Committee: United Nations Environment Programme

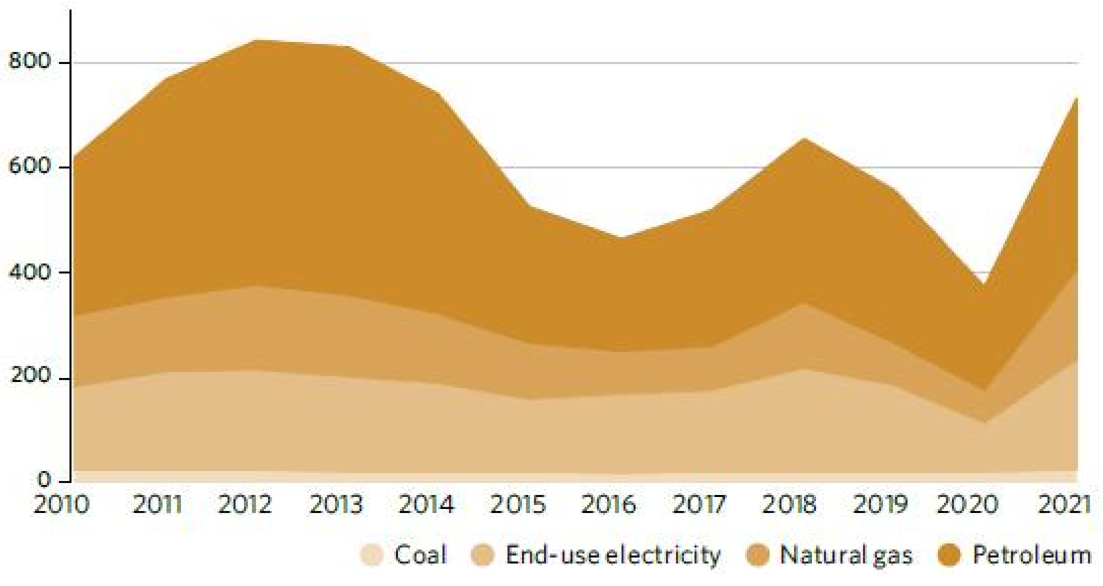
Topic: The question of Implementation of Atomic Energy for Sustainable Development

Student Officer: Eun Seo Lee

Position: Head Chair of UNEP

Introduction

A development agenda for the next 15 years was adopted by all United Nations Member States in September 2015 with the goals of combating extreme poverty, promoting equality, safeguarding the environment, and overall ensuring that by 2030 humanity exists in peace and prosperity. The 17 SDGs (Sustainable Development Goals), which tackle the most significant issues of our day, form the core of the agenda. The foundation of the SDGs regarding energy is the production and use of energy in ways that promote long-term human development in all of its social, economic, and environmental aspects. Consequently, for the world to achieve the SDGs, particularly the 13th goal, "Climate Action," a reliable source of energy that can produce a sizable amount of clean energy and minimize emissions of greenhouse gasses is required.

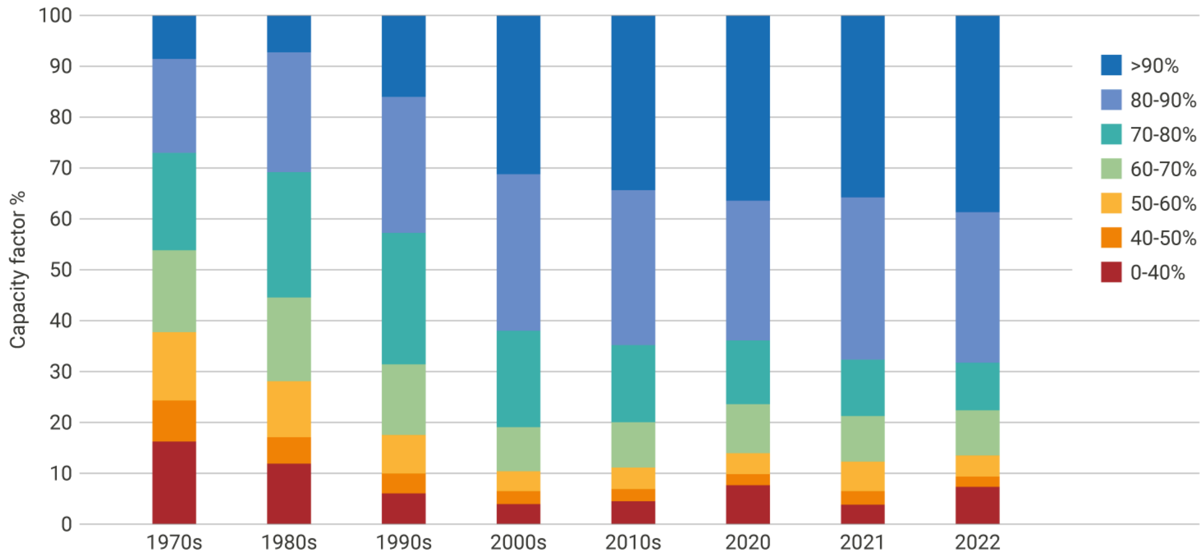


Global estimates of fossil fuel subsidies, by fuel type, 2010–2021, billions of dollars, nominal value (United Nations, 2023)

