Energy In UK: Alternatives To Fossil Fuel Dependence

The UK requires a large amount of energy and does this by many different mediums, such as: Natural Gas 30%, Coal 30%, 19% Nuclear, 9.5% Wind, 6.8% Bioenergy, 1.8% Hydro, 1.8% Other (Carbon Brief 2014). The UK produces so much energy that it can produce over 90 trillion mugs of tea, enough to go around the moon and back to Earth more than 8,000 times if all lined up vertically. The UK use the energy produced by natural gas is used in 4 manners; 36% of the energy is used for heating and cooking in homes, 22% is used for industry, 22% powers the UK's industry, and 14% is used for other things (UK Government 2017). Coal is used for 68% electricity generation, 7% steel manufacturing, 4% cement plants, 3% heating, 8% for other industrious purposes, and 10% for other uses. Nuclear is used, in almost every circumstance, for electricity generation. Very occasionally, it is used for heat to prevent any loss of energy through the nuclear fusion. 21% of the global electricity is produced by nuclear fusion alone. Wind energy is used predominantly for electricity. Bioenergy is used for 3 main things: heating, cooling, and electricity. Most institutions, like schools and hospitals, use biomass for heating. 9% of the global electricity is from biomass. Hydro energy is only used for electricity but only makes for 1% of the Globe's electricity. Solar energy is used for electricity normally but can also be used for heating directly. Many forms of energy are made into electricity first and then changed into other forms of energy. This is because electricity can always be converted to any other form. Changing it to another loses energy. On average over half the original electricity is lost through the transformation (UK Government 2017). The UK needs to plan and adapt its energy strategies now because of climate change and global warming but another reason to do this is because the UK is heavily reliant on fossil fuels, which are not renewable. The fact that the UK have large enough fossil fuel reserves that they can last a reasonably long time by using them to the same capacity as before.

Another problem with the UK's current use of fossil fuels is that it produces lots of waste. One Statistic states "The world's annual CO2 waste equates to 27,000 million tonnes. If this much was frozen into solid CO2 at -80 Celsius it would make a cone-shaped mountain 1 mile high and of 12 miles in circumference. The same quantity of energy produced from nuclear fusion would generate 20 million times less waste, and it would only occupy 16m2 ". The only problem with the nuclear waste is that it is radioactive and requires it to be placed far underground, wrapped in lead, and will only not be radioactive in hundreds of years. A new discovery of nuclear fission that produces waste that is not radioactive, but scientists cannot control the heat energy coming out of the reaction just yet. People say that humans, as a species, will die by 2050 and a temperature increase of 3 degrees Celsius. This would ensure all ice caps have been destroyed and millions of animal species demolished. This was predicted if humans continue at the rate of the Global Energy intake and percentage of fossil fuel uses (Live Science).

The UK is reliant on fossil fuels. This is due to the fact that more than 60% of the energy used is from fossil fuels (2014). In 2019 though, an article stated that for the first time, less than half the electricity has generated by fossil fuels, showing that the UK is making the right steps to lessen the effects of global warming and climate change (Guardian). Another statistic that shows that the UK will be less reliant on fossil fuels is that it is predicted that less energy will be expended in 2030 than 1970 (GeoActive 2016). The reason why the use of fossil fuels is still used is that it is cheap for the amount of energy that it produces. This is why the Industrial Revolution was so

successful and revolutionary. Nowadays however, Solar and Wind power is actually more cost efficient in the long run than fossil fuels because of their recent increase in popularity and demand. The problems with the use of fossil fuels still is that it produces significantly more of greenhouse gasses than any other form of energy production.

There are 5 main possible alternatives to fossil fuel dependence: Nuclear, Wind, Solar, Biomass, and Hydro.

Nuclear energy is created through the splitting up of Uranium – 235 when the atoms smash into each other. This action releases lots of heat energy. This heat is used to create steam in a steam engine which turns a dynamo like system that produces electricity. This whole reaction produces nuclear waste, its radioactive and remains like that for a long time. Because its radioactive and produces gamma rays, the risk of cancer is increased when exposed to them. There is only a small waste production, but it has to be buried miles underground a covered with lead, an extremely dense metal that is able to restrict some of the gamma rays from reaching the surface. A problem with this is that Uranium-235 is not unlimited. Another problem with Nuclear energy is that when it goes wrong in the nuclear power plant, it is devastating. Chernobyl is an example of this. The USSR tried to hide the mistake that produced this disaster but other countries miles away found that there was radioactivity near them. Countries like Finland culled almost all their livestock to prevent the food chain being affected by the radioactivity. Only 2 days after Chernobyl was not able to control the hydrogen flow to the core, 400km away in Minsk it was deemed dangerous to go outside. It was thought 3 million, billion, trillion particles were released from the power plant. In August 1986, it was projected that 4,000 people were going to die according to the IAEA along with the 31 that died directly from the power station, 29 fireman who suffered from acute exposure, and the 2 from the blast (Wikipedia, OurWorldInData). Surprisingly more casualties are found in other productions of energy because accidents are more frequent.

