

ALLIED COMMAND TRANSFORMATION STRATEGIC FORESIGHT ANALYSIS 2023



The futures thinking of various nations and stakeholders within the Alliance do not align by default. Therefore, systemic efforts are necessary to create a shared baseline and understanding of relevant trends and trajectories which affect the transformation of the Alliance's Military Instrument of Power.

The Strategic Foresight Analysis 2023 (SFA23) updates assumptions and extends the focus of the previous Strategic Foresight Analysis (SFA17) to assess the major drivers and most relevant implications of the Alliance's Evolving Security Environment until 2043. SFA23 assumes that present attitudes of strategic competitors will remain enduring amidst increasing global challenges and disruption in the forthcoming period, thus it is a decidedly risk-oriented foresight study. This analysis provides a solid baseline for the Future Operating Environment Study 2024, which will assess the evolving characteristics of actors, the battlespace and the modern warfare.

Even though the knowledge generated by strategic foresight is not scientific, this Strategic Foresight Analysis is the result of extensive research, robust collaboration with Allies and Partners and input from other future-oriented work strands within the Allied Command Transformation.

The SFA23 research was closed on 15 November 2023.



STRATEGIC **FORESIGHT**

TABLE OF CONTENTS

Foreword from the Supreme Allied Commander.....	3
Transformation.....	3
Executive Summary.....	4
Main Findings.....	7
Initial Implications.....	9
Introduction.....	11
AIM.....	11
SCOPE.....	11
BACKGROUND.....	12
METHODOLOGY.....	12
SCENARIO DEVELOPMENT.....	14
The Evolving Security Environment.....	15
Pathways of Evolution.....	16
Characteristics of the Evolving Security Environment.....	19
Drivers of Change.....	21
Climate Breakdown and Loss of Biodiversity.....	22
Resource Scarcity Driving Instabilities.....	28
The Age of AI: Emerging and Disruptive Technologies Converging.....	35
Goeconomics Fuelling Polarization.....	44
Human Networks Empowered.....	49
Scramble for the Commons.....	57
International Order in Transition.....	66
Implications to the Alliance.....	75
DIPLOMATIC.....	79
INFORMATION.....	81
ECONOMIC.....	83
MILITARY.....	85
Appendix A – Scenarios.....	91
1. ‘Four Worlds’ Model: A fragmenting world deteriorating further.....	91
Bibliography.....	93

FOREWORD FROM THE **SUPREME ALLIED COMMANDER TRANSFORMATION**



Few can doubt we are living in dangerous times. Our great Alliance, as it prepares to celebrate 75 years shielding Allied territory from the ravages of armed conflict, is now confronted with challenges on multiple fronts, including from those unwilling to abide by the set of rules that have allowed much of Europe and North America to live in peace and prosperity since the end of the Second World War.

Providing for the defence of over a billion people requires we come together, as Allies, to develop common solutions and capabilities. To do so, we need to have a clear and - just as importantly - shared understanding of what those threats and challenges might be.

By harnessing our combined and diverse intelligence, ACT's Strategic Foresight Analysis can point to the characteristics of our changed and evolving security environment and help NATO make the right long-term strategic decisions for the next 75 years!

PHILIPPE LAVIGNE
*General, French Air and Space Force
Supreme Allied Commander Transformation*

EXECUTIVE SUMMARY



Figure 1: The primary framework of the seven drivers of change

The SFA23 provides a shared understanding of the Evolving Security Environment to 2043, thus establishing the context for Allied futures thinking. Based on this context, the Future Operating Environment 2024 (FOE24) will address the military problem sets for Allied Warfare Development. FOE24 will also serve as a baseline for further conceptual and strategic thinking. The renewed foresight cycle, consisting of SFA23, FOE24 and deployable foresight analytics capacities, will facilitate collective futures thinking within the Alliance, as well as augment individual Ally's foresight capabilities.

Since the publication of SFA17, the security environment has been gravely altered, profoundly shaped by the systemic shocks posed by the COVID pandemic and Russia's full-scale invasion of Ukraine. The years ahead will be most likely characterized by further strategic shocks and structural disruptions, driven by actors and structural forces alike. The international order is in transition and will become increasingly multipolar amidst intensifying great power competition and fragmentation at all levels. Pervasive competition is unfolding and spreading into new domains through all dimensions at all times. Strategic competitors will engage across a blurred continuum of competition at the global, regional and sub-regional, state as well as non-state levels.

SFA23 concludes that the competition and adversarial intent of major state actors and terrorist non-state actors will endure amidst disruptions, and will aim to shape and contest the Alliance, as well as challenge the rules-based international order (RBIO). These actors will continue attempting to accumulate their own power and expand influence through exploiting instabilities and leveraging alternative digital, socio-economic and hybrid means.

The report presents its research findings in three main areas: the Evolving Security Environment, the seven drivers of change, and initial implications to the Alliance for the Instruments of Power. Additionally, its research context is established in the 'Four Worlds' model scenarios. Essentially, the report focuses on the overall trajectories and confluence of the key drivers of change, identifying potential strategic shocks for each, and determines the Alliance's Evolving Security Environment in relation to its Instruments of Power (IoP). The seven interconnected drivers shaping the Evolving Security Environment are depicted in Figure 1.

s in a series of workshops with Artificial Intelligence (AI)-assisted and Partner nations as well as their confluences were c

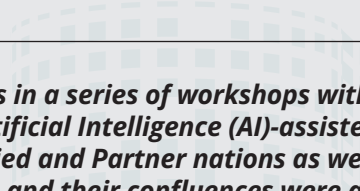


Figure 2: Trend radar for the Strategic Foresight Analysis



The SFA23 also examines the impact of these drivers against the future utility and effectiveness of the Instruments of Power (Diplomatic, Information, Economic and Military):

- The Allied Diplomatic Instrument of Power will be challenged by a rapidly increasing variety of actors, behaviours and attitudes, as well as competing narratives, complexity, contestation and confusion.
- The Allied Information Instrument of Power will face an increasingly congested and confused information environment facing challenges due to the abundance of narratives, AI, and automation, thus complicating detection. Cognitive warfare will play a critical role in shaping public perception and decision-making, requiring countermeasures.
- The Allied Economic Instrument of Power shall be used to retain advantage and will become a key objective for strategic competitors of the Alliance seeking to enhance their power and influence. Retaining an economic

advantage for Allied nations will be fundamental to create resilience against a confused future security environment.

- The Alliance's Military Instrument of Power may become constrained by a wide range of challenges to states, including the costs of climate adaptation and green energy transition. It must keep pace with rapidly changing technology and address economic, financial and technology limitations. Additional factors include the necessity to re-allocate spending to welfare and domestic challenges; ageing societies and the shortage of a skilled workforce; and an increasing defence cost escalation for development, maintenance and stockpiling. Demand for military capabilities is likely set to increase in a rapidly changing, complex, contested and confused security environment.

Allied warfighting development should be informed by the main findings and initial implications of this foresight research. Incorporating these insights will improve NATO's understanding of future challenges and aid in its long-term strategic designs.

1. Climate breakdown and loss of biodiversity is the most consequential and, in the long-term, the most likely existential challenge. It will prompt significant changes in attitudes and behaviours of both state and non-state actors.

2. Resource scarcity is expected to increase and drive further instability, competition and conflict. The green energy transition is emerging as a central tenet for the future of international and domestic affairs.

3. The Age of AI and the convergence of Emerging and Disruptive Technologies (EDTs) will reshape states, societies and armed forces as well as the character of competition and warfare with unprecedented speed. Competition is extending to virtual and cognitive dimensions and increasingly taking shape in the non-geographical space and cyber domains with new converging effects. Diffusion of technology will empower a wide range of actors (primarily non-state actors), including both commercial and terrorist organizations, to pursue their autonomous objectives more effectively and increasingly challenge traditional state power. Additionally, accelerating technology development and changing public-private nexus will profoundly impact security and military matters. Converging effects across operational domains as well as physical and non-physical dimensions will expand the scope and profoundly shape the character of competition.

4. Security and reliance concerns, strategic competition and technology are driving a shift towards geoeconomic blocs and fragmentation with significant implications for trade, technology, demographics, and the global financial system, potentially weakening globalization. The emergence of geoeconomic blocs fuelling polarization is driven by the securitization of supply chains, intensifying strategic competition, and alternative digital, economic and financial ecosystems. Adapting to this Fourth Industrial Revolution (i.e. rapid technological advancements of the 21st century) will pose significant challenges and exert disruptions to most states, societies and armed forces, as well as impact the geostrategic balance.

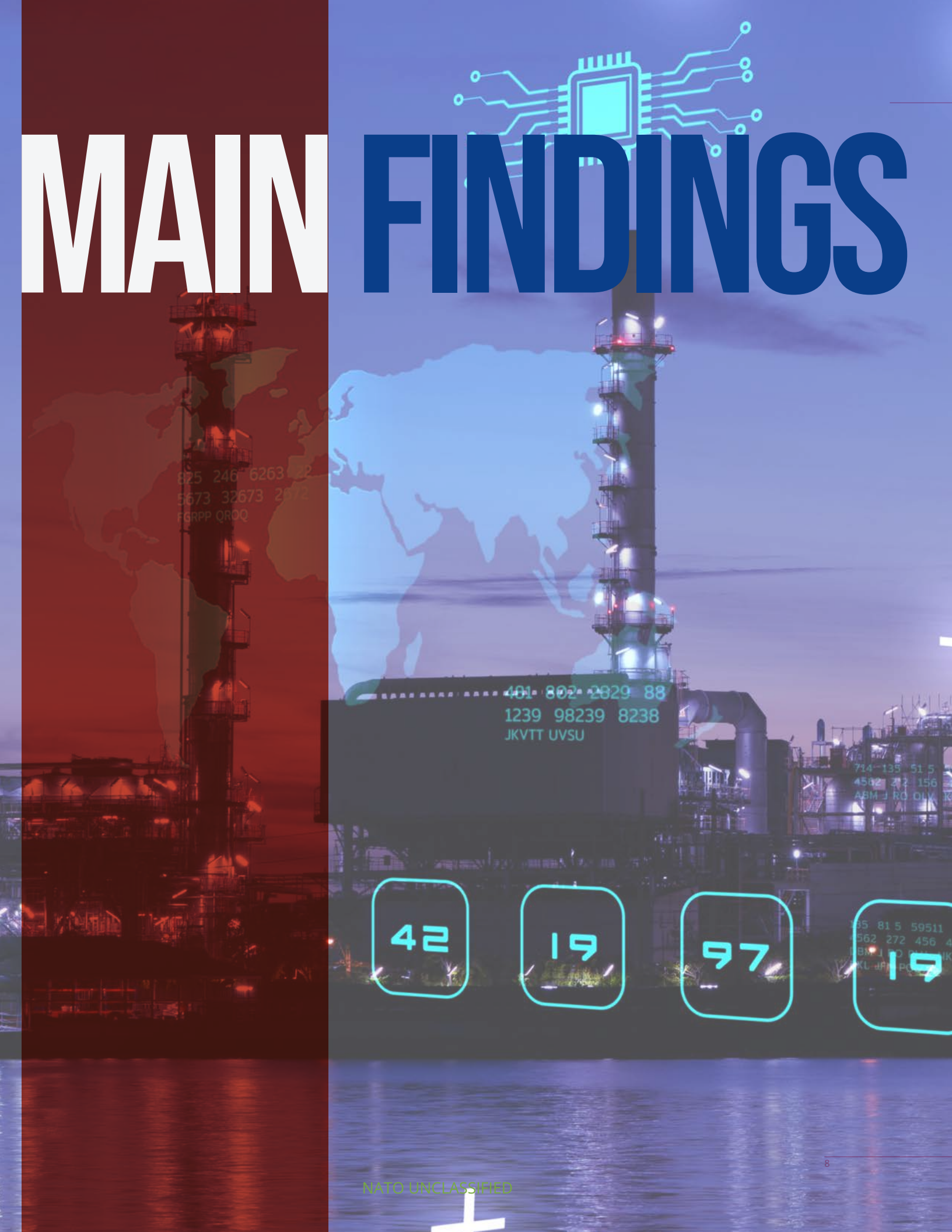
5. The rise of networked non-state actors, technological empowerment, urbanization challenges, changing values, and information/disinformation overload is highly certain. Societal and commercial capabilities emerge as indispensable elements of modern competition and warfare. These human network trends will profoundly affect international relations, security, and governance, creating both opportunities and risks in an increasingly complex and interconnected world. Notably, cities will emerge as the most critical nodes for future military operations, with sub-state actors becoming more agile, adaptable and scalable. Human networks will be empowered by technology diffusion and increasingly impact international and intra-state affairs. Commercial entities emerge as decisive actors and drive both energy and industrial transition, changing the character of warfare. These changes occur while strategic competition intensifies.

6. A scramble for the insufficiently regulated global commons expands due to resource needs, strategic competition and the rapid advancement of technology. Competition into new theatres, from the seabed to the outer space, dramatically increases congestion of actors around critical trade and resource nodes as well as positions of strategic advantage. The commercial sector will drive and lead the scramble with new EDTs, research and autonomous actions. All actors will pursue their own strategic advantage for resources. The ensuing pervasive competition, extending into the virtual and cognitive dimensions, will continue to challenge the RBIO. It will increase the likelihood of fragmented responses to strategic shocks and have profound implications for the global economy, international trade and socio-demographics, thus potentially weakening globalization.

7. Accelerating changes, strategic shocks, pervasive instability and autocratic states will substantially challenge and further fragment the RBIO, intensify strategic competition as well as the emergence of new forms of security cooperation and military alliances. A pathway of pervasive competition across all domains, dimensions and in all times is a most likely scenario. This environment will be complex, congested, commercialized, contested, and inadvertently confused. It is where strategic competitors will attempt to effectively achieve coordination across their instruments of power with an aim to limit the Alliance's Military Instrument of Power in peacetime, through shaping, contesting, exploiting disruptions and instabilities, and confronting from a position of strategic advantage.

MAIN

FINDINGS



825 246 6263 22
5673 32673 2572
FGRPP QROQ

461 802 2829 88
1239 98239 8238
JKVTT UVSU

714 135 51 5
4562 32 156
ABM J RO QLV

95 81 5 59511
562 272 456 4
IBM J RO QLV
KL JRO QLV

42

19

97

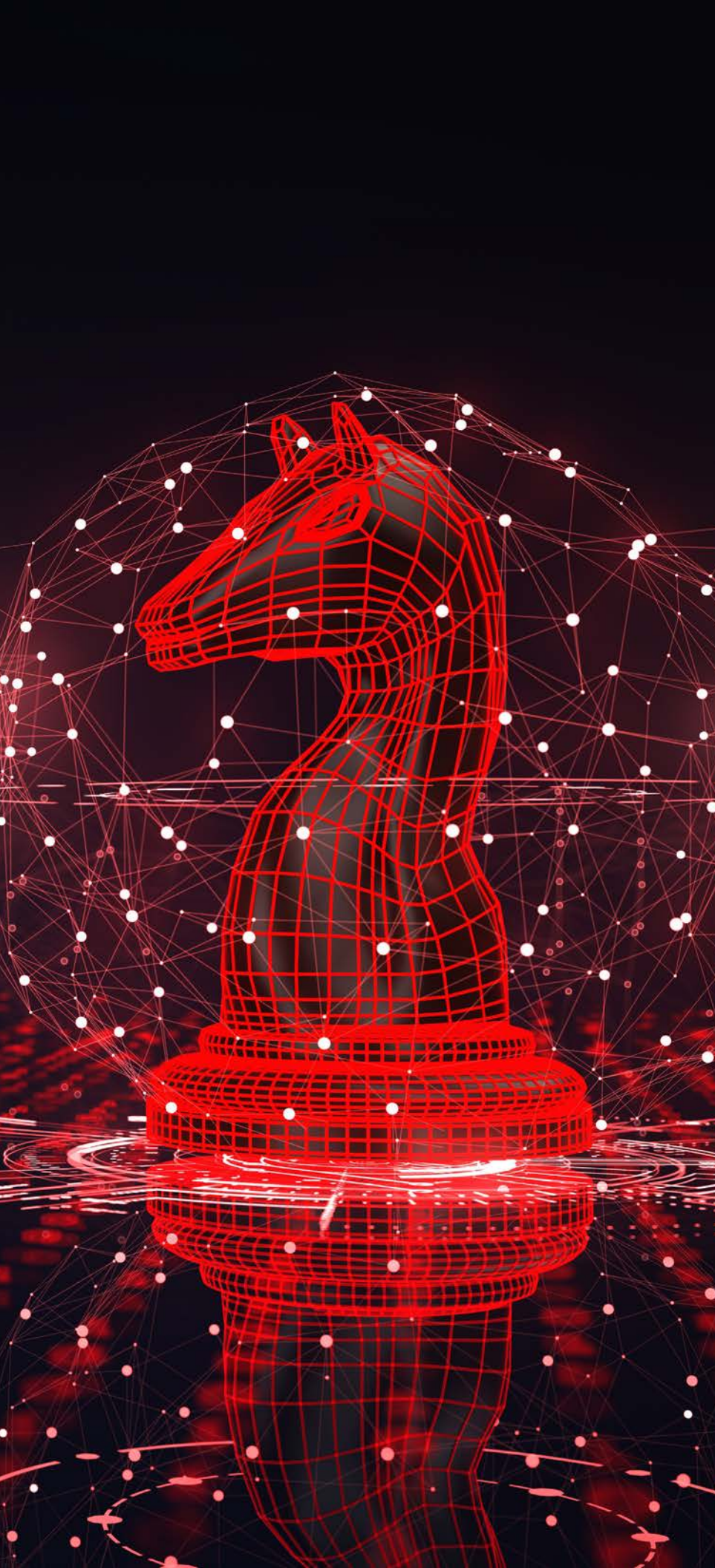
19



INITIAL IMPLICATIONS



1. Climate breakdown poses significant challenges across all sectors and armed forces, leading to attrition and higher costs.
2. Adaptation of military concepts and capabilities to green energy sources and EDTs is crucial.
3. The protection of trade routes and supply chains may become a priority.
4. EDTs will transform the character of warfare increasing the speed, range and scale of threats as well as their damage potential. EDTs will pose novel ethical, moral, conceptual and governance dilemmas and likely increase chances of strategic surprise as well as unintended escalation.
5. Military capabilities will become more intelligent and interconnected, increasingly relying on the commercial sector.
6. Human networks play a critical role in modern warfare, necessitating a new approach to national and human security and private-public partnerships.
7. Cities become critical nodes for military operations and human networks. Urban warfare is becoming the prevalent physical operating environment.
8. The scramble for global commons increases demands for readiness and range of military capabilities, including on the seabed and in the outer space. An increase of operations in the commons will rely on commercial and non-governmental service providers.
9. Adversaries will aim to limit the Alliance's ability to generate fighting power in peacetime through convergent effects and coordinated use of diplomatic, information and economic capacities.
10. The increasing scale and cost of modern warfare makes it increasingly prohibitive for most nations to conduct it alone, thus fostering new security, economic and digital arrangements and military alliances.
11. Effective and efficient management of the aggregation of capabilities through operations and defence planning will remain fundamental to generating future fighting power and preserving NATO's military advantage across all operational domains and effect dimensions. Defence planners must continue to adjust future requirements to the Evolving Security Environment of the Alliance and subsequent futures concept and warfare development strategies.



INTRODUCTION

AIM

The aim of the SFA23 is to anticipate the Evolving Security Environment until 2043, providing an assessment of the driving forces and potential strategic shocks that are shaping it. Additionally, this report draws implications for the Alliance's Military Instrument of Power (MloP) as well as provides assumptions on further impacts on the utility and effectiveness of Diplomatic, Information and Economic instruments. The SFA23 focuses on trends that are the most relevant for the future security of the Alliance. The assessment is decidedly risk-oriented to assist, inform and inspire NATO's warfighting development, defence planning and wargaming communities.

SCOPE

The SFA23 provides information for future-oriented strategic considerations (futures thinking) at NATO Allied Command Transformation (ACT). Its military aspects are being further developed in the FOE24 and support additional classified analyses. The SFA23 also enables the futures thinking of a wide range of customers and partners in the Allied futures' community with up-to-date and robust baseline foresight research. These include Allied and Partner nations, the NATO Military Authorities, International Staff, the Science and Technology Organization, and the Wargaming Community. The findings of this report are in synergy with the NATO Science and Technology Organization's trend analysis. This report is designed to support many users, including the warfighting development and concept development community, defence planners and wargamers, to augment and revise existing assumptions and develop new scenarios.

BACKGROUND

The previous SFA reports (2013, 2015 and 2017) informed both the collective and Allied defence planning processes as foundational documents on futures. Utilizing general trend assessments from the SFA series, the Future Framework of Allied Operations 2018 identified characteristics and abilities of the forces the Alliance needs to retain its military edge.

Built on these foundations, the NATO Warfighting Capstone Concept (NWCC) was approved by Heads of State and governments in 2021, detailing how NATO and Partners must develop their MloP to maintain the advantage for the next twenty years.

In 2022, the Supreme Allied Commander for Transformation (SACT) revived the Strategic Foresight process, with three objectives:

1. Create a new, biennial foresight cycle, after six years of hiatus, with a general trends assessment document as a baseline for futures thinking (SFA23). Create a subsequent analysis of the Future Operating Environment of the Alliance (FOE24) to expand and update existing assumptions on the future operating environments, as set out in the NWCC. Enable the transformation of the Alliance's MloP and Warfighting Development efforts by providing a shared futures baseline and initial implications.
2. Develop subsequent foresight studies to analyse long-term challenges, as identified in the SFA23 research.
3. Establish a foresight community and modernize foresight practices to enhance collaborative foresight research and Allied and Partner interactions, as well as provide support to Allied and Partner foresight efforts, upon request.

The SFA23 research was designed and conducted in line with SACT tasking to establish:

- General trends and implications assessment as a baseline for FOE24.
- Employ novel analytic models and introduce new problem sets to support further foresight analysis.
- Establish means and platforms to revive the Allied foresight community.

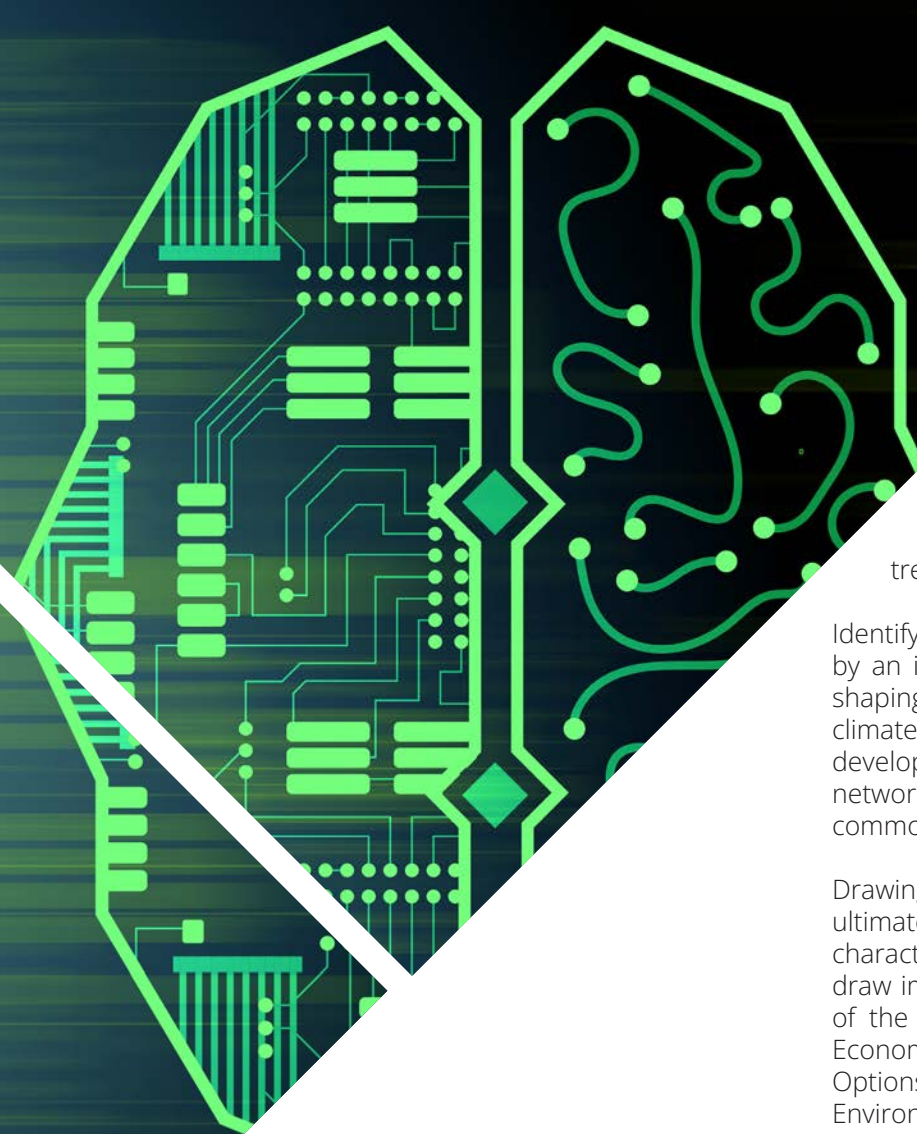
METHODOLOGY

The SFA23 identifies and assesses drivers of change ('7 Drivers Model'), which are shaping the characteristics of the evolving security environment (see Figure 1). This report examines the impact of these drivers against the future utility and effectiveness of the Instruments of power (IoPs). This analysis provides insights into the nature of security threats, challenges, and opportunities that the Alliance and Allied nations may encounter.

The decision to overhaul the existing STEEP (Social, Technological, Economic, Environmental and Political factors) with the 'Driving Forces Model' was based on the appreciation of the increasing complexity and interconnectedness of the most relevant trends in the security environment. Additionally, the six-year gap between the SFA17 and SFA23 also encouraged a complete re-assessment of the trends landscape, intending to create a flexible methodology. Renewed focus on practical implications on the IoPs, introduced by the NATO Military Strategy in 2019 and followed by the NWCC further reinforced the need for a novel approach.

The 'Driving Forces Model' focuses on the underlying causes and dynamics of change. It encourages practitioners to explore the root drivers behind emerging trends, enabling the standardized research of a wide range of complex issues and the development of plausible scenarios with a more robust assessment of their potential implications. By understanding the fundamental forces at play, the Alliance can better anticipate and adapt to disruptions and capitalize on opportunities.

The SFA23 methodology is based on the Framework Foresight Model (Figure 3), tailored to the objectives of ACT. The research has also utilized extensive scenario development and AI-assisted horizon scanning tools, and relied on expansive collaborative dialogue with Allied and Partner nations and external actors in academia and industry. The SFA23 research started in October 2022 and included seven workshops, one conference and one seminar with an overall involvement of 800 participants. Findings on trends and initial implications have been developed as an iterative process between internal research, collaborative thinking and external advice.



identified and confluences assessed with a view to the most demanding outcomes and reduced to the most relevant trajectories (see the trend radar at Figure 2, with the most relevant trends for Alliance's security environment).

Identifying drivers: Drivers of change have been identified by an impact analysis of major trends. Primary drivers shaping the evolution of the security environment are climate change, resource scarcity, disruptive technology development, securitization of economics, human networks empowered, the exploitation of the global commons and an international order in transition.

Drawing implications: The assessment of trends and ultimately of major drivers allowed analysts to identify likely characteristics of the evolving security environment and draw implications for the future utility and effectiveness of the Military as well as Diplomatic, Information and Economic Influences of Power.

Options and integrated approach: The Future Operating Environment Study will be built on the foundations of the generic trends assessment provided by the SFA23 to provide an impact assessment to the transformation process, led by the NATO Warfighting Capstone Concept and the Warfare Development Agenda.

List of Workshops:

- I.** Washington, DC (USA): initial assessment of the evolution of the security environment, including discussions of potential drivers and multiple scenarios.
- II.** Norfolk (USA): NATO ACT's internal discussion on emerging trends and potential implications.
- III.** Berlin (DEU): discussion with Allies on the three horizons, including critical drivers and uncertainties as well as conditions of transitions
- IV.** Helsinki (FIN): assessment of long-term implications of the Russian War of Aggression to future security environment, across first and second horizons.
- V.** Riga (LAT): assessment of the impact on the future utility and effectiveness of Allied Instruments of Power.
- VI.** Bucharest (ROU): testing of the '7 drivers' framework and discussion with Allies on the implications of primary drivers.
- VII.** Norfolk (USA): testing of the 'Four Wars' framework with the future warfighting community at ACT.

Based on this model, the SFA23 team adopted the following definitions and parameters to fit the scope of its objectives:

Past: Assessment of recent strategic shocks.
The Domain of Research: The Evolving Security Environment of the Alliance.

Current (Baseline) Assessment: Strategic shocks and emerging changes are transforming the character of the evolving security environment, creating novel challenges to the Alliance. The extent and frequency of structural disruptions will likely increase, while strategic competitors of the Alliance will seek opportunities to exploit changes. The Alliance's effort to transform the Military Instrument of Power needs to draw on extensive futures thinking to remain fit for the future.

Scanning and mapping trends: 170 trends

VIII. Washington, DC (USA): closing symposium on the major challenges in the first two horizons, scenarios, drivers and uncertainties. (Although it is not counted as a workshop, due to its significance it is reported here.)

IX. Brussels (BEL): additional test of `7 drivers` and

model was developed to improve the understanding of potential new strategies by strategic competitors and the effective capability to combine their national instruments. The `Four Wars` scenario model serves to assess military implications to the Alliance as well as to draw assessment

to the utility and effectiveness of Allied IoPs in the evolving security environment. These scenarios were tested in two workshops (Norfolk and Brussels) with the warfighting development community and industrial experts.

Appendix A contains in-depth scenarios description and diagram of the `Four Worlds` Model.

