

Nuclear Power: Worth the Risk?

by

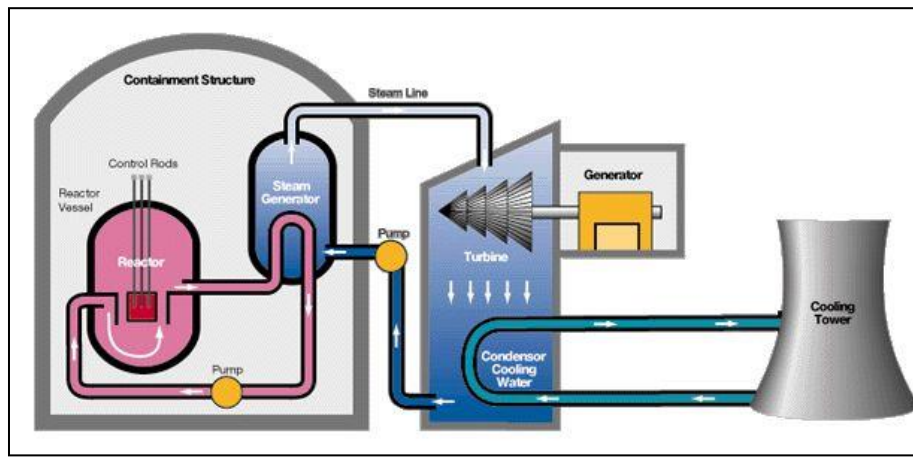
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Have you ever wondered why in December in the year of 2012, it was 75 degrees? Have you ever wondered why global warming is increasing? Did you hear about Fukushima, Chernobyl, or the Three Mile Island accident? Now you're reading this and wondering what all these things have in common. Nuclear power is the answer.

When I heard we had to do our senior project on something that related to science, I immediately started asking teachers for suggestions. I asked my old AP language teacher for ideas and she started to tell me about the Fukushima accident and I was surprised. At first I thought it wouldn't be interesting, but as I read more about nuclear energy I started to oppose the expansion of nuclear energy. While discussing my topic with my experts, they changed my mind about nuclear energy. I then began to agree with the expansion of nuclear energy and I want everyone who opposes this idea to agree as well.

Nuclear power wasn't always at the stage it is now. Nuclear power wasn't always used to generate electricity. Tom and Gena Metcalf in their book *Nuclear Power* explain what nuclear power was first used for. "According to the Department of Energy, nuclear power was first harnessed for use atomic bombs during World War Two." Nuclear power was used to create atomic bombs before it was used to generate electricity. Some critics argue that is the reason they disagree with the expansion of the nuclear industry. Although this may be true in a way, nuclear power is one of the safest and most effective alternatives of generating electricity. To fully understand nuclear reactors, one has to become familiarized with the way the different reactors work. Tom and Gena Metcalf go on further to explain the two main types of reactors in their book. "In the United States, there are two main types of light water reactors: the pressurized water reactor (PWR) and the boiling water reactor (BWR)." The PWR is a nuclear reactor that uses water as a coolant and moderator; the steam produced can drive a steam turbine. The BWR is a nuclear

reactor that uses water as a coolant and moderator; the water boils in the reactor core and the steam produced can drive a steam turbine.



Throughout the entire book, the Metcalf's give several reasons as to why nuclear energy is beneficial to humans and the environment. "Additionally, nuclear energy could be used to solve another growing crisis: the increasing shortage of fresh water available or human consumption and crop irrigation"(106).Although this is not a main reason as to why nuclear energy is beneficial to the humans and environment, it is a contributing factor. Nuclear power plays an important role in the world today. The Metcalf's explain the significance of nuclear power. "Nuclear power plants play a significant role in improving people's lives- whether its powering offices and factories or providing electricity for a digital economy"(82).Every energy source has its flaws but in nuclear power's case, the significant role in powering the things we need the most, outweighs the bad.

Nuclear power reactors are already made safe but there are ways to make them safer. M.V. Ramana, a physicist at the Nuclear Futures Lab at Princeton University who wrote a journal called "Nuclear Power: Economic, Safety, Health, and Environmental Issues of Near-Term Technologies" gives insight on how to create safe nuclear reactors. "According to this view, there are essentially two routes to making a system safe. The first is to design the reactor in

such a way that even if one of many potential accidents occurs, the reactor recovers, and the damage does not spread, even if no protective action, automatic or deliberate, is taken. The second way is to incorporate protective systems, preferably with redundancies that mitigate the effects of an accident." Nuclear reactors are now set up so if an accident does occur, the reactor can withstand it and fully recover from it. There are also new systems set up inside the reactors that can make huge accidents look like small mishaps.