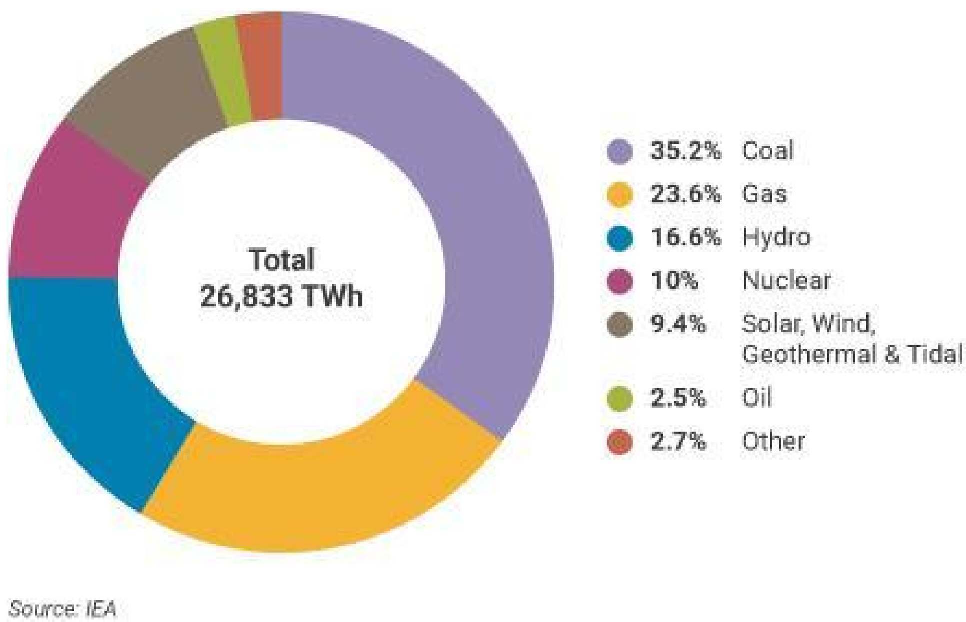
However, the rate of natural resource extraction has accelerated since 2000, and the world's reliance on fossil fuels remains remarkably high, with the world spending $423 billion annually to subsidize fossil fuels for consumers. Additionally, the global material footprint has drastically increased from 43 billion metric tons in 1990 to 54 billion in 2000, eventually reaching 92 billion in 2017. The excessive use of fossil fuels has resulted in greenhouse gas emissions being more than 50% higher than in 1990, accelerating climate change. These fossil-fuel-related emissions are also responsible for almost 65% of the excess mortality rate that is linked to air pollution. Despite these statistics, burning fossil fuels produces more than half of the electricity that people use today.

Fortunately, a number of countries have turned their attention to atomic energy, a relatively new energy source that first emerged in the 1930s and has the potential to be a dependable, sustainable, and environmentally friendly energy source. Nations have realized that for the purpose of eliminating humanity's reliance on raw materials and offering people reliable access to power, it is critical to emphasize the use of nuclear energy. However, disadvantages still exist to make countries reluctant to introduce nuclear energy. These include the challenging management of nuclear waste, the opposition of the public due to safety issues, and while it is cheap to operate, it is far more costly to construct a nuclear power plant than other energy sources. Due to these distinct advantages as well as disadvantages, the implementation of nuclear energy has been a source of contention among individuals for decades.

However, as of 2023, 413 nuclear reactors are in operation in 32 nations, and 58 more nuclear facilities are being built. Although there are impediments to overcome, different nations throughout the globe have conceded that atomic energy is undeniably one of the most efficient greenhouse-gas-free energy sources that need to be developed internationally. As a result of persistent research and investment, nuclear reactor performance has also significantly enhanced over time resulting in the percentage of reactors reaching high capacity factors increased dramatically during the previous 40 years. The development of atomic energy has been the focus of various nations, including the LEDCs (Less Economically Developed Countries), in response to concerns regarding various social and environmental aspects. In March 2024, The EU (European Union) and leaders of over 30 nations gathered in Brussels, Belgium for the first-ever Nuclear Energy Summit. In addition, the Roadmaps to New Nuclear meeting, which the NEA (OECD Nuclear Energy Agency) is hosting in Paris, France in September 2024, will assist in guiding choices on investment and policy for the long-term operation of the nuclear reactor's capacity.



Long-term trends in capacity factors (World Nuclear Association, IAEA PRIS, 2024)



World electricity production by 2020 (World Nuclear Association, 2024)

Definition of Key Terms

Sustainable Development Goals

The Sustainable Development Goals, or SDGs for short, which consist of 17 interconnected global goals, are the blueprint to a better and more sustainable future for all individuals. They tackle the most severe issues that the world is facing, such as those pertaining to poverty, inequality, the environment, climate change, peace, and justice. The SDGs were ratified by all United Nations members in 2015 in order to resolve all challenges by 2030.

Atomic Energy

Atomic energy, or nuclear energy is the second-largest source of low-carbon power worldwide which is generated by the release of an atom's nucleus or core. There are two ways to generate atomic energy: fusion, which occurs when nuclei fuse, or fission, which occurs when atoms divide into different parts. As the steam that was emitted during the process is used to spin the turbines and generate electricity, no fossil fuel byproducts are produced. Approximately 10% of electricity generated worldwide comes from nuclear power, and in developed nations, that percentage rises to nearly 20%.

Uranium

Uranium, a radioactive element that occurs naturally, releases energy as it decays over time. Due to its special properties, uranium serves as the primary fuel source for nuclear reactors. There are 3 natural isotopes of uranium: U-234, U-235, and U-238. The majority of nuclear reactors run on U-235 fuel. Approximately 500 times more frequent than gold, uranium is one of the more abundant elements in the Earth's crust and among those, U-238 makes up 99% of them. Approximately three-quarters of the world's uranium mining production comes from Kazakhstan, Canada, and Australia. Yet, uranium mining needs to be done cautiously with advanced technology as it is likely to have negative effects on the environment.

