Renewable Energy

Abstract
In lieu of an abstract, below is the first paragraph of the paper.

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Fossil fuels are substances in which solar energy has been converted to chemical energy and stored in plants and animals that have died and decayed (Newton et al.). Some fossil fuels include coal, oil and natural gas. All of the energy conservation plans made in the last decade have become necessary, because for the first time ever, first-ring suburbs and cities are gaining population much more rapidly than rural areas (Piers). This large growth of cities means the human population is growing at an extremely fast rate. With more people, come many more houses. Housing costs account for 37% of all United States electricity consumption, and 22% of all United States primary energy consumption (Norton et al.). Coal, oil, and natural gas provide 85% of the total primary energy used around the world, and conservationists estimate that only 3 to 4% is provided by renewable energy (Naseri et al.). These statistics don't seem so bad unless some of the negatives of fossil fuels are reviewed. Fossil fuels, specifically the burning of coal, can cause acidification and generally speaking "regional pollution." It has been a problem all over the world affecting places such as the Baltic Sea, some Scandinavian Lakes, and the Canadian-Great Lakes region. The burning of these fossil fuels has been strongly linked to global warming (Goldemberg). Another problem with these fuels is that they are exhaustible, and if the rate of consumption continues, the known reserves of oil will only last around 41 years, natural gas 64 years and coal 155 years (Goldemberg). Between these undeniable facts and the rapidly growing human population, the dominance of fossil fuels cannot be considered the world's main source of energy for more than 1 or 2 more generations thus, alternative means of energy is needed (Goldemberg).

The general benefits of renewable energy sources are hard to see without examining the benefits of each individual area of renewable energy. For example, a zero energy home (a home that produces as much energy as it uses) actually retains $23.93 dollars a month, meaning the green energy it produces makes it so the owner of the house actually makes money (Norton et al.). Another example is how The Corona Queens Subway maintenance shop uses rainwater and recycles wash water for cleaning cars (Piers). Many examples like these are heard worldwide, and the benefits of green energy are endless. Our world has the potential for full green energy usage. The introduction of carbon taxes or the adoption of mandatory caps on emissions through agreements with various countries, can promote the use of renewable sources (Goldemberg). According to Capell, "A raft of rules and regulations to combat climate change and reduce dependence on oil can boost sales of green companies and upstart manufactures alike." On the current course the world is on, burning fossil fuels and exhausting the environment with wicked emissions, the future global energy situation will remain dirty, vulnerable and expensive (Goldemberg).

Wind power, probably the most popularly known around the US, is quite efficient. Wind energy is also very clean and inexpensive. Generating one kilowatt hour using wind power costs about 8 cents compared to 5 cents and 15 cents for hydropower and nuclear power respectfully (Newton et al.) Wind power has declined in price, by a lot (almost 15 cents per kilowatt hour) making it a competitive resource against fossil fuel energy (Newton et al.). Wind power can also provide an exorbitant amount of energy with relatively ideal efficiency. Windmills can generate 2.5 megawatts of electricity and function at about 30% efficiency (Newton et al.). The 2001 World Wind Energy total was enough to power about 10 million households in industrialized countries. It is estimated that North Dakota alone has enough wind to supply 37% of the electricity used in the entire United States (Newton et al.). The best way to utilize the energy generated by windmills is to balance large amounts of solar with the very carbon dioxide sources they are trying to eliminate (Murray). This means that although wind
energy is very ideal, the best way to utilize the energy from them is to balance with fossil fuels to eliminate half of the emissions caused by the fossil fuels. Wind power also has provided businesses with opportunities. According to Murray, “battery manufacturers want to pave the way for wind and solar power to step up the nation’s electrical grid in a big way”. Windmills are ideal for both individual homes and large energy consuming corporations. Private homes can generate enough electricity to meet its own needs with a small-scale windmill (Newton et al.). “Wind power will become increasingly important as concerns increase over global warming and the pollution caused by the burning of fossil fuels, and as technology makes it cheaper and more available” (Newton at al.).

**As great as wind power seems, “sometimes the wind doesn’t blow, and sometimes the sun doesn’t shine.” Critics say windmills create, and have, some undesirable traits. In a recent incident in west Texas, the wind died down and the entire area of the state experienced blackouts. The same goes for over generation of windmills. When they experience over generation, they must be shut down to avoid damage to the grid connections (Murray). Windmills are also only ideal with areas of constant and relatively fast winds, with no buildings or obstacles such as trees (Naseri et al.). Storage of the energy that windmills generate is also a problem. The wind in areas where windmills are utilized is the strongest in the spring and summer when power is least needed, and the wind is weakest in the winter when energy is most needed (Newton et al.).** The aesthetic beauty of windmills is debatable. They are said to “spoil the natural beauty of an area.” People who live around wind farms sometimes complain of the drone that they make. It is also questionable if their turning/spinning motion creates electromagnetic fields (Newton et al.). Because wind farms are strategically placed where wind currents are strongest, birds use the same wind paths to migrate. The deaths of hundreds of thousands of birds have been recorded (Newton et al.).

