Many contemporary issues surround today’s society. Specifically, America faces intense issues on energy and fuel dependency. Government and industries have been under pressure to find economical and environmentally friendly solutions to meeting our vast energy and fuel demands. For decades, the primary source of energy has come from the burning of fossil fuels like coal, natural gas and petroleum. However, scientists have recently discovered that the burning of fossil fuels poses potential threats to the environment. Also, America’s dependency on foreign oil directly creates economic and social problems. There are some people who believe that alternative energy sources cannot meet the vast energy demand and route to methods of clean coal technologies to diminish harmful pollution on the environment. Conversely, there are people who believe that renewable energy technologies can provide for the energy demand, while greatly reducing greenhouse gas emissions into the environment. To lead the United States into a cleaner and independent future, renewable energy sources must be implemented to meet the growing energy demand.

Fossil fuels including coal, natural gas and petroleum are plentiful sources of energy and are relatively cheap. However, continuing to burn all the carbon emissions would render the planet uninhabitable (Pearce 36). In an article in World Watch Journal, it is reported by James Russell that the world composition of the total primary energy supply in 2006 shows oil taking up 32 percent, coal with 25 percent and natural gas with 21 percent. Coal emits more carbon
dioxide and other greenhouse gases than any other fossil fuel and accounts for about 40 percent of the global carbon dioxide (24). These statistics show that the world is largely dependent on fossil fuels as the primary energy source and that coal alone puts out nearly half of all carbon dioxide emissions. America is the second largest producer of coal that parallels with an economy that is dangerously fossil-fuel based (Russell 25). The U.S. Department of Energy reports that 85% of all the energy consumed in the United States comes from fossil fuels (“Fossil” n.pag.).

There is also a drastic increase in carbon dioxide emissions in the United States with 4212.9 million metric tons of carbon dioxide in 1970 and 5890.3 million metric tons of carbon dioxide in 2006 (“U.S. Emissions” n.pag.). The pollution released by coal-burning power plants and factories affects the health of millions of people. In the United States, 47 workers died due to coal pollution, while China’s State Work Safety Supervision Administration reported 4,746 deaths. An even more staggering statistic reports 350,000 to 400,000 premature deaths a year in China due to the coal combustion air pollution (Russell 24). Regardless of the scientific debate over the scale of climate change, there are evident environmental and human health threats. The new clean coal and carbon capture technologies for coal plants are positive steps towards reducing harmful emissions, but only redistribute the carbon (Pearce 37). There is no single energy source that can compete with fossil fuels. However, the promotion and combination of many promising alternative energy sources like wind, solar, hydroelectric, geothermal and biomass can reverse the exponential rate of greenhouse gas emissions.

Wind energy is an abundant renewable source that is widely distributed and can be used as a domestic environmentally clean source. The United States has land that is capable of harnessing endless amounts of renewable wind energy. Some critics of wind capacities believe that there is not enough available wind energy to provide for the entire U.S. electrical system.
However, it is stated in a report done by the U.S. National Renewable Energy Laboratory that “the land-based and offshore wind resources are estimated to be sufficient to supply the electrical energy needs of the entire country several times over” (Lindenberg 43). It is also criticized that the construction and maintenance of wind turbines would be very expensive due to their locations on mountaintops or offshore seaways. The initial costs may be expensive but there are long-term savings that must be considered. Manufacturers and engineers are developing greater volumes of wind energy equipment. So, producing high-quality products leads to a more proficient and efficient industry. This means that as the technology develops for larger scale products, the overall cost gets cheaper. The U.S. Department of Energy reports that capital costs would be reduced by 10% over the next two decades due to advancements in wind technology (Lindenberg 59). Another issue with wind turbines is that the wind farms have the potential to be eyesores. This is an obstacle for engineers when trying to design turbines with less visual impact. Furthermore, the production and permission of onshore wind farms is hard to attain due to the controversies of visual impact. However, placing these wind farms offshore greatly minimizes the visual impact. The windiest offshore sites are furthest from land, therefore leaving the population unable to see the wind farms (Shikha 12). The U.S. government has put forth major efforts in developing wind energy facilities. The U.S. Department of Energy outlines wind to provide for 20 percent of the U.S. electricity by 2030 and therefore feels wind energy as the most promising renewable source in meeting the countries electrical demand (Lindenberg 20).