These initial framing discussions established that the security environment is in overall decline as a result of a pessimistic outlook for two significant variables: structural disruptions and international cooperation. Disruptions are driven by climate breakdown, increasing scarcity and unequal distribution of resources and

the effects of accelerating technology development. Within this context, behaviour of state and non-state actors was assessed as increasingly competitive and in some cases outright aggressive in a rapidly transitioning international order, in pursuit of securing strategic advantages and resources, as well as hedging against or coping with fragmentation and instability on short and mid-term. In such a security environment, preferences for strategic cooperation will remain limited, with detrimental effects on the efficiency of responses to global challenges and likely undermining international stability. Unfolding fragmentation is manifested in increasing attempts by strategic competitors to undermine the RBIO and challenge the Alliance, or instability caused by non-state actors, and increasing levels of violence on a global scale. In this framework, the COVID pandemic and the Russian invasion of Ukraine have been considered as systemic shocks.

FRAMEWORK FORESIGHT

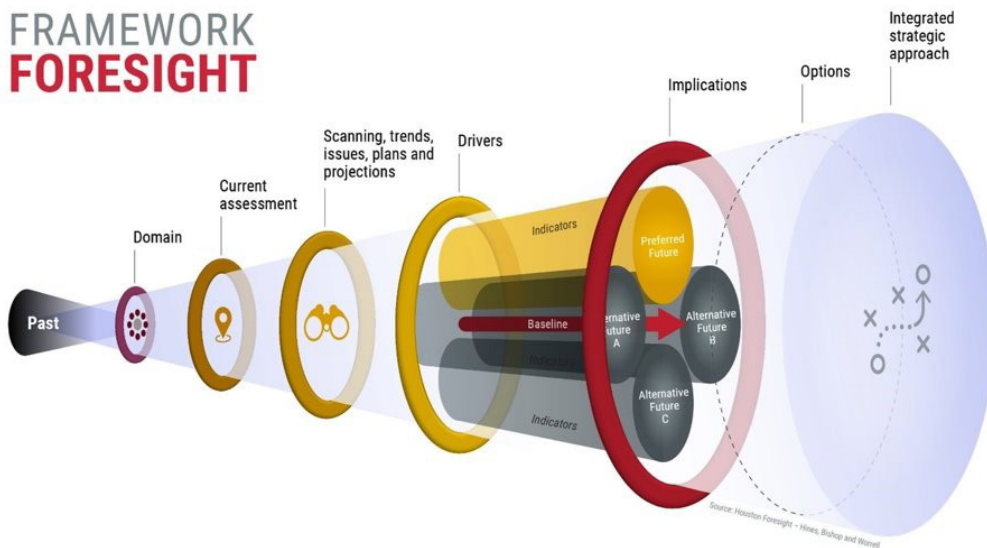


Figure 3: Framework Foresight Model. Source: Houstonforesight.org

`Four Wars` scenario was applied in the assessment of implications with industrial actors.

These workshops have complemented the research by assisting identification of trends and initial implications, providing broad national views, and deliberating drivers and scenarios offered by the Strategic Foresight team.

SCENARIO DEVELOPMENT

To reduce complexity and enable collaborative futures thinking with Allies and Partners, four archetypical (`Four Worlds`) scenario model was developed to explore generic futures, allowing implications to be drawn through the framework of the `seven drivers`. This model was used to assess subsequent future trends and initial implications with Allies, Partners and the Warfare Development community (during the Workshops in Bucharest, Norfolk, Washington DC and Brussels in 2023). In addition to the generic future scenarios, a war-gaming

THE EVOLVING SECURITY ENVIRONMENT



A negative pathway of limited global cooperation and outright competition, resulting in a trajectory from a fragmenting world to pervasive competition, is the most likely and most demanding pathway for the Alliance.



PATHWAYS OF EVOLUTION

As introduced in the Methodology chapter, the 'Four Worlds'(Annex A) model was used to explore generic futures, out of which the Strategic Foresight team discarded the low disruption, high cooperation scenario as not probable. As a result, three generic futures have been assessed against workshop findings, with the 'Fragmenting world' (the Alliance's Strategic Environment as defined in the Strategic Concept 2022) as a baseline, 'Global cooperation' as the positive scenario and 'Pervasive competition' as the negative scenario. During the workshops and engagements with Allies and Partners, the overwhelming opinion was consistently negative regarding the short and midterm outlook of the Alliance's security environment. Additionally, the SFA23 has decidedly taken a risk-oriented approach to inform ongoing considerations in warfighting development and defence planning. As a result, the 'Pervasive competition' [high disruption, low cooperation scenario (see Appendix A) was most likely and informative to properly assess the risks and challenges to the Alliance] pathway has been explored in detail and constitutes the core assessment of the SFA23. Notwithstanding, this chapter will also provide a brief discussion on the other scenarios.

Fragmenting world.

The starting point is defined by heads of states and governments in the Strategic Concept 2022 (SC22) and reinforced in the Vilnius Communique by Heads of States and Governments in 2023. It portrays an already fragmenting security environment where the European security order is violated by the Russian Federation. Authoritarian actors are challenging Allied interests and values through contestation in space and cyber domains, as well as through hybrid means, while undermining multilateral norms and institutions. Terrorism, in all its forms and manifestations, is the most direct asymmetrical threat and non-state armed groups are exploiting conflict and weak governance. For example, conflict, fragility, and instability in North Africa, the sub-Saharan region, and the Middle East affect NATO's security and enables destabilizing interference by external actors.

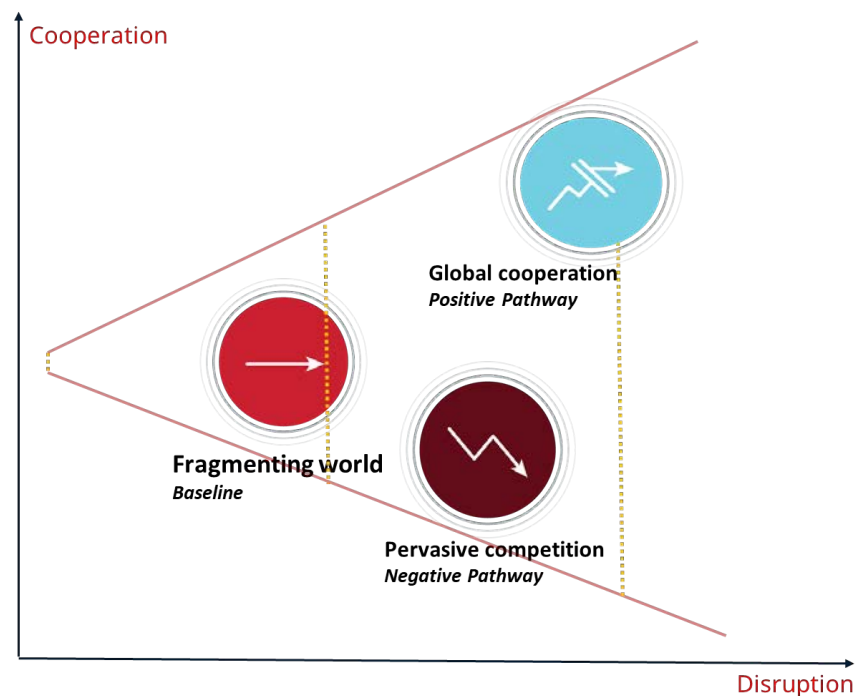


Figure 4: Pathways of the Evolving Security Environment

Likewise, the development of the processes in the Black Sea region is of crucial importance for the Euro-Atlantic area. In addition, China employs a wide range of political, economic, and military tools to increase its global footprint and project power. Furthermore, erosion of arms control, disarmament, and non-proliferation negatively impacts strategic stability. Climate change is also a defining challenge and a threat multiplier with profound impact on Allied security, armed forces operations, and infrastructures. As recognized in the SC22, pervasive instability results in violence against civilians, including conflict-related sexual violence, and these trends pose serious transnational and humanitarian challenges.

The increasing frequency and extent of strategic shocks and the disruptive impacts of changes in digital, economic and security systems necessitate further deliberations to understand how the strategic environment as assessed in the SC22 will continue to evolve.



Pathways of the Future. The SFA23 assesses two possible pathways for the evolution of a baseline security environment as defined in the SC22: Global Cooperation and Pervasive Competition. Changes are primarily driven by increasing disruptions posed by climate breakdown, resource scarcity, technology transformation, and transitions in the international order. Actors (state and non-state alike) respond to these changes through changing attitudes and behaviour. As a key variable, cooperative behaviour in critical areas leads to a more benign scenario, whereas less cooperation leads to a higher level of disruptions and competition.



GLOBAL COOPERATION

The positive pathway of the Alliance's Evolving Security Environment assumes changing attitudes of potential adversaries and actors. It drives an enhanced level of cooperation on a global scale to address increasing disruptions and global challenges. It entails global coordination to mitigate and adapt to climate change, and to provide to fragile and developing states financial assistance and access to technology. This will support their efforts to green energy transition, to reinforce or build critical infrastructure, and to tackle poverty, gender-based inequality and uneven access to resources.

In addition, it requires governance on EDTs and in the global commons, for example space traffic management, as well as shared efforts to provide freedom of navigation, to counter violent extremist organizations and to promote international stability. Arms control agreements for conventional, nuclear, and emerging and disruptive technologies and systems would further assure strategic stability and enhance cooperation and dialogue.

However, such a development is unlikely while the Russian Federation continues to violate the territorial sovereignty of Ukraine, and maintains its hybrid activities, which precludes greater cooperation. Additionally, potential adversaries of the Alliance or Allied states maintain assertive postures and influence to promote alternative norms and regimes. Additionally, strategic competitors of the Alliance can be expected to continue exploiting vulnerabilities in the international system, abstaining from global efforts to provide credible response to global challenges and from establishing new frameworks to promote strategic stability.

PERVASIVE COMPETITION

Accordingly, a negative pathway of limited global cooperation and outright competition, resulting in a trajectory from a fragmenting world to pervasive competition, is more likely. In such a scenario, the green energy transition remains disorderly, the extent of disruptions remains unbounded, multiplying challenges to states, societies, institutions and international norms. Strategic competitors, in anticipation of a degrading security environment, will likely expand operations to gain strategic advantage, to include dominance in the non-traditional and non-geographic domains, such as space and cyber. They will compete with the Alliance in a multi-dimension theatre of physical, cognitive and virtual dimensions, at all times.

Pervasive competition will likely exacerbate the impact of disruptive developments, instabilities, and shocks. Potential adversaries will attempt to exploit these disruptive changes as opportunities to expand influence, shape and contest to ultimately confront the Alliance. Hence, it is of key importance to anticipate and understand such changes along with their implications to the Allied instruments of power.

CHARACTERISTICS OF THE EVOLVING SECURITY ENVIRONMENT

In the most likely pathway, the Evolving Security Environment of the Alliance will continue fragmenting, leading to pervasive competition with potential adversaries in all domains and across all dimensions. Such an environment will exhibit increasing complexity, congestion, commercialization, contestation and confusion.

Complexity: Interdependence and shared vulnerability of economies will continue to grow in space, digital services, and critical resource supply chains. High levels of interconnectivity and interdependence, coupled with heightened competition will continue to complicate international affairs amidst increasing frequency and extent of disruptions.

Global strategic competitors will attempt to promote alternative economic, digital and security systems and expand their influence through diffusion of investment, technology, and power projection. Simultaneously they will likely seek for limited cooperation and retain dialogue, thereby increasing ambiguity of their objectives.

States and empowered non-state actors will scramble for critical resources while simultaneously they will also need to cooperate in providing global responses to global challenges. Despite the imperative for international collaboration to address these challenges, there is an observable diminishing willingness and effectiveness in such collective endeavours. Cooperation and competition will thus likely take place simultaneously.

The variety of actors, attitudes, behaviours, and disputes will increase significantly with empowered human networks and an increasing number of state actors acquiring advanced technologies. This will impact the balance of power generated on the inter- and intra-state levels. Novel frameworks of security cooperation may form as the cost and complexity of warfare increases. This will likely introduce an environment consisting of multiple military alliances.

Boundaries between cooperation, rivalry, and confrontation are already eroded, and technology will further enhance this process. The proliferation of actors and activities in largely ungoverned domains will further increase complexity. Technology advancement and the emerging centrality of non-geographic domains will increase in scale, speed, and distance of actions and effects. Differing rule sets related to advanced technologies and international affairs will further complicate cooperation.

Infinite alternative worlds may emerge in the virtual dimension, unbounded by physical limitations, and eventually the convergence of physical and non-physical (virtual) realities fused into metaverses will further increase variations of realities and perceptions. The expansion of competition from the physical to virtual and cognitive dimensions significantly impacts the continuum and character of conflict. This will likely shape the attitude and behaviour of actors towards more focus on resilience and on the increased exploration of pre-emptive measures.

Congestion: Climate breakdown as well as inequitable and diminishing access to resources will drive actors into new theatres. Changing climate conditions and expanding instabilities will accelerate shifts in both behaviour, attitude and actions of populations, especially in the most severely impacted areas.

Migration, regular and irregular alike, will be a major driver for increased population densities likely in the Northern Hemisphere. Cities will continue to expand by absorbing rural populations. Congestion will also significantly increase in the global commons, with an increasing number of commercial actors in space, cyber, atmosphere, the High Seas and the Poles. Both state and non-state actors will attempt to secure access and dominance within these domains. Accordingly, populations will congest in and around urban areas, critical resources, trade routes and infrastructures. Competition and confrontation may frequently arise to access and dominate these nodes of human networks. Climate

degradation will further contribute to competition for habitable areas and exploitable sea areas. The capabilities of actors will increase, enabling them to explore, exploit, and manoeuvre in all domains. Development and proliferation of sensors and autonomous systems will further increase congestion, but also interdiction, fire, lethality and attrition.

Commercialization: Limits of state power will increase dependence on more agile, scalable, and adaptable commercial service providers. Innovation is already led by the private sector and the gap between the state and private sector's potential will likely increase further. Commercial actors will continue to act as distributed and effective networks, with better economies of scale and efficiency than state actors. Additionally, states' economic power will likely be impacted by series of shocks, the need to balance societal needs, adapt to the green energy and industrial revolution as well as provide for defence spending.

Increasing commercialization will likely proliferate into services in space, cyber, logistics, and telecommunication. The commercialization of security is extending to the military domain, with the expanding role of private military and security companies and violent non-state armed groups. Innovation in most EDTs will be driven by commercial non-state actors, and this surge is revolutionizing warfare. The commercialization of AI, biotechnology, and quantum technologies augments both the potential for innovation and the risk of misuse.

Contestation: Geopolitical rivalry will become more prevalent in a multipolar world. The erosion of RBIO would incentivize actors to resolve contradictions by challenging established rules. Emerging and revisionist powers may pursue strategic campaigns through novel combinations of power, exploitation of EDTs, or triggered by the perceived weakness of targeted states. Non-state actors will play an increasing role. Strategic competitors of the Alliance will be actively shaping, contesting, and

confronting state and non-state actors in specific regions.

Strategic competitors will attempt to shape and contest the Alliance's MloP across all domains, as well as through the combination of IoPs to limit the effectiveness of the Allied fighting power. Such efforts will take place along the entire continuum of conflict, including in peacetime and may escalate into confrontation.

Confusion: The non-linear and non-gradual erosion of RBIO will incentivize actors to ignore or challenge established rules. EDTs will expand in both variability and usability, possibly incentivizing actors to pursue strategic surprise. The expansion of competition from the physical to virtual and cognitive dimensions will blur the continuum and character of conflict. Simultaneous actions for both cooperation and competition will further complicate anticipation, assessment, attribution, and response. Enhanced concealment of intent and capacities will defy physical limitations and increasingly confuse boundaries between traditional and non-kinetic forms of conflict, also challenging the traditional notion of state sovereignty. The changing character of competition, boundary, signal density, simultaneous manoeuvres, and converging effects will challenge the understanding of an actor's attitude and behaviour and various perceptions of competition. Aggression may take place in a distributed manner encompassing all domains, even in times of peace.

The likely pathway of the Evolving Security Environment supports the assessment of the NWCC which understands the changing character of war as persistent, simultaneous and boundless. This will also have enduring impact on the moral, conceptual and physical aspects of the Alliance's fighting power and as such, needs to be analysed with a view to adapt the Alliance's MloP to remain fit for the future. SFA23 provides an initial analysis of the likely consequences under the 'Initial Implications' chapter.

Drivers of Change

This chapter describes the most relevant strategic trends, organized into drivers of change which will significantly affect the Evolving Security Environment of the Alliance. (The `7 Drivers Model` (Figure 1) is discussed in detail in the Methodology section.)

The effects of these drivers are shaping all actors in the Alliance's security environment. Major disruptive change is caused by the Climate Breakdown and Loss of Biodiversity, Resource Scarcity Driving Instabilities, The Age of AI and EDTs converging, Geoeconomics Enabling Polarization, Human Networks Empowered, Scramble for the Commons and, as a result, International Order in Transition, all underlined by the detrimental effects of pervasive competition.



Climate breakdown and loss of biodiversity should be considered as the primary structural force that will have a profound impact on every aspect of the Evolving Security Environment. If unchecked, it will act as a threat multiplier, accelerating disruption and pervasive competition and causing further fragmentation. Societal instability, displacement and essential resource insecurity will pose a significant challenge to military operations across all domains as impacts escalate. This is an existential challenge for humanity.

CLIMATE BREAKDOWN AND LOSS OF BIODIVERSITY

Climate change will continue to enhance devastating extreme weather and climate events (hereafter climate extremes) with increasing frequency and severity. There is unequivocal evidence that the impact of climate change is reshaping living conditions on Earth and poses existential threats driven by human activities such as the burning of fossil fuels and deforestation. Rising global surface temperatures due to increased greenhouse gas emissions (GHG) can lead to the increased frequency and volatility of extreme atmospheric conditions, weather events, rising sea levels, and heat stress.

Extreme terrestrial and marine heat waves will continue to challenge the most vulnerable population's groups, diminish agricultural production and threaten vital terrestrial and

maritime ecosystems. Heat waves and drought will further exacerbate water and food insecurity. Coastal cities will become more vulnerable

intensity of tropical cyclones and associated storm surge combined with rising sea levels. Impacts on human environment will likely relate

not only to mass migration of people, increasing organized crime such as human trafficking and gender-based violence, but also transforming national population demographics, leading to a shift in societal behaviours, values, resiliency and cultural norms as well as decreasing trust in state.

Risks and projected adverse impacts, as well as related losses and damages from climate change will escalate with every increment of global warming. Climatic and non-climatic risks will increasingly interact,

creating compound and cascading risks that are more complex and difficult to manage.

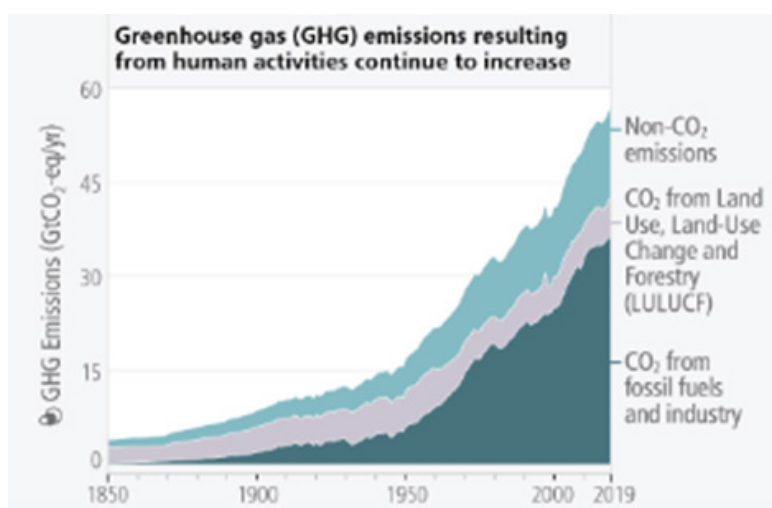


Figure 5: Emissions of GHG have increased rapidly over recent decades (from IPCC, 2023: *Current Status and Trends*, In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, H. Lee and J. Romero (eds.)], IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647)

to natural disasters due to rising sea levels, the changing characteristics of compounding climate extremes such as the increasing frequency and

Human and ecosystem vulnerability are interdependent. Climate degradation and disruption, the loss of biodiversity and rising temperatures are driving the shifting patterns in weather extremes with increasing frequency and duration affecting human systems and vital ecosystems. As temperatures rise, species are at high risk of becoming endangered or extinct, as ecosystems continue to decline. In the extreme case, the collapse of multiple ecosystems will adversely impact the natural balance of our planet. As a result, even slight incremental upticks in temperature will increasingly affect marine, freshwater and terrestrial ecosystems and services such as water and food security, settlements and infrastructure, health, economies, and culture. Climate breakdown and the loss of biodiversity have cascading effects on food production, water supply and other critical ecosystem services that are essential for human well-being.

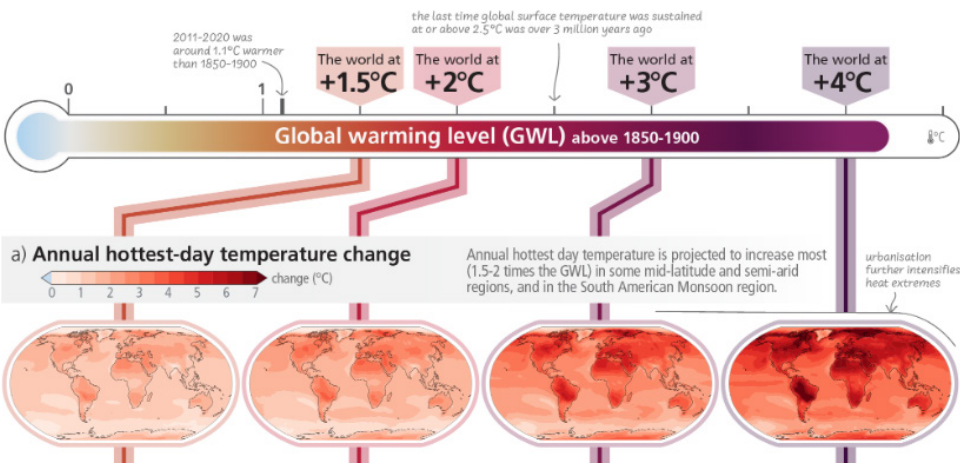


Figure 6: Projected changes of annual maximum daily temperature at global warming levels of 1.5°C, 2°C, 3°C, and 4°C relative to 1850–1900 (Figure SPM.2 (a) from IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1–34, doi: 10.59327/IPCC/AR6-9789291691647.001)

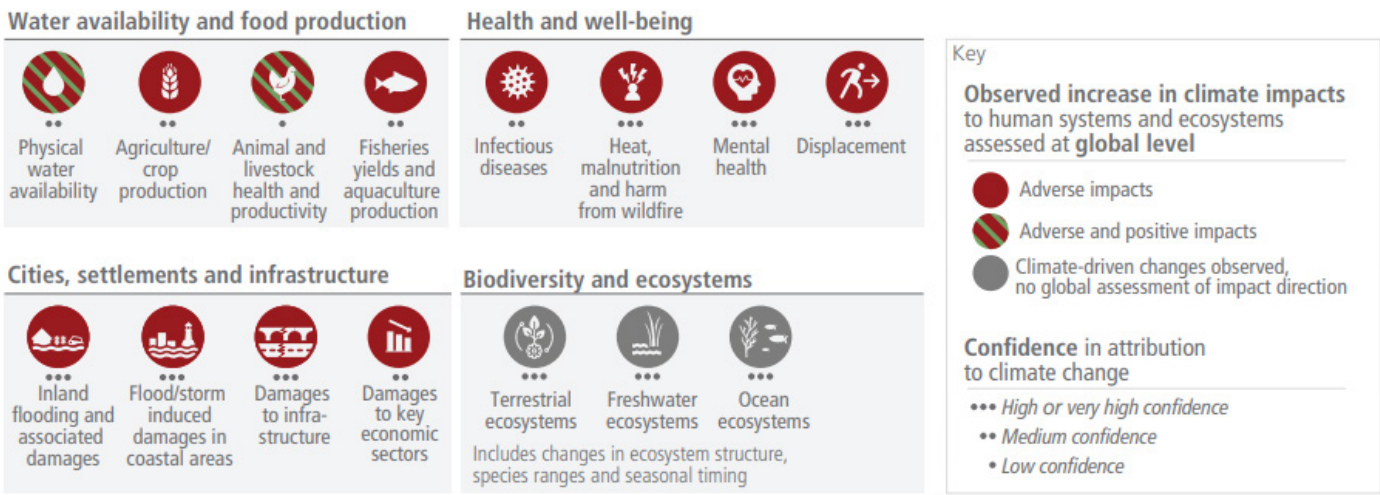


Figure 7: Adverse impacts from human-caused climate change – Observed widespread and substantial impacts and related losses and damages attributed to climate change (Figure SPM.1 (a) from IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1–34, doi: 10.59327/IPCC/AR6-9789291691647.001)

The water and food insecurity will likely exacerbate mass displacement and shifts in human migration patterns, leading to increased regional economic and social instability.

Climatic impact-drivers such as drought, wildfires, flooding, extreme weather events, accelerated thawing, glacier retreat, global sea level rise, ocean acidification, and heatwaves are attributed to human influence. Migration will also continue to be instrumentalized by authoritarian states as done by Russia and Belarus in recent years. Climate breakdown affects states' resources and may lead to social unrest, increased instability, radical movements, and terrorism.

Geoengineering is the deliberate manipulation of the Earth's climate to counteract the effects of global warming or achieve other goals. Worsening climate conditions will induce considerations for the use of multiple geoengineering technologies, which will have several short-term benefits for the global climate, but may also introduce serious ramifications as a result, thus causing international debate. The scalability of these technologies to address global warming is under debate due to the uncertainty of whether these technologies will impact the climate in unpredictable ways. Significant regulatory and governance challenges are to be anticipated, as the severity of climate breakdown will induce stakeholders to experiment with geoengineering without regards to effects on third countries.



Climate Breakdown is causing rapid and potentially catastrophic changes to the Earth's climate system, including extreme weather events, melting ice caps, rising sea levels, and disruptions to ecosystems.

Along with geoengineering, climate terrorism through ecocide, i.e. human induced disasters to enact purposeful attrition, may also become a pervasive new phenomenon in the security environment. Besides the destruction caused by cascading effects of climate breakdown, human-induced catastrophes will also emerge more frequently as new technologies outpace safety considerations. EDTs will likely enable novel strategies to exert pressure on a state or on a population's capacity, capability and will to employ the MloP.

Conventional tools may also be employed with increasing frequency to devastate vital commodities, such as arable soil, mines, plants and livestock, causing severe and/or irreversible damage to the environment. Hence, novel types of ecocide strategies may emerge as a new tool of state coercion. This was recently exemplified by the conscious destruction of croplands, mines, critical infrastructure and agricultural cargo by the Russian Federation as part of their war against Ukraine.

As the value of natural resources continues to rise, systemic disruption of vital ecosystems and services will likely increase.

Exploitation of the environment, using direct and indirect tools, will create lasting damage to the natural environment and may render areas uninhabitable. This may be further amplified by technological advancements, such as the biological engineering of diseases, which target specific natural habitats, or crops and livestock.

including the spread of emerging new infectious and zoonotic diseases, while some diseases become more resistant to antibiotics.

As a result, climate-extreme disruptions will significantly challenge states and societies across the globe. Weaker states, unable to mitigate the impact or successfully implement

climate adaptation, will become more fragile and may collapse with increasing frequency. New diplomatic and economic vulnerabilities and dependencies will emerge, enabling interference and exploitation by external actors and violent non-state actors.

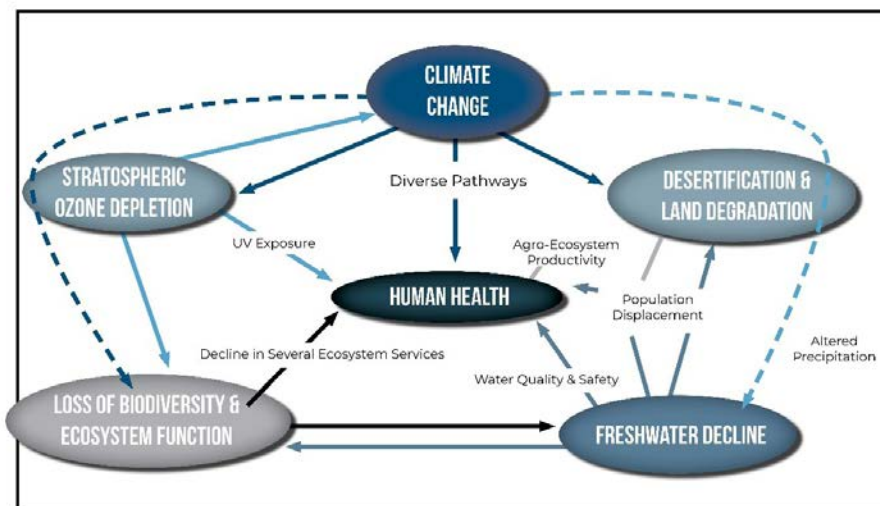


Figure 8: Extent of the loss of biodiversity is portrayed by the Living Planet Index. Source: Our World in Data.

Additional consequences of loss of biodiversity and the destabilization and/or collapse of vital ecosystems and services needed for medicinal resources, also include the emergence of new diseases and antimicrobial resistance, including non-communicable diseases, mental health and neurological disorders. This will further increase vulnerability to targeted biological effects and equally to drastic shifts in climate patterns. Future generations will face significant health challenges,

disruptions increases, narratives will play an increasing role. Likewise, nations that conduct successful, and expensive, transitions to green energy will demand the rest to follow. This may be accompanied with designs to establish novel forms of international cooperation, including assisting smaller states in their climate adaptation efforts. Others may utilize alternative narratives and promote the right to increase the development of fossil-based industries. Climate extreme disruptions will also lead to



a shift in societal behaviours, values, resiliency, and cultural norms. Notably, women, children, the elderly and marginalized groups will remain disproportionately affected by the deteriorating conditions as they are part of the blind spots in climate security and part of the most vulnerable groups in societies. The scope and scale of human migration due to climate change will test the limits of national and global governance, as well as international cooperation.