Nuclear Fission

Nuclear fission is the most common method to produce atomic energy. This procedure includes the division of the atom's nucleus into two or more smaller nuclei while releasing energy. For instance, the nucleus of an atom of uranium-235, or in short terms, U-235 splits into two smaller nuclei and two or three neutrons when struck by a neutron. In a matter of seconds, a chain reaction will be set off when these extra neutrons strike nearby U-235 atoms, which will then split and produce more neutrons through a multiplication effect. Each time the reaction occurs, energy is released as heat and radiation. This heat and radiation are used to generate electricity.

Greenhouse gas

The term "greenhouse gasses" refers to gasses that trap heat in the atmosphere, and as its name implies, these gasses function similarly to a greenhouse's glass walls. The main components are water vapor, carbon dioxide, and methane. When greenhouse gasses are re-emitted to the Earth's surface, the greenhouse effect happens. As this effect is causing greenhouse gas emissions to cover the Earth and trap solar radiation, it results in climate change and global warming. Greenhouse gasses grew by 49% between 1990 and 2022, with Carbon Dioxide contributing to about 78% of this increase.

Radioactive waste

Radioactive waste, commonly known as nuclear waste, is a byproduct of creating or utilizing radioactive elements, in sectors such as mining, nuclear power generation, and defense production. Three broad categories can be used to classify radioactive waste: low-level waste (LLW), which includes items like paper, tools, and clothing, intermediate-level waste (ILW), which has higher radioactivity and needs some shielding and high-level waste (HLW), which is extremely hot and radioactive due to decay heat and needs cooling and shielding. This hazardous waste contains highly toxic chemicals that can cause different diseases in humans when exposed such as cancer. Therefore it must be carefully managed.

Fuel Cycle

A nuclear fuel cycle is an industrial process that produces electricity from uranium in nuclear power reactors. The cycle is carried out in the following order: mining and milling of uranium, conversion, enrichment, fuel fabrication, electricity generation, spent fuel storage, and disposal of spent waste. Following excavation, the uranium ore is crushed and subjected to a chemical separation process known as milling. After uranium oxide turns to powder, it undergoes a procedure known as conversion to transform it into a form appropriate for enrichment. Since U-235, the most used type of uranium isotope, makes up just 0.71% of natural uranium, it is necessary to increase its concentration, this process is referred to as enrichment. U-235 atoms eventually split apart to produce heat and steam, which turn into electricity. After three to five years, spent nuclear waste is often kept under water or dry, or it can be combined with plutonium and recycled into new nuclear fuel.

Nuclear reactor

Any class of devices capable of starting and managing a self-sustaining series of nuclear fissions is referred to as a nuclear reactor. They are also called the hearts of a nuclear power plant. Pressurized water reactors (PWRs) and boiling water reactors (BWRs) are the two primary types of reactors with capacities often exceeding 1000 MWe. These nuclear power plants are high-cost to build but relatively affordable to operate. In contrast with these traditional and large-scale reactors, Small modular reactors (SMRs) are a relatively modern design that can have a power capacity of up to 300 MWe per unit. As these reactors are smaller in size they can be built in off-site construction and on-site assembly, potentially reducing construction times and costs. Due to its advantages several established and emerging nuclear energy nations are carrying out research and development on SMRs, and there are presently 4 SMRs in advanced phases of construction in Argentina, China, and Russia.

Nuclear Power Plant

A nuclear power plant, often known as an atomic power station, is a type of thermal power plant that generates electricity by driving massive turbine blades with steam. While nuclear reactors are machines that release heat formed during nuclear fissions, nuclear power plants utilize the heat produced by nuclear reactors to transform water into steam, which is then used to generate energy.

Nuclear meltdown

The worst-case situation for a nuclear power station is a nuclear meltdown, which can discharge lethal amounts of radiation hundreds of miles away and affect living beings. Reactor meltdowns happen when the fuel isn't properly cooled. This causes the reactor’s fuel temperatures to rise to the point of melting when the chain reaction is uncontrollable. Most nuclear power plant accidents are caused by the nuclear meltdown, most famously the Chernobly and Fukushima incidents.

Background Information

The Advantages and Disadvantages of Atomic Energy

In contrast to other renewable energy sources like solar and wind, which rely on the weather, nuclear power is capable of providing electricity reliably and constantly with little interruption as their facilities have a high capacity factor of about 90%. Atomic energy is also anticipated to assist all interested parties in accessing reasonably priced energy services in the near and distant future. It is known that 88 tons of coal are needed to provide power for a lifetime of energy use, whereas only 1.1 kilograms of uranium fuel would be needed to get the same amount of energy. Considering that 1.1 billion people do not have access to electricity and 2.9 billion people lack clean cooking facilities, an energy source that can produce constant energy at a reasonable price is an ideal solution for nations that are currently combating poverty. Furthermore, radioactive waste generated during the production of atomic power can be recycled and reprocessed in order to create new nuclear fuel.

The management of nuclear waste has the potential to make atomic energy genuinely environmentally friendly, yet it is still very demanding. Public opposition leads to complications in site selection, and it also requires a lot of financial resources to construct and sustain secure storage facilities. Perhaps the biggest reason why the public hesitates to use atomic energy is fear of nuclear power plant incidents. Two of the most tragic incidents, the Chernobyl disaster in 1986 and the Fukushima Daiichi nuclear disaster in 2011, have resulted in a lasting negative impact on human health and extensive environmental damage, which eventually required nations to take countermeasures to protect the public. Finally, while operating and maintaining a nuclear power station is inexpensive, nuclear power plants have substantially greater capital costs than other energy sources like coal and natural gas. This is because nuclear power plants are technically complicated and must meet strict licensing and design standards. Therefore, it is crucial for nations, especially developing nations to receive assistance from different organizations and other nations with advanced technology.

