Research on Nuclear Energy and Fossil Fuels in China

LuDa Feng
Springboard International Bilingual School, Beijing, China
vivian.wang@cas-harbour.org

Abstract. After the courses about Energy and environmental engineering combined with current events, new energy is a very important research object which cannot be ignored. In China, fossil fuels are the major energy resources, it is cheap and high versatility, but when using fossil fuels, it will not only emit fine particles, but also destroy the ecological environment. Nuclear energy has many other advantages within the government's focus. This article analyzes the possibility that the nuclear energy can replace fossil fuels.

1. Introduction
China is decades of development leads to China’s full-blown coal mining technology that modern world craves. In China 1965, the fossil fuel consumption per capita was 2031 kWh, and this number grows to 23,373 kWh in 2019[1]. It can be seen that the domestic use of fossil fuels is very large, fossil fuels can be widely used also cheap. It has played an important role in China's rapid development for decades, but in these years it also brought a lot of shortcomings.

Fossil fuels usually including sulfur and toxic sulfur with a lot of dioxide will been made from fossil fuels when burned, the acid rain is also caused by excessive emissions and damaging the ecological equilibrium, after burning fossil fuels in large quantities, it will produce carbon particles, pollute the air and even cause respiratory diseases.

By comparison, the advantages of nuclear energy can be fully displayed, it is a kind of clear energy, then the nuclear power's energy efficiency are much higher than fossil fuels, at last the accident probability of nuclear energy is far less than that of fossil energy.

2. History and Essential Information of Nuclear Energy
The Technology of using Nuclear energy released by the splitting of atoms in some elements. And it first been found in the 1940s. In December 1942, the United States built the world's first nuclear reactor, but that time was during the Second World War, research initially focused on bomb making. In the 1950s, people's attention turned to the peaceful use of nuclear fission to control nuclear fission to generate electricity.[2]In the late 1960s and early 1970s, the economy of the developed countries was on the rise the urgent need for electricity and the consideration on fossil fuels, the situation made many country focused on another high efficiency energy, many developed countries such as The United States, Britain, France have formulated huge nuclear power development plans. By 2020s, it has been 80 years since the development and utilization of nuclear energy, at first, ignorance led to the use of it in war. Then, after two major accidents in the world, people began to pay more and more attention to nuclear energy and believe that it will become the major power of human in the future.

Nuclear energy that is released in significant amounts in processes that affect atomic nuclei, the dense cores of atoms. [3] The first way of it to release nuclear energy which is to conduct controlled nuclear fission in a method called a reactor, which is now used in many parts of the world to generate
electricity. Another way to get nuclear energy, controlled fusion, is promising, but not perfect by 2020. Nuclear energy is released by fusion and fission those two ways.

Uranium fission is a form of nuclear reaction in which a heavy nucleus splits into two or more smaller atoms, of which uranium fission is most common in nuclear power plants, and fusion is where lighter nuclei come together to release the energy of tuberculosis.[3]

3. Advantages of Nuclear Energy

In this part it is about nuclear energy’s impact, the influence to the environment is one of the important factors to measure that this kind of energy is not suitable for sustainable development, nuclear power as a clean energy it is much less harmful to the environment than fossil fuels. Nuclear is the world's second largest source of low-carbon power (29% of the total in 2017). Over 50 countries utilize nuclear energy in about 220 research reactors.[2] Nuclear power is especially favored by western countries, such as Germany and Britain. Because of many advantages of nuclear energy, some of wealthy western country begin to developing and trying to build more plants. The image below shows the World Electricity Production by Source 2017 and nuclear energy is 10.2 percent of that.
Due to the large demand of old coal-fired power plants in global, power generation accounts for the majority of China's pollution to air, which can be a powerful reason to increase the share of nuclear power. China emits the most carbon dioxide in the world, and become the largest emitter of carbon dioxide fora long time. Nuclear is a zero-emission clean energy source which means those energy not only does not discharge pollutants, but also can be directly used for production and living energy. It generates power through fission, which is the process of splitting uranium atoms to produce energy. The heat released by fission is used to create steam that spins a turbine to generate electricity without the harmful byproducts emitted by fossil fuels.[4] This means that the use of nuclear energy will not emit large amounts of fine particles or cause natural disasters such as acid rain, as fossil energy. Meanwhile nuclear energy is cleaner while generating electricity. Nuclear fission provides energy without releasing greenhouse gases such as carbon dioxide.[5] So in terms of its impact on air quality, nuclear power undoubtedly has more benefits.

