Ensuring Energy Security through Expanded Access to Nuclear Technology for Peaceful Uses and the Challenge of a Nuclear Taboo

Moges Z. Teshome

ABSTRACT

This paper seeks to explore the nexus between expanded access to nuclear technology and science for peaceful uses and sustainable development, on the one hand, and how a nuclear stigma impacts global endeavors to achieve sustainable development goals, on the other. Although nuclear technology and techniques' safe, secure, and sustainable application is directly relevant to the 9 SDGs, this paper highlights energy security. It argues that expanded access to nuclear technology and modern science is quintessential to ensure SDGs; specifically, by informing pragmatic energy transition policy. A nuclear taboo (a public aversion to anything nuclear), as symbolized in an inherent normative contestation within the Treaty on the Non-Proliferation of nuclear weapons (hereinafter the NPT), enduring background knowledge, negative nuclear images, and public aversions to nuclear power, poses a formidable challenge to expanded access to nuclear technology. Consequently, the paper suggests, inter alia, timely management of normative contestations (through a teleological interpretation of Art. IV of the NPT), increasing awareness creation campaigns, effective and timely risk communication system, changing narratives at the grassroots level, ensuring greater transparency, and trust building measures, and enhancing the culture of nuclear safety and security.

Keywords: nuclear taboo, norm contestation, peaceful uses of nuclear energy, SDGS.

M. Z. Teshome*
Vienna School of International Studies, Vienna, Austria
(e-mail: moges.teshome@da-vienna.at)

*Corresponding Author

I. INTRODUCTION

Following President Eisenhower's 'Atoms for Peace' speech, a pledge to "apply atomic energy to the needs of agriculture, medicine, and other peaceful purposes" (IAEA, 1953), the discourse surrounding nuclear energy had shifted from atomic bomb to Atom bond. It was then institutionalized in the IAEA Statute which provides that "The Agency [the IAEA] shall seek to accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world" (IAEA Statute, Art. 2). With the coming into force of the Treaty on the NPT, the inherent rights of the Member States to access peaceful uses of nuclear technologies and science gained normative status. Nuclear technology has evolved and is being applied to transform the lives and livelihoods of many. But its access is distributed inequitably and the disparities between the 'Haves' and 'Have Nots' has widened. This calls for expanded access to nuclear energy, particularly in the least developed and developing countries.

In 2015, the 2030 Agenda for Sustainable Development was adopted, with specific goals and targets, to further enhance the triumvirate values of peace and security, human rights, and prosperity, through the 'whole of government' and 'whole of society approach. Modern science and technology, including nuclear technology, are playing significant roles in the global efforts to meet the SDG goals, not least because 9 out of 17 SDGs are directly related to the applications of nuclear technology. Simply put, nuclear technologies are quintessential to, inter alia, ensure food security and safety, improve healthcare, bolster energy security, and help curb climate change. Throughout its history, nuclear technology and the discourses surrounding it have been challenged. Arguably, none of the challenges is comparable to a deeply entrenched 'nuclear taboo'.

This paper will use a broader definition of nuclear taboo that goes beyond the definition originally conceptualized by Nina Tannenwald, and the term 'taboo' is used in its non-legal, sociological sense. For the sake of simplicity, this loose and broader conceptualization of a nuclear taboo could be interchangeably used with a rather sober term, a 'nuclear stigma'. Accordingly, an extended definition of nuclear taboo refers to a general public revulsion against 'anything nuclear' and the resultant negative image of nuclear energy. The conventional nuclear weapons taboo is subsumed within the extended definition for it feeds

into the taboo against anything nuclear through the instrumentality of negative nuclear images and public perceptions−the spillover effect. Thus, the central argument of this paper is that the general public aversion to anything nuclear energy-related results from the 'images of nuclear energy' (Weart, 1991), background knowledge associated with nuclear weapons, the fear, and perceptions of accidents associated with nuclear power plants, the normative contestation inherent in the duality of nuclear energy−atoms for peace versus the concern of proliferation and the global anti-nuclear movements. The stigma, in turn, has partly given rise to a 'crisis of legitimation' of the technology (Rucht, 1990, p. 194), and affected expanded access to nuclear technologies for peaceful purposes. However, from the outset, it is worth stressing that, within the peaceful uses' framework, much of the stigma is against the power applications and the attendant risk of safety and security. As such, it only affects the non-power applications indirectly, owing to a lack of awareness and the pervasive nuclear image across the board, which results from its connection to nuclear weapons.