The Historical Development of Atomic Energy

Nuclear fission was discovered in 1938 by a German Chemist, and on December 2, 1942, at the University of Chicago, the Manhattan Project successfully created the first chain reaction in history. But the first time nuclear power was used to create energy was on December 20, 1951, when the Experimental Breeder Reactor I (EBR-I) in Idaho, US successfully generated energy, a few years after the end of World War II. The primary areas of interest for nuclear power research and development in the 1950s were submarine propulsion and civilian electricity generation technologies. 1954 saw the first achievements in both civilian power generation and submarine propulsion. The largest regional power-generating business in the Russian Federation, Mosenergo, connected a reactor located in Obninsk, Russia, to its grid on June 26, 1954. Additionally, the USA (United States of America)'s first nuclear submarine, the Nautilus, started using nuclear power in December 1954. A significant factor in the early proliferation of nuclear power was a newfound openness and interaction between nations following the war, largely brought about by a United Nations meeting in 1955 that became known as "The First Geneva Conference." It confirmed to a large audience that a variety of uses for nuclear energy were now possible and removed the veil of secrecy surrounding nuclear research during the war.

Nonetheless, there was some stagnation and decrease in the nuclear power sector starting from the late 1970s. The Three Mile Island accident, the first significant accident at a civilian nuclear power plant that happened in the US on March 28, 1979, resulted in a rise in environmentalism, and anti-nuclear sentiment. However, because of improved load factors and capacity increases, production rose by 60% and capacity by over one-third, and by the late 1990s, the first of the third-generation reactors had been commissioned.

The prospects for nuclear power have been revived in the new century by a number of factors. The first was the realization of how much more electricity is expected to be needed globally, especially in nations that are developing quickly, such as nations in Asia. The understanding of the significance of energy security came in second. The necessity to restrict carbon emissions as a result of worries about climate change came in third. The international enhancement of nuclear safety has also been significantly influenced by the extensive interchange of information between nations, particularly on operational safety experience. Thus, the origins of nuclear power can be traced back to European science, which then grew in the United Kingdom and the USA thanks to their combined scientific and economic might. After a few decades of stagnation, nuclear power has experienced a new boom in Asia, especially East Asia. In doing so, more than 17,000 reactor years of operation have been collected, contributing significantly to the global electricity supply.

Nuclear Waste Management

It is known that roughly 97% of radioactive waste can be utilized as fuel for specific kinds of reactors. In order to safely dispose of nuclear waste, it needs to be properly treated. Nuclear waste is processed in three basic steps: conditioning, treatment, and pre-treatment. Pre-treatment, which gets the waste ready for processing, includes sorting and segregating contaminated from non-contaminated materials. Following appropriate preparation, the waste must be treated to improve safety and lower expenses for subsequent stages of management, including disposal or storage. Treatment procedures often involve isolating the radioactive component from the bulk waste, which lowers the amount of radioactive waste. The burning of solid waste and the evaporation of liquid waste are two common forms of treatment. To transport, store, and dispose of the waste, the third stage, conditioning, transforms it into a controllable, stable, and safe state.

The IAEA (International Atomic Energy Agency), supports its member nations in setting up appropriate safety protocols for the handling of spent fuel and radioactive waste. It creates safety guidelines for radioactive waste predisposal management and assists member states in implementing them. One of the five IAEA Safety Standards Committees, the Waste Safety Standards Committee is also coordinated by the Agency.

Major Nuclear Power Plant Incidents

Since 1952 there have been 14 meltdowns of varying severity at both commercial, military, and experimental reactors. The top two most disastrous meltdowns include Chernobyl in 1986, and Fukushima Daiichi in 2011. Nuclear power plant accidents result in one of the most severe outturns as the consequences can persist for hundreds of years.

It is important to remember that a nuclear meltdown isn't a singular tragic event as is often the case with natural disasters. One of the most known instances is the Fukushima accident which happened when a sequence of tsunami waves hit the plant, taking out the systems that were necessary to cool the nuclear material. There weren't any core explosions at Fukushima, instead, the cores melted and heated more gradually over a far longer time frame. The Japanese government has taken proper precautions and acted quickly, ordering the evacuation of residents and stopping the import of supplies. In order to shield people's glands from radiation exposure, the authorities also gave out potassium iodide. By taking these steps, the accident's negative health repercussions were minimized. Consequently, according to the report of the World Health Organization(WHO) and the United Nations(UN) in 2013, there were very few health risks associated with the radiation emitted during the Fukushima accident, and no radiation-related deaths occurred during the tragedy.

Contrary to the Fukushima incident, human mistakes combined with a defective reactor design caused the Chernobyl accident. This accident emitted around ten times as much radiation as the Fukushima accident. This is because, at Chernobyl, the discharge began with an in-core steam explosion caused by a nuclear criticality accident. Because of this, radiation had clear, open paths and emissions were unrestricted which led to much more severe consequences for both people and the environment. In addition, the Soviet Union's authorities took a while to take action to safeguard the food and milk supplies, which caused a surge in thyroid cancer cases among children and teenagers who ate food that was contaminated. By 2005, about 15 children had lost their lives to thyroid cancer.