Even if the wind doesn’t always blow, and the sun doesn’t always shine, new technology in solar power has made it so even if the sun isn’t shining, stored energy can be utilized. That isn’t the only benefit of solar energy. The most beneficial reason for using solar power is that it is extremely “green”. Solar energy is what has been stored in fossil fuels and burned every day. Solar energy can be utilized directly as heat or indirectly by converting it to electrical power using photovoltaic cells. These photovoltaic cells are capable of absorbing the most intense part of the solar flux, converting the solar energy into electricity with an efficiency of 14% (Naseri et al.). Water can be heated by the sun which splits hydrogen and oxygen which can be recombined to produce carbon free electricity that can be used day or night (New Report Offers Strategies for Solar Power Growth). This new power source is so optimistic worldwide that it is estimated that solar power may account for 2.5% or European electricity consumption. That is enough energy to meet the needs of 65 million people (Capell). This optimism continues; extensions of tax credits on renewable installations are being offered by policy makers (New Report Offers Strategies for Solar Power Growth). Like wind power, the opportunities for businesses to grow and flourish in solar power is inevitable. “Solar Power is becoming a cost effective alternative, and within a decade could cost the same as electricity generate from fossil fuels” (New Report Offers Strategies for Solar Power Growth). It is expected that sales of 476 million dollars will be up from 5 million in 2000. (Capell) Batteries that store solar energy is the main place businesses have taken strides with technology. They have developed a battery that runs on solar energy. This battery has an average life of 20 to 30 years (Murray). This battery has been tested in a new car called the “Volt.” This car won’t be seen for a few more years but the technology is “getting there” says Murray. Large power solar systems have been most effective using trackers that follow the sun, or mirrors that concentrate the sun’s rays, it isn’t bad to say either that they have a relatively low cost (Naseri et al.). The only costs are the initial instillations and repairs. The energy costs are then relied upon sunlight availability and storage. No monthly energy bills arrive each month, so the solar cells essential “pay for themselves.” In addition to saving money the installations of 100 kilowatt solar or voltaic cells reduce annual carbon dioxide levels by an estimated 500 tons (Piers). This could reduce environmental problems such as acid rain. Solar energy, with its high efficiency and relatively low cost, is paving the way for renewable energy activists.

Even though it’s paving the way, it doesn’t mean the process of getting there will be cheap. It is estimated that 450 to 560 billion dollars will need to be invested in solar energy for it to be practical. That is around 26 billion dollars annually (New Report Offers Strategies for Solar Power Growth). Although advances in retaining energy by batteries have occurred, storing the energy from solar panels and
Like solar power, geothermal energy can be used directly as heat or indirectly to generate electricity. The natural heat generated in the interior of the earth heats geothermal brine (salt water solution) which converts injected water into steam. This steam is then used to turn a turbine (Naseri et al.). A new study has found that geothermal energy can be produced at much lower temperatures; even lower than those you may find in your kitchen let alone inside a plant boiler (Blankinship). This study, conducted under the title Geothermal Resource Growth, concluded that geothermal converters can operate at temperatures as low as 200 to 300 degrees Fahrenheit, (like the temperatures found in an average conventional oven) previously thought to be uneconomical for commercial power production (Blankinship). This same study said that “given the high reliability and capacity factors for geothermal power, it could meet the needs of Los Angeles, Phoenix, San Francisco and Seattle combined” (Blankinship). Geothermal power is a natural process; the heating of the core of the earth that is, so tapping into this source does not interfere with life processes. This means that mass production of geothermal energy plants could potentially run many smaller cities in the United States. If geothermal energy can provide many of the United States largest cities with energy, and not many known harmful side effects are known, geothermal power will be one of the leading US renewable energy sources in the near future.

Not many arguments are known against geothermal energy but some speculation about emissions from geothermal power has risen. It isn’t exactly “free from environmental impact”. Generating geothermal energy can contribute to air pollution because it can emit dissolved salts and in some cases toxic heavy metals such as mercury and arsenic (Naseri et al.). The questionability of these emissions is almost a “chance people are willing to take” because carbon dioxide emissions from fossil fuels are known to cause environmental problems. Salts and heavy metals are relatively natural substances so they may not have such damaging effects like carbon dioxide and the greenhouse effect.