Strategic competitors may also exploit disruptive changes to undermine the security of the Alliance, such as planting false narratives on Climate Change, expanding influence through diffusion on critical technologies, or weaponizing the trade of rare materials, which are vital to green energy transition.

Climate adaptation, including decarbonization of industries, will likely require the most significant state effort in the 21st century. It may also induce the emergence of a new wave of commercial, non-state actors who can acquire dominant positions in their market segments and subsequently political influence in domestic and international affairs. Additionally, geoengineering and targeted carbon emission quotas are two likely points of tensions in the future of international affairs.

The chances of global cooperation to take deep, rapid, and sustained mitigation and accelerated adaptation actions in the near term seem to be deteriorating. Resulting instabilities may weaken states' control, inducing a rise of violent non-state actors, conflicts, and further destabilizing regional stability. Notwithstanding, increasing climate extreme disruptions and international coordination may change this in the long term however, in the short to mid-term political influence, the cost of transitioning to green energy solutions along with increased disruptions will continue to destabilize regional stability.

Potential Strategic Shocks:

1. Unexpected climate collapse in multiple countries, severely changing weather patterns and enduring life-threatening conditions, with little to no warning.
2. Increased risks from crop disease and failure in shrinking temperate zones, as extreme weather and loss of biodiversity harm legacy crops and devastate less resilient ones.
3. Sudden emergence of pandemics or collapse of biodiversity as a result of natural causes or human-induced ecocide creating lasting global crisis.
4. Activation of geoengineering of the atmosphere to create disruptive cross-border weather patterns, potentially enabling instrumentalization of the atmosphere and prompting possible pre-emptive responses or conflict.



As climate breakdown further degrades vital ecosystems and interrupts the services they provide, the demand for renewable and non-renewable resources and critical raw materials is set to increase, while the competition and dependencies for these resources become more acute. The high demand and scarcity of resources may cause a tipping point whereby competition turns into confrontation.



RESOURCE SCARCITY DRIVING INSTABILITIES

Emerging resource scarcity of both renewable and non-renewable resources and critical raw materials combined with other climate-extreme events will increase the adverse impacts across all sectors such as the agricultural, energy, social, and economic sectors and regions. This will create inequitable, compounding effects globally. As a result, detrimental effects on nature, people, and materials will continue to increase. This will instigate internal challenges such as displacement and migration, food and water insecurities, conflicts, competition, and violence. Resource scarcity will also drive deepening competition and may lead to conflict around the access to and control of these resources through indirect involvement of states in developing countries, and direct confrontation along critical supply routes or in the global commons.

While agricultural production on a global level is increasing, access remains uneven and exploited as a lever of coercion while it also continues to cause lasting challenges to human security. Increased agricultural production ensued by expanding land use, through deforestation, are causing considerable land degradation.



It is highly likely that the levels of land degradation and deforestation will continue to increase within states that lack funding or the capacity to develop sustainable agriculture and forestry. Enhanced climate-extreme disruptions and land degradation will increase instability in affected regions and will negatively impact water scarcity and lead to acute food insecurity, primarily in Africa, Asia, Central and South America, small islands, and the Arctic.

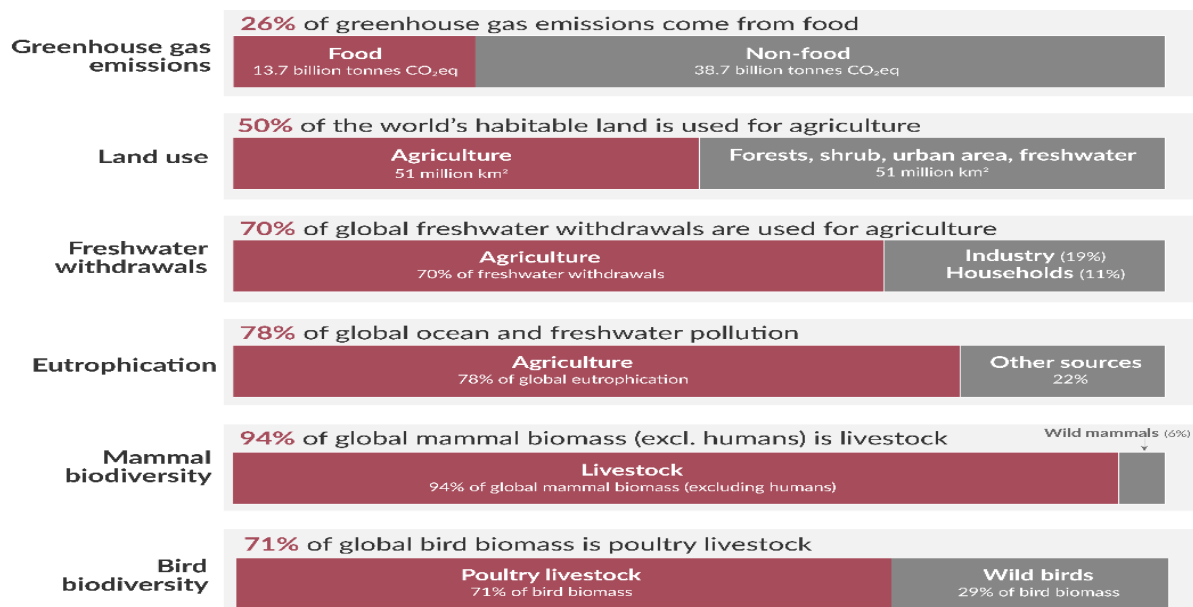
Technology transfer of smart agriculture solutions to include, AI enabled irrigation methods in dry areas, vertical farming in cities and precision agriculture as an alternative form of cultivation, like seaweed plantations, will be critical to stabilization efforts, but may likely become a subject of competition for influence.

High water stress levels (i.e. the lack of fresh water resources to meet the standard water demand) will continue to severely impact sub-Saharan Africa, the Middle East, and parts of Asia. Scarcity will be most severe in already arid climate conditions and urban areas of low-income countries, where water quality will pose an additional challenge. Urbanization, industrialization, electricity generation, exponential use of AI-driven computation, and reliance on large quantities of freshwater for cooling will further exacerbate water stress conditions. Water stressors will also likely affect most of the global population, driving instability, inequalities, discrimination, and marginalization, as well as poverty. This will create favourable conditions for external influence, transnational organized crime, gender-based violence, political violence and terrorism to emerge. Water could become the “the oil of the 21st century”, as drinking water shortages become more prevalent, together with the existing political frictions between states.

In addition, mining and processing of mineral resources, like coal, requires a substantial amount of water thus adding increased water stressors to these regions. Moreover, due to the increasing global electricity demand, electricity production still requires the need for coal mining. There are several global coal-mining hotspots.

The environmental impacts of food and agriculture

Our World
in Data



Data sources: Poore & Nemecek (2018); UN FAO; UN AQUASTAT; Bar-On et al. (2018).
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Licensed under CC BY by the author Hannah Ritchie.
Date published: November 2022.

Figure 9: The Environmental Impacts of Food and Agriculture. Source: Our World in Data

Share of electricity production from coal, 2022

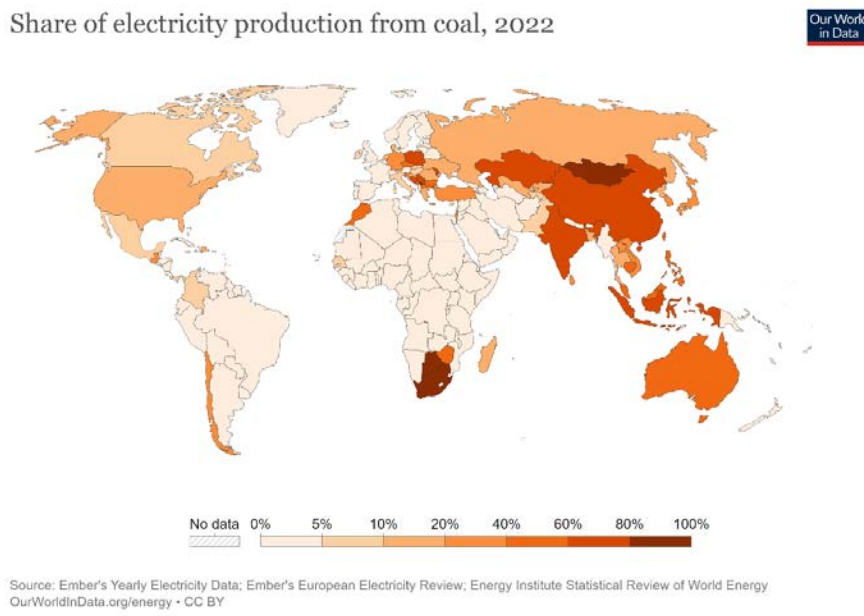


Figure 10: Share of electricity production from coal 2022. Source: Our World in Data.

Non-renewable resources will continue to deplete, exacerbating dependencies as well as vulnerabilities of states, which are not sufficiently transitioning toward alternative energy sources. Geopolitical rivalries and pervasive instability, particularly in Africa, will also shape mining patterns and access to critical resources. This will likely invite strategic competitors of the Alliance to shape the political conditions to favourably expand influence in these regions.

At the same time, states may increasingly seek ownership stakes in critical mines and attempt to build alliances with the parties controlling mining outputs. They may also, navigate trade wars as well as introduce protectionist attitudes. Violent non-state actors will attempt to access and control resource nodes in unstable regions. Instabilities and

incidences affecting trade of critical resources and commodities will continue to increase in pervasive competition and negatively impact supply chain security. This will have a further detrimental effect; trust and globalization may incentivize nations to acquire more stable sources through established economic and security spheres of influence.

The shifting behaviour to commodities and the securitization of economics will likely continue to exert challenges to both globalization and economic cooperation. Diverging economic interests will certainly challenge the cohesion of existing regional security formations and reshape patterns in international cooperation. Members of NATO will likely remain dependent on external supplies for critical rare materials and this vulnerability may be consciously targeted by potential adversaries to shape and undermine cohesion and resolve within the Alliance. Investments to improve resilience and self-reliance, such as in mining and processing industries, will require sustained efforts

on long-term and joint actions by Allies as well as on increased public-private partnerships with the commercial sector.

Green energy transition is emerging as the central tenet of the future security environment. Global cooperation in adaptive efforts towards reducing GHG and transitioning to affordable, equitable and resilient renewable green alternative energy solutions will be crucial to reaching the sustainable development goals. However, this cooperation and the subsequent transition will face challenges due to limited financial resources and the implications of pervasive competition.

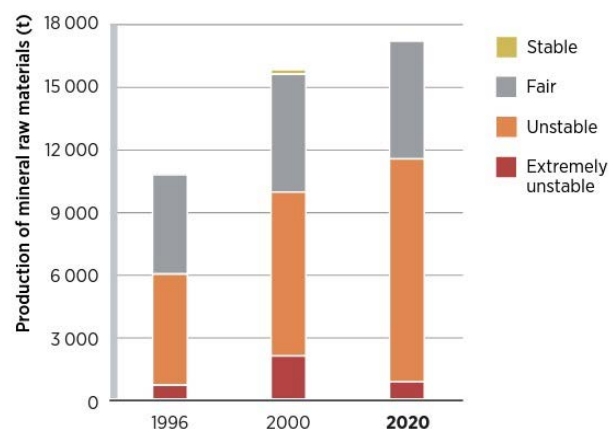


Figure 11: Political instability of mineral producing countries 2020. Source: World Mining Data 2022, (via IRENA: Geo-politics of the Energy Transition-Critical Materials, Fig 2.14).

The Green Energy Transition will challenge nation states' ability to design, develop and implement this transition as well as their capacity to afford both financial and material resources. The success of this transition will also remain dependent on open and equitable access to critical rare earth materials and technology. Equally, the GET will likely induce the enablement and emergence of powerful commercial actors with oversight on the GET supply chains and processing capacities and as a result, become a significant political influence.

The global requirement for electricity will continue to grow while many nations that currently lack optimal access to energy aim to escape from energy poverty and support their growing population and industries. The choices they make will be crucial for global decarbonization and will require an energy alternative to fossil fuel at scale. The price decline of renewable sources to fossil fuel alternatives is a promising trend. It may create economic incentives, where applicable, for mass installation of green energy plants and programs. At the same time, requirements for technology transfer, maintenance and spare parts will create new dependencies to strategic competitors of the Alliance as well.

The security of electric grids will be central for international and national stability as well as for economic and social progress. The existing grid is challenged by growing populations and evolving customer needs expanding digital and mobile data usage and AI-driven computational needs. Operational risks are also increasing primarily by cyber-attacks and the disruptive effects of extreme

climate events. Both will increase considerably. In an age of pervasive competition, electric grids (and symbiotic data networks) will become increasingly exposed to adversarial actions through the use of electromagnetic or cyber effects at scale. Natural variations compounded with climate breakdown will likely fuel extreme disruptions on a global scale. For example, a significant ejection from the Sun's magnetic field may cripple all electric systems causing chaos and economic collapse.

The most promising area for sustained success is found in the transportation sector. Global sales of electric vehicles (EV) may well show tenfold increase by 2030 and reach 50% share in the number of total vehicles. This will fundamentally transform the energy profile of transportation in most developed countries and increasingly in urban areas

worldwide. Saturation in electric cars may pressure armed forces to adapt to the emerging electrification of urban EV infrastructures. This will require advance planning and foresight in force designs.

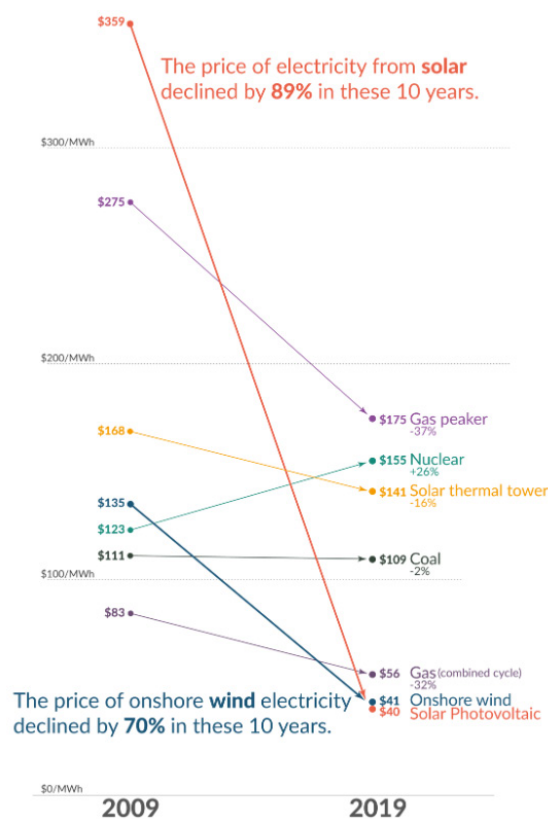


Figure 12: The price of electricity from new power plants. Source: Our World in Data.

A young woman with dark hair in many small braids is the central figure. She is wearing a black t-shirt with white speckles and a light blue denim jacket. She is holding a large, hand-painted globe in front of her. The globe has a blue ocean and green landmasses. In the background, a crowd of people is visible, some holding signs. One sign clearly says "NOT E" and another partially visible sign says "ST. ENIC". A white megaphone is also visible on the right side of the background. The entire image has a semi-transparent red overlay on the left side where the text is located.

**GREEN ENERGY
TRANSITION (GET)
WILL LIKELY MANIFEST
THE MOST ROBUST
TRANSFORMATION OF
ECONOMIES.**



Notwithstanding, successful adaptation will remain dependent on the efficiency of states and, increasingly, the contribution of non-state commercial actors.

Thus, GET will exert a highly selective pressure on states and failure to adapt will undermine national trust and cohesion, which is likely to be exploited by violent non-state actors. A rapidly unfolding scramble for exploration and exploitation of raw earth materials in the global commons will further exacerbate geopolitical tensions and communal violence, and may result in detrimental environmental impacts on vital ecosystems and potential confrontation.

Access to technologies and materials will be fundamental for state security, given the central importance of climate change mitigation and adaptation efforts to reduce GHGs, the rapid development of green energy solutions, and the new reliance on the flows of critical and rare earth materials. Efforts to secure these critical and rare materials may drive the establishment of new multilateral frameworks and security alliances.

By the end of the next 20 years, along with increasing instabilities, non-state actors may be able to control access to

critical resources or refinery processes. Additionally, non-state actors will likely possess capacities to explore and exploit hitherto inaccessible global commons for resources, especially in space, in the depths of the high seas, and at the Poles. Actors will compete for these resources in a commercialized and congested environment.

In addition to physical resources, knowledge which will be secluded from competitors in an era of pervasive competition will inadvertently become a critical resource to gain. Accordingly, it will be targeted in both the physical and virtual dimensions, with simultaneous actions.

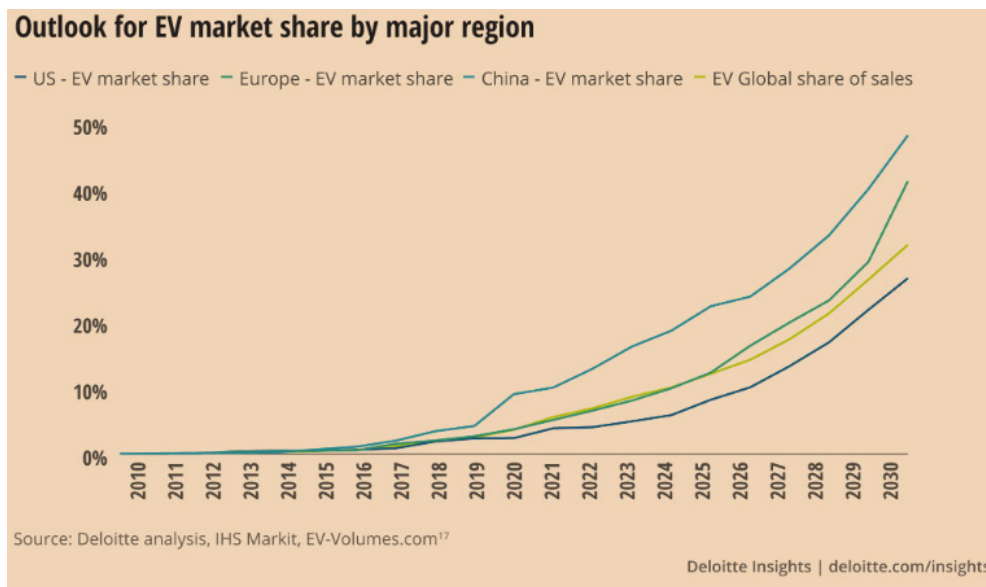


Figure 13: Electric Vehicle (EV) market share outlook out to 2030. Source: Deloitte Insights: <https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/electric-vehicle-trends-2030-2030.html>.

✓ Potential Strategic Shocks:

1. Confrontation over limited resources ('resource wars') expanding to regional and global levels, attracting major powers or security coalitions with further unintended or calculated escalations.
2. Popular movements revolting against fragile governments as a result of deteriorating environmental conditions, prompting internal conflicts, coups and regional escalation as well as major humanitarian crises.
3. The sudden emergence of vast market asymmetries, as a result of instability or export control disrupting the continuity of resource supply chains, undermining efforts of green energy transition and enhancing competition or confrontation with potential adversaries.
4. Human-induced or natural disasters leading to disruptions to electric grids, on a global scale.



AGE OF AI: EMERGING & DISRUPTIVE TECHNOLOGIES CONVERGING

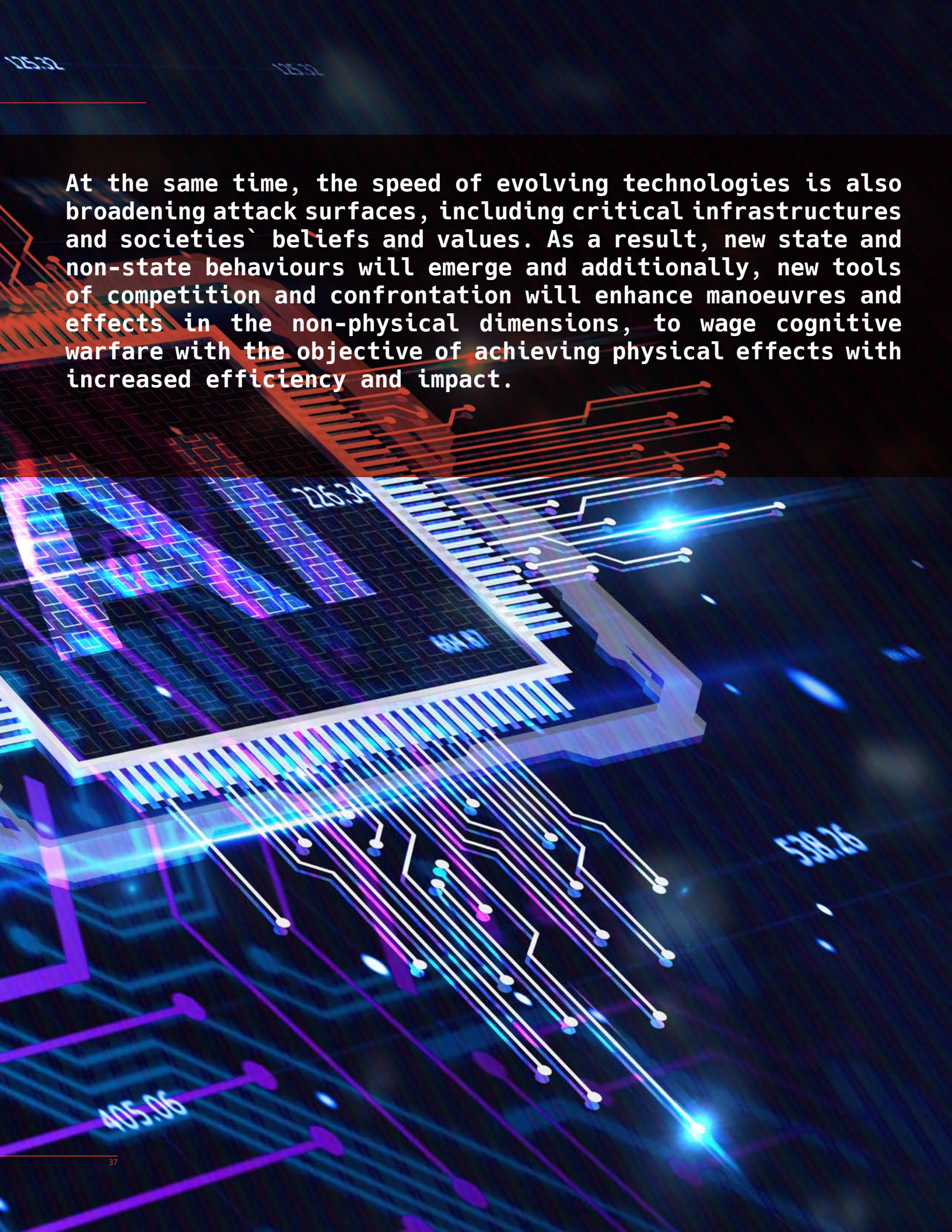


The pace of technology transformation will continue unabated. Emerging and Disruptive Technologies will present opportunities and challenges in an age where effects and enhancements will converge across multi-dimensional environments. Convergence of technology will not only be transformative on a societal level in the next 20 years but will also change the character of warfare where military capabilities are increasingly autonomous, networked, multi-domain and precise, and empowering an increasing number of actors.



The current age of innovation is marked by an unprecedented pace of change and transformation across the entire spectrum of human activities. Over the last few decades technology has rapidly evolved, while costs of entry for accessing technologies have rapidly decreased. Technological innovations will continue to transform human capabilities and provide opportunities to mitigate and adapt to a broad range of challenges from incurable diseases to climate change.

The speed, breadth, and depth of the parallel digital transformations across multiple sectors and in multiple regions are shaping new ways of development and value creation and changing the role of state and non-state actors. Within two decades, an overwhelming majority of the population will have access to the internet and mobile devices, along with virtually a limitless amount of information, while the distinction between the physical and virtual dimensions will decrease. Technology will thus enable and enhance converging effects in an emerging multi-dimensional environment (physical, cognitive and virtual domain).



At the same time, the speed of evolving technologies is also broadening attack surfaces, including critical infrastructures and societies' beliefs and values. As a result, new state and non-state behaviours will emerge and additionally, new tools of competition and confrontation will enhance manoeuvres and effects in the non-physical dimensions, to wage cognitive warfare with the objective of achieving physical effects with increased efficiency and impact.

EDTs such as AI, data, robotics, human-machine interfaces, autonomous systems, quantum technology, space technology, biotechnology, human enhancement technology, novel materials, renewable and directed energy technology, new propulsion technology, and others bring both opportunities and risks. The convergence of these scientific fields will lead to new cutting-edge discoveries with increased efficiency and productivity. As the NATO Science & Technology (S&T) Organization's latest S&T Trends 2023-2043 report explains, in the next 20 years, advanced military technologies will have four defining characteristics: they will be intelligent, interconnected, decentralized, and digital.

AI will confer prime advantage to countries incorporating AI into their existing military weapons and defence systems, while counter-AI techniques will likely emerge but struggle to keep pace. EDTs will impact escalation dynamics, cost-calculus, and diffusion of strategic power and capabilities to non-state actors. The world's most advanced militaries will be capable of producing more accurate, better connected, faster, longer-range and more destructive weapons. AI can power unmanned naval, aerial, and terrain vehicles, deploy "fire-and-forget" missile systems, use stationary systems to automate everything from personnel systems and equipment maintenance, deploy targeted swarms of smart robotic drones, inflict more devastating cyberattacks, or even deploy high-altitude nuclear bursts causing electromagnetic pulses.

Other critical EDTs, such as additive manufacturing, will potentially re-shape industry and revolutionize logistics. Additive manufacturing will likely converge with advances in AI and machine learning, big data, and advanced robotics to enable integrated manufacturing systems that respond in real-time to ad hoc challenges on demand. 3D printing will potentially drive shortened supply chains, which could facilitate regionalization, transform military logistics, introduce new capacity gains, and create new efficiencies in sustainment and readiness. State and private space companies will benefit from the 3D manufacture of parts and components of satellites that are complex and costly using traditional methods.

Quantum sensors will be capable of providing

unparalleled precision and accuracy, including detecting specific locations of a missile launch or identifying a nuclear weapon signature. Quantum technology could also create detailed maps of foreign territory, providing a military tactical planning advantage. In addition to these potential pioneering military capabilities, quantum technologies will bring ground-breaking advantages to societies. However, the high cost of quantum computing will probably increase the divide between the haves and have-nots, as only the wealthy will have access to its greatest advantages. Additionally, a quantum supercomputer will likely boost the capacity to disrupt and decrypt public key cryptography and classified information. Global financial technologies would be at risk as they rely on modern encryption methods. Some attackers are already attempting to steal encrypted data in the hopes that quantum technology will eventually make decryption possible.

While EDTs provide enhancements, the lack of oversight and governance creates significant vulnerabilities that will also lead to increased economic and societal challenges. The rapid pace of technological advancements is already outpacing existing regulations and governance frameworks, increasing complexity and confusion and complicating anticipation, understanding, attribution and response. State and non-state actors are exploring dual uses of EDTs. The research and development budgets of most authoritarian states remain hidden and so does the full extent of their technology development portfolio. It is highly likely, however, that state actors will continue to prioritize EDT development and exploitation of dual usable technologies, led by the private sector enabling them to conceal intent and capacities, and remain undetected until employment.

Strategic competitors will likely prioritize first-mover advantage and attempt to secure critical technologies, which will likely lead to decoupling in scientific research collaboration and increased volume of intelligence operations. Early adoption of EDTs is expected to confer prime advantages, particularly in areas of command and control (C2) and military decision making, while also creating risks and vulnerabilities.

Annual private investment in artificial intelligence, by focus area

Includes companies that received more than \$1.5 million in investment. This data is expressed in US dollars, adjusted for inflation.

Our World in Data

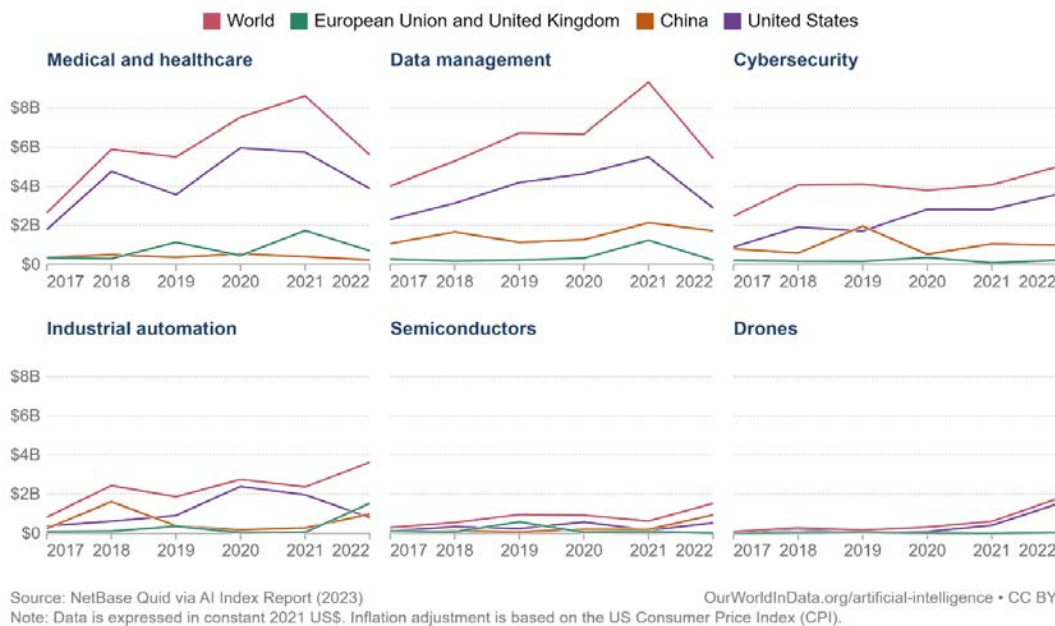


Figure 14: Annual Private investment in AI. Source: Our World in Data

The risk tolerance of desperate actors adopting new technology will likely be higher. Such actors may be in a state of disadvantageous strategic position, enduring economic, social or political crisis or imminent military defeat. The lack of mature policies, regulation and understanding in addition to ethical and moral concerns around EDTs means that societies may not fully comprehend the potential damage and disruption that the weaponization of these technologies, may cause, which could make it easier for decision-makers to deploy them without fully considering the consequences. The speed, lack of human oversight, and opacity of these systems increase the risk of escalation. As a result, in a high signal density and confused security environment, future leaders may not be able to intervene as automated attribution may trigger unplanned crisis and conflict. At the same time, adversaries with a different moral threshold may not want to.

