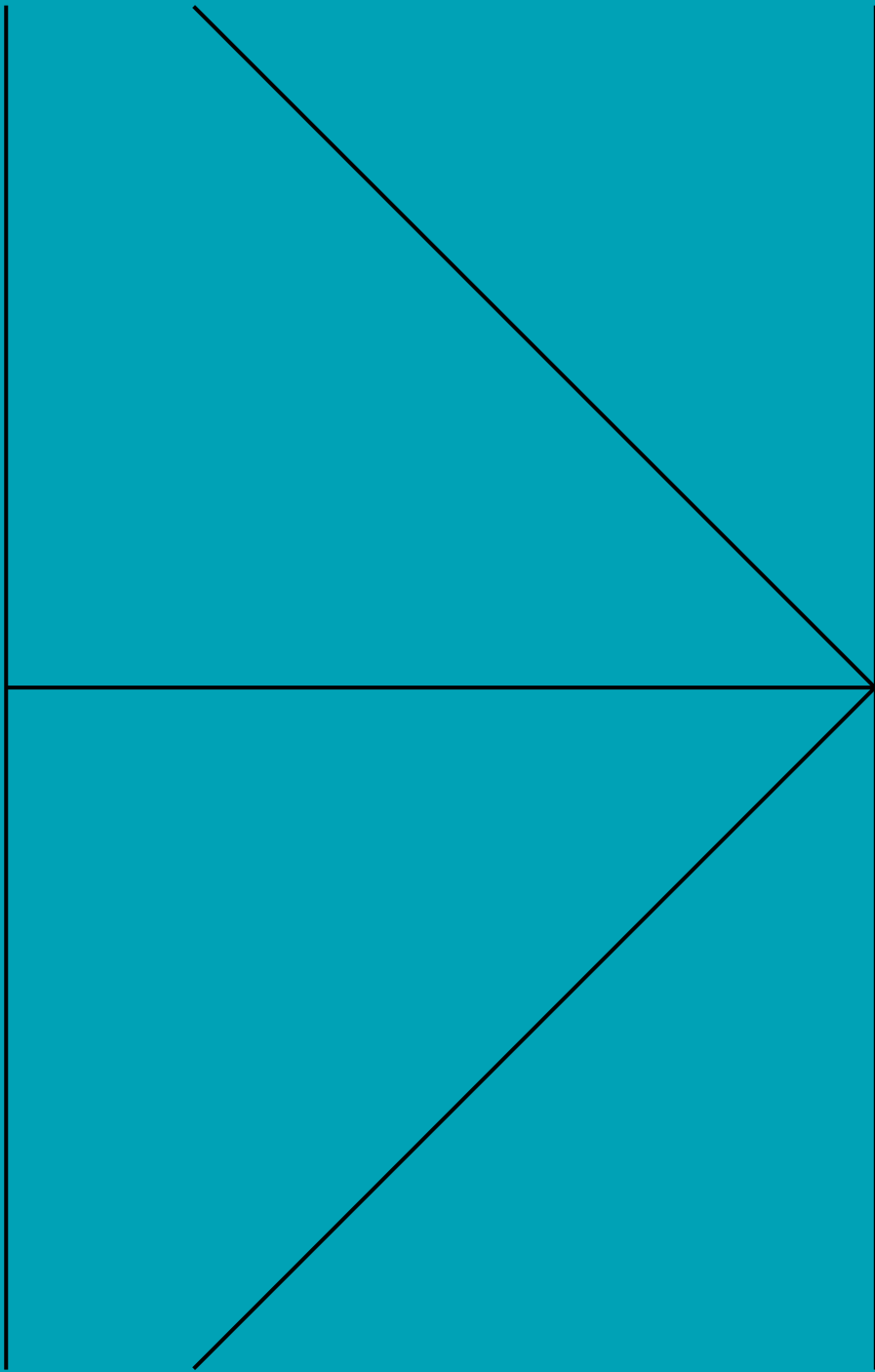


THEORY
OF

CHANGE

Theory of Change

Horizon 2045:
The Promise of a Future Free from Nuclear Weapons
An Audacious Theory of Change



HOW TIGHTLY
MIGHT WE BIND
OURSELVES TO
BEING BETTER
ANCESTORS?

What potential might we unleash by ridding the world of nuclear weapons?

HORIZON 2045

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WHAT IS THIS PROJECT ABOUT?

Horizon 2045 (H2045) is a 25-year initiative to end the nuclear weapons century.

We urgently need to manage the intertwined existential risks of the Anthropocene—the geological era that began with the 1945 Trinity Test and is characterized by humankind’s newfound capacity to destroy itself along with all life on the planet.

Recent research has shown that concerns about existential threats have become palpable, as has the desire to solve human-made problems and move to a brighter future. This offers an important opportunity: By considering nuclear weapons in the context of other dangers, we can dismantle conventional wisdom that nuclear weapons are tools for maintaining global stability, drawing new energy to the effort to rid ourselves of them.

What makes H2045 unique is that we bring a new theory of change. Rather than centering solely on nuclear weapons, our theory of change creates common ground for organizations and thought leaders who share our vision: Humanity can, and will, move beyond the existential challenges we now face. By shifting our sole focus from nuclear challenges to a broader conception of global security, we increase the surface area for collaboration and shared learning. In so doing, we lay the groundwork for a much larger-scale effort.

Horizon 2045 is a long-term systems change effort to develop and bring about a model for global security independent of nuclear weapons.

OUR INVITATION

This document is an invitation to think with us. It is the product of a collaborative effort. It is a snapshot of a work in process. It raises more questions than it answers. It is intended to shake the current paradigm. It uses speculative techniques to bring alternate futures to life. It may cause discomfort. It may cause inspiration. We think this kind of work is important in shaping debates, changing narratives, and provoking change.

We invite you to use this document as a jumping off point for thinking big and long term. It does not need to be read all at once. You may skip to the section that seems most intriguing and start there. What questions does it raise for you? What questions remain to be asked and answered? What answers might you have?

There is a great deal that must be done. In our next phase we will be working to translate these insights into pragmatic solutions. Inspiration and vision light the way for that journey. H2045 will expand to include others in the development of a vision that inspires change.

THE SYSTEMS APPROACH

This whole planet is systems interacting with systems embedded in systems that are conglomerations of systems.

Decades of social change work tells us that to move a system, we can't just be reactive to events of the moment. We have to get underneath what is visible, all the way down to the underlying structures and beliefs at the base layer of a

system. We have to challenge the mental models that drive it, sustain it, and protect the status quo.

Our future is at risk. What we believe shapes our capacity to address that risk. But mental models are powerful, stubborn, and often unconscious. With Horizon 2045, we're not taking the easy route—we're going straight into the much more difficult work of confronting values and beliefs about nuclear weapons, because that's what will enable the kind of transformation that has eluded us so far.

Systems change means exposing and challenging old mental models—and pushing for new ones.

There has never been a better time to take a systems approach. As the public acknowledges its anxiety about interrelated threats—nuclear, climate, health, sociopolitical—data shows that the majority of people support a world free of nuclear weapons. They just do not feel they have agency to make it happen. Efforts to “scare people straight” or get them to act out of fear are therefore counterproductive. This substantiates the H2045 approach, which looks at nuclear risks in the context of other global dynamics and counters the failures of nuclear deterrence—itself a concept that centers on restraining through fear—with a vision for a world in which humankind has moved away from the edge of a dangerous precipice.

THE STORY OF OUR FIRST PHASE

Launched in 2019, Horizon 2045 was designed to challenge conventional wisdom about the efficacy of nuclear weapons as tools for maintaining global security. We based the initiative on the understanding that the story of nuclear deterrence is fundamentally flawed because it places an untestable, highly consequential bet on the idea that world leaders will operate predictably and sociotechnical systems will never fail. H2045 is about disrupting the story of nuclear deterrence and crafting a better story about global security.

REPLACING A THEORY → A FUNDAMENTAL REIMAGINING

Soon after the initiative launched, however, the world around us changed inexorably. And then it kept changing. The COVID-19 pandemic fundamentally reshaped life on Earth; violence against marginalized communities ripped open the ugliest of societal wounds; political systems and economies were upended (Brexit, the rise of authoritarian rule, the January 6th insurrection). Climate-related wildfires, superstorms, and sea-level

rise ravaged communities. Some of our own team members lost homes or spent months on end alone, weighing physical health risks against the very real mental and emotional effects of long-term isolation.

On the nuclear front, even as we watched the nuclear ban treaty enter into force,¹ we experienced significant shocks to the nuclear nonproliferation and disarmament movement. The US-Iran nuclear deal fell apart, decreasing Iran's nuclear weapon breakout time² to a few months at best (and just a few weeks at worst). Nuclear arms control treaties have expired or are under threat while North Korea-US nuclear talks have stalled³ and China is expanding its nuclear capabilities.⁴

What the last few years have illustrated is that nuclear weapons do not help us address the most pressing safety and security concerns in our future. In fact, our shared experience suggests that Horizon 2045's focus should be less on replacing nuclear deterrence theory—a counterfactual model of how people and systems will behave in the face of imminent, catastrophic threat—than on a **fundamental reimagining of global security reflecting the aspirations and challenges of this 21st century world and beyond.** For that to

1 ICAN. (2021). *The Treaty on the Prohibition of Nuclear Weapons: Signature and Ratification Status*. https://www.icanw.org/signature_and_ratification_status

2 Levite, A. (2021, June 24). *Can a Credible Nuclear Breakout Time with Iran Be Restored?* Carnegie Endowment for International Peace. <https://carnegieendowment.org/2021/06/24/can-credible-nuclear-breakout-time-with-iran-be-restored-pub-84833>

3 Shin, H. J. S. (2020, July 3). *U.S. Envoy to Visit South Korea to Discuss Stalled North Korea Nuclear Talks*. <https://www.reuters.com/article/us-usa-northkorea-southkorea/u-s-envoy-to-visit-south-korea-to-discuss-stalled-north-korea-nuclear-talks-idUSKBN2440BG>

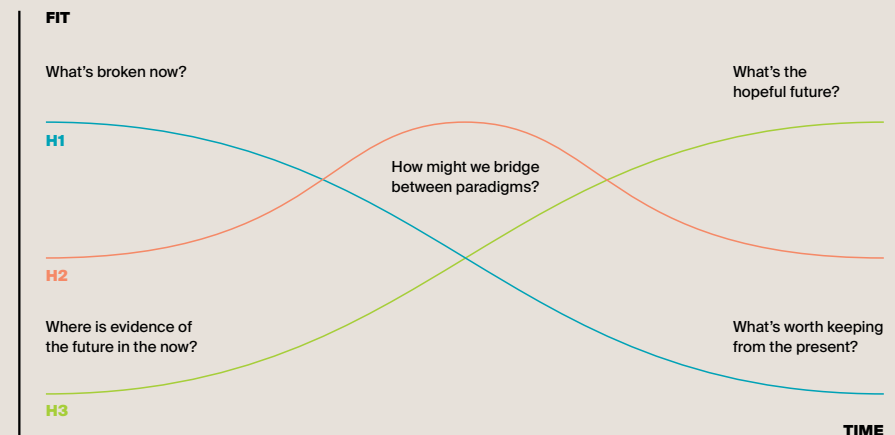
4 Korda, M. (2021, July 16). *China Is Building a Second Nuclear Missile Silo Field*. Federation of American Scientists. <https://fas.org/blogs/security/2021/07/china-is-building-a-second-nuclear-missile-silo-field/>

be possible, we need a more comprehensive understanding of the ways the world around us is changing—indeed, how the human experience itself is changing as we come up against planetary boundaries.

