In recent years, the lack of energy is becoming a more severe problem worldwide since traditional fossil fuels have their inevitable shortages. On the one hand, fossil fuels are unrenewable resources; on the other hand, burning fossil fuels would lead to environmental problems such as air pollution and the greenhouse effect. Under this situation, people put high expectations on burgeoning nuclear power since nuclear energy has many advantages: Firstly, atomic power plants neither produce greenhouse gases nor toxic gases. Secondly, since people are able to manually produce the resources that nuclear power plants require in labs, nuclear energy is considered a renewable resource. Thirdly, benefitted from its unique physical properties, nuclear power has high power density, and nuclear power plants have a relatively long life span. However, nuclear power also faces challenges in financial concerns from the government and safety concerns from the public. In this paper, I will argue that it is wise for the U.S. government to build more nuclear power plants in the next 20 years, but the government should conduct it conscientiously.

The energy crisis has become a severe problem worldwide with the increasing power demand. According to the annual energy review published by the U.S. Energy Information Administration (EIA) in 2022, the total primary energy production in 2019 is 101.437 quadrillion BTU. This number is much higher than the 81.866 quadrillion BTU in 2013 [1]. The increase in the production of energy indicates that consumption is also ascending. The need for power grows at a steady pace of 1 quadrillion BTU from 2005 to 2019, and there is no sign of slowing down. Traditional methods usually generate this electricity from fossil fuels such as natural gas, petrol, and coal.

Fossil fuels make up an absolute majority of electricity production. In 2021, fossil fuels generated 79% of the energy produced in the U.S., including 36% from petroleum, 32% from natural gas, and 11% from coal. However, renewable energy, such as wind and hydroelectricity, only makes up 12% of energy sources [2]. It has been a long history of people utilizing these fossil fuels, but they are running out, and people must find substitute energy sources. According to a paper from N. Abas et al., oil output will peak in 2025 at 120 Mbpd, but by 2115 it will have decreased to 40 Mbpd.Thus, it is urgent to find alternative energy sources to replace these dwindling fossil fuels.

The greenhouse effect is also a significant problem triggered by burning fossil fuels. Since most of the components of fossil fuels contain carbon, the chemical reactions that happen in burning produce carbon dioxide. Carbon dioxide makes up about 0.04% of the atmosphere and is harmless to the human body. Carbon dioxide has a warming effect on the earth, and a moderate greenhouse effect keeps the temperature toasty for human living. However, since the Second Industrial Revolution, power plants have utilized fossil fuels more rapidly to provide enough energy to meet consumer demands. The emission of carbon dioxide increases as the consumption of fossil fuels increases. As a result, the surge in carbon dioxide and the depletion of the ozone layer makes the heat from the sun accumulate and finally lead to global warming. Global warming stresses ecosystems through temperature rises, water shortages, increased fire threats, drought, weeds, and pest invasions. These problems have been troubling the U.S. government for a long time, so the government should put carbon dioxide emissions under strict monitoring to resolve the greenhouse effect.

Another problem from the use of fossil fuels that troubles the U.S. government is rising pollution levels. Although utilizing fossil fuels has advantages such as low economic input, high power efficiency, and minimal technology requirements, conventional power generation methods produce toxic gas and fine particulate matter, which is also called PM2.5. Scientific research has proven that the combustion of fossil fuels contributes to mortality [3]. Burning fossil fuels creates fine particulate matter, which harms the human body in the long term. In the U.S., air pollution damages the local environment and harms other nearby areas through air movement [4]. More and more countries are starting to realize the importance of this issue and develop policies to take control of and reduce the emission of fine particulate matter. The U.S. began to resolve these problems early. Dating back to April 9th, 1998, the U.S. government enacted the first guidance, "Guidelines for Granting Exemptions for Daily PM2.5 Monitoring", which standardized the monitoring of PM2.5 [5].

Since traditional fossil fuels have the disadvantages described above, people are looking for substitute energy. Nuclear power, as one of the options, has many advantages. People consider nuclear power clean energy. Atomic reactions generate energy through fission, which is the process of splitting uranium atoms to produce energy. The splitting of uranium atoms producestremendous heat. After that, devices utilize heat produced by fission to generate steam, which turns a turbine to generate power without emitting the carbon dioxide and fine particulate matter that fossil fuels do. The phrase "clean energy" also stands for energy that does not produce toxic gas. Since the process of nuclear power generation only relates to atomic movement, there are no poisonous gases such as methane or nitrogen oxide produced in the process. So, the U.S. government could save a massive budget in dealing with pollution and repairing damaged ecosystems. And building more nuclear power plants would amplify such an advantage on a large scale.

According to the definition of carbon footprint, it is a system for estimating the total emissions of greenhouse gases in carbon equivalents from a product throughout its life cycle, from raw material manufacturing to completed product disposal [6]. Nuclear power is known as a low carbon footprint energy, which means the carbon dioxide produced per kilowatt is low compared with traditional fossil fuel energy. Some researchers believe that nuclear power could extensively improve environmental conditions by reducing the carbon footprint [7]. Since there is no carbon dioxide emission, switching to nuclear power instead of traditional fossil fuel energy could help ease the greenhouse effect, which would benefit the U.S. and the world in the long term.