Many people oppose nuclear power because they're convinced it is unsafe for the workers, the people around it, and because of the accidents that occurred. They also think that nuclear reactors are attraction to saboteurs, terrorist, and it is used to expand nuclear proliferation. A critic's argument might look like this: Nuclear energy is not safe for the workers. Working in or around nuclear reactors can be very unsafe. Helen Caldicott, the anti-nuclear advocate, is also the author of *Nuclear Power Is Not the Answer*. She has founded several organizations to oppose the growth of nuclear power and anything associated with it. In this book she addresses many problems and disadvantages associated with nuclear power, one major one being safety to workers. "Miners, workers, and residents in the vicinity of the mining and milling functions, and workers involved in the enrichment processes necessary to create nuclear fuel are at a risk for exposure to unhealthy amounts of radiation and have increased incidences of cancer and related diseases as a result"(39). The safety of the workers is very important because if nuclear power is unsafe for the workers it would be unsafe for the environment and the humans living here. The safety of the workers is a big aspect in making nuclear power plants safe in general. Charles Ferguson gives the steps of how the safety of the workers is put into play. "Safety at reactors involves many activities: ensuring operators receive high- quality training, instilling a safety culture in the work habits of all personnel, performing preventive maintenance

on equipment, installing layers of safety systems, retrofitting existing reactors with the best available safety systems, and designing future reactors so that they can achieve higher standards" (137). In order to work at a nuclear reactor you have to go through training and master all the levels of training. Safety systems are installed in the work place as well.

Workers safety isn't the only concern when it comes to nuclear energy the radioactive waste that comes with it is a major concern as well. Caldicott evaluates the several different safety concerns in her book. One section of the book is dedicated to the nuclear waste and how it can affect the environment and humans. "Routine and accidental radioactive releases at nuclear power plants as well as the inevitable leakage of radioactive waste will contaminate water and food chains and expose humans and animals now and for generations to come"(39). If the nuclear waste from the nuclear power plants isn't carefully disposed of, humans and animals could be affected by it and damage the upcoming generations as well. Although nuclear reactors have highly radioactive waste, Tom and Gena Metcalf explain how nuclear the waste can be obtained and managed correctly without harming the people or environment around it. "The many thick layers of the containment building keep radioactive materials safely inside. U.S. nuclear powers plants also use a series of physical barrier to make sure that radioactive material does not escape"(48).Nuclear reactors are created with many different security layers that would keep the hazardous waste inside instead of outside harming the health of the people around. Nuclear waste is only a problem when it has leaked outside, but with the many layers that hold it inside nuclear reactors are made safe. Nuclear power plants could obtain nuclear waste on the inside, so the environment and humans around are not in danger.

Many people oppose nuclear power because they are concerned with the possibility of disasters. The three reporters of Bloomberg; Kasia Kilmasinska, Mark Drajem, and Christine

Harvey came together to discuss how the nuclear reactors today were ready for Hurricane Sandy and they also discuss why Fukushima failed. "Backup diesel generators and cooling systems at Fukushima failed after a 15-meter surge of water tied to a 9-magnitude undersea earthquake on March 11, 2011, led to the worst nuclear disaster since Chernobyl in 1986. Hydrogen exploded as water in the reactors and spent-fuel ponds boiled away and radiation leaked."The earthquake caused a tsunami and caused the hydrogen in the inside of the reactor to explode. Although nuclear reactors have encountered three major accidents, they have improved and added many safety systems that would keep them from getting destroyed if a natural disaster were to happen again. Kilmasinska, Drajem, and Harvey evaluated Hurricane Sandy and the ways the nuclear power plants made it through the hurricane. "Nuclear power plants in the Eastern U.S. activated emergency procedures as Hurricane Sandy barreled toward the coast and appeared to pass the biggest readiness test since the 2011 crisis at the Fukushima plant in Japan."Natural disasters cannot be controlled but they can be prepared for. When Hurricane Sandy hit, no nuclear reactors were destroyed. Many safety systems have been installed in the nuclear power plants, which has prepared them for any natural disasters. Natural disasters cannot be stopped but they can be handled.

