Vol. 8, No. 2, 2022, pp. 488-494
DOI: https://doi.org/10.29210/020221356

Contents lists available at Journal IICET

JPPI (Jurnal Penelitian Pendidikan Indonesia)
ISSN: 2502-8103 (Print)ISSN: 2477-8524(Electronic)

Journal homepage: https://jurnal.iicet.org/index.php/jppi

Nuclear energy as environmentally friendly energy and international politics

Ali Bogheiry[1], Ai Ahmad Faisal[1*)], Sunarno Sunarno[2]
[1]Department of International Relations. Faculty of Political Science and Law, Ahlul Bayt International University, Indonesia
[2]Psychological Science Doctoral Program Universitas Persada Indonesia YAI, Indonesia

Article Info

Article history:

Received Jan 06th, 2022
Revised Apr 12th, 2022
Accepted Jun 02nd, 2022

Keyword:

Nuclear energy,
Environmentally friendly energy,
International politics

ABSTRACT

The growth of the world's human population demands greater energy fulfillment and the main energy source that has been used so far is fossil fuels. Nuclear energy produced in a nuclear reactor is used as a competitive contributor with other sources of electrical energy such as coal, oil, gas, water, and others. So that the contribution of energy from various aspects becomes something that must be taken as a mutually beneficial strategic partner in meeting future energy needs that are economical and environmentally friendly at both national and international levels. The result of this research is energy is a primary need in modern human life. Almost all aspects of life require energy as its prime mover. In the beginning, people used fossil energy to fulfill their needs. The limited amount of fossil energy on earth has resulted in many people competing to create renewable energy with the characteristics of low cost, high stability, and high efficiency. Energy savings are urgent to be done so that the nation can survive in the midst of a crisis like this. In addition, this is also a warning that excessive dependence on fossil energy sources or primary energy such as oil, coal and natural gas is not a good option. Modern energy sources include solar energy, nuclear energy, wind energy, hydro energy, geothermal energy, biomass energy, hydrogen fuel cell energy, and biofuel energy. So that in the development of nuclear energy, treaty rules are made and there is international law in it. This is done so that every country in developing its nuclear energy still maintains international peace and security.

Corresponding Author:

Ai Ahmad Faisal,
Ahlul Bayt International University
Email: faisalsinjiyamada@gmail.com

Introduction

The growth of the world's human population demands greater energy fulfillment and the main energy source that has been used so far is fossil fuels. This fossil energy is non-renewable energy so that the reserves of this energy raw material are increasingly depleting, so that based on the consideration of the increasing energy demand and the effects of fossil energy, it has encouraged the development of new technologies that are considered safer, cheaper, effective, and efficient. The technology is nuclear energy, where nuclear energy technology is considered a clean and green energy source, meaning as a low-carbon energy source (Sutono, 2012).

Nuclear energy in the 20th century until now is in demand by the world community. Because the energy produced from nuclear is abundant and lasts a long time. In addition, nuclear energy can be an alternative energy in the future if the supply of fossil fuels such as coal and oil runs out. That way, countries in the world are competing to build nuclear energy centers and nuclear-powered power plants by collecting fuel, namely uranium. The world community's need for nuclear energy is increasing. However, nuclear energy has its own challenges, namely in the military and defense fields, such as more and more military weapons using nuclear fuel. Weapons of nuclear energy are explosive devices that get their explosive power from fission reactions or a combination of fission and fusion, where nuclear energy weapons are called weapons of mass destruction and their use and control has become an aspect of international policy (Basri, 2014). Weapons of nuclear energy such as nuclear submarines, nuclear missiles, nuclear ballistic missiles, and nuclear bombs.

As a result of the emergence of nuclear weapons. International peace and security began to be disturbed because countries often carried out military exercises with nuclear weapons. So, other countries feel their security is disturbed. Countries that feel disturbed or threatened by nuclear-armed military training activities also want to strengthen their defense base with nuclear weapons as a balance of power. As a result there is a nuclear arms race and the spread of nuclear weapons in the world. So the question arises How to limit the use of nuclear energy for the manufacture of nuclear weapons in the military field? and what is the policy of international law in dealing with countries that threaten other countries with nuclear weapons?

