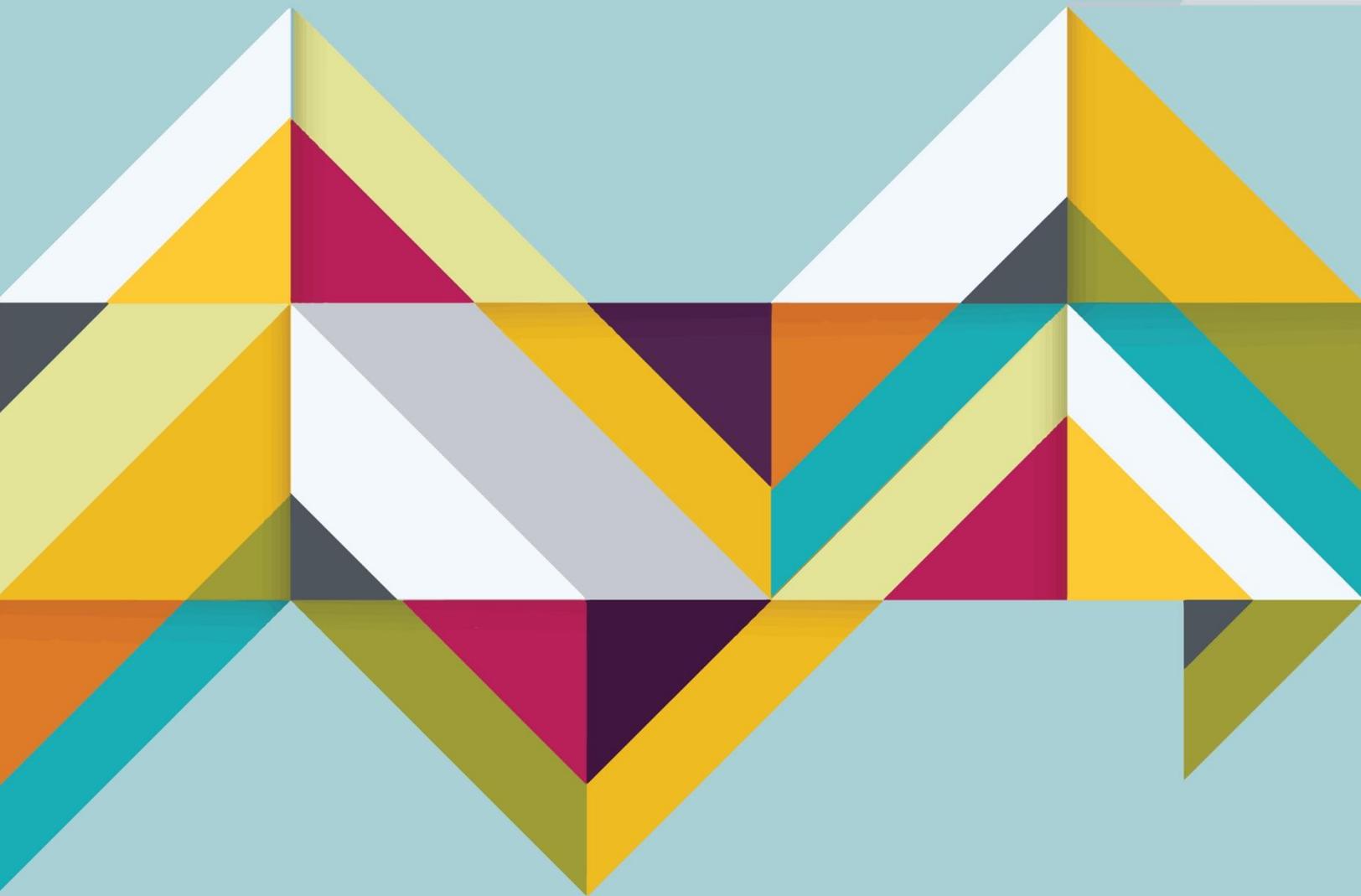


MacArthur Foundation

NUCLEAR CHALLENGES BIG BET



2020 EVALUATION & LEARNING SYNTHESIS

September 2020



EVALUATION & LEARNING TEAM

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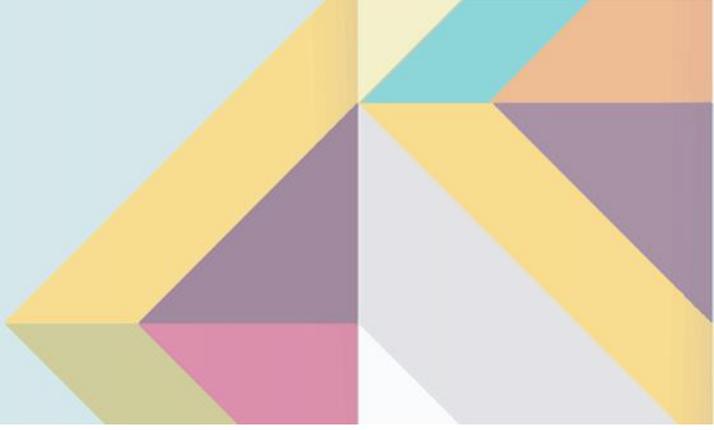
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EXECUTIVE SUMMARY

Introduction

Since November 2017, ORS Impact (ORS) has served as Evaluation and Learning Partner to the John D. and Catherine T. MacArthur Foundation and its Nuclear Challenges team. In this role, ORS has implemented data collection and analysis to help the Foundation understand the status and progress of outcomes and impacts, track developments in the external landscape, frame challenges, and identify opportunities to adjust and strengthen the strategy.

The purpose of this report is to present a strategy-level synthesis of data and findings gathered between May 2019 and June 2020 and facilitate learning and action. The report lays out substantive findings regarding the strategy's outcomes and the external landscape that, together, present a picture of progress to date and are intended to inform ongoing learning and decision making about the Nuclear Challenges strategy. The report also examines the relevance of selected entry points and pathways for the Nuclear Challenges strategy's efforts and, to the extent possible, discusses contribution of the Nuclear Challenges strategy toward intended outcomes. The report sets out to answer three overarching questions:

1. Does progress to date demonstrate momentum and provide a line of sight to significant, meaningful, and sustainable long-term outcomes and impact?
2. Is the theory of change valid and adequate to reach the intended outcomes and impact?
3. Does the landscape suggest continued windows of opportunity for progress toward the Nuclear Challenges strategy's intended outcomes and impact?

Context for the Strategy, Theory of Change, and Implementation

The goal of the Nuclear Challenges strategy is reduced nuclear risk via ceased production and elimination of existing stockpiles of weapons useable material (W-UM). The repercussions of a nuclear detonation—whether accidental or intentional strike—could cause catastrophe at a global scale, significantly impacting the health of humans and other species, as well as climate around the world. The basis of existential risk stems from the material necessary for nuclear weapons, namely highly enriched uranium (HEU) and plutonium. There are inherent risks related to the weapons themselves, as well as risks related to the fuel cycle—meaning the production, storage, and disposal of W-UM.

Globally, management of nuclear risk happens through a governance structure that encompasses shared principles, nations’ domestic policies, bilateral and multilateral treaties and agreements, and countries’ related decision-making processes and behavioral norms—which all together constitute the **nuclear regime**.¹ Good governance within a strong global nuclear regime is critical to addressing the risks posed by W-UM, including risks posed by both weapons and the fuel cycle. Prior to the initiation of the strategy, during U.S. President Barack Obama’s Administration, there was evidence of traction and momentum related to securing the fuel cycle and eliminating W-UM. In one of his first international speeches in 2009, President Obama expressed a vision for elimination of nuclear weapons. Between 2010 and 2016, there was productive multilateral negotiation leading to the reduction or complete elimination of many countries’ held W-UM.² Despite challenges and tensions as the strategy was initiated, the nuclear regime was believed to be stable enough to allow continued progress toward the desired impact of ceased production and total elimination of W-UM globally. However, following the 2016 election of Donald Trump as U.S. President, there were significant concerns, based on promises made during the campaign and following Trump’s election, that his Administration would disrupt or harm the nuclear regime. As of 2017, a heightened, explicit focus for the Nuclear Challenges strategy is to protect

¹ The Nuclear Challenges strategy draws on Krasner’s widely accepted definition of regime: “sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors’ expectations converge in a given area of international relations.” (See: Krasner, S. “Structural Causes and Regime Consequences: Regimes as Intervening Variables.” In Krasner, S., ed., (1983). *International Regimes*. Ithaca: Cornell University Press.)

² Countries may also hold W-UM that has been deemed excessive to the requirements of nuclear weapons programs but is nonetheless stored within a country’s borders. The United States and Russia have each declared significant amounts of highly enriched uranium (HEU) and plutonium as excessive to military requirements. Under the Megatons to Megawatts agreement between the United States and Russia, concluded in 2013, Russia agreed to down-blend 500 tons of HEU originally produced for weapons into low-enriched uranium (LEU) to be sold to the United States to fuel nuclear power generation.

and strengthen the nuclear regime to mitigate risks and realize continued progress toward ceased production and elimination of W-UM.

A central hypothesis of the Nuclear Challenges theory of change is that if the fuel cycle is secured, W-UM production ceased, and stockpiles minimized in certain countries and regions, there is a greater likelihood of eliminating all W-UM globally. A second and related hypothesis is that if the nuclear regime, which is currently under strain, can be sufficiently protected, stabilized, and strengthened, there will be windows of opportunity to advance a set of agreements that would drive ceased production and elimination of W-UM globally. These two intertwined hypotheses reflect the dual pathways by which the strategy pursues impact: efforts related to the fuel cycle occur within the nuclear regime, and thus influence and are influenced by the nuclear regime's strength and stability.

To realize its goal of reduced nuclear risk via ceased production and elimination of W-UM stockpiles globally, the Nuclear Challenges strategy supports activities that both: (1) **protect, stabilize, and strengthen the nuclear regime;** and (2) **assure safety and security across the processes related to production, storage, and disposal of W-UM.** This combination of regime- and fuel cycle-focused efforts is believed to be necessary to realize the strategy's end goal.

The theory of change identifies three approaches: (1) develop and advance policy solutions, i.e., develop a fund of credible, viable, and innovative policy-relevant ideas and share these with governmental decision makers;³ (2) enhance relationships among key actors, i.e., via pursuit of opportunities for bilateral and multilateral dialogue that foster trust and goodwill; and (3) increase the capacity of actors in the nuclear field.⁴ These approaches applied to the five modules will contribute to a more stable regime in which the three core regime principles (disarmament, nonproliferation, and peaceful uses) are upheld, and there is widespread agreement and commitment by countries toward the strategy's end goal.

The five modules (and related components) represent critical countries and relationships believed to play a significant role in the stability of the nuclear regime and advancement of

³ In light of lobbying restrictions applicable to private foundations, the Foundation is careful to ensure that the grants it makes comply with the applicable lobbying laws. Under the laws, the Foundation provides project support to a charitable organization that might in fact lobby if the Foundation receives a budget that reflects a breakdown between the non-lobbying expenses of the project and any lobbying expenses, the Foundation grant is less than the non-lobbying expenses, and none of the Foundation funds are earmarked for lobbying. Alternatively, the Foundation prohibits the grantee from using the Foundation's funds to lobby but a grantee could use other funds to participate in lobbying activity within the legally accepted limits.

⁴ Approaches encompass a cohesive set of activities that together are expected to catalyze or contribute to change. Modules reflect the places or spaces in which the Nuclear Challenges strategy's approach, or pathways, are focused to advance outcomes.

ceased production and elimination of W-UM due to their existing weapons or W-UM stockpiles and/or the risks that potential proliferation poses to global nuclear security. The five modules are: United States (U.S. Congress, U.S.-Russia, Fuel Cycle, and Weapons Policy components), Tough Cases (Iran and North Korea components), Possessor/Non-Possessor Tensions, Threshold Countries (Fuel Cycle and Weapons components), and Global Fuel Cycle.⁵

Regime-focused investments cut across module components, though much of the effort is concentrated within certain areas where investments are believed to offer the best opportunity for progress in the near term. Other module components relate to the fuel cycle, because these investments are believed to offer the best opportunity to realize more secure, reduced, or ceased W-UM production or reduced or eliminated W-UM stockpiles in key countries and regions. Module components focused on the regime and fuel cycle are shown in the table on page 6.

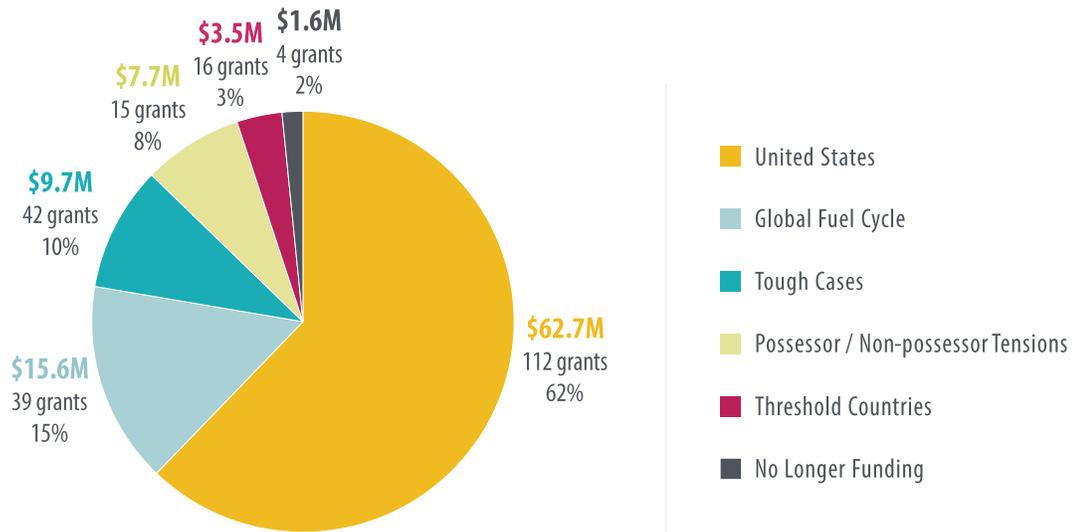
Between October 2014 and June 2020, the Nuclear Challenges strategy made 228 grant investments to 88 organizations, totaling \$100.8 million (as shown in the figure on page 5). In addition, the Nuclear Challenges strategy includes non-grantmaking activities, such as field leadership by MacArthur Foundation staff, grantee convenings, and opportunities for grantees to build communications skills.⁶ Following a strategy pivot endorsed by the Foundation's Board of Directors in 2017 there was increased investment in the regime pathway, both in terms of total grants and investments and the proportion of overall grants. Increased grant investment was the major change reflected by the strategy pivot; there were no significant adjustments to approaches, modules, or expected outcomes in response to the changing landscape and increasingly palliative (rather than transformative) opportunities.

⁵ As part of a robust due diligence process, the MacArthur Foundation assesses its grantees' compliance with applicable anti-terrorist financing and asset control laws, regulations, rules, and executive orders. The Foundation also has provisions in its grant agreements addressing necessary compliance.

⁶ In 2014 and 2015, MacArthur Foundation staff recommended a series of W-UM-related grant awards in the International Peace and Security program that were approved prior to the Board formally endorsing the Nuclear Challenges strategy in December 2015. These grants contributed to the strategy and thus are captured in the figures, which show grants made up to June 24, 2020.

Nuclear Challenges Grants, October 2014 to June 2020, by Module⁷

Total Grants and Dollar Amount:
228 grants, \$100.8M



⁷ The “no longer funding” category reflects grants that had been initially supported through the International Peace and Security program, including work focused on India-Pakistan security, which were discontinued following the 2017 strategy pivot.

Nuclear Challenges Strategy Pathways, Modules, and Components

MODULES	PROBLEM ADDRESSED	CHANGE EXPECTED ⁸
REGIME PATHWAY MODULES / MODULE COMPONENTS		
United States: U.S.-Russia	U.S.-Russia relations are volatile. Within this context the strategy seeks to mitigate or slow down negative developments to prevent further deterioration toward greater risk.	Stabilizing/ Palliative
United States: U.S. Congress	U.S. leadership on nuclear issues exists outside of the executive branch. Building awareness and support for nuclear issues within the U.S. Congress supports broader U.S. nuclear leadership.	Transformative
United States: U.S. Weapons Policy	Strong and visible U.S. leadership regarding regime principles is vital to reversing negative nuclear policy trends at home and supporting productive, regime-aligned bilateral and multilateral nuclear diplomacy.	Stabilizing/ Palliative
Tough Cases: Iran	If Iran withdrew from the Joint Comprehensive Plan of Action (JCPOA), it could lead to a resumption of Iran’s W-UM production. It is important to pursue solutions that ensure Iran’s nonproliferation in any scenario related to the JCPOA.	Preventive/ Stabilizing
Tough Cases: North Korea	North Korea possesses nuclear weapons and has made threatening statements regarding their use. Diplomatic solutions will potentially mitigate nuclear risks posed.	Stabilizing/ Palliative
Possessor/Non-Possessor Tensions	Alleviating tensions between nuclear possessor and non-possessor states is important for ensuring continued nonproliferation.	Stabilizing
Threshold Countries: Weapons	For certain countries whose behaviors could influence others, continued alignment to regime principles, particularly nonproliferation, is especially important.	Stabilizing
FUEL CYCLE PATHWAY MODULES / MODULE COMPONENTS		
Global Fuel Cycle	W-UM production and stockpiles in countries across the world are sources of nuclear risk. It is important to advance policies and agreements that lead to secured, ceased production of W-UM and eliminated stockpiles.	Transformative
Threshold Countries: Fuel Cycle	South Korea, Japan, and Germany all hold supplies of W-UM, and the capacity to produce more. It is important to pursue solutions for ceased production and elimination of stockpiles within these countries, and agreements regarding peaceful uses of nuclear energy.	Transformative
United States: U.S. Fuel Cycle	The United States has one of the largest stockpiles of W-UM of any country, and its policy position has an outsized impact on global norms. It is important to advance supportive W-UM policies within the United States.	Transformative

⁸ Per Liz Ruedy, palliative gains mitigate a declining status quo; stabilizing gains are equivalent to “holding the line”; and transformative gains signal a positive directional shift in the status quo. See: <https://democracyfund.org/idea/six-models-for-understanding-impact/>.

What Are We Learning?

1. Does progress to date demonstrate momentum and provide a line of sight to significant, meaningful, and sustainable long-term outcomes and impact?

PROGRESS TO DATE

Evidence of progress related to the **regime pathway** indicates:

- **Nuclear Challenges grantees' efforts have contributed to a reservoir of solutions regarding nonproliferation, disarmament, and peaceful use** within the United States and among a range of key countries (e.g., Russia, North Korea, Iran, threshold countries, and nuclear possessor and non-possessor states). These solutions have reached senior staff of congressional members and other offices within the Administration.
- **There has been progress regarding some aspects of U.S. leadership and engagement on nuclear issues, although primarily only among a small number of congressional members. What legislative action there has been related to pro-regime positions and policies within the U.S. Congress has been *mostly palliative or stabilizing in relation to the status quo*.** Congressional dialogue and action are highly partisan; it is difficult to interrupt this pattern to enhance a wider nuclear dialogue or to increase the overall number of members of Congress (MOCs) who are pro-regime. In part due to partisan dynamics, there has been limited legislation within the U.S. Congress related to regime-supportive positions or policies.
- **Beyond Congress, there is evidence that grantees have helped to inform and, in some cases, advance policy development across a range of relevant U.S. departments; however, there have been challenges in influencing top executive branch officials and the Executive Office of the President.** This is primarily because the Trump Administration questions the value of multilateralism and has sought to undermine previously negotiated agreements and treaties.
- **Grantees have helped to keep bilateral and multilateral communication and dialogue channels open.** Grantees have effectively supported dialogue, cooperation, and pursuit of regime-supportive solutions among a range of key countries through their support of bilateral and multilateral diplomacy. This reflects palliative progress; grantees have helped to mitigate ongoing degradation of the regime's treaty architecture over the period of the

strategy's implementation—during which multiple nuclear treaties and agreements have collapsed or are under significant strain and there has been profound disruption stemming from the current U.S. administration. There is, however, little evidence of transformative changes that would be necessary to counter these strains.