Solar power technology is another clean, renewable energy source that provides heat and electricity. The two solar power technological areas are Photovoltaics (PV) and Concentrating Solar Power (CSP) (Kimbis 5). PV solar technologies are used to provide direct sources of energy for homes and businesses. The PV panels are installed on top of residential, commercial
and industrial buildings. This allows homeowners to develop their own power and cut loose from fossil fuel based energy supplies. Although the initial investment of solar panels is costly, the free energy they provide will pay off in upcoming years. Similarly, the cost of photovoltaic cells has greatly decreased due to increased sales by 10 percent in the last decade, improved technology and government incentives (Cooper n.pag.). By 2015 the price of electricity from PV cells is expected to match that of conventional energy generators (Smith n.pag.). The federal government’s Energy Policy Act of 2005 rewards a 30 percent tax credit limited at $2,000 for the purchase and installation of residential solar materials (Kimbis 11). From the mid-1970s to the mid-1990s, the average cost of an installed photovoltaic system fell from about fifty dollars per watt to about five dollars per watt (Naff 112). Homeowners with solar energy technologies can also be credited for the electricity they produce. If they produce more electricity than they use, the electricity is fed back into the power grid and the homeowners receive a credit at the same retail price they would normally pay the utility company (Naff 80). Although the amount of generated power is limited by the amount of sunlight received, it is still possible to create electricity on cloudy areas. On these days when there is less generated electricity than needed, the homeowner will rely on the power grid. However, there may be some days when there is a surplus of generated energy. With new technologies, the solar panels can use excess energy to produce hydrogen and oxygen to power household fuel cells (Trafton n.pag.). Therefore, the homeowner will ultimately save money and produce no harmful pollutants.

Concentrating solar power technologies provides electricity for large-scale power grids. The widespread availability of sunshine makes the U.S. Southwest favorable for solar power plants. Although the solar plants are limited to generating electricity while the sunshines, the excess electricity can be stored as thermal energy and be used when needed. In addition, the U.S.
Department of Energy projects that solar energy will cut carbon emissions by 23 million metric tons per year by 2030 (Kimbis 20). The U.S. electrical system currently holds a capacity of 1,000 gigawatts (GW). The U.S. Department of Energy Solar Program projects future CSP system growth to generate more than 50 GW of capacity (Kimbis 5, 10). Although it is a challenge for solar power to replace conventional fuel systems, the combination of solar power with other alternative energies can make that challenge feasible. On the other hand, it is an overwhelming defeat for solar power as a clean fuel with zero emissions compared to fossil fuels.

An additional advancement in solar technology is using solar power satellites to supply Earth with electricity. The satellites collect solar energy and convert it to electricity. Then, radio waves beam the energy back to Earth for use in residential, commercial and industrial buildings (Naff 100). However, the most remarkable growth of solar power is in developing countries. In remote locations where the power grid does not reach the rural villages, the people rely on solar units for electricity. Besides electricity, the solar energy purifies water to help eliminate pathogens (Naff 103). This technology creates great opportunities for developing countries in effort to minimize disease and death brought on by unsafe drinking water.

Hydroelectric power is currently the leading renewable energy source in the United States. The United States Geological Survey reports hydroelectric power to account for about 10 percent of the total produced power (Perlman n.pag.). In 2008, the United States produced a total of 193,172 MW of power from the hydroelectric plants with the Pacific Coast states of California, Oregon and Washington producing 106,945 MW of the total hydroelectric power (“Hydroelectric” n.pag.). Linda Church Ciocci, head of the National Hydropower Association, announces that “it’s domestic, it's affordable, it's reliable,” and “good, clean energy” (Davidson n.pag.). Hydroelectric power plants rely on renewable flowing water and in return produce no
waste or air pollution. The hydro facilities in the United States generate enough power to supply 28 million households with electricity, the equivalent of nearly 500 million barrels of oil (Perlman n.pag.). Of the 80,000 dams in the United States, only 2,400 of them have hydro plants. Although most of the prime sites for hydropower plants have been developed, there are new, efficient technologies for power turbines that can maximize power capacity. The Holtwood Hydroelectric Dam on the Susquehanna River is undergoing construction to boast its power capacity from 109 MW to 125 MW to power 100,000 homes (Davidson n.pag.). Hydroelectricity has great potentials to serving the United States more power with advances in technology.

Despite the dams having fish channels, the fish often cannot find their way due to strong currents. This creates problems for fish and wildlife migrating upstream. However, the new construction on the Holtwood Dam includes a plan to help guide the fish through the dam. The Holtwood manager, Chris Porse, says “by siphoning some water to the new turbines and widening the river channel, the project will ease the flow, letting more fish pass” (Davidson n.pag.). These ideas will be used for further construction of hydroelectric power plants to help minimize the environmental affect caused by the dams.