The nuclear weapons states are the United States, Russia, the United Kingdom, France, the People's Republic of China, India, North Korea and Pakistan. In addition, the state of Israel is believed to have nuclear weapons, although it has not been tested and Israel is reluctant to confirm whether it has nuclear weapons or not. Then there are restrictions on ownership of the spread of nuclear weapons to various worlds aimed at creating peace and security at the global level. In addition, every country that has nuclear weapons is required to comply with nuclear weapons ownership agreements.

Nuclear energy produced in a nuclear reactor is used as a competitive contributor with other sources of electrical energy such as coal, oil, gas, water, and others. So that the contribution of energy from various aspects becomes something that must be taken as a mutually beneficial strategic partner in meeting future energy needs that are economical and environmentally friendly at both national and international levels (Permana, 2005).

History of Energy

Energy is a primary need in modern human life. Almost all aspects of life require energy as the prime mover (Agung, 2013). Energy is an inseparable determinant of the quality of human life. In the beginning, people used fossil energy to fulfill their needs. The limited amount of fossil energy on earth has resulted in many people competing to create renewable energy with the characteristics of low cost, high stability, and high efficiency (Suhantoro et al., 2019).

Urgently needed to be done so that the nation can survive in the midst of a crisis like this. In addition, this is also a warning that excessive dependence on fossil energy sources or primary energy such as oil, coal and natural gas is not a good option. After that, the use of renewable energy resources as raw materials for the production of electrical energy has advantages, including; first, it is relatively easy, even obtained for free, operating costs are very low, secondly there are no problems including the production process does not cause an increase in the earth's temperature, and most importantly does not affect the increase in fuel prices. From the existing alternative energy potential, for the development of national electricity, what needs to be developed more broadly on a large scale is air power, including mini/micro hydro, geothermal or geothermal power (Agung, 2013). Another source of energy is solar power. People use the sun's heat to burn their homes, dry laundry, and preserve food. Another old source of heat is geothermal power, referring to heat that seeps out of the earth in places such as hot springs. In the past this heat was used directly, but in the modern world it is also used indirectly to generate electricity.

With this energy, humans can actualize the free will that is in their minds. The energy in the universe is manifested by the rotation of galaxies so large that they cause thermonuclear reactions in the stars. On Earth, energy is seen as the force of plate tectonics that bottoms the ocean and lifts mountains. Solar energy radiates to all regions of the earth so that photosynthesis occurs in plants. Energy is a scalar quantity that cannot be seen directly but can be recorded and measured by indirect measurements. The absolute value is difficult to measure, the change in alternative energy is easy. For example solar energy. The sun emits a spectrum of energy that travels across space as electromagnetic radiation (Dincer & Rosen, 2012).

Method

This paper aims to explain the importance of nuclear energy as an environmentally friendly future energy and its involvement in international politics. This research includes qualitative research that measures how much political involvement is in regulating nuclear energy. The research method used in this study is a qualitative descriptive method. According to Sugiyono (2019), qualitative research methods are often referred to as naturalistic research methods because the research is carried out in natural conditions, or as an enographic method, is called a qualitative method because the data collected and the analysis is qualitative. Qualitative research data are descriptive in the form of interview notes, observation notes, documents and data were analyzed inductively. Sources of qualitative research data are real world situations, and natural.

Results and Discussions

Modern Sources of Energy

Energy sources are basic needs in human life. Modern energy sources include: solar energy, nuclear energy, wind energy, water energy, geothermal energy, biomass energy, hydrogen fuel cell energy, and biofuel energy. Solar energy is the most abundant source of energy on Earth, but it is so expensive that few developed countries develop it. The cost for a kilowatt hour of electricity ranges from 15 to 225 cents for solar PV (IAEA, 2009). Nuclear energy utilizes energy by splitting and smelting atoms. Nuclear reactions can produce heat energy, which is used to generate electricity. Nuclear energy is an energy source that can reduce carbon emissions. Wind energy power comes from windmills placed in locations with a lot of wind. Wind energy can generate electricity from wind power plants using windmills and then connected using a generator or turbine. Water energy comes from a dam that provides a high-pressure flow of water that spins a turbine, thus generating electricity. It can be exploited at both the macro level (a large dam could be built to create electric power across the nation's largest river) and at the micro level (one can put hydropower in backyard rivers and streams).

