

# The minimum power requirement environmental sciences essay



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Using coal to produce energy has many advantages, but burning coal comes at a price. Faced with greenhouse gas problems, the world needs a solution better than coal. Nuclear energy, when compared with current coal power plants, is the solution to the world's energy problems and needs. At the present, renewable energies, such as wind and solar power, are not mature enough to supply the world's power. Renewable energies are not currently a workable solution, but because the current major source of electricity, coal, is not clean enough, a new solution is necessary. Nuclear energy, power produced through nuclear fission, shares similarities with coal, but it is a superior source of energy in terms of cleanliness, safety, cost, and efficiency. Energy is a controversial topic today. Advocates of global warming want to change the energy industry because of carbon dioxide (CO<sub>2</sub>) emissions. There are, essentially, two different methods of obtaining energy, nonrenewable and renewable. Before coal and nuclear energy, two of the most common nonrenewable energy sources today, are compared, taking a brief look at renewable energies will provide some background information on the topic. Martin Nicholson, a University of Cambridge graduate now a writer for MN Information Technology Group, in his book, *The Power Makers' Challenge: and the Need for Fission Energy*, explains that the main problem with renewable energy is that it cannot provide a dependable and efficient power supply, and until it can, it won't be able to replace nonrenewable energy as the base load generator of electricity (51-52). There is no easy or efficient way to store massive amounts of electricity for later use; therefore, because the supply of electricity has to be kept very close to demand, extra electricity generated may be wasted (Nicholson 43). Wind turbines produce electricity when the wind blows very strong, but this may not be during a

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time that the demand is high; if power companies don't need the extra electricity, they let it go to waste (Nicholson 43). People may argue that, by distributing renewable energy such as wind turbines or solar panels over a large geographical area, at any given time, there will be wind blowing or the sun shining somewhere. However, in a study based in Canada, distributing wind turbines around the country did little to help reliability (Nicholson 44). A major difference between renewable and nonrenewable energy is that there is no control over when renewable energy works. Nonrenewable energy is collected, stored, and then, at any time desired, turned into energy.

Hopefully, renewables will be ready to replace nonrenewable energy in the future, but until new scientific advancements are made, nonrenewable energy, like coal and nuclear, is the world's best energy solution. Coal and nuclear energy, both nonrenewable, share some similarities. Coal is extracted from the ground, crushed into powder, and then burned (Nicholson 74). Nuclear energy is produced from the nuclear fission, or splitting of the atom, of atomic elements such as uranium, plutonium, or, the lesser known, thorium (Shiga). The heat generated from the splitting of the atom is used to boil water. The steam produced powers turbines. Both processes burn a gathered material, create electricity, and, as a result, generate waste. The waste from both processes can be reused. A majority of coal ash can be used in concrete and construction materials such as fillers and wallboard (Peach 1344). Nuclear waste, in the future, could be reused as fuel in more efficient reactors (Nicholson 90). Nuclear energy is the solution to the world's energy needs because nuclear reactors use much less material when creating power. There are little to no greenhouse gas emissions from creating

electricity through nuclear energy, and nuclear power, contrary to popular  
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belief, is one of the safest forms of energy. Nuclear energy also has room for vast advancements and improvements in efficiency and cost. One of the biggest differences between coal and nuclear energy is cleanliness. Coal energy is very dirty, producing a great amount of carbon dioxide emissions, while, on the other hand, nuclear energy is clean by nature, producing no CO<sub>2</sub>. Coal produces 42% of the electricity in the United States, but it is responsible for 75% of the total CO<sub>2</sub> emissions attributed to electricity generation (Nicholson 73). To effectively reduce and control global warming, the Intergovernmental Panel on Climate Change, IPCC, reported that emissions need to be reduced by 85% by 2050 (Nicholson 30). To reach the 2050 goal, the suggested emissions rate needs to be 50 kilograms of greenhouse gas emissions per megawatt hour (50 kg CO<sub>2</sub>/ MWh) when producing electricity (Nicholson 30). Currently, coal produces an abundant and reliable supply of electricity. Although coal is reliable, it is no longer the solution to our energy needs because it produces so much carbon dioxide. Advocates of coal energy suggest, instead of moving away from coal, to make it cleaner through a process called Carbon Capture Storage or CCS (Biello). CCS involves capturing the carbon dioxide during the burning process, and then transporting it to a long term storage space (Nicholson 74). Carbon capture storage keeps coal from emitting a large amount of its CO<sub>2</sub> emissions. The collected CO<sub>2</sub> has uses beyond long term storage, such as to carbonate soda or to extract oil. Oil miners can replace oil with carbon dioxide. Oil can be extracted, in the right circumstances, by pumping stored CO<sub>2</sub> into oil reserves to push oil out of the ground while storing the CO<sub>2</sub> at the same time (Biello). Properly chosen sites can store CO<sub>2</sub> for at least 1000 years (Biello). But a properly chosen site may be hard to come by. Useful as <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>