Self-reliance in critical EDTs and developing effective counter-measures will be of foremost concern, while such capabilities will likely be attainable for only a handful of nations. Other nations may need to seek acquiring technologies through international cooperation.

For many states, transfer of technology may be used as an incentive to strengthen security partnerships and develop efficient joint capacities. Accordingly, both major state and non-state, commercial

actors could attempt to create their own alternative ecosystem of innovation and standards as technology evolves. As a result, a diverging set of standards, technologies, and ethical, legal, and social issues (ELSI) will evolve. This will likely further fragment the global technology landscape and complicate global regulation of critical technologies.

Private sector entities, with the majority of market shares in democratic countries, will continue to invest more than state-led economies in tech development, innovation, and exploitation. State and military (or defence) capabilities will likely become increasingly dependent on public-private partnership, creating reliance problems and security concerns, especially for third states. Private-public partnership will take different forms in democratic and authoritarian countries. Democracies will continue to incentivize partnership with autonomy, while autocracies will aim to obligate and control private actors. Autonomy will likely enable innovation and technology diffusion at scale, while control will provide enhanced cohesion and flexibility to use the diplomatic, information, and economic instruments of power.



Potential adversaries will also seek to erode NATO's technological edge by seeking dominance in non-traditional technological areas. These countries will likely increase the volume of research, development and experimentation. As a result, the Alliance may well lose its edge and advantage in EDT-related research in the short term.

Language and image recognition capabilities of AI systems have improved rapidly

Our World in Data

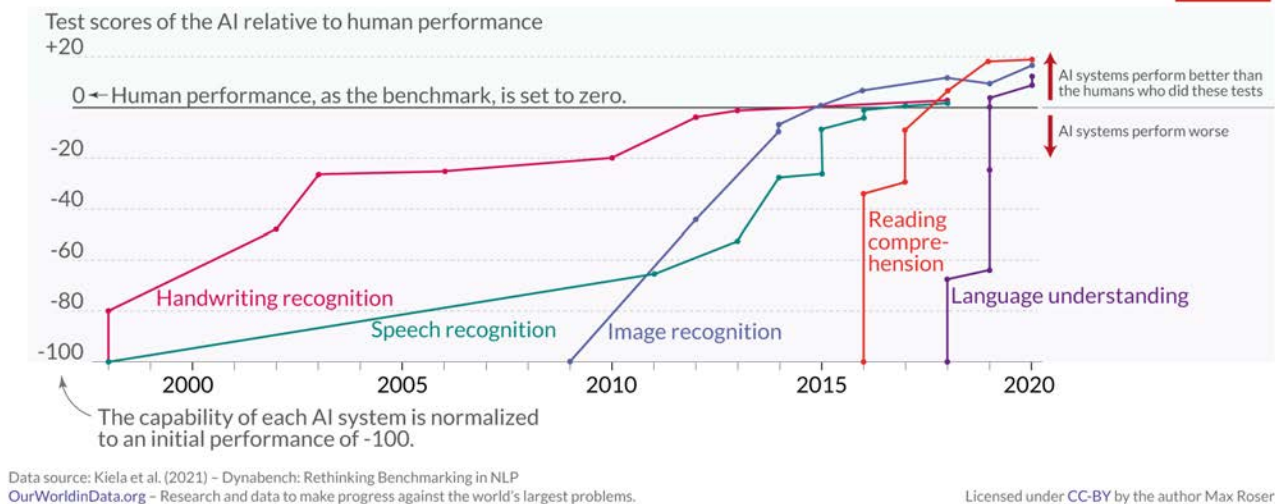


Figure 15: Language and image recognition capabilities of AI systems improvement. Source: Our World in Data.

Economic espionage will likely intensify in a pervasive competition, enabled in the virtual dimension by increasing computational capacities, and broadened attack surfaces on Allied governance and academic information infrastructure.

The prospect of confronting adversaries with a different moral threshold in their decision-making in a technology-driven conflict raises essential concerns.

The diffusion of EDT technologies will empower an increasing number of actors to contest and compete with new economies of scale and efficiency. Historical data confirms that less developed countries gain an asymmetrically larger share in modern military technologies than their Gross Domestic Product (GDP)/capita would justify, meaning that with the advent of EDT-enhanced weaponry, less developed states will also acquire shares from novel technologies. This is further confirmed by the expansive use of intelligent and networked loitering weapons and other forms or by remote violence by developing states and non-state actors.

Accordingly, the accelerating pace of technological advancement increases the risk of a "technology surprise" potentially from all actors, states and non-states alike. Additionally, non-state actors that have fewer resources than states will increasingly adopt dual-use AI technologies as they are cheaper, commercially available, and help them overcome

capability asymmetries vis-à-vis state actors.

Non-state actors, including terrorist and ethnic rebel groups, have already begun using AI-enabled drones to transport drugs or initiate attacks. Non-state actors will also increasingly benefit from 3D printing, biotechnologies, small warheads, and cheaper space capabilities, particularly as these technologies converge to confer greater advantages. AI technologies will likely make terrorist communications and networks more efficient, providing the capability to galvanize larger numbers of people globally. Recruitment propaganda will focus on exploiting young people and their feelings of disconnection, promising community, opportunity, and money. Conversely, the ability to track and intercept communications will increase, forcing these networks to use less regulated platforms like the dark web. This will in turn further fragment cyberspace. In the Middle East and North Africa (MENA) region, terrorists use social media, encryption technologies, and portable satellite technologies to plan and coordinate attacks. EDTs will potentially increase the lethality of coordinated attacks, offering greater accuracy and the need for fewer people.

Some actors may seek to intentionally trigger crises, with the use of EDTs. For example, generative AI's within next-generation social media networks will make it increasingly cost-effective to create confusion at scale using AI generated content to produce disinformation or shape opinion. Countermeasures will need to be AI driven and will become more time-consuming to deploy and difficult

to manage as the threats evolve. As a result, EDTs can mobilize underlying societal tensions and create instability. Employment of EDTs will further facilitate the generation of both enduring and disposable social movements and novel ideologies. As convergent effects coupled with the accelerated diffusion of these technologies, the barriers, including the cost of entry, will decrease and thus enhance the connections of actors in the non-physical (virtual and cognitive) dimensions. Those may be characterized by reliable, continuously collected information, supported by hyper-connected, as well as autonomously generated information by distributed human networks. However, with advent of Generative AI, it may also add confusion by polluting the entire information environment with false and unreliable data.

Long-distance strike capabilities are becoming more cost-effective and accessible. Cross-border rocket, missile, and drone events will continue to occur in peacetime, likely increase in general, and constitute a considerable challenge to states and societies. In the physical dimension, weapons systems and strike capabilities will be enhanced by the high signal density of integrated sensors and the capacity to strike at extended ranges, adding more complexity to an already congested operating environment. This challenges the Alliance's edge to act within severely compressed timelines, notably through space and cyber capabilities and missile and drone technologies through electromagnetic effects such as electromagnetic jamming. Armed forces will still balance mass and technology, quantity and quality, but the characteristics of modern conflict will be enhanced by a range of commercial and dual-use technologies and evolving tactics in electronic warfare. The ability to coordinate state and non-state capacities within the congested operating environment with a high tolerance to surprises and attrition, as well as the resolve to sustain efforts will be vital to winning in future wars.

With the accelerating rate of changes and disruptions posed by EDTs, regulation of standards and practices will become imperative. Such efforts should extend to setting ethical standards and norms, including at the international level, promoting accountability and responsibility, and enhance arms control practices to address dual useable researches and technologies. The absence of global

cooperation as well as enduring and actionable measures could lead to a future where the uncontrolled deployment of these technologies threatens peace, security, and the values we hold dear. Bioengineering advances are opening new terrain for challenging philosophical, political, and economic questions, as well as providing novel military capabilities including bio-manufacturing and human enhancement.

Preceding generations of technology will become obsolete at faster rates, disrupting the practices of employing those technologies as well as the ELM – (Elaboration Likelihood Model) frameworks meant to regulate them. Adaptation will likely be driven by non-state commercial actors, technology empowered super-wealthy individuals, and smaller tech-aware segments of the societies. Most nations, their technology infrastructures, and the majority of people in global societies will be less capable of adapting to the accelerating pace of change. The rate of technology adaptation will vary significantly within and between nations and within societies. Age and gender also determine access to advancements in technology. Armed forces will likely struggle to keep pace with the speed of development, especially in the non-traditional and cross-domain capabilities.

Adoption of disruptive technologies will impact traditional industries and job markets, likely leading to economic dislocation and unemployment for specific sectors of the workforce. Many new jobs will require technical acumen from workers who may need to retrain and learn new skills. A digitally interconnected world will search for a balance between the benefits and threats of open networks, whilst dealing with new cyber and information threats unseen before.

Technology acceptance will emerge as a decisive prerequisite of adopting new technologies. Its rate of adoption will be a key element of technological advantage and resilience amidst geopolitical and geoeconomic competition. Individual acceptance will be influenced by the ease of use (like human-machine interface), the trust in the systems (challenged by cybercrime), and accessibility (technology development inequalities), among other factors.

Potential Strategic Shocks:

1. Significant political or social unrest triggered by the uncontrolled spread of misinformation, disinformation as a result of AI, big data, and advanced language models.
2. The lack of human oversight and the speed of highly interconnected and automated systems triggering escalation or unintended crises due to highly interconnected systems, operating in a confused security environment.
3. Unanticipated use of any Emerging or Disruptive Technology (EDT) to gain strategic advantage in anticipation of imminent confrontation.
4. Enduring and successfully concealed employment of any EDT with effects of mass destruction.



Economic activity across the globe continues to shift towards Asia whilst established economic systems and global division of labour is still transforming, due to security concerns, digital transformation and rapidly evolving manufacturing and production innovations. Pervasive competition is unfolding amidst major shocks to the global economy. This fuels an increasing level of polarization when both states and the private sector face global decoupling, with weaker states choosing or being coerced between systems, while states authority is being challenged with trust issues that become harder to address.



GEOECONOMICS FUELLING POLARIZATION

Over the next 20 years, several geoeconomic trends are expected to shape the global landscape. In a fragmented world, the erosion of the RBIO, heightened geopolitical rivalries, trade and supply re-shoring, technological competition and economic interests will likely drive regionalization and the solidification of geoeconomic blocs with significant implications. Firstly, it will weaken globalization, resulting in slower economic growth, increasing costs to supply chain security and reducing economy of scale for innovation. Secondly, assertive powers will strive to internationalize currency to mitigate potential risks associated with the dominance of the US dollar, albeit this process will take time and has seen limited success thus far. Thirdly, major strategic competitors will increase attempts to establish norms and technological standards that might lead divergence from western standards. Fourthly, developing countries may be compelled to take sides to gain market access, foreign direct investment, technology transfer and aid, leading to alignment of their financial systems with their respective protectors.



The world is thus witnessing the emergence of geoeconomic blocs further fuelling polarization. This shift is driven by security concerns as democracies aim to cut reliance on autocratic countries' supply chains, while autocracies fear democratic influences. While the growth in globalization of digital services will likely continue, global trade seems to have plateaued, with narrow prospects to support a steady globalization. Dynamics leading to polarization have been accelerating as a result of recent shocks and instabilities. Self-sufficiency is emerging as a critical concern.

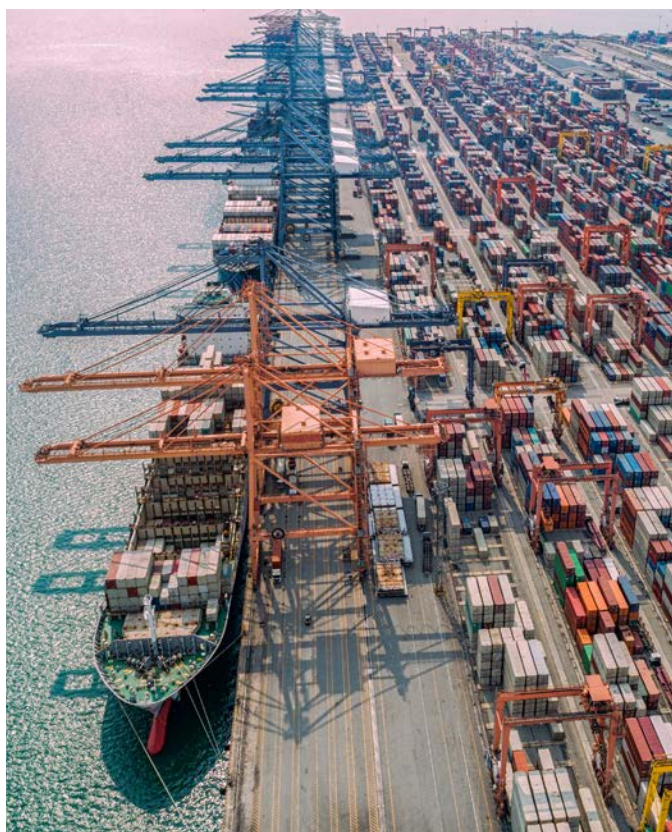
China, for its part, aims to become self-reliant in critical areas, creating the capacity to function independently, particularly in times of crisis and confrontation. Other states with regional influence may follow suit in the future, contributing to further fragmentation of the global economic systems. However, there are challenges to complete decoupling, including economic and market interests, influence of commercial actors and daunting costs. Russia is decoupled from Allied countries to a large extent, but it shows intent and capacity to re-enter global economics through the Chinese and other states markets. The securitization of economics demonstrates a shifting behaviour of actors facing strategic shocks and key uncertainties.

Global economic activity has also been shifting toward Asia in the past two decades, reflecting its higher rate of economic growth in comparison with the rest of the world. The share of Asian countries in the global economic system will continue to increase. Some of the most populous countries in Asia are positioned to be among the world's largest economies in the forthcoming decades.



The share of European Allies' global consumption will continue to shrink. At the same time economic forecasts show that Asian economies, especially China and India are likely to grow faster than the western world, even though the growth is expected to be lower than in prior decades.

In addition, the fourth industrial revolution (i.e. the ongoing automation of traditional manufacturing and industrial practices using modern innovative technology, fusing physical and digital systems) creates novel opportunities and challenges, as well as new dependencies. These are also driving towards more regionalized economies and securitized supply chains. In a fragmenting trade environment, supply chain security, transparency, and resilience emerge as a key concern. This will likely promote further protectionist measures to manage risks. In turn, further fragmentation of global trade of key commodities and technologies will increase. Such dynamics can reduce incentives for global cooperation and enhance the formation of polarized, solid regional ecosystems.



New achievements of the fourth industrial revolution, like additive manufacturing, smart agriculture, space technology, and digital transformation will be key driving factors in shaping wealth and economic power. The efficiency of industrial processes will grow as a result of the fusion of digital and physical systems of manufacturing tools, digital codes, energy consumption, raw material and processing capacities. Early adoption of novel technologies to national industries can offer novel ways to adapt to climate breakdown.

Access to these technologies may emerge as a prominent objective of state politics and, equally, become part of diplomatic and economic IoP. Likewise, additive manufacturing will enable localized production through 3D printing and likely assist resilience against economic coercion, but it also may impact global trade significantly once operations become mainstream. Near-sourcing and automatization of logistics will further accelerate localization. Consumer demands as well as political requirements for locally sourced products may further reinforce this trend. Additionally, the space industry will both benefit from and drive the next industrial technology revolution and will likely be led by agile, adaptable, and scalable commercial sector capacities.

Technology, demographics and the availability of a skilled work force will significantly shape the speed, scale and efficiency of economic policies and growth of the industrial transformation. Declining birth rates and ageing

populations will impact most high- and middle-income countries. Consequences will likely transform economies, and heavily impact politics, social norms and values. For example, negative demographic trends of an unskilled workforce and ageing populations may pose limitations to economic output and innovation. Thus, a higher expenditure on healthcare and welfare will compete with defence budgets. Heavily affected countries may struggle to recruit a sufficient quality and quantity of workforce

in peacetime, as well as to mobilize their economic and military complexes in times of crisis. Such trends will further incentivize automation.

A resulting need for (legal) migration and various pull-factors for a additional workforce in developed countries can unfold the potential where benefits outweigh the costs for new

migrants. Origin countries will likely experience mixed effects as well, that range from critical skill and qualified workforce gaps to a decrease in unemployment.

In NATO's neighbourhood, the population of low-income states will continue to grow steadily during the next decades. These states will also face daunting challenges posed by climate change and increasing frequency of instabilities.

Irregular migration amplified by other instabilities will continue to be a major source of demographic shifts in populations. It will also enhance illegal human trafficking, empower criminal networks and non-state violent actors and undermine state stability, resulting in domestic and

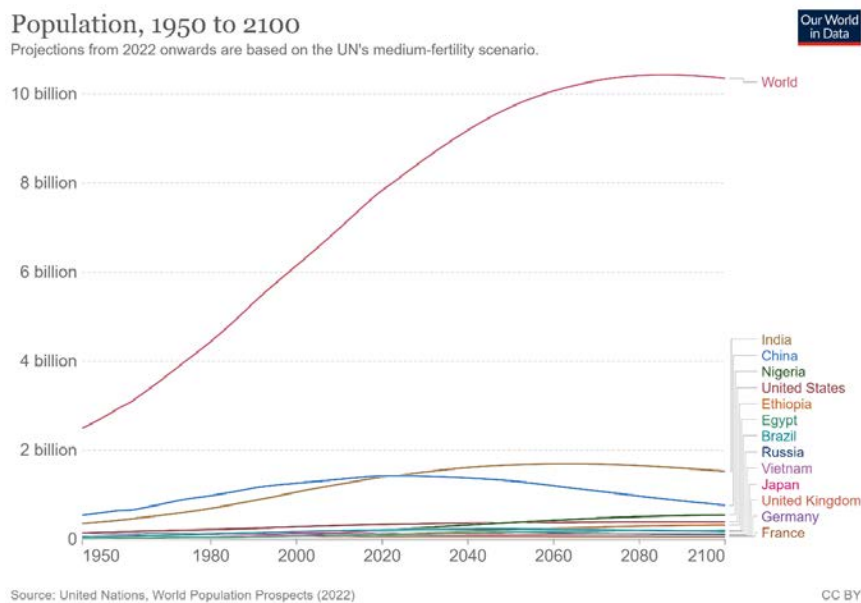


Figure 17: Projected global population growth. Source: Our World in Data.

political disputes, and extreme international conflict.

Tackling irregular migration will increase in scale and remain a foremost challenge for developed states. Additionally, the instrumentalization of migration will also remain highly likely, as done by Russia and Belarus as part of hybrid actions targeted against Allies and Partners of the Alliance for political purposes.

Rising national debts and prolonged stagflation may limit states, especially low- and middle-income countries, to drive effective digital and industrial transformation, sustain and develop education and welfare, and create climate resilience. Incremental debt services may reduce states' abilities to re-allocate resources to resilience, readiness, and defence. The current rate of lending, as an economic means to increase influence, may be curbed in the short term and might be replaced with the transfer of technology and manufacturing processes.

Fragmented economic systems, especially in developing countries, coupled with inequitable access to goods, products, and technologies will continue to boost informal economies. These trends will likely continue to undermine state authority, enhance illicit networks, and exploit women, children, and marginalized communities.

The global financial system will also be impacted by technology developments and pervasive competition in digital finances, cryptocurrencies, and block-chain-based transactions which may increase the share of informal transactions. The dollar-based international financial system may be challenged, as is already the case, leading to multiple financial systems in the wake of the already visible decoupling of economies and trade. Trust will remain a fundamental element of financial transactions, but emerging informal and simultaneous financial systems may undermine it. Sanctions may lose

efficiencies in a decoupling global economy, while the potential for economic coercion will likely increase.

Isolated and fragile states will likely miss the fourth industrial revolution, digital transformation, smart solutions and the productivity gains it promises. At the same time, these actors may likely be able to acquire, retain and enhance offensive cyber capabilities and novel disruptive means at acceptable costs. Incentives for such actor to disrupt these developed digital and economic networks will likely increase in parallel, especially in an era of pervasive competition with an eroding rules-based international order. These actors, as well as potential adversaries may seek preventive strikes against physical infrastructure and persistent targeting of tech industry individuals and firms to inhibit the progress or seize the technology of other states. Additionally, the widening gap in AI acceptance for manufacturing and production of goods between already technologically advanced countries and those lagging will create massive trade imbalances as the latter continues to be structurally outcompeted by increasingly efficient advanced economies.

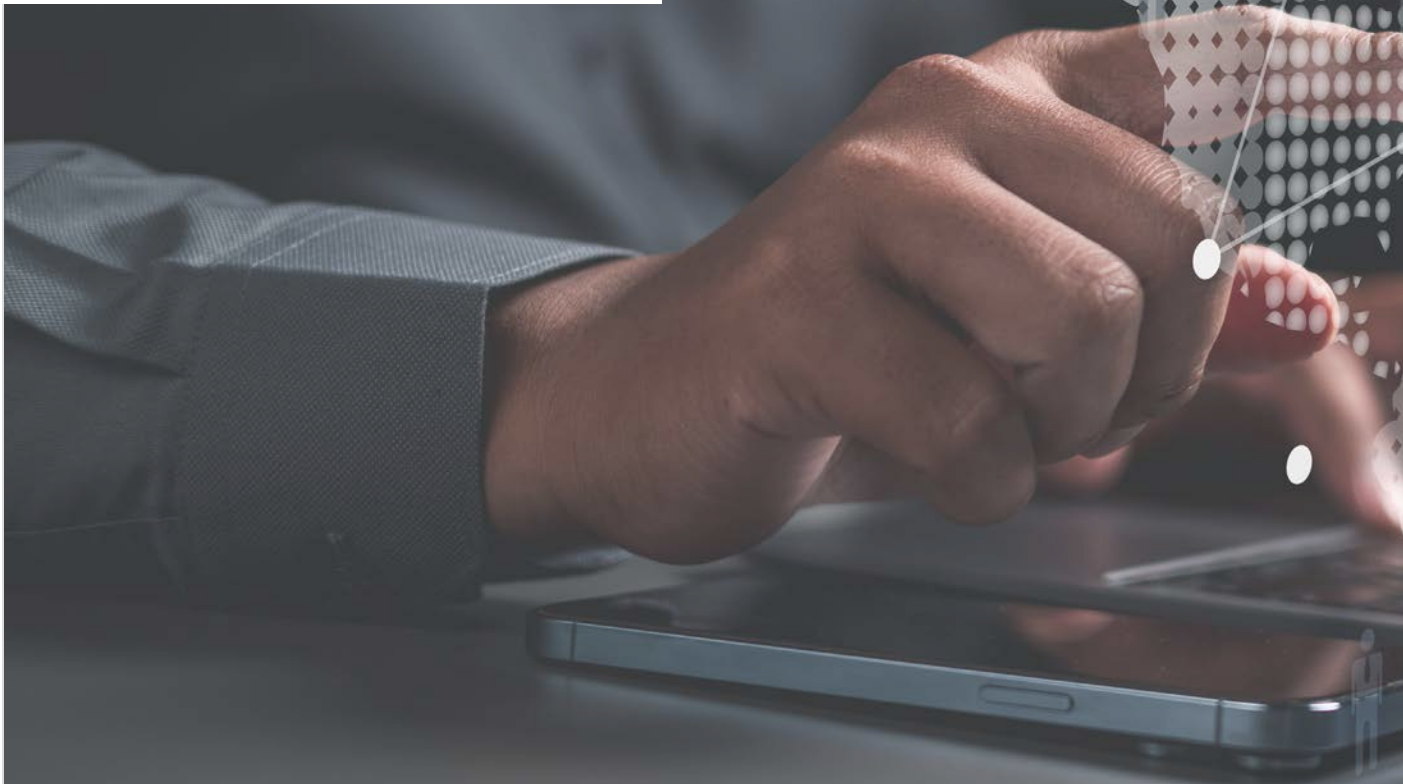
Technology developments, the industrial revolution and pervasive competition will continue to drive the emergence of geoeconomic blocs and more self-reliant regional ecosystems with significant consequences. It will likely weaken globalization, leading to reduced growth and innovation. China may seek to internationalize its currency to lessen risks associated with the US dollar and promote an alternative economic system globally. Technological standards may also increasingly diverge. While the internet will likely remain global, and thus, digital services as well, an increasing number of countries may attempt to create 'security safe zones' which will enable them to control more segments of the global web.

✓ Potential Strategic Shocks:

1. Major supply chain shock resulting from regional conflict, denied access to resource nodes, or severe trade prohibitions.
2. Actors introducing an export ban on critical rare earth materials or energy resources in a concerted and coordinated fashion.
3. Isolated states conducting disruptive strikes against digital and economic global systems causing global shock in telecommunication, supply flows and industrial activity.
4. Alternative financial systems emerging and gathering increasing support.



HUMAN NETWORKS EMPOWERED



Technology accelerates interconnectivity within groups and individuals increasing their influence in the security environment. It empowers them to pursue their objectives independently from and sometimes in contradiction with state actors. Human networks' ability to adapt rapidly, makes them formidable allies, or foes in the future security environment.



Human networks (i.e. a complex set of interconnected relationships that facilitate information exchange, collaboration and resource-sharing) will continue to transform in both the digital and physical realms, achieving new scales of efficiency but also new behavioural patterns as a result of technology enablement. For example, immersive digital communication tools will allow more efficient global collaboration, thereby untangling social groups from geographical boundaries and traditional institutions and values like state and patriotism. The role of AI assistance may transform inter-personal trust and patterns of reliance between individuals and groups. Future human networks will likely continue to decentralize, innovate solutions autonomously, and providing effective governance solutions for their specific problems, potentially vying to defy control of traditional, hierarchical institutions. These developments may create increasing challenges to the existing geography-bounded governance frameworks and ultimately the states themselves. The traditional role of states and international relations will likely be challenged by new, networked non-state actors and their improving agility, scalability and resiliency in the face of disruptive changes.



As the key resource for these networks will likely become the ability to transmit and the capacity to protect data; digital and physical security will likely continue to converge. This will necessitate new capabilities to protect national and Allied cohesion, as well as the morale and efficiency of centralized structures like states and armed forces.

Traditional categories of state-provided security might also be blurred from the cyberspace to the physical world, between the public and the private, between conflict and crime, between the domestic and the international. In any event, the commercial sector will play a crucial role in both supporting state security and building resilience within society. Commercial services will augment and could replace state services. They will likely prove agile, adaptable and scale efficiently. Non-state actors' capacities and influence will grow as private and illicit networks and social groups will adapt better, albeit with high attrition rates. Modern tools of connectivity and technology will enable organized networks that operate across national boundaries. These networks will often prove more efficient than traditional state actors in mobilizing resources and exploiting and disseminating information. The commercial sector will continue to dominate innovation, research, and development in democratic countries.

Diffusion of ideas and beliefs through globalized networks will continue to foster economic and productivity growth, but also polarization and ideological fragmentation. Technology and social media will play a significant role in this trend, empowering human networks, enabling activism, and redefining concepts of virtual violence.

Additionally, exponential and disruptive changes in technology are emerging, re-shaping the characteristics of violent non-state actors in human networks. These new patterns of the fourth industrial revolution are driven by automation and additive manufacturing, the expansion and transformation of the information environment, and the cyber domain.

These dynamics, coupled with the diffusion of technology and violence, are empowering groups and individuals while increasing fragmentation and inequality. Terrorist organizations and violent non-state actors are increasingly enabled by new technologies and able to operate autonomously in strategic distances, shaping and contesting states and societies across vast geographical regions. Their expansion is also driven by a fractured and fragmented human landscape, fuelled primarily by climate disruption, especially in Africa, the Middle East and Asia, as well as increasing poverty and inequality. The inability of the state to respond efficiently to these challenges is providing further opportunities to strategic competitors and non-state violent actors to exploit state vulnerabilities.



Figure 18: Improving capabilities: Timeline of images generated by AI. Source: Our World in Data.

As advanced technology will offer an expanding range of solutions for remote violence it will also enhance deniability in the congested physical and boundless, non-physical dimensions. This will increase incentives for a wide range of actors to exploit innovations and exert violence in pursuit of strategic objectives. In this sense, modern technologies will empower individuals and create an environment of pervasive threats. Civilian uses of these technologies will allow many more actors to have access to their development, design, acquisition, and use than the closed-loop development of specific weapon systems. In this context, connectivity and technology enablement will continue to empower violent non-state actors and terrorist groups. AI will enable terrorist networks to galvanize larger numbers of people globally and exploit social grievances more effectively. Recruitment propaganda will focus on exploiting young people and their feelings of disconnection. Violent non-state actors are already early adopters of EDT and will exploit opportunities to expand their networks and influence. Their capacity to use social media, encryption technologies, and portable satellite technologies to plan and coordinate attacks will further increase. With the advancement and widespread use of technology, and in the absence of strong international cooperation, violence will likely increase, especially in areas of instability or conflict.

Private actors will also emerge as critical enablers, and their capacities may be integrated into military operations with increasing frequency and impact. Future armed forces are unlikely to maximize their capabilities without significant commercial support from private partners. As a result, composite civil-military capability packages may become prevalent. Service providers will participate through the entire capability value chain. However, while commercial services could become indispensable, states must address concerns about reliability and attribution of commercial effects prior to realizing their full potential to contribute to military operations.

