Benchmark I

Objective I

Solar Energy

Solar energy the world's most talked about energy source because of its great potential. It has always existed for billions of years it has been the world's most old energy source but has only tapped into it in the past few years. The solar rays can be converted in two different ways PV devices, or solar power plants. There are 15 known solar plants ten are in California and five are in Arizona they produce 1 megawatt of electricity each. Solar energy has some disadvantages, such as the amount of sunlight that hits the earth it is not constant; weather conditions also affected it. The area that is needed to collect energy must be large to produce a noticeable amount of electricity to power everyday appliances.

There are solar thermal plants that use sunrays to heat liquids up to convert them into steam that turns a turbine to produce electricity. Some advantages to solar energy are that its free, there is an unlimited supply. Yet to produce PV cells waste products are created some of which are harmful to the environment. Also solar thermal plants can harm desert ecosystems if not kept properly maintained. (Energy Kids Page.) Solar energy as stated is not constant, but researchers and companies around the world are working to increase the efficiency of solar panels, and solar plants by 20%.

A great example of how solar rays are converted to energy we can use is right in our backyard Mojave, Ca, has rows of solar panels that have nearly a constant view of the sun during the day. The energy that is gathered of these solar panels is used to power over 350,000 homes.

There is another project in the works called the central power plant or Solar II. This project has over 1,800 mirrors called heliostats. It was built after California received new technology. This solar panel project can power up to 10,000 homes but scientist say that if they make larger ones that they have the potential to power up to 100,000 to 200,000 homes. This new technology has opened up new doorways to the future its giving inventors new ideas about how to create energy from one of the most abundant source the Sun.

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Hydropower

Hydropower, leads the world in renewable energy today. Hydropower makes up about 7% of the United States energy and it was first used here in America. Hydropower was developed by powering lamps for a factory in the later 1800â€™s they used a water turbine to power 16 lamps. (Energy Kids Page) One of the first hydropower plants was opened in 1882 in Wisconsin. It was a great success, because coal was the main use of energy in that era so having water, power lamps was a breakthrough. This was a great discovery because the power used at that time was coal so this was a big improvement. At that time it was not widely used because they did not have the technology to transmit energy long distances. Hydropower is clean; efficient and has virtually no problems so it is great towards our eco system.

The Water cycle is very important to understand if you want to know about hydropower. It is very simple, solar energy heats water causing evaporation then the evaporation forms into clouds and clouds make precipitation then the water or perception falls back onto our river lakes and oceans were the cycle could begin again. That processes is very important to understand. There are many ways to make power out of water energy; run off the river system, hydro dam. (WVIC)

The systems on how to make hydropower energy are simple to understand. In the hydro dam system the water flows trough a pipe called a penstock the water then pushes blades in a turbine causing them to turn causing energy to generate in a generator then the electricity travels to long distances like schools, business (Energy Quest).

Nuclear Energy

Uranium is the fuel most widely used by nuclear plants for nuclear fission. Uranium is nonrenewable. It is a common metal found in rocks all over the world. Nuclear plants use a certain kind of uranium, U-235, as fuel because its atoms are easily split apart. Uranium is about 100 times more common than silver but is relatively rare.   Most U.S. uranium is mined, in the Western United States. Once uranium is mined the U-235 must be extracted and processed before it can be used as a fuel. Nuclear power accounts for about 19 percent of the total net electricity generated in the United States. Which is about as much as the electricity used in California, Texas and New York, the three states with the most people. In 2006, there were 66 nuclear power plants (composed of 104 licensed nuclear reactors) throughout the United States (Energy Kid's Page). The uranium fuel is formed into ceramic pellets. The pellets are about the size of your fingertip, but each one produces the same amount of energy as 150 gallons of oil. These energy-rich pellets are stacked end-to-end in 12-foot metal fuel rods. A bundle of fuel rods are called a fuel assembly. Nuclear Energy can be produced naturally. For example the Sun and other stars make heat and light by nuclear reactions. Nuclear Energy can also be man-made using machines called nuclear reactors, parts of nuclear power plants, which provide electricity for many cities. Man made nuclear reactors also occur in the explosion of atomic and hydrogen bombs.

Some advantages to using nuclear energy are that the Earth only has limited supplies of coal and oil. Nuclear power plants could still produce electricity after coal and oil become scarce. Nuclear power requires less fuel than burning fossil fuel. One ton of uranium produces more energy than is produced by several million tons of coal or several million barrels of oil. Another problem is that coal and oil pollute the air when burned. Fortunately, nuclear power does not release contaminants into the environment.