Geothermal energy taking heat from the earth and redistributing it into buildings, or using heat to generate electricity. This energy is available in tremendous quantities, but is difficult to extract and many capital equipment takes. On a more general level, the heat pumps in homes are a source of geothermal energy, so geothermal energy can be practical and effective at the micro level. Biomass energy is living or recently dead biological material that can be used as a fuel source or for industrial production. Biomass energy can be processed into liquid fuels or solid fuels. Examples of biomass include plants, trees, grass, sweet potatoes, agricultural waste, forest waste, feces and livestock manure. Hydrogen fuel cells energy is electricity. Hydrogen fuel cells combine oxygen and hydrogen to produce water and electrical energy. Biofuels energy are made from biomass products such as: Corn. Corn ethanol is now added to most gasoline supplies in the United States. Despite the high energy consumption of the refining process, biofuels allow the US to import less foreign oil, and so have a desirable political effect. Biofuels can be used in pure form or mixed with fossil fuels (DeGunther, 2009).

Nuclear Energy

At the beginning of the twentieth century, scientists discovered a source of nuclear energy. This energy is released by converting the mass of the atomic nucleus into the kinetic energy (energy of motion) and subatomic particles such as neutrons. Nuclear energy can be generated in two ways, namely the fission pathway and the fusion pathway. In the fission pathway, fissile or fissile materials are used such as uranium, thorium, plutonium. These materials can be cleaved by reaction with neutrons to produce two or more new nuclides and more neutrons from the source. In addition, it also produces a split energy of about 200 MeV for uranium 235. That is why in a nuclear reaction at a weight equivalent to carbon fuel, the energy generated reaches billions of times. (MeV/meV) (Santoso, 2015).

Nuclear energy is an expensive and unsustainable or non-renewable energy source. The reason is that the nuclear raw material i.e. uranium has limitations in its quantity. The scarcity of raw materials will eventually make this energy very expensive and unsustainable (Sutono, 2012). There is a difference in generating nuclear energy through fission and fusion. In fission, the heavy nucleus splits into lighter nuclei, the release of energy is very large ~ 200 MeV per nucleus, both parent and child radioactive long life, the threat of melting of the reactor core, environmental safety, and there is a threat, the fuel can be converted become a nuclear weapon. Whereas in fusion, it requires very high temperature technology to overcome the Coulomb repulsion so that the nuclei will fuse. Required reaction chamber in the form of a strong magnet, the energy per unit weight is greater in fission, the fuel is infinite, the radioactivity is not high with a short life, it is cleaner (Santoso, 2015).

The Advantages of Nuclear Energy for International Community

The benefit of nuclear fission energy is that fossil fuel uranium is relatively cheap. The energy density is so high that the amount of raw fuel is much less than that of fossil fuels. The following are some of the uses of nuclear that have been used by developed countries, which include as a Energy-Saving Source. More than 14% of the world's electricity is generated from uranium in nuclear reactors. This amounts to more than 2500 billion kWh annually, as was the case from all sources of electricity worldwide in 1960. Both uranium and plutonium were used to make bombs before they became important for making electricity and radioisotopes. The types of uranium and plutonium for bombs are different from those in nuclear power plants. The bomb-grade uranium is highly enriched (>90% U-235 instead of up to 5%), the plutonium-bomb is fairly pure Pu-239 (>90% instead of 60% in reactor-grade) and manufactured in a special reactor (Basri, 2014). Uranium is found in many parts of the world, so supply issues are minor in relation to fossil fuels. Maintenance of nuclear power plants is rarely carried out, when compared to fossil fuel type plants. Once a nuclear power plant is up and running, the chain reaction can be maintained for a long time without outside interference.

Nuclear fusion reactions provide 4 billion more energy than chemical reactions and 4 times more energy than fission reactions. The availability of fusion energy will be the same age as the sun. It is certain that deuterium will last for 25 billion years (Morse, E., 2018), so that nuclear fusion energy can be a sustainable energy and does not cause pollution and greenhouse gas problems. In addition, it can solve the problem of clean water and electrical energy. Fusion energy if converted into liquid fuel can replace fuel oil for transportation vehicle purposes (Santoso, 2018). The advantage of nuclear fusion energy is that it provides abundant energy because the ingredients are from nature, for example deuterium is taken from the ground surface while the isotopes of hydrogen and tritium can be filtered from seawater so it is safe to use. Fusion reactions are not affected by weather conditions as long as the element hydrogen must always be present.