The wealthiest 1% of the population will continue to accumulate wealth, power, and influence. Technology-enabled super wealthy individuals will increasingly influence international relations and state affairs, to the point of contesting the power and responsibilities of states. At the same time,

inequalities are on the rise. Shocks and instabilities will further exacerbate inequality, resulting in social unrest, populism, violation of human rights and potential negative consequences for the world economy and the state authority.

Private actors will also emerge as critical enablers, and their capacities may be integrated into military operations with increasing frequency and impact. Future armed forces are unlikely to maximize their capabilities without significant commercial support from private partners.

The ability to generate data, conduct distributed actions, innovate solutions, and support state services fosters societal resilience. Human networks are becoming crucial in an increasingly fragmented security environment. Hence, these networks will be targeted in the cognitive and virtual dimensions prior to and during future conflicts. These targeting efforts will include influencing mobilization and contesting human networks. Such manoeuvres and effects

will become cheaper and more robust due to growing connectivity and AI-enabled information campaigns. As human interactions become more networked, the instruments of national power will gain enhanced range, speed, scale, and impact. This could lead to strategic surprises and converging effects across physical, cognitive, and virtual dimensions. Strategic shaping and effects will likely begin during peacetime, often designed to stay below response thresholds and avoid full-scale war. Providing protection and enhancing resilience for human networks in the virtual and cognitive dimensions may well become a most significant challenge for Allied states.

Human networks will continue to concentrate in urban areas, constituting centres of wealth, innovation and progress as well as political, economic, and symbolic power. Urban areas will account for two-thirds of the population globally, and predicted to peak at approximately 10 billion by 2050. Cities will also constitute

highly complex, congested, and heterogeneous operating environments fusing all IoPs and all actors in compressed physical spaces. Megacities will continue to grow as global hubs. However, their challenges will also deepen from the cascading effects of climate breakdown, resource scarcity, supply chains shocks, increased exposure to unsanitary conditions, diseases and lack of adequate health services.

Africa will likely surpass other continents in urbanization, with increasingly miserable living conditions and slummification in the absence of sustainable economic growth. This will further enhance inequality and disenfranchisement of the population, empowering illicit networks.

Most cities and megacities will steadily continue to increase energy consumption and accelerate human-induced climate change within the next 20 years. Diseases will emerge and spread in these congested and condensed human

networks more rapidly, with heightened risks to population and challenges to authorities.

As the power of major cities continues to grow, their interests may diverge from the general interest of the

Developing countries in South Asia and Sub-Saharan Africa will account for almost all global population growth during the coming decades. However, it may not be able to provide the necessary infrastructure

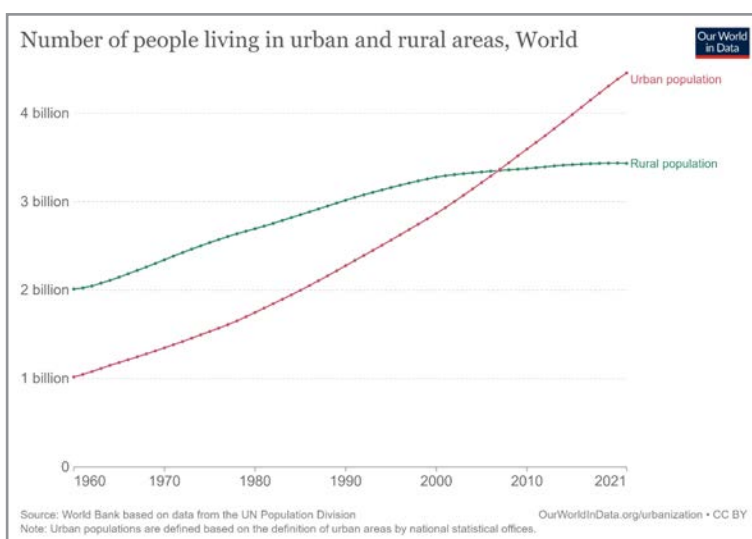


Figure 19: Evolution of population by degree of urbanization. Source: Our World in Data.

state. Robust cities with the willingness to achieve greater autonomy may complicate international affairs by enacting para-state functioning and diplomacy. An increasing urban-rural divide will further exacerbate tensions at the intra-state level.

and education systems while rapidly urbanizing at the same time. Already existing youth bulges contribute to social unpredictability and widen the distance between a young population and their governments that lack the ability to connect with them.



“

Changes in beliefs will continue to shape values in the future. Economic and political challenges, such as inequality and polarization, may lead to a reorientation of values and the rise of extreme ideologies. Disinformation and downplaying of scientific knowledge by certain parties may expedite this shift. Ethical and psychosocial questions along with lifestyle choices will gain prominence in public discourse, particularly in developed countries.

”

User generated content will increase exponentially, creating density and congestion of information. New waves of general-purpose technologies and the continued diffusion of the internet will enable expanding content creation. This could lead to the democratization of opinions but could also lead to a mounting increase in biased content and mass disinformation. The expanding volume of information will lead to ambiguity, challenging the ability to distinguish fact and fiction. The weaponization of public opinion through cognitive warfare involves creating narratives and fuelling emotions, perceptions and opinions; the human mind becomes the battlefield. States and non-state actors will strive and likely become enabled to efficiently create confusion and a state of ambiguity between fact and fiction. Mobilization of populations against the values and systems of government through manipulation, subversion, influence and destabilization are the fundamental goals of actors waging cognitive warfare.

Distributed generation of disinformation is a significant concern in the emerging age of AI. Using sophisticated AI tools, it is becoming increasingly challenging to distinguish fact from mis- and disinformation. While AI can be mobilized to reinforce democracy, it also can be used to undermine it. However, AI models can also be used to detect false or misleading information and recognize the tactics used by social media bots in spreading disinformation. This includes the exploitation of children through AI-generated images and targeted campaigns of online violence against minorities as well as female political leaders to sow internal conflict and weaken confidence in government.

There are likely connections between increasing digital disinformation and rising numbers of youth violence, school shootings, and terrorism across the globe. The potential of AI-based disinformation to wield disruptive effects to shape politics, as well as elite and public perceptions, is considerable and it will likely be used extensively to expand instabilities as well as to shape and undermine NATO and Allied cohesion and the willingness to act.

Widespread employment of AI will also enable mobilization of networks and social movements. Interconnectedness, shifting values, misinformation and AI will likely proliferate social movements, which will evolve around an ideology but will be aimed at a political objective. Such social movements exist globally today and gain prominence via social networking technology, connecting a wide variety of people from diverse backgrounds and societies. It is highly likely that this application of technology will be used more frequently by political, socioeconomic, and non-state actors and groups in the future to generate disposable as well as enduring social movements in both physical and non-physical domains.

Additionally, gaming is increasingly influencing the cognitive and physical skills of the new generations such as decision making, problem solving, spatial awareness and social skills. Social media and its future formats, including virtual and augmented reality, will play a significant role in amplifying the influence of global social movements. The current social media penetration worldwide is around 60%, which will evolve significantly, for example, as the developing countries in Africa and elsewhere catch up, and growth in India reaches its full potential. Projected demographic shifts will increase the social media penetration growth, as the developing

countries with the current low rates are also the ones with the fastest growing youth population. Universal access to the internet as a fundamental human right by 2030 may therefore also boost the vulnerabilities resulting from newly accessible networks.

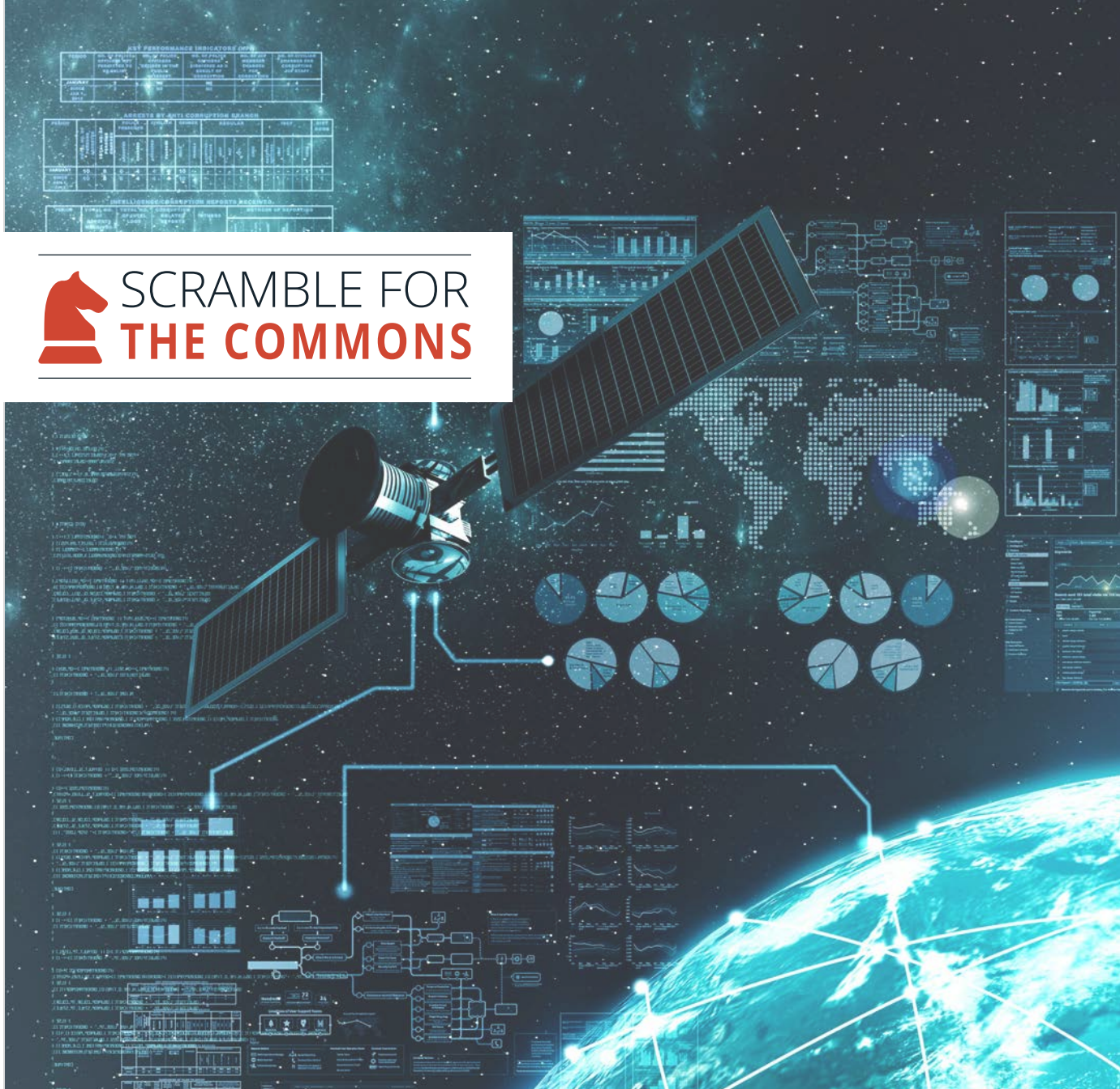
Virtual and augmented reality will initially dominate gaming and entertainment but extend to various fields like learning, healthcare, work, and more. Privacy, data influence, and maintaining a sense of reality will pose challenges. Breakthroughs are possible by the end of the next 20 years and people will adapt to mixed realities with interactive holograms. More people are turning toward like-minded and familiar groups for social encounters, community and security, leaving behind their traditional social habitats without being limited by geographic location or national borders. This creates micro societies and cultures which can enhance confirmation biases and perceptions that feeds extremism and polarization.

Crowdsourcing is becoming a widely adopted production and problem-solving model across various projects. It leverages human networks' collective intelligence and versatility to foster knowledge creation and innovative solutions. With increasing digitalization and expansion of global services, crowdsourcing may be mobilized to improve physical and virtual resilience, conduct cyber and cognitive and virtual operations and crowd sensing and ensure alternative supply chains to armed forces.

Trust in governments varies among states, but shows signs of decreasing, potentially undermining national cohesion and resilience. For this reason, trust will be increasingly targeted in the cognitive and virtual dimensions by adversaries and social groups may be used as proxies to undermine national cohesion.

Potential Strategic Shocks:

1. Non-state actors openly and declaratively contesting and challenging state authority, or replacing state responsibility in critical services, or acting in the state's stead in international affairs. This may include the sudden removal of any previously provided commercial enabler from a state leading to critical reliance concerns and counteractions.
2. Winning a conflict without fighting through successfully shaping and contesting within the cognitive and virtual dimensions, collapsing national cohesion and severing the military instrument from the society.
3. The exponential spread of any emerging norm, belief, idea, technology or disease across the global human networks.
4. Collapse of a megacity.



SCRAMBLE FOR THE COMMONS

Pervasive competition as well as depletion and uneven access of existing resources will drive actors towards the insufficiently governed global commons. Actors will explore and exploit these commons to gain strategic advantage, control or deny access to contest and, if needed, confront. This scramble will require stronger reliance on non-state actors and will be driven by commercial capacities.



As a defining change of the next 20 years, structural forces will make global commons more accessible. Climate breakdown will enable access and push competition towards the global poles, and it will necessitate the eventual geoengineering of the atmosphere. Technology empowerment opens cyberspace for the vast human population, while innovation and decreasing technology costs will throttle exponentially, increasing the number of actors to the space. In the absence of efficient global cooperation, however, these 'new frontiers' will remain insufficiently governed and ripe for competition, for strategic advantages and new resources. State and non-state actors will scramble in the commons to explore and exploit physical and non-physical dimensions alike.



The Arctic and Antarctica are emerging as key strategic focal points of the global commons. They will become more integral to global economies, primarily due to the effects of climate breakdown.

As the regions transform at an unprecedented rate, and cyberspace, as well as the Arctic and Antarctica. Access to these commons will remain fundamental for sustaining global trade, transportation, energy, and food security, as well as digital communication. In the absence of adequate regulation, the global commons will likely become an essential theatre of competition.

The high seas, especially areas beyond national jurisdiction, will experience contestation and confrontation of actors to control trade and natural resources. Blockades and interdiction will be further enabled by unmanned naval drones (initially surface vessels and later submerged unmanned vehicles as well), increased sensor density and satellite imagery, swarming or loitering use of unmanned aerial vehicles,

stand-off precision weapons, and electromagnetic jamming.

Competing claims over internationally disputed territories will likely occur with increasing frequency. Actors will aim to take advantageous strategic positions through various illegal activities, such as conducting piracy, maritime terrorism, and illicit trade. Climate related displacement of people, fish- and live- stocks will potentially exacerbate transboundary tensions, instability and food scarcity between states. Threats will menace the critical undersea infrastructure at an increasing scale and frequency. These include loss of vital marine ecosystems, physical threats from cable cutting, mine-laying or recon underwater unmanned vehicles, and increasing cyber threats by hacking the terrestrial infrastructure at cable landing stations or data centres.

The Arctic and Antarctica are emerging as key strategic focal points of the global commons. They will become more integral to global economies, primarily due to the effects of climate breakdown. As the regions transform at an unprecedented rate, so will their strategic significance at a time when the international system is increasingly strained. Polar Regions will yield huge potential in natural resources, with governance structures that are facing increasing challenges in a fragmenting security environment. Their surrounding areas will become critical supply routes and thus, likely the object of contesting state and non-state actors, similar to the high seas.

The atmosphere is also emerging as a new theatre of contestation. Emerging technologies are changing the way the world strategizes securing the Earth's atmosphere, both from natural occurrences like climate change and from the expansion of military and commercial use of manned and unmanned aerial vehicles, and high-altitude balloons. Air traffic management on state and international levels could fail to keep pace with the proliferation of assets and sensors. The use of drones is driven by vast commercialization, and the cost of entry continues to decrease. Drones are transforming warfare by exploiting the atmosphere in a cost effective and scalable manner. Their ability to create sensor density, saturation in the atmosphere and the increased use of electromagnetic effects adds new efficiencies and creates novel vulnerabilities to existing weapon systems. In the next 20 years, worsening climate conditions will likely drive the creation of new geoengineering technologies, which have several short-term benefits for the global climate. However, they may also introduce serious ramifications leading to international debates and frictions.



Figure 20: "Arctic Sea Routes, Northeast Passage and EEZ's", March 2022. Source: Arctic Portal, Northern Sea Route Office. <https://arcticportal.org>. -- North-West Passage, -- Future Trans Arctic Shipping Route, -- Northern Sea Route, -- North East Passage, -- EEZs

Exploration and exploitation of outer space will be a significant theatre for competition between states and technological cooperation between private and public actors. The global space industry will increase steadily. The development of reusable rockets and other emerging technologies by commercial actors is reducing the cost of accessing space and in turn, broadening the number of actors in space. As a result, congestion and competition in space will likely accelerate, creating geopolitical friction and proliferating objects in orbit, while increasing problems of managing space traffic and debris.

The global energy landscape could change significantly if the profitability of exploiting the vast Helium-3 resources on the lunar surface is realized. In the event of a transfer of resources in the direction of Earth, airspace traffic control would be affected. Likewise, the arrangement of launch and landing sites for the vehicles transporting them would reconfigure the transport routes over the surface of our planet. In this way, geographical regions on the periphery or semi-periphery of today's globalized world could increase in importance to the detriment of others, whetting the appetite of the great powers.

Within 20 years, demand for rare metals, water, and other resources on Earth will drive space-based mining and manufacturing, which has thus far been constrained by a lack of assets, including technology and finances. The convergence of EDTs like AI-enabled navigation Quantum Positioning, Navigation, and Timing (PNT), additive manufacturing, and advanced robotics will increase the prospects of future mining of asteroids and other spatial bodies, which could potentially provide resources like helium-3, gold, iron, and platinum.

Space also serves as a critical enabler for the global economy and security. Actors will continue to build upon existing space-based systems and develop new capabilities to

support more commercial markets including meteorology, energy, telecommunications, insurance, transport, maritime, aviation, and urban development, as well as for defensive purposes.

Space, as the ultimate 'high ground', will grant decisive advantages in warfare. The weaponization of space is thus well underway and will likely proliferate in a pervasive competition.

based and space-based kinetic anti-satellite weapons, while likely possessing space loitering munition disguised as dysfunctional satellites. Smaller nations and non-state actors, hostile to the Alliance may also develop elements of an anti-satellite ecosystem, through technology transfer from major actors. Using satellites as loitering munitions in low earth orbit poses grave challenges to the integrity of satellite constellations.

Major global powers are designing space and lunar stations exclusive to them or their alliances. At the same time, the development, sustainment, and integration of space-based capabilities will remain prohibitive for most nations. This will likely incentivize smaller nations to cluster with

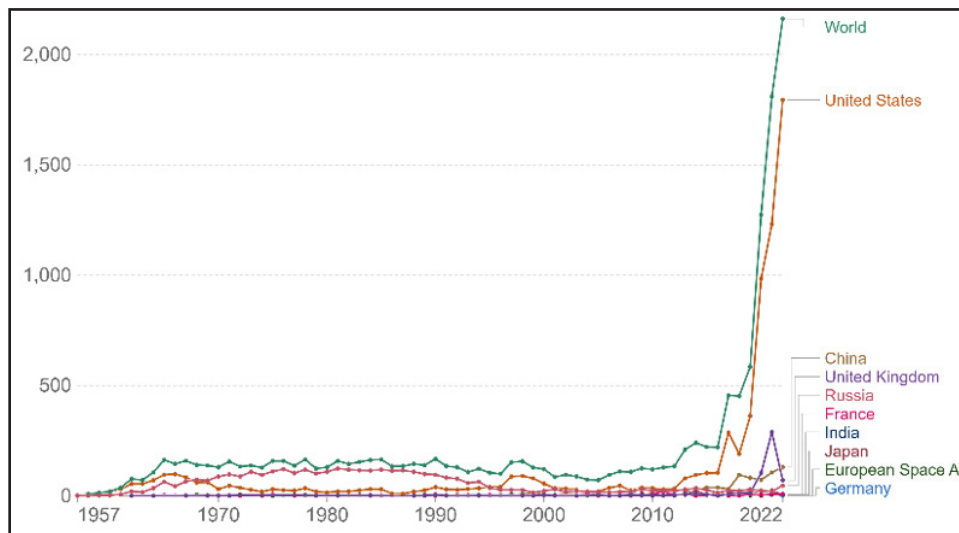


Figure 21: Growing number of objects launched into space, including satellites, probes, landers, crewed spacecraft and space station flight elements. Source: Our World in Data.

Space-based missions are also becoming essential for global military power and competition. They provide nations with increased overhead coverage and enable early detection of inbound threats, tracking, navigation and timing for precision strikes, as well as improved communication to support C2. As the strategic value of space-based capabilities is increasing, states will seek to deny or counter these with conventional and disruptive means alike. For example, China is building a space architecture to provide its military with new long-range strike capabilities. It has constructed ground counter-space weapons to prepare for possible future conflicts. Likewise, Russia is testing its own ground-

major space nations, resulting in new forms of security cooperation and capability aggregation.

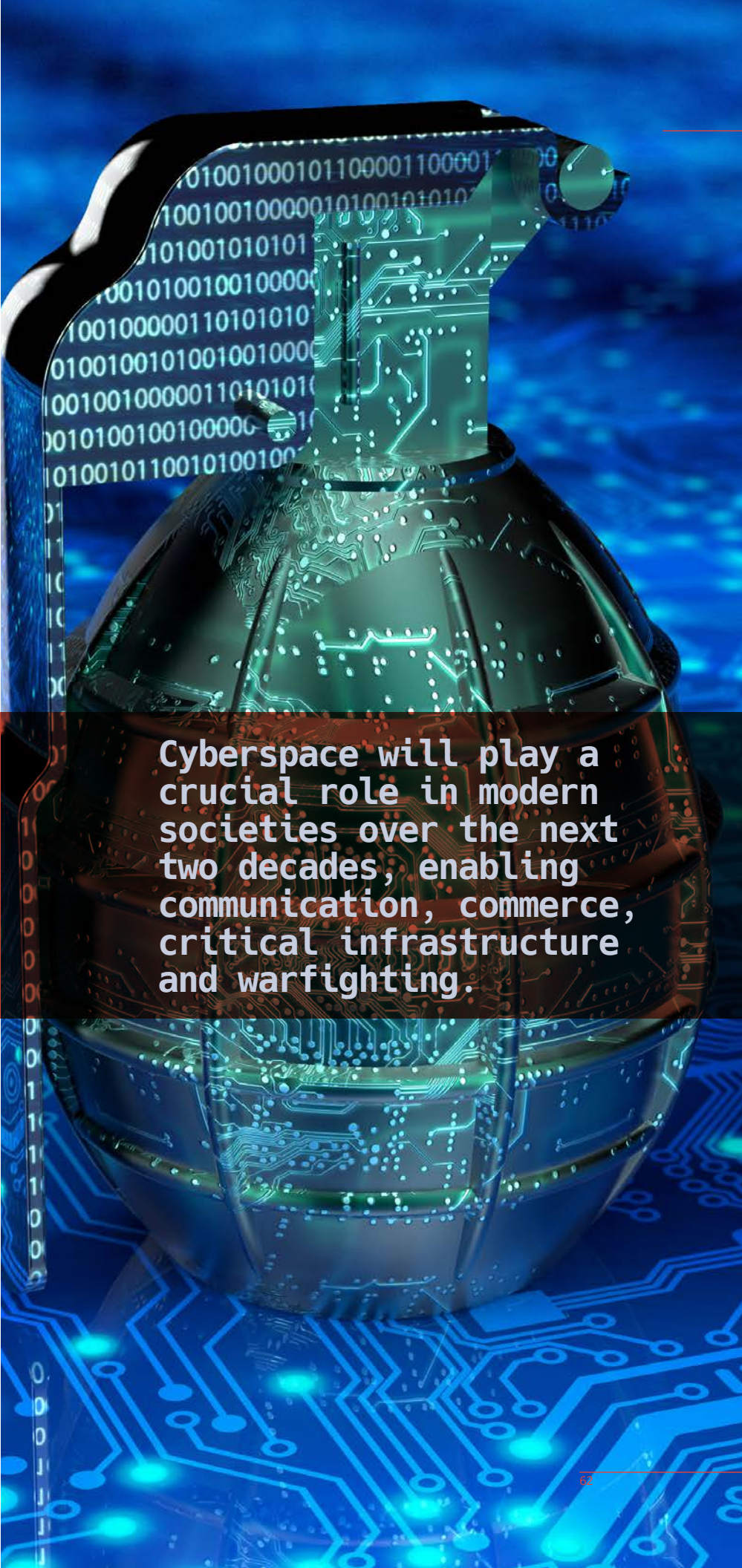
Cyberspace will play a crucial role in modern societies over the next two decades, enabling communication, commerce, critical infrastructure and warfighting. It will continue to support global trade and services, helping economies grow. Notwithstanding, the cyber domain will remain mostly ungoverned, fragmented, distributed, and unstable. This disorder is expected to deepen as user-generated content proliferates with Web 3.0 and large language models combined.

The ongoing digital transformation

will bring significant efficiency improvements across various production chains and financial systems. However, it will also expose critical capacities to malicious cyber activities. This combination of efficiency and vulnerability will be a defining characteristic of the cyber domain. Cyberspace will integrate with emerging technologies like AI and biotechnologies, impacting almost every aspect of life, from medical devices to household appliances.

In the next two decades, cyber-attacks will vary in scale and impact. They may range from hacking personal devices to gaining control over vehicles to more extensive disruptions like shutting down websites or telecom networks, stealing intellectual property, spreading disinformation to destabilize regions, and exploiting critical infrastructure at a relatively low cost. This allows non-state actors to execute more efficient attacks on an increasing scale. The use of cyberspace may dissolve boundaries between the physical and virtual realms, creating new forms of manoeuvre, fires and competition. The characteristics of cyberspace, such as anonymity, deniability, and speed, will contribute to emergence of new characteristics. As a result, distinguishing between acts of espionage, aggression, and war will become more complicated, especially with the sophistication of tools and the rise of autonomous non-military actors and the influence from civil society.

Moreover, cyberspace will provide an ungoverned space for both state and non-state actors to carry out strategic campaigns without direct physical confrontation. This will add to the complexity of managing and responding to cyber threats in the future.

A digital bomb with circuitry and binary code. The bomb is dark and metallic, with glowing green circuitry patterns on its surface. It is set against a blue background with binary code (0s and 1s) and glowing circuit lines. The bomb has a lit fuse and a small circular detail on its top. The overall theme is digital warfare and cyber threats.

Cyberspace will play a crucial role in modern societies over the next two decades, enabling communication, commerce, critical infrastructure and warfighting.

Most states will struggle to keep up with industry leaders who are responsible for most cyber innovations.

Governance challenges in the cyber domain will persist and widen due to differing national perspectives on applying international law to cyberspace. The establishment of comprehensive global regulation or oversight is unlikely, especially in pervasive competition. The lack of international consensus on controlling digital activities will likely remain a permanent characteristic of the Evolving Security Environment. Non-state actors, including political interest groups, extremist organizations, and foreign influence campaigns, will become increasingly capable of

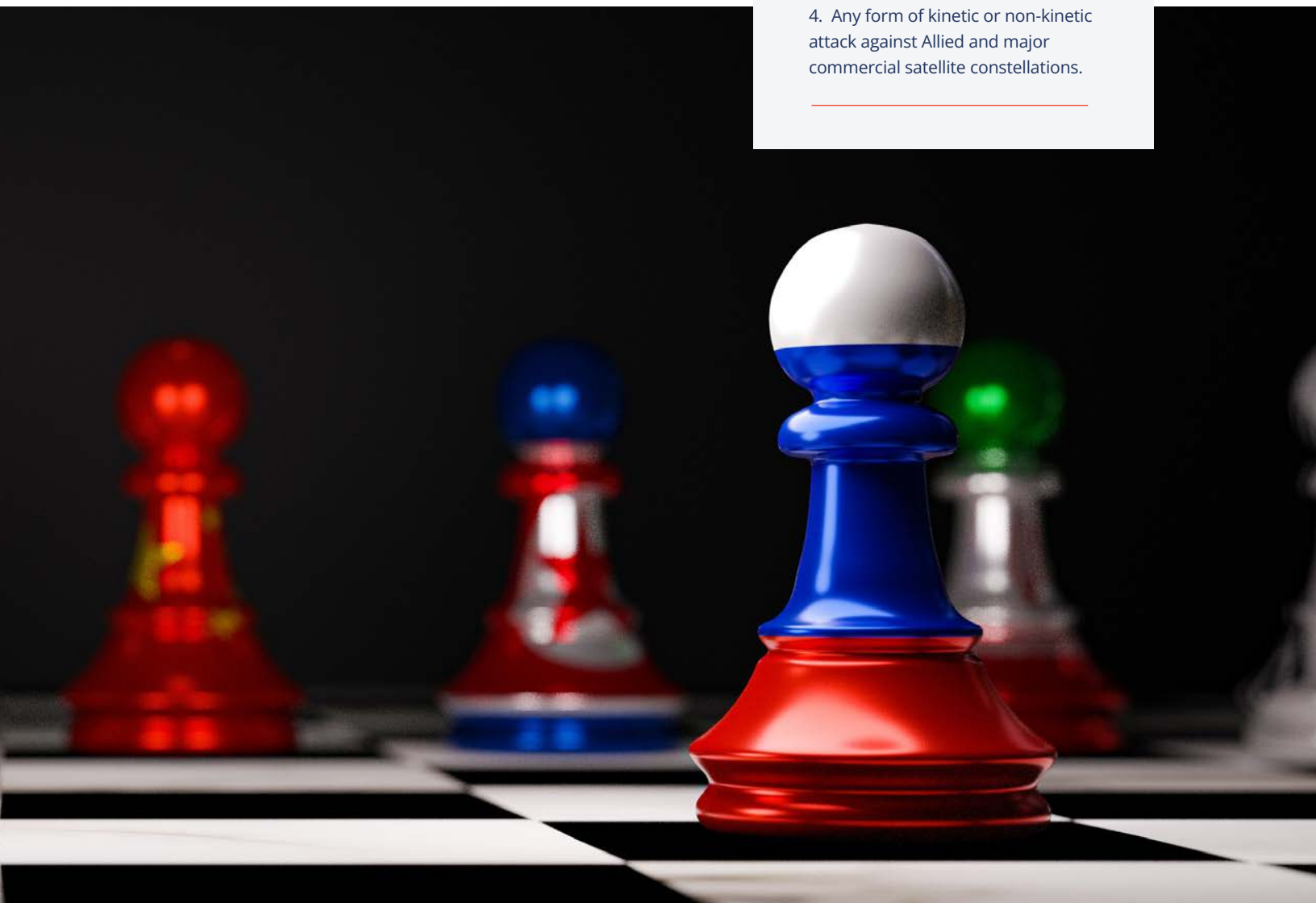
manoeuvres and effects that go beyond physical limitations. Most states will struggle to keep up with industry leaders who are responsible for most cyber innovations. This will lead to a need for expanding technological expertise at the State-level, collaborating with the private sector to find regulatory solutions and to transform the private-public relationship as a whole. Major Powers will be better equipped to provide robust IT infrastructure and security, while other nations may lack the technical capacity to govern the cyber domain effectively.