Our “better story” must—and will—show why, in a future focused on fundamentally different conceptions of human and planetary security, we will no longer need or want nuclear weapons. It must address deficiencies of the current system, particularly the inability of governments and institutions to respond to and manage threats effectively. It must illustrate how our lives are directly affected by decisions relating to nuclear weapons and demonstrate that no country alone can manage global threats at a time when technological and digital advancements create new risks and new opportunities alike.

We have developed a theory of change rooted in thorough and painstaking analysis of the historic and current dynamics of the nuclear “system” and notions of nuclear deterrence. The resulting analyses have produced fresh insights about opportunities to disrupt and replace those dynamics with interventions that promise a more secure future in both human and planetary terms, and we have begun to specify and define the requirements of those interventions in a way that enables broad cooperation with those who share our vision.

THE THREE HORIZONS FRAMEWORK



Setting systems change in motion requires deep understanding of the complex dynamics that keep the status quo stubbornly in place. It requires a vision for a far brighter future, informed by data about how it might unfold and bolstered by a set of big and small experiments that bridge the present we have and the future we want.

The “three horizons” framework—a foresight tool for exploring “the challenges in the present, our aspirations for the future, and the kinds of innovation we might need to address both at the same time”—serves as our scaffolding for this long-term work.⁵ In hewing closely to this framework, our intent was to determine what is worth conserving from the past and present, what to let go of or disrupt, what types of innovation and experimentation are most

promising for creating that change, and how, specifically, we will be better off in a preferred future. The result, so far, is a set of powerful insights about the past, present, and future that surface new opportunities to challenge deterrence theory and move us toward a far brighter tomorrow.

HORIZON 1 (THE PRESENT)

Horizon 1 centers on the nuclear system. The nuclear system comprises a complex network of components and interactions that makes it difficult for anyone to comprehend both the whole and its parts. The goal of our Horizon 1 work is to better understand the full contours of the nuclear system—including its characteristics, the interplay between elements, and the underlying beliefs that

⁵ International Futures Forum. (n.d.). *Three Horizons*. <https://www.iffpraxis.com/three-horizons>
 This framework was developed by an IFF team including Anthony Hodgson, Bill Sharpe, and Graham Leicester.

drive it—in order to gain the information necessary to transform it.

HORIZON 2 (THE BRIDGE)

Horizon 2 defines the opportunity space or “bridge” between Horizon 1 and Horizon 3. That is, it captures the types of interventions that will help us to take advantage of the frailties of the current system (Horizon 1) so that we can bend the course of events toward the future we prefer (Horizon 3).

HORIZON 3 (THE FUTURE)

Horizon 3 centers on the future and the many contextual factors that will influence and help determine its contours. As important and interconnected as nuclear weapons issues are to everything else, they are still only one small part of our world—and the nuclear system is not the only system that needs to be deeply reimagined so that we can arrive at a better future. By thinking about the broader future first, and then considering the implications for nuclear weapons, we reveal a larger canvas, highlighting a broader set of opportunities to bring about real and lasting change.

Horizon 2045 takes a “three horizons” approach to understand more deeply what in the current nuclear system no longer fits our circumstances but may have some characteristics worth preserving (H1), what future system we want to enable (H3), and where to place our bets to enable that new system to take shape (H2).

HISTORICAL STORIES AND THE SYSTEMS MAP

STORIES OF [ATTEMPTED] DISRUPTION

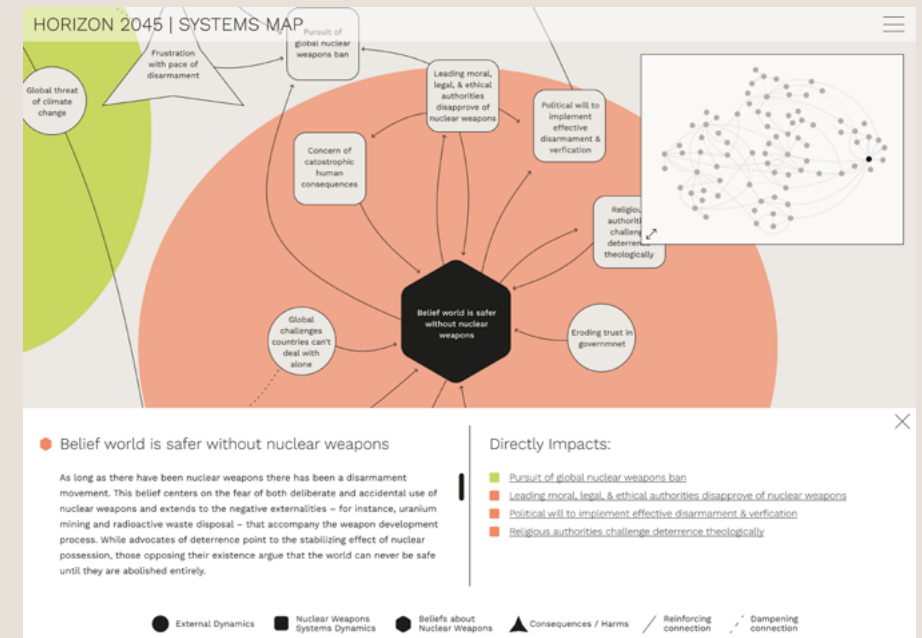
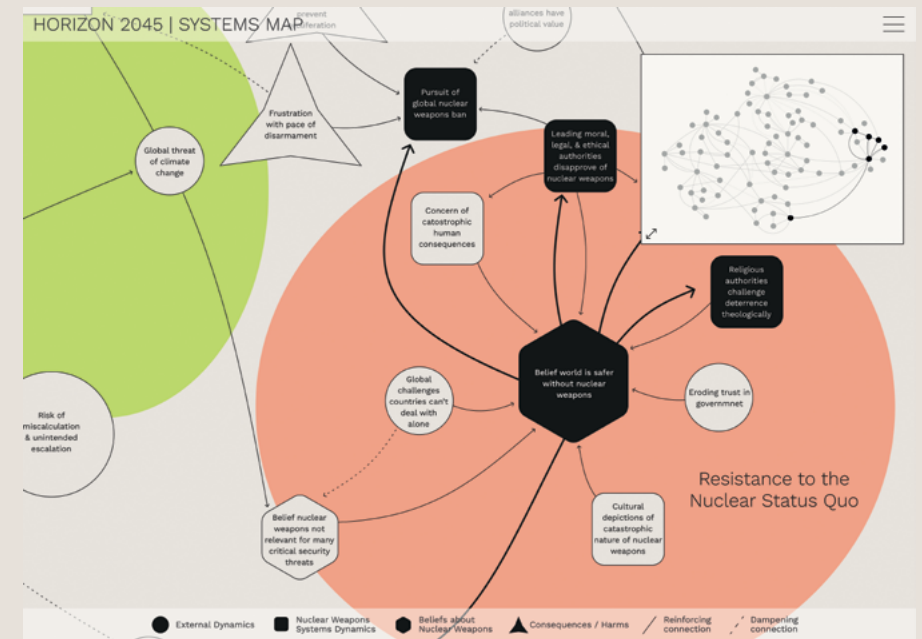
We started our Horizon 1 work by gathering historical stories about nuclear deterrence—both moments when actions and decisions created change in the system, and times when efforts to change the system failed. The goal was to gain a deeper understanding of how to influence future disruption. We then analyzed these stories through multiple methods and compiled them into a database that will eventually be made available to researchers and educators in the nuclear field.

VISUALIZING THE NUCLEAR SYSTEM

The nuclear weapon system is sprawling and secretive, maintaining itself and resisting change through a complex set of dynamics. No one has created an in-depth portrait of all the elements to this space—until now. Using causal loop diagramming—a mapping tool that helps visualize complex systems and how different variables are interrelated—we created a prototype of the present system that can serve as a “game board” for collaboration. We understand the H2045 systems map to be the first and only map of the behaviors and mental models that underpin the nuclear weapons status quo.

What underlying patterns and interactions drive the system? What is the system beyond what we think it is?

The dynamics depicted on the map are not the institutions or structures that are in the system, but rather the underlying behaviors and dynamics of the system that are driving the status quo. The map highlights entry points for a range of stakeholders, and grants us a new ability to explore how high-impact projects could have deeper impact on the system. As one nuclear expert put it: “This is a completely new way of conceiving the nuclear threat. Trying to understand a system at the meta level and what’s driving actors in the system is totally new.”

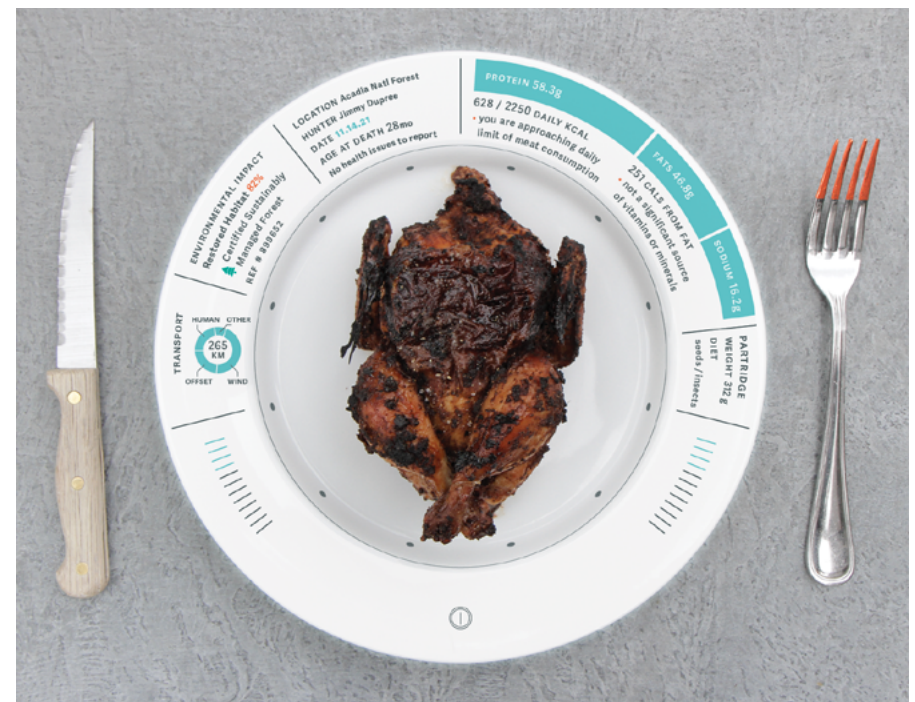




Policymaking Instrument

Ceremonial seal used in policymaking procedures, made of natural materials. Ancient wood representing the air we breathe is held in shaped mycelium symbolizing the cycles of life and death. Recorded evidence of burning materials gives new significance to official documents and approval mechanisms, creating marks of authenticity beyond the reach of digital forgery. With new institutions will come new rituals and procedures. What symbols will be chosen as core?