Treaty on the Non-Proliferation of Nuclear Weapons (NPT)

The Treaty on the Non-Proliferation of Nuclear Weapons or NPT for short is a historic international agreement, whose objectives are to stop the proliferation of nuclear weapons and related technology and to encourage collaboration in the peaceful uses of nuclear energy. The treaty came into force in 1970 after being made available for signature in 1968 and it was perpetually extended on May 11, 1995. Five nuclear-weapon states are among the 191 states that have ratified the treaty. Under the NPT, the IAEA (International Atomic Energy Agency) conducts on-site inspections to ensure that nuclear materials are solely utilized for peaceful purposes

123 Agreements

The "Cooperation With Other Nations" section of Section 123 of the United States Atomic Energy Act of 1954 stipulates that any nuclear agreement between the US and any other country must first include a cooperation agreement. This type of agreement is referred to as a 123 Agreement and it is about cooperation for peaceful uses of nuclear energy. With 48 nations, the United States has signed about 23 123 Agreements to date. Among those agreements, the Indo-US nuclear deal, a 123 Agreement signed between the United States of America and India is the most renowned agreement due to the fact that civilian nuclear trade is now allowed between the US and India, a country that has not signed the NPT (Treaty on the Non-Proliferation of Nuclear Weapons).

The International Atomic Energy Agency (IAEA)

The International Atomic Energy Agency or IAEA is the world's leading intergovernmental system for scientific and technological collaboration in the peaceful use of nuclear energy. IAEA was founded in 1957 as an independent international body under the United Nations system and is currently working with its 164 Member States and other international partners. The agency is comprised of 5 safety committees: Emergency Preparedness and Response Standards Committee (EPReSC), Nuclear Safety Standards Committee (NUSSC), Radiation Safety Standards Committee (RASSC), Transport Safety Standards Committee (TRANSSC), and Waste Safety Standards Committee (WASSC). Despite not being a party to the NPT (Treaty on the Non-Proliferation of Nuclear Weapons), as the international safeguards inspectorate, the IAEA is given important verification authority under it. By the end of 2014, the IAEA had installed safeguards in around 1300 facilities and was protecting over 190,000 large quantities of radioactive materials.

International Framework for Nuclear Energy Cooperation (IFNEC)

The International Framework for Nuclear Cooperation (IFNEC), which developed from the former Global Nuclear Energy Partnership (GNEP), brings together 64 members and 6 international organizations with the goal of the safe, reliable use of nuclear energy for peaceful purposes. The IFNEC is composed of 5 groups: the Steering Group, the Infrastructure Development Working Group (IDWG), the Reliable Nuclear Fuel Services Working Group (RNFSWG), the Nuclear Supplier and Customer Countries Engagement Group (NSCCEG) and the Technical Secretariat.

The OECD Nuclear Energy Agency (NEA)

The OECD Nuclear Energy Agency (NEA) is an intergovernmental agency that facilitates cooperation among countries with advanced nuclear technology. NEA membership consists of 34 countries, representing 82% of the world's installed nuclear electricity generating capacity, yet Russian membership is currently suspended. The NEA also established NEA Nuclear Safety Research Joint Projects Week to honor the numerous successes that the global community has made possible through these initiatives over the past 40 years.

Possible solutions

Educate and raise public awareness

Educating the public is a vital first step in eliminating public opposition. By engaging with the public, the government could address misconceptions among citizens that are intercepting the implementation of atomic energy. By providing scientifically accurate and transparent information through educational programs, campaigns, or social media, nations can combat this misinformation. Focusing on the perception of the public could strengthen trust and encourage citizens to recognize the potential of atomic energy.

Address the risk of nuclear proliferation

When it comes to the implementation of nuclear energy, addressing the risk of nuclear proliferation, and the spread of nuclear weapons or technology is an essential stage in order to maintain the world's peace. There are two main ways to ensure the peaceful use of atomic energy: strengthen existing treaties and guidelines or establish new ones. Some existing treaties aimed at prohibiting the use and manufacturing of nuclear weapons include the NPT (Non-Proliferation Treaty), CTBT (The Comprehensive Test Ban Treaty), and FMCT (Fissile Material Cut-off Treaty). Additionally, nations could cooperate with organizations and associations such as the IAEA and NSG (Nuclear Suppliers Group) to monitor the use of nuclear technologies.

Funding research programs

To develop nuclear energy research and prepare the upcoming generation of nuclear energy leaders, it is vital for the government to provide incentives and subsidies to research programs and R&D (Research and Development). For instance, the Office of Nuclear Energy has awarded $59.7 million to 25 USA colleges and universities, two national laboratories, and one industry organization. Federal investments are crucial as they allow and support consistent research which would eventually contribute to enhancing the safety, technology, efficiency, and sustainability of atomic energy. Nowadays, a lot of financial resources are going into research efforts to develop new types of nuclear reactors, such as Small Modular Reactors or next-generation nuclear reactors.

Create regulations on nuclear waste management

Proper nuclear waste management is critical to preventing the release of radioactive material and radiation from resulting in significant environmental damage and health risks, hence all wastes are regulated. However, despite the fact that no radioactive waste is allowed to cause pollution, due to high cost there are several cases of spent fuel being improperly discarded. For instance, from 1946 until 1970, the United States disposed of low-level radioactive waste in the ocean. Therefore, nations must strictly restrict the improper disposal of nuclear waste internationally. When creating regulations, nations must keep in mind that wasted fuel is typically stored underwater for at least 5 years before staying dry, and deep geological disposal is widely agreed to be the best solution. Nations could also collaborate with organizations such as the IAEA or NEA to find proper ways to manage these wastes or strengthen existing standards such as the EU's legal framework for waste management (Council Directive 2011/70/EURATOM).

Create safety standards for uranium mining

Uranium mining has a widespread effect on the environment and human health due to its radioactive dust. Additionally, uranium waste can be radioactive for thousands of years which means that mining sites can be dangerous even after operations have stopped. On top of that, uranium mining is also the first step in the development of nuclear weapons. As a result, frameworks and standards for uranium mining should be implemented. Different organizations such as the IAEA and the World Nuclear Association are already providing guidelines for mining methods. Nations could utilize the already existing criteria or create their own depending on their situation.