As the cyber domain becomes more complex and confused, and as it extends into the physical, cognitive and virtual dimensions, it will increasingly impact states, economies and societies. National weaknesses in cyber capabilities will be exposed and exploited in such an environment. Without IT champions or public-private frameworks of sufficient scale, nations will find it challenging to achieve self-defence and resilience in cyberspace. Smaller nations will increasingly rely on commercial or external, state-owned capabilities to cope with cyber challenges.

✓ Potential Strategic Shocks:

1. Unintended escalation from confrontation of state or state-sponsored commercial actors in scrambling for exploration and exploitation beyond national jurisdiction, in the insufficiently governed global commons.
2. Interdiction of naval trade, air traffic, satellite orbits and critical undersea infrastructure in critical nodes or locations with global effects.
3. Autonomous actors imposing paralysis in physical and digital infrastructure by creating strategic disruptions in cyber space, driven by alternative ideologies or beliefs.
4. Any form of kinetic or non-kinetic attack against Allied and major commercial satellite constellations.





Across all aspects of the Evolving Security Environment, pervasive competition will accelerate as strategic competitors of the Alliance adapt to increasing levels of global fragmentation and the erosion of the current international systems. As a result of increasing uncertainty and instability, rivals will position themselves to undermine international norms, shape and contest in peacetime and prepare for confrontation. The relationship between Russia and China is likely to strengthen and smaller states may be exposed to coercion as pervasive competition gathers pace. Formation and solidification of new forms of regional security cooperation and military alliances may become more prevalent.



INTERNATIONAL ORDER IN TRANSITION

In 2023, the Euro-Atlantic Area is not at peace and the short-term security outlook is frustrated by a series of recent crises and transitions. Lasting food, energy and financial insecurities and challenges have emerged in the wake of the COVID crisis, amplified by the Russian war of aggression. Climate change, regulation of AI, tackling poverty, nuclear proliferation and arms control, governance (and protection) of the global commons, and regulation of new domains like cyber and space would all require successful collaboration, whereas the trends are showing a general decline in the efficiency and willingness of such efforts. The enduring absence of credible and collective international cooperation will certainly exacerbate disruptive effects of the unfolding global challenges.

The COVID-19 Pandemic has fundamentally re-shaped near-term futures with long-term consequences. The global pandemic has erased roughly four years of progress in decreasing poverty worldwide. At a minimum, it infected more than 500 million people, led to more than ten million deaths, and disrupted essential health services in almost all countries. The pandemic has deepened a global learning crisis, obstructing more than one hundred million children from in-person school in 2020-2021 as they were forced to immediately adapt to an entirely virtual environment with less social interaction. COVID-19 has led to increased inequality, violence and polarization. Social and political divisions deepened over differing beliefs surrounding the methods, effectiveness, and enforcement policies of distributing the vaccine.



The Russian invasion of Ukraine has further deepened existing challenges and gravely violated the RBIO and global security. The cumulative cost of the war in Ukraine in loss of global GDP has surpassed 3 trillion dollars.

The effects of the war, combined with losses caused by the pandemic, have raised the number of people living in extreme poverty, with sub-Saharan Africa and already failing states experiencing the highest poverty rate increases. Access to food and energy and resulting market asymmetries are creating further instabilities in the Alliance's southern neighbourhood and highlighted global vulnerabilities of interconnected economies and production as well as corresponding increases in violence. As a result, the war in Ukraine has created additional adverse effects on the global economy and increased inequality, poverty, overwhelmingly affecting woman and children and impacting human security on a global scale. These events have also led to increasing changes in migration patterns, social attitudes, and polarization.

These two global shocks are thus primary disruptors of a current security environment amplifying the negative

effects of most major trends, which would have been unfolding without these shocks with likely less severe disruptions to the existing international order. Major shocks and instabilities, such as the war in Ukraine, will also likely lead to a more precise division between Allied countries and strategic competitors. The governments of Russia, Iran, and North Korea are openly averse to Allied states. Additionally, systemic competition between major powers is intensifying challenging the West and the existing RBIO across all instruments of power. The ability of the RBIO to prevent, mitigate and resolve disputes between states will be undermined by such dynamics and particularly by the adverse and non-complying behaviour of strategic competitors. These powers will seek to alter the current international order to reflect their own interests, ideologies, and values and advocate for alternative international governance models.

Furthermore, they weaken global intergovernmental



organizations, creating political deadlock and decreasing global cooperation and collective decision-making capacity. Solutions may be sought increasingly on a regional level and with selected partners instead of utilizing existing international institutions. Additionally, fragmentation and instability will increase as the number of unresolved and unmitigated disputes will further increase.

The perception of pervasive competition will encourage states to hedge against threats by generating mutual security guarantees and aggregating capabilities to achieve higher economies of scale. Such efforts will also be driven by the need to create agility and resilience in space and cyber domains at scale, as well as in sensor density and offensive means across all dimensions. Notwithstanding, generating these capacities will likely prove to be challenging for most nations. Potential adversaries will likely use it as an incentive to solidify technology, economic and ultimately military cooperation. The governments of China and Russia will seek to shape and influence international norms, standards, and institutions, challenging the Western-led order and advocating for alternative models of global governance. Chinese objectives to develop independent financial and digital ecosystems will severely challenge existing global institutions and may incentivize states to develop their own alternatives or join in. As a result, multiple orders may emerge across the security, economic, or digital ecosystems. Allied actions and resolve to address challenges will be indispensable to mitigate the detrimental effects on the existing rules-based international order.

As a result, the number of regional security formations and military coalitions may evolve already in the short to mid-term. In the event of increasing clustering into ad-hoc or structured security formats, non-aligned powers will become centrally important. Such states may increase their power and influence asymmetrically or become a space for pervasive competition by other actors. The emergence of new, structured military alliances, rivalling NATO or benevolent to it, is thus likely.

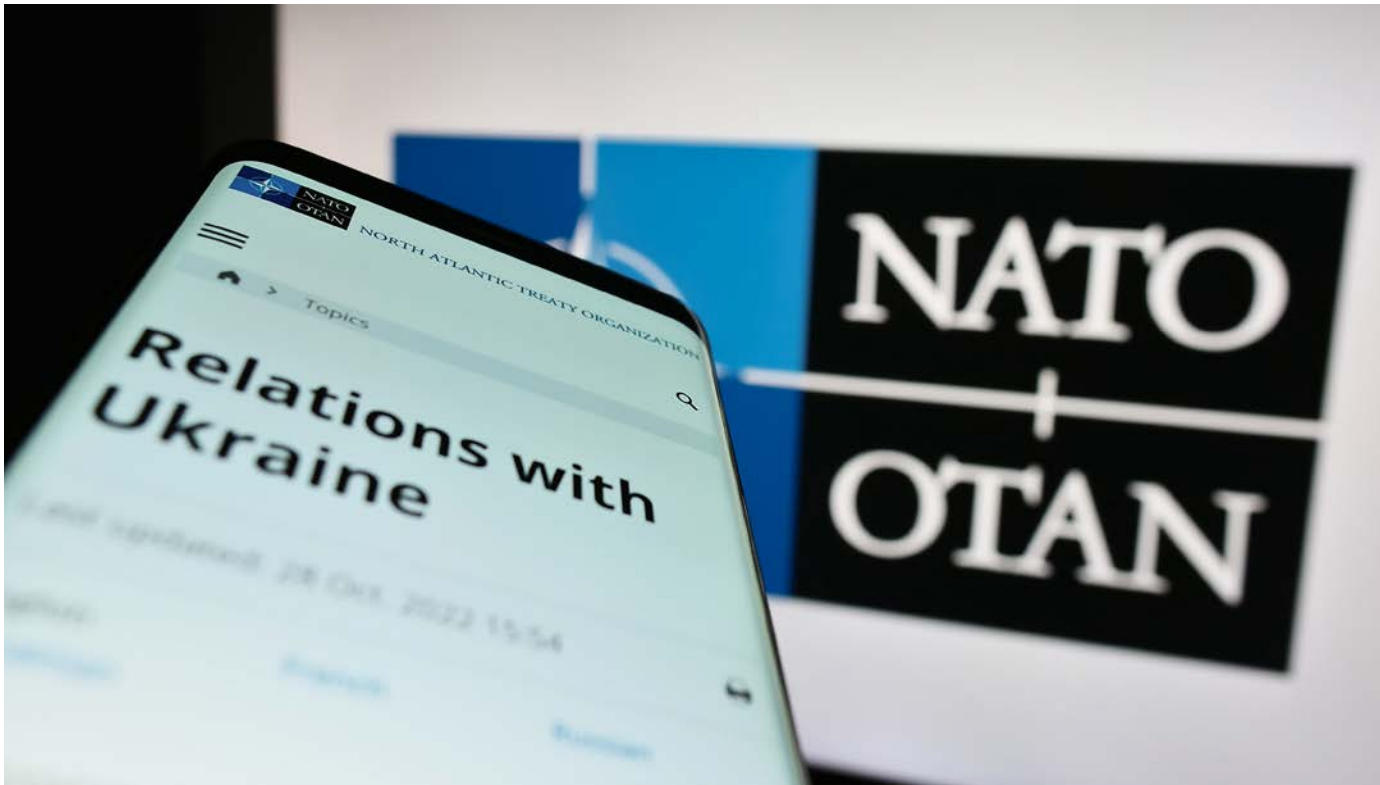
Consequently, there will be more shaping and contesting, higher probabilities of confrontation, and decreasing levels of economic and technological cooperation. The absence of global cooperation in key global challenges will likely exacerbate negative dynamics and drive competition further. Pervasive instability is also an ever-defining feature of the global South, with long-lasting global consequences. Primarily, new challenges, including climate change, financial and cost-of-living crisis, poverty and inequality, disruptive technology development and geopolitical rivalries, are exposing the weaknesses of developing states and pressing them to adapt or fail. One of the most evident ways of a state failure is defaulting on debt. This trend is occurring with an increasing frequency, and is set to expand further in the years to come. Other states have chosen to leave the international system and pursue their own approach, usually benefitting only a small segment of the society and pushing the overwhelming majority into poverty. North Korea is a current example. Such states may pose heightened risks in the future, with advanced offensive capabilities in cyber and missile technologies, potentially able to disrupt global systems, such as space-based services, major trade routes or critical infrastructures.

The outcome of the Russian war in Ukraine will have long-term implications for alignment patterns in the international order. Major nations as well as actors from Africa, Middle East, Central Asia and the Indo-Pacific may re-assess their alignment strategies because of the war in Ukraine. In order to compensate for the losses suffered due to the war, the Russian Federation will probably seek to quickly take control of the disputed areas in the Arctic regions and to apply the 'fait accompli' policy it is familiar with. In addition, it will seek to become more involved in the competition in the Middle East and Africa. Similarly, attempts to develop Russian operational assets in Transnistria and the Balkan region, especially in Serbia, Bosnia and Herzegovina and Montenegro, are possible. Behind-the-scenes activities in cooperation with organized crime are also credible, including false flag operations aimed at increasing non-military threats and lowering the sense of security across Europe.

The Russian economy will likely be able to sustain a protracted conflict, albeit at daunting long-term costs, while partially reconstituting their armed forces.



It is unlikely, however, that Russia could sustain a conflict on more than one front due to significant losses of personnel, equipment, and conventional supplies.



The unfolding shift towards an autarchic wartime industry is likely to lead to economic decline and a loss of innovation and productivity on a long-term.

At the same time, conventional low-value military capabilities may be reconstituted in the short to midterm, however the quality of capabilities will suffer. Crucially, the state's role in the economy is increasing. Other consequences of the war will likely exert lasting frictions, including degraded social cohesion, economic depression, ethnic rivalries, proliferation of criminal organizations and illicit trade.

A decoupled Russia with devastated IT capacities may miss out on the fourth industrial revolution and digital transformation. Both the Russian technology sector and industrial defence base will likely fall behind, increasing their dependence on China and other states. This will likely be further deepened by Russian inability to promote its own

digital ecosystem and remain inherently reliant on external actors to maintain a semblance of technology fitness. Russian military reconstitution beyond 2030 may be empowered by imported dual use EDTs and weapons of mass destruction. Russian armed forces may also choose to invest in a hybrid toolbox to off-set the attrition of their conventional forces. The Sino-Russian cooperation will likely continue to strengthen, in the absence of viable alternatives, with Russia as a junior partner and China prepared to exit should the relationship become unfruitful or too costly for Beijing. The solidification of existing and the emergence of new regional security formations that involve Russia are possible.

A weapon of mass destruction is a nuclear, radiological, chemical, biological, or other device that is intended to harm a large number of people or cause great damage to infrastructure and the environment.



China is emerging as the only actor that will possess dominant capacities across all instruments of power to promote alternative systems and will likely pose a growing range of challenges to the Alliance. China will also likely remain a global leader in green energy transition and expand its influence through the transfer of technology and provision of services. By prioritizing technology innovation and scientific research, China aims to become a leading global engine of innovation, rivalling developed countries in economic advancements, income levels, and technological capabilities. China's military-civil fusion strategy seeks to integrate civilian technology advancements with military capabilities. This will present a growing challenge for NATO's Military Instrument of Power in terms of understanding the potential dual-use nature of emerging technologies and their impact on future warfare. As China continues to advance its military-civil fusion initiatives, it becomes crucial for NATO to enhance its own capabilities for assessing and mitigating the risks associated with technology transfers, safeguarding critical infrastructure, and adapting its defence posture to address the evolving security landscape.

Country position on nuclear weapons, 2022

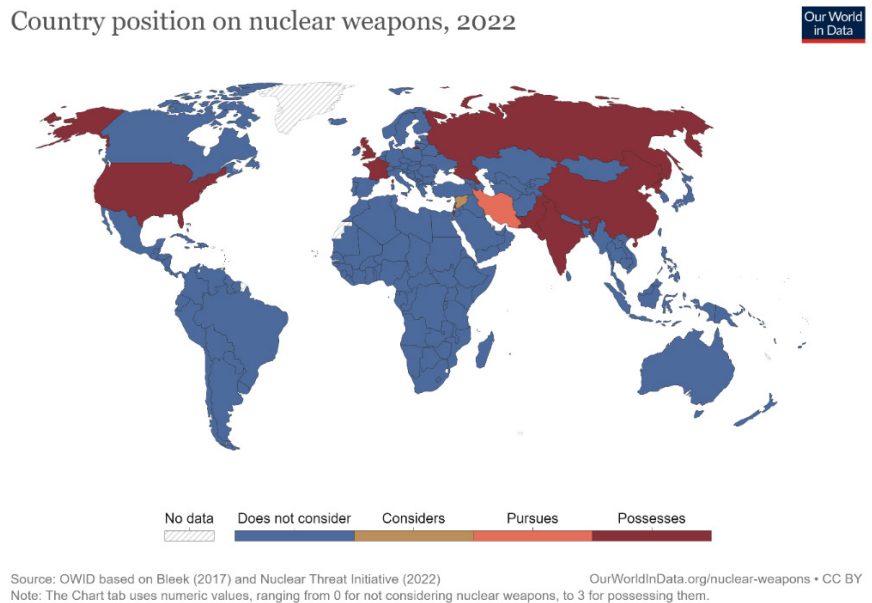


Figure 22: Country position on nuclear weapons 2022. Source: Our world in data.

With China's rapid expansion of its nuclear capabilities, a tripolar nuclear order between the United States, Russia and China will emerge, with other major nuclear powers continuing the development of their nuclear and missile programs. For the next decade, Russia will likely maintain its practice of coercive nuclear signalling. Russia has suspended its participation in the 2010 New Strategic Arms Reduction Treaty (New START) since February 2023. China has not yet engaged in arms control negotiations, which is raising additional risks.

The continued threat of proliferation of nuclear weapons in violation of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and the collapse of multiple nuclear weapons treaties in recent years threatens to undermine strategic stability and complicate strategic deterrence calculations. Potential adversaries and strategic

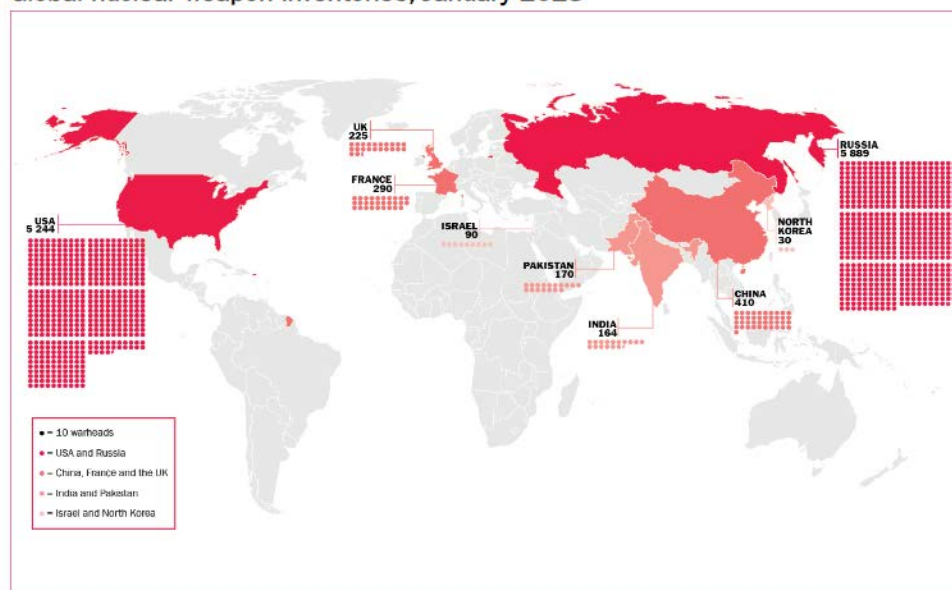
competitors could use nuclear weapons for intimidation, coercion and limited nuclear use to shape the security environment and advance their interests. AI and EDTs in nuclear technologies, such as autonomous systems and cyber capabilities, will pose new opportunities and risks for deterrence, crisis stability, and escalation risks. This is also the case for intercontinental ballistic missiles (ICBM) and space sensors that provide capabilities for swifter and less predictable incorporation of nuclear weapons in warfare. Finally, new uses of biological weapons might also be posing a threat in future warfare, especially where dual use components are involved and can be overlooked by arms control and inspections.

The cost of modern conflict will continue to increase at levels that will be generally prohibitive for most nations. As such, state and non-state actors will continue to design increasingly composite armies with a 'high-low mix' to reflect their military culture, as well as economic and industrial limitations. Human labour will constitute a fundamental challenge for the armed forces, especially for developed countries. The availability of the workforce will be limited due to demographic tendencies, especially aging and decreasing fitness, market competition, and insufficient technical qualities. Global defence spending is on the rise in the 21st century and the trend will continue in a deteriorating security environment.. The total global military expenditure has almost doubled since 2000 and continues to expand in the years to come. The Russian invasion of Ukraine has further triggered defence spending with the European defence expenditure showing the steepest increase since the end of the Cold War. Further increase will likely be driven by increasing scale, complexity and costs of modern warfare.

Additionally, the lack of oversight of newer technologies integrated with weapon systems will increase the possibility of unintentional escalation. Decision makers may deploy some advanced technologies without fully understanding the consequences, particularly with automated and unsupervised systems. Future leaders will struggle to intervene in a highly automated world, hampering human ability to orient and make quick decisions to adversarial moves.

Further, as the future continuum of conflict presents a novel spectrum of actions, from low-level crisis to full-scale conflict, there is a potential for increased risks and uncertainties surrounding the use and control of nuclear weapons. The nuclear domain becomes increasingly relevant in escalation dynamics when specific allied or adversary red lines are crossed. The introduction of cyber and cognitive warfare into nuclear competition will instigate new dynamics. A cyberattack targeting a nuclear system or national interest or an AI-driven disinformation campaign can significantly complicate escalation dynamics in the nuclear realm. As nuclear competition broadens, it creates a higher risk of ambiguous or misunderstood signals between nuclear-armed adversaries. Misinterpretation of actions, perceptions, intentions, or capabilities can increase the risk of unintended escalation. Therefore, appropriate human oversight in critical decision-making should serve as an important safeguard for the future security environment.

Global nuclear weapon inventories, January 2023



Note: The boundaries used in this map do not imply any endorsement or acceptance by SIPRI.

Figure 23: Global nuclear weapon inventories 2023. Source: SIPRI.

Generating mass and quality in the new forms of competition will require efficient integration of capacities and interoperability of equipment, as well as agile development of digital ecosystems and new methods of training.



The efficiency of alliance management will be dependent on collective anticipation and information sharing, effective planning and aggregation of capabilities, and political cohesion to sustain unity of efforts. This will be a key challenge for new formations and a fundamental advantage for NATO. The interoperability of platforms and capabilities through the multi-domain operations concept will increase agility and scalability of Allied as well as NATO's MlOP, at the cost of losing national autonomy in operations.

A growing number of actors coupled with the diffusion of technologies will likely complicate improvement of existing and establishment of new arms control regimes. This will increase the risk of miscalculation, unintended escalation, and human-induced disasters. Concepts and methods of arms control may also expand to include considerations of emerging technologies, such as autonomous, cyber, and space-based weapon systems and non-state actors, like private military companies or commercial actors as well as military alliances. Concealment and dual usability of weapon systems will complicate detection and adherence. Additionally, in a fragmenting world, amidst accelerating changes, arms control agreements may

need to become more flexible and adaptable to changes in technology, armaments, and the balance of power. To improve credibility of such regimes, information sharing and enhanced detection capacities will be fundamental. Human security is also emerging into the forefront of the competition and the necessity of the Women, Peace and Security agenda is ever more relevant. The overwhelming majority of conflict-related population displacement are women and children. Disruptive tactics, like ecocide and mass deportation, are impacting and altering societies for generations. Urbanization will increase the likelihood that millions of non-combatants in the human environment will be exposed to direct or indirect consequences of military operations. Pervasive instability, both exacerbated and exploited by pervasive competition, coupled with the diffusion of technology, will result in growing inequalities and increasing violence against civilians. This includes conflict-related sexual violence, as well as attacks against cultural property and environmental damage. It contributes to forced displacement, fuelling human trafficking and irregular migration and other criminal activities like smuggling. Employment of remote violence and targeted assassinations are already on the rise. These developments degrade human rights and will



pose lasting challenges to human and state security and have a disproportionate impact on women, children, and minority groups.

A shift from the unipolar world towards multipolar is thus already observable and will likely continue to unfold. There is a corresponding trend of increasing violence within the international system. The consequence of this is continued fragmentation, instability and pervasive competition across all domains. It is envisaged that global institutions will be increasingly challenged as regulators of economic and political processes by regional economic blocks, which will gradually transform into political or political-military blocks.

Coercive interference between strategic competitors empowers opportunist regional proxy actors including terrorist groups and organizations. Access to natural resources and modern weapons enable these threat actors to use violence as a tool for forced demographic change resulting in disruption of demographic structure and threats to territorial integrity.

✓ Potential Strategic Shocks:

1. A Russian attack against Allied countries or assets or any action by actors to violate territorial sovereignty with overt or covert confrontation.
2. Formation of a military alliance, openly adversarial to NATO.
3. Major war expanding to multiple regions leading to instability, prompting humanitarian crisis and mass migration. Major systemic war is a distinct possibility. Its emergence will be more likely a result of miscalculation (including underestimated NATO reaction) or unintended escalation.
4. Surprise employment of massed autonomous weapons to create an asymmetrical advantage against high-value targets.
5. Nuclear exchange between states.



IMPLICATIONS TO THE ALLIANCE



In a pervasive competition scenario, Diplomatic, Information and Economic Instruments of Power could potentially be used to target Allied cohesion, exert influence over sovereign nations, solidify regional security formations and military coalitions, and fuel as well as exploit grievances in areas of instability.

The capacity of potential adversaries and their efficiency to coordinate and employ IoP will increase, while non-military instruments will likely gain more relevance. Potential adversaries will likely prefer to avoid open and direct conflict with the Alliance, due to NATO's advantage in the Military Instrument of Power. Their objectives will reflect that, in attempting to conceal intent and capacity to achieve strategic surprise. These adversaries may introduce plausible deniability to avoid attribution and response, extensive use of EDTs, cyber warfare to cause lasting damage to critical infrastructure, and robust technology-enabled cognitive warfare designed to undermine unity. These actors will take advantage of their ability to efficiently combine employment of all instruments of power to limit the Alliance's military instrument, already in peacetime.





Congestion of actors and challenges to traditional states will require a new type of diplomacy, simultaneously with the traditional state-to-state relations, to address an increasingly wide variety of non-state actors as influential stakeholders.

This will complicate international affairs and further impact the efficiency of the RBIO. The Diplomatic IoP will be challenged by the high complexity and variety of actors as well as by the sophistication of their strategies.



The technology-enabled IoP will likely achieve devastating effects in shaping virtual and cognitive warfare, contesting the Alliance's narrative with the potential to undermine political and social cohesion to limit the effective use of the Military IoP in the event of a conflict. Additionally, the Economic IoP will be a central tool to deter, coerce or align states. It will constitute a critical element of economic growth, industrial adaptation, digital transformation as well as the key factor to regionalization of economic cooperation and securitization of supply chains. Adversaries may also prefer reliance on third party actors, proxy states or non-state actors. Confrontations with such actors will likely take shape in the territory of weak or collapsing states. The likelihood of major, systemic war will remain possible, but its emergence is more likely a

result of miscalculation or unintended escalation.

Effective management of aggregating capabilities through collective defence planning and force development as a means to generate fighting power and cohesion across the operational domains will remain fundamental to preserve NATO's edge against its potential adversaries. Anticipation and detection of adversarial intent, information sharing to address an increasing variety of actors, capacity to credibly respond attacks, resilience and political cohesion to sustain efforts will be fundamental to successfully deter and defend against adversaries, across the physical and non-physical dimensions. Such efforts may require more exploration of mechanisms to coordinate Allied and collective instruments more efficiently.



DIPLOMATIC

The Diplomatic Instrument of Power will be challenged by a great variety of actors, behaviours and attitudes, as well as competing narratives and increasing complexity.

The Allies' Diplomatic instrument of Power (DloP) will complement the use of information, economic, and military instruments to create incentives for cooperation and dissuade adversaries from undesired actions. It will also persuade or encourage actors to comply with existing rules and norms of the international order. Allies will use this instrument to enhance security through partnerships, improve military and civilian resilience, contribute to arms control, non-proliferation, and disarmament and assist aspirant countries to building up their defence capacities.

In addition, the diplomatic instrument may be employed to reinforce the RBIO against subversions by assertive powers and non-state actors. The Alliance may take part in actions, under UN mandate, to supervise ceasefires, monitor and report developments in conflict areas, and support counterterrorism and counter-piracy to uphold the RBIO. Theatres may expand to atmosphere, outer space, high seas and Polar Regions. In these operations, the security environment will likely be degraded, consisting of transnational, state and non-state actors, terrorist organizations with their affiliates and extensions, and commercial organizations.

Climate breakdown will exert global challenges, multiple crises and instability. Food and energy insecurity will likely grow in the Alliance's southern neighbourhood. EDTs, such as AI, will both enable and deny reach and impact of diplomatic actions. Dual usable weapon systems, EDTs, and non-compliance will challenge existing arms control and non-proliferation regimes. Securitization of supply chains and designed dependencies through economic means will challenge a growing number of actors, and their narratives will complicate the effective employment of traditional diplomacy.

In the likely absence of an effective global solution, regional powers may step up to mediate conflicts and instability around the world. This will enhance the influence of regional powers and potentially enable the formation of new security cooperation frameworks in the Alliance's neighbourhood. Both deterrence and security cooperation will become more complex with an increasing number of actors, principles, and objectives. Alliance-to-alliance and alliance-to-non-state-actor interactions may become more prevalent, requiring changes to traditional diplomacy, which was built upon state-to-state relations.

Potential adversaries will continue to promote their own alternative systems, undermining the RBIO. The DloP will likely be employed in a degraded environment with waning respect and adherence to the norms and principles. Negotiation will be increasingly complicated in a congested environment with high numbers of state and non-state actors, a high density of disinformation, and signal interference. Managing relationships will be challenged by diverging values, norms, and interests in the virtual and cognitive dimensions.

DloP will likely rely on sensors and AI-enabled decision-making processes in an environment where detection and attribution of intent, capacities and actions will be fundamental but challenging.

Information sharing in a complex commercialized, contested, congested, and confused future will remain key to promoting transparency, trust, and solidarity between Allies, providing situational awareness and

operational coordination and enhancing interoperability and integration. As the development and maintenance of strategic intelligence capacities remains cost-intensive, more coordinated, federated and joint capacities will become necessary amongst Allied and Partner countries. The commercialization of sensors and intelligence, as well as the boom of publicly available data, will enable greater use of non-state commercial and public capabilities, while also creating reliance concerns.

Diplomatic engagement and coordinated actions at the Alliance level will remain a crucial tool to mitigate future risks and challenges. Effective employment of this instrument will require anticipation and foresight, AI-enabled data analytics, situational awareness, campaign mindset and the capacity to sustain reach and engagement with Partners. Adherence to core values and enduring, credible strategic communication will be key.