- **Efforts to enrich U.S. policy debates and create spaces for productive bilateral and multilateral dialogue have been valuable, and investments have resulted in progress against some of the short-term outcomes.** Investments have translated to advancement of some though not all short-term outcomes that ostensibly reflect building blocks toward a stabilized nuclear regime. This is partly a reflection of the limited role that civil society can play *beyond* providing advice and creating space for productive dialogue, especially when windows for policy advancement have become increasingly narrow.
- **There is no evidence that the regime is becoming stable enough to enable advancement of the strategy's longer-term outcomes.**

Evidence of progress related to the **fuel cycle pathway** indicates:

- **Collectively, grantees have produced a deep reservoir of credible, significant, policy-focused research and analysis to make the case for minimizing use and production of HEU and plutonium and provided practical pathways for country-level W-UM policy reflective of the strategy's desired impact.** Several strong examples connect grantees' work to country-level policy action focused on security and minimization of W-UM.
- **There is evidence of policymakers' increased awareness about beneficial W-UM policies reflective of the regime principles.** Grantees' reputations and tenure in the field have yielded numerous opportunities to engage directly and substantively with key officials to build their awareness and support for country-level W-UM policies that uphold the regime and advance toward the desired impact. Outside of the intergovernmental bodies such as the United Nations (UN), grantees have most frequently engaged with country-level officials from the United States, although there has also been some direct engagement with officials from other countries or regions including Asia (Japan, South Korea, China), South America (Brazil), and the Middle East (Saudi Arabia).
- **When conditions have been conducive—meaning decision-making bodies have actively considered consequential W-UM policies—grantees have taken advantage of opportunity windows and contributed to discrete, country-specific policy actions that represent incremental progress toward W-UM minimization.** Four examples illustrate supportive policy action and grantees' contributions in the United States, Japan, and Finland:
 - Closure of a South Carolina plutonium reprocessing (mixed-oxide, or MOX fuel) facility;

- The decision to allocate research and development funding to explore the feasibility of converting U.S. naval submarines from HEU to low-enriched uranium (LEU) fuel;
 - Emergence of viable solutions for Japan’s excess plutonium reserves; and
 - Pursuit of viable and credible long-term W-UM storage solutions in Finland.
- **Grantees have contributed to the development and advancement of multilateral policy solutions that address major W-UM issues, although thus far, political will to adopt such solutions globally has been lacking.** Among these efforts was pursuit of a Fissile Materials Cutoff Treaty (FMCT) within the UN Conference on Disarmament and a proposed regional HEU moratorium in Latin America. Grantees have engaged directly with officials to promote these solutions and convened spaces for productive dialogue and discussion, but so far, neither measure has advanced to a stage of formal negotiations.

ASSESSMENT OF LINE OF SIGHT

Assessment of line of sight is meant to surface whether progress to date indicates a clear likelihood of advancing and achieving the outcomes of the Nuclear Challenges theory of change. The sequential progression of outcomes identified in the theory of change illustrates belief that the Nuclear Challenges strategy’s investments will result in short-term outcomes that, along with ongoing investments, help create enabling conditions for intermediate-term outcomes, including a strengthened and stabilized nuclear regime by 2025. A sufficiently strong and stabilized nuclear regime combined with ongoing Nuclear Challenges investment will, in turn, enable progress toward the long-term outcome of a negotiated W-UM agreement by 2030. That agreement would result in ceased production and elimination of W-UM stockpiles, the ultimate impact sought by the Nuclear Challenges strategy.

Line of Sight: Regime Pathway

Evidence to date is mixed regarding line of sight toward regime-related outcomes. On the positive side, for the stabilized nuclear regime intermediate outcome, two of four measures (the number of weapons countries and the number of nuclear weapons held globally) have not adversely changed. That said, it is hard to identify any contributory links between Nuclear Challenges investments (credible policies and solutions, and productive spaces for track 2 and track 1.5 dialogue) and these weapons-related measures of regime stability at this stage of the strategy’s development.

While Nuclear Challenges investments related to policy development and productive dialogue—which largely reflect palliative and to some extent stabilizing changes—have been important, it is not clear, based on the evidence to date, that those forms of investment will catalyze other

transformative outcomes that require political will and alignment between key leaders, and supportive decisions within the highest echelons of government to pursue more regime-positive policies. In addition, there has been degradation of treaties, agreements, and norms that are aligned with and uphold the nuclear regime (for example, the U.S. withdrawal from the Intermediate-Range Nuclear Forces Treaty (INF), the Treaty on Open Skies, and the Joint Comprehensive Plan of Action (JCPOA); and the risk that New START, the remaining U.S.-Russia bilateral arms control treaty, may not be renewed). Compared to the situation at the inception of the strategy, the nuclear regime is considerably weaker today and it is unclear if the current mix of investments (either between now and 2025 or on any other timeline) will be able to prevent further degradation of the regime, or result in a sufficiently stable regime to the extent needed to realize the long-term outcome identified in the theory of change and the strategy's desired impact.

Nuclear Challenges investments have addressed some important new areas of nuclear policy development and support to increase the effectiveness of the field and expansion of networks, particularly by reaching beyond the traditional nuclear field and its related orthodoxies. However, it is too early in the cycle of investment to assess the extent to which supported efforts might result in significant policy alternatives or advancements (for example, alternatives to deterrence) or new or strengthened intra- or cross-field relationships and approaches that could propel the strategy toward intermediate and long-term outcomes.

Overall, there is not a clear line of sight to intermediate outcomes, including a stabilized nuclear regime, by 2025—unless the landscape evolves in ways that facilitate progress, and there are changes to the strategy's theory of change and investments.

Line of Sight: Long-Term Outcome and Impact

Progress to date does not provide evidence of a line of sight toward long-term strategy outcome or desired impact. While grantees contributed to a proposed FMCT that, if enacted, could have led to the cessation of global W-UM production, progress on the FMCT has stalled and prospects for renewed progress are at best uncertain. Further, it is not clear that grantees are well positioned to address the factors that have led to the stall. Thus, despite early progress toward a negotiated agreement that would eliminate global W-UM stockpiles, there are no positive signs regarding further progress on the FMCT nor is there evidence of a clear multilateral mechanism through which such an agreement would be negotiated and adopted.

Progress to date suggests that grantees can influence and contribute to beneficial W-UM policy decisions within the context of specific countries, and there are a few examples of grantees' efforts linked to changes in country-level W-UM stockpiles or production. Despite these positive

developments, it is not clear how or to what extent these country-level wins set the stage for a future negotiated global agreement regarding W-UM.

2. Is the theory of change valid and adequate to reach the intended outcomes and impact?

The Nuclear Challenges theory of change lays out an expected sequence of outcomes to which the strategy's collective investments are hypothesized to contribute. Outcomes correspond with efforts to protect, stabilize, and strengthen the nuclear regime and secure the fuel cycle.

Certain aspects of the theory of change are valid, primarily the link between the strategy's approaches and expected short-term outcomes. There is evidence that within the regime and fuel cycle pathways, grantees' case-making analysis and recommendations, along with efforts to build and enhance relationships and communications channels between experts and governmental officials, have led to officials' greater awareness and engagement, and have maintained key (increasingly fragile) bilateral and multilateral communications. There is also evidence indicating that grantees' efforts have helped generate and support productive bilateral and multilateral discussion and nuclear dialogue. Evidence also shows that grantees' efforts have contributed to incremental policy gains related to securing the fuel cycle and minimizing W-UM outside of nuclear arsenals.

Evidence is weaker regarding the linkage between short-term outcomes and the intermediate outcome of stabilized regime, believed to be achievable by 2025. Although no timeline is specified for realization of other intermediate outcomes, the story is similar. Data across modules do not offer strong evidence that short-term changes realized to date are adequate to influence intermediate-term regime-related outcomes.

There are many potential reasons; limited progress could reflect the difficult external environment. It could also be that data and analysis are insufficient to surface and explain connections between the strategy's investments and approaches and their contributions to protecting and strengthening the nuclear regime, the strategy's current focus. Limited progress could also signal gaps in the theory of change's logic and coherence which, if considered, might be addressed and remedied so as to usefully guide grantmaking toward outcomes—particularly the logical linkage between approaches, short-term outcomes, and intermediate-term outcomes and the degree to which investments within modules cohesively address outcomes. The state of progress may also indicate that there are aspects of the theory of change that are still formative and could be more fully conceptualized, such as developing credible alternatives to deterrence

theory, and between these outcomes and the likelihood of advancing other module and strategy outcomes.

3. Does the landscape suggest continued windows of opportunity for progress toward the Nuclear Challenges strategy's intended outcomes and impact?

The Nuclear Challenges strategy is taking place in a highly dynamic landscape. Over the course of the strategy's implementation, there has been growing turbulence in the nuclear regime, affecting relationships and alliances, security concerns, and willingness and motivation toward cooperation. A number of current significant uncertainties have implications for the strategy, including the U.S. presidential election in November 2020; the dynamics related to the global coronavirus pandemic and resulting economic downturns which will likely add to domestic stressors and countries' positions vis-à-vis their own security; and, the degree to which countries will be inclined to stand by the Treaty on the Nonproliferation of Nuclear Weapons (NPT) and maintain commitments amid the current turbulence.

Windows of opportunity related to the **regime pathway**:

- There are opportunities for **continued development of U.S. nuclear leadership**, including building leaders' support for regime-aligned policy options and engagement by a range of officials. Another opportunity is continued efforts related to dialogues that help to maintain U.S. security alliances and relations.
- A tumultuous relationship between the United States and Russia has continued to deteriorate—with implications for the regime. Navigating the challenges in the relations between the two largest nuclear possessors in the landscape will be difficult. Grantees' best opportunities to be influential within the regime are efforts to **bolster and sustain the NPT**. With their built-in role in the NPT's preparatory and review conferences, civil society organizations are well-positioned to bring influence to bear with parties to the treaty, including nuclear possessor and non-possessor states.
- There are opportunities for the MacArthur Foundation to continue to explore **alignment among nuclear funders** and potentially leverage existing or new investments to support and enhance regime-related efforts.

Windows of opportunity related to the **fuel cycle pathway**:

- The United States and Russia have designated some stored HEU and plutonium as excess to military needs, which means these materials could be down-blended or disposed. While neither country has yet taken significant steps to follow through on dispensation agreements, there are opportunities to pursue this outcome.
- Japan has issued positive statements signaling its commitment to dispose of plutonium stockpiles.
- Driven largely by commercial interests, there has been much research and development toward new reactor technologies. While not all will be viable, new reactor models are likely and many more countries could acquire them for energy production. The risks and policy implications of these new reactor technologies and their use on a global scale are not currently well understood. Ultimately, the Nuclear Challenges strategy and its grantees could contribute to the development of a framework for managing and minimizing the risks associated with new reactors where one does not currently exist. These efforts could also link those of adjacent fields that address climate change.

Conclusion

In the context of a shifting and challenging international security environment, the Nuclear Challenges strategy aspires to achieve ceased production and eliminated stockpiles of W-UM globally via a negotiated multilateral agreement.

Since its initiation in 2015, the Nuclear Challenges strategy has invested in advancing dual pathways related to stabilizing the regime and securing the fuel cycle. The analysis reflected in this report indicates the Nuclear Challenges strategy has been able to effect progress at the short-term outcome level across the dual pathways. These important areas of investment have resulted in credible policy solutions, engagement on nuclear issues among a selection of key governmental actors, and a degree of increased capacity among actors in the nuclear sector.

Importantly, the Nuclear Challenges strategy has allowed civil society actors in the field to continue to have an important voice in policy-related processes, including those related to W-UM, and to provide critical insights and solutions to challenging U.S. domestic nuclear policy issues and bilateral and multilateral nuclear diplomacy efforts. These investments have resulted in a palliative effect on the regime. Realizing progress toward regime-focused intermediate-term outcomes, believed to be achievable by 2025, has proved more challenging. This is partly because of the complexity of the landscape but may also reflect some weaknesses in the theory of change that, if addressed and remedied, could increase or amplify progress.



INTRODUCTION

Since November 2017, ORS Impact (ORS) has partnered with the John D. and Catherine T. MacArthur Foundation to evaluate the theory of change for the Nuclear Challenges strategy, one of the Foundation's three Big Bets. As Evaluation and Learning Partner, ORS is responsible for providing feedback about the Nuclear Challenges strategy, measuring progress, and offering constructive critiques to inform decisions and refinements made by the Foundation. ORS has implemented data collection and analysis to help the Foundation understand the status and progress of outcomes and impacts, track developments in the external landscape, frame challenges, and identify opportunities to adjust and strengthen the strategy.

Previously, ORS produced several technical briefs addressing specific components of the strategy and the external landscape.⁹ The purpose of this report is to present a strategy-level synthesis of data and findings and facilitate learning and action. The report summarizes evaluation and learning evidence gathered by ORS between May 2019 and June 2020. The evidence explores progress to date, as well as factors in the broader landscape that could affect the hypothesis about how the Nuclear Challenges strategy will advance and contribute to reduced nuclear risk or facilitate or impede the Nuclear Challenges strategy's work. The paper also examines the relevance of selected entry points and pathways for the Nuclear Challenges strategy's efforts and, to the extent possible, discusses contribution of the Nuclear Challenges strategy in promoting reduction of nuclear risk.

⁹ Technical briefs produced by ORS summarized early findings within several Nuclear Challenges modules, status of and progress toward impact measures, and discrete landscape factors.

This report sets out to answer three overarching questions:

1. Does progress to date demonstrate momentum and provide a line of sight to significant, meaningful, and sustainable long-term outcomes and impact?
2. Is the theory of change valid and adequate to reach the intended impact?
3. Does the landscape suggest continued windows of opportunity for progress toward the Nuclear Challenges strategy's intended outcomes and impacts?

Evidence and interpretation that addresses these questions is provided in the section titled *What Are We Learning*. More detailed evidence addressing each of the module and strategy outcomes and associated measures is provided in the Appendix. This paper also presents an overview of the Nuclear Challenges theory of change, describes the strategy's implementation to date, and provides an overview of the evaluation and learning framework, including the evaluation design, sources of data and evidence, and the methods employed.¹⁰

Findings and evidence presented in this report represent the specific time period in which data were collected. The paper includes reflection on key developments and their implications for the future of the strategy. We acknowledge that since data collection for this report concluded, there have been further developments and continued evolution in the external landscape that have implications for nuclear issues and the Nuclear Challenges strategy and investments.

¹⁰ More comprehensive information regarding evaluation design, findings, methods, and data collection is provided in the Appendix to this report and Annexes 1 (Summary of Methods) and 4 (Evaluation and Learning Framework).



CONTEXT FOR THE STRATEGY

The goal of the Nuclear Challenges strategy is to reduce nuclear risk via ceased production and elimination of existing stockpiles of weapons useable material (W-UM). The repercussions of a nuclear detonation—whether accidental or intentional strike—could cause catastrophe at a global scale, significantly impacting the health of humans and other species, as well as climate around the world.

The basis of existential risk stems from the W-UM necessary for nuclear weapons, namely highly enriched uranium (HEU) and plutonium.¹¹ There are inherent risks related to the weapons themselves, as well as risks related to the fuel cycle, i.e., the series of processes necessary for the production, storage, and disposal of W-UM.¹²

¹¹ The vast majority of W-UM is held by a small number of countries. While most W-UM is designated for military (weapons) purposes, countries may hold small amounts of W-UM for non-military purposes, primarily energy and medical research, or for use as naval submarine fuel.

¹² The risks related to the fuel cycle include the potential for accidents, theft of unsecured material, and environmental damage.

Globally, management of nuclear risk happens through a governance structure that encompasses shared principles, nations' domestic policies, bilateral and multilateral treaties and agreements, and countries' related decision-making processes and behavioral norms—which all together constitute the nuclear regime.¹³

Three core principles express the fundamental values that undergird the regime:

- **Nonproliferation:** nuclear weapons possession does not spread or increase
- **Disarmament:** reduction toward elimination of nuclear weapons stockpiles
- **Peaceful uses:** applications of nuclear technology for peaceful purpose such as power production and medical diagnosis and treatment

These principles are enshrined in agreements such as the Treaty on the Nonproliferation of Nuclear Weapons (NPT), entered into force in 1970 and widely considered to be a cornerstone of the nuclear regime.¹⁴ Under the NPT, most countries have decided against acquiring W-UM and building nuclear weapons; in exchange for their restraint, non-possessor states have historically received assistance with security and peaceful uses of nuclear material, e.g., for energy production. This long-standing norm forms the basis of a so-called “grand bargain,” designed to lower countries' incentives to produce or acquire nuclear weapons to shore up their own security.¹⁵

The strength of the nuclear regime is dependent on countries upholding and supporting its core principles and corresponding behavioral norms; if countries do so, then the architecture of the regime is more likely to remain stable and strong. If countries violate or fail to honor the regime's core principles (with the United States and Russia having an outsized effect in this regard), the strength and stability of the regime are threatened. As commitment to core principles falters, historic alliances become strained, treaties and agreements unravel, behavior norms are disrupted, and there is growing destabilization within the nuclear regime. Under these conditions, countries that have not done so previously could be more inclined to seek or produce W-UM or

¹³ The Nuclear Challenges strategy draws on Krasner's widely accepted definition of regime: “sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations.” (See: Krasner, S. “Structural Causes and Regime Consequences: Regimes as Intervening Variables.” In Krasner, S., ed., (1983). *International Regimes*. Ithaca: Cornell University Press.)

¹⁴ Nuclear nonproliferation, disarmament, and peaceful uses reflect the three core principles of the nuclear regime. In addition to enshrining these principles, the NPT also established a safeguards system to verify that nuclear material and technology intended for peaceful purposes (such as energy production) is accessible and is not diverted for weapons. Besides the NPT, other treaties and agreements that constitute the regime's architecture include the Comprehensive Test Ban Treaty (CTBT); the Joint Comprehensive Plan of Action (JCPOA), and bilateral treaties such as the Intermediate Range Nuclear Forces (INF) treaty and the New Strategic Arms Reduction Treaty (New START).

