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LONDON

# Remaining relevant:
# Why the NPT must address
# emerging technologies

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# The project

Over the past two years, the Centre for Science and Security Studies at King's College London has brought together a unique and diverse range of nuclear stakeholders to explore opportunities for building trust between nuclear possessors, non-possessors, governments and civil society. The goal of the project was to move beyond existing 'siloes' in nuclear thinking, and focus on specific opportunities for collaboration between groups that might seldom talk to each other, let alone agree. Our first report, 'Meeting in the middle: Opportunities for progress on disarmament in the NPT', was published in December 2019 in partnership with Stiftung Wissenschaft und Politik (SWP), the German Institute for International and Security Affairs. The collection of expert papers outlined dozens of potential projects for collaboration between nuclear possessors and non-possessors.

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## About the Centre for Science and Security Studies at King's College London

The Centre for Science and Security Studies (CSSS) is a multi-disciplinary research and teaching group at King's College London that brings together scientific experts with specialists in politics, international relations, and history. CSSS forms part of the School of Security Studies at King's and draws on experts from the Department of War Studies and the Department of Defence Studies. Members of the Centre conduct scholarly and policy-relevant research on weapons proliferation, non-proliferation, verification and disarmament, nuclear security, space security and mass effect terrorism including the CBRN (chemical, biological, radiological and nuclear) dimension. In addition to academic staff, CSSS hosts masters and postgraduate research students, as well as visiting fellows and associates drawn from the academic, government, and business sectors. Our educational activities include contributions to the undergraduate and postgraduate offerings in the Department of War Studies, as well as professional development workshops for industry professionals.

# Executive Summary

Ignoring emerging technology will make the Nuclear Non-Proliferation Treaty (NPT) irrelevant. In an attempt to initiate a wider conversation on the intersection of emerging technology and the NPT, this policy paper addresses three key questions:

1.  Should the NPT address issues of emerging technology?

2.  Does emerging technology increase nuclear risk?

3.  How might emerging technology impact prospects for nuclear disarmament?

Emerging technologies, such as cyber, hypersonics, and cryptography, have the potential to exacerbate existing tensions within the NPT and to undermine progress towards disarmament, by, for example, increasing reliance on nuclear weapons. But these technologies might also offer opportunities for pursuing and achieving the NPT's objectives. While the NPT itself has been slow to take up the issue of emerging technology, academics and non-governmental experts have been developing a rich body of research on these issues and how they intersect with nuclear issues. It is time for these discussions to carry-over to the foundation of the nuclear order, the NPT itself.

This paper offers an ambitious vision for the NPT. Its recommendations for nuclear possessors include incorporating emerging technology into the P5 process, and increasing transparency. But non-possessors and civil society also have important roles to play in this mission. Non-Nuclear Weapon States can launch a Track 1.5 Commission on Nuclear Weapons and Emerging Technology, and civil society can incorporate diverse perspectives, particularly in examining the asymmetric impact of emerging technologies on NPT States Parties. These recommendations would not only contribute to reinforcing the NPT's relevance in an era of rapid change and uncertainty, but also promote cooperation between nuclear possessors and non-possessors.

# Introduction

In 2020, UN Secretary General Antonio Guterres observed, 'Technological advances are moving faster than our ability to respond to – or even comprehend – them.'[1] This rapid rate of technological change has serious implications for the global nuclear order and the Nuclear Non-Proliferation Treaty (NPT), in particular. Emerging technologies might create new non-proliferation challenges, for example, but might also offer new verification technologies. Addressing these developments will require a concerted and cooperative effort by NPT States Parties to ensure technologies do not increase nuclear risk. States also must do more to understand the potential impact of technological change on prospects for nuclear disarmament and on states' commitments to work towards 'general and complete disarmament' and 'cessation of the nuclear arms race at an early date' under Article VI of the treaty.

Some NPT observers have recognised the potential implications of emerging technology on the NPT. For example, at the 2019 NPT Preparatory Committee (PrepCom) the International Committee of the Red Cross (ICRC) cited the risk that, 'command and control systems have become more vulnerable to cyberattacks.'[2] Yet the NPT has been relatively slow to take up issues relating to emerging technologies, such as cyber, hypersonics, space-based capabilities, artificial intelligence (AI), bitcoin or quantum computing. At the most recent PrepCom in 2019, Iceland noted a growing consensus that there is 'an urgent need to apply more energy, more creative thinking and even more resources to the disarmament and arms control efforts, not only when it comes to weapons of mass destruction but also on conventional weapons, emerging technologies and hybrid threats.'[3] Aside from these occasional calls for action, however, States Parties have not fully addressed the impact of emerging technology. As a result there is a gap between civil society's engagement with these issues and how it is addressed in the NPT itself.

