

**FORUM:** United Nation Commission on Science and Technology for Development

**ISSUE:** Promoting Safe and Sustainable Nuclear Technology for Energy and Medical Applications in Developing Countries

**STUDENT OFFICER:** Jun Woo (Karo) Yoo

**POSITION:** Deputy President of UNCSTD

---

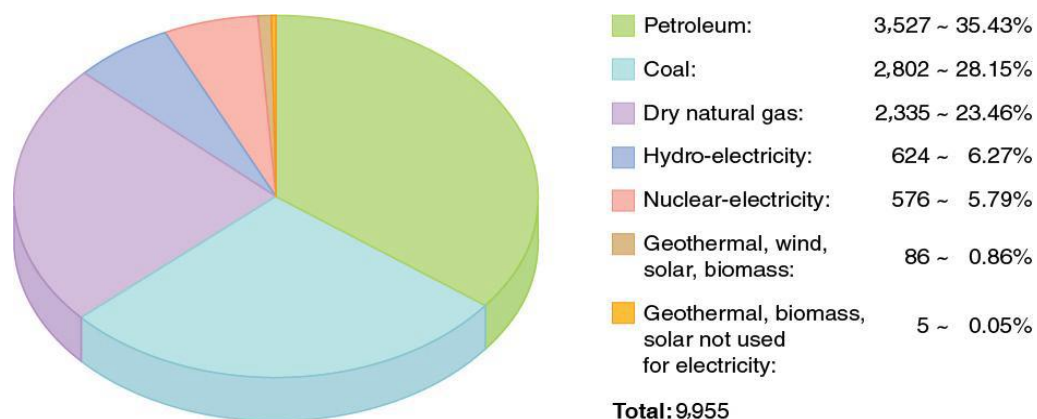
## Introduction

“With a combination of industrialization, economic development, and a projected doubling of the world’s population in the 21<sup>st</sup> century, global energy consumption will surely continue to increase. Growth will be driven principally by the demand in developing countries, as they now have 75% of the world’s inhabitants but consume only 31% of all energy produced worldwide. Conservation and improved efficiency in energy use will restrain but not stop demand. The World Energy Council (WEC) projects growth in energy demand of anywhere between 50% and 300% over the next five decades, depending on environmental and economic factors” (Mourogov). In view of projected energy demands, today’s global pattern of energy production is not sustainable. The use of fossil fuels, which is responsible for about 90% of the total energy supply of the world, adversely affects the atmosphere and environment through the combination of emissions of greenhouse gases and other noxious and toxic pollutants. The world has already formed a universal consensus to control the heavy dependence of fossil fuels. However, developing and emerging economies especially face a two-fold energy challenge in the 21<sup>st</sup> century, as they need to meet the needs of billions of people who still lack access to basic, modern energy services while simultaneously

participating in a global transition to clean, low-carbon energy systems. Of course, the need for a more sustainable and safe energy use has been widely recognized in the mounting concerns about global climate change.

Countless reports have been

written on the subject of sustainable energy, but few have approached this specifically from the



*World Energy Use Graph*



perspective of a developing country. In a country where a significant portion of the population still lacks access to rudimentary energy services, the concerns about sustainable energy use is often overshadowed by more immediate challenges about energy access and affordability. Thus, the need for promoting safe and sustainable energy in developing countries is crucial where they are compelled to rely on more accessible, immediate sources of energy sources such as fossil fuel, as, while the demand of energy is constantly increasing, the supply is continuing to decrease. To combat this issue, though it is not completely problem free, nuclear energy poses a possible and feasible solution, where it has shown a clear advantage in contributing to the goals of sustainable development. For its entire energy chain from production to waste disposal, it has limited emissions of greenhouse gas and other pollutants. Yet, there is no international consensus concerning nuclear energy's future role. Therefore, this report will aim to further address this issue of promoting safe and sustainable nuclear technology for energy and medical applications in developing countries.

## Background

A rather novel and innovative technology, nuclear technology involves the use of nuclear reactions to generate energy and produce materials with various applications, relying on processes such as nuclear fission, nuclear fusion, and radioactive decay. The applications of this technology ranges extensively across various fields, but its primary use is in energy production and medical fields.