Thus, this paper aims to critically examine the nexus between sustainable development and peaceful uses of nuclear technology and the impacts of nuclear stigma on expanded access to peaceful uses and suggests the way forward. Accordingly, following this introduction, section two will provide a general overview of the relationship between the SDGs and the application of nuclear technology and techniques for peaceful purposes, by taking the case of energy security. Section three highlights the challenge posed by the nuclear taboo or stigma, with a specific reference to normative contestation, background knowledge, and public attitudes and perceptions. Section four suggests the way forward and provides specific recommendations based on the preceding discussions.

II. EXPANDED ACCESS TO NUCLEAR TECHNOLOGIES: ENSURING ENERGY SECURITY

It is ubiquitous that energy is the mainstay for a functioning global economy. SDG 7.1 aspires for universal access to clean modern energy. It has been reported that more than 790 million people worldwide do not have access to electricity, most of them living in sub-Saharan Africa and developing Asian counties (International Energy Agency (IEA), 2021, 167). This figure gets even worse if the energy's stability, quality, and adequacy are considered. On top of the underlying energy poverty, the world is currently facing an unprecedented "energy crisis" (Englund, 2021). Energy security could mean different things for different countries, depending on the prevailing circumstances and the indicators used. In developing countries, energy insecurity entails a lack of development and perpetual poverty. The European Commission defines energy security as an "uninterrupted physical availability of energy products on the market, at a price which is affordable for all consumers (private and industrial)" (The Commission of European Community 2000). Generally, energy security is ensured where it is adequate, affordable, and reliable (Samantha Ölz, 2007, p. 13).

From the above transpires the common indicators of energy security, which include the availability of supply, price stability and affordability, efficiency, and diversity of sources of supply. Diversity of energy supply is one of the main indicators of energy security due to the fact that "energy systems that are diverse are more resilient and adaptable to shocks in energy supplies" (Ayoo, 2020, p. 15) and reduces the impact of a disruption in energy supply through expanded alternatives (Yergin, Ensuring Energy Security, 2006, p. 76). As a result, investment in nuclear power should be taken as part of the broader energy diversification scheme, alongside traditional energy sources and renewables. Nuclear energy is part of the energy solution (Rhodes, 2018) mainly because it has a high base-load capacity as compared to all other energy sources, it is a reliable source of energy supply because it is less affected by external factors such as bad weather, due to abundance of uranium in the world and relatively speaking, the operation of power plants is less vulnerable to geopolitical shifts. Further, the most recent IAEA report noted that "nuclear energy is increasingly recognized not only as a climate-friendly energy option but also as an enabler of the broader transformation of the energy sector" (International Atomic Energy Agency 2021, p. 2). It further added, "nuclear power, while playing a more modest role, can however help complement and integrate the expected large shares of renewable generation by ensuring energy supply reliability and dispatchability" (Ibid, 3) (emphasis added). With the same token, the safe, secure, and sustainable use of nuclear energy can also help with improving the efficiency of energy since clean and efficient energy "remains the central measure for increasing energy security" (International Energy Agency, 2021, p. 175). According to the Eurobarometer data that was conducted in 2010, "69% of people [in Europe] believe that nuclear makes their country less dependent on energy imports and so increases the security of supply while 50% agree that it ensures lower and more stable energy price' (Organization for Economic Co-operation and Development, 2010, 21). Even though public opinion had dramatically changed, and national policies have shifted following the Fukushima accident, the recognition of the usefulness of nuclear power generation and the need to reduce reliance on external energy supply has remained intact (Kitada, 2016).

It should be stressed that an abrupt and unsustainable energy transition has proven ineffective. Even for

Germany, a country that has embarked on an aggressive energy transition (energiewende) policy for a long, it has been met with setbacks, for it still heavily relies on imported fossil fuels (Wettengel, 2020). More specifically, given that the EU is the largest energy importer in the world and to bring about a 'resilient energy union', the adoption of a holistic energy transition policy appears to be pragmatic. In 2015, the European Union (the EU) adopted a Framework Strategy for a Resilient Energy Union to ensure energy security within the union and connect the member states through energy infrastructure, among others.

