

**Forum:** Environment Commission

**Issue:** Evaluating and implementing the use of nuclear energy as a mean of electricity generation

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## Introduction

The United Nations Sustainable Development Goal (UNSDG) 7 aims to “ensure access to affordable, reliable, sustainable and modern energy for all”. As negative consequences of traditional energy generation increase in severity, the United Nations (UN) has placed a growing emphasis on finding and perfecting means of electricity generation that are more environmentally and economically sustainable. Of the many new types of energy generation, nuclear energy generation is among the most promising due to 1) its efficiency and 2) the lack of greenhouse gases emitted during its process.

As understanding of nuclear energy has evolved over time, countries across the globe have expressed growing interests in nuclear energy as a form of electricity generation. Indeed, 11% of the world’s electricity is currently generated by 450 nuclear power plants and that number is predicted to grow with the construction of 60 more nuclear power plants. Of the countries that generate nuclear energy, the United States leads with 805 TWh as of 2017.

As of now, the main form of nuclear energy generation comes from nuclear fission. In the case of nuclear fission, energy is generated in nuclear power plants through a process of splitting the nuclei of highly unstable substances (e.g. uranium). However, due to concerns about the sustainability and safety of the method, countries across the globe have begun to re-evaluate conventional processes of producing nuclear energy.

## Definition of Key Terms

### Sustainability

The UN Brundtland Commission defines sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” Particularly regarding the topic at hand, the United Nations defines sustainable energy as that that is “affordable and clean”.

### Nuclear Fission

Nuclear fission is the predominant way that nuclear energy is currently generated. During this process, neutrons are fired at unstable substances to generate heat from the splitting of the nuclei. This heat is then used to create steam and power a turbine to generate electricity. While processes of nuclear fission, along with those of nuclear fusion, do not produce any carbon emissions, many are concerned by the by-production of nuclear waste and the potentiality of various security issues.

### **Radioactive Contamination**

After the aforementioned substances are spent as means of fuel, they are disposed of and become nuclear waste. These largely radioactive materials (classified into low, intermediate, and high-level waste) are placed in spent fuel pools before transferred into permanent repositories. However, if not disposed of correctly, this nuclear waste can radioactively contaminate the surrounding area. Radioactive contamination remains one of the largest problems that the safe implementation of nuclear energy faces.

### **Nuclear Fusion**

Nuclear fusion is a process in which nuclear energy is generated by combining nuclei. Naturally occurring in stars, the nuclear fusion produces several times more energy than nuclear fission. Furthermore, no highly radioactive waste is produced in the process. Despite its benefits, however, processes of nuclear fusion are not yet viable sources of energy due to the large amount of energy required as input in the process of combining nuclei.

## **Background**

Though uranium was first discovered in 1789, scientists only began documenting the properties of radioactive material centuries later. In the late 1940s, scientists Otto Hahn and Fritz Strassman demonstrated an artificial atomic fission in Berlin. Later, scientists Lise Meitner and Otto Frisch calculated that the energy released from that fission was approximately 200 electron volts. As understanding of the processes of nuclear reactions and how to manipulate them advanced, some began considering the prospect of harnessing nuclear energy.

Returning from World War II (WWII), the Soviet Union and the United States began developing technologies to transform nuclear energy into electricity competitively. In the December of 1951, the Argonne National Laboratory—sited in Idaho—created the first nuclear reactor to produce electricity. While in the Soviet Union, the BR-1 fast neutron reactor began operating and was continuously improved upon. As time progressed, however, countries such as Canada, France, the United Kingdom, and Kazakhstan all began developing nuclear reactors.

Arriving at the present day, the harnessing of nuclear energy as a mean to produce electricity has become widespread globally as the technology has become more mature. In 2017, 13 countries across the globe use nuclear energy to support at least a fourth of their total energy. In particular, Hungary, Slovakia, and Ukraine produce more than half of their electricity by harnessing nuclear energy. This widespread interest in nuclear energy is owed to its many unique advantages.

## Advantages of Nuclear Energy

Nuclear energy is dissimilar to traditional and modern means of electricity generation alike due to the unique combination of its economic and environmental sustainability.

### *Environmental sustainability*

Unlike traditional sources of energy that rely on chemical processes to generate electricity, most notably fossil fuels, nuclear energy processes do not intrinsically generate harmful waste products like air pollutants and greenhouse gases. Even taking into consideration the amount of harmful waste products involved in the secondary processes of producing nuclear energy (e.g. transportation), nuclear remains a much cleaner source of energy. The Nuclear Energy Institute states that, with the implementation of nuclear power, predicted levels of NO<sub>x</sub> and SO<sub>2</sub> (harmful air pollutants) in the US has been reduced by more than 29 percent. Furthermore, from 1990 to 1995, states in the US reduced their greenhouse gas emissions by 37 percent by expanding nuclear energy generation by 16%.