¹⁵ Weiss, L. (2012). Retrieved 6/29/2020 from: https://www.armscontrol.org/act/2003_12/Weiss

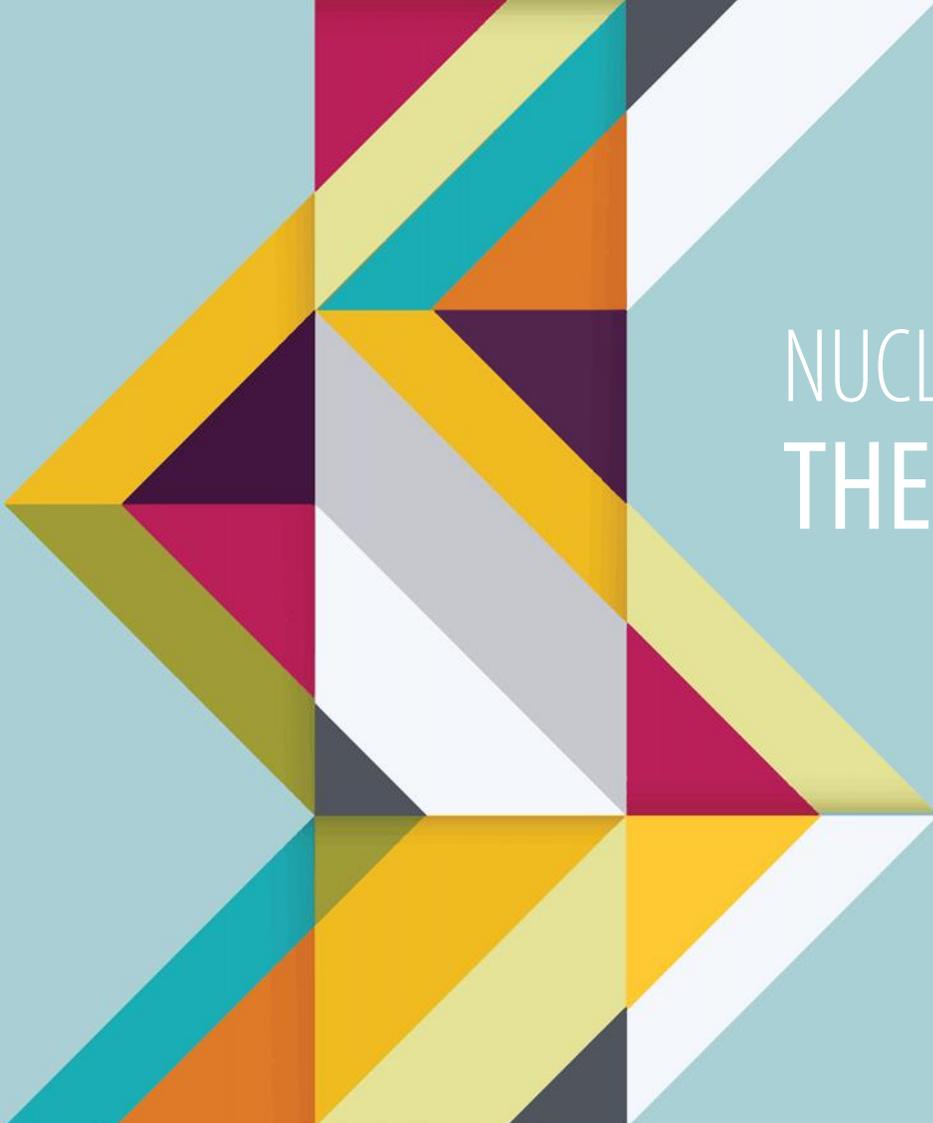
weapons for their own security. The spread of W-UM or weapons portends the greater risk of their use and increases the potential for an accident.

Good governance within a strong global nuclear regime is critical to addressing the risks posed by W-UM, including risks posed by both weapons and the fuel cycle. If the processes that encompass the production, storage, and disposal of W-UM are not safe and secure, there are increased risks for theft or spread of W-UM or an accident.¹⁶ Prior to the initiation of the strategy, during the years of U.S. President Barack Obama's Administration, there was evidence of traction and momentum related to securing the fuel cycle and eliminating W-UM. Between 2010 and 2016, there was productive multilateral negotiation through a series of Nuclear Security Summits leading to the reduction or complete elimination of many countries' held W-UM.¹⁷

Despite challenges and tensions as the strategy began, the nuclear regime was believed to be strong and stable enough to allow continued progress toward the end goal of reduced nuclear risk via ceased production and total elimination of W-UM globally. However, following the 2016 election of Donald Trump as U.S. President, governmental and civil society nuclear experts were significantly concerned about Trump's approach and policy stance based on his campaign promises, and—given existing challenges and tensions—the potential for his Administration to disrupt or harm an already strained nuclear regime. As of 2017, a heightened, explicit focus for the Nuclear Challenges strategy is to protect and strengthen the nuclear regime to mitigate risks and realize continued progress toward ceased production and elimination of W-UM.

¹⁶ Accidents include meltdowns, such as what occurred at Japan's Fukushima nuclear plant following an earthquake and tsunami in 2011, or accidental detonation. Recent technological advancements may increase the risk of accidental detonation in the context of a conflict by potentially compressing a countries' decision timeline regarding whether to use a nuclear weapon, disrupting the flow of accurate information, or leading countries to mistakenly think they have been the target of a nuclear attack, thereby prompting an unintended nuclear retaliation. The expanding technological frontier has outpaced governance, though the nuclear regime's mechanisms and structures provide a means to address risks related to advanced technology.

¹⁷ Countries may also hold W-UM that has been deemed excessive to the requirements of nuclear weapons programs but is nonetheless stored within a country's borders. The United States and Russia have each declared significant amounts of HEU and plutonium as excessive to military requirements. Under the Megatons to Megawatts agreement between the United States and Russia, concluded in 2013, Russia agreed to down-blend 500 tons of HEU originally produced for weapons into LEU fuel to be sold to the United States for nuclear power generation.

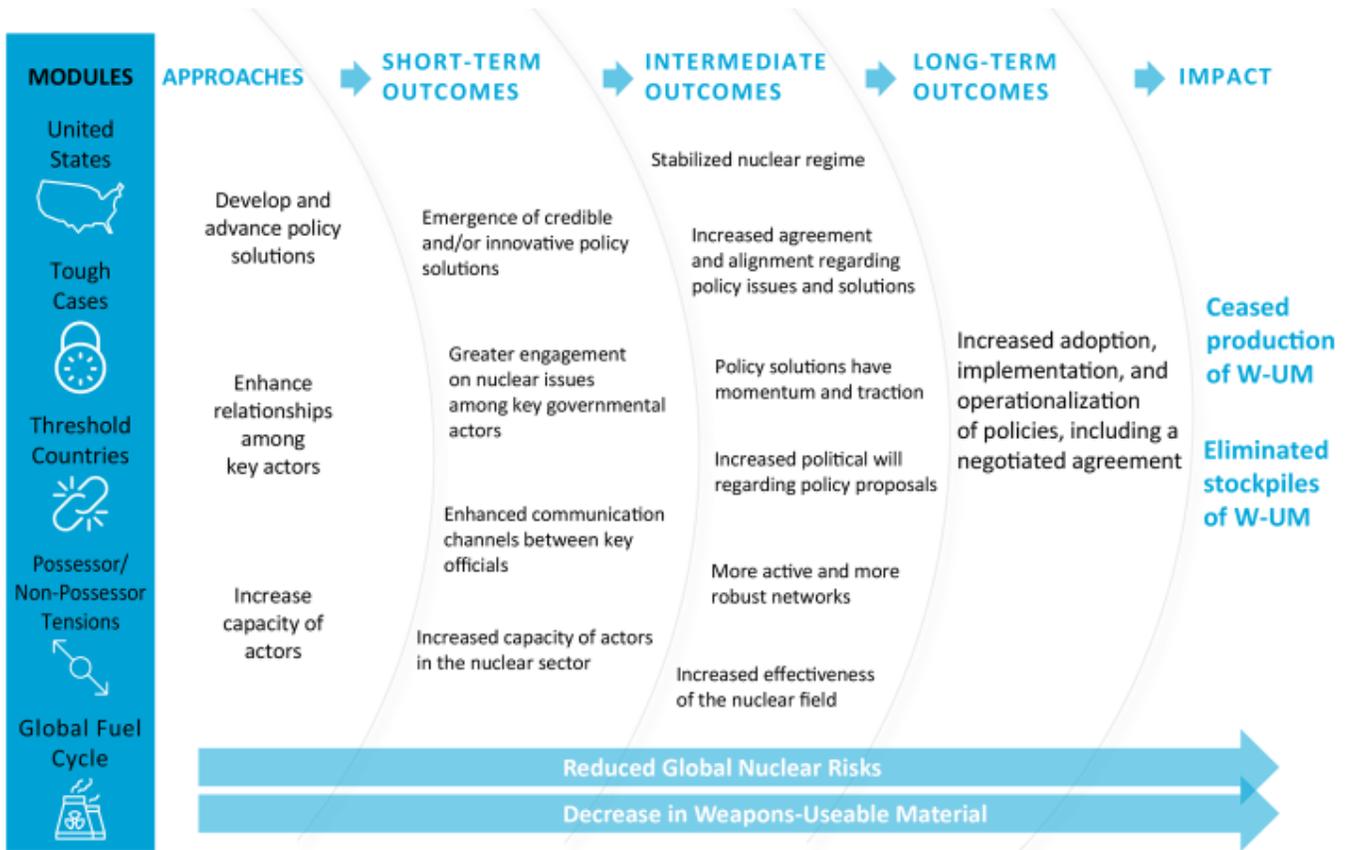


NUCLEAR CHALLENGES: THEORY OF CHANGE

To reduce nuclear risk, the Nuclear Challenges strategy aims to end production and eliminate stockpiles of W-UM globally. To realize this goal, the Nuclear Challenges strategy promotes effective action on two pathways: 1) to protect, strengthen, and stabilize the nuclear regime so that there will be favorable conditions for advancement of the W-UM end goal; and 2) to ensure greater safety and security across the fuel cycle, i.e., the processes related to production, storage, and disposal of W-UM. This combination of efforts is believed to be necessary to advance the strategy's end goal.

Figure 1 presents a high-level view of the Nuclear Challenges theory of change.

Figure 1 | Nuclear Challenges Theory of Change



A central hypothesis of the theory of change is that if the fuel cycle is secured, W-UM production is ceased, and stockpiles are minimized in certain countries and regions, there is a greater likelihood of eliminating all W-UM globally. A second and related hypothesis is that if the nuclear regime, which is currently under strain, can be sufficiently protected, stabilized, and strengthened, there will be windows of opportunity to advance a binding global-scale agreement or set of agreements that would drive ceased production and elimination of W-UM globally. These two intertwined hypotheses reflect the dual pathways by which the strategy pursues its desired impact: efforts related to the fuel cycle occur within the nuclear regime, and thus influence and are influenced by the regime’s strength and stability.

The hypothesis that the regime is essential for realizing progress toward the impact of ceased production and elimination of W-UM has been constant since the initiation of the strategy. This hypothesis became a heightened, more explicit focus following the November 2016 election of President Donald Trump, amidst concerns about how his leadership could destabilize or harm the regime. A strategy pivot, endorsed by the Foundation’s Board of Directors in 2017, proposed that more robust investments aimed at protecting and stabilizing the nuclear regime would facilitate progress toward the desired impact.

There are similarities in the expected trajectories of change across the two pathways. In the short term, the Nuclear Challenges strategy's investments and approaches are expected to contribute to emergence of credible analysis and policy recommendations, governmental officials' greater awareness and engagement in nuclear issues, maintenance or improvement of communication channels that yield productive dialogue within both official and unofficial spheres, and increased capacity of actors in the nuclear field. In the intermediate term, there are expectations of achieving a stabilized nuclear regime, as well as other regime-related outcomes such as an increasingly effective influence by civil society actors, increasing (and, ultimately, achieving a critical mass of) support for regime principles among officials and decision makers across multiple countries and institutions, and widespread agreement and alignment regarding regime-supportive solutions and actions.

The theory of change identifies three approaches: (1) **develop and advance policy solutions**, i.e., develop credible, viable, and innovative policy-relevant ideas and share these with governmental decision makers;¹⁸ (2) **enhance relationships among key actors**, i.e., pursue opportunities for bilateral and multilateral dialogue that foster trust and goodwill; and (3) **increase capacity of actors** in the nuclear field.¹⁹ The three approaches collectively reflect actions that protect, stabilize, and strengthen the regime, and are applied across five modules, which along with their associated components, represent critical countries and relationships believed to play a significant role in the stability of the nuclear regime and advancement of ceased production and elimination of W-UM due to their existing weapons stockpiles, W-UM stockpiles, and/or the risks that potential proliferation poses to global nuclear security. The five modules are: United States, Tough Cases, Possessor/Non-Possessor Tensions, Threshold Countries, and Global Fuel Cycle. These approaches applied to the five modules are hypothesized to contribute to a more stable regime in which the three core regime principles (disarmament, nonproliferation, and peaceful uses) are upheld, and there is widespread agreement and commitment by countries toward the strategy's W-UM goals.²⁰

¹⁸ In light of lobbying restrictions applicable to private foundations, the Foundation is careful to ensure that the grants it makes comply with the applicable lobbying laws. Under the laws, the Foundation provides project support to a charitable organization that might in fact lobby if the Foundation receives a budget that reflects a breakdown between the non-lobbying expenses of the project and any lobbying expenses, the Foundation grant is less than the non-lobbying expenses, and none of the Foundation funds are earmarked for lobbying. Alternatively, the Foundation prohibits the grantee from using the Foundation's funds to lobby but a grantee could use other funds to participate in lobbying activity within the legally accepted limits.

¹⁹ Approaches encompass a cohesive set of activities that together are expected to catalyze or contribute to change. Modules reflect the places or spaces in which the Nuclear Challenges strategy's approach, or pathways, are focused to advance outcomes.

²⁰ As part of a robust due diligence process, the MacArthur Foundation assesses its grantees' compliance with applicable anti-terrorist financing and asset control laws, regulations, rules, and executive orders. The Foundation also has provisions in its grant agreements addressing necessary compliance.

As shown in Table 1, regime-focused investments cut across the strategy’s module components, though much of the effort is concentrated within certain areas where investments are believed to offer the best opportunity for regime-related progress in the near term. Other module components relate to the fuel cycle, because these investments are believed to offer the best opportunity to realize secure, reduced, or ceased W-UM production and reduced or eliminated stockpiles in key countries and regions.

An underlying hypothesis is that meaningful change resulting from the Nuclear Challenges strategy’s approaches, investments, and grantees’ efforts can be palliative, stabilizing, or in some cases transformative in nature.²¹

²¹ Per Liz Ruedy, palliative gains mitigate a declining status quo; stabilizing gains are equivalent to “holding the line”; and transformative gains signal a positive directional shift in the status quo. See: <https://democracyfund.org/idea/six-models-for-understanding-impact/>.

Table 1 | Nuclear Challenges Strategy Pathways, Modules, and Components

MODULES	PROBLEM ADDRESSED	CHANGE EXPECTED
REGIME PATHWAY MODULES / MODULE COMPONENTS		
United States: U.S.-Russia	U.S.-Russia relations are volatile. Within this context the strategy seeks to mitigate or slow down negative developments to prevent further deterioration toward greater risk.	Stabilizing/ Palliative
United States: U.S. Congress	U.S. leadership on nuclear issues exists outside of the executive branch. Building awareness and support for nuclear issues within the U.S. Congress supports broader U.S. nuclear leadership.	Transformative
United States: U.S. Weapons Policy	Strong and visible U.S. leadership regarding regime principles is vital to reversing negative nuclear policy trends at home and supporting productive, regime-aligned bilateral and multilateral nuclear diplomacy.	Stabilizing/ Palliative
Tough Cases: Iran	If Iran withdrew from the Joint Comprehensive Plan of Action (JCPOA), it could lead to a resumption of Iran’s W-UM production. It is important to pursue solutions that ensure Iran’s nonproliferation in any scenario related to the JCPOA.	Preventive/ Stabilizing
Tough Cases: North Korea	North Korea possesses nuclear weapons and has made threatening statements regarding their use. Diplomatic solutions will potentially mitigate nuclear risks posed.	Stabilizing/ Palliative
Possessor/Non-Possessor Tensions	Alleviating tensions between nuclear possessor and non-possessor states is important for ensuring continued nonproliferation.	Stabilizing
Threshold Countries: Weapons	For certain countries whose behaviors could influence others, continued alignment to regime principles, particularly nonproliferation, is especially important.	Stabilizing
FUEL CYCLE PATHWAY MODULES / MODULE COMPONENTS		
Global Fuel Cycle	W-UM production and stockpiles in countries across the world are sources of nuclear risk. It is important to advance policies and agreements that lead to secured, ceased production of W-UM and eliminated stockpiles.	Transformative
Threshold Countries: Fuel Cycle	South Korea, Japan, and Germany all hold supplies of W-UM, and the capacity to produce more. It is important to pursue solutions for ceased production and elimination of stockpiles within these countries, and agreements regarding peaceful uses of nuclear energy.	Transformative
United States: U.S. Fuel Cycle	The United States has one of the largest stockpiles of W-UM of any country, and its policy position has an outsized impact on global norms. It is important to advance supportive W-UM policies within the United States.	Transformative

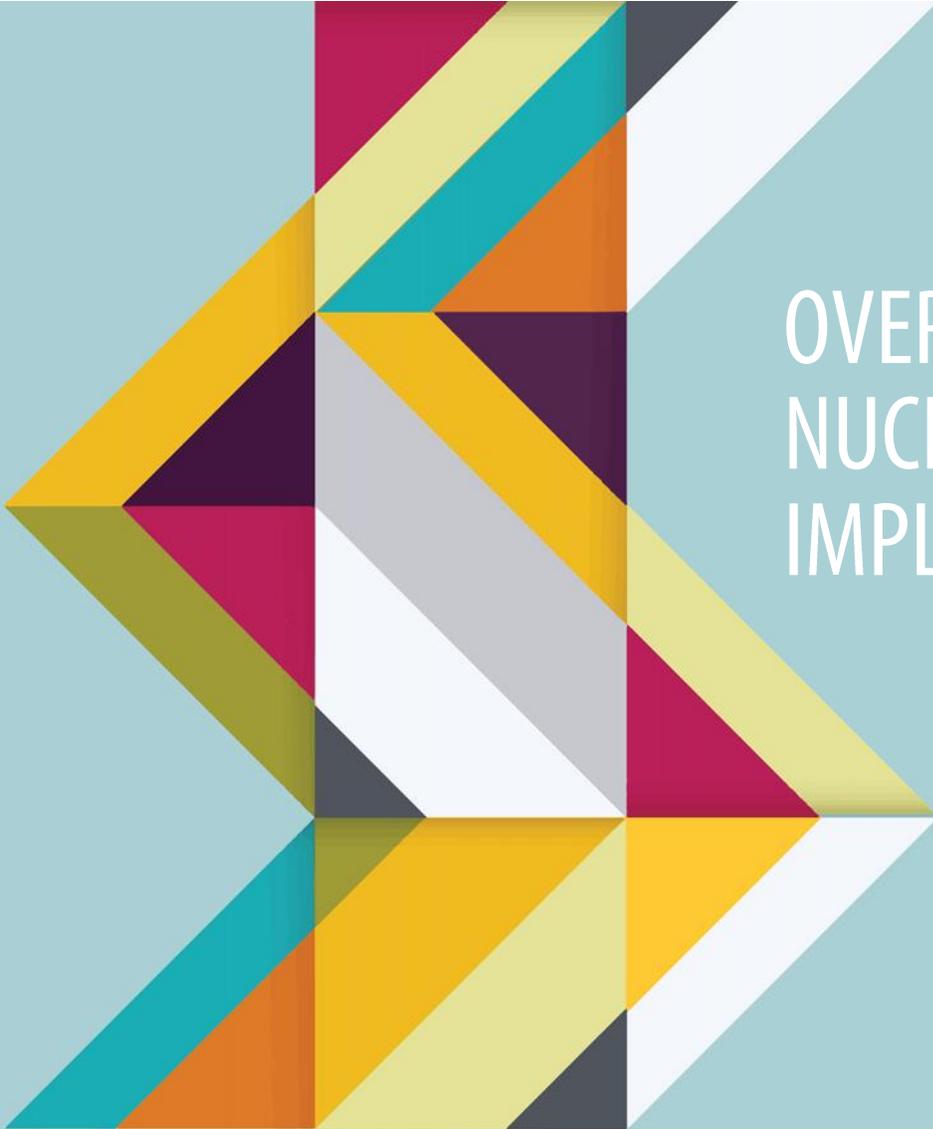
Each module component's outcomes and change models are distinct (see Appendix for a full summary of module outcomes). Module outcomes reflect changes such as:

- Emergence and uptake of credible analysis and promising recommendations regarding nonproliferation, disarmament, and the peaceful use of nuclear materials.
- Informed leaders and officials who are aware of and motivated to address the dangers of nuclear material, technology, and weapons, and the importance of their security, reduced amounts, and the likelihood of their use.
- Dialogue aimed primarily at nonproliferation and disarmament within the United States and between countries.
- Decisions and actions by leaders and officials in key countries that do not degrade or defy, or that signal commitment or adherence to regime principles and behavioral norms (key countries include the United States, Russia, North Korea, Iran, and certain threshold countries).²²

Beyond expansion of regime-focused investments, adjustments following the 2017 strategy pivot did not dramatically alter the Nuclear Challenges strategy; the three approaches and five modules remained the organizing structures for investments. More robust regime-focused investments were intended to be protective to yield largely palliative progress in the face of growing challenges within the nuclear regime. Realization of a sufficiently stable nuclear regime was believed to be possible by 2025,²³ and negotiation toward multilateral agreement(s) to end production and eliminate W-UM stockpiles was believed to be possible by 2030. It was clear that the external landscape could create challenging dynamics for advancing progress within certain module components and pathways. An underlying assumption was that the strategy's intermediate-term and long-term outcomes could be advanced even if there was no evidence of positive progress across all modules and components, though progress in certain areas was thought to be critical.