To be sure, the NPT agenda is already ambitious and will be further challenged due to delays around COVID-19. In recent years, NPT politics have been defined by polarizing debates around the pathway to disarmament and concern from Non-Nuclear Weapon States (NNWS) that Nuclear Weapon States (NWS) are not making enough progress towards nuclear elimination. Arms control agreements are breaking down, such as the Intermediate-range Nuclear Forces (INF) Treaty and Open Skies Treaty. Emerging technologies have

the potential to exacerbate these existing tensions, as demonstrated in numerous non-governmental studies and as repeatedly warned by academic experts.[4]

Ignoring emerging technology will make the NPT irrelevant. Specifically, emerging technology will affect States Parties' ability to deliver on disarmament and non-proliferation commitments, and potentially increase nuclear risks. Separating this from the NPT will be to the detriment of international security and cooperation. In an attempt to initiate a wider conversation on the intersection of emerging technology and the NPT, this policy paper addresses three key questions:

1. Should the NPT address issues of emerging technology?
2. Does emerging technology increase nuclear risk?
3. How might emerging technology impact prospects for nuclear disarmament?

To answer these questions, I offer a number of demonstrative examples of how emerging technologies *might* impact nuclear risks, disarmament and the NPT. However, whether or not technologies are dangerous or not ultimately depends on their application. The scenarios discussed here are by no means exhaustive, but rather highlight the need for more thinking and cooperative efforts to understand the impact of emerging technology on nuclear politics.

This paper offers an ambitious vision for the NPT. Reinforcing the NPT's relevance in an era of rapid change and technological development will require cooperation by all NPT stakeholders: NWS will have to be more transparent about the impact of emerging technology on nuclear postures, NWS and NNWS alike will have to work cooperatively to reduce risks associated with emerging technology, and the NPT will have to become more agile and update the review process. The COVID-19 crisis has been tragic and a challenge in many ways but has also highlighted opportunities for more flexible and remote work, which can shape a more modern NPT review process. This is indeed an ambitious agenda given the state of nuclear politics, but such a pivot is necessary to prevent further polarisation in the NPT and its demise into a hollow treaty.

# The NPT must address emerging technology

Emerging technology is an increasingly popular topic *outside* of the NPT. Academic and think tank scholarship is exploring the ways in which emerging technologies might impact nuclear risk, many of which are discussed below. This matter has become a prominent talking point in national policies and doctrines. The 2018 U.S. Nuclear Posture Review pointed to growing technological uncertainty and non-nuclear threats to nuclear systems.[5] In his February 2020 speech on French 'Deterrence and Defence Strategy', President Macron cited technological changes, to include cyber and AI, as one of the three paradigm shifts impacting on France's nuclear strategies.[6] While it is important that the NPT take up emerging technology's impact on nuclear issues, expanding this conversation into the NPT is not without challenges.

There are at least three reasons why the NPT has not yet taken up issues of emerging technologies. First, in recent years attention on disarmament has been focused elsewhere. The most recent NPT review cycle, 2016-2020, has had to consider the impact of the Treaty on the Prohibition of Nuclear Weapons (TPNW) on the NPT, the breakdown of arms control agreements and proliferation risks in Iran and North Korea, among other priorities. Second, there has been reluctance in the NPT by both nuclear possessors and non-possessors to include *non*-nuclear weapons in their discussions. This was evident in debates in 2017 and 2018 about whether or not the NPT was the place to discuss the use of chemical weapons in Syria. Questions around non-nuclear technologies, such as missile defences, were typically addressed in bilateral settings. And finally, the NPT is not particularly nimble. Its structures and processes often struggle to adapt to rapidly changing geopolitical and technological developments.

Despite these challenges, however, emerging technologies are an unavoidable reality in nuclear weapons policy bringing both risks and opportunities to all three pillars of the NPT. Numerous experts have pointed to the potential for 3D-printing, or additive manufacturing, to facilitate the production of items prohibited under the NPT. Tristan Volpe of the Naval Postgraduate School, for example, highlighted that 'new innovations can muddy the grey zone between clear civil and military applications of nuclear technology' and that additive manufacturing, specifically, could present compliance challenges for Article II of the NPT[7]. In terms of peaceful uses, new technologies, such as bitcoin, might make nuclear technology more accessible

> ## EMERGING TECHNOLOGIES ARE AN UNAVOIDABLE REALITY IN NUCLEAR WEAPONS POLICY.

for peaceful uses through the International Atomic Energy Agency (IAEA). While this paper deals primarily with pillar 1, disarmament, further research is needed into the impact of emerging technology across the NPT's full set of objectives.