What is nuclear energy? Nuclear energy, while it may seem sophisticated, is a form of energy released from the nucleus, the core of atoms, made up of protons and neutrons that is widely used all around the world. Most people are probably not aware of the significance and prevalence in which nuclear technology contributes to our quality of life. Even just the term “nuclear technology” might not be familiar to us. Despite its unaccustomedness, nuclear



*Nuclear Power Plants*

technology's practicality actually transcends our dull expectations. From the switch we flick to turn on the lights in the morning to the fruits we eat for breakfast, it is more than likely that nuclear technology contributed in one way or another. As a more sustainable source of energy, it serves as a viable alternative option of energy against other energy sources such as fossil fuel. It encompasses a wide range of advantages despite its minimal drawbacks: production of nuclear energy emits far less greenhouse gases and toxic chemicals compared to energy production from fossil fuel; nuclear energy contains a much higher energy density than fossil fuels, meaning that it can produce more energy than fossil fuels; and



nuclear energy serves as a sustainable and stable source of energy, unlike other renewable energy sources which can be intermittent. However, it still poses some challenges such as managing radioactive wastes, dealing with safety issues, and requiring high initial costs in building power plants.

Applying nuclear technology to the medical field can seem odd to many people. Nonetheless, nuclear technology plays a crucial and significant role in today's medical field. For example, nuclear technology is utilized in diagnostics, therapy, and

sterilization. In diagnostics, nuclear technology is widely used in medical imaging techniques such as Position Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), X-Rays, and CT scans. These techniques rely on the use of radioactive tracers that emit gamma rays detected by special cameras to produce detailed images of organs and tissues.



*Nuclear Technology in Medical Fields*

Moreover, nuclear technology is also commonly used in radiation therapy or radioisotope therapy to treat cancer, and it is sometimes used for sterilization of medical equipment.

These methods provide considerable advantages such as forming detailed information about the functioning of organs and tissues without the need for invasive procedures and providing a highly effective mode of treatment in curing various diseases. However, the availability and cost of utilizing nuclear technology can be limiting factors in some regions, especially in developing countries.

In developing countries, accessibility to nuclear technology is very limited, addressing the need for its promotion. Promoting safe and sustainable nuclear technology in developing countries is necessary for several compelling reasons. These reasons encompass energy security, economic development, and geopolitical stability.

First, developing countries are experiencing rapid urbanization and industrial growth, which significantly increases energy demand. Nuclear power can provide a stable and large-scale energy supply to meet these needs efficiently. Moreover, access to reliable and affordable energy is essential for improving living standards. Nuclear energy can play a critical role in providing electricity to underserved regions, thereby promoting social and economic development.

Second, a stable and continuous power supply is crucial for industrial activities, manufacturing, and overall economic development. Nuclear energy can provide the reliability needed to support these activities. The development and operation of nuclear facilities create numerous jobs in construction, engineering, operation, and maintenance. This also fosters the development of a skilled workforce. Nuclear energy can reduce dependence on imported fossil fuels, enhancing energy security and economic



stability. This is particularly important for countries that spend significant portions of their GDP on energy imports.

Lastly, by developing domestic nuclear energy capabilities, countries can reduce their dependency on foreign energy sources, which can be subject to geopolitical tensions and market volatility. Participation in the global nuclear community through initiatives like the International Atomic Energy Agency (IAEA) fosters international cooperation and knowledge sharing, contributing to global stability.

## Problems Raised

### *Safety and Accidents*

Safety and accidents are critical concerns in the use of nuclear technology, especially in developing countries where regulatory frameworks and infrastructure may not be as robust. Reactor safety is a significant factor to consider when regarding nuclear technology. Nuclear reactors are designed with multiple safety systems to prevent accidents and mitigate their consequences. These include physical barriers, emergency cooling systems, and redundant control systems. In developing countries, the adequacy of these safety systems can vary, and any lapses can lead to serious incidents. One famous nuclear accident as a result of a failure in the reactor system is the Fukushima Daiichi Nuclear Disaster in 2011. In Japan, the Fukushima disaster was triggered by a massive earthquake and tsunami that overwhelmed the plant's safety systems. The failure of cooling systems led to meltdowns in three reactors, releasing radioactive materials and leading to large-scale evacuations and environmental contamination. Even a country that is not a developing country can experience a massive disaster due to a failure in the reactor system. In developing countries, where there is a lack of proper materials and security, this type of problem would be prevalent, possibly leading to frequent accidents or even disasters if safe and sustainable nuclear technology is not promoted.