Collaborations between nations

Cooperating with one another is one of the most effective ways nations could accelerate their technological advancement. International collaboration allows the exchange of experience, technology, knowledge, resources, and expertise. Nations could foster their relationship in ways such as establishing a framework, signing an agreement, hosting or joining a conference, and creating or strengthening an organization. Through these methods, nations could leverage collective efforts to achieve global objectives.

Furthermore, partnerships between MEDCs and LEDCs can enable LEDCs, which typically lack financial resources and advanced technology, to receive assistance from MEDC nations. In order to lessen their dependence on fossil fuels, a number of developing countries, like Bangladesh, Brazil, and Egypt, intend to build nuclear power plants, yet, constructing a nuclear power plant independently would cause a financial burden to these nations. Therefore, it is crucial for developed nations, such as the USA, Russia or China to foster partnerships with developing countries and provide them with financial and technical assistance. In fact, these kinds of relationships frequently result in broader trade agreements. This is mainly because uranium doesn't exist in every country. For instance, Pakistan and China partnered together to complete Pakistan's nuclear power facility in 2021, and as a result, the two countries have signed a new trade agreement. These cases benefit both sides as developed countries are permitted to exchange more minerals and developing nations receive aid.

Construct Small Modular Reactors (SMRs)

Small modular reactors, or SMRs, are a relatively modern type of nuclear reactor that employs fission to generate heat, much like traditional nuclear reactors. Yet they are far smaller in size, have improved safety measures, and exhibit greater flexibility than traditional large-scale reactors. On top of that, these innovative technologies could potentially provide power to smaller electrical grids and remote, off-grid locations. SMRs can be utilized on small grids where power output requirements are typically less than 300 megawatts (MWe) per facility; this can power about 300,000 houses. SMRs can also be used in edge-of-grid or off-grid applications with low power requirements ranging from 2 to 30 MWe. These properties allow SMRs to be scaled according to demand which enables them to energize for local settlements or diverse industrial purposes. Since these reactors minimize upfront capital costs and allow for more customizable energy solutions, they may address some of the major drawbacks of traditional reactors, ultimately providing countries, particularly emerging countries, with a new answer.

Construct Next-Generation Nuclear Reactors

Next-generation nuclear reactors, commonly known as generation IV reactors, are nuclear reactor design technologies intended to outperform generation III reactors. While many other types of reactors are being developed, only six are currently accepted. These include supercritical water-cooled reactor (SCWR), lead fast reactor (LFR), sodium fast reactor (SFR), molten salt reactor (MSR), gas fast reactor (GFR), and the very-high-temperature reactor (VHTR). All generation IV reactors are designed to improve safety, use fuel more efficiently by co-generating low-emission electricity while producing high-temperature heat, and minimize waste management. Although there are several technical issues to overcome, these new form of reactors aims to deal with the current challenges and deliver a far more safe and sustainable nuclear technology.

Implement a Passive Safety System

A passive nuclear safety system is a design concept for safety elements in nuclear reactors that do not require active human involvement or external power to achieve a safe shutdown condition. Recently, modern nuclear reactor types have been designed with a passive safety system that enables them to shut themselves down by using the basic nature of physics, reducing the risk of accidents caused by human errors or natural disasters like those seen in the past. Current pressurized water reactors and boiling water reactors incorporate one type of passive safety mechanism. Making use of this system is essential as it ensures a major safety advantage for individuals.

Major Parties Involved

The United States of America

The United States of America is the world's leading generator of nuclear power as 30% of the nuclear electricity generated worldwide is produced by the USA. In 2022, with 94 operational nuclear reactors, nuclear power produced 18.2% of the nation's electricity. In addition, a significant amount of funds is being provided by the Department of Energy (DOE) to establish a domestic nuclear fuel supply chain and encourage improved reactor designs. Congress provided $2.72 billion for the Nuclear Fuel Security Act of 2023, which aims to increase enrichment and conversion services. Furthermore, the United States and the "Sapporo 5"(the United Kingdom, France, Japan, and Canada) are investing a total of $4.2 billion to create a safe worldwide nuclear fuel supply chain.

The Russian Federation

With 36 nuclear reactors that are now in operation, 19.6% of Russia's electricity is generated from nuclear sources. In addition to the reactors that are now under development, a government decree from 2016 mandated the building of 11 more nuclear power reactors by 2030. Russia had 3 reactors under construction in the beginning of 2023. Russia's nuclear sector is strong, as evidenced by its dominance in the export market for new reactors. The country's national nuclear industry is currently involved in new reactor projects in Belarus, China, Hungary, India, Iran, and Turkey and, to varying degrees, as an investor in many other nations such as Bangladesh, Nigeria, and South Africa.

People's Republic of China

China is also one of the largest nuclear energy producers in the world. With 55 nuclear reactors that are still operational, nuclear power produced 5% of China's electricity in 2022. As of the end of October 2023, there were 25 reactors under construction, demonstrating its continued dominance in the new nuclear build sector. China was also the first nation to order the AP1000 and the EPR (The European Pressurized Water Reactor), two innovative designs, in 2018. By 2024, China is expected to have invested more than $18 billion in nuclear energy. China is heavily pushing the development of new nuclear power due to the need to lower greenhouse gas emissions and enhance the quality of the air in cities.

French Republic

France has 56 nuclear reactors that are now in operation, and one more reactor is being constructed. In 2022, nuclear power accounted for 62.5% of France's electricity production. According to the French plan, at least six additional reactors will be constructed by 2050, and work will begin in 2028 and be completed by 2035. A previous administration's 2014 strategy established the goal of bringing nuclear power's contribution to electricity generation down to 50% by 2025. However, this target was delayed in 2019 to 2035, before being abandoned in 2023. The country continues to be the leading producer and exporter of clean electricity in continental Europe.