The NPT is not the only treaty to address nuclear issues, of course. Indeed, emerging technology should be considered across the spectrum of nuclear and other disarmament agreements, to include the Comprehensive Test Ban Treaty (CTBT), the Conference on Disarmament (CD) and nuclear weapon free zones. The NPT is a particularly important setting to address these issues, however, because it has two roles, both as a treaty and a forum. Under the NPT, states are committed to specific legal obligations, such as prohibitions on the spread on nuclear technology. Emerging technologies may impact both on states' ability to uphold commitments and on their ability to monitor them. But the NPT review process is often a unique opportunity for nuclear possessors and non-possessors to consider a host of issues impacting the nuclear order and their ability to fulfil their treaty commitments. With regards to disarmament, NWS will not be the only ones impacted by emerging technology. Indeed, NNWS also have an obligation under Article VI, and their development of emerging technologies could also impact on disarmament commitments.

# Emerging technology introduces both nuclear risks and opportunities

On the one hand, emerging technology has the potential to increase ambiguity and complexity around nuclear decision-making, and could therefore increase nuclear risks. On the other hand, emerging technology could provide valuable insights into nuclear doctrine along with additional safety and security measures. Understanding whether or not emerging technology increases nuclear risks, therefore, requires a deeper understanding both of contemporary approaches to nuclear risks and of 'emerging technology'.

Risk reduction has become one of the few areas of consensus within the NPT in recent years. There is general agreement that nuclear risks are rising, and NWS and NNWS alike must cooperate to address threats stemming from renewed geopolitical competition. A 2019 inquiry by the UK House of Lords, for example, concluded that, 'Irresponsible rhetoric, combined with a lack of communication between nuclear possessor states, creates serious risks of nuclear use due to misinterpretation and miscalculation.'[8] In the same year, UNIDIR released a study on nuclear risks, stating, 'Responsible management rather than luck may be the reason for the lack of detonation events over seven decades but changes to that management will be necessary to respond to technological developments across nuclear weapons systems and other systems impinging on the nuclear balance.'[9]

But risk reduction means different things to different stakeholders. For some, such as France, risk reduction is qualified as 'strategic risk reduction' and should focus on misperception and inadvertent escalation between nuclear possessors. Others, such as Irma Arguello of NPS Global in Argentina, take a much broader approach and argue risk reduction must address risks associated with the very existence of nuclear weapons, such as accidents. 'Besides the risks of potential use', according to Arguello, 'the mere existence of the weapons entails more negative impacts. Nuclear-armed states jointly spend around $11 million dollars per hour to maintain their nuclear weapons complexes, and the rate of spending follows an upward trend.'[10] Emerging technologies will impact every point on this spectrum of risk reduction.

Three examples help demonstrate this point. James Acton at the Carnegie Endowment for International

Peace recently outlined an 'entanglement' scenario wherein a cyber attack on command and control could inadvertently escalate to include nuclear threats and, potentially, nuclear use.[11] In such a hypothetical scenario, China, Russia or the United States might use non-nuclear capabilities against nuclear command and control with the intent of degrading conventional assets. However, because nuclear command and control are co-located on satellites along with conventional command and control, the country being attacked cannot know if the attack was targeting conventional or nuclear assets. Taking out communications and intelligence functions could be a precursor to an incoming nuclear attack and pre-empt a country to launch a retaliatory strike, especially if it has a narrow 'window of opportunity'.[12]

In another scenario, nuclear doctrines are increasingly highlighting the potential of non-nuclear attacks leading to nuclear escalation. Ben Buchanan of Georgetown University describes a 'cybersecurity dilemma'. In the process of trying to improve its cyber defenses, many states engage in intrusive cyber activities that could be perceived as 'offensive.'[13] Indeed, cyber attacks can increase uncertainty, ambiguity and misperception, further complicating strategic decision-making. The International Campaign to Abolish Nuclear Weapons (ICAN) notes in a recent briefing paper, 'The increased application of advanced machine learning in defense systems can speed up warfare – giving decision-makers even less time to consider whether or not to launch nuclear weapons.'[14]