In addition, other benefits of nuclear fusion that do not require a large area to operate. Nuclear fusion technology as an environmentally friendly energy needs cooperation between the government and the community. The international community needs a supply of low-carbon energy because it has used energy that is not environmentally friendly. Both developed and developing countries are increasing their economy due to increasing population. Energy that is not environmentally friendly will affect climate change and contribute to greenhouse gas emissions as well as political intervention from powerful countries that can monopolize the world's energy supply (World Bank, 2010)

There are 3 global issues regarding the use of nuclear energy and we have to start thinking about them from now on, namely: the issue of "Nuclear Safety" or nuclear reactor safety, "nuclear nonproliferation" or restrictions on the use of nuclear materials, and "radioactive waste management". For nuclear reactor safety issues, the estimated risk of a high-risk reactor accident is a low risk compared to all risks to human life in general. These advances in reactor safety can be achieved by strenuous efforts to enhance and maintain reactor safety, safety management and human resources. Nuclear non-proliferation relating to the regulation and restriction of the use of nuclear fuel must be ensured not only in technical measurement and optimization but also in all matters relating to international politics. Although the amount of radioactive waste per unit of electricity production from NPP is relatively very small, the toxicity of radioactive waste must be reduced as low as possible, in order to gain better public acceptance and reduce the risk of terror attacks (Permana, 2005).

Debate about nuclear

There is a debate between the government that supports the development of nuclear energy and scientists who tend to be less supportive of the use of nuclear energy because of the effects of radiation emitted from nuclear energy waste. Governments in various countries argue that nuclear energy is built for peaceful purposes in building military strength, developing renewable energy, and improving economic aspects.

Increasing government involvement in the economy by using the Research and Development model, namely looking for new innovations, developing applications, engineering successful prototypes, applying technology commercially. Because of the importance of nuclear energy, and its potential constraints on trade and technology transfer, most governments seek to be self-sufficient in the technology and materials used for nuclear power generation.

So the negative impact of using nuclear fusion energy is that uranium mining and refining can expose workers to radioactive dust, and can also release dust into the air, physical reactor waste that remains radioactive for years. In addition, nuclear fusion energy also has a negative impact, namely, although no radioactive waste is generated directly by the Deuterium-Tritium fusion, the emitted neutrons ultimately form the containment structure of the radioactive reactor. This problem can be reduced by using low activation materials in the structure. Materials become less radioactive from a neutron blast than knocked-out materials such as steel. Unfortunately, activation alloys tend to be expensive. Although no radioactive waste is

generated directly by deuterium-tritium fusion, some tritium will be emitted by the reactor during normal operation.All of the tritium fuel produced is rapidly recycled and burned in power plants the raw materials needed for the fusion fuel, lithium and water, are completely nonradioactive. Nuclear fusion can be developed over a very long period of time to burn only deuterium. some structural components of the fusion power plant will become highly radioactive. components that must be removed for repair or replacement must be handled using remote robots and stored in large concrete enclosures. At the end of its life, a fusion power plant must be protected for only 100 years before it can be completely destroyed (McCracken & Stott, 2013).

Politicians comment on the opinion of scientists about the dangers of nuclear energy, they say that if energy can be controlled carefully then nuclear energy will be safe from the risk of accidents. by limiting nuclear energy processing activities will certainly have a good impact for the peace goal of mankind. therefore, the government and politicians drafted legislation to limit the use of nuclear. In 1946 the atomic energy bill was passed by the United States congress. After a few years precisely in 1951 the President of the United States, Eisenhower in his speech spoke of "Atoms for Peace". Then in 1954, the "atomic energy law" was renamed to "atoms for peace" which aimed to provide assistance to other countries in the peaceful use of atomic energy. Therefore, a comprehensive international agreement is needed and to address the effective energy development of countries wishing to develop energy on the one hand and the international community wishing to address growth related to non-proliferation and disarmament on the other (Black-Branch & Fleck, 2016).

For nuclear development in the world, an agreement was made under the name of the Nuclear Non-Proliferation Treaty which was supervised by the governments of the United States, Russia, China, France and the British Empire. The five countries are recognized as possessing nuclear weapons. may not transfer their nuclear weapons to anyone. Meanwhile, for other borrowing countries not to receive nuclear weapons, not to produce nuclear weapons and not to seek or receive any assistance in the manufacture of nuclear weapons. The nuclear agreement is based on three main pillars: The first pillar requires the non-proliferation of nuclear weapons or other means of detonating weapons. The second pillar, ensuring the inalienable right of all parties to develop, produce and use energy for peaceful research purposes. The third pillar requires effective steps towards disarmament (Black-Branch & Fleck, 2016).