Not only are people worried about the meltdowns and the overall safety regarding a nuclear reactor, but also the fact that a saboteur or terrorist can easily destroy it. Also the expansion of nuclear power can potentially cause an expansion of nuclear weapons. With nuclear power there are many dangers that come with it, including saboteurs, terrorism, and proliferation expansion. It would be easy for a saboteur to destroy a reactor, the environment, and the people around it. Caldicott writes about the dangers terrorists could bring to the nuclear reactors."Once inside the plant with access to the control room the saboteurs would and could easily flip a few

well-learned switches, shutting pumps and operating key valves to cause a deadly loss of coolant"(90).Nuclear reactors can be a target for saboteurs. There are controls on the inside of the reactor that if they are interrupted with can destroy the reactor and anything around it. Saboteurs can destroy a nuclear reactor but the government assures that the nuclear power plants are made safe. The Metcalfs explain the governments' part on how nuclear power reactors are made safe."Plant operators are committed to manage the nation's used nuclear fuel safety responsibility until the federal government opens a centralized repository. Doing so not only protects public health and safety, it also ensures that Americans can enjoy the benefits of reliable economical and emission-free nuclear energy" (83).The government makes sure that the nuclear reactors obtain a safe system and that everyone benefits from the nuclear power. Nuclear power is a safe and beneficial energy source that everyone can enjoy without the worries of the emission of greenhouse gases. The government has safety enhancements installed in nuclear reactors to be positive that they are safe and environmental friendly.

Those who oppose nuclear power might say that is vulnerable to terrorist attacks and for that the nuclear industry should not expand. The Metcalf discussed the negative ends up the nuclear industry. "A nuclear power plant could be a prime target for terrorism because of the long-term effect- an attack can lead to far-reaching radioactive contamination with long-lived radio nuclides"(56). If a terrorist wanted to destroy a large population at once; they can attack a nuclear power and destroy the people and environment around it. Nuclear power plants are very sensitive, which is why many disagree with the statement that nuclear power is safe for the environment and humans. Securing a nuclear reactor in every aspect is a major way in increasing the safety of nuclear power. Ferguson describes the ways the nuclear reactors are secured and safe from any intruders."Securing a nuclear facility first requires understanding the interplay

among a set of factors: potential attackers or saboteurs, vulnerabilities to that facility, and ways the attackers or saboteurs may breach defenses and exploit those vulnerabilities"(173). Nuclear reactors are designed in a way that even saboteurs can't harm them and their surroundings. In the past nuclear power plants have been very vulnerable, but they have been improved so that they can handle almost any situation. Nuclear power reactors are made safe and although there may be a few glitches here and there, nuclear power is one of the safest ways to generate electricity.