However there are also scenarios in which emerging technology could *reduce* nuclear risks, particularly the risks of misperception and inadvertent escalation. Artificial intelligence is much broader than 'killer robots'[15] and is increasingly used in a variety of applications ranging from intelligence collection to drone targeting. Its use in pattern recognition for intelligence purposes is particularly relevant for nuclear decision-making and risks of inadvertent escalation. Artificial intelligence is a, 'brand of computer science that deals with developing hardware and software systems that operate autonomously, perform tasks or discern solutions to complex problems in a human-like fashion, and mirror natural intelligence by emulating neurobiological processes and functions.'[16] What does this look like in practice for intelligence collection? Intelligence

agencies collect massive amount of data from signals and human intelligence and the growing amount of open source material. Machine learning and AI can identify which data is most important, identify patterns and anomalies and predict response to certain actions. This can provide decision-makers with improved information to understand an adversary's behaviour and potential outcomes, even during crises. This type of visibility is unprecedented, but could *reduce* misunderstanding and misperception and increase decision-making time during crises.

To be sure, whether or not emerging technology reduces nuclear risks depends on the technology. The examples discussed here are intended to demonstrate

the complexity of these rapidly evolving technologies and their applications, and to demonstrate how they impact on the NPT's growing interest in risk reduction. The next step for researchers and states should be to identify specific ways in which technology could increase nuclear risks, particularly related to misperception, and strive to mitigate these. Organisations such as the Open Nuclear Network are already leading on these efforts. Research must also explore ways in which technology could reduce risks of misperception and improve nuclear safety and security. In a 2019 report, for example, a team led by Laura Rockwood identified opportunities for blockchain technology to be incorporated into International Atomic Energy Agency (IAEA) practices, many of which are already in operation.[17]

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**IRRESPONSIBLE RHETORIC, COMBINED WITH A LACK OF COMMUNICATION BETWEEN NUCLEAR POSSESSOR STATES, CREATES SERIOUS RISKS OF NUCLEAR USE DUE TO MISINTERPRETATION AND MISCALCULATION.**
UK House of Lords

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**WHETHER OR NOT EMERGING TECHNOLOGY INCREASES NUCLEAR RISKS REQUIRES A DEEPER UNDERSTANDING OF BOTH CONTEMPORARY APPROACHES TO NUCLEAR RISKS AND 'EMERGING TECHNOLOGY.'**

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# Emerging technology impacts on progress towards nuclear disarmament

Emerging technology will complicate progress towards nuclear disarmament. The reasons for this include increased vulnerability to nuclear systems, shifts in the conventional-nuclear balance and changes to nuclear delivery systems. At present there are numerous competing visions for a pathway to disarmament, ranging from a security-driven approach to calls for normative and legal change. Indeed, debates over these pathways and pressure for more progress towards disarmament have dominated recent NPT discussions. Emerging technology will have an impact on all these pathways, but as with the impact on risk reduction, it could help or hinder progress.

Hypersonic technology is poised to increase reliance on nuclear weapons, because increasingly fast means of nuclear delivery could put existing nuclear systems at increased risk. This would very probably inhibit progress towards disarmament. Indeed, a hypersonic arms race is already afoot.[18] In a 2019 paper, Shata Shetty of the European Leadership Network argues that, hypersonic weapons could generate crisis instability and fuel a U.S.-Russia-China arms race.[19] Hypersonic weapons can travel at five times the speed of sound and can carry both conventional and nuclear weapons. China and Russia are particularly interested in hypersonic glide vehicles which are manoeuverable and can evade missile defences, in the same way as cruise missiles do. Russia deployed its Avangard hypersonic missile in 2019, and in a 2018 speech following a missile test, President Putin stated, 'The Avangard is invulnerable to intercept by any existing and prospective missile defence means of the potential adversary.'[20] The hypersonic arms race, arguably, motivates possessor states to continue reliance on nuclear weapons as a deterrent.

A final example demonstrates how emerging technology could support nuclear technology through the use of blockchain and cryptography. In brief, blockchain ensures the integrity of data and verifies that it has not been tampered with. In 2016 the Defense Advanced Research Projects Agency (DARPA) invested $1.8 million in blockchain technology, explicitly stating it could have implications for nuclear command and control.[21] And in March 2020 Finland launched the first blockchain prototype for safeguarding nuclear material.[22] These improvements could contribute not only to reducing the risk of accidents involving physical material, but also to disarmament verification.

At present there are no formal arms control regulations on the intersection of nuclear and emerging technology, and in 2019 Chinese Ambassador Fu Cong acknowledged, 'advances in emerging technologies bring about new security challenges, and the absence of international rules in these new domains is becoming increasingly prominent.'[23] The absence of arms control around emerging technology does not bode well for nuclear disarmament.