Although governments and politicians limit the amount of nuclear use and manage it with extreme care, scientists argue that none of this happened because of technical errors or natural disasters. By integrating science, technology, and nuclear astronomy, the government seeks to design nuclear reactors that will be placed in outer space and can orbit the earth. So that the reactor accident will not befall human life on earth. Space technology is used as a nuclear power plant through a fusion reaction that produces alternative energy for the future to build environmentally friendly development.

International Politics and Nuclear Weapons

Nuclear energy is very beneficial for human life if managed properly and very carefully. However, if nuclear energy is used in the military field such as the manufacture of nuclear weapons, nuclear submarines, nuclear bombs are very dangerous for human survival. Possession of nuclear weapons is an identity as pride, as a balance of power, and as a deterrent to repel the enemy when they are about to be attacked. In addition, having nuclear weapons has always been a scary conversation if it is used for war purposes. If detonated in a big city, millions of people's lives can be lost, and leave radiation effects for decades. Very dangerous. However, currently, there are several countries still developing nuclear weapons (Basri, 2014).

Several countries are reported to have minimized the use of nuclear weapons as war ammunition. However, even though they have been reduced, the nukes are allegedly still in a state of high alert. That is, nukes are ready to be launched at any time in an emergency. Reuters launches, February 13, 2013, although the exact number of nuclear weapons owned by countries is a secret, but the Strategic Arms Reduction Treaty (START) claims to have counted the number of nuclear weapons in nine countries in the world (Basri, 2014).

Nuclear possession is also considered a deterrence and balance of enemy forces. So there is motivation and ownership of nuclear weapons by countries in this world has been going on for a long time. There are three important reasons that motivate them to have these weapons of mass destruction. These three things are the reasons for Strategy, Politics and Prestige. The strategic reason is because nuclear weapons have a very important role in securing their country from enemy attacks from outside, this is in accordance with the concept of deterrence, which is an effort to prevent military threats from other parties from carrying out aggressive actions or military attacks with other terms war prevention. and it focuses more on the psychological war than on the physical. Meanwhile, for political reasons and prestige, countries that have nuclear weapons are simply trying to improve their countries in the international political arena (Purwanto, 2011).

To limit nuclear weapons in the world, it is necessary to control so that nuclear weapons are not used to threaten other countries. there are a number of international agreements that regulate nuclear, such as: the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Comprehensive Nuclear Test-Ban Treaty (CTBT), the Treaty on the Southeast Asia Nuclear Weapon Free-Zone and other nuclear agreements. A number of resolutions of the organs of the United Nations also respond to the issue of nuclear weapons. General Assembly Resolution No. 68/47 calls on Nuclear Weapon States (NWS) to provide guarantees not to use and not to threaten Non-Nuclear Weapon States (NNWS) with nuclear weapons (UN General Assembly Resolution, 1995).

It was also strengthened in the UN Security Council Resolution No. S/RES/984 (1995), where the Nuclear Weapon States provide security guarantees not to use nuclear weapons against Non-Nuclear Weapon States that are members of the Treaty on the Non-Proliferation of Nuclear Weapons (UN Security Council Resolution, Paragraph 1). The resolution also explained that the United Nations Security Council and the Nuclear Weapon States, which are permanent members of the United Nations, will immediately act in accordance with the provisions of the United Nations if any country becomes a victim of this action and becomes the object of threat from aggression using nuclear weapons.

If a country has threatened another country with nuclear weapons, then international law imposes sanctions on the holding country. International law provides sanctions in the form of diplomatic sanctions, economic sanctions and military sanctions. The softest sanctions, namely diplomatic sanctions, can be in the form of a decrease to the termination of diplomatic relations, for example a decrease in the degree of diplomatic relations from the Embassy to a Consulate, the withdrawal of the Ambassador, or the assignment of charge d'affairs to replace the Ambassador. Economic sanctions include trade embargoes or boycotts, asset freezes, prohibition of cash transfers, prohibition of sending technology and travel warnings. Meanwhile, military sanctions are the most severe sanctions, namely in the form of military intervention, such as military invasion or aggression (Charter of The United Nations, VII, 12)

Based on Article 41 of the UN Charter, a country that uses nuclear power as a threat can be subject to diplomatic sanctions in the form of severance of diplomatic relations and economic sanctions in the form of an embargo. If it is deemed that the two sanctions are not sufficient to solve the problem, then based on Article 42 of the United Nations Charter, military sanctions in the form of military invasion or aggression can be applied to countries that carry out threats with nuclear weapons.