²² The term "threshold countries" refers to non-possessor countries that, per a strong security alliance with the United States, have not sought to develop nuclear weapons, but that could move away from that status quo in response to eroding confidence in U.S. security guarantees.

²³ This timeline for realizing sufficient regime stabilization assumed that if a U.S. President supportive of regime principles were elected in 2020, achievement of sufficient progress would require that President's entire term.



OVERVIEW OF NUCLEAR CHALLENGES IMPLEMENTATION

The Nuclear Challenges strategy includes 228 grants made to 88 organizations between October 2014 and June 2020, totaling \$100.8 million. In addition, the Nuclear Challenges strategy includes non-grantmaking activities, such as field leadership by the Nuclear Challenges team, grantee convenings, and opportunities for grantees to build communications skills.²⁴

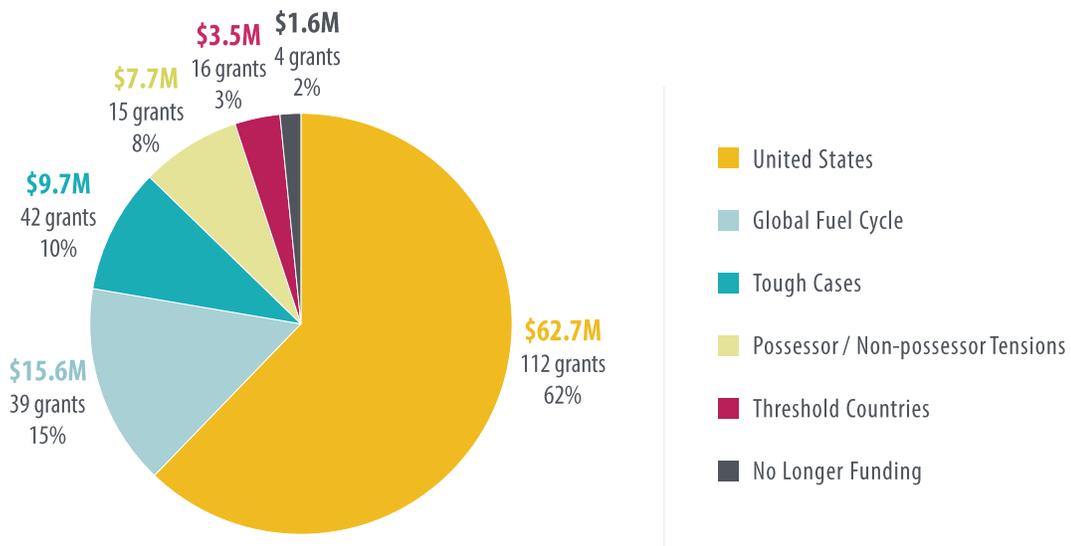
Figure 2 shows grantmaking by module; Figure 3 shows two snapshots of grantmaking by pathway, before and after the strategy pivot. Given that modules are interconnected and that grantees often work on more than one issue or set of issues, some grants cut across modules and the two pathways. In other words, a grantee may have been funded to primarily engage in work related to one module, while simultaneously addressing aspects of other modules. The majority of Nuclear Challenges grants have been to U.S.-based organizations, reflecting the significance of the U.S. module, and—as one of the two largest possessor states—the United States’ outsized

²⁴ In 2014 and 2015, MacArthur Foundation staff recommended a series of W-UM-related grant awards in the International Peace and Security program that were approved prior to the Board formally endorsing the Nuclear Challenges strategy in December 2015. These grants contributed to the strategy and thus are captured in the figures, which show grants made up to June 24, 2020.

role and influence within the nuclear regime. Following the strategy pivot in 2017, there was increased investment in the regime pathway, both in terms of total grants and investments and the proportion of overall grants. As noted, there were no significant adjustments to approaches, modules, or expected outcomes in response to the changing landscape and increasingly palliative (rather than transformative) opportunities.

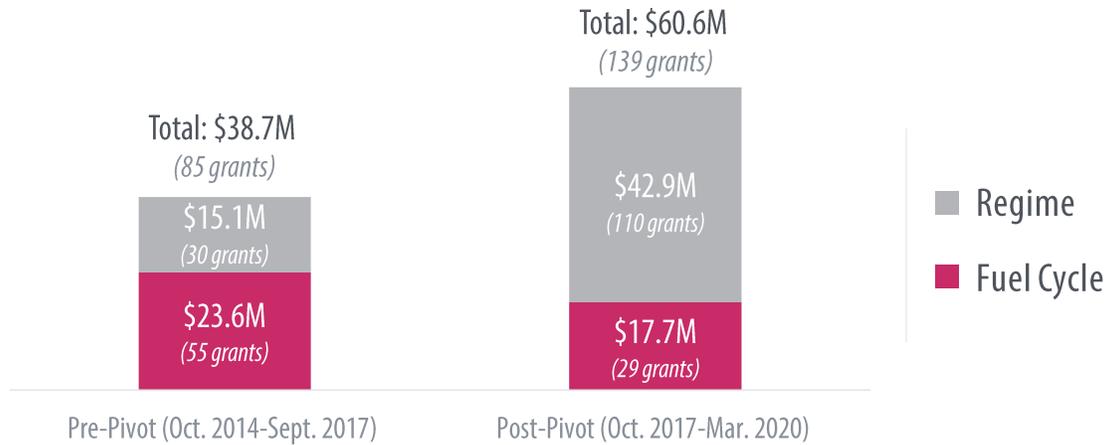
Figure 2 | Nuclear Challenges Grants, October 2014 to June 2020, by Module²⁵

Total Grants and Dollar Amount:
228 grants, \$100.8M



²⁵ The “no longer funding” category reflects four grants supported through a previous Nuclear Challenges strategy approach, including work related to the India-Pakistan security dynamic. This area of work was discontinued following the 2017 strategy pivot, and related grants were not included in ORS’ data collection.

Figure 3 | Nuclear Challenges Grants, October 2014 (Pre-Strategy Pivot) to September 2017 and October 2017 to June 2020 (Post-Strategy Pivot), by Theory of Change Pathway*



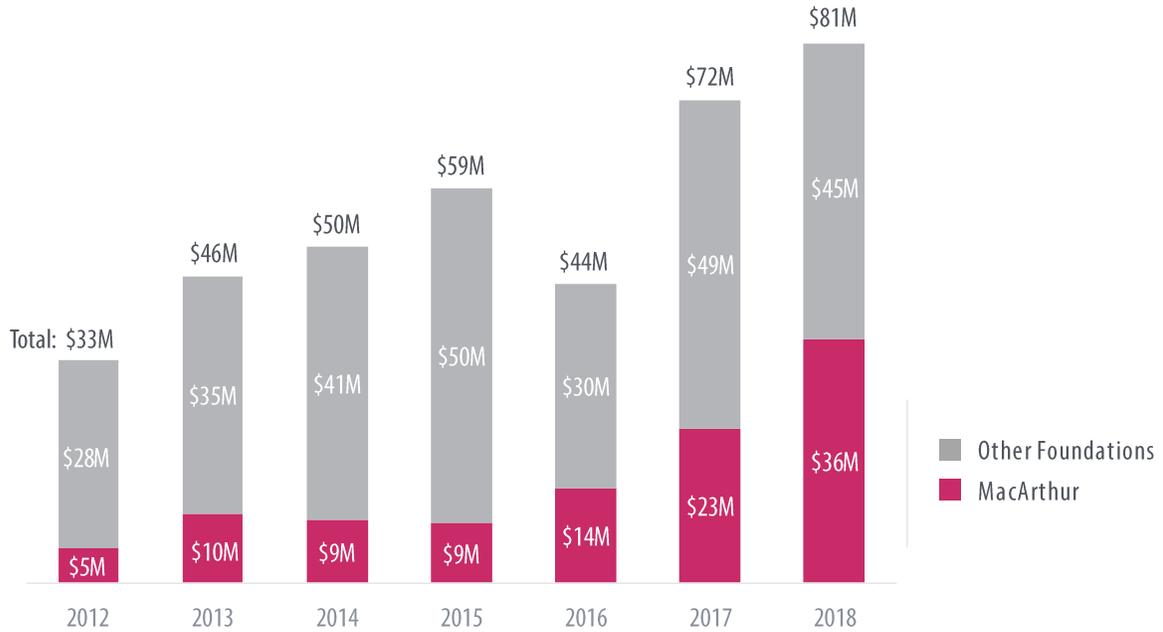
*The strategy pivot was endorsed by the MacArthur Foundation Board in September 2017.

The Nuclear Challenges Big Bet grew out of the MacArthur Foundation’s previous International Peace & Security (IPS) program. Some grantees received funding through the IPS program and have since been awarded grants through the Nuclear Challenges strategy. Throughout the strategy’s implementation, investments have been consistent in terms of their emphasis on W-UM and the fuel cycle, and protecting, stabilizing, and strengthening aspects of the nuclear regime.

Compared with other substantive issue areas like education, climate, and health, the nuclear field is relatively small, both in terms of the number of civil society organizations and funders that address nuclear issues, and in terms of total nuclear-related investments. According to a MacArthur Foundation analysis, from 2015–2018 at least 17 funders made annual grants totaling \$1 million or more.²⁶ Going back to 2012, the MacArthur Foundation has consistently been among the three largest funders of nuclear issues. Following launch of the Nuclear Challenges strategy the MacArthur Foundation’s increased funding for nuclear issues (see Figure 4) also represented an increasing proportion of total philanthropic nuclear funding (see Figure 5). Since the Nuclear Challenges strategy began in 2016, the Foundation has been the largest nuclear funder.

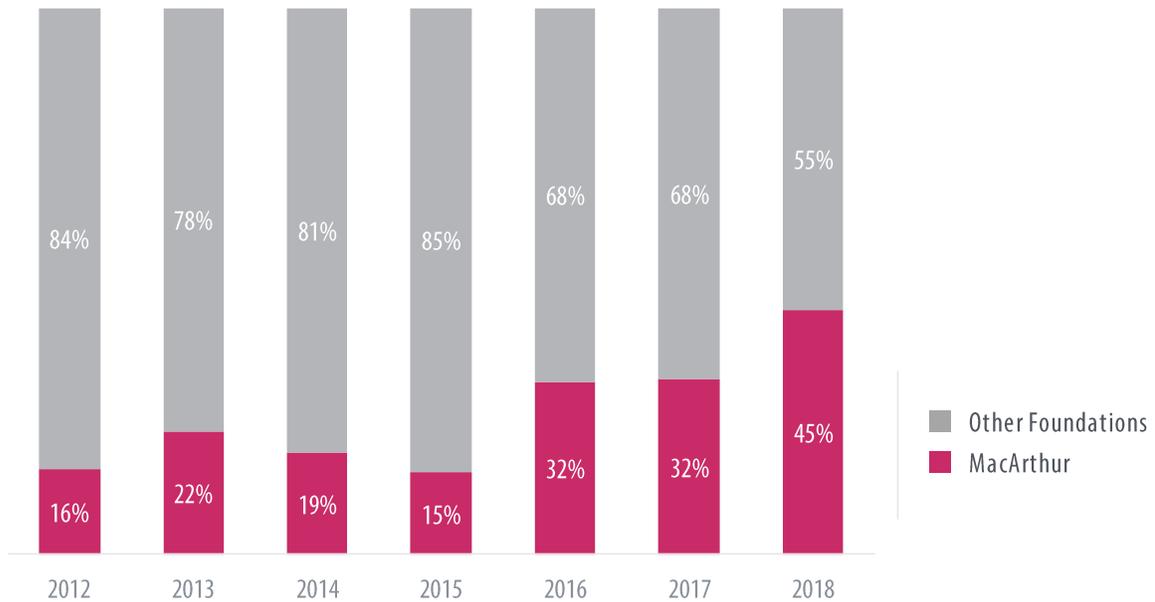
²⁶ Data related to philanthropic funding of the nuclear field shown in Figures 4 and 5 come from two sources. Data about the MacArthur Foundation’s funding to the nuclear field comes from its internal grants management system. Data about funding directed to the nuclear field by other foundations come from the Peace and Security Funding Index created by Candid and the Peace and Security Funders Group (PSFG). The last year for which comprehensive data from the PSFG’s Funding Index are available is 2018. The Funding Index reflects self-reported data and thus may not be comprehensive. Notably, data from the Funding Index do not include information from philanthropic organizations that fund nuclear issues anonymously.

Figure 4 | Philanthropic Funding in the Nuclear Field, 2012–2018*



*Based on data from the Peace and Security Funding Index; 2018 is the last year for which data are available

Figure 5 | MacArthur Foundation’s Funding in Proportion to Other Nuclear Funders, 2012–2018*



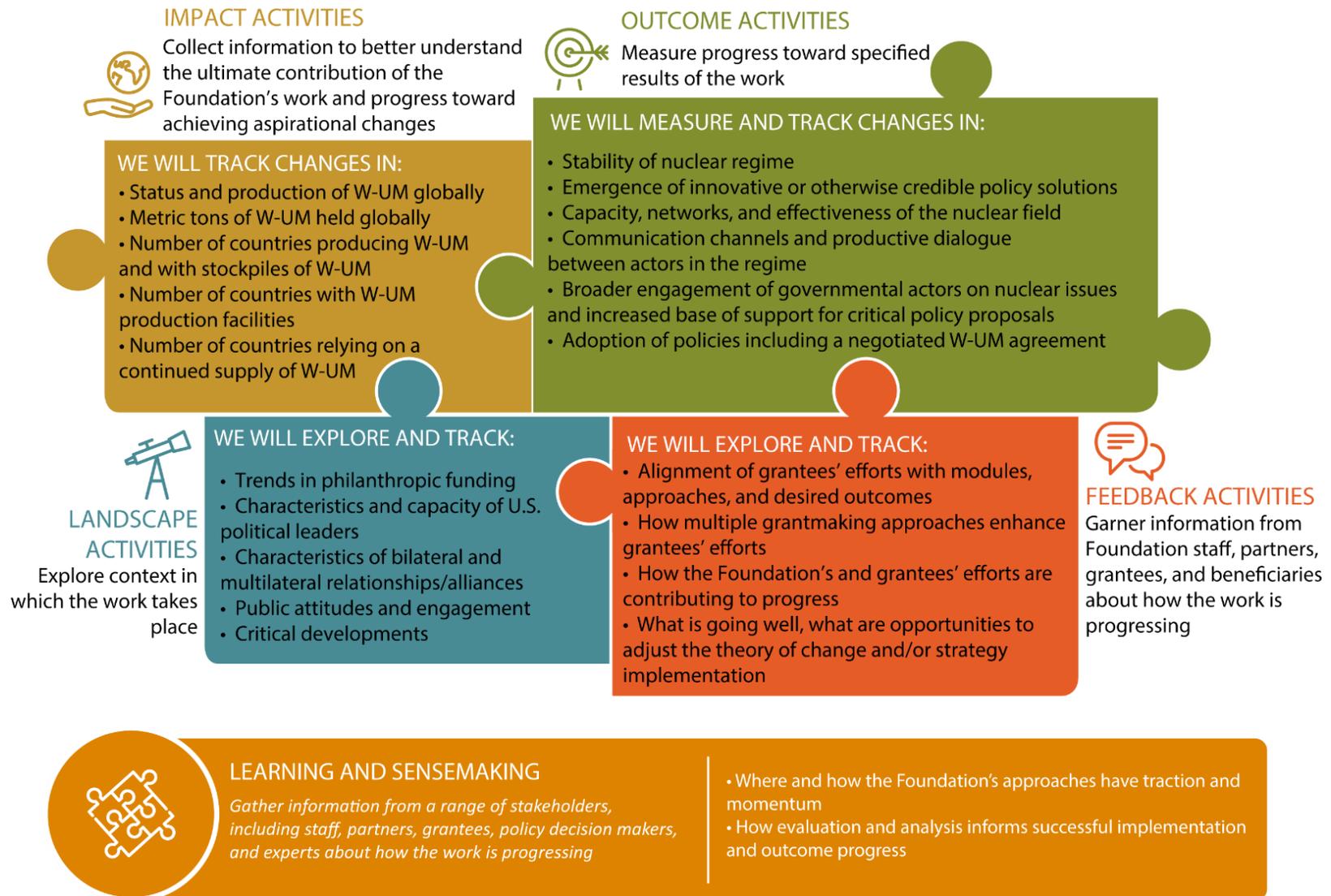
*Based on data from the Peace and Security Funding Index; 2018 is the last year for which data are available



OVERVIEW OF THE EVALUATION AND LEARNING FRAMEWORK

Evaluation and learning activities were designed to address two equally important purposes: (1) facilitate ongoing learning to inform the Nuclear Challenges strategy's decision makers, and (2) provide evidence of whether and how the Nuclear Challenges strategy has realized progress toward results and contribution to change. The Evaluation and Learning Framework addresses evaluation questions related to outcomes, impacts, landscape, and feedback (see Figure 6).