Some disadvantages to using nuclear energy are that the nations of the world have more than enough nuclear bombs to kill every person alive on Earth. Russia and the United States have around 50,000 nuclear weapons between them. Nuclear explosions produce radiation, which harms cells in the body causing injury or even death. Illness can strike years after exposure. On possible type of disaster is known as a meltdown. If a meltdown were to occur the fission reaction would go out of control leading to a nuclear explosion and the emission of lethal amounts of radiation. One example of a nuclear accident occurred in 1979 at the Three Mile Island nuclear reactor near Harrisburg, Pennsylvania. The cooling system failed and radiation leaked, forcing tens of thousands of people to evacuate the area. Luckily, the problem was solved just minutes before a total meltdown. Fortunately, there were not deaths. Another incident occurred in 1986 at Russia's Chernobyl nuclear power plant. What happened was a large amount of radiation escaped from a reactor. Unfortunately, hundreds of thousands of people were exposed to the radiation. Several dozen people died within a few days. In recent years, thousands have died of cancers induced by the radiation from the incident. Nuclear reactors also have a waste disposal problem. Reactors produce nuclear wasted which emit dangerous radiation. They cannot be thrown away like normal garbage because the danger of people touching it. If people touch the nuclear waste, they could die. Currently, many nuclear wastes are stored in cooling pools built special for nuclear reactors. The United States does plan to change this problem by moving nuclear waste to a remote underground dump by 2010. One similar solution was used in 1957 at a dumpsite in Russia's Ural Mountains. Buried nuclear waste exploded and killed dozens of people. Also, nuclear reactors only last forty or fifty years before they need to be replaced or worked on to ensure the safety of the reactor and to those that may live near the reactor.

Changes In Energy

In the period of time over the past 100 years their can be no doubt that the world has been exposed to a great, continuous succession of rapid changes that have been brought upon as the direct result of an era of limitless scientific triumphs and discoveries. Through the continuous discovery of new effective, efficient ways to generate fuel to power our cities and towns, the people of the Earth have expanded their boundaries and created opportunities of growth and development that have never before been thought possible. These new, and in some cases cleaner methods of generating electricity include solar, wind, hydro, ethanol/biodiesel, and perhaps most importantly, nuclear power. With the door to the future swinging wide open, their remains one dilemma standing in the people of the world's way; the Earth's limited resources, and almost every nation's great dependence on them.

Despite modern breakthroughs in the creation of new means of obtaining power and electricity, oil and other fossil fuels have remained to this day the most widely used form of energy in the world. This point is driven home by the addictions of world powers such as the U.S., Russia, and China, to a limited supply of coal and oil. Unless a change that is both drastic and effective is made soon, the world is well on track to running out of these resources in the next few decades. More pressing still are those issues described by environmental science as global warming and greenhouse gases. It seems that if we are not done in by a depleted supply of resources, that we will be placed in jeopardy by the pollution that they cause.

The solution to this problem that has plagued our generation is truly quite simple. The people of our countries must come together in an effort to both discover and modernize new, better means of energy production. Environmental science and engineering, as well as the innovation and ingenuity of the human race, may provide the answer. Through familiarizing the citizens and residents of the Earth's nations to the overall efficiency and effectiveness, and in some cases superior cleanliness, of alternative forms of energy in comparison to that of conventional forms such as coal, oil, and other fossil fuels, nations on a united front will benefit from more consistent, cost-effective forms of energy, that in the cases of renewable resources such as solar, hydro, and ethanol/biodiesel are virtually limitless. In addition, the Earth's environment will benefit from less pollution and cleaner fuel emissions, preserving the Earth for both ourselves, and our posterity. These alternative forms of energy, along with nuclear power, are highly probable to succeed and pay off in the long run.

Therefore, the solution of alternative forms of energy production is one that sounds far more beneficial and superior, compared to a continued reliance upon the filth ridden, greenhouse gas emitting, and completely ineffective form of energy known as carbon-based fuels. Many countries, including both the United States of America and the Russian Federation will suffer immeasurably if steps are not taken to reverse this long dependence. In China's case, if the country's economy continues to grow at its current pace, and the Asian giant doesn't cut its rate of energy use, by 2030 it could be emitting as much carbon in the atmosphere as the entire world does today (China's Carbon Dragon). Also, if sea levels rise on the Chinese costal cities by just three feet due to global warming- a real possibility that by the end of the century major industrial regions will be flooded, that will amount to almost 35,000 square miles larger than the state of South Carolina, and research also suggests that by 2030, climate changes such as more severe droughts stand to reduce Chinese agricultural output by five to ten percent. However, China is making some important strides including the reforestation of vast areas, despite little international help in doing so (China's Carbon Dragon).