Arms control increases transparency and predictability into states' strategic doctrines. In the absence of arms control or regular strategic dialogues, states are more likely to adopt 'worst-case scenario' thinking about emerging technology and how it will intersect with nuclear doctrines and postures. There is a growing body of scholarship on how arms control might incorporate emerging technology,[24] but ultimately this will depend on the technology, its application and geopolitics.[25] In one attempt to develop mechanisms and institutions for arms control in this area the German Ministry of Foreign Affairs and the Stockholm International Peace Research Institute (SIPRI) hosted a conference on emerging technology and arms control in March 2019.[26] These important efforts will have implications on prospects for nuclear disarmament, and therefore should be part of NPT dialogues.

> **ADVANCES IN EMERGING TECHNOLOGIES BRING ABOUT NEW SECURITY CHALLENGES, AND THE ABSENCE OF INTERNATIONAL RULES IN THESE NEW DOMAINS IS BECOMING INCREASINGLY PROMINENT.**
>
> Ambassador Fu Cong

# Recommendations for nuclear possessors, non-possessors and civil society

Emerging technologies are increasingly part of a suite of capabilities for nuclear possessor states. Nuclear doctrines mention non-nuclear technologies, such as cyber, and therefore will impact on states' reliance on nuclear weapons. Paradoxically, a commitment to nuclear disarmament now requires consideration of non-nuclear weapons. In the context of the NPT, pillar 1 discussions on nuclear disarmament must include consideration of these issues. Nuclear possessor states can provide transparency into their strategic doctrines and the intersection of their nuclear and non-nuclear capabilities. Non-nuclear possessors can champion the positive applications of emerging technology and disarmament, such as Finland's research on blockchain and exploring the potential use of cryptography in the International Partnership for Nuclear Disarmament Verification. To reiterate, the NPT is not the only nuclear forum that should address these issues, and other initiatives are considered here.

## Recommendations for nuclear weapon states

In February 2020 the Stockholm Initiative Statement called on, 'Nuclear-Weapon States and Nuclear Possessor States to engage in a structured dialogue to assess, minimize and address nuclear risks', including 'to minimise potential vulnerabilities emerging from disruptive technologies and cyber threats, e.g. on command and control.'[27] Indeed, major advances in emerging technologies are typically taking place in the NWS and therefore nuclear possessors might explore risks and opportunities of emerging technologies in the following ways:

1. **Discuss emerging technology in the context of the P5 meetings.** This would very probably happen organically in the ongoing discussion on doctrine transparency; however, the group should also discuss specific technologies and scenarios in the context of strategic risk reduction dialogues. For example, what are cyber threats to space-based command and control? And are there opportunities to mitigate these risks?

2. **Engage with civil society as part of the P5 process.** The 2020 P5 meeting in London was unprecedented in its inclusivity and diversity of NGO participants. Future P5 meetings should include a panel of experts on emerging technology to explain how such technologies might increase nuclear risks. Given that P5 meetings are typically short on time, such briefings could be done remotely beforehand.

3. **Present conclusions to NPT PrepComs and RevCon.** The P5 has been increasingly open about its activities and provided regular briefings at full NPT gatherings. These should now include information on how they are addressing risks associated with emerging technologies. Additionally, such presentations would be an important opportunity for the P5 to better articulate the impact of emerging technologies on their nuclear postures and deterrence doctrines.

## Recommendations for non-nuclear weapon states

Nuclear possessors are not the only ones responsible for considering risks associated with emerging technology and nuclear weapons. A 2018 report by the Japanese Group of Eminent Persons recommended, 'All States should assess how emerging technologies may complicate strategic stability and increase dangers of nuclear-weapons use, and adopt measures to prevent this; civil society should contribute to these efforts.'[28] Continuing the work of the Group of Eminent Persons will require a concerted international cooperative effort. Nuclear non-possessors can take the following steps:

1. **Establish a Track 1.5 Commission on Nuclear Weapons and Emerging Technology.** The Commission would include representatives from NWS and NNWS alike, along with experts from academia and the private sector. The Commission could identify specific risks of cyber, AI, space, quantum and hypersonics to nuclear disarmament and nuclear use, along with ways these technologies might contribute to disarmament, particularly through disarmament verification.