Figure 6 | Overview of Evaluation and Learning Activities



The inquiry employed a mixed-methods design to measure the status of and progress within module components and related to the strategy's end goal and expected impact. Synthesis of module components allowed for assessment and description of progress within the strategy's regime and fuel cycle pathways. This report reflects data collected between May 2019, following the Board's approval of the Nuclear Challenges theory of change and evaluation and learning framework, and June 2020. In addition to the data and evidence related to assessment of outcomes and measures documented in the theory of change and evaluation and learning framework, synthesized findings include exploratory and descriptive data to answer landscape and feedback evaluation questions. Data presented in this report reflect both primary and secondary sources. Primary sources included:

- Interviews and focus groups with grantees, government officials, and other experts
- Surveys of grantees and nuclear funders
- Analysis of congressional narratives related to nuclear issues
- Analysis of congressional legislative behavior
- Feedback gathered via grantee workshops

Secondary sources included grantee reports; expert-authored reports, briefs, and white papers; scholarly and media articles; and data resulting from monitoring of nuclear materials production and stockpiles. Not all evaluation outcomes were measured with equal attention; data and evidence presented reflect necessary choices about priorities and areas of focus.^{27, 28}

Ongoing evaluation by a learning partner can be integral to the Foundation's work throughout the strategy and the strategy review process. ORS has produced a series of technical reports for the MacArthur Foundation to document and track progress in advancing the Nuclear Challenges strategy's desired outcomes and impact. The inquiry is aimed at supporting the Nuclear Challenges team to understand where meaningful progress is evident or falling short of expectations; where the Nuclear Challenges strategy is making a difference or seemingly not gaining traction; the extent to which the theory of change is adequate and valid; and how landscape factors are enabling or hindering the strategy and its progress. In the spirit of the

²⁷ A full description of methods, as well as the strengths and limitations of the data collection, is provided in a separate Annex (Summary of Methods).

²⁸ For example, due to the fact that the strategic elements of the module were still being developed into March 2020, timeframe demands to include data/findings in this report prohibited the opportunity to conduct a set of grantee interviews related to some outcomes within the U.S. Weapons Policy (USWP) component of the U.S. module (as had been done for other modules). Assessment of some USWP outcomes is based solely on a grantee survey.

Foundation’s design-build approach, findings and evidence are intended to surface and inform improvements or adjustments to the strategy that may be warranted.

The synthesized results presented in this report reflect cross-module data, analysis, findings, and evidence which speak to the theory of change. Given the dynamic external context and the complex ways in which the Nuclear Challenges strategy’s and grantees’ efforts interact with it, it is challenging to objectively isolate the contribution story for a specific set of Nuclear Challenges investments. Because the purpose of data is to support learning about the strategy, which is situated in and must respond to a real-world environment, ORS employed a constructivist approach to data analysis. This approach presumes that data do not offer a singular hard truth, but rather a mosaic of truths that reflect multiple valid sources of knowledge and experience, as well as relationships between actors and with the environment.^{29, 30} Thus, analysis was grounded in a “sense making” approach and focused on identifying particular themes and patterns, including those reflective of common and divergent perspectives, for which data offered a weight of evidence. ORS sought to link themes and patterns to surface plausible and nuanced explanations and lift up insights to guide future strategic choices. The evaluation’s rigor was maintained via triangulation of multiple sources of data regarding outcomes and measures.

²⁹ See: Hennig, C. *Confronting Data Analysis with Constructivist Philosophy*. In: K. Jajuga, A. Sokolowski, H.H. Bock (eds.). (2002). *Classification, Clustering, and Data Analysis*. Berlin: Springer. Pages 235-244.

³⁰ See: Coffman, J. and Beer, T. (2011). *Evaluation to Support Strategic Learning Principles and Practices*. Paper published by the Center for Evaluation Innovation. Available at: <http://www.evaluationinnovation.org/sites/default/files/Strategic%20Learning%20Coffman%20and%20Beer.pdf>



WHAT ARE WE LEARNING?

1. Does progress to date demonstrate momentum and provide a line of sight to significant, meaningful, and sustainable long-term outcomes and impact?

This section presents stories of progress related to the two pathways identified in the Nuclear Challenges theory of change: regime and fuel cycle.

REGIME PATHWAY

The nuclear regime has been in a dynamic state throughout the period of the strategy's implementation, marked by a challenging environment for the pursuit of cooperative bilateral and multilateral efforts related to nuclear diplomacy and regime stability. The period has seen increasing tensions and declining trust among the five permanent members of the UN Security Council (P5);³¹ rising tensions between the United States and Russia, the two largest nuclear-weapon states; and volatile nuclear relations with key countries such as North Korea and Iran. In addition to these dynamics, it became clear that another significant risk to the regime was weakened and disruptive U.S. nuclear leadership.

The story of progress related to the regime pathway reflects *regime-reinforcing* efforts (to stabilize) and *regime-supporting* efforts (to protect and strengthen) within three of the U.S. module components (U.S.-Russia, U.S. Congress, and U.S. Weapons Policy), both Tough Cases module components (Iran and North Korea), the Weapons component of the Threshold Countries module, and the Possessor/Non-Possessor Tensions module. This section summarizes progress related to those modules under two broad frameworks:

- Progress regarding U.S. leadership and policy engagement
- Progress in bilateral and multilateral dialogue

PROGRESS REGARDING U.S. LEADERSHIP AND POLICY ENGAGEMENT

Throughout the strategy's implementation, a substantive area of investment has focused on delivering credible analysis, raising awareness, and increasing leadership capacities among U.S. officials. Within this investment area, a significant focus has been engaging and influencing members of Congress (MOCs) to increase their knowledge and awareness in order to enhance the quality of dialogue related to nuclear policy and spur meaningful policy action in furtherance of nuclear regime principles. Grantees' efforts related to this focus have included providing policy advice, hosting convenings, and providing trainings to MOCs and their staff. In addition, since 2017, the Nuclear Challenges strategy has supported the Nuclear Security Working Group (NSWG) housed at George Washington University by funding 18 fellowship positions within

³¹ The five permanent members of the UN Security Council (P5) are China, France, Russia, the United Kingdom, and the United States.

congressional offices, distributed across the two political parties.³² More recently, the Nuclear Challenges strategy has made intentional investments aimed at diversifying the types of civil society organizations working within the nuclear field, with the aim to develop new (and disrupt old) nuclear policy frameworks though it was not anticipated that progress related to this newer area of focus would be evident by this point.

This section describes evidence of progress against outcomes related to U.S. leadership and policy development, along with challenges encountered while pursuing the strategy.

Grantees have contributed to a reservoir of solutions regarding nonproliferation, disarmament, and peaceful uses, and these solutions have reached MOCs and their senior staff. A number of MOCs and staff, including those who have hosted NSWG fellows or engaged with grantees, reported greater awareness and knowledge about nuclear issues. There is evidence that grantees and fellows have influenced dialogue within congressional hearings and supported public statements made by MOCs, as well as directly provided expert testimony before Congress. In interviews, MOC staff attested to finding value in their engagement with grantees. Findings from congressional narrative analysis confirmed that a small number of MOCs—including those with whom grantees have engaged—demonstrated strong awareness on nuclear issues.³³ Since 2016, 11 MOCs have been identified as “narrative champions” regarding regime principles, meaning their statements and actions primarily indicate narratives that are supportive toward the regime principles of disarmament, nonproliferation, and peaceful uses.

There has been progress regarding some aspects of U.S. leadership and engagement on nuclear issues, though only among a small number of MOCs. What legislative action there has been related to regime-supportive positions or policies within the U.S. Congress has been mostly palliative or stabilizing in relation to the status quo. Since the beginning of strategy implementation, certain bills, amendments, and other legislation have reflected priorities or recommendations identified by grantee organizations. As one grantee noted, *“[I know I have been influential] when they lift my language and write it into law.”* Some of this legislative activity has related to U.S. domestic nuclear priorities, as noted by a grantee: *“There are at least six of our longstanding goals on key weapons systems which were for the first time reflected in the House version of the defense authorization.”* Grantees have also supported efforts to bring about

³² Most fellows (17 of the 18) have been housed within congressional offices; one served as staff for the House Foreign Affairs Subcommittee on Asia, the Pacific, and Nonproliferation. Fellows have been allocated equally within the House and Senate; nine fellows have served within each body. The 2020 fellowship class, comprising an additional seven fellows, have not yet completed their fellowship term.

³³ See Annex 1 (Summary of Methods) for a more detailed description of how MOC narrative champions were determined.

legislation promoting a No First Use policy.³⁴ In addition to U.S domestic-focused issues, grantees have had sustained collaborations on congressional activity related to U.S. engagement with other countries, including pursuit of nonproliferation by Iran, renewal of the New START treaty, and pursuit of disarmament by North Korea.

In analyzing the role of NWSG fellows, data from a congressional scorecard³⁵ surfaced a correlation between some MOCs who hosted a fellow and greater levels of legislative activity in relation to nuclear issues, as well as a greater inclination among this group to introduce regime-supportive legislation compared with colleagues. In the 116th Congress (the most recent), 13 of 15 nuclear bills in the Senate were introduced by MOCs who had hosted a fellow. In the most recent House, MOCs from the Democratic Party who hosted fellows introduced non-binding resolutions that upheld the NPT, signaling their support for regime principles.³⁶

Grantees also supported MOCs in successfully defending against legislation that would have contributed to increased nuclear risk, for example, preventing bills in the Senate that would have led to sanctions on Iran, as well as on niche issues such as preventing reduction of oversight of low-yield nuclear issues and developing intermediate range missile systems.

Despite the positive examples of some U.S. congressional action and dialogue related to promoting regime principles, congressional dialogue and action is highly partisan and it is difficult to interrupt this pattern to enhance a wider nuclear dialogue or to increase the overall number of pro-regime MOCs. Partisanship has been overcome in a few select cases; for example, some MOCs who hosted fellows have sponsored bipartisan legislation. Overall, however, there is no evidence that partisan divides have narrowed since the initiation of the Nuclear Challenges strategy (or since the strategy's baseline period, 2009-2015). Further, data suggest extreme partisan differences in both nuclear narratives and in the types of nuclear legislation that MOCs support. The Nuclear Challenges investments do not focus on a specific political party or set of MOCs; as such, some grantees have focused their congressional engagement efforts on moderate Democratic offices, and others have focused their efforts on educating and convening MOCs and staff from both parties to create space for dialogue and debate.

³⁴ No First Use refers to a pledge or a policy by a possessor state that they will not use nuclear weapons as a means of warfare unless first attacked by an adversary using nuclear weapons.

³⁵ Congressional scorecards are tools used to rank sitting legislators (or candidates for legislative office) on their voting record. ORS subcontracted with Foreign Policy for America (FP4A) to develop a customized scorecard to track lawmakers' actions on nuclear-related legislation. The FP4A scorecard covers six sessions of the U.S. Congress—111th, 112th, 113th, 114th, 115th, and 116th—allowing for assessment of the nature and extent of legislative action on nuclear-related issues over time.

³⁶ It is unclear, however, the extent to which fellows specifically influenced these actions, or whether these MOCs were likely to pursue regime-positive legislation regardless.

Data also suggest that grantee influence is only one input that determines the action of MOCs, and officials' comments reveal perceptions that grantees may at times lack political awareness or sensitivity regarding what drives MOCs decision making. Some officials also noted the need for timeliness in the delivery of recommendations to MOCs, and the importance of a keen understanding of congressional milestones as well as specific windows for influencing Congress, which officials felt that grantees sometimes misunderstood.

In part due to partisan dynamics, there is little evidence of a growth in congressional leadership that demonstrates commitment to regime principles, including within key committees. In addition, congressional engagement in nuclear issues is relatively low compared to other issues. This evidence was clear across data sources, including voting trends, public-facing narratives, and interviews with officials, grantees, and external experts. For example, MOCs' public-facing narratives on nuclear issues averaged less than 1 percent of their overall public-facing discourse over the four years between 2016–2019. While the number of legislators frequently and consistently engaged in online dialogue related to nuclear issues has grown over time (from 17 to 27 MOCs between 2016–2019), the majority of this group puts forth positions that are not regime-supportive.

There is evidence of the same pattern in nuclear-relevant congressional committees. The MOCs who most actively speak in the public domain about nuclear issues are those serving on the Senate Foreign Relations Committee, as compared to the other key congressional committees, however their public-facing narratives have become less regime-positive over time.³⁷ The congressional scorecard data also indicated that support for regime-aligned policies largely breaks along partisan lines. Interviews with officials corroborated the limited level of engagement on nuclear issues, and the partisan nature of that engagement within Congress.



Right now, I would say [Congress does] not have a huge priority [on nuclear issues]. Maybe the Iran issue, sort of North Korea but not really, but I would say they are very low. It's very sad. They're very low on people's priorities.

Given partisan dynamics, as well as the relatively even split between the parties within Congress, it has been difficult to build a broad enough coalition of champions necessary to support advancement of regime-aligned policies.

Beyond Congress, there is evidence that grantees have helped to inform and, in some cases, advance policy development across a range of relevant U.S. departments; however, there have been challenges in influencing the U.S. Executive Office. Nuclear Challenges grantees have strong

³⁷ The narratives from this committee reflect a 1.2 percent share of nuclear volume as compared with .8 percent of all the committees analyzed (11 in total).

connections to a network of relevant actors, including the State Department, Department of Defense, and the National Security Council. Grantees have supported officials' learning and provided the underpinnings for policy development in a range of ways, including unpacking complex international treaties to allow officials the ability to better navigate policy positions of the United States. As one official highlighted:



The nuclear nonproliferation treaty covers nonproliferation to states that don't have nuclear weapons, reducing nuclear weapons for states that do have them and then also peaceful uses of nuclear and energy... and I've found many situations where something I've picked up at NGO events or publications helps me understand the conversations and different statements that countries are making... I would say it's been directly relevant to building my background knowledge and really being able to follow what's going on at these meetings.

Since the Trump Administration took office, there has been marked weakening of U.S. nuclear leadership, especially from the executive office. This has in turn led to weakened capacities within departments responsible for nuclear issues, for example via long-standing vacancies in key positions and a general lack of clarity and confidence on the part of department and agency administrators to lead or set an agenda aimed at upholding the U.S.' historic nuclear posture or addressing nuclear risks in relation to U.S. engagement with a range of countries, including historic allies. This is particularly evident with U.S.-Russia nuclear relations.



The U.S.-Russia policy is in complete chaos which is part of the paralysis of the U.S. government right now. Nobody is willing to stick their neck out. Nobody is willing to take a bold position because they are all worried that the next day the policy will have turned around again and they'll be slammed.

The result of weakening U.S. leadership is reduced opportunities for civil society organizations' influence under the Trump Administration, as decision making on many key nuclear issues rests with the Executive Office. U.S. grantees also expressed that the polarizing tendencies of the Trump Administration had impacted their ability to access counterpart officials in other countries as regular nuclear relations and diplomacy waned. Limited U.S. leadership on nuclear issues has been coupled with inflamed political rhetoric on the part of President Trump, particularly regarding nuclear relations with North Korea and Iran. This development has had reverberations internationally as other countries are unclear about U.S. foreign policy vision and strategy and see limited options for productive multilateral cooperation.

PROGRESS IN BILATERAL AND MULTILATERAL DIALOGUE

Other significant strategic investment within the regime pathway involved support for bilateral and multilateral dialogues; investment in this area was augmented as a result of the strategy pivot. Efforts were particularly focused within North Korea, Iran, U.S.-Russia, Possessor/Non-Possessor Tensions, and Threshold Countries modules and module components. Grantees' efforts in these areas have included support for U.S. nuclear diplomacy with key countries; support for track 1.5 and track 2 diplomacy; and support for multilateral dialogue.

Grantees' support for U.S. nuclear diplomacy with key countries has been an important avenue for supporting officials' awareness and diplomatic approaches. High-level U.S. officials acknowledged the value of grantees' recommendations related to North Korea.

Related to Iran and its commitment to nonproliferation, primarily represented by the Joint Comprehensive Plan of Action (JCPOA) signed in July 2015, Nuclear Challenges investments supported efforts to counter a growing U.S. Administration narrative that the JCPOA was a "bad deal," not only to potentially salvage the deal in the United States, but more importantly, to maintain Europe's commitment for as long as possible. As one grantee highlighted:



The MacArthur Foundation's reaction as far as I recall is that they and others stepped up because they understood that a slow death of the JCPOA is better than a quick death.

The Nuclear Challenges grant support to European entities was also strategic in that it gave grantees additional routes to engaging with key decision makers. This evidence comes from interviews with grantees and key officials from both the United States and European countries and reflects grantees' often good access and standing with officials before and after negotiations. This type of access could not be achieved without officials' high trust and regard for grantees' work and the role they play. Grantees efforts have included working with the E3³⁸ and the European Union on the development of humanitarian special purpose vehicles with a goal to facilitate transactions with Iran to avoid breaking U.S. sanctions, and other possible routes to providing sanctions relief to Iran.

³⁸ The E3 refers to two permanent members of the United Nations Security Council—France and the United Kingdom—plus Germany.

There is evidence that grantees’ work has helped to enrich spaces for productive bilateral dialogue among civil society and ex-officials. This has not, however, resulted in more productive official dialogue among key countries, for example in relation to North Korea or between the United States and Russia. Within the Nuclear Challenges strategy, grantees have facilitated or been involved in track 1.5 and track 2 dialogues with a view to keeping channels of communication open when they otherwise may not exist, or when circumstances require additional venues to pursue solutions. This has occurred across a range of modules and settings, but most notably in relation to Iran, North Korea, U.S.-Russia relations and Threshold Countries. For example, in the absence of any current official engagement between the United States and Russia on nuclear-related issues, Nuclear Challenges investments have focused on track 2 dialogues to engage in nuclear policy-related exchanges, one of which was at the request of a representative of U.S. Strategic Command. The Nuclear Challenges strategy supported track 1.5 diplomacy related to North Korea during the lead-up to the Singapore Summit in 2018 and track 1.5 and track 2 diplomacy related to Iran. As noted earlier, investments in dialogues related to Iran were initially designed to counter the growing “JCPOA is a bad deal” narrative in the United States, but after the U.S. withdrawal from the JCPOA in 2018, investments focused on opportunities to maintain Europe’s commitment.

For Iran and North Korea, track 1.5 and track 2 dialogues have allowed access to information, analysis, and recommendations—including sometimes sensitive and timely information—for government representatives and non-government actors from each country and the United States, which has facilitated interpretation of counterparts’ perspectives and positioning. At times, the dialogues have included unofficial messages and questions for counterparts supplied by the U.S. government. For U.S.-Russia dialogues, grantees have attracted senior ex-governmental and ex-military officials, creating the space and opportunity to build on these exchanges if, or when, conditions change.