If other countries are capable of taking an initiative to do things such as investing in alternative power sources, and helping the environment through acts such as reforestation across the globe, things will be looking up for our future. Through international cooperation and a continuing non-proliferation of energy resources, we just might stand a fighting chance.

The following are a series of terms that are used to describe certain aspects of the nuclear cycle and other process.

Boiling Water Reactor -A nuclear reactor in which water is allowed to boil in the core. The resulting steam is used to drive a turbine generating electric power.

Circuit(s) -A conductor or a system of conductors through which electric current flows.

Cofiring -The process of burning natural gas in conjunction with another fuel to reduce air pollutants.

Collector Field –The area where many solar collections are situated in a solar power plant.

Ethanol –A colorless liquid that burns to produce water and carbon dioxide. The vapor forms an explosive mixture with air and may be used as a fuel in internal combustion engines.

Generator –A device that turns mechanical energy into electrical energy. The mechanical energy is sometimes provided by an engine or turbine.

Geothermal Energy –The heat energy that is produced by natural processes inside the Earth. It can be taken from hot springs, reservoirs of hot water deep below ground, or by breaking open the rock itself.

Heliostat –Flat sun-tracking mirrors to reflect and concentrate the suns' energy onto a central receiver tower.

Hydropower –Energy that comes from moving water.

Induction –The process of producing an electrical or magnetic effect through the influence of a nearby magnet, electric current, or electrically charged body.

Kinetic Theory of Energy –The theory that the minute particles of all matter are in constant motion and that the temperature of a substance depends upon the velocity of the motion.

Liquefied Petroleum Gas (LG) -A group of hydrocarbon-based gases derived from crude oil refining or natural gas fractionation. They include ethane, ethylene, propane, propylene, normal butane, butylene, isobutane, and isobutylene. For convenience of transportation, these gases are liquefied through pressurization.

Longwall Mining - An automated form of underground coal mining characterized by high recovery and extraction rates, feasible only In relatively flat-lying, thick, and uniform coal beds. A high-powered cutting machine is passed across the exposed face of coal, shearing away broken coal, which is continuously hauled away by a floor-level conveyor system. Longwall mining extracts all machine-minable coal between the floor and ceiling within a contiguous block of coal, known as a panel, leaving no support pillars within the panel area. Panel dimensions vary over time and with mining conditions but currently average about 900 feet wide (coal face width) and more than 8,000 feet long (the minable extent of the panel, measured in direction of mining). Longwall mining is done under movable roof supports that are advanced as the bed is cut. The roof in the mined-out area is allowed to fall as the mining advances.

Methane -A colorless, flammable, odorless hydrocarbon gas (CH_4) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas.

Natural Gas Hydrates - Solid, crystalline, wax-like substances composed of water, methane, and usually a small amount of other gases, with the gases being trapped in the interstices of a water-ice lattice. They form beneath permafrost and on the ocean floor under conditions of moderately high pressure and at temperatures near the freezing point of water.

Ohm - The unit of resistance to the flow of an electric current.

Peak Load Plant- A plant usually housing old, low-efficiency steam units, gas turbines, diesels, or pumped-storage hydroelectric equipment normally used during the peak-load periods.

Penstock - A large pipe which carries moving water from the reservoir to a turbine generator in a hydropower plant.

Pressurized Water Reactor - A reactor in which water, heated by nuclear energy, is kept a high pressure to prevent the water from boiling. Steam is then generated in a secondary coolant loop.
Radiant Energy - Any form of energy radiating from a source in waves.

Reactor Core - Part of a nuclear power station - the structure inside which fission occurs in millions of atomic nuclei, producing huge amounts of heat energy.

Semiconductor - Any material that has a limited capacity for conducting an electric current. Semiconductors are crystalline solids, such as silicon, that have an electrical conductivity between that of a conductor and an insulator.

Solar Dish - A device that receives radiation collected by motorized collectors which track the sun. The collectors focus the radiation the energy at a focal point of the dish.