it may be presented, CCS is sweeping the dirt under the rug; the process puts off the problem to deal with later. One of the main arguments for the urgency in fixing global warming now is to protect the future generations of the world. A big leakage could be extremely dangerous; not only would the leak undo all the reduced emissions, carbon dioxide is lethal in high doses and could kill local animals and possibly people (Nicholson 75). Carbon capture storage is costly, both monetarily and in efficiency. It would take up to 40% of a pulverized coal plant's electricity just to complete the process (Nicholson 74). Coal also produces a great deal of tangible waste. Coal produces a great deal of ash as it generates electricity. A gigawatt coal power plant can produce enough waste ash in a year to fill an entire thirty-story building (Nicholson 90). Coal ash, alongside carbon dioxide, can be an equally serious problem to the environment. Fifty years of waste ash, called fly ash, was spilled into the Tennessee Valley in the winter of 2008. The toxic material desolated 300 acres of land (Peach 1347). The entire area is still trying to recover today. The EPA has put about one billion dollars into the recovery of the area, but progress is slow (Peach 1347). Coal produces an immense amount of carbon dioxide and leftover ash. The emissions from coal are the main reason a new energy solution is needed. In contrast to coal's dirty emissions, nuclear power plants produce very little greenhouse gas emissions and much less physical waste. Nuclear energy, at its highest CO<sub>2</sub> production rate, 40 kg CO<sub>2</sub>/ MWh, is six times less than black coal with CCS at its lowest, 247 kg CO<sub>2</sub>/ MWh. Nuclear energy produces, on the low end, only 3 kg CO<sub>2</sub>/ MWh (Nicholson 31). Compared to coal, nuclear energy produces very little carbon dioxide. A uranium power plant produces no carbon dioxide in operation (Nicholson 85). Nuclear power is cleaner than <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>

coal because it produces almost no carbon dioxide emissions. Nuclear energy is the solution to the world's energy needs because it can meet environmental goals for the future and produce enough electricity at the same time. Antinuclear advocates argue that nuclear energy, like coal power plants, produces a lot of highly dangerous byproduct. While coal produces two products during the burning process, CO<sub>2</sub> and leftover ash, nuclear power, essentially, only produces radioactive spent fuel rods. But for nuclear waste, the story doesn't end at indefinite storage. A gigawatt nuclear power station produces about 30 tons of waste a year. Thirty tons of nuclear waste could fit in a telephone box (Nicholson 90). In theory, there is no reason that all of the fuel put into a nuclear reactor cannot be converted into energy, producing no waste at all. Today, nuclear reactors are only using 1% of uranium's energy potential, meaning, that in the future nuclear power plants could be up to 100 times more efficient (Nicholson 84). Also, all of the "waste" that was used previously could potentially be collected and reused as fuel. Nuclear waste recycling has been successful for a number of years and it is only a matter of time before it becomes extremely efficient (Morrison). Coal and nuclear energy both produce electricity and a waste product, but nuclear is a much cleaner source of electricity. Analyzing the outputs and waste of coal and nuclear energy, nuclear power is a vastly cleaner solution. Every industry has its risks and rewards, and the energy industry is no exception. The safety of energy is a politically and emotionally charged issue. Some people advocate for the complete shutdown of all nuclear activity. Others point political fingers; some coal advocates claim that President Obama's Administration has been "waging a multi-front war" on coal ("Future of Coal"). Nuclear energy, compared to coal however, is a safer

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energy source. A great motivator of politics and people in general, is fear. Fear, especially unfounded fear, is one of the biggest obstacles in the energy industry. Safety is a big concern in all aspects of life. One of nuclear energy's greatest challenges is a bad name; many advocating for nuclear energy's cessation do so out of fear for safety. Coal, however, even though it doesn't have the same reputation, is actually more dangerous than nuclear energy. In his article, Phil McKenna, an MIT graduate and freelance writer, describes the safety of fossil fuels. McKenna presents a study that compared fatalities per unit of power produced over the complete life-cycle of an energy source, and the results are found that nuclear was the safest and coal the deadliest energy source (McKenna). The air particles produced by coal power plants cause the death of 13, 200 people in the United States each year (McKenna). McKenna suggests though his article that coal power production is overlooked as a hazard because it slowly progresses. Mining coal is another factor that concerns people. Coal mining is considered to be one of the most dangerous occupations in the world. Although it does not top the list, mining in general is considered extremely dangerous, where 27 out of every 100, 000 lose their lives (Zupek). Both as a dangerous occupation and a big health risk, coal is very dangerous, more than people may realize. Because coal has been in use for over one hundred years, it has slipped into the back of our minds, but its effects are still very prevalent today. Coal is very dangerous to the health of thousands, and its safety concerns should be brought into account while the world looks for the source of its energy. Is nuclear energy as dangerous as many people advocate? Many fears of nuclear energy are unfounded. As stated, nuclear energy came out as the safest among the main energy producers. While coal causes over 13, 000