Republic of Korea

As one of the leading nuclear energy producers in East Asia, South Korea has 26 operable nuclear reactors, with nuclear generating 28% of the country's electricity. The government is building a four-unit plant in the United Arab Emirates in addition to 3 additional reactors being built domestically. The new president, who took office in July 2022, abandoned the previous administration's energy policy, which called for phasing out nuclear energy over 45 years, with the goal of keeping the nuclear portion of the nation's energy mix at least 30% by 2030.

State of Japan

There are now 33 nuclear reactors in operation in Japan. Nuclear power provided 30% of the nation's electricity in the past, but following the devastating Fukushima accident, public opposition reduced that percentage to just 6.1% in 2022. However, according to a survey by the Asahi Shimbun newspaper, 51% of respondents were in favor of restarting reactors, compared to 42% who were against, outnumbering those who were against for the first time since the national newspaper started conducting polls on the subject following the accident. As a result, as of October 2023, 16 reactors were awaiting restart approval, while 11 had already been brought back online.

The Republic of India

23 nuclear reactors in India are currently in operation. Atomic energy generates 3.1% of the nation’s electricity and it ranks as the fifth-largest source of electricity. The government of India is dedicated to expanding its nuclear power capability as a component of its extensive infrastructure development

initiative. Consequently, India was building 8 reactors as of the end of October 2023. In addition, the government declared in April 2023 that it will raise nuclear capacity from 6,780 MWe to 22,480 MWe by 2031, meaning that by 2047, nuclear power would provide about 9% of India's electricity.

European Union

Nuclear power stations are currently located on the territory of 12 out of 27 EU Member States, including Belgium, Bulgaria, Czechia, Finland, France, Hungary, the Netherlands, Romania, Slovakia, Slovenia, Spain, and Sweden. The European Union has had a nuclear policy from the very beginning. One of the three foundational treaties creating the EU, the Treaty on the European Atomic Energy Community (Euratom Treaty), was signed by the six founding nations in 1957. The Euratom Treaty, to which all current EU Member States are parties, has essentially not changed over time. Additionally, approximately 25% of the electricity in the European Union comes from nuclear power, which also produces roughly half of the low-carbon electricity. Two reactors are being built at the moment, one in Slovakia and one in France.

People's Republic of Bangladesh

Although almost all of the nation's electricity is now generated from fossil fuels, Bangladesh began building the first of two planned Russian reactors in 2017. With intentions to have the first unit operating by 2024, construction on the second unit began in 2018. The nation's need for power is growing quickly, and it wants to rely less on natural gas. To meet the objectives of Vision 2021, which is the political manifesto of the Bangladesh government, the MoST (Ministry of Science and Technology) projected in 2014 that $6.2 billion would be required over the course of the following 10 years. This is being aided by the Science and Technology Act of 2010, and as gas supplies run out, MoST is currently dedicating more than $150 million annually to the development of nuclear technology.

Dominion of Canada

Nuclear power generates 15% of Canada's electricity and the majority of its 19 reactors are located in Ontario. The country has also budgeted $26 billion for a 15-year initiative that would rank among the biggest clean energy projects in North America. Canada also holds strong leadership in the international community regarding SMRs (small modular reactors). For instance, in February 2023 the Canadian government launched the 'Enabling Small Modular Reactors Program', providing about $22 million in support for the development and deployment of SMRs. Nuclear energy has also brought positive impacts on the nation's economy as it has been reported that the Canadian nuclear industry created 76,000 jobs in 2019.

United Kingdom of Great Britain and Northern Ireland

There are 9 nuclear reactors in the United Kingdom that are currently in operation, providing 14.2% of the nation's electricity. The UK has also started a high-tech nuclear fuel program, known as HALEU (High-Assay Low-Enriched Uranium), investing up to £300 million in domestic manufacture, making it the first nation in Europe to do so. Moreover, the country's Civil Nuclear Roadmap outlines how the UK would produce 24 GWe of atomic energy by 2050, which is equivalent to four times the country's current output and a quarter of its electricity demands.

The Kingdom of Saudi Arabia

Despite the fact that fossil fuels are now virtually used to provide almost all of the nation's electricity, Saudi Arabia intends to develop a civil nuclear power sector. The nation did, in fact, plan to increase its nuclear energy capacity up to 17 GWe by 2032, however, two years later, that goal was canceled. The country requires an energy source that can generate consistent electricity since, despite estimates of a significant rise in energy demand, oil output is expected to fail to keep up with the need. In January 2021, Energy Minister Prince Abdulaziz bin Salman stated that the nation is dedicated to being carbon neutral, and by 2030, it hopes to generate 50% of its electricity from renewable sources and the remaining 50% from natural gas

Timeline Of Events

Date	Description of event
1789	**The discovery of uranium** While experimenting with pitchblende, German chemist Martin Klaproth found a new element that he named after the recently discovered planet Uranus.
December 1938	**Discovery of nuclear fission** Chemists Otto Hahn and Fritz Strassmann, as well as physicist Lise Meitner, discovered the creation of fission products by colliding uranium with neutrons.
15 August 1942	**The Manhattan Project** The production of the first controlled nuclear chain reaction was succeeded at the University of Chicago by Enrico Fermi. It was also a top-secret, research program led by the US during World War II with the purpose of developing nuclear weapons.
20 December 1951	**The world's first electricity-generating nuclear power plant** The Experimental Breeder Reactor I (EBR-I) located in Idaho has become the first-ever instance to successfully produce electricity from nuclear heat.
27 June 1954	**The world's first grid-connected nuclear power plant** Obninsk nuclear power plant in the Soviet Union becomes the first nuclear power plant to generate electricity for an existing commercial grid.
29 July 1957	**The establishment of the International Atomic Energy Agency (IAEA)** President Eisenhower of the United States suggested the establishment of the IAEA in the UN General Assembly. Finally, President Eisenhower's ratification of the Statute officially established the International Atomic Energy Agency.
1 July 1968	**The signing of the Nuclear Non-Proliferation Treaty (NPT)** The NPT was opened for signature and signed by the Soviet Union, the United Kingdom, and the United States. The treaty entered into force after 2 years.
28 March 1979	**The occurrence of the Three Mile Island accident in the United States** A cooling malfunction in the Three Mile Island nuclear power plant caused part of the core to melt in Reactor 2, consequently releasing radioactive gases.
26	**The occurrence of the Chernobyl accident in the Soviet Union**