Type Of Energy Production Deaths Per Terawatt Hours

- Brown Coal 32.72
- Coal 24.62
- Oil 18.43
- Biomass 4.63
- Gas 2.82
- Nuclear 0.07

Nuclear Energy is reasonably cheap, $6 billion to $9 billion, considering how much energy could be produced in the long term. It is cost efficient and waste efficient compared to fossil fuels and has much lower casualties per Terawatt Hour than other energy producers. But some disadvantages of Nuclear Energy is that the waste is radioactive and emit gamma rays, causes cancer.

Wind energy is created through the wind turning large blades that turn a dynamo. Modern turbines normally have a diameter of 40 meters to 90 meters and are rated between 500 Kilowatts to 2 Megawatts (Wikipedia). Larger blades do produce more energy but can produce greater problems like increased instability of the turbine which ensures accidents are more likely to occur. Even though wind energy is clean and renewable, its efficient is dependent on wind patterns and the wind speed. If there is less wind speed than average the wind turbine will

produce less electricity than average and the same will happen when the wind speed is greater than average, it will produce more electricity. Along with being very dependant on the wind speed, it is still significantly less cost affective than nuclear energy; Three Mile Island, a small nuclear power plant that produces 850MW, would have to have 852 average wind turbines at a constant average wind speed to accumulate the same amount of energy (Quora). Along with this, wind farms are not very efficient when it comes to space, just to get the same output of Three Mile Island, the farm would need over 1,917 acres of land (Quora). Not only is this land expensive to own or rent, but the wind turbines themselves are not very cost efficient. A commercial wind turbine costs $3 million to $4 million. The London Array has 175 wind turbines over offshore of England which would cost between $525 million to $700 million according to the cost of a commercial wind turbine. This means to have the equivalent energy output of a small nuclear power station if the wind was at a constant average speed, it would cost between $2556 million to $3408 million. 2000 million was the cost of Three Mile Island's construction. All these statistics are not considering the cost of running each power plant. The London Array produces 630MW, covers 100km2, and has 450km of underwater cabling. It produces enough power for half a million homes and reduces CO2 emissions by more than 925,000 tonnes per year. It has two offshore substations and one onshore substation. The project was coined in 2001 when the area was deemed that it would be good for a wind farm after environmental studies in the outer Thames Estuary. Then in 2003, the Crown Estate gave the London Array the area on a 50-year lease and all the cabling that would be needed to link the site back to shore. But only in 2006 was planning permission granted for a 1GW farm, the farm will only become a 1 GW one in Phase 2. The onshore substation at Cleve hill was started in July 2009 and was finished in October 2012, also when first power was achieved. However offshore construction started in March 2011 with 177 foundations installed for the turbines. It took a year to install the wind turbines, the first turbine being built in January 2012 and the last turbine being built in December 2012. Wind energy is an alternative to fossil fuels but is not very efficient with cost, or energy (London Array).

Solar Energy is another alternative to fossil fuels. Solar energy is created from solar panels, also known as photovoltaics, which absorb heat radiation from the sun with photovoltaic cells. The radiation can either be used directly for heating or be changed into electricity, the most versatile type of energy. The majority of the time the radiation is turned into electricity. Even when it is cloudy, the solar panels are still able to generate some electricity. Photovoltaic cells are made of layers of metals that are semi-conductors, usually Silicon. When the heat radiation hits the layers, an electric field is produced. Therefore, the more sunshine that hits the cell, the greater the electric field, the more electricity produced. These cells are grouped together and then either placed on the roof or on the ground. Depending on where the solar panels will be on the Earth, it will have to face different directions. If it is on the Northern Hemisphere it will have to face South but with a greater gradient the further the place is away from the equator. This is the same for if it is in the Southern Hemisphere, but it must face the North instead. The closer the solar panel is to the equator, the more useful it is, but when it gets too close it is not so useful as clouds are formed near it. How useful the Solar Panels are measured in Kilowatts Peak (KWP) which is how much power it can absorb if the sun's energy was infinite. The average solar power system is 4KWP and costs £6,200 and can save someone in the South of England 4,200 Kilowatt Hours of electricity a year, enough to turn the London Eye 56 times and save 1.6 tonnes of CO2 a year (Energy Saving Trust). The more the panel can generate the more it costs. The panels cost less than panel that are built into the tiles. Panels or tiles that have more than 15 degrees of a gradient can be cleaned by rainfall and have a smaller chance of a great build-up of debris. Gujarat is a state in India with a growing use of solar power. It is a

large state that is really desolate. It was one of the first states in India to have a solar power generation capacity (Wikipedia). In March 2016, 1100MW were commissioned in lots of parks varying in sizes between 1KW to 40MW. In December 2018, Gujarat had commissioned 1637MW of solar power generation. The state has large plans in terms of renewable energy; 15,000 to 10,000MW of energy generation over the next couple of years (Wikipedia). In January 2019, Gujarat said that solar power generation will increase by 3,000MW annually. Along with the promise of increased solar power generation, they said that they will create 4 or 5 hybrid parks of solar-wind energy. Gujarat Solar Park-1, or Charanka Solar Park, is being built on a land of 4,900 acres. 615MW was commissioned of solar panels to this farm by 31 developers so far but another project of 10MW is being planned (Wikipedia). The main developer, The Gujarat Power Corporation Limited or GPCL, said in April of 2018, that some additional projects might occur: one of 150MW, some of 95MW, and some of 30MW. The main disadvantage to solar energy is that it is dependent on the weather and whether it is sunny or not. The advantages are that if it works, it could even mean that a household could be in a energy surplus allowing them to export the energy to the National Grid and gain money from it, but this is very rare.