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deaths a year, Chernobyl, one of the most notable and infamous nuclear reactor accidents in history, has caused an estimated 9,000 deaths since 1986 (McKenna). When living close to a nuclear reactor, radiation may seem like a very real threat. Surprisingly however, a coal power plant can leak up to 100 times more radiation than a regulated nuclear power plant (Nicholson 89-90). A study by the Nuclear Regulatory Commission concluded that the risk of death or cancer from a nuclear power plant was one in 10 million (Nicholson 89). The three major nuclear accidents in history are Three Mile Island, Chernobyl and recently Fukushima. Each failure is the result of a backup system failure, meaning the design of the system was the main fault, and improvements in design can easily be made such as passive safety measures that need no human intervention (Nicholson 89). Advocates against nuclear energy argue that even though natural disaster resilience systems may be in place, they are still susceptible to terrorist attacks. It may appear dangerous to transport a truck full of nuclear waste across the country to storage, but in reality, a nuclear explosion is physically impossible (Nicholson 90). It concerns some that terrorists could steal unused or left over radioactive material to build a bomb (Graetz 76). In reality, this would not be practical; Nicholson answers this argument by explaining that the process to enrich radioactive material is expensive and easily detectible. It would be more practical to steal or buy an already produced bomb (91). Radioactive material is not confined to the energy industry. Shutting down nuclear power plants to prevent terrorism would prevent little in the end; it would be just as practical for terrorists to steal radioactive material from any other industry. Is nuclear energy dangerous? Yes, but so is every industrial process. Including mining, nuclear energy, on a per unit of power basis, is a <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>



considerably safer energy source (Nicholson 89). Many fears of nuclear energy are unfounded. Accidents, sadly, are a part of life, but they are opportunities for advancement. Nuclear energy is a safer energy solution than it is made out to be by many. Coal is more dangerous than nuclear energy, the cleanest and safest source of energy. The safety benefits of nuclear energy are the reason why nuclear energy is the solution to the world's energy needs. For many people, especially politicians and accountants, cost is the bottom line of every project or program. Nuclear energy and coal power highly contrast each other in terms of cost. Coal is not costly now, but it may turn out to be in the future. Considered a cheap and efficient way to produce energy, coal costs about a third of what renewables cost ("Future of Coal"). There are people campaigning to create a new tax that will financially impact companies that produce CO<sub>2</sub> emissions (Peach 1349). Currently, there is no cost or monetary consequence for emitting greenhouse gases, but a new tax imposed on coal power plants for not meeting emission regulation, could substantially increase the price of electricity. To avoid the tax, a coal power plant may invest in carbon capture storage. However, CCS is a costly and currently inefficient process. The Department of Energy estimated in 2007 that installing the capturing process could double the price of electricity per megawatt hour (Biello). If greenhouse gas emission fines are not properly set, it may come out cheaper for coal power plants to pay the fines. CO<sub>2</sub> fines may dramatically increase the cost of electricity. If coal power plants were switched over to nuclear power plants, the short term costs may be high; in the 1970s nuclear power plant costs rose 170% in 6 years (Graetz 66), but the long term benefits in areas of safety, cleanliness, and cost would be great. In contrast to coal, a <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>

nuclear reactor can be a very expensive source of energy to build. Nuclear reactors built in the 1970s, estimated to be \$900 million, turned out to cost almost \$6 billion (Graetz 75). Martin Nicholson describes a pitfall in energy creation costs. According to Nicholson the true comparison is the cost per megawatt hour (65). This comparison adjusts for operating cost benefits. A nuclear power plant, a dam, or a solar panel field may be expensive to construct, but the operating costs are small compared to coal or gas (Nicholson 65). In building materials, a nuclear power station appears to use a lot of resources, but nuclear power stations are the most efficient use of materials per megawatt-hour when compared to solar and wind (Nicholson 67). Nuclear power plants may have a large upfront cost, but they are an efficient use of materials and have a long life. While coal is cheap to start and nuclear is expensive now, in the future things may become very different. Coal may seem like the cheaper energy solution, but in the long run nuclear energy may turn out to be the best energy option. The efficiency levels between coal and nuclear power are also drastically different. Coal, like any technology over time, has become more efficient since it was first used on a large scale. In coal's infancy, its efficiency was generally below 30%. Then coal was pulverized, and the efficiency rose to 35% as it was burned. New technologies in the 1950s allowed for coal to burn at "supercritical" temperature allowing for 40% efficiency. A relatively new technology, converting coal to gas, can theoretically be 60% efficient, but this efficiency level has yet to be attained (Nicholson 74). Coal is reaching its very peak efficiency. Even at its high efficient levels today, it still produces high levels of CO<sub>2</sub> emissions. As far as environmental efficiency goes, coal is not a strong option. Waste efficiency is another challenge for coal power <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>