The Russian invasion of Ukraine a year ago only revealed the structural problems of energy security in Europe and made the need to ensure nuclear energy an urgent matter more than ever in recent history.

The war has affected global energy security and national policies in multifaceted ways. The World Economic Forum (2022) has noted 6 ways in which the war affected the energy sector across the board: a shock to the system, disruption of the supply chain, energy policy changes, effect on global trade, impact on CO_2 emissions, and a push toward renewables (emphasis added). For instance, Japan, South Korea, and the United Kingdom have explicitly indicated their plan to rely more on nuclear energy, Germany, China, and the European Union revisited their renewable energy policies and the Czech Republic, Romania, and Slovenia passed emergency laws to phase-out coal-fired power plants. Seen against this backdrop, nuclear energy plays a significant role in realizing energy transition in Europe and beyond in the near future.

III. The Main Drivers of Nuclear Taboo, Manifestations, and Its Impacts on Peaceful Uses

A. Main Drivers of the Nuclear Taboo

1) Normative Contestation

Normative contestation is inherently political and subject to political dynamics. In fact, Fennimore (Fennimore, 1996, p. 342) argued that "normative contestation is in large part what politics is all about; it is about competing values and understandings of what is good, desirable, and appropriate in our collective communal life." Competition among norms does not necessarily mean the weakening of the extant norm; rather, it indicates the dynamic nature of the normal cycle. The process of contestation should be taken as an inherent feature of norm evolution. Essentially, even though "behavior violating norms might not necessarily undermine the norm" (Schillinger, 2016, p. 34), many normative changes result from the process of contestation. As such, norm contestation, not political backlash (Deitelhoff, 2020), provides an opportunity to (re)define the meaning and scope of a norm and guide its practical implementation−ultimately leading to norm consolidation. In short, it is principled contestation among different norms, and tensions between norms and social practices that drive a dynamic mic process of norm development and change (Sandholtze, 2008, p. 103).

Normative contestation within the NPT regime is mainly reflective of the structural fault lines inherent in the treaty body itself, in the sense that "what is usually described as the regime's three interrelated "pillars" (non-proliferation, peaceful uses, and disarmament), installed as a result of a "grand bargain" between the different groups of states, constitutes at the same time the regime's fault lines" (Wunderlich, 2018, p. 5). Despite the fact that Art. 4 of the NPT provides that States Parties to the treaty, particularly the developing countries, have inherent (inalienable) right to access nuclear technology through the acquisition and transfer of nuclear information, development of research, and bilateral and multilateral cooperation, contestation still persists among the 3 pillars. This contestation is partly the result of divergent interpretations of what constitutes "inalienable rights", the obligation it entails, and the extent of restrictions on and/ or limitations to the rights therein.

Ergo, the issue is then whether to equally promote the three pillars of the NPT (preserve the grand bargain) or continue giving undue emphasis to some pillars at the expense of others (eventual fracturing of the NPT regime).

It is true, as has been widely observed and empirically proven, that the atoms for peace initiative have, on some occasions, resulted in the proliferation of nuclear weapons (Weiss, 2003); (Kroenig, 2009); (Fuhrmann, 2009). Indeed, it has been widely debated that newcomer nuclear weapons possessor States such as India and Iran have diverted peaceful uses programs to the development of nuclear weapons. Also, it should be noted that there is no nuclear program that is proliferation-proof yet. Be that as it may, only one-third of the countries that possessed nuclear programs have decided to acquire nuclear weapons (Jackson, 2009), which implies that proliferation is a deliberate policy choice. Recognition of an inherent right to access nuclear technology within the same regime alongside non-proliferation and disarmament has retained the salient taboo against nuclear energy and given rise to competing narratives. The taboo towards nuclear power emanates from three interrelated factors.