While efforts to create spaces for productive bilateral dialogue have been valuable and have preserved nuclear relations during a time of strain and challenges in the international security context, there is little evidence of traction or momentum regarding key countries’ decisions or actions that demonstrate commitment to nonproliferation, disarmament, and peaceful use. For example, there was an opening for U.S.-North Korea dialogue in 2018 and 2019 but that window has since closed and there has not been a clear way for grantees to influence the process outside of the now-stalled official dialogue between Trump and Kim Jung Un. While there is some hope that these relations could become more productive in the future (potentially under different U.S. presidential leadership), the current situation—where North Korea openly pursues nuclear missile testing—meanwhile serves as a problematic example to other non-possessor states with

similar ambitions or sense of threat due to the perceived weakened security alliances with the United States. For the situation regarding Iran, the U.S. withdrawal from the JCPOA and subsequent foreign policy campaigns of “maximum pressure” on the part of the U.S. and “maximum resistance” on the part of Iran, has resulted in the JCPOA, while still technically in place, in significant peril. Motivations for Iran to maintain its commitments to the JCPOA are unclear, and the other parties to the agreement have had limited opportunities for nuclear diplomacy with Iran. In this context, grantees have struggled to be influential, particularly under the current U.S. Administration, with reduced access and interest and with decision making held within the Executive Office. Strategic thinking within U.S. leadership around approaches to both North Korea and Iran is currently largely absent.

The U.S.-Russia relationship has deteriorated since the strategy began, which has made it challenging to advance U.S.-Russia nuclear diplomacy, particularly in a U.S. presidential election year. To date, prospects for the renewal in early 2021 of the bilateral arms control treaty New START have not been positive; this reflects the ongoing degradation of the treaty framework environment between the two countries, including the end of the Intermediate-Range Nuclear Forces (INF) Treaty in 2019 (following President Trump’s decision to withdraw) and the decision on the part of the United States to leave the Treaty on Open Skies Treaty in 2020. Actions by the United States point to, as one interviewee noted, a “*larger problem of skepticism [by the United States] toward negotiated restraint*” and an Administration interested in dismantling international bodies and frameworks not because they do not serve its or other’s interests, but because they limit flexibility. While Russian leadership has made clear its commitment to renewing New START, and has said that renewal would come with no preconditions (at least for now), its behavior sends contradictory signals by taking steps to modernize its nuclear arsenal (new hypersonic weapons, missile testing, etc.), which suggests the lack of a firm commitment to pursue disarmament.

A challenge for the Nuclear Challenges program to progress the regime stabilization outcome is the limited role that grantees can realistically play in influencing the political machinery of nuclear diplomacy and bilateral relations, with only narrow windows to defend against the erosion of treaties, agreements, and other regime protocols, and limited ability to create new policy champions. Grantees have provided credible solutions and kept spaces for dialogue open, though these important efforts may not be sufficient to open windows for significant change. Highly coordinated efforts of non-governmental actors can sometimes be successful in promoting policy change even when the context is not favorable. However, grantees noted that for the most part, they do not engage in highly structured forms of coordination as would likely be needed to advance the Nuclear Challenges program goals given challenges in the current environment.

Grantees have created opportunities to provide valuable, informed, independent perspectives to multilateral dialogue via track 1 forums and track 1.5 engagements. This has been possible partly due to the formal and built-in mechanisms for the civil society voice within multilateral processes. Grantees' work on multilateral dialogue has largely been within the Possessor/Non-Possessor Tensions module, with a view to maintaining and building on the momentum of the Obama-era Nuclear Security Summits, particularly between delegations from both possessor and non-possessor states in the lead-up to the Preparatory Committees (PrepCom) in advance of the NPT Review Conference (RevCon) which focuses on global nuclear nonproliferation efforts. There is evidence that grantees' work across various forums elicited more frank discussion and better set the stage for productive engagement in official track 1 venues.



[Track 1.5 and track 2] meetings are important. They are away from the usual/formal multilateral conferences. We use the Chatham House rule so diplomats can speak openly and without fear of being directly attributed and speak in a personal capacity. This encourages a more free-flowing discussion as opposed to the prepared statements that happen at PrepCom/RevCon.

Grantees have also directly engaged with officials during track 1 dialogue, for example, during the 2019 PrepCom. The opportunity and ease with which grantees can engage in these forums is due to the formal role that civil society plays in multilateral convenings; in other words, there is a formal and built-in mechanism for including the civil society voice in such processes. Officials corroborated the value of grantees' material in supporting an enhanced quality of dialogue:



Being able to actually talk to people that have made this their life's calling and their life's work and have studied it and have been there and [been] creative with this is fundamentally of value to us. We don't always agree and we will have a debate and we'll have a discussion but getting those opinions is incredibly useful.

Beyond providing advice and space for multilateral dialogue, there are limits to the role a small group of civil society actors can play in advancing commitments among countries to nonproliferation and disarmament, particularly as it hinges on relations between the two dominant possessor states, the United States and Russia. Possessor and non-possessor relations are ultimately pegged to the commitments of these two countries, which own approximately 90 percent of the world's W-UM and nuclear stockpiles. The current bilateral relationship was described by some key informants as toxic, and the continued deterioration of that relationship and lack of progress on U.S.-Russian nuclear issues (e.g., if the United States does not renew New START) is likely to limit progress regarding broader possessor and non-possessor tensions:



It's difficult to see how the current situation between the U.S. and Russia, the two largest nuclear possessors, [won't affect] the larger global dialogue regarding nuclear risk reduction.

Experts shared some doubts about the strength of the NPT as a regime cornerstone, signaled in part by the fact that the PrepComs and RevCons to uphold and support the NPT process have been marred by conflict since 2018. While grantees have kept dialogue going during this challenging time, the most contentious issues of renewed commitment to regime principles have not been taken up. One bright spot is that the rhetoric around the Treaty on the Prohibitions on Nuclear Weapons (the Ban Treaty), which has become less divisive in recent years. Other initiatives to address gaps in multilateral dialogue or the lack of momentum toward disarmament—such as the Swedish-led Stepping Stones approach or the U.S.-led Creating an Environment for Nuclear Disarmament (CEND) initiative—are important and welcome, but they risk diffusing the multilateral processes designed to protect and uphold regime principles. The fact that civil society can play a role in shaping and maintaining forums during tough times is important, though any opportunities for progress in the foreseeable future would likely be best characterized as palliative rather than transformative.

FUEL CYCLE PATHWAY

W-UM, namely HEU and plutonium, are the critical components of nuclear weapons and represent a key component of global nuclear risk. The risks associated with non-weapons stockpiles of HEU versus plutonium, and therefore the focus of grantees' efforts related to securing and minimizing each material, are different. Related to plutonium, grantees' work has highlighted the risks and downsides associated with plutonium reprocessing, as well as alternative options for safely storing and disposing of nuclear waste. Grantees' work has also highlighted the risks associated with continuing to hold plutonium and has recommended options for safer storage and elimination. Related to HEU, grantees have focused on promoting the use of alternative fuel sources for the non-military applications of HEU and reducing existing HEU stockpiles. This work has sought to reinforce and strengthen the norm that there is no need to hold HEU for civilian purposes and that military HEU should be minimized.

The following sections provide a summary of progress related to HEU and plutonium minimization in country-specific and in multilateral and regional contexts.

PROGRESS ON COUNTRY-SPECIFIC FUEL CYCLE ISSUES

Evidence indicates that, collectively, grantees have produced a reservoir of credible, significant, policy-focused research and analysis to make the case for minimizing use and production of HEU and plutonium and provided practical pathways for country-level W-UM policy reflective of strategy's desired impact. Grantees have long championed policies aimed at HEU and plutonium minimization, including policies aimed at elimination of existing stockpiles and preventing additional production, with many grantees receiving MacArthur grant support both prior to and during the Nuclear Challenges strategy.³⁹ The launch of the strategy aligned with the Nuclear Security Summits initiated under the Obama Administration, and this summit process created an opening for increased engagement and momentum around W-UM policy within governmental and intergovernmental forums.⁴⁰ Taking advantage of this window of opportunity, grantees

³⁹ Reflecting the MacArthur Foundation's long history of investment related to nuclear policy, many grantees received MacArthur Foundation support both prior to and during the time period covered by the strategy.

⁴⁰ Following President Obama's 2009 speech in Prague where he emphasized the risks of W-UM and sought to draw attention to need to secure these materials and thus reduce global nuclear risks, the Nuclear Security Summits included four official, multilateral convenings held between 2010 and 2016. A focus of the summits was consideration of action steps that could promote further security and minimization of W-UM.

collectively contributed to the emergence of credible, significant, policy-focused research and analysis to make the case for minimizing use and production of HEU and plutonium and identify practical pathways for policy implementation at the country level. As part of the formal Nuclear Security Summit process, as well as in other venues for international dialogue regarding W-UM, grantees elevated their research and analysis, directly engaged with officials, and contributed to discrete policy gains related to W-UM materials management. Following the close of the summit process in 2016, grantees sought to maintain the momentum and realized continued progress on country-level W-UM policy.

Grantees have addressed a wide array of country-specific topics related to W-UM policy within the United States and in other countries. Grantees have engaged with officials both within and outside of the United States in relation to their research and analysis. The following examples are shared for illustrative purposes, though do not reflect a comprehensive list of all issues addressed by grantees' research and analysis.

Examples of Grantees' Fuel Cycle Analysis and Recommendations: United States

- Made the case against plutonium reprocessing at the South Carolina mixed-oxide fuel (MOX) facility and proposed alternative disposal methods for separated plutonium stockpiles deemed in excess of military needs.
- Outlined the case and concrete steps needed to transition nuclear submarines to run on LEU fuel as opposed to HEU fuel.
- Re-envisioned nuclear waste policy to align with the strategy's desired impact.
- Recommended a structure for a potential nuclear cooperation agreement between the United States and Saudi Arabia that would include the "gold standard" of verification.

Examples of Grantees' Fuel Cycle Analysis and Recommendations: Other Countries

- Made the case against further plutonium reprocessing at the Rokkasho facility in Japan and explored options for management of Japan's plutonium surplus.
- Made the case against South Korea's plans to use pyro-processing to extract plutonium for power production, and the economic trade-offs, technological challenges, and inherent risks for doing so.
- Analyzed China's plans to use plutonium for power via "fast reactors," and the economic trade-offs, technological challenges, and inherent risks for doing so.
- Analyzed Brazil's proposed development of a naval nuclear program that would rely on HEU fuel for submarines.

- Documented and explored different approaches and solutions for dealing with nuclear waste, including some countries' implementation of waste storage underground in deep geological repositories, which could inform future W-UM management policy.

Evidence indicates grantees' direct engagement with country-level policymakers has contributed to increased awareness about W-UM policy options reflective of regime principles. As

representatives of civil society organizations (and not policy decision makers), grantees are best able to influence policy action within the context of established decision-making structures and processes, particularly when there is need for civil society expertise and participation to educate and inform policymakers regarding specific decisions. However, in the absence of a supportive environment, grantees have not typically been able to create openings to bring W-UM issues to the forefront of the policy agenda, and their influence is therefore likely to be confined to raising awareness. Grantees' reputations and tenure in the field have yielded numerous opportunities to engage directly and substantively with key officials to build their awareness and support for country-level policies that uphold the regime and advance W-UM impact.

Outside of the intergovernmental bodies such as the UN, grantees have most frequently engaged with country-level officials from the United States, although there has also been some direct engagement with officials from other countries or regions including Asia (Japan, South Korea, China), South America (Brazil), and the Middle East (Saudi Arabia). Grantees have used a variety of mechanisms to engage policymakers, including organized convenings and one-on-one or small group meetings or briefings. Grantees have on occasion utilized well-timed strategic communications—sometimes in collaboration with other civil society actors—to raise visibility, hold policymakers accountable, or make a politically palatable case for their proposed solutions. Grantees have primarily engaged with mid-level officials, including MOCs and their staff, United States and foreign military representatives, and representatives of governmental and intergovernmental agencies responsible for management of nuclear materials and representatives. Grantees have also on occasion engaged with higher ranking government officials, for example the U.S. Secretary of Energy and the U.S. Assistant Secretary of State for International Security and Nonproliferation, and senior diplomatic or ministerial officials from other countries, including in the UN context. Data from grantees provided numerous examples of efforts to raise awareness and promote dialogue among officials. In some cases, it was possible to corroborate the influence of grantees' work via interviews with governmental officials, who confirmed the value and utility of information provided by grantees.

Grantees also shared examples of how their work had created space for productive dialogue to inform country-level W-UM policy, for example workshops with senior officials from Europe and China to facilitate dialogue regarding China's plans for plutonium reprocessing related to nuclear

power generation and commitments to considering and monitoring risk. Grantees have also engaged with officials indirectly by deploying savvy communications such as op-eds or other media placements to raise issues, make their case in a visible public form, and thereby get the attention of important policymakers as they are engaged in decisions on fuel cycle issues. For example, grantees have prepared op-eds for local newspapers where MOCs live timed to go out just ahead of key decisions regarding the issues they are working on.

When conditions were conducive, meaning when decision-making bodies were actively considering consequential W-UM policies, evidence shows grantees took advantage of opportunity windows and contributed to discrete country-level policy actions that represent incremental progress toward W-UM minimization, notably in the United States, Japan, and Finland. The following are four of the clearest examples from the data of supportive policy action and grantees' contributions. These examples are illustrative and do not necessarily reflect an exhaustive summary of grantees' contributions.

Closure of a South Carolina plutonium reprocessing (MOX) facility

The United States holds a large reserve of plutonium, produced as part of its nuclear weapons program, and this material poses significant health, environmental, and nuclear proliferation risks. Under an agreement with Russia in 2000, the United States agreed to dispose of 34 tons of its excess plutonium. The U.S. Department of Energy (DOE) was tasked with developing a specific disposal plan with the goal of disposing half of the excess plutonium (17 tons) via immobilization, i.e., storing the material such that it would not be easy for a third party to access the plutonium and potentially use it for a weapons-related purpose. For the remaining 17 tons, the United States pursued a plan to create a facility able to utilize the plutonium as (mixed oxide or MOX) fuel for nuclear power, despite the fact this approach posed risks to public safety and the potential for proliferation. At the time the strategy was initiated in 2015, DOE had yet to make significant progress on implementing a disposal plan. Construction of the immobilization facility had not started, though construction of a site for MOX fuel production had begun in Savannah River, South Carolina. The Savannah River project, however, was years behind schedule and billions of dollars over budget.

Nuclear civil society actors, including Nuclear Challenges grantees, had long recognized the threats posed by the United States' excess plutonium. In an effort spanning multiple presidential Administrations (prior to and during the strategy), grantees conducted in-depth research and analyses and produced multiple publications focused on various aspects of the risks of plutonium reserves and the case for closing the MOX facility in Savannah River. The case against MOX incorporated political as well as technical arguments. On the technical side, grantees' work

explored alternative waste disposal solutions instead of using plutonium as nuclear fuel, including down-blending, immobilization, and other direct disposal methods. On the political side, grantees sought to counteract the DOE’s narratives that justified the need for the MOX facility. DOE argued that converting weapons to plutonium for power was akin to “turning swords to ploughshares,” and therefore a viable path. However, as one grantee put it:

“ You can’t just take nuclear waste, throw it in a reactor, and burn it up. You have to reprocess it, and extract fuel-usable material, and convert that into a form that’s usable in a reactor. That’s the trick. That’s where a lot of the [proliferation] risk lies. A big part of our case was countering this narrative, explaining that it’s not so simple to use or consume nuclear waste.

Another element of the political case against the MOX facility pointed to poor implementation of the project. In the mid-2010s, its construction was behind schedule, and anticipated costs had ballooned far beyond initial projections. By 2014, the projected \$1.5 billion cost to complete the project had grown to \$30 billion, with \$4 billion already spent. In their research and analysis, in one-on-one meetings with officials, and through media pieces, grantees specified their concerns about the risks and costs of the facility. One grantee was even able to raise concerns about the cost of the project as part of their official duties.

As grantees reported and interviews with officials corroborated, civil society engagement and dissemination efforts shaped debate and discussion about the MOX facility and helped turn the political tide toward action. One grantee reported confirmation that the grantee’s work had helped to “make the intellectual case against MOX.” In 2017, with agreement from DOE, Congress approved a version of the National Defense Authorization Act that would allow the Secretary of Energy to cease construction on the facility. In 2018, nearly 20 years after planning for the facility began, the facility was officially closed.⁴¹

Despite the successful closure of the MOX facility, recent developments show that debate over plutonium in Savannah River is not over. The 2019 version of the National Defense Authorization Act included new funding for plutonium pits for bomb core production that are slated to be housed at the Savannah River site. Although the use of the site for bomb core fabrication will not necessitate additional production of W-UM, one of the chief fears around the originally proposed MOX facility was that the site would be used for nuclear weapons production; a decision to do so would counter the strategy’s end goal of reduced nuclear risk. However, the United States is still

⁴¹ The fight over the MOX facility spanned multiple presidential Administrations, including both those of Obama and Trump. Interestingly, the final decision to close the MOX facility occurred during the Trump Administration, which has been more resistant to W-UM policies that uphold regime principles,

pursuing options to dispose of its excess plutonium. Both issues are likely to remain a focus of grantees' efforts.

Allocation of research and development funding to explore feasibility of converting U.S. naval fuel from HEU to LEU

In addition to HEU stockpiles held as part of nuclear arsenals, some countries also hold smaller amounts of HEU for select non-weapons purposes, including as fuel for naval submarines. In the United States, HEU for naval submarine fuel represents the greatest proportion of the stockpile held for non-weapons purposes. As asserted in grantees' research and analysis, maintaining a large supply of HEU naval fuel presents a significant proliferation risk, while LEU is a lower risk potential alternative fuel source. Some countries, such as France, have developed naval reactors that can be powered with LEU. Leadership by organizations the Nuclear Challenges strategy supports has led to a broader awareness and debate regarding potential policy solutions in the United States.

Beyond making the technical case regarding risks posed by HEU and the potential of LEU as a viable alternative, grantees have also worked to directly engage with decision makers, including MOCs, executive branch officials, and naval officials. Grantees' analyses proposed that a first step to advancing LEU as an alternative naval fuel would be congressional approval of research and development (R&D) funding. Grantees reported the ability to get some traction for this proposal in Congress, though U.S. naval officials were more resistant to fuel conversion. Besides direct engagement, grantees have also used the media to generate increased visibility of the issue and proposed solutions, shape debate, and put pressure on officials—in particular, executive branch officials.

Interviews with congressional staff confirmed grantees' influence promoted action on LEU fuel within Congress, culminating with introduction of legislation by Representative Jim Langevin (D-RI). Beginning in 2016, Congress allocated \$5 million per year to begin R&D on LEU naval reactors, and the allocation increased to \$10 million in 2019 representing a big win for those hoping to encourage LEU as an option for naval fuel in the future. This funding was continued in 2020. While much work remains to realize the U.S. nuclear submarine program's full transition to LEU fuel, the step of allocating funds for R&D is an important early milestone in this process. As one grantee put it:



The fact that Congress is appropriating funds to do research on LEU fuel for submarines is more progress than anybody could have hoped for in the past few decades.

Emergence of viable solutions for Japan's excess plutonium

Japan currently holds a large stockpile of plutonium, generated via reprocessing of spent nuclear fuel. Ostensibly, Japan's plutonium stockpile is destined for use in domestic nuclear power reactors. In reality, most of Japan's reactors have been offline since the nuclear disaster in Fukushima that followed the 2011 earthquake and tsunami. However, Japan still has a plan to reprocess spent fuel in order to produce more plutonium for nuclear power.

Japan relies on U.S. nuclear technology for its reactors per a nuclear cooperation agreement with the United States signed in 1988. The agreement granted either party permission to renegotiate in 30 years. In 2015, a grantee recognized a window of opportunity to renegotiate this agreement and to push for reduction of Japan's plutonium production and stockpiles. Engagement with officials continued as the Trump Administration formed in 2017, and grantees also engaged with officials in Japan. Grantees also conducted various media engagements in both the United States and Japan to share and promote recommendations.

