Energy Cards, page 1

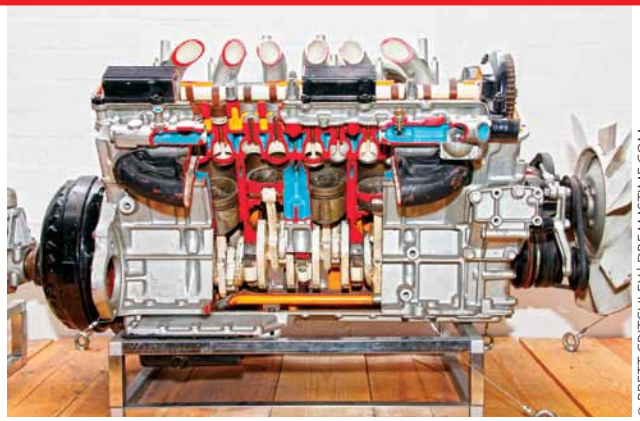
PHOTOVOLTAIC CELLS

Many people are installing solar panels on homes and buildings. Solar panels are made of photovoltaic (PV) cells that are designed to capture photons of sunlight and transform this energy into electricity. PV cells are made of two layers with different charges in order to generate an electrical field in the center of the cell. Sunlight hits electrons in top layers of the PV cells and causes them to move around. Some of these electrons reach the electric field and are pushed toward metal conductor strips on the bottom of the cell. These strips connect to a wire that conducts this electrical energy toward the house or building. Electricity also flows back in the opposite direction from the building toward the PV cells in order to create a circuit necessary for the transfer of electricity.[4] Solar panels are usually about 10-20% efficient.[5] This means that only 10-20% of the sunlight that reaches solar panels is converted into electricity. There are many reasons for this inefficiency. Not all wavelengths of sunlight are absorbed by PV cells and some light is reflected away from the panels. Also, some of this light is converted into heat rather than producing electricity.[6]

JODIE VAN DE WETERING

INTERNAL COMBUSTION ENGINE

Unless you drive an electric car, an internal combustion engine fueled by some sort of chemical energy (usually gasoline) lies just under the hood of your car. This engine converts chemical energy into heat energy in order to move the parts of the engine. The engine's motion energy is then transferred to the car's wheels to move your entire car.[7] Not all of the chemical energy from gasoline is converted into motion energy, however. In fact, only about 14-26% of the fuel's energy is used to move your car.[8] A tremendous amount is released as heat and the rest helps power the car's accessories, such as heating, air conditioning, and windshield wipers. The way you drive impacts your car's efficiency, too. The faster you drive and the more you idle, the less gasoline is converted into kinetic energy!



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POWER PLANT

Power plants generate electricity. They have 3 main parts that help them do this: a turbine, shaft, and generator. A turbine is a machine made of blades that turns when pushed by something with kinetic energy (such as steam, wind, or water). The turbine is connected to a shaft that turns inside the generator whenever the turbine moves. There are copper coils and magnets inside the generator and when the shaft turns, kinetic energy is converted into electricity. This electricity is sent from the power plant to the electrical grid and eventually makes its way to your home. Remember that energy cannot be created out of thin air! Therefore, all power plants must have some sort of energy input. Thermal power plants burn chemical energy or use nuclear fission to produce steam or hot gases that move the turbine.[9] The efficiency of thermal power plants ranges from 29-55%. In other power plants, moving water or wind turns the turbine. Wind power plants are about 45-50% efficient while hydropower plants can be 90% efficient![10]

FUEL CELLS

Depending on their size, fuel cells can be used as a power source for cell phones, cars, or even entire power plants. They can be a back-up supply of power for people without access to the electrical grid or during disasters. For instance, during Hurricane Sandy fuel cells were used to provide power for cell phone towers in order to help communication lines stay open.[11] Fuel cells function like batteries in that they use chemical energy to generate electricity. Chemical reactions take place inside the cells and produce electrons that flow around an external electric circuit to provide power for the machines they are connected to. Fuel cells use hydrogen as fuel and oxygen from the air to produce electricity, water, and, heat. No pollution is emitted during this process and no oil is needed to fuel the car.[12] The energy efficiency of fuel cells for cars ranges from 40-60%.[13]

Name Date Class

Analyzing Energy Technology, page 1

Directions: Draw an energy flow diagram to represent the energy transformations that take place for each of the following pieces of technology. Then answer the questions below.

Photovoltaic Cells	Internal Combustion Engine
Power Plant	**Fuel Cells**

1. In general, what is the purpose of the above technology? In general, what are some trade-offs of the above technology?

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2. Which technologies listed above require an input of potential energy?

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Analyzing Energy Technology, page 2

3. Which technologies listed above require an input of kinetic energy?

4. Which of the above technology can be easily transported from one place to another?

5. Which seem to be dependent upon location? Why?

6. In general, which forms of energy were produced that were considered "waste" energy?

7. How do the machines above demonstrate the law of conservation of energy?