Speculative artefact
#749876-0
inspired by Shifts 4, 7



Smart Plates

Cutlery and tableware system offers just-in-time data display to user-diners such as health analysis, personal risks, animal diet, living conditions, supply chain, sourcing info, and social/environmental impact. What kind of information would we want to access? What kind of transparency is unbearable? Who should curate that knowledge and why?

Speculative artefact
#308512-3
inspired by Shifts 4, 6

HORIZON 1

WHAT ARE WE AIMING TO DISRUPT?

THE NUCLEAR PROBLEM IS A SYSTEMS PROBLEM

The nuclear problem is a systems problem—that is, a complex, multifactorial problem driven by an interplay between policies and procedures, human actions and decisions, infrastructure, incentives, and beliefs and assumptions. Like most systems problems, it is hard to describe, dynamic in nature, and rife with competing interests and interdependencies. The current global nuclear system comprises multiple dynamics relating to controlling nuclear materials and weapons, nuclear weapon infrastructure and investments, drivers of risks of nuclear weapons use, power and authority structures, structural discrimination, dynamics that help sustain the status quo, and dynamics working to resist it. Some aspects of the system have been developed intentionally; others have emerged over time as consequences of, or reactions to, other elements. When we say “the system” or “the nuclear system,” our definition includes all of this.

1. The system runs on unproven beliefs and assumptions.
2. The system is self-isolating.
3. The system is riddled with risk.

4. The system creates and perpetuates deep inequity.
5. The system has mechanisms for resisting change.

FIVE KEY OBSERVATIONS

We set out to untangle the complexities of the present-day nuclear system in order to create a clearer picture of how it operates and how it might be influenced. Our Horizon 1 work revealed a set of deeply interdependent factors that are driving the system, serving to hold it in place, and making it vulnerable to disruption. Together, these factors paint a picture of a system ripe for transformation, pinpointing areas where there might be potential for leverage.

The system runs on unproven beliefs and assumptions.

CORE BELIEFS: The system is driven by untestable beliefs, including: Nuclear weapons are a source of national security, the risks of disarmament are greater than the risks of possession, there could be a winner in a nuclear war, and nuclear deterrence theory “works.” Meanwhile, neither the state nor the system can imagine a future in which they do not exist or are rendered anachronistic.

ROOT MYTHS: Underlying myths prop up the system and feed a willingness to maintain nuclear weapons, including: Western anthropocentrism (humans are the most important entity in the universe), the idea that competing states must win at the expense of others and that cooperation is self-sacrifice, and traditional notions of colonialism.

POLARIZED VISION/PURPOSE: The system has multiple conflicting, incompatible, and often mutually exclusive ideologies and understandings of the role of nuclear weapons in providing security, whether risks of nuclear weapons can be managed, and the desirability of a world free of nuclear weapons.

The system is self-isolating.

SILOLED: The system is largely closed off from adjacent fields, issues, and movements, ignoring the interconnected nature of systems, the truly global risks and impact of nuclear weapons, and the exponential value of intersectionality and collaboration for problem-solving.

OPAQUE: The system’s lack of transparency and reliance on inaccessible techno-strategic language alienate lay audiences, close off understanding and debate, and keep it removed both from public view and engagement and from necessary scrutiny and accountability.

OSSIFIED: Performative/ritualized statements and interactions dominate the space, squashing inquiry and novel interaction. The bureaucratization of this issue space and its efforts draws it further away from civil society.

NARROW: The system is addicted to its own expertise and largely unreceptive to new approaches and ways of knowing that would widen the usual set of perspectives and engage new audiences.

The system is riddled with risk.

ACCIDENTS AND CLOSE CALLS: Since the 1950s hundreds of nuclear weapon incidents and accidents have occurred, leading to radioactive contamination, activation of a nuclear-capable weapon system, and theft or loss of a nuclear weapon. Many other accidents or close calls have been averted by luck or human intervention, and the likelihood of more happening keeps growing.

WIDENING THREATS: Nuclear weapons are highly vulnerable to cyberthreats, accidents, miscalculations, human error, and other threats. The system in which they sit faces a host of broader, contextual global challenges that it is neither accounting nor preparing for.

ESCALATION BIAS: The system bends toward escalation, requiring states to continually hold military exercises, rehearse pushing the button, and otherwise appear willing to use nuclear weapons for deterrence to be “credible.” There are more mechanisms and habits to support ramping up and increasing risk than ramping down/deescalating.

RISK BLINDNESS: There is disagreement about the system’s vulnerabilities and how to manage them, as well as avoidance of serious discussion about the risks of nuclear deterrence and the consequences of both the possession and use of nuclear weapons. As a result, the system is not taking sufficient actions to understand, address, and avoid these knowable dangers.

The system creates and perpetuates deep inequity.

UNDEMOCRATIC: Only a limited group of individuals have the authority to shape or influence worldchanging decisions about nuclear weapons. This exclusivity stands in sharp contrast to the scale of the impact if weapons are ever used.

IMPERIALIST: Nuclear weapons grant dramatically more global power to nuclear weapon states than non-nuclear weapon states. Frontline communities that have been most impacted by nuclear weapons have had little or no voice or rights when it comes to nuclear decisions and policies.

BLINKERED: The system is dominated by insular national security considerations, rendering it unable or unwilling to consider broader human security factors in its decision-making. The devastating human and environmental impacts of nuclear weapons—including secondary impacts—are not well understood and almost entirely disregarded by governments of nuclear weapon states.

ANTI-PLANET, ANTI-POSTERITY: The problems created by the life cycle and potential use of nuclear weapons are planetary yet considered narrowly. The wellbeing of the planet, its diverse environments, and non-human living beings are not considered; neither are the rights and wellbeing of future generations.

The system has mechanisms for resisting change.

INHERENTLY COMPLEX: The nuclear system is technically, politically, culturally, and economically complex and operates within an even more complex and rapidly evolving global security architecture, making foundational change difficult to achieve.

EMBEDDED: The system is well established, expensive to maintain, supports a vast enterprise that provides thousands of jobs, and delivers significant profits to powerful actors.

SELF-PERPETUATING: Nuclear deterrence theory presents a kind of circular logic: The belief that nuclear threats will prevent nuclear war drives states to maintain nuclear deterrence and thus nuclear weapons forever. The nature of these weapons also necessitates arms races/competition between states.

LACKING INCENTIVES: Under nuclear deterrence, a state's incentives to "give up" weapons are extremely weak, while the disincentives remain extremely strong, further perpetuating the system's inherent inertia.

RISK REDUCTION ITSELF: Risk reduction efforts, rather than disrupt the system, largely reinforce the status quo. The system only allows risk reduction measures that de-risk the existing system, versus those that aim to disrupt or transform it.

STATE + SECURITY: By framing the possession of nuclear weapons as the highest-order expression of national security, states entrench the nuclear system and ensure its continuity.

RISK REDUCTION AND DISARMAMENT

Steps that reduce the risk of nuclear weapons use have become a neutral ground in the system; because risk reduction is critical to making the system safer and to making progress toward disarmament they have widespread support. But risk reduction not tied to the goal of disarmament often just serves to make the system safer to itself, which can inhibit progress toward disarmament. This "dual use" of the term risk reduction creates problems of language and understanding, and its overuse prevents all who aim for disarmament from getting behind one bold goal. Risk reduction is a necessary but insufficient mechanism toward disarmament, but disarmament must be the goal.

THE SYSTEM IS DOING BOTH MORE AND LESS THAN IT PURPORTS TO DO

The Anthropocene began with the advent of nuclear weapons, around which a post hoc system emerged. It was not “designed” per se; the system evolved as a response to and a way of protecting nuclear weapons as a tool for global security. The original, stated objective of the nuclear system was to deter nuclear use by others and to manage the risks of nuclear use. But in looking at the behaviors and incentive structures of the system, it’s clear that deterrence is not its sole function—it protects certain rights and interests over others, for instance. We believe our analysis also exposes the myth that the system works as described at all; indeed, our analysis shows that avoidance of nuclear conflict to date has relied on individual actors risking everything to behave in direct opposition to the system’s dictates.

It’s tidy to think of the nuclear system as a bounded, technocratic system that can be controlled. It isn’t. It is having effects that are beyond anyone’s control, including all the incentives to keep the system in place not because nuclear weapons make us safer but because their existence and maintenance generate both profit and power. The behaviors, motivations, beliefs, and mental models of people orbiting in and around the system are not external to it. They are a core part of it.

Avoidance of nuclear conflict to date has relied on individual actors risking everything to behave in direct opposition to the system’s dictates.

This sprawling nuclear system is not designed to protect humanity. Instead, the system has curled itself around the purpose of protecting itself and therefore protecting an existential threat. And if the current nuclear system is not protecting us now, then it’s certainly not going to be doing it 20 or 30 years into the future when the needs and issues facing humanity will have changed dramatically. The system has not adapted to the changes in the world; it is almost completely disconnected from today’s circumstances. It is also disconnected from—and stands in opposition to—the future we want.

WHAT’S WORTH PRESERVING

While we focus here on the characteristics and dynamics of the nuclear system that are inhibiting progress, it’s important to point out that there are bright spots within the current system—positive dynamics and behaviors that, if amplified, could help shift the system toward far safer territory.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is one of several examples of **strong cooperative arrangements** that could form the foundation for new governance structures in the future. The CTBT verifiably bans nuclear explosions by all state signatories—on the Earth’s surface, in the atmosphere, underwater, and underground—establishing a norm against nuclear testing and making it very difficult for countries to test nuclear weapons without detection. The CTBT is almost universal but can only enter into force after specific countries with nuclear technology have ratified it. Its International Monitoring System, comprising 337 facilities using advanced technologies to conduct seismic, hydroacoustic, infrasound, and radionuclide monitoring, is already operational. These facilities are collecting huge amounts of data that ensure detection of nuclear testing and also provide information about other seismic and acoustic events that could help us better understand oceans, volcanoes, the impacts of climate change, and even the movement of whales. The CTBT and its monitoring tools, knowledge, and networks will be critical to retain and build upon for the future.

While still a limited feature of the nuclear system, important **transparency practices**—the provision and exchange of information about nuclear weapon policies, doctrines, capabilities, and activities—should be preserved and built upon. A recent example: The decision in 2021 by the United States government to release its aggregate number of active and inactive nuclear warheads (no other nuclear state produces a public unclassified accounting of their nuclear stockpile). Transparency is an essential ingredient for accountability, building trust among parties and demonstrating where progress on disarmament has, and has not, been made. If we are going to succeed in dismantling global nuclear stockpiles, and do that with confidence, all nuclear possessing states will first have to disclose the number of weapons and fissile material stocks, both civilian and military, they possess by making an initial baseline declaration that can then be verified.