Biomass is another option instead of fossil fuels. There are 4 types of biomass: wood and agricultural products, solid waste, landfill gas and biogas, and alcohol fuels. Energy is created when biomass is burnt in the form of heat. When burning the biomass, CO_2 is emitted but is still deemed a renewable resource by the EU and UN as it is deemed that the CO_2 is absorbed by the plants anyway. It is even deemed CO_2 negative by some because through each cycle some of the CO_2 is transferred to the soil. The transfer and storage of the carbon to the soil is called sequestration. Soils that are most efficient for sequestration are those with minimal carbon within them already. Cofiring with coal has become more popular which is when they use biomass along with coal to release more CO_2 without the cost of purchasing more infrastructure. There are two main groups of biomasses: First Generation and Second Generation. First Generation consists of plants directly like sugarcane and corn starch, whereas second generation consists of non-food-based and agricultural waste sources. There are 4 variations of biomass that are used for different purposes. They are Thermal, Chemical, Bio-Chemical, and Electro-Chemical conversion. Thermal conversion uses heat to change biomass into a more useful or versatile energy form. Chemical conversion uses chemical processes or reactions to convert biomass into a new form. Chemical conversion is normally used to store the energy in a more compact and efficient way. Biochemical conversion is the use of microorganisms such as worms for either: anaerobic respiration, fermentation, or composting. Electrochemical conversion is used to directly convert biomass into electricity by the electrochemical oxidisation of the material. Normally the product of the oxidisation is put into a fuel cell which then further changes it to CO or H_2. Sweden uses biomass to power a large amount of its cars. 32% of its energy usage is Biomass which is one of the largest percentages in the whole of Europe. Sweden’s use of this form of energy is split into 3 sections: housing and services (heating), industry (electricity), and transport (fuel). Sweden plans are to be fuelled by 85% by ethanol fuel, a type of biomass. This project has ensured that Sweden’s greenhouse gas emissions have decreased by 25% between 1990 and 2014. In 2014, Sweden used 555TWh of energy of which 130 was from Biomass related (Wikipedia). Laws and Acts were passed to help this process; Carbon Dioxide tax and energy were introduced in 1991 that did not affect biomass as well as a 950 million Swedish Krona agreement between three parties in bioheat facilities (Wikipedia). In 2004, all major fuel stations had to provide an alternative fuel option and because Biofuel had little tax and it was cheap to manufacture, biofuels appearance increased within fuel stations drastically. In 2005 all major companies were required to sell at least one type of biofuel. In 2009, this regulation affected all fuel-based companies. This change

was met with support from car manufacturers as in Sweden, SAAB, Volvo, VW, Koenigsegg, Skoda, SEAT, Citroen, Peugeot, Renault, and Ford all had an option of a car that runs on biofuel in 2007. This helped Sweden become less and less polluting.

Hydro energy is the final alternative for fossil fuels this essay will address. Hydro energy is always turned into electricity. It is generated by stored water suddenly being allowed to rush through turbines which act as dynamos which creates electricity. This form of creating energy is extremely popular; Roughly 150 countries use it. The Asia-Pacific region produces around 33% of the whole hydroelectricity generation in 2013. China is the largest producer however, producing 920TWh, which is 16.6% of hydroelectricity that is being used domestically also in 2013 (Wikipedia). The net cost of hydroelectricity is relatively low as the use of the water is completely free. Another advantage of hydro power is that no water is being consumed in the process, unlike coal or natural gas. On average, a hydro power station larger than 10 Megawatts costs 3 to 5 cents per kilowatt hour. There are 4 methods to create hydroelectricity: Conventional, Pumped-Storage, Run-of-the-river, and tide. Conventional energy is the energy from a dam. The amount of energy is dependent on the volume of water blocked by the dam and the difference in height from the blocked water and the river below it. Pumped-Storage is a method which is used when there is a sudden demand for electricity. When there is little need for the electricity, water is pumped up to the higher reservoir so then when more energy is needed, it can be released to the lower reservoir. Run-of-the-river method is one in which there is little to no reservoir capacity so only the water travelling upstream can be used to turn the turbines. Normally places near the reservoir of the dam are ideal places for this method. Tidal power is power taken from the rise and fall of the ocean. They take the kinetic energy from the water molecules to achieve a gain in electricity. In Great Britain it is believe there are 8 sites in which if they were developed properly, could generate 20% of the electricity used in 2012 (Wikipedia). The Three Gorge Dam in China is the largest dam in the world and has the largest installed capacity of 22,500 MW.