Key challenges to the effective use of DloP:

- 1)** Strategic designs by state actors to undermine the credibility of diplomatic efforts and the RBIO through the exploitation of the information environment in the cognitive dimension;
- 2)** Employment of cyber capacities to shape, contest, and disrupt diplomatic efforts and operations in the virtual dimensions;
- 3)** Diffusion of dual usable EDTs enabling concealment of intent and capacities in the physical dimension to undermine effective arms control regimes;
- 4)** Employment of legal operations, corruption, and promotion of alternative standards and norms in pervasive competition or exploitation of the global commons' insufficient regulation.

As the continuum of conflict becomes blurred and contests become prevalent, enduring diplomatic engagement will become crucial. Increased competitive activities will require persistent engagement by the Allies, as well as by the Alliance, to reinforce Partner capacities across the physical, virtual, and cognitive dimensions and to respond in the legal and normative aspects of pervasive competition.

Legal Operations refers to the use of law as an instrument of power. It encompasses all types of action in the legal environment by state and non-state actors aimed at gaining/undermining legitimacy, advancing/undermining interests, or enhancing/denying capabilities at the tactical, operational and/or strategic/political levels. Such actions may occur across the peace-crisis-conflict spectrum alone or in conjunction with other instruments of power in the Diplomatic, Information, Military, Economic, Finance, Intelligence and Law (DIMEFIL) spectrum.

INFORMATION

Allied actions in a congested information environment will face challenges due to the abundance of narratives, AI, and automation complicating detection. Cognitive warfare will play a critical role in shaping public perception and decision-making, requiring countermeasures in pervasive competition.

Allied actions across all IoPs will take place in a heavily congested and contested information environment where the abundance of narratives will challenge the success of these campaigns. In addition, AI and automation will enhance the quantity and quality of effects and complicate detection. Human networks will continue to be vulnerable to these efforts, hence they will be targeted in peacetime and with a campaign mindset.

Green energy transition will evolve amidst the battle of narratives. Additionally, resource scarcity driving poverty, inequality, and social unrest will complicate positive Allied narratives in unstable regions, fragile states or disaster-affected areas. AI and large language models will enhance the saturation of misinformation, signal density and noise. Identification of target audiences and exploitation of individual biases will be disseminated across various platforms, challenging the tracking and countering of such operations. Deep fakes and synthetic media will complicate detection. Information operations may exploit media outlets, celebrities, politicians, to endanger democracy, human rights and freedom of speech.

The Information Instrument of Power (IIoP) is a key beneficiary of exponential growth of connectivity, data, and information processing. Information changes the attitude, behaviour and resource allocation priorities of human networks. The AI revolution affects it by further empowering agents for autonomous actions to influence and shape perceptions. The speed and depth at which users can receive data that is relevant, accurate and representative has grown through advancements in technology and digital competencies. The content-based, AI-enabled automated data generation could further fuel the unfolding information revolution but also signal density and noise. At the same time, it will also

drown the information environment with vast amounts of misinformation and alternative realities.

Cognitive warfare will be wielded with increasing impact to build and challenge narratives, shape public perception, impact audiences' behaviours, and influence decision makers. It can potentially disrupt societal resilience and undermine national as well Allied cohesion to limit the capacity and the will to fight, as well as the efficient generation and employment of the military instrument.

At the same time, the vast amount of publicly available information, novel employment of open-source intelligence, and support by non-state actors will open new avenues to transmit credible narratives to public audiences globally. The potential impact of non-state actors in the information environment will also likely surpass their physical capacities, resulting in social groups and movements shaping the information environment without a significant physical footprint or resources.

Potential adversaries will enhance and expand their information operations through social media and other platforms to reach the masses. The scramble for the commons will likely entail a promotion of alternative worldviews, norms, and principles. Pervasive competition will provide an enduring problem set in countering information and influence operations.

Key challenges to the efficient use of IIoP:

- 1) State actors using disinformation and alternative narratives will undermine the credibility of the RBIO and the core values of the Alliance, discredit collective and Allied actions to Partners, and erode Allied cohesion and the will to act in the cognitive dimension.
- 2) Adversaries may choose to use influence campaigns by leveraging the increasing reach and targeting the potential of AI-enabled data analysis, extended reality spaces, digital platforms, and networks. They can also launch disruption and deception operations to disrupt communication networks, conduct technology-enabled violence and infiltrate virtually augmented spaces and digital infrastructure to gain sensitive information to exploit. Novel means in the cyber domain can also undermine credibility, identity, and norms in the virtual dimension.

3) The IloP will be extensively used to shape and contest resilience, cohesion, and support of Allied actions in the physical battlespace. This will likely include highly personalized and contextualized digital and media information campaigns at mass scale, diplomatic efforts to discredit, employment of disposable social movements, as well as interference in political processes and the sovereignty of nations.

4) Promoting the superiority of alternative rules, norms, and standards as well as discrediting the existing status quo will intensify, amplifying existing fragmentation. It will polarize society and weaken the RBIO. Forced divergence and promotion of alternative rules, norms, and standards will be implemented in the normative battlespace.

5) Lacking clarity on the ownership and posture within the IloP across the continuum of competition will continue to enable adversaries to maintain their initiatives in the cognitive dimension.

The complex and confused security environment will complicate audience analysis, perception of stakeholders' actions, and anticipation and detection of threat signals. It will be more challenging to understand opponents' intentions and imagine the possible effects of Allied actions in the operating environment. Information sharing, trust, and cohesion are required to address such complexities. Access to and use of the information data will be essential to understand the actors' attitudes and likely behaviours in order to provide better coordination among Allies and Partners to confront threats. Effective partnerships with commercial service providers will become fundamental to enhance detection, attribution and response to counter disinformation as well as create resilience against adversarial actions in the virtual dimension.



ECONOMIC

Gaining an economic advantage over competitors will become a key objective for nations seeking to enhance their power and influence, while retaining an economic advantage will be fundamental to creating resilience against a chaotic future security environment.

The Economic Instrument of Power (EIoP) will be influenced by relative economic strengths and weaknesses, technological advancements, commercial interests, and geopolitical dynamics. The interplay between these factors will shape the strategies employed by nations, the effectiveness of economic instruments, and the outcomes they seek to achieve in this rapidly evolving landscape. Commercialization will enhance the influence of the private sector and technology-empowered super wealthy individuals. It will also aid technology companies who may choose to interact with the diplomatic and economic instruments of the Alliance's potential adversaries, or remain benevolent, or actively support the Alliance and its Partners.

The economic instrument will likely gain increasing utility in the Evolving Security Environment, where fragmentation and an increasing frequency of disruptions and instabilities will drive the securitization of climate adaptation, industrial and technological achievements, the weaponization of resources, and the redistribution of wealth and influence.

Technology advancements will enable a more efficient employment of economic power beyond traditional financial sanctions. Non-financial sanctions, such as export controls, technology restrictions, and visa bans, may become more prominent. Emerging technologies could be subject to heightened scrutiny and export controls, impacting international collaboration and technology transfer.

Geopolitics will facilitate the formation of new alliances and partnerships to counter the economic instruments of power employed by others. In response to sanctions and coercion, states will likely establish alternative trade arrangements, create parallel financial systems, or develop regional economic blocs to reduce vulnerability to external pressures. Decentralized financial systems and digital currencies could provide alternative transaction channels, bypassing traditional financial sanctions. Regulators' success in adaptation by developing new frameworks to monitor and control these emerging technologies will be a key benchmark for the efficacy of the RBIO.

Actors will scramble for exploration and exploitation of resources in the global commons. Outright challenges by state and non-state actors will block or interdict resource and trade flows.

In a pervasive competition, states will seek to create and exploit dependencies and use them as leverage and a means of coercion in expanding influence, shaping, and contesting potential adversaries. Securitization of economies and motivation to secure advantages will solidify new forms of regional and security cooperation and may disrupt existing ones. Gaining an economic advantage over competitors will become a key objective for nations seeking to enhance their power and influence. Retaining economic advantage will also be fundamental to create resilience against a chaotic future security environment. Self-preservation and

perseverance may emerge as key driving principles.

Potential adversaries will employ coercive economic strategies like sanctions, export control, market closures, and investment withdrawal with increasing frequency to cause economic disadvantages. These measures will be used as coercive tools to compel or deter certain behaviours, thereby exerting influence and achieving strategic objectives without resorting to armed conflict. New dependencies driven by climate adaptation, industrialization, the scarcity of critical resources, as well as human induced disruptions to food supply chains and water distribution systems, will amplify the effects of such strategies.

Key challenges to the effective use of ELoP:

- 1)** NATO as a military Alliance will not be able to fully exploit its economic advantage of scale. Potential adversaries may be able to mobilize and employ the economic instrument without the need to consult or manage relations with other actors in the international system to the same extent.
- 2)** National interest remains a fundamental pillar of state policies, so it may limit the economy of scale of actions on the Alliance level.
- 3)** The impact of accelerated changes remains unclear in many areas, thus decreasing resilience against external interference.
- 4)** The securitization and decoupling of economic and digital ecosystems, as well as scientific research, will negatively affect the scale and efficiency of global economic cooperation. Any attempt to do so will be contested by narratives, hindered by national positions, and may potentially instigate domestic polarization.

The economic instrument will also be employed increasingly in concert with other instruments to achieve greater effects or, conversely, to provide greater resilience. Countries and international organizations will likely emphasize the use of soft power tools such as cultural diplomacy, education exchanges, assistance in climate adaptation, and human and industrial development to enhance the efficiency of the other instruments of power. Potential adversaries may attempt to influence the Alliance's cohesion and limit its ability to generate fighting power through economic actions.

MILITARY

National ability to generate fighting power may become constrained by a wide range of challenges to states, including costs of climate adaptation and green energy transition; keeping pace with accelerating technology changes; and economic, financial and technology limitations. In addition, social dynamics, including the need to reallocate spending to welfare and domestic labour challenges (ageing societies, shortage of skilled workforce) will pose further demands for states resources. At the same time, cost escalation in the defence sector is set to increase further.

The character of NATO's three core tasks (deterrence and defence, crisis prevention and management; and cooperative security) will be shaped by the Evolving Security Environment. Fulfilling these tasks will require collective and Allied commitment to providing the quality and quantity of capabilities required to conduct future operations. Development of the right set of capabilities is therefore a fundamental prerequisite for a NATO that is fit for the future.

Interconnectivity will increase across the IoPs. The utility and effectiveness of the Alliance's Military Instrument of Power (MloP) will be increasingly shaped by structural disruptions and adversarial strategies, enabled by technology and the combined employment of all IoPs. The current and anticipated future character of warfare is one where threats and challenges to the Alliance will be simultaneous, persistent, boundless, across all domains and IoPs.

Conditions for the employment of the military IoP therefore may degrade significantly due to non-military factors, including climate breakdown, EDTs, and non-state actors, expanding theatre of competition and adversarial manoeuvres in physical and virtual dimensions.

Deployment of the military instruments may be impacted by emerging economic and environmental factors. In areas of instability and acute resource scarcity, states may be more prone to accept warfare as a means for political goals to address dire conditions that put their societies at risk of collapse. In the next 20 years, protecting natural resources, trade routes, and supply chains will become a greater priority for actors. This will enhance exploration, exploitation and manoeuvring in and around critical resource and trade nodes, likely utilizing new scales of sensor density, unmanned naval and aerial assets in mass, and expanded precision strikes. Non-state actors may acquire capabilities to challenge states and commercial actors in these areas. The global commons will be prone to a robust influx of actors due to the lack of international governance and a state of pervasive competition. New spaces will open further to exploration, increasing competition for access and resources. For example, effects will be generated within the space, cyber, and the information domains without physical limitations.

Development of the military instrument will be further complicated by an increasing complexity of warfare and changing balances in quality and quantity as well as economic limitations. Efficiency gains provided by AI-enabled manufacturing and sustainment and continued aggregation of capabilities within the NATO Defence Planning Process may alleviate some pressure and create more resilience among the Alliance. Moreover, if synergies are developed in an Alliance-wide division of labour, economies of scale could be enhanced. Technical innovations such as autonomous robot delivery services, drones, AI, and on the long-term, quantum computing will likely optimize logistics operations. Shortages of a skilled workforce and the increasing distances of military sustainment may further accelerate the introduction of automated and autonomous systems, robotics and the integration of modern technologies.

Notwithstanding, in the foreseeable future, military equipment will continue to be labour intensive, cost intensive, technology intensive, and in the case of most countries – scarce. Shrinking fleets of weapons systems will cost more and will therefore become more precious. This may potentially lead to risk aversion, especially in the case of high value assets deployed in a degraded environment congested with autonomous and unmanned systems. This will incentivize focus on stand-off weapon systems with extended range.

Augmented decision-making may bring profound changes to the offense-defence balance and considerations of costs. It may provide enhanced tools for high-tempo operations, expansive manoeuvres and global fires but at the same time, it may create additional requirements to detect, attribute and respond to early signs of offensive posturing by potential adversaries. EDTs will further increase the speed and transparency of operations, compressing the tactical, operational, and strategic levels.



Driven by the growing costs and complexity of force development, future military designs will be increasingly heterogeneous and likely commercialized. The private-public sector will lead innovation and likely enable, augment or replace military capacities with increasing frequency, primarily in space, cyber, logistic and communication services. This may open concerns of trust, reliability and dependency, and necessitate a continued focus on military resilience and collective, long-term defence planning.



Defence budgets will remain under significant pressure by competing demands for state resources and increasing cost of warfare in a deteriorating security environment of multiple challenges, and, as a result, may not commensurate with threat levels in a pervasive competition.

The war in Ukraine has increased threat levels and the likelihood of a major war scenario, which will likely drive a new ascent of global armaments, albeit with mixed results. Both stockpiles and readiness are at lower than optimal levels worldwide, which will further incentivize actors to focus on these areas and prioritize defence investment. The age of ascending defence spending, however, will be coupled with high global demand for weapons as a result of increasing threat levels but also due to the Russian exit from part of the global defence market. Additionally, increasingly uneven access to critical materials, as well as inflation levels, will keep prices high. Budget deficits will continue to upsurge globally while the average GDP growth within Allied countries will likely continue to lag behind the pre-crisis levels. A significant portion of weapons systems will reach the end of their lifecycle in the next two decades, increasing maintenance costs, while wages will continue to remain high and recruitment of a skilled workforce continues to be challenging for most Allies. Finally, climate-related disruptions as well as expansive instability will likely demand more capacities incrementally.

Alliances, built on the deterring power of aggregated capabilities and unified efforts, will be critical to successfully deter state actors and employ the military instrument to address increasingly complex, multidimensional threats. The efficiency of deterrence will be challenged in a fragmenting security environment where deception emerges as an organic state strategy, while modern technologies will enable concealment of intent and capacities alike. Resolve will be attacked by novel means in all dimensions and at all times. Critical deterrence capabilities can be potentially disrupted, degraded, or denied by EDTs. Deterring non-state actors will likely become a growing problem set, as their risk acceptance, high variation, and technology-enabled capacities will complicate deterrence, especially in a deteriorating RBIO. At the same time, societal resilience, through enhanced coordination of private and public capacities could enhance deterrence by denial.

The military instrument will likely remain able, with external, often commercial enablers, to detect, deter, and defend against aggression and remain resilient to shocks in the physical and to a limited extent, in virtual dimensions. However, the confused security environment with the blurred continuum of competition will present challenges in the cognitive dimension and normative aspects. Risks will emerge in case of an aggressor conducting activities through the coordinated use of all IoPs and across all dimensions. Societal support and resilience are fundamental for sustaining military efforts in a degrading security environment, ripe with friction and attrition. Therefore, human networks will be shaped and contested, then confronted by potential adversaries well before the confrontation phase.

The scale and speed of networks are increasing, and data exploitation is a decisive factor, changing the character of war. Data is emerging as a strategic resource that must be protected, creating its own new structure of services. AI is increasingly affecting sensor-to-shooter systems and automated decision making. Space assets are essential to orchestrate multi-domain operations, transforming the fog of war into a more transparent battlefield. Interconnectivity will increase across the IoPs and all dimensions, along with increased use of automated and autonomous unmanned systems, an increased number of sensors, and the proliferation of the Internet of Things (IoT). The ability to conduct advanced data analytics and planning will be crucial for gaining military advantage. Strategic, operational, and tactical augmented decision-making will be compressed. Critical EDTs, such as hypersonic missiles and autonomous weapon systems capable of swarming will become prevalent. The combination of dual use technologies to include EDTs, AI, and quantum computing may enable amassed self-operated weapon systems (drones, missiles) to conduct missions in denied electromagnetic spaces. EDTs will likely empower an increasing number of actors to retain freedom of manoeuvre in a denied environment, albeit likely at high attrition rates and at increasing costs.

The ability to control MloP employment through time/space has always been critical for the synchronization of forces and the achievement of success. However, in the future operating environment, the time between indicators and warnings and escalation from crisis to conflict will shorten considerably. Information flow is accelerating; the velocity,

volume, variety and value of information continue to increase, all while the veracity and reliability of information is on the decline. Leveraging data and information can empower timely cognitive superiority to take advantage of, or create, opportunities. The MloP, traditionally seen through time, force, and space dimensions, has become information-centric, demanding increased situational awareness for enhanced decision-making. In order to be successful now and in the future, the MloP must provide variation of symmetric, asymmetric, offsetting and other approaches to deliver synergistic effects through the multi-domain “theatre” driven by time scale dictated by the conflict.

Efficient coordination across all IoPs, efficient aggregation of the Alliance’s capabilities, and joint actions in a multi-domain environment will remain fundamental to the successful conduit of the three core tasks in a degraded security environment.

Key challenges to the effective use of MloP:

- 1)** Accelerating changes in technology will shape the character of warfare and be characterized by:
 - a. Increasing complexity and confusion of the security environment;
 - b. Concealment of intent (due to dual use tech and a dense information environment) will complicate the cognitive component and demand rapidity and agility in decision making, resulting in compressed timelines;
 - c. Integration of AI and sensors will enhance detection, attribution and rapid decision making to guide responses;
 - d. Increasing speed, scale, range and precision of strikes;
 - e. Compressed decision making cycles;
 - f. Low-cost, dual use autonomous systems on land, air, and sea will be ubiquitous across the battlespace;
 - g. A limited number of high-value autonomous weapons for strategic effects and an exponentially increasing number of low-cost, unmanned and human-machine systems will allow an increasingly contested and degraded security environment for Allied forces;
 - h. Emerging technologies include bio-toxins, human enhancement technologies, quantum technology, directed energy weapons, engineered pandemics, and generative AI. These will have the power to wield existential damage to societies. States will be challenged to produce countermeasures that can keep pace with these advancements and be pressed to develop mitigation strategies at pace to respond to these low-probability, high-impact events;
 - i. EDTs will make military capabilities increasingly intelligent, interconnected, distributed, and digital in nature.
- 2)** Active shaping and contesting by potential adversaries in virtual and cognitive dimensions will be aimed at disrupting the moral component through:
 - a. Cognitive warfare;
 - b. The promotion of alternative norms and principles,
 - c. A complex congested and confused information environment with a high variety of actors, stakeholders and narratives;
 - d. Technology-enabled concealment of capacity and intent increasing legal challenges and complicate attribution.

3) The physical dimension will be challenged by a range of factors, which are shaped by the key drivers of change:

a. The Personnel Element will require adaption due to changing demographics:

- i. Ageing;
- ii. Scarcity of a skilled and available workforce;
- iii. Increasing personnel (human resources) costs.

b. The equipment element will face:

- i. Accelerating changes in technologies resulting in obsolescence at faster rates;
- ii. A low industrial base for large scale, enduring conflict;
- iii. Challenges for rapidly adopting commercial and dual-useable technologies;
- iv. Cost escalation;
- v. Interoperability challenges;
- vi. An austere operating environment with high attrition rates;
- vii. An increasing need to automate and re-balance the quality and quantity of force structures.

c. The training element will be faced by increasing incremental cost and be resource intensive for a variety of previously unintroduced conditions, including:

- i. Operating in extreme weather environments;
- ii. Utilization of more advanced technologies in weapons and systems;
- iii. Increasing complexity of multi-domain operations and integrated effects.

d. The Readiness Element will depend on:

- i. Availability of sufficient force elements;
- ii. Availability of sufficient materiel stockpiles.

Whilst being challenged by:

- iii. Strategic distances;
- iv. Increasing variability of potential employment and deployment scenarios with no or short notice;
- v. Sustainment issues due to a requirement to rebuild a strong industrial base;
- vi. Political resolve to continue engagement despite associated costs;
- vii. Capacity to absorb attrition.

4) Potential adversaries:

a. Likely possess the means to target Allied and social cohesion in peacetime, in order to:

- i. Limit the capacity and will to fight;
- ii. Disrupt resolve to sustain operations.

b. Will take advantage of insufficient rules and regulations in new theatres of operation and increasingly shift:

- i. To the virtual and cognitive dimensions;
- ii. Towards insufficiently governed global commons;
- iii. To conduct hybrid activities;
- iv. Towards actions under plausible deniability and utilizing concealment and proxies.

5) Climate breakdown and rising global temperatures will require:

- a. Armed forces to adapt and operate under extreme conditions;
- b. Operations in austere environments to increase;
- c. Facing climate-related attrition on equipment, forces, and stockpiles, which will lead to higher operating costs; and
- d. Extreme weather disruptions which will pose challenges to the safety of navigation and to access to land forces in affected coastal areas.

6) Resource scarcity driving instabilities will require Allied forces to:

- a. Accelerate transition to green energy sources to reduce carbon footprint and dependence on fossil fuels;
- b. Ensure increased operational effectiveness as a result;
- c. Adapt force designs and, as necessary, operational concepts to increase the use of electric vehicles in and around urban areas;
- d. Prepare to protect freedom of navigation against novel ways of interdiction as well as to protect critical trade nodes in the global commons, as appropriate.

7) Empowered human networks through Public (State) and Private (commercial) partnerships will become critical enablers for the military instrument. In the modern operating environment:

- a. State capacities are insufficient;
- b. Commercial services are expanding steadily;
- c. Armed forces alone cannot effectively wage



modern warfare across multiple domains without substantial support from commercial actors;
 d. Trust, reliability and attribution concerns must be resolved;
 e. Prevalence of commercial service providers will necessitate a new approach to national security;
 f. Future cyber and space commercial service providers will be ubiquitous across the domain. They are not necessarily combatants and may be citizens of third countries.

8) Scramble for the commons will require a new mind-set, including anticipation and detection as well as modern capabilities by Allied forces to ensure success for missions and operations in a complex, congested, commercialized, contested and confused environment. Areas and actions are as follows:

a. On the High Seas and Oceans:

- i. Control and secure trade routes;
- ii. Counter piracy and maritime terrorism;
- iii. Protect undersea infrastructure;
- iv. Utilize unmanned naval drones and advanced sensors.

b. In the Arctic and Antarctica:

- i. Increase monitoring of the region;
- ii. Assert sovereignty and uphold international law;
- iii. Manage resources sustainably;

iv. Address climate-related tensions;

v. Protect critical supply routes.

c. In the Atmosphere:

- i. Reinforce air traffic management;
- ii. Address emerging threats from drones;
- iii. Start assessing long-term implications of geoengineering;
- iv. Prepare and protect against electromagnetic effects.

d. In the Outer Space:

- i. Prepare for protecting increasing commercial traffic;
- ii. Explore ways to manage congestion and debris in orbit;
- iii. Protect space-based assets and capabilities;
- iv. Address potential space weaponization in concepts.

e. In the Cyberspace:

- i. Defend against cyber-attacks of varying scales;
- ii. Adapt to evolving tactics and actors;
- iii. Enhance technological expertise;
- iv. Collaborate with the private sector for cybersecurity;
- v. Address governance challenges and vulnerabilities stemming from insufficient regulation as appropriate.



APPENDIX A – SCENARIOS

1. `Four Worlds` Model: A fragmenting world deteriorating further

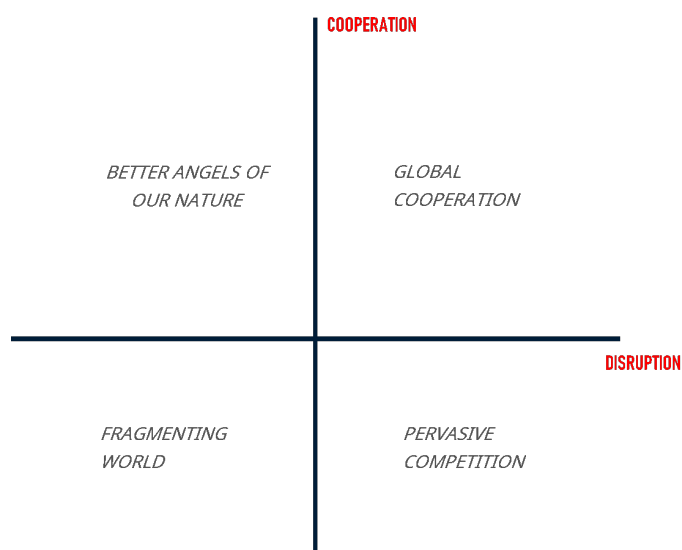
To reduce complexity and enable collaborative futures thinking with Allies and Partners, the four archetypal scenarios were developed to explore generic futures, allowing to draw implications through the framework of `seven drivers`. As depicted in Figure 24, this model was used to assess subsequent future trends and initial implications with Allies, Partners and the Warfare Development community.

Low disruption, low cooperation (`Fragmenting world`): The Alliance's strategic environment is taken as described in Strategic Concept 2022 (SC22), with an additional assumption that it continues to evolve without major strategic shocks and discontinuities. The likelihood of this scenario is assessed to be low, as both the climate breakdown and technological changes increase the chances of strategic shocks. In contrast the unfolding strategic competition may likely intensify around the securitization of resources and economics, access and control of the commons and exploitation of instabilities by potential adversaries.

High disruption, low cooperation (`Pervasive competition`): The Alliance's strategic environment as described in SC22 is increasingly impacted by structural disruptions, strategic shocks and cascading effects to states, societies and armed forces. Challenges posed by major drivers of change, notably climate change, technology, economic and social, require global cooperation but responses are impeded by strategic competitors of the Alliance. Structural disruptions have been assessed by the Strategic Foresight team while the attitude of strategic competitors is described in the SC22. Accordingly, competition and adversarial intent of major state actors and terrorist non-state actors will endure amidst disruptions and will aim to shape and contest the Alliance and challenge the RBIO. These actors will continue to attempt to accumulate their own power and expand their influence by exploiting instabilities.



High disruption, high cooperation 'Global cooperation': This scenario presupposes a significantly changing attitude by strategic competitors towards more cooperation. Such change would likely emerge initially as global responses to strategic shocks and disruptions and, eventually, to participating in the enduring adaptation of the RBIO to the disruptive changes. The Allied foresight community did not explore this option, as it was not deemed probable amidst the Russian aggression against Ukraine and increasingly assertive behaviour by China. At the same time, avenues of a more cooperative international order should be explored, as a follow-on study for ACT Strategic Foresight.



Low disruption, high cooperation ('Better angels of our nature'): This scenario has been discarded after initial testing as not probable, considering the certainty of an increasing extent of disruptions and the lack of indicators for the positively changing attitudes of strategic competitors.

THIS HIGH DISRUPTION, LOW COOPERATION SCENARIO IS THE MOST LIKELY AND INFORMATIVE TO PROPERLY ASSESS THE RISKS AND CHALLENGES TO THE ALLIANCE.

Figure 24: 'Four Worlds' generic future scenarios

Bibliography

- ACLED, "ACLED Year in Review Global Disorder in 2022", January 31, 2023, ACLED Year in Review: Global Disorder in 2022 (acleddata.com)
- Africa Center for Strategic Studies, "Conflict Remains the Dominant Driver of Africa's Spiraling Food Crisis", October 14, 2022, Conflict Remains the Dominant Driver of Africa's Food Crisis (africacenter.org)
- Armstrong, Martin, "Where Water Stress Will Be Highest by 2040, Statista, March 22, 2023, Chart: Where Water Stress Will Be Highest by 2040 | Statista
- Armstrong, Martin, "World Poulations Reaches 8 Billion", Statista, November 15, 2022, Chart: World Population Reaches 8 Billion | Statista
- Atlantic Council, "How the US and its allies should respond to evolving space threats", January 2023, <https://www.atlanticcouncil.org/blogs/new-atlanticist/how-the-us-and-its-allies-should-respond-to-evolving-space-threats/>
- Bates, S. "Study Confirms Importance of Southern Ocean for Absorbing CO2". NASA Global Climate Change 2021. <https://climate.nasa.gov/news/3136/nasa-supported-study-confirms-importance-of-southern-ocean-in-absorbing-carbon-dioxide/>
- Becker, Jordan, "Order, Counter-Order, Disorder? Alliances, Orders, and International Security", Alliances, Orders, and International Security, March 2021, <https://dx.doi.org/10.2139/ssrn.3799085>.
- BENCHMARK SOURCE, "More than 300 new mines required to meet batter demand by 2035", September 6, 2022, More than 300 new mines required to meet battery demand by 2035 | Benchmark Source (benchmarkminerals.com)
- BioSpace, "Biotechnology Market Size to Worth Around US\$ 3.44 Trillion by 2030", April 25, 2022, Biotechnology Market Size to Worth Around US\$ 3.44 Trillion by 2030 | BioSpace
- Bishop, Peter, and Andy Hines, "Teaching about the Future", Springer, June 2012, <https://doi.org/10.1057/9781137020703>.
- Biswas, Rajiv, "The Ascent of APAC in the Global Economy", S&P Global Market Intelligence, July 1, 2022, <https://www.spglobal.com/marketintelligence/en/mi/research-analysis/the-ascent-of-apac-in-the-global-economy-june22.html>
- Bjorklund, Rasmus, "Semiconductors in the Global Race for AI", April 19 2021, Institute for Security and Development Policy, <https://isdsp.eu/semiconductors-in-the-global-race-for-ai/>
- Blattman, Christopher, "Why we fight: The roots of war and the paths to peace", Viking, April 2022.
- Bockel, Jean-Marie, "The Future of the Space Industry", NATO Parliamentary Assembly, 2018, ESC 2018 General report - The Future of the Space Industry (nato-pa.int)
- Breaking Energy, "5 Energy Industry Trends to Watch in 2023", January 10, 2023, 5 Energy Industry Trends to Watch in 2023 « Breaking Energy - Energy industry news, analysis, and commentary
- British Antarctic Survey (BAS), "60 years of Antarctic ice sheet data released", July 17, 2023, 60 years of Antarctic ice sheet data released - British Antarctic Survey (bas.ac.uk)
- Brock, Joe, "U.S. and China wage war beneath the wves- voer internet cables", Reuters, March 24, 2023, U.S. and China wage war beneath the waves - over internet cables (reuters.com)
- Carpenter, Z., "Scientists: We Cannot Geoengineer Our Way Out of the Climate Crisis", Truthout, 2015, <https://truthout.org/articles/scientists-we-cannot-geoengineer-our-way-out-of-the-climate-crisis/>
- Center for Reserach on the Epidemiology of Disasters, "Disasters by number 2022", 2023, https://cred.be/sites/default/files/2022_EMDAT_report.pdf
- Chan, Serena, "Complex adaptive systems". ESD. 83 research seminar in engineering systems. Vol. 31, November 2001.
- Chancel, Lucas, et al., "World Inequality Report 2022", 2022, World Inequality Lab, wir2022.wid.world.
- Charlotta Collén, "Digital Democracy: Tech Can Strengthen Open, Free Societies", January 31, 2023. <https://cepa.org/article/digital-democracy-tech-can-strengthen-open-free-societies/>
- Choudhury, Rizwan, "Thirsty AI: Study finds ChatGPT requires 500ml of water for Every 50 questions" Mashable Middle East, April 14, 2023, <https://tinyurl.com/3vd8jdhy>
- Cohen, Raphael S., et al, "Assessing the Prospects for Great Power Cooperation in the Global Commons", 2023, RAND Corporation, https://www.rand.org/pubs/research_reports/RRA597-4.html
- Cohen, Raphael S., et al., "Vanishing Trade Space: Assessing the Prospects for Great Power Cooperation in an Era of Competition — A Project Overview", RAND Corporation, 2023, https://www.rand.org/pubs/research_reports/RRA597-1.html

Cooley, Alexander, and Daniel Nexon, "Exit from hegemony: The unraveling of the American global order", Oxford University Press, March 2020, <https://doi.org/10.1093/oso/9780190916473.001.0001>.