In a July 2018 white paper, the Japanese government publicly recognized for the first time the need to draw down its plutonium stockpile. Later that year, the Japan Atomic Energy Commission issued a more detailed policy statement that incorporated some specific grantee recommendations. The grantee reported their belief that civil society's research and analysis helped to shape the thinking of the two governments involved, and thus contributed to the advancement of decisions consistent with the Nuclear Challenges strategy and outcomes—decisions that fostered nonproliferation and the reduction of plutonium stockpiles. Interviews with former U.S. officials involved in these efforts confirmed grantee involvement and influence.

Long-term W-UM storage solutions

Spent nuclear fuel stemming from nuclear power production presents significant risk to human health and the environment, and if reprocessed, also represents a source of plutonium that could be used in weapons production.⁴² Deep geological repositories (DGR), whereby spent fuel is stored securely deep underground, have long been recognized as a viable permanent solution for safely storing nuclear waste. Grantees' work has highlighted the advantages of DGRs, and grantees have promoted their implementation. A number of countries have begun work on DGR

⁴² Currently, an estimated 400,000 tons of spent nuclear fuel are stored at hundreds of sites across dozens of countries. Typically, spent fuel has been stored onsite at the nuclear power production facilities where there were originally utilized as fuel using a variety of storage methods (e.g., within dry casks). Current methods of nuclear waste storage do not represent a permanent solution since they degrade over time, thereby increasing the risk of harmful exposure. As many nuclear reactors across the world are projected to go offline, the need for secure and long-term storage solutions will only grow in the coming years.

projects, including the United States, South Korea, Australia, and Finland. Although these projects are in different phases of development, a common need is the development of viable and credible approaches to safeguarding and verification. If it is not possible to keep a tamper-proof record of the materials contained within a DGR, it will be difficult to keep track of the disposed material.

Working with the nuclear regulatory body in Finland, one grantee has supported development of a new method for nuclear verification that takes advantage of blockchain, the same technology that underlies many cryptocurrencies. The blockchain approach is currently being piloted and the hope is that this technology can also be utilized for DGR management in multiple countries.

PROGRESS ON MULTILATERAL AND REGIONAL FUEL CYCLE ISSUES

In addition to country-level W-UM policy, a few grantees have contributed to development and advancement of multilateral policy solutions that address major W-UM issues. Among these efforts was pursuit of a Fissile Materials Cutoff Treaty (FMCT) within the UN's Conference on Disarmament and work on a proposed regional HEU moratorium in Latin America. Grantees have engaged directly with officials to promote these solutions and convened spaces for productive dialogue and discussion, but, so far, neither measure has advanced to a stage of formal negotiations.

A treaty that would ban further production of W-UM has long been an ambition of those working to reduce nuclear risk, and pursuit of such a treaty long predates the strategy. Prior to the strategy's inception, Nuclear Challenges grantees contributed to a report that included draft language for a proposed FMCT that, if ratified by the UN, would accomplish that goal. Grantees have continued to support efforts related to advancing the FMCT within the UN forum, and in 2018 a group of grantees consulted with the UN preparatory group empowered to work on developing a potential multilateral treaty. Grantees offered their analyses, and briefed and advised high-level decision makers, culminating in a report that was entered into the General Assembly.

Grantees shared that their efforts contributed to growth in officials' awareness and support for the FMCT, but progress toward formal treaty negotiations ultimately stalled as the international political and security landscape became more challenging. Challenges include growing tensions between non-possessor states (some of which envision the FMCT as a key step toward global disarmament) and possessor states (some of which disagree with or are otherwise wary of non-possessors' aspirations). Grantees also noted a collective lack of goodwill toward undertaking negotiations at the UN and expressed that while they remain committed to advancing an

agreement, overcoming current challenges to pursuing cooperative multilateral negotiation falls beyond their ability to influence.

Grantees have also supported multilateral efforts related to enshrining progress within countries that have successfully removed W-UM from their borders, e.g., adoption of regional HEU moratoria. While grantees have engaged directly with relevant decision makers in those countries and convened multi-country dialogues, there is currently not appetite among officials to commit to such permanent agreements, which some perceive could disadvantage their country in terms of future national security.

LINE OF SIGHT

Assessment of line of sight is meant to surface whether progress to date indicates a clear likelihood of advancing and achieving the outcomes of the Nuclear Challenges theory of change. The sequential progression of outcomes identified in the theory of change illustrates belief that the Nuclear Challenges investments will result in short-term outcomes that, along with ongoing investments, help create enabling conditions for intermediate outcomes, including a stabilized nuclear regime in 2025. A sufficiently stabilized nuclear regime combined with ongoing investment will, in turn, enable progress toward the long-term outcome of a negotiated W-UM agreement by 2030. That agreement would result in ceased production and elimination of W-UM stockpiles, the ultimate desired impact of the Nuclear Challenges strategy.

In this section, we lay out an assessment of how progress to date does not provide a line of sight toward the identified progression of intermediate outcomes related to the regime, nor to the long-term outcome related to a W-UM agreement.⁴³

LINE OF SIGHT: REGIME PATHWAY

As outlined in the theory of change, intermediate-level outcomes for the Nuclear Challenges strategy relate to changes within the nuclear regime. Desired outcomes include a stabilized nuclear regime, expected by 2025, as well as other regime-related changes for which no clear timeline for achievement was articulated. The strategy-level outcome of a stabilized nuclear regime has four identified measures of progress:

- There are no new weapons countries.
- There is not a significant increase in the number of weapons globally or by country.
- There is no or little erosion of treaties, agreements, norms, or regime protocols.
- Statements and actions indicate policymakers' perception that the regime is stable.

⁴³ As noted previously, the regime and fuel cycle pathways are interrelated; fuel cycle efforts occur within and may also influence the regime. While it is possible that discrete progress on securing the fuel cycle could contribute to regime-related outcomes or the long-term outcome, evidence is not indicative at this time.

Other intermediate outcomes include:

- Increased agreement and alignment regarding policy issues and solutions among key leaders
- Momentum and traction on policy solutions which reflect the core principles of the regime
- Increased political will among key decision makers regarding critical policy proposals
- More active, robust, productive, and responsive networks
- Increased effectiveness of the nuclear field

Evidence to date is mixed regarding line of sight toward regime outcomes. Overall, there is not a clear line of sight to intermediate outcomes, including a stabilized nuclear regime, by 2025—unless the landscape evolves in ways that facilitates progress, and there are changes to the strategy’s theory of change and investments.

Regarding the measures for the stabilized nuclear regime outcome, on the positive side, the number of weapons countries and the number of nuclear weapons held globally have not changed significantly. That said, given that the strategy’s approaches and areas of investment do not directly influence changes in weapons at the country level, it is not possible to identify any contributory links between Nuclear Challenges investments and the number of weapons and/or weapons countries-related outcomes. In addition, experts indicate that a form of restrained arms race is currently taking place between the United States and Russia, largely reflecting *qualitative* changes in each country’s arsenals rather than a *quantitative* increase in the number of weapons; this qualitative change is a significant consideration in the assessment of progress and the line of sight. In addition, during the period of strategy implementation there has been degradation of treaties, agreements, and norms that are aligned with and uphold the nuclear regime (for example, the U.S. withdrawal from the INF, the Treaty on Open Skies, and the JCPOA; and the risk that New START may not be renewed). Alongside this, statements from leaders and policymakers indicate that the regime is perceived to be unstable.

The other intermediate regime-related outcomes related to leaders’ agreement and alignment on policy issues, solutions gaining traction, and increased political will are also not evident. Compared to the situation at the inception of the strategy, the nuclear regime is considerably weaker today, and while some palliative progress is evident, it is unclear if current investments (between now and 2025) will be able to prevent further degradation of the regime—unless the landscape evolves in ways that significantly facilitates progress, which is unknown at present and not within the Nuclear Challenges strategy’s ability to control.

Nuclear Challenges investments have addressed important new areas of nuclear policy development and support to increase the effectiveness of the field and expansion of networks, particularly by reaching beyond the traditional nuclear field and its related orthodoxies. However, it is too early in the cycle of investment to assess the extent to which these investments might result in any significant policy alternatives or advancements (for example, alternates to deterrence theory) or new or strengthened intra- or cross-field relationships and approaches that would serve to lift the strategy toward strengthening the regime and replace (or at least counter) the policies, agreements, treaties, and norms that have been in play over this period.

LINE OF SIGHT: LONG-TERM OUTCOME AND IMPACT

Line of Sight Toward Long-Term Outcome

The Nuclear Challenges strategy seeks progress toward the long-term outcome of **increased adoption, implementation, and operationalization of policies, including a negotiated agreement, that further W-UM impacts consistent with the strategy.** Measures indicative of progress include:

- A viable agreement on W-UM is negotiated and later passed
- Evidence of implementation or operationalization of policy solutions that aim to close/dismantle W-UM production facilities and dispose of W-UM
- No new countries express interest in W-UM production, or take steps toward it
- Number of countries that commit to use LEU rather than HEU for power generation
- Number of countries that commit to decrease or end W-UM production and dispose of stockpiles

Per the hypothesized timeframe, realization of a clear opening toward a negotiated agreement was believed to be possible by 2030. **Evidence does not reveal a strong line of sight toward the long-term outcome within this timeframe.** As previously noted, there is not a clear line of sight toward intermediate strategy-level outcomes related to changes in the nuclear regime. To the extent that these outcomes represent the pathway for progress toward negotiation of a global W-UM agreement, there is also no clear line of sight to the long-term outcome within the identified timeframe. While to date, advancing progress toward a negotiated agreement has not been a primary focus of grant investments, a few grantee-driven efforts have contributed to advancement of a FMCT that, if enacted, would lead to the cessation of global W-UM production. Despite signs of momentum earlier in the strategy's implementation, progress on the FMCT has stalled and prospects for renewed progress are at best uncertain. Further, it is not clear that grantees are well positioned or will be able to address the factors that have led to the stall.

While evidence suggests a few positive multilateral developments—including no significant change in the number of countries interested in acquiring W-UM, countries’ commitments to decrease their W-UM production or stockpiles, and countries’ commitments to use LEU rather than HEU—there are not strong contributive links between grantees’ efforts and these changes. And, examples of how grantees’ efforts have contributed to positive country-level developments on the W-UM policy front do not clearly signal how or to what extent these country-level gains set the stage for a future negotiated global agreement.

Line of Sight to Impact

Evidence does not suggest a contributory link between investments and changes in global W-UM levels. To the extent that the pathway toward achievement of these changes is predicated upon progress toward long-term outcomes, line of sight toward desired impact is not strong. The desired impact of the strategy is ceased W-UM production and elimination of W-UM stockpiles globally. Table 2 shows global stockpiles of HEU and plutonium over time. Over the course of strategy implementation, there has been incremental progress related to the fuel cycle and W-UM minimization though global levels of W-UM have changed only slightly. Change in global HEU is driven primarily by the United States and Russia disposing of HEU supplies deemed excess to military needs. The global inventory of plutonium has marginally increased since 2009, though at a relatively low rate compared to historical Cold War plutonium production rates. A few countries have produced plutonium for their civilian stockpiles since 2009, though these stocks fall under international safeguards and are therefore of less concern. India, Israel, North Korea, and Pakistan have produced plutonium for weapons purposes.

Table 2 | Global HEU and Plutonium Stockpiles Over Time

	Civilian HEU			Military HEU			Overall HEU (Civilian and Military)		
	2009	2015	2019	2009	2015	2019	2009	2015	2019
Global HEU⁴⁴ (in Metric Tons)⁴⁵	325	115	n/a	1290	1260	n/a	1600 ± 300	1370 ± ↓ 125	1315 ± ↓ 130
Global Plutonium (in Metric Tons)	240	270	300	245	235	220	500 ± 25	505 ± 10	520 ± 15

Sources: International Panel on Fissile Materials (2009) Global Fissile Materials Report; International Panel on Fissile Materials (2015) Global Fissile Materials Report; Stockholm International Peace Research Institute (2020) Yearbook: World Nuclear Forces Chapter.

⁴⁴ Data for Russia is highly uncertain given their lack of transparency. Overall estimates of HEU in Russia are ±300MT in 2009, and ±120MT in 2015 and 2018.

⁴⁵ Global numbers are rounded to the nearest 5MT to reflect the uncertainty of estimates.

2. Is the theory of change valid and adequate to reach the intended impacts?

OVERVIEW

The Nuclear Challenges theory of change lays out an expected sequence of outcomes to which the strategy's collective investments are hypothesized to contribute. Outcome trajectories corresponding with the two pathways, efforts to 1) protect, stabilize, and strengthen the nuclear regime and 2) secure the fuel cycle and minimize W-UM held outside of countries' nuclear arsenals, are similar. In the short term, the strategy's investments and approaches are expected to contribute to emergence of credible analysis and policy recommendations; governmental officials' greater awareness and engagement in nuclear issues; maintenance or improvement of communication channels that yield productive dialogue within both official and unofficial spheres, and increased capacity of actors in the nuclear field. In the intermediate term, there are expectations of achieving a stabilized nuclear regime (by 2025), as well as other outcomes such as an increasingly effective influence by civil society actors, increased (and, ultimately, a critical mass of) support for regime principles among officials and decision makers across multiple countries and institutions, and widespread agreement and alignment regarding regime-supportive solutions and actions. Uniquely and in combination, both pathways of change are expected to contribute to the goal of reduced nuclear risk and advancement of the strategy's desired impact: ceased production and eliminated stockpiles of W-UM globally.⁴⁶

Certain aspects of the theory of change are valid, primarily the link between the strategy's approaches and expected short-term outcomes. There is evidence that within each of the two pathways and across modules, grantees' analyses and proposed policy solutions, along with efforts to build and enhance relationships and communications channels between experts and governmental officials from multiple countries, have led to officials' greater awareness and

⁴⁶ In assessing the validity and adequacy, we rely on the sequence of outcomes identified in the theory of change and the central hypotheses underlying the theory of change about how change is intended to occur. Although not an emphasis of the synthesis report, the evaluation and learning framework also includes a list of assumptions that underly the strategy. Some of the assumptions have been addressed by ORS' technical reports, while others will be addressed in future data collection.

engagement, and have maintained key (and increasingly fragile) bilateral and multilateral communication channels. There is also evidence that grantees' efforts have helped generate and support productive bilateral/multilateral discussion and dialogue. Within the fuel cycle pathways, there is evidence that grantees' efforts have contributed to incremental policy gains related to securing the fuel cycle and minimizing W-UM outside of nuclear arsenals.

Data across modules do not offer strong evidence that short-term changes realized to date have been adequate to influence regime factors *to the extent necessary* to provide line of sight to the intermediate outcome of a stabilized regime by 2025. Although no timeline has been identified, the story is similar for other intermediate outcomes: officials' and leaders' increased agreement, support, and political will toward regime-aligned decisions. There are many potential reasons for limited progress, including the difficult external environment. It could also be that data and analysis are insufficient to surface and explain connections between the strategy's investments and approaches and their contributions to protecting and strengthening the nuclear regime, as is the strategy's current focus. Limited progress could also signal gaps in the theory of change's logic and coherence which, if considered, might be addressed and remedied in order to usefully guide grantmaking toward outcomes. The state of progress may also indicate that there are aspects of the theory of change that are still formative and could be more fully conceptualized, such as the relationships between investments and developing credible alternatives to deterrence theory, and between these outcomes and the likelihood of advancing other module and strategy outcomes.

While acknowledging the many potential explanations for weak evidence of progress toward regime-related outcomes, our assessment of the theory of change's adequacy—in keeping with the intent to provide information that informs ongoing development of the strategy—is focused on its logic and coherence, areas where the theory of change and strategy implementation could be better synchronized, and still-formative areas where there are opportunities for clearer articulation of the strategic approach and intent.

THEORY OF CHANGE: LOGIC AND COHERENCE

A key hypothesis of the Nuclear Challenges theory of change is that cumulative investments across the two pathways could contribute to positive conditions for adoption of a binding multilateral agreement outlining steps that countries will take to end production and eliminate stockpiles of W-UM. Central to this hypothesis are the following premises: (1) investment in civil society organizations' expert analysis and recommendations will contribute to a stable regime and a secure fuel cycle, and (2) those positive changes will generate a productive enabling environment to advance policies, treaties, and agreements that enable widespread disarmament and the elimination of W-UM. Evidence to date raises questions about these premises and whether investments in the identified efforts are, in fact, sufficient to advance the strategy within the hypothesized time frame.

The logic and linkages between approaches and outcomes raises questions, particularly the linkage between short-term outcomes and the intermediate- and long-term outcomes and impacts. For example, it is not entirely clear that—despite some evidence of short-term progress—the approaches of supporting credible analyses and recommendations, and officials' awareness, engagement, and participation in dialogue, are sufficient for achieving change within the nuclear regime that would enable further strategic progress toward the long-term outcome. Another concern is the scope and spread of investments both within and across module components. Within the overall portfolio as well as within module components, grant investments address a wide range of topics. Within some module components, it is difficult to determine the logical relationship between funded activities and expected outcomes or how grants could collectively and additively contribute to a set of common outcomes. These factors may to some extent limit the potency of the strategy.

Further, identified intermediate and long-term outcomes are significantly affected by factors that are outside the strategy's direct influence. Nuclear Challenges investments and grantees' efforts take place within a dynamic landscape shaped by national policy and security concerns, political dynamics, the spectrum of bilateral and multilateral relationships, and emergent technological changes, as well as significant global events such as the coronavirus pandemic. Since the strategy was initiated, numerous factors outside of the Foundation's or grantees' control have altered dynamics in ways that negatively affected the stability of the regime, and reshaped the potential trajectory for progress. Evidence suggests that efforts to date and short-term progress, while valuable, are nonetheless insufficient to overcome significant challenges posed by the landscape

which affect the potential for progress on intermediate and long-term outcomes. As it stands, it is not clear that intermediate outcomes could be realized (1) via grantees' (diffuse and loosely aligned) research and analysis and dialogue promotion, or (2) within the hypothesized timeframe (by 2025).

Another question is the extent to which the strategy's narrow focus on engagement with officials is sufficient to realize identified outcomes. While grantees have access to senior officials in multiple countries, they do not typically have direct access to political leaders who are often the decision makers regarding nuclear issues (secretaries, ministers, heads of state). Furthermore, evidence shows that analysis and recommendations from civil society organizations, even those that house the foremost experts, is only one of many inputs into the nuclear policy process. Data suggest that the strategy of engaging and informing officials—sometimes called an “inside game”—may be limited in terms of its ability to influence political leaders' alignment with or support for the kinds of transformative policy decisions necessary to realize some regime outcomes, i.e., decisions that endorse alternatives to the status quo or for which expressions of support may be politically risky. While the inside game can be a key lever for realizing policy-related gains, it may not be sufficient on its own to drive transformative outcomes without significant supplemental actions, or a more supportive landscape.

Lastly, the theory of change appears to encompass implicit assumptions about the extent to which the United States or even the P5 could be expected to influence, sway, or elicit behaviors from countries such as North Korea and Iran. It is not clear whether these assumptions are valid, and they may become problematic if they are interpreted as conveying different expectations related to regime principles for the United States as compared to other non-Western, non-European possessor states, notably Iran and North Korea. As one of the two main nuclear weapons possessors, the United States may not be able to credibly make the case to these countries of its own demonstrated commitment to regime principles without clear, near-term action to reduce their own nuclear weapons stockpiles.