### *Economic sustainability: input to output efficiency*

Nuclear energy also has substantial advantages over other forms of clean energy, including solar, hydro-electric, wind, and geothermal energy, due to its high input to output efficiency. In particular, nuclear energy produces more electricity per unit of land than any other form of clean energy. Though nuclear reactors are costly to build, running them is relatively inexpensive. With few regional exceptions, nuclear energy generation is cost-competitive with traditional means of energy generation.

In particular, the levelized cost per unit output (LCOE) of nuclear energy remains amongst the lowest in countries such as France, Republic of Korea, the UK, and the US—in comparison to popular alternatives such as gas, wind, coal, and solar.

## Problems with nuclear energy

Despite its many advantages over alternative forms of energy, the widespread implementation of nuclear energy generation should be re-evaluated on the grounds of its high initial costs, potential for radioactive contamination, and non-renewability.

### *High initial costs and barrier of entry*

Compared to more established means of energy generation, nuclear energy requires both substantial expertise and financial capital in order to ensure the successful construction and running of nuclear reactors. This makes establishing nuclear energy as a means of electricity generation in LEDCs exceptionally difficult and unappealing. While organizations such as the International Atomic Energy Agency (IAEA) and other member states such as the Russian Federation and the People's Republic of China have offered both intellectual and financial help to developing countries regarding nuclear energy, much more international cooperation is needed to implement it.

### *Nuclear accidents and radioactive contamination*

Though exceptionally rare, nuclear accidents can devastate the surrounding area for an extended amount of time by radioactively contaminating it. In particular, the Fukushima and Chernobyl nuclear accidents are the most cited in discussions of safety concerns of nuclear power plants. Large-scale nuclear power plant malfunctions—such as that of Chernobyl—dispense the radioactive material in the plant to the surrounding area. Exposure to such material may cause long-term health issues in the residents of the area as well as mutate plant and animal life. Indeed, the Chernobyl accident caused 30 fatalities and approximately 4,000 cases of thyroid cancer. Nonetheless, direct fatality rates from nuclear energy remain the lowest amongst any other major source.

Another concern regarding the potentiality of radioactive contamination is the current lack of permanent repositories for nuclear fuel waste. Usually in the form of spent fuel, high-level nuclear waste is first deposited into large pools to cool down before being disposed of permanently. However, despite the growing number of nuclear reactors, many countries still lack permanent repositories for the waste products. As an example, many spent fuel pools in the US house more than five times the amount of nuclear waste they were designed to hold.

## **Major Parties Involved**

### **International Atomic Energy Association (IAEA)**

Founded in 1957, the International Atomic Energy Association is heavily involved with the United Nations in resolving problems related to nuclear technology. Among the largest of nuclear-related, non-partisan international organizations, the IAEA aims to promote the peaceful implementation of nuclear technology by assisting member states with both monetary and intellectual aid. In particular, the IAEA is heavily aimed towards the upkeeping of safety regulations in nuclear reactors across the globe. It currently has a membership of 171 nation states.

### **World Nuclear Association**

The World Nuclear Association is an international organization aiming to represent the global nuclear energy industry. This association promotes the implementation of nuclear energy by providing authoritative information and fostering debate in order to establish consensus within the industry. The membership of the World Nuclear Association is comprised of companies across the globe involved in different steps of the nuclear supply chain (e.g. research, reactor construction, and disposal).

### **World Association of Nuclear Operators (WANO)**

The World Association of Nuclear Operators is a non-partisan international organization that aims to maximize “the safety and reliability of power plants worldwide” (WANO) amongst its members of both private companies and entire nation states. Founded after the occurrence of the Chernobyl nuclear accidents, the WANO

exists to ensure that such devastations be prevented in the future through “mutual support, exchange of information, and emulation of best practices” (WANO).

## France

Deriving 75% of its energy from nuclear energy, France is leading nation in nuclear power. Nuclear energy is not only used in France to support its national energy usage but is also exported to nations across the globe. In fact, France is the world’s largest net exporter of electricity because of its prevalent use of nuclear energy. France’s heavy dependence on nuclear power originates from its history of engineering expertise combined with a lack of other sources of energy (e.g. fossil fuels). However, despite the success this country enjoys as a result of nuclear energy, its government policies dictate that the amount of energy it derives from nuclear energy would drop to 50% by 2015.

