewable energy.
 4. Renewable energy device that produces water and heat as its only waste products.
 5. Using moving water to spin turbines and produce electricity.
 6. Category of renewable energy that involves burning, fermenting, or extracting oil from organic material to produce energy.
 7. Involves the conversion of the sun's energy into usable electricity.
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8. Which of the following energy sources are produced from biomass?
 - I. Biodiesel
 - II. Ethanol
 - III. Methane
 - IV. Natural Gas
- A) I only
 - B) II only
 - C) III only
 - D) I, II, and III
 - E) I, II, III, and IV



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1.A. Identify and describe one negative environmental impact of building and using hydroelectric dams.



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Multiple Choice Scoring Guidelines

1. D	3. B	5. D	7. A
2. E	4. E	6. C	8. D

Free Response Scoring Guidelines

1.A. (2pts total) 1pt each for a correct identification and description of a negative environmental impact of building and using hydroelectric dams.

Impact	Description
Destruction of habitat	Caused by upstream flooding or the formation of a reservoir
Alteration of natural hydrology	Water is being redirected from its natural destination for use elsewhere
Increase in release of Methane and Carbon dioxide	When a reservoir is built the sediment, detritus, and flooded plant life that is trapped behind the dam goes through a period of rapid decomposition releasing large amounts of methane and CO ₂

Multiple choice points earned + Free response points earned / 10 * 100= Quiz average

(_____ + _____) / 10 * 100 = _____ Quiz Grade