Solar Energy - The radiant energy of the sun, which can be converted into other forms of energy, such as heat or electricity.

Solar Power Tower - The conceptual method of producing electrical energy Cc
from solar rays. It involved the focusing of a large number of solar rays on a single source (boiler), usually located on an elevated tower, to produce high temperatures. A fluid located in or passed through the source changes into steam ,and used in a turbine generator to produce electrical energy.

Solar spectrum - The total distribution of electromagnetic radiation emanating from the sun.

Solar Thermal Heating System - Systems using concentrating collectors to focus the sun's radiant energy onto or into receivers to produce heat.

Spent Fuel - Irradiated fuel that is permanently discharged from a nuclear reactor. Except for possible reprocessing, this fuel must eventually be removed from its temporary storage location at the reactor site and placed in a permanent repository. Spent fuel is typically measured either in metric tons *of* heavy metal (i.e., only the heavy metal content of the spent fuel is considered) *or* in metric tons *of* initial heavy metal (essentially, the initial mass *of* the fuel before irradiation). The difference between these two quantities is the weight *of* the fission products.

Steam Generator - A generator in which the prime movers (turbines) are powered by steam.

Superconductivity - The abrupt and large increase in electrical conductivity exhibited by some metals as the temperature approaches absolute zero.

Tank Farm - An installation used by trunk and gathering pipeline companies, ~ crude oil producers, and terminal operators (except refineries) to store crude oil.

Tanker and Barge - Vessels that transport crude oil or petroleum products.

Tesla Coil- A device for producing a high-frequency, high-voltage electric current.

Thermal Energy - The total potential and kinetic energy associated with the random motions of the molecules of a material.

Transformer - A device which converts the generator's low-voltage electricity to - higher-voltage levels for transmission to the load center, such as a city or factory.

Transmission {Electric} - The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers or is delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution to the consumer.

Transmission System (Electric) - An interconnected group *of* electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points *of* supply and points at which it is transformed for delivery over the distribution system lines to consumers or is delivered to other electric systems.

Turbine - A device which blades, which is turned by a force, e.g. that *of* wind, water, or high pressure steam. The mechanical energy *of* the spinning turbine is converted into electricity by a generator.

Underground Mine - A mine where coal is produced by tunneling into the earth to the coal bed, which is then mined with underground mining equipment such as cutting machines and continuous, long wall, and short wall mining machines. Underground mines are classified according to the type *of* opening used to reach the coal, i.e., drift (level tunnel), slope (inclined tunnel), or shaft (vertical tunnel).

Uranium - A heavy, naturally-occurring, radioactive element.

Uranium Fuel Cycle - The series *of* steps involved in supplying fuel for nuclear power reactors. It includes mining, refining, the making *of* fuel elements, their use in a reactor, chemical processing to recover spent (used) fuel, re-enrichment if the fuel material, and remaking into new fuel elements.

Utility Generation - Generation by electric systems engaged in selling electric energy to the public.

Volcanic Energy - Energy produced from volcanic action.

Voltaic Electricity - Electricity produced by chemical action.

Waste Energy - Municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw used as fuel.

Water Cycle - Water constantly moves through a vast global cycle, in which it evaporates from lakes and oceans, forms clouds, precipitates as rain or snow, then flows back to the ocean. The energy *of* this water cycle, which is driven by the sun, is tapped most efficiently with hydropower.

Water Turbine - A turbine that uses water pressure to rotate its blades. Primarily used to power an electric generator.

Well - A hole drilled in the earth for the purpose of (1) finding or producing crude oil or natural gas; or (2) producing services related to the production of crude or natural gas.

Wellhead - The point at which the crude (and/or natural gas) exits the ground.

Wind - The term given to any natural movement of air in the atmosphere. A renewable source of energy used to turn turbines to generate electricity.

Wind Machine - Devices powered by the wind that produce mechanical or electrical power.

Wind Tower - Devices, some as tall as 120 feet, which lift wind turbine blades high above the ground to catch stronger wind currents.

Wood and Waste (as used at electric utilities) - Wood energy, garbage, bagasse (sugarcane residue), sewerage gas, and other industrial, agricultural, and urban refuse used to generate electricity for distribution.

Wood Energy - Wood and wood products used as fuel, including round wood (cord wood), limb wood, wood chips, bark, sawdust, forest residues, charcoal, pulp waste, and spent pulping liquor.