*Fukushima Daiichi Nuclear Disaster*

## *Technical Challenges*

There are various requirements for the development of a country, and among them one of the most important elements is securing economical and good quality energy sources. Especially for developing countries striving for economic development, securing stable and economical energy sources is on their top priority list in order to accomplish sustainable



*Living Conditions in Developing Countries*

economic development, and for this, nuclear power constitutes a viable alternative energy source. Indeed, several developing countries have already launched nuclear power programs. Nonetheless, nuclear power poses specific demands on national infrastructures that have to be satisfied by any country to achieve success in its introduction and its safe and reliable use. These demands include technical complexity, the required high level of investment, and strict safety requirements. Technical challenges are one of the most significant issues to overcome, as the implementation of nuclear technology can't even be initiated if these challenges can't be solved. Developing countries, however, often lack the necessary infrastructure and trained personnel to build and operate nuclear facilities safely and efficiently, leading to significant investment in education and training programs to build local expertise. Furthermore, ensuring the long-term safety and maintenance of nuclear facilities can be challenging due to a lack of local technical expertise and resources.

## **International Actions**

### *Energy Policy Act of 2005*

As plans to use nuclear power for electricity generation revived around the world, to promote a nuclear energy “renaissance,” the U.S government included, in the Energy Policy Act of 2005, significant incentives to encourage the private sector to build new power reactors. For the first reactors built, such incentives (in the form of subsidies and guarantees) are estimated to have the potential to reduce the cost of electricity produced by 30 percent. Although such policies led to a flurry of applications to build new reactors, none has so far been constructed.

Moreover, to reduce the risk posed by high-activity radioactive sources, the US Energy Policy Act of 2005 included “the importance of developing and implementing alternative technologies in order to reduce the number of radiation sources.” The US government, through its national laboratories,



supports the installation of security cameras at sites that use high-activity radioactive sources, nationally and internationally, and encourages users of these sources to replace them with alternative technologies.

### *South-South cooperation*

Thanks in part to developing countries' active collaboration with the IAEA over decades, many of them have significantly enhanced their capacities in nuclear technology and have been using these technologies to reach their development goals. Some of these countries are now able to support other developing countries through a framework known as South–South cooperation.



*The South-South cooperation*

South-South cooperation refers to technical cooperation support between developing countries. It covers many areas of the United Nations development agenda, such as agricultural development, health and climate change, and is of growing importance in addressing global challenges. As a part of the South-South cooperation, Indonesia is one of the countries now actively supporting the use of peaceful nuclear technologies. Due to the collaborative efforts from IAEA and Indonesia, Indonesia has become a resource for neighboring countries and is helping to promote regional self-reliance and strengthen local ownership of nuclear science and technology.

## **Key Players**

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

The IAEA has a long-standing reputation for providing advice and technical assistance to developing Member States seeking to launch a nuclear power program. This promotional effort has been part of the Agency's



*The International Atomic Energy Agency (IAEA)*

activities since its inception in 1957 and has been accomplished through all variable means. These include advisory missions, training courses and study tours, fellowships, guidebooks, meetings, maintenance of



data banks, provision of opportunities and channels for worldwide information and data exchange, and the development of planning tools, such as the Model for Analysis of Energy Demand (MAED) and Wien (Vienna) Automatic System Planning (WASP). These two planning models have been and are currently the mainstay tools available to developing Member States in energy and electricity planning, and to assist them in determining the economic role of nuclear power in their electric power systems.

### *France*

France has actively engaged in the promotion and development of nuclear technologies in developing countries. For Instance, The French company AREVA, with the active support of the French government, has been engaged in lobbying to sell reactors required for the application of nuclear technology to a large number of developing countries around the world, at least 13 of which are in the Middle East.