The next problem is to disposal wastes. Fossil fuel combustion (FFC) wastes are the wastes produced from the burning of fossil fuels (i.e., coal, oil, natural gas). [6] Those large number of industrial wastes produced by fossil fuels are very cumbersome and troublesome when they are treated, a little improper treatment of those wastes will cause serious impacts. For example, the wastes dumped in the sea will damage coral reefs, cause damage to many marine organisms and even kill them. The wastes on land are also harmful. Toxic wastes will not only destroy the soil, but also cause damage to the surrounding plants. But the waste produced by nuclear energy is much less harmful than the former, the nuclear fuel has extremely dense, so the waste’s scale of nuclear energy is much more smaller than fossil fuel made. The United States is a good example of nuclear waste disposal, all of the used nuclear fuel produced by the U.S. nuclear energy industry over the last 60 years could fit on a football field at a depth of less than 10 yards![7] And the waste from the nuclear power plant’s fuels will be reprocessed and recycled if the government ask them to do it.

Then, the second advantage of the nuclear energy is it efficiency, nuclear energy is already one of the most efficient types of energy available today. Natural gas produces an average of 50 percent while coal produces energy at almost 59 percent. Wind power operates with a low 32 percent efficiency.[8] Compare to other clean energy that people use today, no of them will be as efficient as nuclear power. Among all the advantages of nuclear energy, energy efficiency is absolutely the most indispensable one. Because of the high density of nuclear fuel, nuclear energy can use less fuel to create more energy, making it more efficient than fossil fuel in many cases. A six gram uranium pellet contains the energy equivalent to 17000 cubic feet of natural gas, 149 pounds of oil, or in a ton of coal. Nuclear has a much higher energy output compared to its fuel intake. A single plant can even fuel an entire city.[9] Due to the powerful efficiency of nuclear energy, the Chinese government began to plan for the development of nuclear energy in the future, In July 2007, Westinghouse, along with consortium partner Shaw, signed the contracts with SNPTC, Sanmen Nuclear Power Company, Shandong Nuclear Power Company, China National Technical Import & Export Corporation (CNTIC) for four AP1000 reactors. These data show that although it started late and lacks experience, the Chinese government still attaches great importance to this kind of stable and efficient energy. China is a country with a large land area and a large population. Even many small cities have an increasing demand for energy, not to mention large chemical plants distributed all over the country. Therefore, it is a wise decision to prepare and develop nuclear energy as soon as possible before fossil energy is exhausted. Then in December 2007 the Chinese and US governments signed the intergovernmental agreement for the construction of AP1000 projects in China and technology transfer.[2] After signing the relevant orders with the United States, the Chinese government began to vigorously develop nuclear energy and try to build their own nuclear plant.
From this image, there are 12 operating nuclear plant in China, and the location of these nuclear power plants has a feature that is located in the southeast coastal area. Four of the yellow dots are located in inland areas. After the technology of nuclear power generation matures, it has become the second goal to develop inland areas. A pellet of nuclear fuel weighs approximately 0.1 ounce (6 grams). However, that single pellet yields the amount of energy equivalent to that generated by a ton of coal, 120 gallons of oil or 17,000 cubic feet of natural gas. [10] China is the country that consumes huge fossil energy, after changing the fossil fuels to nuclear fuels the efficiency will higher than before and the scale of fuel footprint will also be reduce. Another reason for building nuclear power plants around coastal cities is that some coastal cities in China are highly developed in industry, just as Dalian is known for its shipbuilding technology.