April 1986	The No. 4 reactor of the Chernobyl Nuclear Power Plant has exploded leading to serious radiation sickness and contamination to the people and environment.
11 March 2011	**The occurrence of the Fukushima Daiichi nuclear accident in Japan** A tsunami resulting from the largest earthquake ever recorded in Japan has struck the nuclear power plant located in Fukushima. As a result, radiation levels rose in food, water, and the ocean near the Fukushima Daiichi power facility.
September 2015	**The adoption of SDGs (Sustainable Development Goals)** The SDGs were born at the UN Conference on Sustainable Development in Rio de Janeiro in 2012 and were adopted by the United Nations Member States in September 2015 at a historic UN Summit.
2020s	**The continuous improvement of Atomic energy** Nuclear power has gained more attention than ever which allowed it to continuously develop. Nuclear power currently accounts for about 10% of electricity generation globally.

UN Involvement, Resolutions, Treaties and Events

- The establishment of a Commission to Deal with the Problems Raised by the Discovery of Atomic Energy, 24 January 1946 (A/RES/1) was adopted by the General Assembly. Via this resolution, the UN Atomic Energy Commission (UNAEC) was established and charged with developing suggestions for the eradication of atomic weapons from state armaments, as well as the use of atomic energy solely for peaceful purposes.

- The International Atomic Energy Agency (IAEA) is an autonomous international organization within the United Nations system which was created in 1957. The organization submits reports to the General Assembly and Security Council of the UN.

- The Nuclear Non-Proliferation Treaty (NPT) was adopted by the UN and opened for signature on 1 July 1968 and entered into force on 5 March 1970.

- Declaration on the Right to Development was adopted by the United Nations General Assembly on 4 December 1986.

- Energy for sustainable development, 2001 (E/CN.17/2001/DEC.9/1)

- Prohibition of the dumping of radioactive wastes, 2003 (A/RES/58/40) was adopted by the General Assembly.

- United action towards the total elimination of nuclear weapons, 2 December 2014 (A/RES/69/52) was adopted by the General Assembly.

- Effects of atomic radiation, 5 December 2014 (A/RES/69/84) was adopted by the General Assembly.

- In 2015, the United Nations adopted the Sustainable Development Goals (SDGs) which suggest the development of renewable energy.

Bibliography

Galindo, Andrea. "What is Nuclear Energy? The Science of Nuclear Power." *International Atomic Energy Agency*, 15 November 2022, https://www.iaea.org/newscenter/news/what-is-nuclear-energy-the-science-of-nuclear-power. Accessed 10 August 2024.

International Atomic Energy Agency. *Country Nuclear Power Profiles*, https://cnpp.iaea.org/public/. Accessed 10 August 2024.

International Atomic Energy Agency. "IAEA Nuclear Energy Series Nuclear Energy Basic Principles." *Scientific, technical publications in the nuclear field | IAEA*, https://www-pub.iaea.org/MTCD/publications/PDF/Pub1374_web.pdf. Accessed 10 August 2024.

International Atomic Energy Agency. "Nuclear power and sustainable development." *Scientific, technical publications in the nuclear field | IAEA*, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1754web-26894285.pdf. Accessed 10 August 2024.

International Atomic Energy Agency. "Nuclear waste processing | IAEA." *International Atomic Energy Agency*, https://www.iaea.org/topics/processing. Accessed 10 August 2024.

"NEA) - Sustainable development and nuclear energy." *Nuclear Energy Agency*, https://www.oecd-nea.org/jcms/pl_33568/sustainable-development-and-nuclear-energy. Accessed 30 August 2024.

International Atomic Energy Agency. “50 Years of Nuclear Energy.” *International Atomic Energy Agency*, https://www.iaea.org/sites/default/files/gc/gc48inf-4-att3_en.pdf. Accessed 10 August 2024.

Tarakanov, Vladimir. “What is Uranium? | IAEA.” *International Atomic Energy Agency*, 16 August 2023, https://www.iaea.org/newscenter/news/what-is-uranium. Accessed 10 August 2024.

The United Nations. “Treaty on the Non-Proliferation of Nuclear Weapons (NPT) – UNODA.” *UNODA*, https://disarmament.unoda.org/wmd/nuclear/npt/. Accessed 30 August 2024.

The United Nations. “Breaking up with fossil fuels | United Nations.” *the United Nations*, https://www.un.org/en/climatechange/breaking-fossil-fuels. Accessed 10 August 2024.

The United Nations. “The International Atomic Energy Agency.” *the United Nations*, https://www.un.org/en/conf/npt/2015/pdf/IAEA%20factsheet.pdf. Accessed 10 August 2024.

The United Nations. “— SDG Indicators.” *— SDG Indicators*, https://unstats.un.org/sdgs/report/2023/Goal-12/. Accessed 10 August 2024.

World Nuclear Association. “Nuclear Power in the World Today.” *World Nuclear Association*, https://world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today. Accessed 10 August 2024.