While **collaboration and trust** can seem difficult to establish, we have demonstrated a capacity for both—as well as for cooperative agreements based on verification—in the past and must build on these precedents in the future, making them a more prominent feature of the nuclear story. For example, the collapse of the Cold War in 1989 completely changed the nature of global nuclear threats from fear of nuclear war to fear that Russia and the former Soviet states would lose control of their huge nuclear assets—tens of thousands of nuclear weapons, over a million kilograms of fissile materials, hundreds of thousands of nuclear workers, and a huge nuclear complex. This quickly led to the mutual understanding between Russia and the US of the benefits of collaboration between their scientific communities, paving the way for the Cooperative Threat Reduction program to help safeguard and reduce these weapons and materials, as well as US/Russian scientific “lab-to-lab” exchanges. For the next two decades scientists and engineers at the DOE laboratories and the Russian nuclear weapon institutes joined forces to address nuclear dangers. These kinds of deep collaborations can (and must) happen again.

WHAT ARE THE CONTEXTUAL FORCES THAT WILL INFLUENCE, INHIBIT, OR ACCELERATE CHANGES TO THE NUCLEAR SYSTEM?

The nuclear system does not operate in a vacuum. Some of the highest-value levers for change stand outside it, tied into larger global shifts that directly influence people’s lives and shape how they think and feel about issues. These shifts present both opportunities for and obstacles to change; regardless, they alter the fundamental conditions in which the nuclear system operates and threaten the endurance of existing mental models. The challenge is knowing when and how to use these shifts to push the system in a newer, safer direction.

While Horizon 2045 is by no means the first initiative to lay out a plan for achieving a world without nuclear weapons, it is identifiably different from, and we hope complementary to, other efforts because of its focus on contextual forces. Our innovation is not just in identifying and seizing opportunities to initiate major change but also in acknowledging that the social, political, technological, economic, and environmental context in which these “interventions” take place will determine whether they are successful—or even possible.

Among the many contextual forces we are factoring into our strategy:

Accelerating
climate change

Continued habitat destruction
driven by development

Rising acknowledgment that
we've entered the Anthropocene

State borders/boundaries under
the stress of increasing migration

Fluctuating but ever-present
geopolitical tensions

Major demographic shifts

Food systems evolving
to feed 10 billion

Deepening divide between those who
are secure and those who are insecure

Changing awareness of high-consequence/
low-probability incidents like COVID-19
and future pandemics

Democratization
of information

The speed and scale
of dis/misinformation

Rising authoritarianism and
waning faith in state authority

Corporations driving solutions
to large-scale problems

Rising social
movements

People/companies creating
their own forms of security

The changing mechanics for decision-making
and democratic engagement

Circular economies and alternatives
to prescribed economic value

Infrastructure failing physically
and/or being vulnerable to hacking

Rapidly emerging new technologies outpacing
human comprehension, like data analytics and AI

Expanded use and
occupation of "outer" space

Military innovation growing faster
and more consequential

Augmented intelligence
and memory

Growing sophistication
of blockchain technology

Rise of
cryptocurrency

HORIZON 3

THE WORLD AROUND THIS WORK IS CHANGING.

We often hear people comment that “if only the public cared about nuclear weapons, we could make faster progress on policy change” or “if only funders committed more resources to this issue, we could more effectively achieve our goals.” While these are critical concerns, we believe there are other, deeper barriers to progress that won’t be addressed by more money or a bigger megaphone. One is the fact that the system is far more complex, entrenched, and resistant to change than a narrow conception of it would suggest. But another is context. By focusing on contextual forces of change—those political, social, technological, environmental, and economic drivers that will shape the future—we can look at nuclear weapons challenges in relationship to other elements of a dynamic and changing world.

For instance: How will our notions of security (and insecurity) evolve over the next decade as we emerge from a pandemic, confront a rise in authoritarianism, or endure climate-induced weather catastrophes? How might the role of nation states evolve? How will emerging technologies empower new forms of public engagement? And how might all that change the way we deal with nuclear challenges? Breaking the frame in this way is what distinguishes our approach from other projects where the tendency is to center nuclear weapons at all stages of analysis.

Thinking about the nuclear system separate from the world around us is a big reason why we’re stuck in the same old conceptual loops. The questions we’re asking, that we need to ask, call for a different approach.

CHANGE IS ALREADY UNDERWAY

Anyone can observe today that our world is in the midst of a period of deep and rapid transformation. Many of the old stories we use to make sense of the world, and the systems that organize our world, are crumbling. The mental models that drive our behaviors and shape our perspectives are curving in new directions, due in large part to external forces. Institutions at all scales are changing in form and practice. Indeed, we are living within a kind of status quo void where massive change feels both impossible and just within our reach. With so much change upon us, what once seemed improbable—like the elimination of nuclear weapons—can also begin to feel inevitable.

OUR FIRST FUTURES PUSH

When contemplating Horizon 3, our first instinct was to create a vision for a preferred future—a plausible but imaginative story of a future in which the world has moved beyond nuclear weapons. But along the way it became clear that describing that “end state” was not our first step. The research and workshops

we conducted over the course of a year unearthed significant data about the trends and contextual forces that are now actively shaping our future. What rose out of these findings was a different, and urgent, question: What is the nature of the change that these trends are suggesting? To get to a better future, what are the deeper shifts in how humans operate that we might need to pass through?

HORIZON SCANNING

In Horizon 2045's first phase, we launched multiple strands of original futures work to explore these contextual factors that are influencing the present and will influence the future. In one strand, we engaged a small international group of nuclear and other experts to participate in a multi-month horizon scanning process. The group's goal was to identify contextual forces that are already shaping the future, so that we could better understand how they interact with the nuclear system and be prepared to leverage those changes in ways that serve our H2045 goals.

Horizon scanning, the backbone of any serious futures exercise, is a systematic technique for detecting early signs of potentially important developments. The process differentiates between developments that are "predetermined" (the evolution of artificial intelligence, for instance) and those that are uncertain but highly relevant to the question at hand (e.g., the specific ways in which artificial intelligence will affect the threat landscape). Horizon scanning exposes us to novel and unexpected signals from both mainstream and unconventional sources. A comprehensive scanning proposes that certain shifts be monitored closely over time because they have the power either to facilitate or to disrupt achievement of particular outcomes. In all cases, horizon scanning provides an evidence base from which to challenge assumptions and formulate effective strategy.

THE SEVEN SHIFTS

Many contextual forces are shaping the broader environment in which the nuclear system, and all systems, reside. As part of our initial futures work, we chose to highlight seven shifts with the power to change how we collectively think about the nature of security, the world around us, and ourselves. If the nuclear system is a kind of fortress, then these shifts, already underway, are the strong winds swirling and squalling around it, testing its very foundation.

We think of these shifts, which are grounded in data, as forces that can facilitate movement toward a preferred future—a future in which, as a planet, we move through a period of existential threat and into a new era of possibility. To be clear, we aren't predicting that these shifts will all bend positively in the ways we envision, although we do see signs right now that all of them could do so. Rather, we focus on them here because we feel it's imperative to “go there”—to allow ourselves to envision how we might move through the tumult of the present, confront our mental models, and catalyze the audacity and ingenuity required to punch through to a better future.

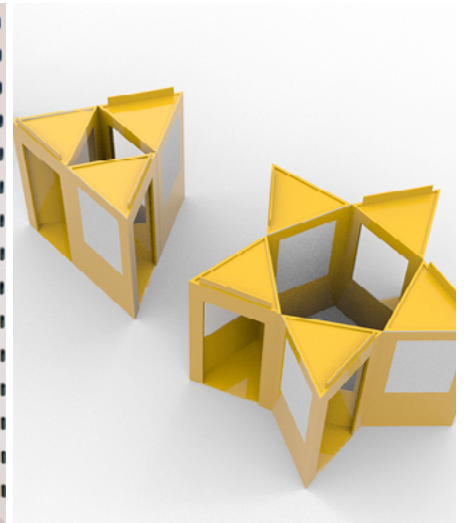
We've written about these shifts in a way that's designed to grip the imagination and stir a sense of possibility. These shifts are not scenarios exploring alternative futures. Rather, they are stories of deep change, offering an opportunity to hover over the future and to contemplate the scope and breadth of the changes that might lie ahead as we navigate through interconnected global threats. These stories walk through the messy near-term future in order to imagine a better future beyond it.

We are not suggesting that achieving a world without nuclear weapons hinges on these shifts. Rather, we want to drive home that the nuclear system is operating inside myriad contextual forces—the ones we name here and many beyond them. By shining a flashlight on these forces of change, we can see ways in which we might harness them in order to get to the goals that we set for ourselves, perhaps even faster than we would otherwise. We see these shifts as helping to facilitate the kind of change that's necessary to reach our destination. The seven shifts, which are fundamental cultural shifts, are not hoops that we have to jump through before we can eliminate nuclear weapons.

We know that these shifts also have dark sides—something we will explore in our next phase of work. Our futures work is not done. Indeed, in recognition that H2045 will span decades, our investment in strategic foresight is only beginning. Looking at the challenges and conflicts embedded within these shifts and within other drivers of change—through scenario planning and other approaches—will be part of our Phase 2 work.

1. We Untether from the Past and Orient to the Future
2. We Safeguard the Wellbeing—and the Promise—of Future Generations
3. Humans Become Accountable to the Natural World
4. We Reshape and Resize Our Approaches to Problem-Solving

5. We Embrace a More Democratic Orchestration of Knowledge
6. The World Becomes Far More Transparent and Knowable
7. Managing the Commons Becomes Common Sense



WE UNTETHER FROM THE PAST AND ORIENT TOWARD THE FUTURE.

In the coming years we make a vital choice. Climate change grows severe enough that our normal responses no longer create traction. Holding onto the places and practices we'd taken for granted, or thought we could save if we needed to, proves increasingly futile. Moving coastal houses back from rising seas, or protecting communities in severe wildfire zones, no longer works; nor does planting farmland turned arid or finding fish in radically warmed waters. Despite the scramble, we suffer from losses that we now cannot prevent. Many of the rhythms and landscapes of our daily lives disappear. We reach the limits of our capacity to rail against change, to adapt, and to hold on defiantly to what was, leading to a planetary reckoning.

We reckon with the irreparable harm we have done to the planet, process our grief, and empower ourselves to pursue radical change in service of building a better future.

We'd known for decades that we had not developed the right systems of global laws, governance models, and agreements to stave off grave climate impacts. But the problem ran deeper than

that. Humanity's habitual short-term thinking allowed a crisis to become a condition. In not doing more while we could, we demonstrated a kind of pathological path dependency—an unwillingness to move away from “normal” ways of operating, examine the myths underlying our actions, and compel a planetary conversation about revising our operating model. But sacrificing the future by perpetually prioritizing the present had a steep cost. By not challenging our thinking and acting beyond the familiar, we had inexorably changed our world.