Researchers from the Chinese government have published numbers that show that the nation’s “nuclear capacity could more than double to 130 gigawatts by 2030” as summarized in a Bloomberg Green article from this week. [11] In the short term, people may not be able to achieve the pre-set target of nuclear power generation this year, but in the future, the sustainable development of nuclear energy, a high-efficiency energy source, is what we should plan most at present.

The third point is safety concern. On the topic of nuclear energy as a new energy source, the safety of nuclear energy is always discussed widely. When people see the advantages of nuclear energy, such as strong efficiency and almost zero emission, people will also worry about the harm caused by nuclear reactor accidents, these concerns are often due to several well-known nuclear power plant accidents, such as Chernobyl in the former Soviet Union and Fukushima in Japan, worst possible incident at a nuclear plant still tremendously less destructive than coal-mining incident. Comparing mortality from major energy sources. [12] In an article published in 2007, detailed data were given. The official death toll was 573. Nuclear energy is by far the safest energy source in this comparison – it results in more than 442 times fewer deaths than the ‘dirtiest’ forms of coal; 330 times fewer than coal. [13] These data of fossil fuels are still from developed countries. Compared with developing
countries, their technologies are more developed and their safety is higher. However, accidents still occur. In contrast, with the development of nuclear energy for 60 years, the technology is becoming more mature, and the probability of accidents is also declining.

![Death rates from energy production per TWh](image)

**Fig.4 Death rates from energy production per TWh[14]**

Cost is also an integral part of determining whether an energy source is suitable for the future. The average total cost of electricity generation includes operations, maintenance and fuels. Costs are reported in mills per kilowatt-hour where one mill equals $0.001 or one-tenth of a U.S. cent.[15] With the continuous exploitation of fossil energy, the price of both coal and natural gas resources will continue to rise. In order to avoid one of the reasons why the price of fossil energy is too high in the future, it is very necessary to prepare and plan the development of nuclear energy in advance, so we should accumulate experience as early as possible in case of unexpected needs.

4. **Some Disadvantages of Nuclear Energy**

The most serious problem of nuclear energy is the radioactive waste, unlike other waste the radioactive waste will produce a lot of radiation and is affected by both solid, liquid and gas. Another reason that most people are more concerned about is that although the maintenance of a nuclear power plant does not need too much cost, building a nuclear power plant often requires a lot of expenses and takes a long time to complete and put into use.

But is not hard to solve those questions in China, first the domestic laws will not allow the privatization of such complex and difficult projects as the process of building a nuclear power plant. Therefore, all the treatment of pollutants or nuclear waste will be carried out in strict accordance with the steps. It is unlikely that there will be nuclear waste pollution. Second, although China is still a developing country, Chinese have the ability to plan and implement the future development. What's more, it is not a state of energy shortage at present.

5. **Conclusion**

Compared with fossil energy, nuclear energy has advantages in the following three aspects: less impact on the environment (environmental pollution), higher efficiency and lower accident rate, while...
the disadvantages are high waste treatment and high cost, but there are solutions. The government's supervision and investment reduce the disadvantages of developing nuclear energy.

In the first part of this essay, gives the history and some basic information of nuclear and how does it work, decades of research on nuclear energy has given us enough experience to continue to develop it, the second part is about advantages of nuclear energy, clean, high efficiency and low death rates are all it’s strong points, the third part is the disadvantages of nuclear power like all other energy, nuclear is not perfect, it’s wastes are difficult to disentangle and the spend on build a single nuclear plant is really expensive, but with strict management and government support, these problems can also be solved.

China's use of nuclear energy has become more and more mature, and its application is more and more extensive. In the future, this new type of energy will replace the fossil fuel we use now. We must also be clear that nuclear energy is like a double-edged sword. While providing a high-efficiency and clean energy for mankind, it will also bring high cost and some difficult on solving wastes, but all those troubles can not stop up to explore and develop.

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