First, due to the dual purposes of nuclear energy, attempts to both promote and restrict access to nuclear energy for peaceful purposes, in the form of wide-ranging non-proliferation measures, within the same treaty would inevitably lead to a normative contestation. Second, a comprehensive study conducted on the

American people's attitude toward nuclear power shows an interplay between nuclear weapons and nuclear power (Herzog, 2020); that is, a public aversion to nuclear power has in part resulted from the nuclear weapons taboo or the invariable "association of nuclear technology with weapons of mass destruction" (Sokova(eds), 2021, p. 8). Moreover, the long-standing German public's opposition to nuclear weapons (Smetana, 2021) has directly reinforced the stigma attached to nuclear power. In other words, a taboo against nuclear weapons has spilled over to the peaceful uses of nuclear power. Third, as will be discussed shortly, the perpetual state of contestation also feeds into the background knowledge of policymakers and the general public, constantly triggering the negative nuclear image.

Even though the contestation between peaceful uses and non-proliferation is not as pronounced as the one between non-proliferation and disarmament, there is a noticeable and growing contestation out there. It has been widely debated that newcomer nuclear weapons possessor States such as India and Iran have diverted peaceful uses programs to the development of nuclear weapons.

Therefore, the duality of nuclear energy, taking the form of normative contestation and competing narratives, the parallel impact of nuclear weapons taboo on peaceful uses, and the reinforcing background knowledge, have both a direct and indirect bearing on expanded access to nuclear technology for peaceful uses.

2) Background knowledge and the nuclear image

More often than not, political actors make decisions based on their background knowledge, which reinforces their prejudgments and prejudices, for they are deeply "embedded in backgrounds upon which they rarely reflect but that makes reflection for instance, in terms of consequences or appropriateness possible in the first place" (Kornprobst & Senn, 2016, p. 1–2). People generally tend to interpret new information in light of what they already knew, by using background knowledge as an interpretative frame. When it comes to nuclear energy, it is no different; a process of stigmatization of nuclear energy partly emanates from the entrenched background information, which is immortalized by and visualized in powerful symbols. This is so because the world order is underpinned by various forms of symbolic politics (Linklater, 2018) and the well-functioning of society, as Durkheim remarked (Durkheim (1947 [1915]), 231), has been made possible only through a shared web of symbols.

In the realm of nuclear governance, the image of nuclear energy is salient so much so that "the word 'nuclear' would carry a burden of deep, scarcely admitted anxieties" (Weart, 1991, p. 34) and as noted by Kessides and Kuznetsov, "the very word nuclear strikes fear into the hearts of many people" (Kuznetsov, 2012, 1808). That is to say, without making any distinction among the multifaceted uses of nuclear energy, the negative image of nuclear energy is perpetuated through background knowledge, as symbolized in the mushroom cloud and power plant accidents. That is, the taboo against the use of nuclear weapons, by serving as the repository of background knowledge and interpretative shortcut, affects public perception and reinforces general aversion against 'anything nuclear'. The taboo against the use of nuclear weapons, by serving as the repository of background knowledge and interpretative shortcut, affects public perception and reinforces general aversion against 'anything nuclear'.

Even though nuclear energy represents both the symbol of fear and hope (the so-called duality), it is the former image that has dominated the public discourse and States' practice, because the symbol attached to nuclear energy is that of disasters, absolute horror, and the ultimate extinction of the planet. The image of nuclear energy is strongly symbolized in Movies such as "the China Syndrome"; "Chernobyl"; "Godzilla"; and "the Dark Night Rises", and various media framings. Media outlets rarely present a holistic view of nuclear energy, by excessively glorifying only nuclear disasters and accidents. Media narratives have a strong potential to shape public opinion, for good or bad. In China, for example, mainstream media regularly report on the multifaceted contributions of nuclear energy for development while anti-nuclear opinions have rarely been published (Yongxiang Wang, 2014). Consequently, favorable media reports and narratives about nuclear power have led to a positive public opinion toward expanded uses of nuclear energy in China.