Instead of fighting wars about it, finally, finally, we process both our guilt and our loss and reckon as humans with what we have done. Whole species, whole forests, and whole human communities aren't coming back because of our actions or our failure to find ways to stop them. Kids will enter a world that is tougher and less hospitable than what we had enjoyed and had magically believed they would too. We also mourn the loss of our own sense of invincibility, asking ourselves why we clung for so long to old norms, beliefs, and ways of being even when it was clear that they were failing us. We've lost some of our core assumptions about how the world works, and must manage that sense of loss without profoundly losing our sense of security.

And so we begin to let go, as gracefully as we can, to what is no longer possible. Instead of continuing to drag the past forward, we commit to prioritizing the future by safeguarding what remains. We work incredibly hard to save what we can, but we also ask: What is dying, and how can we help it to let go? We abandon near-extinct rural areas

and coastal cities that are filling irreversibly with water. We triage species and landscapes, sometimes giving up long efforts to save them. Joshua trees can no longer grow in the forest named for them. In Acadia National Forest trees get overrun by the brambles favored by global warming, but we now know we can't stop the loss so we don't fight it. We have come to accept that we can't save everything.

Navigating the path from recognition through grief, forgiveness, repair, learning, and ultimately to transition proves powerful. The act of untethering ourselves from the past in order to take a leap forward involves making hard choices, sharp turns, and a reorientation unlike anything we've ever experienced. Having taken incremental progress to its limit, we stop “tinkering at the edges of our discredited status quo”¹ and refocus on building a better future with all the boldness it requires. By clinging to the old normal, we had held so much back, including our own ingenuity and the promise of our breakthrough ideas. Now, in shifting our orientation from how we did things before to how we must do them in and for our future, we open a path toward radical change. If we can keep up the courage this transition requires, different possibilities will flourish.

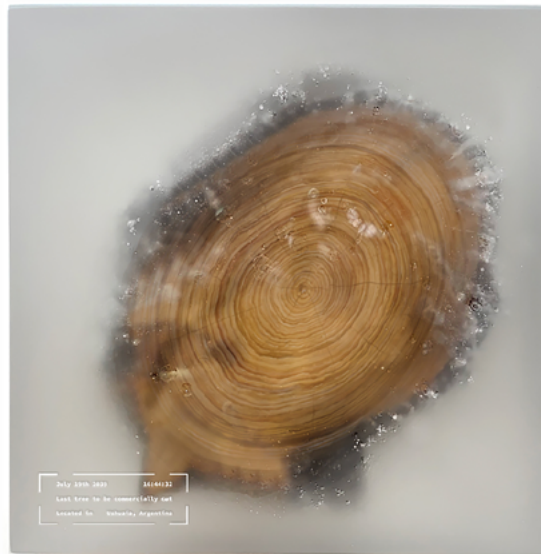
1 Editorial Board. (2021, March 16). *George Floyd's Killing Sparked a Debate on Police Reform. We Need to Think Bigger*. Washington Post. <https://www.washingtonpost.com/opinions/interactive/2021/reimagine-safety/>



"The Wall of Lasts"
Centerpiece

Cross-sectional slice from a white oak—the very last tree cut down for commercial purposes. Installed to memorialize the pivotal role played by the International Security and Innovation Collective (ISAIC), the wall commemorates unsustainable practices that the organization has worked to end since its inception. It also records notable extinctions due to a lack of urgency in passing legislation. What might we commemorate with shifted priorities? What can be accomplished when mourning is actionable?

Speculative artefact
#520951-9 inspired by
Shifts 1, 2, 4, 7



WE SAFEGUARD THE WELLBEING—AND THE PROMISE—OF FUTURE GENERATIONS.

In the coming years we align around a bold civilizational goal—to ensure that future generations have both the planet and the protections they need to manifest humanity's potential. Our world had become stuck inside a nesting set of short-term frames—the next election cycle, the next quarterly report, the next paycheck, the next hurricane, the next policy fight, where the next meal might come from, that 10-year window we allegedly had to achieve miraculous reversals in carbon emissions. With our immediate foreground held in hyper focus, and with our goalposts set so close, it was hard to think about the future, and easier to wishfully think that the future and the people who populate it would somehow take care of themselves.

We realign our human experience around propelling humanity forward.

But in seeing the long-term consequences of the damage we've done to the Earth manifesting all around us—and with so many of our systems crumbling behind us—the part of our human story that comes next moves back into our frame. By not protecting our planet, and by optimizing our systems and behaviors for the short term, we'd compromised the ability of future generations

to exist at all. And if they didn't exist—if we allowed our existential crises and our human infighting to fully overwhelm us—what might be lost? As a species, we were still so young. Could we preserve our capacity to keep going, and to break through to a far better version of ourselves than what we had achieved so far?

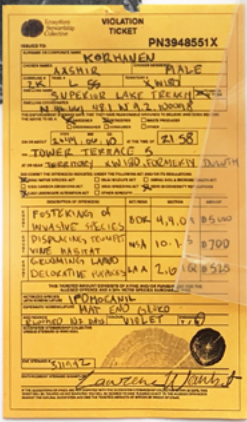
And so we begin to safeguard the human condition in ways we simply hadn't before, operating with humanity's long-term future in mind. Just as the Iroquois practice "seven generation thinking," we reframe our planetary worldview to consider the impact of our actions and decisions on the next 2,000 years and beyond. Instead of just noting the rights of future generations in their charters, more states move these rights to the center of their planning. Following the lead of Wales, with its 2015 Well-Being of Future Generations Act, we see a proliferation of similar plans designed to create "the ambition, permission, and legal obligation to improve social, cultural, environmental, and economic wellbeing." More states and cities appoint "ombudspersons for future generations" to ensure that legislative actions and policy proposals pose no irreversible threat to the future. Whereas "developed" used to describe states that were economically and technologically advanced, now it references a state's capacity to take care of planet, people, and future.

International court cases brought on behalf of future generations surge, as crimes against the future—defined as "acts and conduct that have severe consequences on the long-term health, safety, and means of survival of any identifiable group or collectivity of hu-

mans”¹—gain international legal standing. The ability to prosecute future damages and impact, versus harm already realized, creates new avenues to punish those living today for violations that will be fully felt tomorrow. But the act of aligning around the future is not restricted to policies and legal rulings. Across the planet, people of all ages reorient themselves around the future, taking it as their job to guarantee “more future” for the people who will come next. Elders use their bonus time to contribute to the cause of human betterment. Young people, seeing the buds of a new future, channel their anger at prior generations into a determination to ensure that their descendants can thrive. Mothers, whose neurobiology compels them to answer the cry of any child, work to fix the future on behalf of all children. Increasingly and collectively, we bind ourselves to being good ancestors and to elevating the rights of humankind as a core design principle for our future.

In doing so, our lives begin to take on more depth and scale. In reclaiming a respect for the future we forge a much deeper commitment to one another, perhaps finally coming to see ourselves as part of the same human family. And in orienting around our “duty” to future generations we also find the coherence and the agency we had long been lacking; we have a more meaningful way of making sense of our lives and the larger human experience. We pride ourselves on what this reorientation may unleash. But we have already begun building a better story of who we are.

1 Jodoin, S., & Saito, Y. (2012). *Crimes Against Future Generations: Harnessing the Potential of Individual Criminal Accountability for Global Sustainability*. SSRN Electronic Journal. Published. <https://doi.org/10.2139/ssrn.2942145>



Ecosystem Violation Tickets

Ecosystem stewardship is legally enforced at a granular level, paired with advanced monitoring technology that holds offenders accountable. Citations are written for offenses like microplastic traces found in an alpine trout and invasive species used for decorative purposes in urban gardens. How tightly might we bind ourselves to being better ancestors? At what scale should commitments be enforced?

Speculative artefact #820917-2 inspired by Shifts 3, 6, 7

HUMANS BECOME ACCOUNTABLE TO THE NATURAL WORLD.

In the coming years our knowledge of the natural world explodes. New breakthroughs in animal intelligence reveal the complexity of many species' cognition and communication, uncovering their extraordinary capacity to solve problems, express emotion, and understand the world around them. Other breakthroughs add new layers to our growing knowledge of the memory and intelligence of trees and plants, including the ways they communicate and assist one another in adapting to desperate conditions. These studies reveal what humans have mostly known all along: That the natural world is vastly more complex, interdependent, and aware than we believed—or chose to believe as we busily destroyed habitats and hastened a sixth mass extinction.

We break the longstanding hubris that humans have dominion over all things, shift our notions of “us” to include all nonhuman life, and extend our empathy and our protection to the natural world.

This deeper knowledge, combined with unmistakable evidence of how quickly killing our environment is killing us too, finally renders the willful destruction of the planet's habitats and ecosystems

punishable by law. The International Criminal Court adds “ecocide”—on par with genocide and crimes against humanity—to the offenses it prosecutes, complementing a powerful new suite of legal tools designed to protect the natural world. Animals as diverse as lemurs and Labradors get internationally recognized as sentient beings, their inalienable right to exist, to evolve, and to flourish legally enforced. Laws change the status of many habitats and ecosystems from property to rights-bearing entities, vital rivers receive legal personhood, and UN seats are created for nature and wildlife.

This legal infrastructure forces a ban on many of the major human practices linked to wanton habitat and biotic diversity devastation that we have never before been able to stop, from destructive farming to the burning of fossil fuels. Greenwashing fades, as omnipresent sensor data offers an exact record of behaviors deemed damaging to the environment and nonhuman life, and new metaverses and data-rich augmented reality experiences allow us to see environmental changes over time. These mediated landscapes bring the natural world into new focus, making it impossible to dismiss as a simple green backdrop.

All around us, the relationship between humans and the natural world is shifting. Our interactions with animals become more frequent, as cities fill up not just with more people but with animals seeking the habitats they need to reproduce and survive. Bears drink from our rainwater harvesting containers; red foxes wander New York City, building dens in shaded alleyways. Instead of erecting walls or tranquilizing

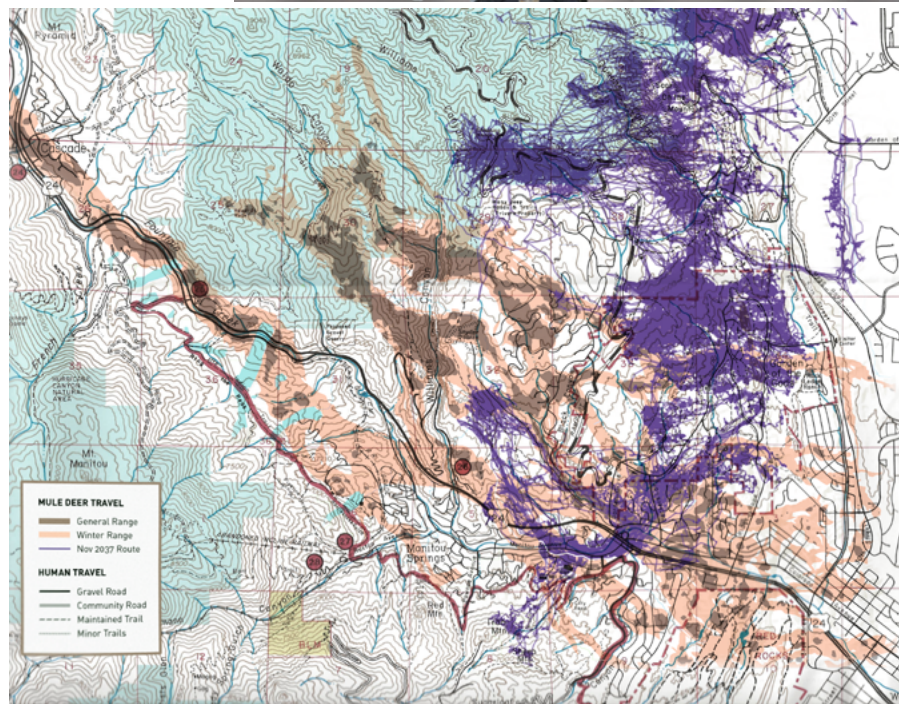
them, we welcome these living beings as best we can. It's not just our planet, not even mostly. We come to accept, even welcome, that our spaces are now truly shared.