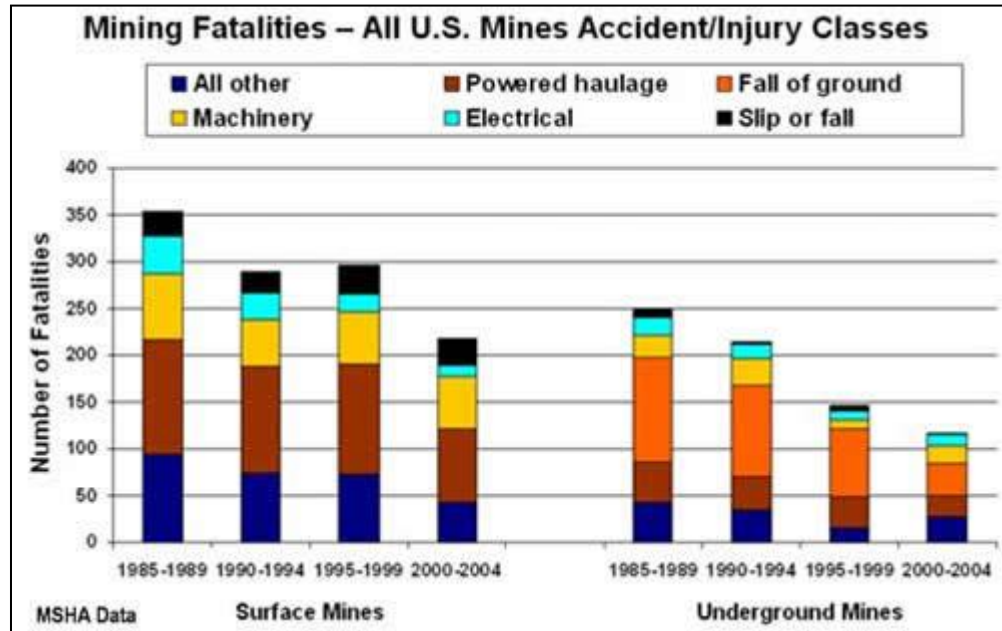
Many people do not want the nuclear industry to expand because of the problems that come along with it. Ramana gives insight on what those who oppose the expansion of the nuclear industry think about nuclear power in general."A number of analysts have argued that an expansion of nuclear power would lead to unacceptable risks related to catastrophic accidents and the proliferation of nuclear weapons and nuclear terrorism, as well as to the challenges of more waste disposal (9, 10, and 23)."However, all of these problems can be avoided if the nuclear power industry was to either stay the same or the number of reactors was to decrease. Although many people worry about the dangers of nuclear power, nuclear reactors today are made much safer than the past ones with systems that will rarely fail. Ramana addresses the way nuclear reactors are set up and the ways they maintain a safe set up."The goal is 'to design systems that use human capabilities in appropriate ways, that protect systems from human frailties, and that protect humans from hazards associated with the system'" (97). The way nuclear reactors are designed, they are able to withstand accidents. An increase of nuclear weapons today has not been a major factor of decreasing the nuclear industry but the systems are designed to protect people from anything affiliated with nuclear power. Nuclear reactors today are more safe and beneficial than ever before. Nuclear power is beneficial to the environment and humans, despite the minor flaws. Nuclear power is safe and beneficial for the environment and humans.

Nuclear energy is safe and beneficial to the environment and humans because it does not harm the environment. Nuclear energy does not expose humans to as much radioactive waste or air pollution as any fossil fuel.

Charles D. Ferguson is the author of a book called Nuclear Energy: What Everyone Needs To Know. In his book he talks about how nuclear energy is better than the source the US normally uses for electrical power, which is coal. "By comparison, coal-fired power plants emit radioactive materials in the fly ash. These materials are made up of uranium and other naturally occurring radioactive substances that are present in the coal. According to the Oak Ridge National Laboratory, fly ash releases 100 times more radioactive material than does a nuclear plant for the same amount of electrical energy produce"(197). Nuclear power plants can produce the same amount of energy as coal with no radioactive material polluting the air. Nuclear power is a better and safer way to generate electricity. It does not pollute the air but it does give the world a lot of electricity, which is why nuclear power is safe and beneficial to the environment and humans.

Tom and Gena Metcalf are authors who often focus on major issues in the world today; in their book *Nuclear Power* they discuss the benefits of nuclear power. "Nuclear energy is the only non-greenhouse-gas-emitting power source that can effectively replace fossil fuels and satisfy global energy demand" (102). Nuclear energy generates energy without the many problems that coal and the renewable energy sources acquire. Coal pollutes the air and coal mining could be very

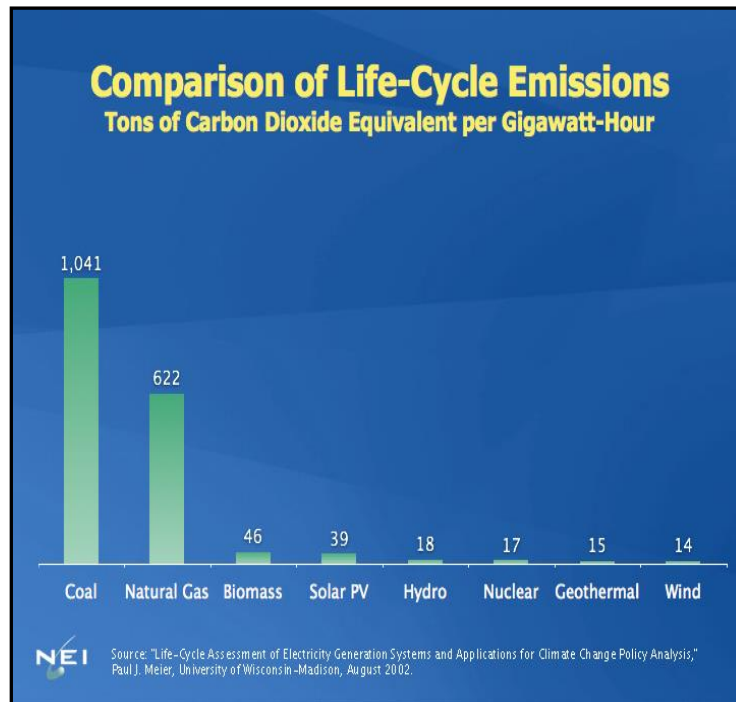
dangerous and injuries can be fatal.