3) Public Attitudes toward Nuclear Power

Nuclear disasters have shaped negative public perceptions toward nuclear power. As Rucht (Rucht, 1990, p. 205) has succinctly shown, the nuclear power accidents such as the Three Miles, Chornobyl, and Fukushima have either led to the gestation of new anti-nuclear movements or intensified the pre-existing opposition to nuclear power plants in the United States, France, and Germany. Successive Opinion Polls conducted following the accident at the Fukushima Daichi nuclear power station are testaments to this fact. In Japan, public reactions to nuclear energy are primarily driven by accident risks, whereby the 'percentage holding negative opinions like 'to reduce, to abolish, to stop and no longer use' increased rapidly from May to July 2011 and accounted for 70% and after that, it remained steady" (Kitada, 2016, 1698). Suzuki, who has analyzed the role of lack of public trust, argues that "the loss of public trust is one of the biggest impacts of the Fukushima nuclear accident" (Suzuki, 2019). The effects of recurring accidents are not limited to influencing public perceptions but also serve as a powerful tool to trigger background knowledge and re-

activate the dark image of nuclear power.

Some of the concerns are legitimate, especially those related to the safety and security of nuclear power plants. In this regard, the international community, as spearheaded by the International Atomic Energy Agency (IAEA), has been increasingly enhancing the 'culture of nuclear safety and security'. Needless to state, expanded access to nuclear technology necessarily calls for the safe, secure, and sustainable use of nuclear power.

However, it could be argued that it is public fear rather than the actual accidents, that led, in most cases, to a nuclear power stigma. The public fears, which are essentially dynamic in nature, mainly emanate from perceptions of risk and its assessment. This is not to say that perceptions are irrelevant (as they really do); rather, the fears are not mainly informed by facts and/or scientific evidence.

The general public perception has been (and still is) an opposition against nuclear power with less distinction between peaceful uses and nuclear weapons. This is so because "large parts of the public are still unaware of (or choose not to believe) the potential benefit of nuclear energy to reduce the emissions of climate change related carbon dioxide" (Organization for Economic Co-operation and Development, 2010, 7). Even though some of the fears are justified, "the main risk of nuclear power is the fear of probable disaster, not the objective probability of an accident breaking out" and the higher perceptions of risks have resulted from the lack of trust in the government (Kim, 2018, 3). In Japan and most countries in Europe, a lack of trust in the government plays an additional role in shaping public perception.

Any public reaction to nuclear issues usually starts not from the clean energy that nuclear reactors supply to their household on a daily basis but begins with the distant but powerful "images of sudden, enormous destruction, symbolized in the rising mushroom cloud of a nuclear bomb blast" (Modigliani, 1989, 12), which is, of course, reminiscent of Hiroshima and Nagasaki. Perception of risk is particularly pronounced when it comes to public acceptance of the sitting of nuclear facilities (Anaka, 2004). In most cases, it is a perceived risk rather than an objective reality on the ground that induces antinuclear sentiment and policy responses.

B. Manifestation and Impacts: From Fukushima to Frankfurt

The nuclear taboo, particularly public aversion to nuclear power plants, is manifested in various forms and has evolved over time. Well-organized anti-nuclear movements; polarized debates as to the utility of nuclear power; and policy shifts at national levels are the notable ones. More than anything else, the Fukushima Accident has brought a renewed opposition to nuclear power and profoundly re-activated the negative image of nuclear power, as signified by anti-nuclear movements and policy changes: from Fukushima to Frankfurt. In other words, the legacy of Fukushima is long-lasting and will be here to stay for years to come.

Fig. 1. Opposition against nuclear energy.

Among the enduring manifestations of the contemporary nuclear taboo is the 'Not in My Backyard (NIMBY) Syndrome'. NIMBY refers to "intense, sometimes emotional, and often adamant local opposition to siting proposals that residents believe will result in adverse impacts" (Clary, 1991, p. 300). The NIMBY syndrome, which is partly prompted by the real concern for the safety of nuclear power plants and a related

issue of sustainable radioactive waste disposal, has led to intense parliamentary debates, becoming one of the potent public mobilization strategies (Welsh, 1993). In the aftermath of Fukushima and as embodied in the resurfacing background information and powerful nuclear image, nuclear stigma has been spread through various strategies including 'fearmongering' by opposition political groups and transnational networks of anti-nuclear movements. It should be noted that a decision made by one country has had a domino effect, especially given the transboundary nature of the consequences of nuclear accidents and the transnational form of the anti-nuclear movements. That is precisely what was observed in Europe, which can be deduced from the series of measures taken at national levels in Europe, following the Fukushima Accident. Germany decided to shut down most of the power plants and to gradually phase out the remaining power plants by 2022, then Italy held a referendum in 2011 to say no to nuclear power and soon, the Swiss Parliament followed suit which resulted in the total-phasing out of nuclear power and replaced it with renewable energy sources.