One relatively uncommon, but very useful type of renewable is tidal power. The power obtained from oceanic tides is based on the difference between high and low water (Naseri et al.). One benefit of tidal energy is that the energy can be used directly off shore to operate a floating plant such as a cannery. The energy can also be shipped to shore and be converted into stored energy in battery cells (Naseri et al.). The only bad thing about tidal energy is a difference in water height must be more than 15 feet. Very few places like this exist around the world, but where they do the energy harnessed from the tides is extremely valuable and efficient (Naseri et al.).

With the cost of garbage and waste disposal increasing, the burning of garbage and recycling of methane gas is becoming a viable option as an energy source (Patrabansh et al.). The burning of trash will only be idea if adequate air pollution controls are necessary but municipal garbage can be used to heat buildings (Patrabansh et al.). As far as the generating of biogas is concerned, converting livestock into a domestic renewable fuel source could generate enough electricity to meet up to 3% of all of North America’s entire energy consumption needs and lead to a significant reduction in greenhouse gas emissions (Cow Power). The hundreds of millions of livestock inhabiting the United States could produce approximately 100 billion kilowatt hours of electricity which is enough to power millions of homes and offices (Cow Power). Not to mention that 10% of the traditional biomass (waste) was in the form of agriculture and animal wastes with wasteful and inefficient technologies in rural areas and towns (Goldemberg). Plus, not only is collecting the gasses from decomposing manure providing valuable energy, if the same manure is left to decompose naturally, it has a very damaging effect on the environment. The new waste management system generates power by collecting the gasses released; by collecting these gasses 99 million metric tons of GHG emissions will be cut from the total GHG emissions from electricity production (Cow Power). The gas that is being spoken of is methane gas which is generated by the anaerobic breakdown of organic waste in sanitary landfills from wastewater treatment plants. The process requires no moving parts and runs at an efficiency of 20 to 30% (Naseri et al.). Expansion in biogas business is also an opportunity (like most renewable energy sources) for businesses to expand and make quite the profit. A German company known as Envitech builds power plants that run on
organic waste; they have raised their profits with the world's growing need for alternative energy by 166 million dollars in the past year alone (Capell). Other advances in biogas technology make it even more affordable. A biogas fermenter costs about 30 dollars in the United States, which is less than any domestic liquid petroleum system (Smith). This same fermenter allows biogas to burn efficiently in simple devices with a blue flame where the intensity can be easily controlled (Cow Power). Biogas is also cheaper than liquid petroleum gas because it is produced locally from raw materials (Smith). The waste products of the biogas being burned are about 1 to 5 liters of effluent (the waste product of biogas). It contains all natural minerals so it can be used as fertilizer (Smith). Biogas is also ideal for use in developing countries where the constant worry of dependence on fossil fuels is ever growing. Sericulture waste (a waste product of the silk industry) is quite prominent and can be used for biogas production. In developing countries, especially in China, this waste product is in high demand. “These countries’ energy problems cannot be solved solely by agriculture and tree planting activities, therefore utilization of sustainable energy should be a target of future planning” (Patrabansh). With the knowledge that sericulture and livestock manure can be used to generate clean burning gas, it is a good alternative in developing countries because these materials are in abundance. A biogas fermenter is also only 400 liters in size making for easy use in kitchens to power utilities (Smith).

As nice as the plan sounds to use biogas fermenters in developing countries, production has been found to be limited in areas by cost, climate and resource requirements. Even so, if the fermenters are directed carefully to the appropriate populations they can bring benefits to millions of households (Smith). In developing countries the cattle dung in the villages is an inadequate source and is accessible to only the richer segments of rural society. Dung is also a limited resource and the collection of it isn’t practical (Patrabansh et al.). These arguments to biogas are valid, but methane digestion is still very valuable in developed countries and as technology spreads to other areas of the world biogas can be utilized in third world nations.

Renewable Energy will be a prominent source in the future as concerns for the environment and people’s health increase. Green energy is ideal for developing countries and creates jobs and generates capital for businesses investing in this new trend. As the shift in the use of energy begins, the political, social and economical parts of society will shift along with it. With this, “mother nature will reap the benefits too”. Hopefully the environmental problems the world faces today will improve as renewable energy is utilized in many nations and it will spark a new trend in care for the earth we all live in.

Works Cited