Renewables are very environmental friendly but cannot lead the nation in the number one energy sector because they depend solely on the environment, which is unpredictable. Nuclear energy is beneficial for the environment because it does not pollute the air; instead of emitting greenhouse gases, it releases water vapor into the air. Stewart Brand, writer and member of the Global Business Network, participated in a debate where he argued that nuclear energy is beneficial and necessary in the world today. In the debate he compared nuclear energy to the world's most used energy source, coal. "One gigawatt a year of coal waste is equal to 8,000,000 tons of CO₂" Coal produces 8,000,000 tons of CO₂ a year, whereas nuclear power emits no CO₂. The nuclear power plants do not emit CO₂, instead they emit water vapor which is not harmful to humans or the environment.

Nuclear energy reduces greenhouse gas emissions. In their book Nuclear Power, the Metcalf's talk about how nuclear power produces energy without emitting any greenhouse gases. "Nuclear power plants are the nation's largest source of emission-free electricity. No other source of

electricity in the United States contributes such a large share of energy production while having such a limited environment impact"(82).Nuclear energy is the only source that can produce a large amount of energy without a large amount of greenhouse gases.

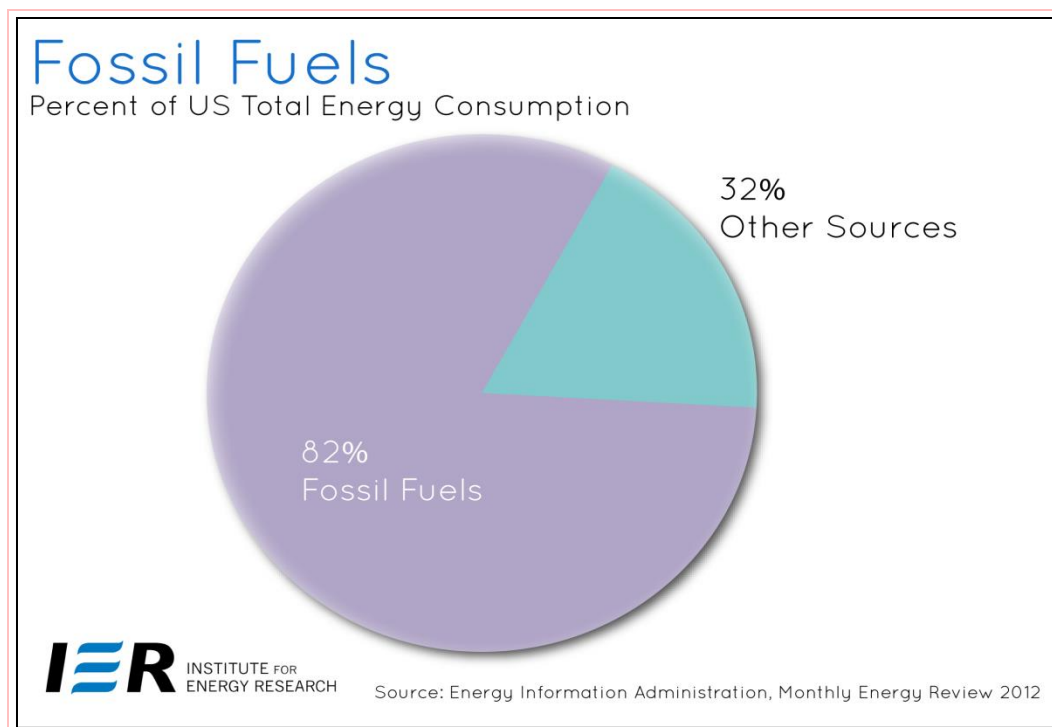


Nuclear energy is, without emitting any gases, a beneficial energy source. In the same aspect, the Metcalf's explain how nuclear energy is totally environmentally friendly. "Nuclear energy- combined with the use of renewable energy sources like wind, geothermal and hydro- remains the only practical, safe and environmentally friendly means of reducing greenhouse gas emissions and addressing energy security"(106).Nuclear energy is as environmentally friendly as renewable energy sources. It benefits humans and the environment because it can produce a lot of energy without harming the environment and humans. Nuclear energy is an environmentally friendly energy source because it does not emit any greenhouse gases.

Most of the US energy currently comes from coal power plants, but nuclear power plants could produce the same amount of energy with less global damage. Coal produces large amounts of carbon dioxide. In his book, Ferguson compares nuclear energy to fossil fuels and

focuses on why nuclear energy would be the best way to generate electricity. "If natural gas replaced the world's nuclear plants, the additional increase in emissions of approximately 2,000 million metric tons of carbon dioxide would be about half of what it would be with coal plants"(95).If the world continues to use coal as the leading source of energy that would mean more CO₂ in the atmosphere. If the world switches to nuclear energy less CO₂ would be in the air, and the chances of global warming happening would decrease.

Because nuclear energy does not emit any greenhouse gases, it does not contribute to climate change, which is a sign of global warming. Fossil fuels generate 82% of electricity in the United States.