The surprise is that in elevating the needs of the natural world and reexperiencing its wonders, we improve human lives, too. People feel less isolated from the world around them, and find purpose in serving as stewards of nature. In watching and helping these species survive, we learn something about resilience: The ability to bounce forward from destabilization or disturbance to create something new. Our efforts to safeguard nature and nonhuman life—from ourselves and from the deep damage we have wrought by our ambitions—start to feel like a measure of our humanity. It's not about “connecting” with the natural world. We are the natural world, but we had forgotten.

Mixed-Use Migration Routes

Trail maps are published with equal emphasis on megafauna migration and human pathways. We enforce highway closures rather than spending billions on new over/underpasses—conservation is no longer dictated by human convenience. What defaults change with changing priorities? What problems become newly worth solving?

Speculative artefact
#416693-1 inspired by
Shifts 3, 5, 6, 7



WE RESHAPE AND RESIZE OUR APPROACHES TO PROBLEM-SOLVING.

In the coming years governance becomes far more dynamic, participatory, and planetary. For quite some time we'd lived with an uncomfortable tension—relying on governments to solve the mammoth and intertwined problems hitting our world even as we experienced their increasing inability to do so. Many governments tried to work better and faster, and occasionally they could. But top-down technocratic approaches to problem-solving were not sufficient or right-sized for the task at hand. We stopped believing that traditional institutions, with their bureaucratic pacing, could manage the pileup of urgencies facing our world.

Civic engagement flourishes not just locally but laterally, as enabling technologies spur a rise in “planetary will” and create new mechanisms and pathways for inclusive governance.

We see an eruption of problem-solving at the local level, as communities apply new urgency to mitigating climate and public health emergencies, managing their commons, and streamlining coordination among the “systems of systems” operating in their areas.

Communities that rally together across differences get to better outcomes, highlighting the profound benefits of inclusive, full-community action and of engaging at scales where we can see the consequences of our interventions. We see an invigoration of local governance dedicated to educating, informing, and building on the energies of constituents. Civic participation gets revitalized just when the world requires it most.

We also activate far better mechanisms for engagement. New digital tools for consensus building, self-organizing, and cooperation proliferate, creating marked innovation in democratic practice. Citizens use smart agents and bots to gather, analyze, and synthesize vast amounts of data about issues we care about, enabling us to connect with digital action groups that share our sensibilities or political movements that best represent our interests. Other tools empower us to hold governments accountable for faster, more responsive, and more efficient problem-solving. We can monitor governments' financial transactions in real time through distributed ledger technology, readily calculate the financial and human impacts of proposed policy change, and more accurately determine whether budgets and policies reflect our values.

Our reinvigorated civic action extends beyond national boundaries, however, with new kinds of alliances forming across the planet. Armed with open data, machine learning, and a portfolio of other tools, ecosystems of aligned global citizens can “out” governments—not just their own—for being unresponsive or slow. Networks of cities share best practices on similar problem sets;

mayors are sometimes more influential than presidents and prime ministers. Around the world, governance becomes more lateral and planetary than vertical and nation-state bounded; progress results from interplay and entanglement rather than top-down governance practices.

This interplay opens up new solutions and possibilities, resulting in methodically diverse, cross-ideological activism and a more open and generative governing environment. People clamor for brand-new forms of coordination at a planetary level, because our challenges won't be solved any other way—and because our unleashed ingenuity requires bigger outlets. Using semantic AIs (the combination of knowledge graphs, natural language processing, and artificial intelligence) we can now poll the entire world to include all people's perspectives and opinions when seeking to achieve consensus. Emerging planetary governance models embrace these tools and this energy, and we see a powerful rise in cooperative global institutions built on a culture of flexible prototyping, power sharing, and collaboration.

Governance is now more an open, shared process than a set of institutions, and we can feel the rebalancing. The hallmark of our age is a vibrant ecosystem of governing models and a shifting locus of control, all aimed at ensuring “more future” for the planet.



Council Quorum Terminal

Home device collects public input and foster discussion. It makes local meetings more accessible, sets alerts for topics or policy initiatives, and sends immediate feedback. Designed to encourage contribution and increase agency. What are the systems needed to foster a healthy direct democracy? How can we curate civic engagement over mob rule? Who participates? Who is still left out?

Speculative artefact #557199-3 inspired by Shifts 4, 5

WE EMBRACE A MORE DEMOCRATIC ORCHESTRATION OF KNOWLEDGE.

In the coming years we come to see the necessity of applying diverse forms of knowledge to questions about our world and our efforts to solve pressing challenges. We've long known that cognitively diverse groups solve complex problems more quickly and correct for error more effectively than those with homogeneous knowledge or expertise. But now we put that wisdom to practice at planetary scale, pooling our perspectives, experiences, and know-how to get to breakthroughs faster. Through these more frequent interactions we develop a kind of epistemic humility—a deeper realization that everything we know is not everything there is to know.

We recognize that there is no one way of knowing, and that our collective wisdom is far richer and valuable than our more blinkered dominant frames.

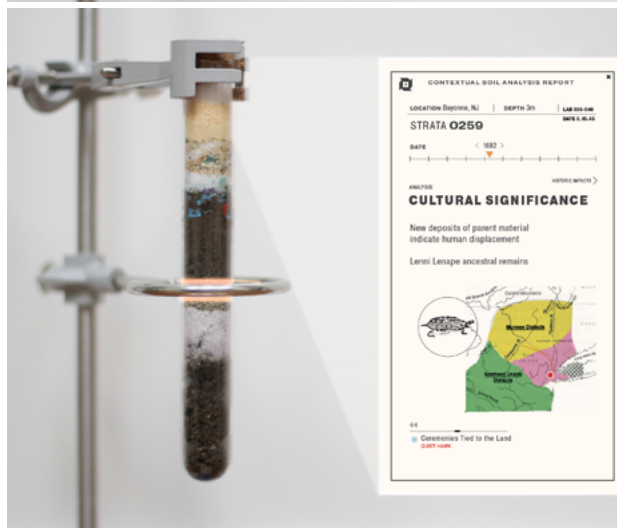
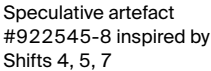
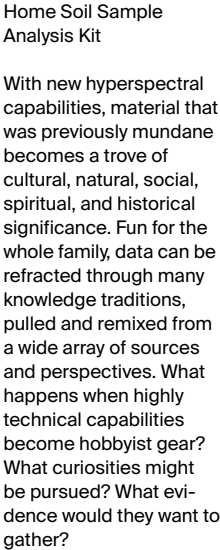
This realization sparks a deep reconsideration of how knowledge is derived and discerned. We take a fresh look at forms of knowledge we rejected in the past, because we understand that there are facts about the world that are not legible to our dominant structures of knowledge. And we no longer tolerate

the suppression or willful ignorance of others' lived experience and situated knowledge because it does not conform to a dominant epistemology; we know now that there are manifold lived experiences and forms of wisdom that western models and technologies alone cannot see and do not account for. Indeed, one of the key forces holding western epistemic hegemony in place—the idea that some ways of thinking or making sense of information are more credible than others—is itself no longer acceptable or sufficient.

We see a surge in ethnoscience—the study of how different cultures perceive and categorize the world—and explore long-held cultural wisdoms that had never been given proper weight and respect. While we now produce more knowledge than ever before in history, we also realize how much we are losing; we work to collect and share oral histories and build bridges between scientific and other forms of knowledge about the world around us. In academia, open science flourishes, as researchers make their data and results publicly accessible. Citizen scientists conduct their own research, yielding rich new data about our world. Acknowledging the complexity and interdisciplinary nature of academic and societal problems, researchers are rewarded for learning and experimenting across domains and disciplines.

Industry, government, and others discover that they too can accelerate learning, progress, and innovation by unlocking their silos and working at the intersections between domains of expertise. And learning how to think—rather than merely what to think—becomes central to contemporary education. We

teach long-term thinking, systems analysis, cultural literacy, and design from elementary school all the way through college. Just as citizen scientists boost academic research, children add wisdom and creativity to real-world problem-solving, offering fresh perspectives on how the world could work better that hold real value. Flourishing intersectionality and interconnectedness allow us to tap into the human propensity for patterning and systems thinking in order to elevate the pace of change, sharpening our ability to act collectively on all-planet problems. We make progress on issues of inequality and privilege because our knowledge environments give many more people a voice. Now, we are building a new global knowledge base that reflects the thriving interplay between western and non-western perspectives, ancient wisdom and modern analytics, technocratic elites and those previously excluded from decision-making. Now, our knowledge comes from, and is available to, all of us.



Might the story of the Anthropocene ultimately be one of problem-solving and regeneration?

THE WORLD BECOMES FAR MORE TRANSPARENT AND KNOWABLE.

In the coming years advanced transparency technologies bring our world into greater focus, making starkly visible much that was once opaque or beyond our view—including within ourselves. Developments in machine learning, big-data analytics, miniaturization, 8G, and new materials revolutionize medicine at the micro scale, creating bright new windows into our health and our bodies. Tiny, cheap, ubiquitous devices—wearable, implantable, ingestible—collect, transmit, and interpret a spectrum of health data continuously and in real time, shifting the paradigm on diagnostic medicine. Quantum computing enables full DNA sequencing in minutes and the human genome is well understood and far more easily editable, leading us to cure an accelerating list of diseases. This ability to know ourselves on the minuscular level has far-reaching effects, enabling broad access to quality healthcare delivered at a distance.

Transparency comes to many other terrains as well. Hyperspectral imaging, a technology that uses remote sensing to detect the unique signature of nearly any substance or object, brings unheralded knowability to fields as disparate as physics, astronomy, and agriculture. Hyperspectral libraries contain the “spectral signatures” of millions of substances and materials, enabling drone-mounted sensors to sniff out their match in the real world. Images of Earth’s surface delivered by hyperspectral satellites orbiting in space add

acute detail to our knowledge of not just Earth’s terrain but the complex human behavior playing out upon it.