2. **Highlight the humanitarian consequences.** One important component of this research would be improved understanding of the humanitarian impacts at the intersection of emerging technology and nuclear weapons. For example, might technology be used to increase the lethality and destructiveness of nuclear weapons? And do emerging technologies put certain regions or communities more at risk of nuclear escalation than others?

3. **Flag impact of emerging technology in regional dialogues.** Recent PrepCom Chairs and the RevCon President have made regional outreach

a priority in the NPT review cycle. This should continue for the 2025 review cycle. These regional dialogues offer an opportunity to explore issues and perspectives that may be under-represented in larger NPT forums. Regional dialogues should include a panel of experts in open dialogue on the impact of emerging technology so that everyone can better understand how different actors view recent developments. This might include concern about a hypersonics arms race, but could also point to the opportunities of emerging technology in areas such as peaceful uses and/or nuclear security.[29]

## Recommendations for civil society

1. **Develop publications for NPT diplomats.** Academics and think tanks are increasingly focused on the changing technological landscape and how this might impact on nuclear deterrence and nuclear disarmament. For various reasons, however, this research is not always translated into NPT politics or the NPT review cycle. Non-governmental experts can condense these findings into short policy briefs to be published either as a collected volume or presented at NPT PrepComs and the RevCon.
2. **Organize virtual roundtables.** A state or NGO should organize a series of virtual roundtables with emerging technology experts to highlight this growing body of research and make it more accessible to NPT diplomats.
3. **Address asymmetries in emerging technology.** Emerging technologies are primarily being developed by nuclear possessors and threaten to exacerbate growing divides between NWS and NNWS. Cooperation between nuclear possessors and non-possessors is needed to avoid mistrust. This is something civil society can explore both through research and in organizing conferences and workshops.

## Recommendations for all

Perhaps the biggest challenge to incorporating emerging technology into the NPT is the treaty's modus operandi. The NPT is hardly an agile institution. It provides an indispensable and unique forum for dialogue and transparency among nuclear possessors and non-possessors alike. It is not a decision-making body, but rather affords opportunities for states to explore challenges and opportunities in relation to its commitments under the treaty. To succeed in this mandate, the NPT must take a more flexible approach, otherwise it risks becoming a hollow organization that cannot keep up with geopolitical and technological

shifts. Suggesting that the NPT take on issues relating to emerging technology also presents a practical challenge: the NPT schedule is already fully loaded and many states have a limited capacity to expand their remit. The recommendations below, therefore, will require a delicate and gradual approach:

1. **Shorter PrepComs and RevCons.** The COVID-19 crisis highlighted the scheduling challenges of convening 190 states in New York for four weeks. This crisis has forced NPT diplomats and organizers to adopt new methods of interaction, which will remain valuable beyond the current pandemic. Workshops on emerging technology can be held remotely in advance to inform these dialogues.
2. **Joint research projects.** States should develop joint working papers on the impact of emerging technology on their respective areas of interest. This can be done to inform both national policies and NPT discussions. One benefit of working on such documents in advance is that states can call on non-governmental experts for inputs or review, as well.
3. **Collaborate with other initiatives, especially CEND.** This paper has highlighted the work of numerous other initiatives and individuals working on emerging technology and nuclear weapons issues. These national and multilateral initiatives should provide regular updates in NPT forums, such as the German initiative on emerging technology and arms control. The Creating an Environment for Nuclear Disarmament (CEND) initiative is particularly well-positioned to incorporate the impact of emerging technology across all three subgroups working on reducing reliance on nuclear weapons, strengthening mechanisms and institutions and reducing risks. This paper has highlighted numerous ways emerging technology touches all three themes. As part of their reporting to the NPT, the CEND co-chairs should highlight their findings and discussions on emerging technology and disarmament. The NPT PrepComs and RevCons should include at least one NGO plenary specifically devoted to emerging technology and disarmament, so that these initiatives can report their findings.

# Conclusion

The vision offered here is innovative and forward-looking. The challenges of emerging technologies are not going away, but will only become more complex. The sooner the NPT takes up these issues the more likely it is to reinforce its relevance as the primary institution for promoting nuclear disarmament, non-proliferation and peaceful uses. Indeed, these technological developments may present unique and timely solutions to many of the practical challenges for the NPT, such as disarmament verification.

But there is an additional benefit to incorporating emerging technology into the NPT. Despite fundamental ideological differences about pathways to disarmament, a diverse mix of actors agree that emerging technology poses new challenges to the NPT. This mutual interest can become a catalyst for not only incorporating emerging technology into NPT discussions, but also for promoting cooperation and finding common ground within the NPT review cycle.

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