Besides the distinct mechanism of electricity generation, nuclear power has some unique properties. For example, nuclear power plants have a relatively long service term compared with other types of power plants. According to research from J. R. Lamarsh and A. J. Baratta in 2001, the lifespans of nuclear power plants in the U.S. are around 40 - 60 years [8], and this number is increasing with technological breakthroughs in nuclear energy. However, conventional fire-coal power stations have a global average lifespan of only 46 years, and gas power plants have an average life span of 40 years [8][9]. The average life spans of clean energy power plants are even shorter: the average lifespan of hydroelectric power plants is 30 years, and windmills have only 20 years lifespan on average [10]. It is clear that the idea of building power plants that hold short lifespans is not economical. For the U.S. government, building more nuclear power plants would benefit the environment and the ecosystem in other ways. Under most circumstances, people might not dispose of the senescent devices properly: after repurposing parts that are still functional, people might abandon the rest of the defunct machines directly.

Moreover, the pollution produced in the process of removing devices is also a tricky problem. A team in China noticed that heavy metals used in coal-fired power plants might pollute the land and harm food crops. According to research from Rui Li et al., 79% of vegetable samples and 67% of grain samples grown from land polluted by mercury might damage the human body if consumed [11]. A longer serving lifetime for nuclear power plants requires less demolition, so people could waste fewer resources and produce less pollution.

Furthermore, one of the reasons that nuclear power is considered promising is that it has strikingly high power efficiency. The final step to storing energy as electricity for all power plants is turning the turbine with moving fluid; however, the process of producing such fluid differs significantly. For traditional fossil fuel power plants, burning fossil fuel heats water to get steam, and the turbine is driven by high-temperature steam. For nuclear power plants, reactors even use nuclear fuel rods to control the speed of reaction. Nuclear reactors in spacecraft take advantage of this property. Brown LC et al. found that combining nuclear energy with fuel cells would increase power efficiency largely and make electricity generation on a large scale with high energy efficiency possible [12].

Another reason scientists have high expectations for nuclear power is that it is a renewable resource. Fossil fuels come from decomposing plants and animals, requiring hundreds of thousands of years to produce, and are not renewable resources. On the other hand, the resources that nuclear power plants need could be produced manually. Scientists could produce the necessary uranium and deuteroxide with sophisticated devices in laboratories. Moreover, the U.S. has an abundant uranium reserve; according to U.S. Energy Information Administration, the U.S. held 1,227 million pounds of U3O8 in total in 2008 [13]. Thus, replacing fossil fuels that are non-renewable and inefficient with nuclear power with abundant reserves and high-power density would be wise.

With so many advantages described above, the public still holds an unfavored attitude toward nuclear power plants. The voice opposing building more nuclear power plants has been getting stronger in recent years. This is because the nuclear power accident is a horrible disaster for people and the government, no matter how severe the accident is. For the U.S. government, the Three Mile Island incident was a lesson. In 1979, a large amount of nuclear coolant escaped due to mechanical failures in the Three Mile Island nuclear facility in Pennsylvania. Luckily, since the U.S. government made a quick response to this emergency, the situation finally got controlled in time. According to a report from International Atomic Energy Agency (IAEA) in 1979, the maximum total increase in radiation measured at ground level is less than 100 millirem, and the average exposure in the Harrisburg area per person is 1.7 millirem only [14]. This accident is considered the most serious nuclear accident in the U.S. After this incident, concerns about nuclear safety emerged among the public and anti-nuclear activists, resulting in new regulations for the nuclear industry. In September 1979, in New York, more than 200,000 people participated in the anti-nuclear demonstrations, listening to Jane Fonda and Ralph Nader's speeches [15].

However, as one of the most severe nuclear accidents in history, the Chernobyl disaster damaged the USSR in almost every field: political, economic, and environmental. On April 26th, 1986, the No.4 reactor in the Chernobyl Nuclear Power Plant encountered a reactor core meltdown and steam explosions. What made the situation worse was that the severe reactor core fire, which lasted for a week, made airborne radioactive contaminants released to not only the USSR but also Europe [16]. Though the USSR paid great attention to this crisis and responded amazingly quickly, the result was still catastrophic. However, due to the USSR's concealing, it is hard to trace the exact number of direct deaths in this crisis [17]. According to a report from the World Health Organization (WHO), the estimated total number of death due to radiation exposure from the Chernobyl nuclear power plant accident is about 4000 deaths, and the number of people who suffer from radiation is countless. [18].

Apart from the safety concerns, another shortcoming of nuclear power is the high expense. Replacing fossil fuel power plants on a large scale would consume a considerable budget. The construction cost of each kilowatt capacity in an advanced nuclear reactor is $5,366. However, a new wind farm only costs $1,980 per kilowatt in construction [19], and traditional fossil fuel power plants are even cheaper.

Though nuclear power has the disadvantages discussed above, people should not neglect the advantages it has. Like the sword of Damocles, building more nuclear power plants has both risks and benefits. For the U.S. government, it is vital to make decisions with deliberation.

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