plants. The United States uses 900 million tons of coal per year ("Future of Coal"). 140 million tons of fly ash, a waste byproduct of coal power plants, is produced every year which is approximately enough fly ash to fill a line of boxcars from the United States to Australia (Peach 1347). Coal power plants produce a lot of waste, and are at the climax of their efficiency levels. While coal power is reaching its maximum production efficiency, there is no way it can compete with other environmentally efficient sources of energy. Coal was a great and convenient solution to the world's energy needs through the industrial revolution, but now the world needs a new type of efficiency. Coal power plants, if they were to become more environmentally efficient, would lose a great portion of their production efficiency. A lack of efficiency and growth makes coal energy a poor solution in comparison to nuclear energy, which has room to become substantially more efficient and is naturally environmentally efficient. Nuclear energy is an extremely powerful resource. As stated earlier, nuclear energy could potentially become 100 times more efficient. Compared to coal, which is reaching its maximum efficiencies, nuclear power has decades of advancements to come. Nuclear energy, unlike coal, is a yet to be harnessed resource that can become more efficient and valuable in the future. Nuclear waste has an appealing attribute; it can be recycled and used again to produce energy (Morrison). Because uranium is so cheap, it is more cost effective to store the waste, but later, if prices were to rise, nuclear waste could be recycled to generate 25% more energy (Nicholson 101). A 25% increase sounds great, but it could be better. Many nuclear advocates are waiting for, fast reactors, the next generation nuclear reactors (Nicholson 102-103). Having room for a lot of improvement, fast reactors could potentially extract 160 times more energy from uranium than <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>

current reactors can, and, at the same time, use all of the material put in. A fast reactor wouldn't produce waste to deal with afterwards, and all of the waste that has been previously accumulated can be converted into pure energy (Nicholson 103). Nuclear energy has the ability to be nearly 100% efficient, being able to convert all material into energy. Creating no waste, nuclear energy would almost be as clean as renewable energies. The potential environmental efficiency in nuclear energy is astounding compared to coal which is reaching, if it hasn't already reached, its full potential.

Another technology developing in the nuclear field that would make the process not only more efficient, but safer as well, is a thorium reactor.

Thorium reactors, a budding technology in nuclear power that uses the element thorium instead of uranium or plutonium, allows for the benefits of nuclear power generation without any of the safety concerns of uranium and plutonium that have devastated areas like the Fukushima power plant (Shiga). Thorium nuclear power plants use fluoride salts, which are not flammable like their solid fuel rod predecessors (Shiga). Nonflammable fluoride salts may be the solution to safety problems faced today such as the Fukushima reactor meltdown in Japan. Also, thorium reactors burn off much more waste than uranium or plutonium reactors would (Shiga). Nuclear power plants are not only currently very clean and efficient, but they also have the capacity to become extremely efficient in years to come.

Production efficiency is one of nuclear energy's strongest attributes, but it also is environmentally efficient. Comparing coal and nuclear energy in terms of efficiency, the two are starkly different. Nuclear energy is currently more efficient than coal, and it has the potential to become even more so.

Being more efficient is one reason why nuclear energy is the solution to the <https://assignbuster.com/the-minimum-power-requirement-environmental-sciences-essay/>

world's energy needs. In the United States nuclear power plants generate about 20% of the country's electricity (Grunwald). In France, about 70% of the country's electricity is generated by nuclear energy (Morrison). The world is faced with a global crisis. Coal is extremely dirty, emitting millions of tons of carbon dioxide into the air, while nuclear is clean. Coal causes the death of thousands of people each year, while, in contrast, nuclear energy is strictly regulated and surprisingly safe. Coal seems like a cheap, quick solution now, but it may cost everyone in the future. Knowing how coal affects our wallets and health, we need to turn to a better, more efficient, energy solution. Until technology advances enough to make renewable energy a more viable solution, nonrenewable energy will supply the world's hunger for energy. Nuclear energy and coal share some similarities, but, in the end, they are very different sources of energy. Nuclear energy is the only solution that can live up to coal's reliability and strength, but take care of the environment and reach future requirements for emissions. Unless there is advancement in the science of energy generation, nuclear energy is the world's only worthwhile option.