In order to generate electricity, the fossil fuels must be burned and when they are burned they are releasing tons of greenhouse gases into the air. This causes the greenhouse effect where the gases are trapped in the atmosphere. If the gases are trapped in the atmosphere that can cause global warming. Global warming is when the temperature of the earth's atmosphere increase. An

increase of global warming can potentially kill everyone and everything if greenhouse gases are steadily emitted into the atmosphere. Ramana, a physicist at the Nuclear Futures Lab at Princeton University, wrote a journal called Nuclear Power: Economic, Safety, Health, and Environmental Issues of Near-Term Technologies where he addressed the environmental benefits of nuclear energy. "Many have argued that an expansion of nuclear power would help combat climate change" (138–140). Because nuclear power plants do not emit any greenhouse gases, it does not contribute to climate change which is a sign of global warming. Nuclear energy is safe and beneficial for the same reasons coal is not.

Nuclear energy is safe and beneficial for the same reasons coal is not. James M. Acton, senior associate in the Nuclear Policy Program at the Carnegie Endowment, wrote an article titled Nuclear Power Is worth the Risk where he clearly explains the environmental advantages of nuclear power. "Fossil fuels, which (for the time being at least) are nuclear energy's principal rival, carry the risk of catastrophic climate change." Global warming can cause sea levels to rise and an increase of severe weather events. As of right now, in the US coal is the leading energy source, which means global warming is more likely to happen. Nuclear energy is beneficial to the environment and humans because it does not pollute the air, contribute to global warming, and it reduces greenhouse gas emissions.

Nuclear energy does not emit any CO₂ and it can produce a large amount of electricity which is why it's safe and beneficial for the humans and the environment. Coal, however, leaves negative effects on humans. In his book, Ferguson explains the negative effects that coal could have on one's health. "Coal plants emit copious quantities of carbon dioxide—a greenhouse gas—and worldwide, thousands of coal miners perish or suffer substantial harm to health" (197). The amount of carbon dioxide coal powered plants emit can cause serious harm to someone's health.

Nuclear power plants are created so that the world would have something to depend on that could get the job done, but also be environmentally friendly.

Ferguson elaborates further on the effects coal could cause when it comes to health dangers. "These emissions- particularly sulfur dioxide- can exacerbate respiratory conditions such as asthma. Nuclear plants do not emit these gases"(198).The carbon dioxide coal emits can be the cause of asthma, but nuclear energy does not emit those gases. Most people are hesitant of expanding the nuclear reactors for minor reasons, but once they're aware of the dangers of the leading energy source in the US, they would lean towards a clean, environmental friendly source like nuclear. The gases coal emits can be harmful to human health. Nuclear power doesn't emit those gases so that isn't a problem the world would have to worry about when it comes to nuclear power.