## Japan

Similar to the case of France, Japan is also faced with the geographical obstacle of lack of conventional energy stores. As a result, Japan has historically relied heavily upon energy imports. As a means to establish energy independence, Japan began developing its nuclear energy technology by the later decades of the 20<sup>th</sup> century. While its usage of nuclear energy as a means of electricity generation increased over the decades, its prominent seismic activity has proven to be an obstacle for the security of its 37 currently operable reactors. Indeed, after 2011 Fukushima incident, Japan’s reliance on nuclear energy dropped. However, its reliance is expected to increase in future years as 17 Japanese reactors are currently undergoing the process of restart approval.

## Previous Attempts to Resolve the Issue

One of the main issues with nuclear generated energy is the concern of safety. The well-known events that have to do with nuclear power include Chernobyl and Fukushima. In order to prevent further events like the Fukushima event, power plants are being created so that they are more resistant to natural disasters such as tsunamis and earthquakes.

Most nuclear power plants are located near large bodies of water due to the need of a coolant. In order to prevent further cases of meltdowns cause by natural disasters such as floods, multiple flood barriers would be placed wherever possible. Another aspect of safety that should be considered is the disposal of nuclear waste that is produced as a result of nuclear power generation. A method for solving the issue of nuclear waste disposal that was previously attempted was to select viable candidates where nuclear waste disposal could be done. The UN or the government of each countries would select locations appropriate for either deep geological disposal or other containment/storage methods. The problem with this method was that people do not want nuclear waste near where people live. In the case of Yucca, the Yucca mountains were selected as a viable candidate for where nuclear waste could be stored using the method of deep geological

disposal. However, the mountains were not used to store nuclear waste as a result of the people disagreeing with nuclear waste disposal occurring in the Yucca mountains. Another method was when Germany tried to cut down the usage of nuclear electricity generation and shut down many of its power plants. The result was that although the amount of money invested in other clean energy resources increased the total efficiency and return of economic profit was less than that of other countries that continued to use nuclear energy.

Despite these attempts, however, the UN's involvement with the global industry of nuclear energy is largely restricted to its support for the IAEA. In other words, instead of directly assisting member states regarding issues on nuclear energy, the UN monitors and validates the actions of the IAEA. Examples include the following resolutions:

- A/72/L.6
- A/72/221

## Possible Solutions

- Nuclear energy is, as a resource very valuable. Perhaps the most valuable renewable energy resource existing in the current world. Largely there are two ways to address the problem of nuclear energy. One would be to try to abandon the idea altogether and invest in other energy resources. This solution may be more effective and safer. This is because Nuclear energy produces waste that we do not know how to effectively store or get rid of.
- Waste that are produced as a result of nuclear power generation is usually toxic and radioactive. There are methods that have been developed that enable humans to store these radioactive wastes in containers. Another method that could be used and is acknowledge as one of the best methods is deep geological disposal. Deep geological disposal is a method where one buries the waste deep into the ground or more often underneath a mountain. For instance, in the case of America, the Yucca mountains. The Yucca mountains were a case where it was one of the best places where deep geological disposal could be applied. A problem with this method of storage was that it wasn't guaranteed to be able to keep nuclear waste stored for as long as it would take for the waste to decay and that not a lot of people want to place radioactive waste near where they live.
- The other method would be to abandon nuclear energy as a mean electricity entirely. The problem with this method is that there are not many clean sources of energy that provide as much electricity as nuclear. Other statistics show that although clean energy sources are cleaner than that of means such as coal, they still produce some amount of carbon. Compared to that nuclear energy produces much less and is a cleaner source of energy as a result. The most widely used clean energy resource is solar and wind power. The problem with this is that the amount of energy that is produced as a result of these energy resources is not

constant. The amount of energy that is produced through solar energy largely depends on how sunny the weather is at that time. With the case of wind power, the amount of energy varies depending on how windy the weather was at that time. If the weather is not windy enough the amount of energy produced is not enough to supply the amount of minimum energy required.

- The high cost of the initial installment of nuclear power plants is another issue that must be solved in order to improve nuclear as a mean of electricity generation. This could be resolved by reducing regulatory risks or reducing how often these regulations change. These regulations will often change during construction of the power plants. This often delays and can, in the worst-case scenario, render the plant useless. However, when regulations are changed during constructions, they will most often raise the overall price of the installment of the power plant. Therefore, in order to lower the cost of nuclear power plants, political problems and regulations such as this could be resolved as a method to lower the cost of the nuclear power plant.

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