## **Possible Solutions**

### *Collaboration of IAEA and Developed Countries for Enhanced Support to Developing Countries*

Though most developing countries aspire to get nuclear energy related technologies, it is very hard for them to realize their desire without help from IAEA and developed countries simply because they do not have enough resources. So, IAEA and developed countries with nuclear energy need to provide training programs to human resources; and they need to give free access to a nuclear reactor for research.

By diffusing nuclear technology from developed countries, developing countries can minimize the time and mistakes of their own technology development in launching new nuclear power programs. Also, an economic effect can be promoted through nuclear energy technology transfer and facility export. IAEA also needs to diversify attendance at its training programs; from primarily European and American countries to Asian countries which have a strong need for those programs. Support for the nuclear related department at universities should go side by side with improving interest in the nuclear power generation area for gifted students.

### *Reducing the Technological Gaps Among Countries.*

In order to motivate participation of developing countries in the international joint projects on nuclear energy, technological gaps among countries should be reduced. One of the universal common



features of technological industries is forming a barrier due to technological gaps. It is almost impossible



*The difference in living conditions in developed and developing countries*

for newcomers to reverse the technology gap which was led by existing players. Especially in the area of architecture, engineering and construction of nuclear power generation facilities, which is a huge integrated

science/technology which includes nuclear physics, machinery, chemistry, radiation and information technology, new players are left out in the cold.

To induce developing countries to invest on the long-term research and development projects, including radioactive waste and spent fuel disposal, the participation of developing countries on these projects is encouraged.

**Glossary** – Define jargons specific to the topic

*IAEA (International Atomic Energy Agency)*

An international organization that promotes the peaceful use of nuclear energy and aims to prevent its use for military purposes, including nuclear weapons

*WEC (The World Energy Council)*

A global multi-energy organization that promotes the sustainable supply and use of energy for the greatest benefit of all people.

*WASP (Wien (Vienna) Automatic System Planning)*

A sophisticated computer model used for optimizing the expansion of electric power generation systems.LA



## Sources

- Ahuja, Dilip, and Marika Tatsutani. "Sustainable Energy for Developing Countries." *S.A.P.I.EN.S. Surveys and Perspectives Integrating Environment and Society*, Institut Veolia Environnement, 7 Apr. 2009, [journals.openedition.org/sapiens/823](https://journals.openedition.org/sapiens/823).
- José Goldemberg. "Nuclear Energy in Developing Countries." *American Academy of Arts & Sciences*, 20 Sept. 2019, [www.amacad.org/publication/daedalus/nuclear-energy-developing-countries](http://www.amacad.org/publication/daedalus/nuclear-energy-developing-countries).
- Nuclear Power Development: Global Challenges And ...*,  
[www.iaea.org/sites/default/files/publications/magazines/bulletin/bull39-2/39205080208.pdf](http://www.iaea.org/sites/default/files/publications/magazines/bulletin/bull39-2/39205080208.pdf).  
Accessed 27 July 2024.
- "The Many Uses of Nuclear Technology." *World Nuclear Association*, [world-nuclear.org/information-library/non-power-nuclear-applications/overview/the-many-uses-of-nuclear-technology](http://world-nuclear.org/information-library/non-power-nuclear-applications/overview/the-many-uses-of-nuclear-technology). Accessed 28 July 2024.
- VCDNP, [vcdnp.org/wp-content/uploads/2021/07/Nuclear-Applications-Industry-and-Agriculture-Case-Study\\_final.pdf](http://vcdnp.org/wp-content/uploads/2021/07/Nuclear-Applications-Industry-and-Agriculture-Case-Study_final.pdf). Accessed 27 July 2024.
- "What Is Nuclear Energy? The Science of Nuclear Power." *IAEA*, IAEA, 15 Nov. 2022,  
[www.iaea.org/newscenter/news/what-is-nuclear-energy-the-science-of-nuclear-power](http://www.iaea.org/newscenter/news/what-is-nuclear-energy-the-science-of-nuclear-power).