Coal contributes to climate change unlike nuclear power. Hae-Yong Jeong, the principal researcher for the Korea Atomic Energy Research Institute in the interview with Michael Reilly talks about how fossil fuels change climate, basically contributing to global warming. "In our civilization various types of services are provided based on the fossil energy resources. This is believed to be the main source of pollution and severe climate change now."Fossil fuels in general are a contributing factor to global warming. In the US today, coal is the main energy source which means global warming will constantly increase. Nuclear energy is a safe resource to use because it does not pollute the air and it is beneficial because it can produce just as much energy as coal without the negative effects.

Fossil fuels are nonrenewable sources."These fossil fuels are in limited supply, and now threaten our very existence by causing irreparable harm to the global climate", Jeong says.

It takes a lot of coal to produce a lot of electricity which means coal would run out faster. It only takes a small amount of uranium to produce electricity in a nuclear reactor, which is why nuclear power is beneficial. Four uranium pellets could produce as much energy as a trainload of coal. Nuclear power can replace fossil fuels efficiently.

Between wind, solar, and nuclear power, nuclear power is the best alternative for producing electricity. Nuclear energy is more efficient than both of the alternatives. Brand, in favor of increasing the nuclear industry, argues that wind and solar does not compare to nuclear energy. "What we're discovering about wind is like solar; it's a very dilute source of energy." It requires a lot of wind and a lot of solar to produce a large amount of energy and electricity, but with nuclear power it takes a small amount of uranium to produce electricity.

In the debate, "Does the world need nuclear power", Brand tells why nuclear is more reasonable than wind and solar. "With wind and solar, the power lines are getting over loaded."

Wind and solar power lines are getting flooded and if that happens and can cause all the power to go out that depends on wind and solar. With nuclear power, this is not a problem.

Wind and solar power require much more land than nuclear reactors. Brand goes on to explain how the land requirements differ between solar power and nuclear power. "One gigawatt is equal to fifty square miles of bulldozed solar farm." "One solar farm takes up a lot of land to make electricity. So if the world decided to use solar power instead of nuclear power, a lot of land will be used up. Whereas, with nuclear power, land is not a problem. It only takes one nuclear reactor and it only takes us one acre.

Not only does a nuclear power reactor take up less space as solar farms but wind farms as well. "One gigawatt is equal to two hundred and fifty square miles of wind farm" Brand says. In order for wind to generate a large amount of electricity, a lot of wind is required which means a

lot of land is required. Nuclear power is more beneficial because it doesn't take up as much space. In a wind farm, the wind reactors are scattered all over and the land around it cannot be used. Nuclear is beneficial to use because it does not take up as much land as any other alternative.

Depending on solar and wind power to lead the world as the number one energy and electricity source would land the world in a situation that would be hard to get out of. Brand, in favor of an expansion of the nuclear industry, explains why any other alternative would lead the world into a helpless situation. "Wind and solar take a very large footprint on the land." If the world depended on wind and solar power than majority of the land will be occupied by the wind and solar farms. A nuclear power plant is more beneficial than a wind or solar farm, especially when it comes to the amount of land each energy sector uses.

If we depend on wind and solar to be leading energy sources of the world, Brand explains the consequences. "With wind and solar we've run out of good sites." Because it takes up a lot of space for one wind or solar farm, there aren't many sites left over to set them up. With nuclear reactors there are many places to set one up and still have space left over to expand.

Nuclear power is safe and beneficial to the environment and humans so the U.S should invest in nuclear power more. The first nuclear reactor was built on June 27, 1954 and since then there were only three accidents and the last was in March of 2011. In order for the government to allow more reactors to be built they must first reassure the public that there have only been three major accidents involving nuclear power and switching to nuclear power means a reduction of greenhouse gases and a chance at saving the world from global warming. A lot of people oppose the idea of expanding the nuclear industry because of the outcome of these accidents. Nuclear power has been around for hundreds of years and has only come across three

major accidents. Once the majority of the public is in favor of nuclear power the government has to find money to expand the nuclear industry. The government has to find a way to fund money for the construction of nuclear reactors. The government needs to promote nuclear power so that they can receive money for new reactors. Once there is enough money to build new reactors, the government must find places to build the reactors. The reactors must be place in a city because that's where most of nuclear energy is used. Also the nuclear reactors cannot be place in a city with a large population to be even safer.

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