After years of political polarization and skirmishes, most recently, Belgium decided to phase out nuclear power plants. Inevitably, this dramatic turn of events has effectively reinforced the nuclear taboo and significantly affected the contribution of nuclear power in the energy mix, as evident from the steady decline in the share of nuclear power-generated energy.

In a nutshell, the stigma towards nuclear power and negative perceptions have resulted in limited public awareness about the peaceful uses of nuclear technology, including the indirect impact on the non-power applications of nuclear energy. Coupled with the concern of proliferation, the stigma led to a reduction or total phase-out of nuclear power plants, polarized political debates (Suzuki, 2019), visceral opposition to anything related to nuclear and limited access to and sharing of nuclear technology between developed and developing countries.

IV. THE WAY FORWARD

Based on the foregoing discussions and with a view to overcoming the challenge of nuclear taboo and related issues, this section provides some reflections on the way forward.

A. Ethical Approach to Expanded Access to Nuclear Technologies and Science

The laudable aspiration of sustainable development in which no one is left behind cannot be realized without equitable access to nuclear technology and modern science. To this end, the NPT regime, the 2030 Agenda, and the Paris Agreement recognized equity as their guiding principle. One way of expanding access to nuclear technology and science and ensuring sustainable development is through a teleological and progressive interpretation of the NPT12, particularly Article IV. Although some argue that Art. IV was originally crafted to reflect intentional ambiguity (Xinjun, 2006), access to peaceful uses is an inalienable right13, which entails both legal and political obligations. The language of Article IV shows that the peaceful uses pillar has its own inherent values. This was further reinforced by the 2010 Review Conference which partly reads: "The Conference recognizes that this right constitutes one of the fundamental objectives of the Treaty. In this connection, the Conference confirms that each country's choices and decisions in the field of peaceful uses of nuclear energy should be respected without jeopardizing its policies or international cooperation agreements and arrangements for peaceful uses of nuclear energy and its fuel cycle policies" (NPT RevCon, 2010, Para.31), emphasis added). As such, a holistic construction of the NPT should regard Art. IV as one of the fundamental pillars upon which the treaty body was founded and the relationship among the three pillars is not that of rule exception but mutual interdependence. Furthermore, a human rights-based approach to development, whereby access to nuclear technology and science is linked to the norm of the 'right to development', could provide additional impetus. To this end, the UN Declaration on the Right to Development provides: "sustained action is required to promote the more rapid development of developing countries. As a complement to the efforts of developing countries, effective international co-operation is essential in providing these countries with appropriate means and facilities to foster their comprehensive development." (United Nations, 1986, Art.4(1)). Furthermore, the Draft Convention on the Right to Development states that "every human person and all peoples have the inalienable right to development by virtue of which they are entitled to participate in, contribute to and enjoy economic, social, cultural, civil and political develop' (United Nations Human Rights Council, 2020, Art. 4(1)). Thus, the narrative of a human rights-based approach to sustainable development has the potential of enhancing expanded access to nuclear science and technology, particularly in developing countries through international cooperation and sustained actions.

There are two approaches with regard to the interpretation of Art. IV of the NPT: the originalist and purposive (teleological) interpretation. The first holds that the raison d'être of the treaty is the prohibition of proliferation while peaceful uses are an exception, whereas the latter interpretation treats all the three pillars as having inherent values−and hence−they are interdependent in nature. In the legal sense of the term, what is inalienable cannot be given away nor dispossessed at will, for it is an inherent right.

B. Managing Normative Contestation

To begin with, nothing can be done about the duality of nuclear energy in the meantime until such a time that nuclear weapons are both legally and practically banned, and the temptations for proliferation will have waned. Normative contestation is an inherent feature of any legal norm and an integral part of the global political order. However, the process of normative contestation, if not handled timely and adequately, may lead to norm conflict and eventual decay of the extant norm. And of course, the natural outcome of norm decay would be the delegitimization of the existing regime and an emergence of a separate treaty on peaceful uses. We already have a precedent in this regard. The Treaty on Prohibition of nuclear weapons (the TPNW) is the result of an unhealthy normative contestation. Thus, in order to save the global nuclear regime (NPT serving as a cornerstone) and maintain the 'grand bargain', giving due consideration to all pillars of the NPT is imperative.