Other tools for transparency pop up or accelerate, fueled by new investment. Inventors swarm to build space-based telescopes that are far more adept at detecting near-Earth asteroids than our usual terrestrial technologies—a leap forward in the heretofore underfunded human effort to manage and eradicate an off-planet existential threat. Meanwhile, climate change losses spur us to boost our efforts and capacities to explore the deep ocean for new life, for evidence of climate impacts, and to hold open our sense of wonder about the unfamiliar and the uncharted.

Transparency technologies offer profound new insight into our world and into ourselves, opening up new solution spaces and creating a world that increasingly runs on clarity and knowability.

Among the most groundbreaking technologies are those expressly designed to bring visibility to formerly murky processes: The revolution in blockchain and other distributed ledger technologies fully arrives. Supply chains, voting records, government budgets, and more are no longer error-prone information piles stuck in silos or plagued by inefficiencies. Instead, they are unalterable records, easily accessed and verified. This transformational shift in how we store and “prove” information

cleans up our dataverse, creating more shared reality and leaving little room for the obfuscations and misinterpretations of fact that wreak havoc on systems and societies.

In the past, the prospect of heightened transparency raised alarms, because it was assumed that the enabling technologies would remain in limited hands and represent a threat to privacy and civil liberties. But the tools of transparency are increasingly accessible to everyone, not just governments, and we have an equitable means to process and understand the information they produce—we are better equipped to understand what we are seeing. These technologies and the new knowledge they produce put us into a different kind of information environment in which clarity is an expectation rather than a rare commodity.



FIELDSTONE

0738

LOCATION

MIDDLE BAY
LAT 43.8276°
LONG -69.9831°

STEWARD

Judy Smith
Yarmouth, ME



RECENT ACTIVITY

REPORT
VIOLATION

Watercraft

PETROLEUM DISTILLATES DETECTED

Audio Disruption

45 SEC

Wildlife Movement

SEA BASS

PH Imbalance

POSSIBLE FARM RUNOFF

PH VALUE

8.1

CO2 LEVELS

7 GtCO2yr-1

Ostrom Stones

Tastefully camouflaged, self-powered devices can be scattered throughout habitats, allowing public access to a distributed network of environmental monitoring information. Citizen scientists can sign up as stewards of specific locations, or specific conditions, creating customized alerts for their pet concerns. How might stewardship be fostered beyond market forces and private property rights? What tools would people offer to the commons?

Speculative artefact #564318-2 inspired by Shifts 4, 6, 7

MANAGING THE COMMONS BECOMES COMMON SENSE.

In the coming years managing the commons becomes our guiding philosophy. Whereas the aim of politics was once to protect markets as they carved up the commons in the name of permanent growth, our collective mission these days is to protect and replenish our shared natural resources and the non-state spaces that we hold in common, from the deep oceans and atmosphere to our polar regions and outer space. An unfettered hubris—the obsession with “progress”—had led us to breach planetary boundaries, sending us barreling toward an unlivable planet. To give ourselves a future, our behaviors didn’t just need to change; they needed to transform.

We shift from exploiting the world’s resources to building collective structures and vibrant practices to safeguard them.

And so we work on, rather than merely around, the deep structural challenges relating to the commons. We shift from exploiting the world’s resources to building collective structures and vibrant practices to safeguard them. From the global to the community level, we establish rules for governing our resources, creating monitoring protocols and efficient processes for settling

disputes and setting clear limits on use. We radically and equitably accelerate efforts to overhaul our food systems, make cities sustainable, decarbonize our energy systems, and shift from a “take-make-waste” to a circular economy. Recognizing that our practices of overuse and disregard have spread quickly off-planet, we enshrine outer space (along with our oceans and atmosphere) in international law as “global commons” with the responsibility for stewardship residing with the global community.

In learning how to better manage our commons, we tap existing wisdom from indigenous cultures and societies that have done so effectively for millennia. We also create a living catalog of thousands of current successful efforts by communities around the world to manage local resources, building an abundant databank of best practices.

But managing the commons becomes more than an approach to resources—it becomes an ideological framework for solving problems and creating equitable solutions at all scales, a new organizing principle running through our systems and behaviors. It offers a diversity of solutions and methods of consensus-building that would have once seemed impossible, and in some places leads to a fundamental reimagining of who owns what and for what purpose. We also apply “commons thinking” to a broader set of domains that, like our natural resources, were overly commodified for private profit-making. Whereas we might have once used the word “economy” to describe the sum of our productive activities (the local economy, the gig economy, the service economy) we now say “com-

mons” (the learning commons, the financial commons, the digital commons).

The shift to seeing the world through the lens of what we hold in common gives new shape and meaning to our lives, prompting many to reconsider or remember what we value most. Far more aware of the ways we are depleting not just our world but ourselves, we find ways to live more sustainably and as part of nesting sets of communities. Ours is now a world where individuals can prosper but not at the expense of their fellow humans or the vitality of the planet we inhabit, and where we take pride in living, collectively as one planet, within our natural world means.



Hyperspectral "Argus" Tablet

Portable multi-sensor platform to observe, monitor, and document aspects of the changing environment. Live feed unveils the historic context of different spaces and analyzes human impact and activity. Transparency and open monitoring allows for verification of a range of expected activities and deters illicit ones. Who would embrace this capability? Who would seek to counter it?

Speculative artefact #077745-6 inspired by Shifts 5, 6, 7

RIISING REFLECTIONS

In Phase 2 of Horizon 2045, we will dive more fully into the complexities and tensions that are pushing and pulling these shifts, in order to better understand how the future could play out and how our collective actions can influence its direction.

Our notions of security are changing. We need a new framework for a global security free from existential threats, featuring an effective global nuclear weapons and technology control system.

For now, we are reflecting on these shifts and what they might mean for advancing our nuclear weapons goals. For example, if there is broader acknowledgment that we need to let go of old ways of thinking to preserve the future, might we have more mental space and a wider "Overton window" to build and sustain political change? In what ways could transparency technologies help draw attention to government practices and data, including showing the world the costs of nuclear weapons programs and who benefits? In a world aligned around preserving the existence of the promise of humanity, would the prevailing sentiment be that all humans side with the interests of the future of humanity versus the interests of individual countries? Might an ideological shift toward "commons thinking" help ac-

celerate legal changes around nuclear weapons use and erode acceptance of nuclear deterrence?

These shifts raise as many questions as they answer—which indeed is their purpose. Collectively, they open new possibilities that we are only beginning to explore. Might humanity, in recognizing our future is in peril, come to embrace the belief that we have an obligation to both past and future generations to safeguard our existence and that of the planet? And what might we be capable of as a species if our interconnectedness were more obvious and more operational? Could a new paradigm of cooperation—driven by urgent necessity, and combined with social and technological advancements and increasing transparency—supplant the notion of using fear to constrain the actions of others? If cooperation becomes the dominant paradigm, what could this mean for nuclear weapons?

REIMAGINING GLOBAL SECURITY

The nuclear system—and other Anthropocene-era systems—have brought us to a precipice. To ensure that humanity can get beyond it, we need new systems designed with different goals in mind. Horizon 2045 posits that overcoming our perilous present will require a new, more expansive definition of security and a new system for achieving and maintaining it. Instead of a system designed to protect the right to possess and use nuclear weapons, we need a reimagined global security system that puts the protection of people, the planet, and our future at its center. We need to redefine security as a bigger system in which weapons and technologies that

threaten the future of humanity are no longer tolerated.

All of our work to date—developing a deeper understanding of the present dynamics of the nuclear system, building new approaches to driving change at the base layer of the system, scanning the horizon for driving forces and other signs of change, developing a point of view on key shifts that could impact the environment in which the nuclear system operates—points to this key observation.

We seek a future in which states, publics, and global actors have expanded the definition of security from protection, defense, and preservation of the state to the long-term protection, defense, and preservation of the environment and all present and future generations of humanity. More equitable and future-oriented, this new definition of security aims to safeguard future generations' opportunity to manifest humanity's fullest potential.

A NEW NUCLEAR SECURITY PARADIGM

In a world where we continue to accept the risk of a nuclear system that operates on the basis of threatening mass annihilation to prevent nuclear use, we will always be living with unacceptable existential risk. We believe it is both possible, and necessary, to design a new nuclear security paradigm that prevents the use of nuclear weapons through the implementation of effective, universal global controls around nuclear technologies—without the accompanying risk of civilizational catastrophe. Unlike the world of 1945, when the initial operating model of the nuclear system began to take shape, the technological capabilities of today's world provide a strong basis for a shift from a threat-based system to a control-based system.

A durable nuclear weapons prohibition is feasible if we have the controls necessary to ensure that nuclear technologies are never again used for anything but peaceful purposes (powering our communities, healing the sick, conducting research).

Such a system will require...

...new forms of legislation and regulation. Nuclear weapons must be prohibited and their development, possession, and use made illegal under international law. Global publics, private-sector actors, and NGOs must be well-equipped to monitor states' adherence to the law.

...strong global mechanisms and institutions cooperating to maintain the prohibition and control system. These institutions must continually evolve and adapt to changing power dynamics and circumstances to anticipate and resolve potential clashes of interest. Operating at global and regional levels, including both private-sector and governmental entities, and powered by the most advanced forms of technology, a new breed of global mechanisms and institutions will assume responsibility for enforcement, verification, inspection, monitoring, and detection.

...innovative technologies that shape new and more transparent protocols for detection, monitoring, and verification. We must take advantage of evolving technical capacity to build and retain the systems we need to safely and securely manage the entire nuclear life cycle, including to detect, monitor, and verify the use of nuclear technology, the dismantlement of nuclear weapons, and the safe disposal of spent fuel. These systems will help build confidence that nuclear disarmament, once achieved, is universal, verifiable, and irreversible. This includes robust and effective mechanisms for controlling prohibited and dual-use capabilities, facilities, materials, and activities in order to assure states and publics that cheating will be quickly detected and addressed.

While we already have much of the requisite technical capacity, the system will, perhaps most importantly, require that leaders and societies come to **believe that the global risks and consequences of nuclear weapons—including to human health, economies, ecosystems, and future generations—outweigh any perceived security benefits.** Active, diverse, and robust global networks—including engaged publics, private companies, and nongovernmental organizations—must directly promote and support the changes necessary for a sustainable new nuclear weapons control system grounded in new conceptions of planetary security.

Horizon 2045 has identified high-level goals of a new nuclear security paradigm and categories in which experimentation and cooperation will be critical. The details of that system will emerge from our next phase of work.

THE SECURITY STUDIO

In the first phase of Horizon 2045, we began exploring the future of global security—how and by whom security is defined, whose security is included in that definition, and how the definition itself will evolve in response to changing conditions. We assembled a cross-domain team of design and security experts to explore security challenges, dilemmas, and opportunities. That work yielded ample insights and strategies, spotlighting key topics for further consideration and laying the groundwork for more expansive work to follow.

Cooperation and responsibility

- What kinds of institutions will be required for a better global security architecture? What principles should they enshrine? What powers should they hold? Can current institutions be retrofitted or do we need to establish something new?
- Is there a realistic vision that prioritizes cooperation and shared transnational responsibilities in service of collective security?