Again, the initial investment of equipment to build hydroelectric dams is expensive, but there are low maintenance costs and long-term savings to consider. Also, the investment includes hydro equipment that can generate for 75 years or longer (Davidson n.pag.). Hydropower is the most efficient way to generate electricity. Within the last 10 years, the Department of Energy has spent $1.2 billion on research and development for other renewable sources like wind, solar, and geothermal, while only $10 million was spent on hydropower. (Moan 65) Therefore, hydropower is the least expensive in renewable energies and generates high outputs of energy.
Geothermal energy is contained in underground reservoirs of steam, hot water, and hot dry rocks. Deep, high temperature geothermal reservoirs supply steam to power electric utilities, while moderate to low temperature resources are used for direct-use applications such as district and space heating and shallow reservoirs are used by geothermal heat pumps to heat and cool buildings. Geothermal energy has many environmental benefits. It is a renewable source that is unlimited due to the heat created by the Earth’s core. Although, the long-term sustainability of geothermal sites is questioned, the geothermal fluids are often reinserted with excess water back into the reservoir deep below the Earth’s surface to prolong the life of the reservoir (“Geothermal” n.pag.). This recycles the geothermal water and replenishes the reservoir. The geothermal fields make only about one-sixth of the carbon dioxide that natural gas fueled facilities create, while closed binary geothermal plants emit zero emissions (“Geothermal” n.pag.). Likewise, some geothermal facilities produce few solid materials for disposal. Instead, these solids like zinc, silica and sulfur are being extracted for sale. This makes these plants even more valuable and environmentally friendly.

Although the prime spots are located in Alaska, Hawaii and western states, geothermal hotspots can be generated almost anywhere due to enhanced geothermal systems (EGS) (Smith n.pag.). This recent technology involves breaking hot rocks and adding water, which heats up around the rocks and then is pumped back up the surface through turbines to create electricity. The cost of locating and researching to see if the land is suitable for geothermal stations is costly, but the actual construction of the plant is not. Professor of chemical engineering, Jefferson Tester, Ph.D, at the Massachusetts Institute of Technology notes that the cost of $600-800 million to build a geothermal power station is actually less expensive than building a clean coal power plant (Tester n.pag.). Likewise, it is less expensive for the construction of geothermal
plants on existing oil or gas sites that already have boreholes available for EGS (Smith n.pag.). The Geothermal Energy Association reports power from natural gas costing 8 or 9 cents per kilowatt-hour, while geothermal power sells at 5.5 cents per kilowatt-hour (Smith n.pag.). Power produced by geothermal sites is less expensive for the consumer and more environmentally friendly than traditional fossil fuels. Currently geothermal energy provides 0.3 percent of America’s total energy supply or 3000 MW (Tester n.pag.). Although this is only a portion of the energy demand, the growing geothermal industry has potential to maximize energy output. In 2006, the Massachusetts Institute of Technology highlighted geothermal energy to supply the United State’s energy needs 2000 times over (Smith, n.pag.). In short, geothermal energy along with enhanced geothermal systems can boost the industry to exploit clean, cheap and sustainable energy for America.

Bioenergy is clean, renewable energy made from organic biological material such as photosynthetic trees, municipal waste, agricultural and aquatic crops called biomass. These biomass sources are used to produce electricity and biofuels. Biomass is truly a renewable and replenishable source because it is easy to grow, gather, and replace quickly. Additionally, the burning of biomass products creates a carbon neutral cycle, therefore does not increase atmospheric carbon dioxide concentrations like dirty fossil fuels. The United States consumes 7 billion barrels of oil and produces 100 million barrels of ethanol from corn grain each year (From Biomass 4). Corn is only a small part of the biomass resources available. Utilizing many biomass products can help meet the country’s demand for transportation fuels. Currently, scientists are researching new methods to advance biomass conversions into useable fuels. An interesting project involves speeding up the process of bacteria that naturally break down cellulose and produce ethanol as a byproduct. Amyris, a biotechnology company in San Francisco, is
engineering microbes that will generate longer-chain hydrocarbon molecules like those found in
gas and diesel. Another firm is modifying algae that naturally produce diesel-like oils so that the
oil is more available and abundant (Langreth n.pag.). The U.S. Department of Agriculture
believes that with the best conversion technology, biomass can replace 30 percent of petroleum
that the nation currently uses. With the government predicting a 25 percent increase in U.S.
petroleum consumption by 2025, biofuels stand as a great competitor in replacing petroleum
fuels (From Biomass 4).

Renewable energy sources like wind, solar, hydro, geothermal and biomass play important
roles in the future of energy. Taking advantage of natural, alternative energy sources will pave
the way for a cleaner and healthier environment. In addition, these domestic technologies can
help protect the nations security and economy and establish energy independence. These
innovative technologies have the power to transform the energy industry and overcome the
ruling conventional fuel sources. Although there is no single energy source that can compete
with fossil fuels, the combination and diversification of renewable energy sources can undertake
the United State’s energy demands.


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