Benchmark I

Objective II

The Nuclear Fuel Cycle

The production of nuclear energy, even though it is slow here in the United States has been used and implanted to fulfill the needs of countless European nations. Germany for example is one of the few nations that have the vast majority of its energy needs meet through nuclear means. As we all know one of the biggest issues that we have in the world today is global warming, conventional forms of producing energy came through the burning of fossil fuels that unleash great amounts of greenhouse gases the culprits of global warming. Nuclear energy on the other hand completely eliminates these gases. In the following the process involved in the production of nuclear energy will be explained.

The nuclear production of energy starts with the mining of the nuclear fuel, here we will use the most common fuel uranium-238. Now uranium-238 is not the fuel, within itself it holds the true fuel uranium-235, which must be increased in percentage to be used as fuel. Natural uranium holds only 1% of U-235, so this means U-238 must be enriched. The enrichment of uranium is complex; two processes can be used gaseous diffusion and gas centrifuge (…Production). Here in the United States the gas centrifuge process is used. After the enrichment process the now enriched uranium must be shaped to fit in reactors around the world. Once they are shaped they are shipped or nuclear power plants to produce energy. This process is used by all, first the fuel must be mined, converted and enriched to U-235, the shaping of the uranium to be sent to power plants to be used in nuclear reactors, finally the storage and disposal of the used uranium.

The storage is the final step yet one of the most important. Special precautions must be meet to ensure that the fuel does not contaminate the environment (Nuclear). One way is to store the spent fuel is in ponds that decrease the heat given of by the fission process and keep radioactivity at a minimum. This is one way, but is meant to be a temporary step after this it fuel is either stored in container of buried underground in a special way to stop the leak of radioactivity into neighboring grounds (Advance).

Fission is the process that many power plants if not all use to create energy. Fission is a very simple concept to understand it is basically splitting an atom in half, this in turn gives heat and tremendous amounts of energy this in turn splits another and a perpetual chain starts. In the following the fission process of U-235 will be explained. First a free neutron strikes the U-235 atom this splits it in half giving off Kr atoms and Ba atoms (…Production). Once that happens more free neutrons are expelled and those strike other U-235 atoms which also split in half giving off Kr, and Ba atoms more free neutrons are sent out and the chain starts until it runs out of fuel to do so.

Now energy is being produced but there are people out there that will like to get their hands on nuclear materials to produce instruments of terror. The most logical place to divert nuclear materials is in the shipment of already enriched uranium to power plants. If someone wanted to do this all they need is time, to learn schedules of when shipments depart knowing this will allow an individual to find a place and time to steal the material, all they need is time and all they have is time. This will open the doors to nuclear proliferation, the material can be sold to rogue states, or terrorist organizations to build and produce nuclear weapons.

As we all know the war sparked the interest in nuclear devices, it took a war to give us the final push to complete the basis for a technology that can bring destruction and triumph to both the civilians of a country and a military of a country. Civilians, sole use of nuclear material is for the production of energy, which makes their lives easier. Now the military, uses nuclear materials for the production of weapons, which bring upon destruction to civilians of other nations (…Fuel Cycle). The processes are the same for both sectors but can bring about completely and utterly different outcome to both sectors. This dual nature of nuclear energy and materials is evident in the world most developed countries the United States, UK, Germany, Israel, and Germany to name a few will have this dual nature (Nuclear Power).

Today many of the old phased out nuclear power plants are being replaced by more cost effective designs. Also the types of power plants that are proposed to replace the old ones have integrated systems that will keep the plants ahead of the safety curve. These are two main strengths the power plants of today have over the plants of years past. It takes less money to build these new generation power plants, which makes them more appealing to government officials. This will in turn give the nuclear industry a push that will go through many generations. The second, safety is one of the most important attributes any installation that carries dangerous materials has, nuclear power plants are no exception. They posse materials that are use to create powerful weapons, safety will always play a key role in their designs. Not just in the safety of the reactor but also in safety of the entire facility so no unauthorized individual may enter and put the lives of countless civilians in jeopardy (Advace).

As the strengths of a facility are known then the weaknesses will follow on suit, regardless of any safety procedure or safety system that is put into place the ingenuity of human beings, and perseverance to complete their objectives will always hinder the effectiveness of safety systems. No matter how sophisticated a facility is, a weakness that is set forth unintentionally will always be found.

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