Conclusion

The result of this research is energy is a primary need in modern human life. Almost all aspects of life require energy as its prime mover. In the beginning, people used fossil energy to fulfill their needs. The limited amount of fossil energy on earth has resulted in many people competing to create renewable energy with the characteristics of low cost, high stability, and high efficiency. Energy savings are urgent to be done so that the nation can survive in the midst of a crisis like this. In addition, this is also a warning that excessive dependence on fossil energy sources or primary energy such as oil, coal and natural gas is not a good option. Modern energy sources include solar energy, nuclear energy, wind energy, hydro energy, geothermal energy, biomass energy, hydrogen fuel cell energy, and biofuel energy.

Nuclear energy can be generated in two ways, namely the fission pathway and the fusion pathway. The benefit of nuclear fission energy is that uranium fossil fuels are relatively cheap. The energy density is so high that the amount of raw fuel is much less than that of fossil fuels. The following are some of the uses of nuclear that have been used by developed countries, which include as a Energy Saving Source. More than 14% of the world's electricity is generated from uranium in nuclear reactors.

However, there is a debate between the government that supports the development of nuclear energy and scientists who tend to be less supportive of the use of nuclear energy because of the effects of radiation emitted from nuclear energy waste. Governments in various countries argue that nuclear energy is built for peaceful purposes in building military strength, developing renewable energy, and improving economic aspects. Although governments and politicians limit the amount of nuclear use and manage it with extreme care, scientists argue that none of this happened because of technical errors or natural disasters. By integrating science, technology, and nuclear astronomy, the government seeks to design nuclear reactors that will be placed in outer space and can orbit the earth. However, if nuclear energy is used in the military field such as the manufacture of nuclear weapons, nuclear submarines, nuclear bombs are very dangerous for human survival. Nuclear possession is also considered a deterrence and balance of enemy forces. So there is motivation and ownership of nuclear weapons by countries in this world has been going on for a long time.

There are three important reasons that motivate them to have these weapons of mass destruction. These three things are the reasons for Strategy, Politics and Prestige.

References

Agung, A. I. (2013). Potential Alternative Energy Sources in Supporting National Electricity. Jurnal Pendidikan Teknik Elektro, 2(2).

Basri, T. H. (2014). History and Development of Nuclear Weapons. Seuneubok Lada, 1(2), 96–105.

Black-Branch, J. L., & Fleck, D. (2016). Nuclear Non-Proliferation in International Law-Volume III: Legal Aspects of the Use of Nuclear Energy for Peaceful Purposes. Springer.

Charter of the United Nations, Chapter VII, Article 42, p.12.

DeGunther, R. (2009). Alternative energy for dummies. John Wiley & Sons.

Dincer, I., & Rosen, M. A. (2012). Exergy: energy, environment and sustainable development. Newnes.

IAEA. (2009). Climate Change and Nuclear Power. Vienna: IAEA, 22.

McCracken, G., & Stott, P. (2013). Fusion: the Energy of the Universe. Academic Press.

Permana, S. (2005). Nuclear Energy and Future Energy Needs. Majalah INOVASI, 22.

Purwanto, A. J. (2011). Weapons of Mass Destruction and the Future of International Security. Spektrum, 8(1).

Santoso, B. (2015). The Development of Fusion Nuclear Energy. Ilmu Dan Budaya, 39(48), 5523–5534.

Sugiyono. (2019). Research Methods Quantitative, Qualitative, and R & D. Bandung: CV Alfabeta Suhantoro, M., Handayani, L., & Linuwih, S. (2019). The History of Invention of the Triboelectric Nanogenerator (TENG): Today's Self-Powered System for Future Energy Needs. Seminar Nasional Lontar Physics Forum, 17–22.

Sutono, A. (2012). Humanistic Value in Control of Nuclear Energy Sources. Civis, 2(1).

UN General Assembly Resolution No. A/RES/68/47 on Nuclear Disarmament, Paragraph 9, p. 5

World Bank. (2010). World Development Report, Development and Climate Change. Washington, DC: The World Bank,