Agency and proximity

- How can we give individuals and communities a more meaningful ability to contribute to their own security?
- What new narratives can help people regain a sense of collective consequences for their actions and their responsibility for one another beyond societal barriers?

Root myths and cooperative narrative

- What are examples of a cooperative society or species? How does this inform our understanding of security? Are principles evident?
- What stories and what incentives will bend actors toward a better security architecture? What kind of roles should incentives and stories play? What stories or incentives do we need to give up?

Security at personal–local–national–global scales

- Where and in what situations do we begin to defer our security to other actors? What should be questioned when our security lies in other hands?
- What are the major categories of information shaping security at a macro/global scale?

- How might structures that work to secure communities replicate or scale? Can they function in a way that makes the world more secure?

The question of profit

- What role does private/for-profit activity play in a better security architecture? Which parts of the private sector should we be looking to for leadership in this realm?



Revell MQ-20 Diver

1:32 scale model of military drone platform repurposed for oceanography research. How might defense contractors re-imagine themselves in the context of a new definition of security? What new systems and machines would they build? How would the economic dynamics shift? The hobbyist collectible format implies multiple levels of enthusiasm for a US exceptionalism that finds national pride beyond military might.

Speculative artefact #017127-5 inspired by Shifts 4, 6, 7

HORIZON 2

HOW WILL WE DRIVE CHANGE FORWARD?

Horizon 2 will be a period of experimentation and rapid iteration based on current and future insights. We will launch test projects, facilitate collaborative innovation, and accelerate the adoption of new approaches.

Clearly articulating the vulnerabilities and leverage points of the present system (Horizon 1) and exploring the new possibility spaces being opened by the contextual forces shaping the future (Horizon 3) reveals numerous opportunities to influence, alter, and wholly rethink the system we have in service of moving the world toward a more cooperative future free from the threat of nuclear weapons. If Horizon 1 is the present and Horizon 3 is the future, then Horizon 2 is the bridge—a set of actions, investments, and explorations capable of sparking significant change and creating still more opportunities yet to be imagined.

1. Broaden the community of people engaged in the nuclear issue.
2. Link the nuclear issue to other challenges facing humankind.

3. Drive change at the base layer of the nuclear system.
4. Challenge the system's entrenched dynamics.
5. Prototype or pilot new models of large-scale cooperation.

FIVE AVENUES FOR CHANGE

Broaden the community of people engaged in the nuclear issue.

The best and freshest ideas for achieving a future where states no longer depend on nuclear weapons will come from a wide range of voices and backgrounds from around the globe, drawn together into a far more diverse community of practice. H2045 seeks interventions that...

...make the nuclear issue accessible, attractive, and inclusive to the global public.

...engage greater numbers of, and more diverse, problem-solvers and partners, including outsized policy influencers, Gen Z leaders of the future, members of the communities most impacted by nuclear weapons, and other stakeholders.

...engage, elevate, and empower leaders and populations of states without nuclear weapons that resist the belief that nuclear weapons provide security.

...apply proven strategies/methods for successfully reshaping social views and beliefs to this issue space.

Link the nuclear issue to other challenges facing humankind.

Connecting this issue space to other systems, issues, and movements will unlock new insights, partnerships, and

opportunities to drive change at scale. Tying nuclear system questions to a broader field of questions related to security and the future will bring nuclear issues into more prominent light, and also help to reveal how nuclear weapons impede our collective ability to address other global challenges. H2045 seeks interventions that...

...connect/partner with issue spaces outside the nuclear realm, including those centered on climate change, biological risks, and social justice, as well as the growing movement of people looking at all existential risks collectively.

...assess what base layer changes and disruptions these other issue spaces are aiming to drive through their work, in order to surface linkages and synergies that are authentic, natural, and useful to all, and seek to apply theoretical and practical work from other global challenges that center cooperation over coercion.

...create increased global understanding of the gap between human and technological evolution and the criticality of developing new ways of working together as a global community to mitigate the existential risks we have created for ourselves.

...raise awareness and support inside the nuclear field of the necessity of thinking about nuclear issues as part of a broader issue set.

...articulate and build support around a set of human and planet centered design principles for the future that reframe security as a global issue and make a clearer connection between nuclear disarmament and basic human rights and justice issues.

...spark discussion, engagement, and collaboration around ethics, rights, and attendant responsibilities in a world of interconnected planetary risks.

Drive change at the base layer of the nuclear system.

The deeply entrenched beliefs undergirding the nuclear system, including the nuclear deterrence myth, limit the possibilities for change. Exposing these beliefs and their attendant frailties—and replacing them with something far better—will open new opportunities and momentum for change. H2045 seeks interventions that...

...expose the ways in which many of the assumptions fundamental to the nuclear system are fragile, flawed, or simply wrong. Create deeper knowledge of the underlying myths feeding these assumptions and how to influence their reexamination and re-creation.

...reveal the ways that human decision-making and behaviors have protected us in some high-risk nuclear situations by overriding the deterrence system, and how human or machine errors have increased risks of accidental or unintentional use.

...research emerging concepts or myths from other cultures and fields that lend themselves to the change we seek here (e.g. “managing the commons” in a time when we are painfully aware of planetary constraints).

...boost understanding of the stories of non-military exceptionalism countries tell themselves that contribute positively to the global condition.

...create better ways to communicate the consequences of nuclear use or nuclear accident—and strategies for preventing them—on the road to building an architecture that replaces the current system.

Challenge the system's entrenched dynamics.

The actions, behaviors, and relationships that make up the nuclear system are well established and well practiced, yet these dynamics and their global impact remain persistently underexposed. Finding ways to disrupt these dynamics, and to create new ones designed to orient the system toward a more safe, sustainable, and equitable future, will be critical to achieving a world free from nuclear threat. H2045 seeks interventions that...

...identify where/how to rewire behavioral and feedback loops so that actions can create significant disruptions to the system rather than marginal improvements.

...raise awareness and repair the harm done by the nuclear weapons system, particularly to marginalized communities, and ensure that further harm cannot be perpetrated going forward.

...use economic and business levers to incent change in this system as they have done on environmental issues (ESG investors), and make vivid the significant investment opportunities inherent in a new security paradigm.

...build support among a broad range of stakeholders for compelling new narratives about a far brighter future (Horizon 3) and for a replacement strategy for managing the nuclear threat.

...identify and amplify the incentives to denuclearize, aligned to a compelling vision for greater human security in the future.

Prototype or pilot new models of large-scale cooperation.

A new level of technical, political, and cross-sector cooperation is essential for achieving a verifiably nuclear-disarmed world. Novel forms of cooperation will help overcome the current atmosphere of extreme mistrust and scarcity, break deadlocks, and open new avenues of action. H2045 seeks interventions that...

...create reconfigured or new institutions purpose-built for new models of international cooperation and security, informed by 21st century technology and practice. These institutions must reject the usual bureaucratic approach and instead foster bi- and multilateral cooperation between state and non-state actors.

...design a credible nuclear control regime to ensure that once nuclear weapons are dismantled they are not reconstituted and that no more will be built. In a world with no or fewer weapons the knowledge and materials will remain; strong institutions and regulations to prevent proliferation and quickly detect cheating will be critical.

...design/prototype new governing structures, ethical guidelines, and mechanisms for planetary cooperation that can create cohesion across sectors, address interconnected security issues that are global in nature,

and take on the most urgent issues facing humanity.

...illuminate how new governance models and innovations in democratic practice could help us better understand the mechanisms we will need to support our vision for the future.

What might we be capable of as a species if our interconnectedness were more obvious and more operational?

THE PROMISE OF A WORLD BEYOND NUCLEAR WEAPONS

Ending the existential threat of nuclear weapons is a giant goal all by itself. But in working deeply on Horizon 2045 over the course of two very intense years, we have come to believe that the success of this initiative is bound up in something bigger that is just now coming into view, and that is a new conception of our collective purpose and role. As we contemplate the myriad natural and anthropogenic risks clouding our view of the future, we are confronted with a choice: 1,000 years from today, 10,000 or 100,000 years from today, will the Anthropocene be notable for humanity's failure to overcome challenges—many of which, like nuclear weapons, we created ourselves—or for being the beginning of a much healthier, safer, and more prosperous era for planet and people alike? What is possible on the other side of the challenges we face today?

Homo sapiens emerged about 200,000 years ago. As philosopher Toby Ord points out, humanity is still in its adolescence, “just coming into our power, just old enough to get ourselves in serious trouble.”¹ Yet even as we contemplate the dangers we have wrought, every day we make extraordinary advances in science, technology, and healthcare that improve the lives of billions. We make strides in artificial intelligence, nanotechnology, and quantum science; we develop neural interfaces that help us diagnose brain disorders; we eradicate more diseases and educate more children. If humanity survives to “maturity” and all these advancements converge, what might we—the

species distinguished by our capacity to cooperate—be capable of in the future? Might the story of the Anthropocene ultimately be one of problem-solving and regeneration, beginning with our decision to improve our odds of survival by ridding ourselves of nuclear weapons?

Like Toby Ord, we believe that “the future of a responsible humanity is extremely bright.” That future begins at the horizon: The end of the nuclear weapons century.

1 Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity* (Illustrated ed.). Hachette Books.

ABOUT OUR ORGANIZATIONS— AND A CALL TO JOIN US

A UNIQUE PARTNERSHIP TO PURSUE AN AUDACIOUS GOAL

Horizon 2045's three partner organizations bring the creative process expertise of designers, innovators, and futurists together with the political, diplomatic, and subject matter knowledge of nuclear security professionals.



The Center for Complexity at Rhode Island School of Design brings state-of-the-art communications and project design capabilities to the collaborative, along with a history of applying the craft of design to complex human challenges. → complexity.risd.edu

Launched in 2014 by five of the world's largest peace and security funders, N Square is a path-breaking initiative intent on transforming the nuclear risk reduction field into one of the world's brightest sources of cross-sector creativity and innovation. → nsquare.org

The Nuclear Threat Initiative is a non-profit, nonpartisan global security organization focused on reducing nuclear and biological threats imperiling humanity, with a proven track record of innovating and galvanizing real-world, systemic solutions that create lasting change. → www.nti.org

A WHOLE OF SOCIETY EFFORT

While Horizon 2045 was founded by three organizations, it has become something much broader. With the publication of this document, we are now entering Phase 2 of this project. We hope that many more partners will join us on this journey toward a brighter future. We are clearly not alone in our belief that rhetoric, weapons, and systems that risk mass destruction are antithetical to humanity's potential to flourish. Numerous organizations and thought leaders are doing innovative work relating to systems change, strategic foresight, existential dilemmas, and the interconnection of nuclear weapons and global risks. A goal of our next phase is to invite this broader community of actors into this work—bringing in new partners and funders, and engaging more sectors and fields in reimagining global security and our shared future free of nuclear risks. There are many ways to join us. To learn more about Horizon 2045 and how to get involved, please visit www.horizon2045.org.

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