OPPORTUNITIES TO FURTHER DEVELOP AND STRENGTHEN THE THEORY OF CHANGE

What has been learned over the past year suggests that clarifications and adjustments to the theory of change could be useful.

Clarify what constitutes a stabilized regime, and that regime stability reflects a fluid condition rather than a static outcome. Related to the regime pathway, it is not clear what would constitute a sufficiently protected, strong, or stabilized regime to allow for advancement toward a multilateral agreement. Identified measures related to the specific intermediate outcome pertaining to a stable nuclear regime are a start, but other facets of regime stabilization or strength may also be necessary to advancement. To date, much of the regime-focused effort has been palliative, focused on mitigating ongoing erosion. However, palliative success is unlikely to be adequate to ensure a line of sight to the strategy's long-term outcome and impacts. It would be useful to clarify when and how efforts are hypothesized to shift from palliative to more transformative outcomes, e.g., agreement and uptake of alternative policy frames (other than deterrence) or how much degradation the regime could endure before a different approach is required. While the theory of change suggests it would be possible to achieve a stable nuclear regime by 2025, the reality is that ongoing efforts to protect the regime and assure its robustness as a global nuclear governance structure are likely needed, from now to 2025 and beyond, if a stabilized nuclear regime is to be maintained.

As written in the theory of change, the outcome of a stabilized regime seems to reflect an end state. However, regime stability is not necessarily a static outcome to be permanently realized or achieved within a defined timeframe. To strengthen the theory of change, it may be helpful to clarify that a stabilized nuclear regime will require the ongoing efforts of civil society actors to protect and maintain the strength of the regime to a sufficient degree, and that realistic outcomes will likely depend on the windows of opportunity present at any given time. Depending on the external context, pro-regime efforts might be palliative, stabilizing, preventive, and/or transformative in nature. As outcomes are clarified, future measurement might usefully focus on discerning what it takes for the strategy to contribute to meaningful outcomes under certain conditions. Further, given uncertainty about how the landscape will evolve, it could be useful to consider whether and how the strategy's identified approaches and modules could best contribute to advancing intermediate and long-term outcomes within a future landscape that is

equally (or more) challenging, as well as within a future landscape that is more enabling for the strategy.

Support broader and deeper alignment among grantees and reduced duplication of effort. One area where the theory of change’s logic might be usefully examined relates to the extent to which grantees’ activities are best implemented as individual endeavors or collective efforts. Evidence indicates that grantees do work together on occasion, sometimes systematically (e.g., within the context of the U.S. Congress). However, grantees are also pursuing a myriad of different goals and there may be opportunities to enhance effectiveness by coordinating and aligning efforts of civil society organizations based on an explicit shared goal. Pertinent to the theory of change is an implicit hypothesis that if multiple civil society organizations, each bringing unique expertise to the decision-making context, can effectively implement their work with some degree of alignment, they will successfully influence and contribute to outcomes, including policy decisions. However, evidence raises some questions about this hypothesis.

For example, to what extent does alignment among civil society organizations represent an effective means by which to advance policy? Some grantees spoke of the additive value of coordination or alignment among multiple non-governmental groups when there is the opportunity to advance a specific policy solution or shared goal. However, grantees also noted the complications of aligning their work; different organizations have different missions and related goals, as well as different funders that put forth different grant requirements. There is also a limited number of nuclear funders; civil society organizations may therefore carry a scarcity mentality, leading to competition for funding spurred by belief that collaboration could potentially result in reduced organization’s funding. Intentional coordination and alignment is not the norm for nuclear civil society organizations, and there are few mechanisms through which multiple organizations could coordinate their efforts, outside of specific opportunities related to advancing a policy solution. Other barriers to coordination relate to the complexity of nuclear solutions and the dynamic external environment. A working assumption for both the Nuclear Challenges strategy and grantees is that the nature of the environment means multiple possible pathways to advance outcomes are possible, including unplanned pathways that result from changing opportunity windows. This working assumption may lead grantees, and potentially some funders, to resist coordination, instead opting to keep a range of possible solutions or pathways open at any one time.

Consider supplemental areas of investment to complement the “inside game” and further influence increased awareness and engagement. One of the strategy’s initial assumptions was that it would be difficult and costly to implement public awareness and engagement approaches, with little certainty that public engagement could contribute to incremental or broader regime

and fuel cycle outcomes. Thus, the strategy does not currently include investments aimed at constituency building. However, key informants offered the perspective that public awareness and public pressure are often useful and critical complements to an inside game. Interviewees also noted that targeted public engagement could be particularly effective for building alignment and support for pro-regime policy among key MOCs, for example efforts to engage constituents in a particular district or state that is more directly affected by nuclear issues (e.g., because the community houses a nuclear facility) as a means to influence officials.

Further articulate the intent of investments to increase capacity and effectiveness of actors in the field, and the link between these investments and outcomes. The theory of change encompasses a premise that investments to boost the capacity of civil society actors will contribute to the effectiveness of the field as a whole, such that outcomes may be accelerated or amplified. In the context of the strategy, one way that capacity has been understood is organizations' ability to usefully pivot and respond to the dynamic external landscape. Accordingly, the Nuclear Challenges strategy has provided some flexible and responsive grants to support organizations' nimbleness and responsiveness. Capacity-focused investments have also been directed at opportunities for grantees to develop certain skills, namely communications and messaging skills. Capacity has also been framed as: a broadened pipeline of experts, potentially accomplished by attracting and maintaining younger and more diverse experts; broadened nuclear risk reduction efforts, such as engagement of new audiences or links with other/adjacent fields; and increased utilization of new frames to talk about nuclear risks (i.e., beyond deterrence). While capacity-oriented investments may indeed be important to the success of the strategy, it would be useful to further articulate the hypothesized link between *capacity* as it has been framed and grantees' resulting *effectiveness* in terms of advancing intermediate and long-term outcomes within a specific timeframe, as well as under specific landscape conditions. In other words, what aspects of capacity are most necessary to advancement of outcomes given the landscape?

Clarify the extent of the strategy's dependence on the landscape. Despite evidence that grantees have been active and effective while windows of opportunity are open, there is no evidence to suggest that civil society organizations are consistently able to create openings for advancing the sorts of outcomes identified, or to stop open windows from closing. In the case of Iran and North Korea, there are currently few opportunities for grantees to engage as windows regarding advancement of policy, treaties, and agreements have recently closed. Even if grantees had substantial capacity (expertise, flexibility to respond, key skills), there are limits to civil society organizations' abilities to influence officials' decisions and actions when the windows are not there. In other words, the lack of progress on protecting and strengthening the regime, or securing the fuel cycle, may not be due to civil society organizations' capacity or their potential for effectiveness, but rather signal that windows of opportunity are not present. With few or no

windows of opportunity, there may be limitations to the strategy and grantees' ability to influence policy progress. Hypotheses in this area are still developing and yet to be fully fleshed out.

Clarify the extent to which module outcomes are necessary to strategy outcomes. There is an implicit hypothesis that achievement of the strategy's intermediate outcomes may not require progress within every module. However, the question of whether certain module outcomes, or combinations of outcomes, are more important or necessary to regime stabilization than others has not yet been fully answered. There are opportunities to further develop the theory of change by considering and clarifying how and where investments should focus and be prioritized in order to achieve outcomes that are most necessary to advancing the strategy and offer the most potential given the landscape. For example, given the outsized roles of the United States and Russia within the nuclear regime, what type of progress in this area of work is necessary or even non-negotiable? Despite grantees' efforts to keep track 2 dialogue channels open (reflecting palliative progress), neither the United States nor Russia—the two largest nuclear-weapon states—have shown leadership or a strong commitment to regime principles and, in fact, the United States has pulled out of significant treaties. Significant challenges remain in the bilateral relationship which could frustrate prospects for New START renewal. There is some opportunity to clarify how the strategy might address and frame outcomes related to U.S.-Russia relations to promote meaningful progress toward regime stabilization.

Support grantees' greater awareness of the strategy and theory of change. Interviews with multiple grantees indicated that at the time grants were made, grantees had little awareness of and were not fully clear about the Nuclear Challenges strategy, its approaches, desired outcomes, or goal.⁴⁷ Refining the theory of change for the next period of work, ideally before significant new grantmaking occurs, will allow for examination and clarification of expected outcome trajectories within the strategy's modules or pathways and the related hypotheses. Doing so would ensure clarity about how pathways and modules represented within the theory of change align with and are expected to contribute to a hypothesized sequence of outcomes. Clarity on these points could help grantees better understand and appreciate how their work, both individually and collectively, can catalyze progress toward desired outcomes and desired impact. This will help ensure grantmaking is more fully aligned to the strategy itself and directed at most meaningful outcomes.

⁴⁷ Grantees have since had opportunities to learn about the theory of change in convenings held in September and October 2019.

3. Does the landscape suggest continued windows of opportunity for progress toward the Nuclear Challenges strategy's intended outcomes and impacts?

OVERVIEW

The Nuclear Challenges strategy is taking place in a highly dynamic landscape. Throughout the strategy's implementation, there has been growing turbulence in the nuclear regime, affecting relationships and alliances, security concerns, and willingness and motivation toward cooperation. A 2017 strategy pivot was implemented in response to growing stresses on the regime by virtue of the challenging dynamics between countries and allies, and the risk that once-strong nuclear leadership by the United States could be seriously weakened following the election of President Donald Trump. The assumption underlying the strategy pivot was that treaty architecture and key regime structures could be kept stable through the 2020 U.S. presidential election or until such a time as U.S. political leadership and/or conditions in the multilateral environment become more favorable to progress on agreement and decisions that strengthen the regime, and further the strategy's W-UM agenda. Despite palliative success and a potential change in U.S. presidential leadership in 2021, it is unclear that the landscape will improve sufficiently. For example, the election of Joe Biden as President will not erase the current tensions between the United States and Russia, the lingering effects of the United States' withdrawal from the INF treaty with Russia and the JCPOA, nor the work required to avoid potential discontinuation of New START, the one remaining U.S.-Russia arms control treaty.

A number of current significant uncertainties have implications for the strategy, including the outcome of the November 2020 U.S. presidential election; dynamics related to the global coronavirus pandemic and resulting economic downturns which will likely add to domestic

stressors and countries' positions vis-à-vis their own security;⁴⁸ and the degree to which countries will be inclined to stand by the NPT and maintain commitments amid the current turbulence. These uncertainties and the profound challenges of the landscape call into question whether Nuclear Challenges investments as currently conceived will be sufficient to stimulate sufficient progress to advance the strategy's end goal of reduced nuclear risk via ceased production and elimination of W-UM. At the moment, there are not many opportunities for the transformative change that would likely be required to advance multilateral agreements necessary for realization of ceased production and eliminated W-UM stockpiles, and efforts to date have been mostly palliative in nature. Some windows that were open earlier have closed for now or are very fragile, particularly those related to the Tough Cases module, i.e., advancement of nonproliferation in Iran and disarmament in North Korea. However, we see windows of opportunity for progress on nuclear risk reduction across both pathways identified by the theory of change.

⁴⁸ Data collected for this report wrapped up just as the COVID-19 pandemic was beginning. Therefore, findings and evidence do not reflect COVID's impacts on the landscape.

WINDOWS OF OPPORTUNITY

REGIME PATHWAY

Numerous uncertainties related to the November 2020 U.S. election could shape windows of opportunity regarding the regime. The reelection of President Trump could have profound negative implications, though election of former Vice President Joe Biden does not guarantee there will be immediate stronger opportunities to successfully influence or contribute to policy development.

However, there are clear opportunities for **continued development of U.S. nuclear leadership**, including building support for policy options in support of regime principles and differentiated engagement among officials about nuclear threats. Grantees can also continue what are now nascent efforts at developing and advancing new frames for nuclear risk, e.g. the moral imperative to never use nuclear weapons versus the security frame of deterrence. Additionally, there are windows for continued efforts and attention to dialogues that help to maintain U.S. security alliances and relations.

The relationship between the two largest possessor states is very tenuous and continues to grow more so. It is unclear what would be necessary or sufficient to improve U.S.-Russia nuclear relations, or even keep them from deteriorating further. Realizing progress would almost certainly demand significant and steady attention and it would be very difficult to navigate the relationship even with a change in the U.S. Administration. However, there are key opportunities for grantees to be influential via efforts to **bolster and sustain the NPT**. Given their built-in role in the NPT's preparatory and review conferences, civil society organizations are well positioned to bring their influence to bear with the parties to the treaty, including nuclear possessor and non-possessor states.

Finally, there are opportunities for the MacArthur Foundation to continue to explore **alignment among nuclear funders** and potentially leverage existing or new investments to support and enhance regime-related efforts.

FUEL CYCLE PATHWAY

While the traction and good will for multilateral efforts generated by the Nuclear Security Summits has all but disappeared, windows remain open for country-level progress related to securing the fuel cycle. It's likely that these windows would be enhanced by stronger and more credible U.S. leadership regarding nuclear policy and risk reduction, and its stronger commitments to W-UM minimization and disarmament.

The United States and Russia have designated some stored HEU and plutonium as excess to military needs, which means these materials could be down-blended or disposed of. To date, neither country has taken significant steps to follow through on dispensation agreements. While there are serious questions about whether grantees can successfully influence Russia's decisions and behavior, grantees are well positioned to **continue pushing U.S. officials on policy and related decisions aimed at down-blending excess HEU and disposing of excess plutonium.**

Another shift in the landscape that has implications for the strategy's opportunity window relates to the pending expansion of nuclear energy reactors globally. Driven largely by commercial interests, there has been much research and development toward new reactor technologies. While not all will be viable, new reactor models are likely and many more countries could acquire them for energy production. The risks and policy implications of these new reactor technologies and their use on a global scale are not currently well understood. It is quite possible that many countries outside of nuclear possessor states and the regime frameworks would acquire new nuclear reactors for energy production. Whatever new technologies are adopted, they are unlikely to run on HEU, but some could use plutonium, and thus there are clear and inherent proliferation risks—even if the reactors are intended solely for nuclear energy.

The development of new reactor technologies falls completely outside of current frameworks. For example, as development efforts are commercially driven, it is unclear whether these reactors would be governed by the IAEA, as is now the norm for civilian nuclear reactors. **Nuclear Challenges grantees with deep expertise in these issues seem well positioned to conduct useful research and analysis and to surface key policy questions related to the management of materials and related policy concerns.** Ultimately, the Nuclear Challenges strategy and its grantees could contribute to the development of a framework for managing and minimizing the risks associated with new reactors where one does not currently exist.

There are also opportunities to support **further field-level discussion about the nexus between nuclear and climate-focused efforts.** An important debate regarding nuclear energy's role in climate-focused efforts is the following: Is nuclear material—even in peaceful civilian uses—a large enough risk that it should be avoided altogether, or are responsible and well-governed

peaceful uses of nuclear material acceptable, and perhaps even necessary to address the serious concerns of climate change? Understanding that the Nuclear Challenges strategy's intent is not to take sides, **participation in and support for this debate could facilitate important linkages between nuclear and climate-focused work.**

Finally, there are opportunities for **continued efforts to enhance the capacity of the field and diversify the field of experts.** The prevalence of white male experts has influenced the nuclear field's cultural norms, making it difficult to attract younger, female, or non-white experts or broaden thinking, relationships, influence, and the range of potential solutions. Challenges to diversification and inclusion in the field have been acknowledged by the Nuclear Challenges strategy and were noted by many interview respondents. As defined in the strategy, capacity-building efforts are currently quite broad; there could be opportunities to narrow the scope of effort and focus more intentionally on diversity and inclusion in the field.



CONCLUSION

In the context of a shifting and challenging international security environment, the Nuclear Challenges strategy aspires to reduce nuclear risk via ceased production and eliminated stockpiles of W-UM globally. Over the course of implementation, the Nuclear Challenges strategy has sought to identify ways to make progress toward this important end goal.

Since initiation in 2015, the Nuclear Challenges strategy has invested in dual pathways related to stabilizing the nuclear regime and securing the fuel cycle. In response to significant challenges in the landscape, particularly the change in the U.S. Administration in 2017, the strategy sought to reinforce investments related to protecting and strengthening the nuclear regime, recognizing the growing risks to nuclear stability across key countries.

Analysis reflected in this report indicates the Nuclear Challenges strategy has been able to effect progress against short-term outcomes within each of the two pathways. The strategy's valuable areas of investment have resulted in the emergence of credible policy solutions, engagement on nuclear issues among a selection of key governmental actors, and a degree of increased capacity among actors in the nuclear sector. Importantly, the strategy has allowed civil society actors in the nuclear field to continue to have an important voice in policy-related processes, including

those related to W-UM, provide critical insights and solutions that offer alternatives to U.S. domestic nuclear policy, and continue key bilateral and multilateral nuclear diplomacy efforts.

Progress toward a stabilized nuclear regime, the strategy's current primary focus, has proved to be challenging. This is partly because of the complexity of the landscape and the time needed to deliver change, but may also reflect some weaknesses in the theory of change and the strategy's implementation, that, if addressed and remedied, could further drive progress. At the present time, a line of sight toward intermediate-term outcomes, including a stable nuclear regime, believed to be achievable by 2025, is not discernable.

Evidence suggests that examination of the theory of change and modifications to the strategy may be warranted, particularly if the long-term outcome of a negotiated multilateral W-UM agreement and the desired impacts of ceased production and eliminated stockpiles of W-UM globally remain the same. In particular, the strategy will need to consider where and how best to respond to a dynamic and uncertain landscape in which challenges are likely to continue over the next five (and more) years. Investments geared to cope with significant contextual change, as per the MacArthur Foundation's design-build approach, are likely to be needed. This is particularly important in relation to some immediate landscape factors, including the outcomes of 2020 U.S. elections; tense multilateral dynamics as reflected in the NPT review process; and the state of nuclear relations between the two largest nuclear powers, the United States and Russia, including whether there is a renewal of the sole remaining arms control treaty. In addition, the ongoing coronavirus pandemic creates further uncertainty for each of these factors.

Evidence also offers insights into opportunities. Going forward, it will be important to consider the role (and limits) of civil society in the nuclear landscape, and other ways in which investments might affect change within the political and security landscape across possessor and non-possessor states. Questions of scale and depth of investments in key areas could also be explored.

As highlighted at the outset of the report, the repercussions of a nuclear detonation—whether an accidental or intentional strike—would be a global catastrophe with devastating humanitarian and environmental consequences. The MacArthur Foundation plays a critical philanthropic role in addressing this global threat. As the leading funder in the nuclear space, the Foundation, via the Nuclear Challenges strategy, is decisively positioned to invest in ways that could protect and strengthen the regime. The Foundation's strategy review process offers an important opportunity to draw on evaluation evidence, consider beneficial adjustments to the strategy, and identify investments that will better position the Nuclear Challenges strategy to achieve its end goal.



APPENDIX AND ANNEXES

Provided under separate cover:

Appendix: Full Evidence by Module and Strategy

Annex 1: Summary of Methods

Annex 2: Data Collection Tools

Annex 3: Secondary Sources

Annex 4: Nuclear Challenges Theory of Change and Evaluation & Learning Framework (Design)





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