Copeland, Dale C, "Economic Interdependence and War: A Theory of Trade Expectations", *International Security* 20, no. 4, April 1996, <https://doi.org/10.2307/2539041>

Coykendall, John, et. al., "Riding the exponential growth in space," Deloitte, March 22, 2023, <https://www2.deloitte.com/us/en/insights/industry/aerospace-defense/future-of-space-economy.html>

CSET, "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035", May 13, 2021, CSET Original Translation: China's 14th Five-Year Plan (georgetown.edu)

Dahan, Maha, El., Yaakoubi, Aziz El., "China's Xi calls for oil trade in yuan at Gulf summit in Riyadh," Reuters, December 10, 2022, China's Xi calls for oil trade in yuan at Gulf summit in Riyadh | Reuters

DCDC (UK MOD), "Global Strategic Trends (6th ed.)", Ministry of Defence, 2018, Global Strategic Trends (publishing.service.gov.uk)

De Clercq, Matthieu, Anshu Vats, and Alvaro Biel, "Agriculture 4.0: The future of farming technology", Proceedings of the world government summit, February 2018, <https://www.oliverwyman.com/our-expertise/insights/2018/feb/agriculture-4-0--the-future-of-farming-technology.html>

Deloitte, "2023 semiconductor industry outlook: Balancing shortages with oversupply", 2023, 2023 Semiconductor Industry Outlook | Deloitte US

Deloitte, "Deloitte research reveals inaction on climate change could cost the world's economy US\$178 trillion by 2070", May 23, 2022, <https://www.deloitte.com/global/en/about/press-room/deloitte-research-reveals-inaction-on-climate-change-could-cost-the-world-economy-us-dollar-178-trillion-by-2070.html>

DNI, "Global Trends 2040: A More Contested World", March 2021, Office of the Director of National Intelligence - Global Trends (dni.gov)

Don, Bruce W., "Network Technologies for Networked Terrorist: Assessing the Value of Information and Communication Technologies to Modern Terrorist Organizations", 2007, RAND Corporation, Network Technologies for Networked Terrorists: Assessing the Value of Information and Communication Technologies to Modern Terrorist Organizations | RAND

Donaldson, Alasdair and Younane, Isabelle, "A diplomatic deficit? The rise of non-state actors" British Council, 2018, <https://www.britishcouncil.org/research-policy-insight/insight-articles/diplomatic-deficit-actors>

Dooley, Kevin J, "A complex adaptive systems model of organization change", *Nonlinear dynamics, psychology, and life sciences* 1, January 1997, <https://doi.org/10.1023/A:1022375910940>

EASTASIAFORUM, "Chines rare earth consolidation a cause for concern", March 30, 2022, <https://www.eastasiaforum.org/2022/03/30/chinese-rare-earth-consolidation-a-cause-for-concern/>

Edmond, Charlotte, "Global migration, by the numbers: who migrates, where they go and why", World Economic Forum, January 10, 2020, Global migration, by the numbers | World Economic Forum (weforum.org)

Felbab-Brown, Vanda, "The key trends to watch this year on nonstate armed actors", Brookings, January 15, 2021, <https://www.brookings.edu/blog/order-from-chaos/2021/01/15/the-key-trends-to-watch-this-year-on-nonstate-armed-actors/>

Foedde, Lutz, et al., "Agriculture's connected future: How technology can yield new growth", McKinsey & Company, October 9, 2020, <https://www.mckinsey.com/industries/agriculture/our-insights/agricultures-connected-future-how-technology-can-lead-new-growth>

Forbes, "Artificial Intelligence will Enable 38% Profit Gains By 2035", June 22, 2017, Artificial Intelligence Will Enable 38% Profit Gains By 2035 (forbes.com)

Forbes, "Social Media Increasingly Linked with Mass Shootings", May 25, 2011, Social Media Increasingly Linked With Mass Shootings (forbes.com)

Forbes, "The Weaponization of Artificial Intelligence", January 14, 2019, The Weaponization Of Artificial Intelligence (forbes.com)

Forbes, "Three Critical Metals Supply Chain Challenges and How Businesses Can Address Them", April 26, 2023, Three Critical Metals Supply Chain Challenges And How Businesses Can Address Them (forbes.com)

Freedman, Lawrence, "The future of war: a history", *PublicAffairs*, 2017, <https://doi.org/10.1080/03071847.2018.1455348>

Geospatial World, "Space-Based Assets Have Revolutionized Warfare", August 2022, <https://www.geospatialworld.net/prime/special-features/space-based-assets-have-revolutionized-warfare/>

Goldman Sachs, "The Path to 2075—Slower Global Growth, But Convergence Remains Intact", December 6, 2022, Global Economics Paper The Path to 2075 — Slower Global Growth, But Convergence Remains Intact (goldmansachs.com)

Goncharenko, Oleksiy, "Russia's Black Sea blockade is part of Putin's war on international law", Atlantic Council, March 22, 2023, Russia's Black Sea blockade is part of Putin's war on international law - Atlantic Council

Greenhill, Kelly M., "When Migrants Become Weapons". *Foreign Affairs*, February 22, 2022, When Migrants Become Weapons | Foreign Affairs

Halpern, Benjamin, S., et al., *Science*, Vol 319, "A Global Map of Human Impact on Marine Ecosystems", 2008, <https://doi.org/10.1126/science.1149345>

Harvey, C. "Geoengineering Is Not a Quick Fix for the Climate Crisis", *Scientific American*, April 2023, <https://www.scientificamerican.com/article/geoengineering-is-not-a-quick-fix-for-the-climate-crisis-new-analysis-shows/>

Hofpaur, D., "Space Debris: Understanding the Risks to Spacecraft", NASA, 2016, <https://www.nasa.gov/centers-and-facilities/nesc/space-debris-understanding-the-risks-to-nasa-spacecraft/>

Holmes, Bob, "How sustainable are fake meats?", *Knowable Magazine*, July 20, 2022, Fake meats: How sustainable are they? (knowablemagazine.org)

Huang, Françoise, "The World is Moving East, Fast," Allianz Research, January 18, 2021, 2021_01_18_AsiaPostCovid19.pdf (allianz-trade.com)

IMF, "World Economic Outlook Update - Inflation Peaking Amid Low Growth", January 2023, IMF / IMF World Economic Outlook January 2023 Update

ING, "3D printing: a threat to global trade", September 27, 2017, https://think.ing.com/uploads/reports/3D_printing_DEF_270917.pdf

International Energy Agency, "World Energy Outlook 2022", October 2022, <https://www.iea.org/reports/world-energy-outlook-2022>

IPCC Report, AR5 Synthesis Report: Climate Change 2014 — IPCC

IPCC Report, AR6 Climate Change 2021: The Physical Science Basis — IPCC

IPCC Report, AR6 Climate Change 2022: Mitigation of Climate Change — IPCC

IPCC Report, AR6 Synthesis Report: Climate Change 2023 — IPCC

IPCC Report, Special Report on the Ocean and Cryosphere in a Changing Climate — (ipcc.ch)

Jensen, Lois, "The Sustainable Development Goals Report-2022", United Nations, 2022, <https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022>

Development-Goals-Report-2022.pdf.

Johnson, Trevor, et al., "Additive Manufacturing in 2040: Powerful Enabler, Disruptive Threat", 2018, RAND Corporation, Additive Manufacturing in 2040: Powerful Enabler, Disruptive Threat | RAND

Jungsberg, L. et al. "Atlas of Population, Society and Economy in the Arctic." Nordregio, 2019. <https://nordregio.org/publications/atlas-of-population-society-and-economy-in-the-arctic/>

Kaldor, Mary, "New and Old Wars: Organized Violence in a Global Era", John Wiley & Sons, April 2013.

Kambale, Bhagyashri, "The Future of Additive Manufacturing: Trends and Predictions", January 21, 2022, The Manufacturing Report, <https://manufacturing.report/articles/the-future-of-additive-manufacturing-trends-and-predictions>

Kaplan, Robert D., "A new cold war has begun", Foreign Policy, January 7, 2019, <https://foreignpolicy.com/2019/01/07/a-new-cold-war-has-begun/>

Kemp, Simon, "Digital 2023: Global Overview Report", DATAREPORTAL, January 26, 2023, Digital 2023: Global Overview Report — DataReportal — Global Digital Insights

Khan, Sarmad, "Global debt surges to record \$30305tn in first quarter on US and China borrowing", The National News, May 19, 2022, Global debt surges to record \$305tn in first quarter on US and China borrowing (thenationalnews.com)

Kissinger, Henry A., et al., "The Age of AI and Our Human Future", 2021.

Klusener, Edgar, "The internet: Can it really influence social movements?", Manchester 1824, June 17, 2018, <https://sites.manchester.ac.uk/global-social-challenges/2018/06/17/the-internet-can-it-really-influence-social-movements/>

Kramer, Kat and Ware, Joe, "Count the cost 2021 – A year in climate breakdown", Christian Aid, December 2021, Counting the cost 2021 - A year of climate breakdown.pdf

Kreps, Sarah and Li, Richard, "Cascading chaos: Nonstate actors and AI on the battlefield", February 1, 2022, Cascading chaos: Nonstate actors and AI on the battlefield (brookings.edu)

Larsen, John, et al., "A turning Point for US Climate Progress: Assessing the Climate and Clean Energy Provisions in the Inflation Reduction Act", August 12, 2022, Rhodium Group, A Turning Point for US Climate Progress: Assessing the Climate and Clean Energy Provisions in the Inflation Reduction Act | Rhodium Group (rhg.com)

Liang, Qiao, and Wang Xiangsui, "Unrestricted warfare", PLA Literature and Arts Publishing House Arts, February 1999.

Malik, Saif, "Six trends that are shaping the future of global trade", Standard Chartered Bank, July 15, 2020, <https://www.sc.com/en/feature/six-trends-that-are-shaping-the-future-of-global-trade/>.

Masakowski, Yvonne R., "Artificial Intelligence and Future Global Security Environment", July 15, 2020, DOI:10.1108/978-1-78973-811-720201001

Mazzolin, Robert, "The Strategic Military Importance of the Space Domain", Centre for International Governance Innovation, February 2, 2023, <https://www.cigionline.org/multimedia/the-strategic-military-importance-of-the-space-domain/>

McKinsey & Company, "The raw-materials challenge: How the metals and mining sector will be at the core of enabling the energy transition", January 10, 2022, The raw-materials challenge: How the metals and mining sector will be at the core of enabling the energy transition | McKinsey

Mining Technology, "Mining powered by robotics and AI promises explosive growth", December 22, 2021, Mining powered by robotics and AI promises explosive growth - Mining Technology (mining-technology.com)

Morach, Benjamin, et al., "Food For Thought: The Protein Transformation" Boston Consulting Group, March 24, 2021, Food for Thought: The Protein Transformation | BCG

NASA, "Vital Signs", 2023, <https://climate.nasa.gov/vital-signs/ice-sheets/>

National Intelligence Council, "Global Trends 2040 - MENA", March 2021, <https://www.dni.gov/index.php/gt2040-home/gt2040-5-year-regional-outlooks/mena>

NATO "2022 Strategic Concept", 2022.

NATO ACT Regional Perspectives Report on the Indo-Pacific. Source: <https://www.act.nato.int/wp-content/uploads/2023/05/regional-perspectives-2022-07-v2.pdf>

NATO ACT Strategic Foresight, Arctic Report, <https://www.act.nato.int/application/files/8516/3236/7596/regional-perspectives-2021-04.pdf>

NATO OPEN Publications: A New Age of Geopolitics in Central Asia. NATO's role in the evolving security order. Source: <https://openpublications.org/2023>

NATO STO "Science and Technology Trends, 2023-2043: Across the Physical, Biological and Information Domains (Vol 2)", March 2023, NATO_stt23-vol2.pdf (atelierdesfuturs.org)

NATO, "Allied Joint Publication-01, Ed. F, Ver.1", December 2022, Allied Joint Publication 01 (publishing.service.gov.uk)

NATO-STO, "Cognitive Warfare: First NATO scientific meeting on Cognitive Warfare Bordeaux, France-21 June 2021", June 2021, Workshop - Cognitive Warfare Concept - NATO's ACT

Nicholson, Matt, "7 Predictions for the Future of Renewable Energy", April 18, 2023, NES Fircroft, 7 Predictions For The Future Of Renewable Energy | NES Fircroft

NOAA, "Scientists Detect a Reshaping of the Meridional Overturning Circulation in the Southern Ocean", 2023, <https://www.aoml.noaa.gov/noaa-scientists-detect-reshaping-of-the-meridional-overturning-circulation-in-southern-ocean/>

NSF, "Research and Development: U.S. Trends and International Comparisons", April 28, 2022, Research and Development: U.S. Trends and International Comparisons | NSF - National Science Foundation

NSTXL (National Security Technology Accelerator), "Quantum Technology in the Military", February 1, 2023, Quantum Technology in the Military - NSTXL

Nye, Joseph S., "Is the American Century over?", Political Science Quarterly, Volume 130, Issue 3, 2015, <https://doi.org/10.1002/polq.12394>

Nye, Joseph S., "The rise and fall of American hegemony from Wilson to Trump". International Affairs, Volume 95, Issue 1, 2019, <https://academic.oup.com/ia/article/95/1/63/5273551>

O'Hanlon, Michael E., "The role of AI in future warfare", November 29, 2018, Brookings, The role of AI in future warfare (brookings.edu)

OECD, "World Economic Outlook Report", 2022.

OECD, "Illicit Trade: Converging Criminal Networks", 2016, <https://doi.org/10.1787/9789264251847-en>.

Office of Director of National Intelligence, "Global Trends 2040: A More Contested World", March 2021, Office of the Director of National Intelligence

- Global Trends (dni.gov)

O'Hanlon, Michael E, "Technological change and the future of warfare", Brookings Institution Press, January 2000.

Organisation for Economic Co-operation and Development, "A long unwinding road", June 2023, <https://oecd.org/economic-outlook/june-2023/>

Payne, Kenneth, "Artificial intelligence: a revolution in strategic affairs?", *Survival* 60.5, September 2018, <https://doi.org/10.1080/00396338.2018.1518374>

Pew Research Center, "Concerns about democracy in the digital age", February 21, 2020, <https://www.pewresearch.org/internet/2020/02/21/concerns-about-democracy-in-the-digital-age/>

Pew Research Center, "Experts Optimistic About the Next 50 Years of Digital Life", October 28, 2019, Experts Optimistic About the Next 50 Years of Digital Life | Pew Research Center

Pew Research Center, "People in Advanced economies Say Their Society is More Divided Than Before Pandemic", June 23, 2021, People in Advanced Economies Say Their Society Is More Divided Than Before Pandemic | Pew Research Center

Pinker, Steven, "The Better Angels of Our Nature: Why Violence Has Declined", Penguin Books, September 2012, <https://doi.org/10.1080/03057240.2012.723941>

Porter, Patrick, "The Global Village Myth: Distance, War, and the Limits of Power", Georgetown University Press, 2015, <http://www.jstor.org/stable/j.ctt13x0dk5>.

Porterfield, C. "Space Industry Grew To Record \$469 Billion Last Year", *Forbes*, July 2022, <https://www.forbes.com/sites/carlieporterfield/2022/07/27/space-industry-grew-to-record-469-billion-last-year-report-finds/?sh=54794f2e17f1>

Posen, Adam S., "The End of Globalization? What Russia's War in Ukraine Means for the World Economy", *Foreign Affairs*, March 17, 2022, <https://www.foreignaffairs.com/articles/world/2022-03-17/end-globalization>

Ramez Naam, "Solar's Future is Insanely Cheap (2020)", May 14, 2020, Solar's Future is Insanely Cheap (2020) – Ramez Naam

Republic of Austria, Federal Ministry of Agriculture, Regions and Tourism, "World Mining Data 2022", April 2022, <https://www.world-mining-data.info/wmd/downloads/PDF/WMD2022.pdf>

Richer, Felix, "Why the War in Ukraine Threatens Global Food Security", *Statista*, April 11, 2022, Chart: Why the War in Ukraine Threatens Global Food Security | Statista

Ritchie, Hannah, et al., "Populations Growth", *Our World in Data*, 2023, <https://ourworldindata.org/world-population-growth>.

Rogers, Sol, "the Role of Technology in the Evolution of Communication", *Forbes*, October 15, 2019, The Role Of Technology In The Evolution Of Communication (forbes.com)

Rossiter, Ash, "Undersea cables in an age of geopolitical competition", *TRENDS Research and Advisory*, February 19, 2023, TRENDS Research and Advisory - Undersea cables in an age of geopolitical competition

Rüßmann, Michael, et al., "Industry 4.0: The future of productivity and growth in manufacturing industries", Boston consulting group 9.1, April 2015.

Ryan, Mick, "War Transformed: The Future of Twenty-First-Century Great Power Competition and Conflict", Naval Institute Press, February 2022.

Salter, Andrew M., "Insect Protein: A Sustainable and Healthy Alternative to Animal Protein" *The Journal of Nutrition*, Volume 149, Issue 4, April 2019, <https://doi.org/10.1093/jn/nxy315>

Scharre, Paul, "Army of none: Autonomous weapons and the future of war", WW Norton & Company, April 2018, <https://doi.org/10.1093/ia/iyy153>

Scharre, Paul, "Four battlegrounds: power in the age of artificial intelligence", WW Norton & Company, February 2023.

Schiffing, Sarah, "5 challenges facing global supply chains," *World Economic Forum*, September 7, 2022. <https://www.weforum.org/agenda/2022/09/5-challenges-global-supply-chains-trade/>

Shin, Hyun Song. "Global Value Chains under the Shadow of Covid." *The Bank for International Settlements*, 16 Feb. 2023, www.bis.org/speeches/sp230216.htm.

Siliezar, J., "Antarctic Sea Ice Melting to lift sea level rise higher than thought", *Harvard University* APR 2021. <https://news.harvard.edu/gazette/story/2021/04/study-says-antarctic-ice-sheet-melt-to-lift-sea-level-higher-than-thought/>

Slapakova, Linda, "Towards an AI-Based Counter-Disinformation Framework", *Rand Coporation*, March 29, 2021 Towards an AI-Based Counter-Disinformation Framework | RAND

Smith, Adam B., "2021 U.S. billion-dollar weather and climate disasters in historical context", *NOAA*, January 24, 2022, <https://www.climate.gov/news-features/blogs/beyond-data/2021-us-billion-dollar-weather-and-climate-disasters-historical>.

Soare, S. "Turning the Tide: How to Rescue Transatlantic Relations". *European Institute for Security Studies*, 2020. <https://www.iss.europa.eu/content/turning-tide-how-rescue-transatlantic-relations>

Stockholm International Peace Research Institute, "SIPRI Arms Transfers Database", March 2023, <https://www.sipri.org/databases/armstransfers>

Stockholm International Peace Research Institute, "SIPRI Military Expenditure Database", 2022, <https://www.sipri.org/databases/milex>.

Strauss, Jordan and Green, Megan, "10 of the Biggest Geopolitical Risks by Likelihood and Impact", September 09, 2022, 10 of the Biggest Geopolitical Risks by Likelihood and Impact | Kroll

The Centre for Strategic Futures (CSF), "A world reaching inflection point, Driving Forces 2040", 2021, <https://www.reuters.com/business/energy/chinas-xi-tells-gulf-nations-use-shanghai-exchange-yuan-energy-deals-2022-12-09/>

The Diplomat, "China Prioritizes 3 Strategic Technologies in Its Great Power Competition", April 22, 2023, China Prioritizes 3 Strategic Technologies in Its Great Power Competition – The Diplomat

The Economist, "Future of the high seas hangs in the balance", August 2022, <https://impact.economist.com/ocean/biodiversity-ecosystems-and-resources/future-of-the-high-seas-hangs-in-the-balance>

The Economist, "Why a new UN treaty to safeguard the high seas matters", March 8, 2023, <https://www.economist.com/the-economist-explains/2023/03/08/why-a-new-un-treaty-to-safeguard-the-high-seas-matters>

The International Institute for Strategic Studies, "The Military Balance 2023: The Military Balance for Strategic Studies", February 2023, <https://www.iiss.org/publications/the-military-balance>

The White House, "FACT SHEET: CHIPS and Science Act Will lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China", August 9, 2022, FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China | The White House <https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen->

supply-chains-and-counter-china/

Tokat, Yasin "Navigating the Paradoxes of Digital Technology Policy: Examining The Six Major Challenges of Regulating Cyberspace", The Digital Constitutionalist, 2016, Navigating the Paradoxes of Digital Technology Policy: Examining the Six Major Challenges of Regulating Cyberspace" — The Digital Constitutionalist)

UK Ministry of Defence, "Global Strategic Trends: The Future Starts Today Sixth Edition", 2018.

UN FAO "Action Against Desertification", Desertification and land degradation | Action Against Desertification | Food and Agriculture Organization of the United Nations (fao.org)

UN FAO Remote Sensing Survey, <https://www.fao.org/3/cb7449en/cb7449en.pdf>

UN FAO, "Agricultural production statistics 2000-2020, Agricultural production statistics 2000-2020 (fao.org)

UN GCRG Brief. Global impact of war in Ukraine: Energy crisis. <https://news.un.org/pages/wp-content/uploads/2022/04/UN-GCRG-Brief-1.pdf>

UN World Water Development Report 2019, UN World Water Development Report 2019 | UN-Water (unwater.org)

UN, Department of Economic and Social Affairs, "World Social Report 2020: Inequality in a Rapidly Changing World", 2020, <https://www.un.org/development/desa/dspd/world-social-report/2020-2.html>

UN, Department of Economic and Social Affairs, Technical Paper no. 2015/2. "Risk of Exposure and Vulnerability to Natural Disasters at the City Level: A Global Overview", 2015, Microsoft Word - NaturalDisaster_TechPaper_Final.docx (un.org)

UNCTAD, "The Evolution of FDI Screening Mechanisms", Investment Policy Monitor Issue 25, February 2023, Investment Policy Monitor No. 25 (unctad.org)

UNDP, "Three trends that will shape the energy sector in 2023", January 12, 2023, Three trends that will shape the energy sector in 2023 | United Nations Development Programme (undp.org)

UN-Habitat, "World Cities Report 2022: Envisaging the Future Cities", 2022, wcr_2022.pdf (unhabitat.org)

UNICEF, "Water Scarcity", <https://tinyurl.com/39df4p94>.

United Nations Department of Economic and Social Affairs, "World Urbanization Prospects: The 2018 Revision", August 2019, <https://doi.org/10.18356/b9e995fe-en>

United Nations Global Crisis Response Group on Food, Energy and Finance, Brief N 01: "Impact of War in Ukraine on Food, Energy and Finance Systems", March 2022, UN-GCRG-Brief-1.pdf

United Nations, "Peace, dignity and equality on a healthy planet", <https://www.un.org/en/global-issues/youth>

United Nations, "The Sustainable Development Goals Report 2022", 2022, <https://unstats.un.org/sdgs/report/2022/The-Sustainable-development-Goals-Report-2022.pdf>.

United Nations, "World Population Prospects 2022", World Population Prospects - Population Division - United Nations

United Nations, "World Social Report 2023: Leaving No One Behind In An Aging World", 2023, 2023wsr-fullreport.pdf (un.org)

US DOE, "Reducing Reliance on Cobalt for Lithium-ion Batteries", April 6, 2021, Reducing Reliance on Cobalt for Lithium-ion Batteries | Department of Energy

US EPA, "Climate Impacts on Agriculture and Food Supply", 2016, <https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply>

Van Creveld, Martin, "Transformation of war", Simon and Schuster, November 2009, <https://doi.org/10.1080/09592310208559177>.

Vanatta, Natalie; Johnson, Brian David; Brown, Jason C.; Lindsay, Greg; and Carrott, James, "Future Implications of Emerging Disruptive Technologies on Weapons of Mass Destruction", 2022, <https://hdl.handle.net/20.500.14216/511>

Veer, Renske van der., "Terrorism in the age of technology", Strategic Monitor 2019-2020, 2019, Terrorism in the age of technology | Strategic Monitor 2019-2020 (clingendael.org)

Vergun, David, "Official Details Space-Based Threats and U.S. Countermeasures", U.S. Department of Defense, April 26, 2023, Official Details Space-Based Threats and U.S. Countermeasures > U.S. Department of Defense > Defense Department News

Wijninga, Peter, et al., "4 State and Non-State Actors: Beyond the Dichotomy" Hague Centre for Strategic Studies, 2014, <https://www.jstor.org/stable/resrep12608.8>

Wittes, Benjamin, and Gabriella Blum, "The future of violence: Robots and germs, hackers and drones-confronting a new age of threat", Basic Books, March 2015, <https://doi.org/10.1080/09546553.2017.1341788>

Wolf, H., "Where Will The Drone Industry Be In 2023", Forbes, December 20, 2022, <https://www.forbes.com/sites/harrisonwolf/2022/12/20/where-will-the-drone-industry-be-in-2023/?sh=517b9b1f1f1e>

World Bank Group, "China Country Climate and Development Report," October 2022, <https://openknowledge.worldbank.org/server/api/core/bitstreams/35ea9337-dfcf-5d60-9806-65913459d928/content>

World Bank Open Data | Data

World Bank, "Groundswell: Preparing for Internal Climate Migration", 2018, <https://openknowledge.worldbank.org/handle/10986/29461>

World Economic Forum, "Does the future of science lie in 'bioconvergence'?", January 4, 2023, What is 'bioconvergence' and is it the future of science? | World Economic Forum (weforum.org)

World Economic Forum, "Global Risk Report 2023, 18th edition", 2023, https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf

World Economic Forum, "IEA: More than a third of the world's electricity will come from renewables in 2025", March 16, 2023, Renewable energy will produce 35% of global electricity by 2025: IEA | World Economic Forum (weforum.org)

World Economic Forum, "The Fourth Industrial Revolution: what it means, how to respond", January 14, 2016, The Fourth Industrial Revolution: what it means and how to respond | World Economic Forum (weforum.org)

World Economic Forum, "The Global Risks Report 2023", January 2023, https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf

World Economic Forum, "The Global Social Mobility Report 2020: Equality, Opportunity and a New

Economic Imperative", January 2020, Global_Social_Mobility_Report.pdf (weforum.org)

World Economic Forum, "The space economy is booming. How can it benefit Earth?", October 2022,

<https://www.weforum.org/agenda/2022/10/space-economy-industry-benefits/>

ACT Strategic Foresight Team

IDEA CONTRIBUTION

Editor:
Maureen Archer
Cristal Armijo
Klaus Dodds
Olivier Schmitt
Erwan Lagadec

Andy Hines
Gibbs McKinley
Fiona Butcher
Jason Pogacnik
Florence Gaub

Joseph Voros
Benedetta Berti
Ruben Diaz-Plaja
Matt Levinger
Lauranne Bureau

Anca Agachi
Jordan Becker
Jason Brown
Katy Lindqvist
Cho Kong

Point of Contact:

Gergely Nemeth

Head of Strategic Foresight

Gergely.nemeth@act.nato.int

Andreas Wangberg

Deputy Head of Strategic Foresight

Andreas.wangberg@act.nato.int

Heiko Bauer

Information

Management Officer

Heiko.bauer@act.nato.int

Joseph D`Costa

Major General, USA Army

Deputy Chief of Staff for
Strategic Plans and Policy

Yuval Weber
Sanna Ahvenharju
Richard Sherburne
Erika Ricci
John Rafter

Sinikukka Saari
Toni Ahlqvist
Alexander Lanoszka
Mathew Burrows
Nathan Berrick

Gabriele Rizzo
Daniel Bayless

Graphic Designer:
Tamara Vaughn