C. Improving the Nuclear Image and Perceptions

Opposition to nuclear energy, particularly in regard to nuclear power, is grounded in both legitimate concerns and perceptions. The concerns of safety, security, and proliferation could be addressed by strengthening existing legal and political frameworks and mechanisms. One way of doing so is by continuously inculcating the culture of nuclear safety and security, which has evolved over the last decade. To ensure sustainable access to nuclear technology for peaceful uses, the culture of security and safety should be taken seriously, so that the "highest level of safety, security and safeguards" (Sokova(eds), 2021, p. 12) will be materialized. However, the nuclear stigma is also driven by distorted narratives, acute lack of awareness, perceived risk of nuclear energy, and trust deficit. To this end, awareness-raising campaigns, changing narratives through effective and innovative risk communication, and reliance on science to inform national policies are paramount. The good news is that, as the most recent finding has shown, the vast majority of the EU people (to be precise, 86%) believe in science and technology (European Union 2021, 8). Media outreach, grassroots social movements and trust-building measures can shape public perceptions. After all, "knowledge plays a role in reducing the perceived risk of nuclear energy, which finally increases its acceptance" (Kim, 2018, 4). In order to further enhance public confidence and trust, greater transparency and public participation in decision-making processes is paramount.

D. Pragmatic Policy Measures

Given the clear linkage between SGDs and nuclear technology, the urgent need for climate actions, and the looming energy crisis, adopting a pragmatic policy vis-à-vis nuclear energy is an opportune moment. Pragmatism has been reflected in the European Commission's recent report on nuclear power (European Commission, 2021), where scientists have finally concluded that nuclear power is a safe and clean energy source, making it eligible for the EU's Green Finance Taxonomy. In most developing countries, where markets are dispersed, grid infrastructure is poor, access to capital is severely limited and the energy mix is at an infant stage, Small Modular Reactors (SMRs) provide distinct advantages (Black, 2015, p. 92). On top of this, since SMRs "incorporate innovative approaches to achieve simplicity, modularity and speed of build, passive safety features, proliferation resistance, and reduced financial risk" (Kuznetsov, 2012; 1806), they may partly address concerns regarding safety and proliferation. It should be noted, however, that since the SMRs designs are in flux and vary to some degree, safety guidelines should be updated regularly, as pointed out in a recent publication (IAEA 2021).

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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Moges Z. Teshome was born in Ethiopia. He has an LLB degree from Addis Ababa University, Addis Ababa, Ethiopia, in July 2013. He also earned LLM in international criminal justice and human rights from the University of Dundee, United Kingdom, in November 2017; a Master of Advanced International Studies (MAIS) from the Vienna School of International Studies, in July 2021, and currently, he is a Ph.D. student at Vienna School of International Studies/ University of Vienna.

He served as a Lecturer in Law at Haramaya University, Ethiopia, from November 2013 to March 2019. He interned at Vienna Center for Disarmament and Non-proliferation (from May 2021 to January 2022), Vienna, Austria, and International Institute for Peace (from March 2022 to September 2022), Vienna, Austria. And currently, he works as a Research Assistant at the Vienna School of International Studies. He has published three academic articles: (1) Teshome, Moges. (2021). Management of ethnic conflicts: the case of Amhara and Oromo ethnic groups. *Journal of Law and Conflict Resolution*, 12(2), 25–33; (2) Teshome, Moges. *Confronting past atrocities: a critical analysis of the defunct Ethiopian Reconciliation Commission* and (3) Teshome, Moges. (2023). Management of water conflict: Egypt, Ethiopia, and the Blue Nile Basin. *Abbay Journal of Water and Environmental Sciences (AJWES) 1(1*), forthcoming. His research interests include the management of conflicts, international norms, international relations theories, comparative constitutional law, and regional security.

Mr. Teshome is one of the recipients of the Chevening Scholarship 2016–2017 and was previously a member of the Ethiopian Young Lawyers' Association (2013–2015).